Next Generation Automobiles
in Miyagi

http://www.miyagicar.com/

Strategic Regional Innovation Support Program by MEXT(for recovery from Tohoku Disaster) Next-Generation Automobiles / Miyagi Area

Revised March, 2013

Strategic Regional Innovation Support Program by MEXT
(For recovery from Tohoku Disaster)
Next-Generation Automobiles / Miyagi Area

Global/Local Innovations for Next Generation Automobiles

Program, abstracts, and presenting materials for

- ICFD OS5 "Global/Local Innovations for Next Generation Automobiles" on November 25-27, 2013
- "Worldwide Leaders Meeting on Global/Local Innovations for Next Generation Automobiles" on November 28, 2013

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Tohoku Economic Federation
Tohoku University
Miyagi Prefecture
The 77 Bank
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Tohoku Economic Federation
Tohoku University
Miyagi Prefecture
The 77 Bank
Intelligent Cosmos Research Institute

To All People around the World,

We thank you very much for your enormous support for our recovery and reconstruction in the areas devastated by the 2011 Tohoku Earthquake and Tsunami. Although we still experience many difficult days, going through this hardship has allowed us to discover new ways to strengthen bonds that invigorate our attitude toward reconstruction and revival.

In this situation, the automotive industry has largely been considered a major center of economic opportunity because of its economic impact. All over the Tohoku region but especially in Miyagi prefecture, the expectation for the automotive industry is enormous. Emblematic of this expectation is the recent startup of the Toyota Motor East Corporation.

Our project the "Strategic Regional Innovation Support Program" supported by MEXT (Ministry of Education, Culture, Sports, Science and Technology) kicked off in July 2012 in order to realize the reconstruction and revival of Tohoku, through the development of new products and system by the collaborative efforts of industry, academia and government. This collaboration is primarily based on the strong and diverse R&D at Tohoku University, a leader in domestic and international education.

As a research-oriented university, Tohoku University has been involved in a number of collaborative efforts with big business but less so with smaller, local businesses. As one might assume, the importance of developing local businesses is of the highest order. Since June 2012, we have held a wide variety of events: Research information session for local business people, over thirty lectures for manpower training, more than forty laboratory tours for local business people, our researchers were invited to tour local companies, and poster presentations by all laboratories which joined in this project. These events broke down the borders separating the university from local businesses and as a result a number of new collaborations have begun to bloom.

We also understand that there are many leaders who are trying a variety of challenges to realize both global and local innovations in next generation automobiles. We are very happy to organize an international symposium on global/local innovations for next generation automobiles by inviting such worldwide leaders and design a variety of ways to realize global/local innovations in next generation automobiles. We have to emphasize that many local companies greatly contribute to this symposium in addition to leading laboratories in Tohoku University. We sincerely hope that this symposium provides opportunities to deepen our friendship and promote reconstruction and revival of Tohoku Area through a variety of challenges for the innovations in next generation automobiles.

Katsuto Nakatsuka, Project Director

Akira Miyamoto, Chairman of Research Promotion Committee

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Please visit our official website for details of the project;
www.miyagicar.com

If you have any inquiry, please contact the laboratories and companies directly. And please don't hesitate to contact the Research Promotion Committee to refer which of them may help you.

International Conference
"Global/Local Innovations for Next Generation Automobiles"

Part1: Program of Special Session of Tenth International Conference on Fluid Dynamics (ICFD2013)
OS5: "Global/Local Innovations for Next Generation Automobiles"
Organizers: A. Miyamoto (Tohoku University)
P. Kapsa (Ecole Central de Lyon)

Date: November 25(Mon) – 27(Wed), 2013
Conference Site: Sendai International Center, Sendai, Japan

November 25(Mon)

12:00-12:50	**Session OS5 Lunch Meeting (Sakura 1)**	
13:00-13:10	**OS5 Session Opening** Akira Miyamoto and Philipe Kapsa	
OS5-1 13:10-13:50	**Convergence of Transportation and Energy in the Future** Mark C. Williams (URS, USA)	1
OS5-2 13:50-14:30	**Research and development of fully automated vehicles** Keiji Aoki (Japan Automobile Research Institute, Japan)	6
OS5-3 14:30-15:10	**Human Factor Research Using a Driving Simulator** Kimihiko Nakano (The University of Tokyo, Japan)	8
15:10-15:30	BREAK	
OS5-4 15:30-16:10	**Vehicle Innovations Bring Regional Community into the New Age** **– Fuel Cell Vehicle and Hydrogen Move to the 2015 Introduction –** Katsuhiko Hirose (Toyota Motor Corporation, Japan)	10
OS5-5 16:10-16:50	**Research and Development of Transport Simulation** Alexandre Torday (Transport Simulation Systems Pty Ltd., Australia)	12
OS5-6 16:50-17:30	**NDT-Innovations in The Automotive Industrial Sector** **And To Light-Weight Materials** Gerd Dobmann (Fraunhofer-IZFP, Germany)	13
OS5-7 17:30-18:00	**Compact-Sizing of Optical Topography Technology (NIRS)** Kiyoshi Hasegawa (Hitachi, Ltd., Japan)	15
19:00-21:00	**OS5 Session Dinner Party** **At Westin Hotel 25th Floor TSUKI**	

November 26(Tue)

9:00-12:00	**Short Oral Presentations of Poster - Part 1**	50
	(BREAK 10min)	
	Short Oral Presentations of Poster - Part 2	
12:00-12:50	**Session OS5　Lunch Meeting (Sakura 1)**	
13:00-14:30	**Poster Presentations**	48
OS5-8 14:30-15:00	**Understanding the Triple Helix Model and the Finance of Innovation: Implications for Japan** Masato Hisatake (Tohoku University, Japan)	17
OS5-9 15:00-15:40	**Understanding the Triple Helix Model and the Finance of Innovation** Erik P. M. Vermeulen (Tilburg University, The Netherlands)	17
OS5-10 15:40-16:20	**Innovation, University Entrepreneurship and the Role of Triple Helix** Shigeo Kagami (The University of Tokyo, Japan)	19
16:20-16:30	BREAK	
OS5-11 16:30-17:10	**Can Functional Brain Imaging Prompt Innovations in Next-generation Automobiles?** Ryuta Kawashima (Tohoku University, Japan)	22
OS5-12 17:10-17:50	**Alzheimer's disease: from pathology to therapeutics** Takeshi Iwatsubo (The University of Tokyo, Japan)	24
18:00-20:30	**ICFD Banquet at SAKURA**	

November 27(Wed)

OS5-13 9:00-9:30	**The Japanese Next Generation Vehicle Strategy: A Successful Strategy to Achieve CO_2 Emission Reduction and Global Green Vehicle Leadership** Noriko Behling (Author, USA)	26
OS5-14 9:30-10:00	**NH_3-DeNO_x Performance of the Composite [Fe-Beta + Fe(Mn)MCM-48] Catalyst: Combining SCR Activity and NH_3 Oxidation Activity for NH_3 Slip Removal** Alexandr Yu. Stakheev, Dmitry A. Bokarev, Alina I. Mytareva (N. D. Zelinsky Institute of Organic Chemistry, Russia), Rajesh Kumar Parsapur and Parasuraman Selvam (Indian Institute of Technology Madras, India)	28

OS5-15 10:00-10:30	**Li-ion Battery Module for Small Electric Vehicles** Hiroshi Matsuo (Micro Vehicle Lab. Ltd., Japan)	30
10:30-10:40	BREAK	
OS5-16 10:40-11:00	**Research and Development of Tribological Techniques for Automotive Parts** Naruhiko Inayoshi, Keiji Sasaki and Ryoichi Hombo (DENSO CORPORATION, Japan)	32
OS5-17 11:00-11:20	**Starved Lubrication: Contribution of Laser Surface Micro-Texturing** Florian Brémond (IREIS, France), Denis Mazuyer (Ecole Centrale de Lyon, France), Philippe Maurin-Perrier (IREIS, France) and Juliette Cayer-Barrioz (Ecole Centrale de Lyon, France)	34
OS5-18 11:20-12:00	**Traffic Management Future** Reinhard Pfliegl (A3PS,Austria)	36
12:00-12:50	**Session OS5　Lunch Meeting (Sakura 1)**	
OS5-19 13:00-13:30	**Tribology for the future: Biomimetism and Surface Engineering** Philippe Kapsa (Ecole Centrale de Lyon, Fracne)	38
OS5-20 13:30-14:10	**Synthetic Biofuels From Biomass** Joachim Knebel, Nicolaus Dahmen and Jörg Sauer (Institute for Catalysis Research and Technology, Germany)	40
OS5-21 14:10-14:50	**VEHICLE TECHNOLOGY & ENERGY CENTRE Canadian Applied Research Experience at Red River College** Ray Hoemsen (Red River College, Canada)	42
14:50-15:00	BREAK	
OS5-22 15:00-15:20	**RED RIVER COLLEGE VEHICLE TECHNOLOGY & ENERGY CENTER Applied Research Project Selection: "Student & Staff Centered"** Neil Cooke (Red River College, Canada)	44
OS5-23 15:20-16:00	**Modeling, Simulation, Analysis and Control of Freeway Traffic Corridors** Roberto Horowitz (University of California, USA)	46
	Concluding Remarks Akira Miyamoto and Philippe Kapsa	
17:00	**Move to Akyu Hotspring Resort by Arranged Bus**	
18:00-20:00	**Worldwide Leaders Dinner Party of Next Generation Automobiles** **At Sakan Hotel, Akyu Hotspring Resort**	

Part2: "Worldwide Leaders Meeting on Global/Local Innovations for Next Generation Automobiles"

Organizers: A. Miyamoto (Tohoku University) and K. Nakatsuka (ICR)

Date: November 28(Thu), 2013

Conference Site: Sendai Trust Tower, Sendai, Japan

November 28(Thu)

10:00-10:10	**Introductory Talk** Akira Miyamoto	
10:10-10:40	**Regional Innovation Cluster Policy of MEXT** Hiroki Takaya (Ministry of Education, Culture, Sports, Science and Technology (MEXT))	148
10:40-11:10	**VisLab's latest Autonomous Driving challenges: from intercontinental to urban tests** Alberto Broggi (VisLab, The Artificial Vision and Intelligent Systems Lab.)	153
11:10-12:00	**My Idea for the Progress in Global/Local Innovations for Next Generation Automobiles-Part 1** Katsuto Nakatsuka Mark C. Williams Yasutaka Iguchi Philippe Kapsa Tokuta Inoue Roberto Horowitz Hideomi Koinuma Alberto Broggi Osamu Okada	163
12:10-13:50	**Lunch Meeting at Japanese Restaurant** **At Westin Hotel Sendai**	
14:00-14:30	**Next-Generation Advanced Mobility System** Fumihiko Hasegawa (Tohoku University, Japan)	178
14:30-16:00	**My Idea for the Progress in Global/Local Innovations for Next Generation Automobiles- Part 2** Hiroshi Matsuo Thomas Behling Masato Hisatake Tsunemoto Kuriyagawa Kazuhiro Kosuge Akihiro Isomura Akira Hasegawa Toshio Kato Masahiro Nishizawa Nozomu Hatakeyama Naoto Miyamoto Yuui Yokota Shiro Takahashi Tsugio Sato Parasuraman Selvam	182
16:00-16:10	**Summary and Concluding Remarks**	

Please note that some of the presentations above are not on this book.

Convergence of Transportation and Energy in the Future

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ABSTRACT

Energy and transportation are major world industries joined inextricably together. Each available energy source – fossil, nuclear, renewable - has used as used as a transportation fuel. The future of fuel availability is the future of transportation. The existing dominance of fossil fuels can only persist through a transition period. In the future hydrogen, solar, natural gas and other renewable will dominate the transportation. Solar cars, battery vehicles, PHEV, hydrogen fuel cell vehicles, and natural gas vehicles, represent tomorrow's propulsion future.

1.Introduction

Reducing energy use and reducing the negative human impact on the environment in a constrained, highly populated state with frequent interactions with multiple consequences. It is critical to do as little damage as possible and intrude as little as possible on the environment. We are obviously in a transition period for energy and transportation as we search for new fuels and attempt to use now dominant fuels more efficiently. Energy and transportation are major world industries joined inextricably together. Each available energy source – fossil, nuclear, renewable - has been used to support transportation (Figure 1). The future of fuel availability is the future of transportation. In the future hydrogen, solar, natural gas and other renewable fuels will dominate transportation. Solar cars, battery vehicles, plug-in hybrid electric vehicle (PHEV), hydrogen fuel cell vehicles, and natural gas vehicles, represent tomorrow's propulsion future. Efficient and environmentally sound energy conversion in transportation depends on new and improved transportation technology. In many cases electrochemical technology, such as fuel cells, solar, solid-state lighting and batteries, is a vital component of that future.

2. Oil

The world is rapidly consuming the finite amounts of stored energy, especially petroleum. By way of example, USA consumes 20 million barrels (BBL) per day (seven billion BBL per year) of petroleum products. Canada (2-3 million BBL/day - half from tar sands) and Middle East (1.5 million BBL/day) help supply USA petroleum [1]. Canada tar sands contain 300 BBL, one of the world's largest resources ever known, would supply USA for only 40 years. The relentless hunt for oil will continue to the limit of economic viability.

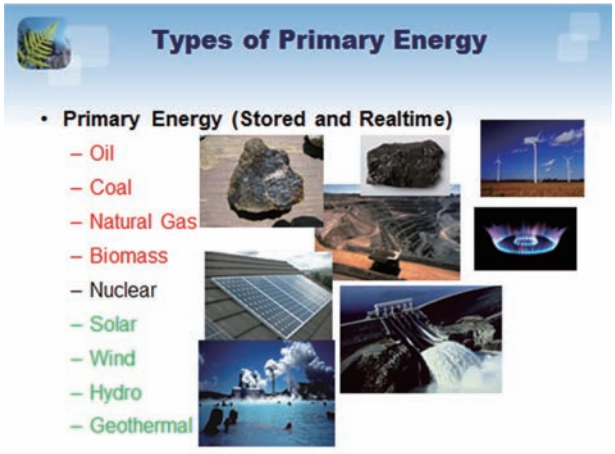

Figure 1 Types of Primary Energy

However, the internal combustion engine hybrid, such as the Prius, has already made inroads to improve automotive efficiency. Electrochemical storage with batteries is, of course, an integral part of that hybrid vehicle.

3. Natural Gas

We benefit from the chemical energy, like

natural gas, extracted from sunlight on this planet. As long as there is life and sunlight, we will always have renewable natural gas on this planet in the future. Methane from human (ADG) and plant and animal and plant residues and wastes captured from sunlight are available today and in the future.

In addition, huge reserves of natural gas have been found and are being extracted with fracturing techniques. It has been estimated by Pennsylvania State University (PSU) that 4,400 trillion cubic feet of natural gas is located in the Marcellus Shale in the Eastern USA [2]. In addition, huge reserves of gas some 50,000 TCF are believed to exist in methane hydrates in the United States alone (Figure 2).

By way of comparison, the US uses only 23 trillion cubic feet per year. At the PSU estimate, the Marcellus Shale gas, if only one third was recovered, could replace USA petroleum for transportation for around 50 years. Natural gas at $5 per million BTU is the energy equivalent of $28 per BBL oil which sells for currently $100 per BBL.

Figure 2 Methane Hydrate Drilling

Currently, the only natural gas light-duty vehicle manufactured in the USA is the Honda Civic ($26,000 list price; 24 city/36 hwy/28 combined gasoline equivalent miles per gallon). Only roughly 110,000 of the 12 million CNG vehicles worldwide are in the USA, including aftermarket conversions. There are roughly 250 million registered passenger vehicles in the USA [1]. The cost to convert vehicles to NG is estimated $12,500 to $22,500 depending on the vehicle, engine, size of CNG tanks needed, and who does the converting [3]. Without the development of significant infrastructure and improved storage, natural gas vehicles cannot be a reality. Due to the short range operation of natural gas internal combustion engine vehicles, alternative electrical technology such as high-efficient solid oxide fuel cells operating directly on natural gas are being considered [4]. In addition, the fuel cell could be hybridized with a turbo-generator for additional performance [5].

4. Hydrogen

Hydrogen fuel cell vehicles will require a hydrogen infrastructure. Natural gas is currently the principle method to generate hydrogen [1]. Production from renewable energy – wind, solar, geothermal and biomass is also possible. The use of hydrogen for vehicles may require the development of two infrastructures – one for natural gas and one for hydrogen.

Fuel cell technology transforms electricity production in stationary and transportation applications because it is the most efficient way to convert chemical energy to electricity. While major, multi-billion dollar development world-wide has centered on polymer electrolyte fuel cells [6] for the future of transportation, solid oxide fuel cells operating directly on natural gas are a definite possibility, as previously mentioned.

5. Solar

All the energy stored on the earth comes from the supernova of suns or the Sun itself. See Figure 1. With the solar electric vehicle (SEV) solar system, the Toyota Prius, for example, can operate up to 30 miles per day in electric mode thus improving fuel economy by up to 34-60%. Power from a solar array is limited by the size of the vehicle and area that can be exposed to sunlight. While energy can be accumulated in batteries to lower peak demand on the array and provide operation in sunless conditions, the battery adds weight and cost to the vehicle.

The power limit can be mitigated by use of conventional electric cars supplied by solar (or other) power, recharging from the electrical grid. This is the triple hybrid vehicle—the PHEV that has solar panels as well to assist. While sunlight is free, the creation of photovoltaic (PV) cells to capture that sunlight is expensive although costs for solar panels are declining. The photoelectric effect occurs when certain materials produce electric current when exposed to light. In 1905, Albert Einstein described the nature of light and the photoelectric effect on which PV's is based. (see Figure 3)

Figure 3 Solar Vehicle – Courtesy Toyota

6. Stationary Power from Coal, Nuclear, Natural Gas, and Renewables for Transportation

Primary non-renewable energy sources for stationary power – coal, nuclear, and natural gas nuclear - will continue to be used until unavailable or until environmental pressure curtails their usage. While direct propulsion in transportation with these fuels is limited, the use of this energy for transportation and especially plug-in hybrids is increasing.

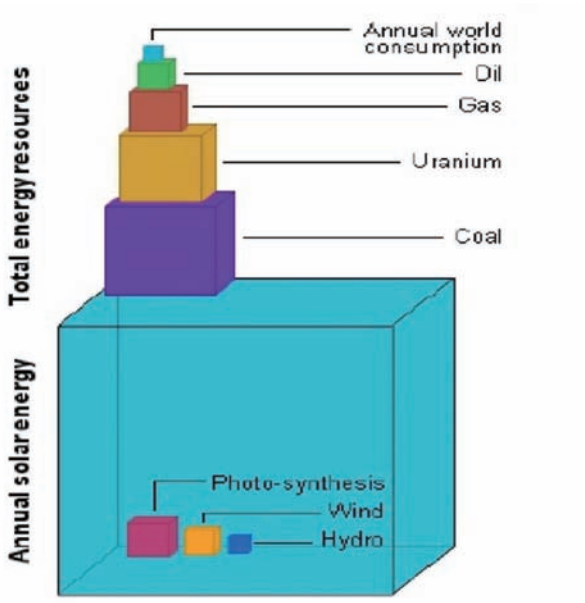

Figure 4 Energy Consumption, storage energy, and incident energy [7]

However, the efficiency of stationary power generation is problematic (Figure 2). Greater use by plug-in hybrids will only shorten the long term availability of primary non-renewable fuels like coal and increase reliance on an inefficient system.

However, electrochemical technology – solid oxide fuel cells, particularly solid-oxide fuel cell turbine hybrids, and solid-state lighting have the opportunity to increase stationary power generation efficiency by an order of magnitude [8]. See the bottom of Figure 5.

In the nuclear energy fuel cycle, the fuel rods will spend about 3 operational cycles (typically 6 years total) inside the reactor or generally

until about 3% of their uranium has been fissioned [9]. Then they are moved to a spent fuel pool where the short lived isotopes generated by fission can decay away. After about 5 years in a spent fuel pool the spent fuel is radioactively and thermally cool enough to handle, and it can be moved to dry storage casks or reprocessed. There is no storage facility for nuclear waste in USA. All our nuclear waste belongs to the American people.

Despite the efficiency limitations of the current grid, complete electrochemical electrification of the transportation sector through stationary power and electric vehicles would eliminate the need to depend on petroleum. This, of course, by itself, has strategic security implications.

The use of renewable biomass is questionable. While it has been estimated by Oak Ridge National Laboratory that 600 million to a billion tons/year may be available in the USA alone [10], a reliable source of biomass within a hundred miles of power generation sources is not always feasible. In addition, ethanol production impacts food prices [11].

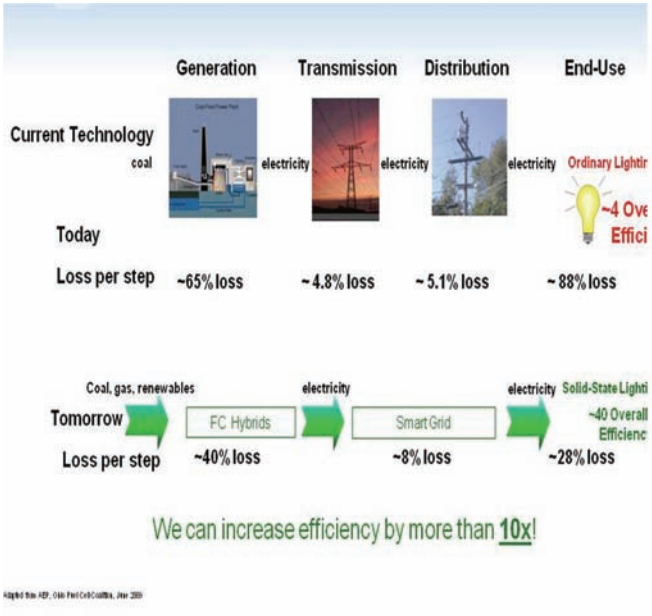

Figure 5 Energy Efficiency in Stationary Power Generation [12]

7. Electrochemical Storage Battery

Today the energy for charging batteries must come from some currently dominate, primary energy sources – fossil and nuclear. Battery vehicles depend on electricity from the current electrical grid system and stationary power. However, the grid efficiency could be improved as we have seen and, in addition, the grid is changing and renewables could account for a greater and greater share of global power [13].

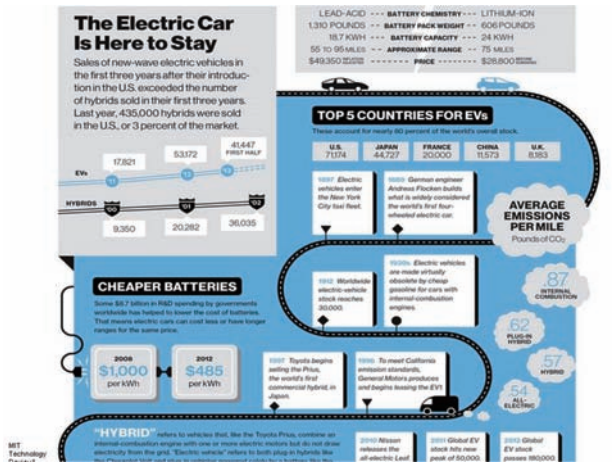

Figure 6 MIT's View of Battery Vehicles [14]

Electrochemical storage is the great enabler of PHEV's and electric vehicles. Energy storage costs are falling, but batteries remain expensive. In fact, the electric car is making great progress [14] and appears here to stay. The USA leads the world with over 70,000 battery vehicles deployed (Figure 6).

8. Future of Transportation - Concluding remarks

Energy and transportation are major world industries joined inextricably together. The available energy in the future will determine the fuel to be used in transportation. Efficiency of energy conversion will determine when and to what fuel the industry will vector. Electrochemical technology innovation with fuel cells, solar, solid-state lighting, and

electrochemical energy storage batteries is helping to shape this future.

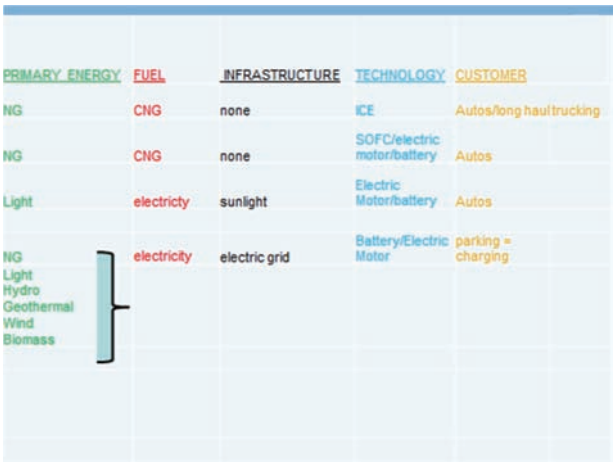

Figure 7 The Future of Energy and Transportation

When all practical oil, coal and nuclear energy is exhausted, transportation will have to rely on sunlight and natural gas. Any available energy from other renewables, like geothermal, wind, and biomass, will support the grid. Natural gas ICE's and natural gas solid oxide fuel cells, which can use natural gas directly as a fuel unlike other fuel cells, will provide bulk and long haul transportation needs. Battery vehicles will dominate personal and local travel. Research areas include battery cost reduction and reliability, solid oxide fuel cell cost and durability, and improving solar efficiency and lowering its cost until it can out perform any fossil fuel grid generation.

9. References

[1] EIA, 2013.
[2] "Got gas, lots", Pittsburgh Tribune-Review, 2008-11-05.
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[4] E. Wachsman, et al., "Lowering the Temperature of Solid Oxide Fuel Cells," Science, Volume 334, p. 935 (2011).
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About the Author

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Research and development of fully automated vehicles

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ABSTRACT

Automated truck platoon is focused on being able to improve the fuel economy and operation cost as next freight transportation system. In order to achieve 15 % of CO_2 reduction, an automated platoon system with closed gap distance of 4 m, have been developed. Trucks are equipped with automated steering and speed control system so that vehicles can travel at closed gap distance alone the lane. Automated platoon composed from three heavy duty trucks and one light duty truck has been demonstrated successfully at gap distance of 4 m.

1. Introduction

Automated vehicles being able to improve safety, fuel economy and traffic efficiency which are main issues on automobiles are anticipated as next generation automobiles. Currently, automated vehicles which must become next generation automobiles are being developed in Japan, Europe and United State America. Especially, automated truck platoon is focused on being able to improve the fuel economy and operation cost as next freight transportation system.

In 2008, a national project for reducing CO_2 gas emitted from heavy duty trucks on the highway, called "Energy ITS," was initiated in Japan under the auspices of the New Energy and Industrial Technology Development Organization. The mission of this project is to build an automated platoon system with closed gap distance which will be able to reduce CO_2 gas emission without engine modification. It has been already proven through many studies that the air-drag of each truck can be reduced by the closing of gap distance between trucks, resulting in improvement of fuel consumption. [1] In order to achieve 15 % of CO_2 reduction, an automated platoon system with closed gap distance of 4 m, have been developed and also the automated platoon within three heavy duty trucks have been tested at a speed of 80 km/h on oval test track.

In this paper, automated platoon technologies developed in this project will be described.

2. Concept of Automated Platoon

While it is required for platoon to keep the gap distance closely in order to improve fuel economy by reducing the air-drag, the task of keeping of closed gap distance on mixed traffic within conventional vehicles will be difficult for human drivers because of limited human's physiological response time. Automated vehicle control will be essential for keeping of closed gap distance. Both Lateral and longitudinal control can be made automatically trucks in platoon. Image of platoon is illustrated in Fig.1. The Steering is controlled automatically so that vehicles can keep the lane alone the painted lane line and also the propulsion of engine and the brake is controlled automatically for keeping gap distance between vehicles.

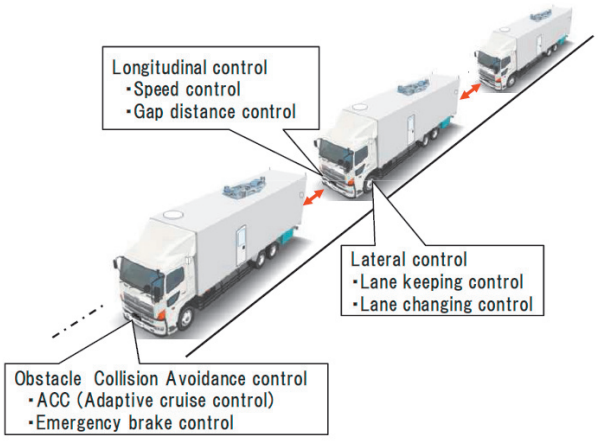

Fig.1 Concept of automated platoon

3. Detail of vehicle control

3.1 Lane keeping control

Block diagram of lane-keeping control system is shown in Figure 2. Nonlinear model based control algorithm was applied to the path following. [2]

The control algorithm consists of feed-back control and feed-forward control module in order to compensate the time lag of sensor and actuator. Feed-back control module can compensate the deviation of the lateral displacement and yaw angle and Feed-forward control module compensates the error due to both the cant and curvature of road.

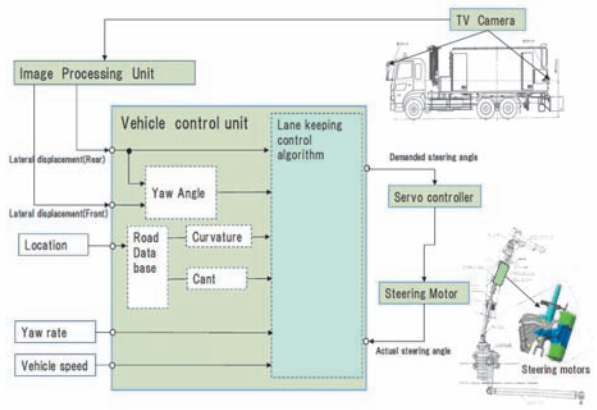

Fig2. Block diagram of lane keeping control system.

The lateral displacement and yaw angle with respect to white lane-marking line is measured by 2 kinds of lane detection sensor which are TV cameras and laser mounted on the left side of a truck. These sensors are mounted on so as to look down road surface in order to prevent the misdetection under the condition of rainy weather or against sun beam. The lateral displacement can be detected by the image processing unit which can recognize the while lane line from the image captured by TV cameras and laser. The yaw angle can be calculated from both lateral displacement of front and rear.

3.2 Longitudinal Control

For longitudinal control, in order to achieve precise controllability under the transient condition such acceleration and deceleration, cooperative distance control algorithm using the vehicle to vehicle (V-V) communication has been developed. The data concerning to vehicle speed, acceleration and deceleration rate of a leading truck is transmitted to following trucks by using V-V communication. Gap distance can be measured by 76GHz mill wave radar and laser radar. The engine propulsion and braking of a truck are controlled to maintain the inter-vehicle distance constantly.

4. Experimental vehicles

Experimental trucks have been developed in order to evaluate lateral and longitudinal controllability and fuel economy.

Figure 3 shows the configuration of experimental trucks. TV cameras and laser sensor are mounted on the top of the cabin and the rear of the cargo compartment on the left side. A mill-wave radar with 76GHz and a LIDAR for distance detection between vehicles are mounted near the front bumper. The steering motors for lane keeping are mounted on steering shaft. Radio-wave based inter-vehicle communication unit with 5.8 GHz and the communication protocol was developed specifically for platoon. HMI unit has been developed for the interface between human driver and automated control system.[3] Mission of human driver during automated control mode is to survey the control state by using display of HMI unit. If control system will be broken, human driver will take over the steering and braking operation.

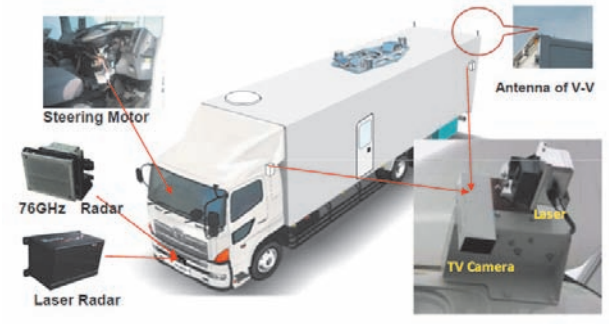

Fig.3 Experimental automated truck

5. Evaluation test result and demonstration

Controllability of lane keeping and gap distance has been evaluated on oval test track and new express-way under the construction. The lateral deviation on lane keeping control is approximately ±0.2 m during the curved road with 180 R. Longitudinal deviation for the Control of gap distance within platoon is approximately ±0.2 m at a constant vehicle speed of 80 km/h and ±1.0 m during the deceleration of 0.4 G.

It has been proven to achieve highly accurate controllability during emergency braking by using V-V communication.

Fuel economy of the platoon composed by tree heavy duty trucks has been evaluated on test track. The saving rate of fuel consumption due to gap distance is shown in Fig. 4. Fuel economy of platoon can be improved up to 15% at the condition of gap distance of 4.5 m compared to the single truck operation.

Finally, automated platoon composed by three heavy duty trucks and one light duty truck has been demonstrated successfully at gap distance of 4 m.

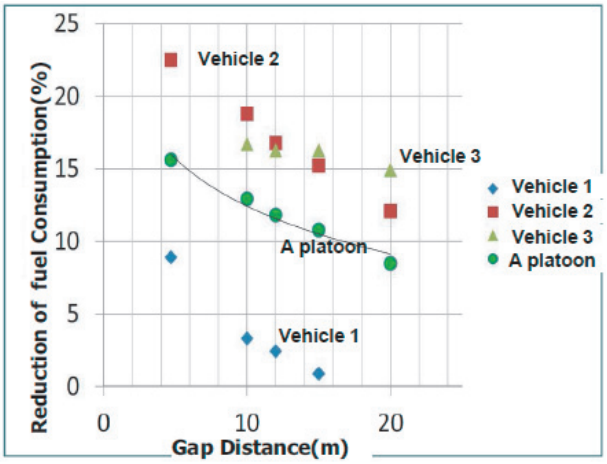

Fig.4 Result of fuel economy by platoon with 3 trucks

6. Conclusion

The automated platoon system with closed gap distance of 4 m, have been developed in order to improve fuel economy and safety on mixed highway traffic. Automated platoon composed from three heavy duty trucks and one light duty truck has been demonstrated successfully at gap distance of 4 m.

However, there are some non-technical issues to be solved so that automated platoon can be implemented to next freight transportation.

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Human Factor Research Using a Driving Simulator

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ABSTRACT

Two recent topics on human factor research using a driving simulator are introduced. One is evaluation of driving comfort by activity of sternocleidomastoid(SCM) muscle of a passenger, and the other is evaluation of human-machine interface for an automatic platooning truck. To examine human responses, it is essential to carry out experiments since it is hardly possible to make a model of human behavior for numerical simulation. In both researches, driving simulators are utilized to conduct the experiments with safe and ease. The meaningful results are obtained in both researches through the experiments using the driving simulators.

1. Introduction

In the field of automobile engineering, higher importance is placed on human related topics such as comfort, human-machine interface, and safety. It is demanded to carry out human factor researches. As it is difficult to express human behaviors with some mathematical models, we need carry out experiments including humans. Although an experiment using a test car is one of the best methods, it brings risk of accidents. Then a driving simulator is utilized to analyze behaviors and responses of drivers and passengers. Two recent researches on human factor using driving simulators are introduced. The first one is evaluation of driving comfort by activity of sternocleidomastoid (SCM) muscle[1] of a passenger. As SCM is a muscle to keep position of the head, electromyography(EMG) signal of the SCM increases when the unwanted lateral acceleration grows. Usually an automobile having poor driving comfort produces unwanted lateral acceleration when it is steered, thus the comfort can be evaluated with the amplitude of the EMG signal. The effectiveness of the proposed method is examined through experiments using test cars and a driving simulator. The second one is evaluation of human-machine interface for an automatic platooning truck[2]. This research is carried out as a part of project of Development of Energy-saving ITS Technology, financially supported by New Energy and Industrial Technology Development Organization of Japan (NEDO)[3]. Driving environment of a cabin of the truck under automatic platooning control is reproduced on the driving simulator. Then human-machine interface of the controller for the automatic platooning is evaluated on the driving simulator. Through introducing these two research topics, direction of the human factor research on the automobiles and significance of the driving simulator in the research topic are discussed.

2. Evaluation of driving comfort

The possibility to use passenger`s EMG of SCM muscles as an objective evaluation indicator to vehicle dynamics is discussed. The SCM is in the neck, and its main function is keeping the head in the appropriate position. Two same cars are prepared for the experiments. One is the normal car, and the other is the modified car, whose body is reinforced to increase its rigidity. While the test cars were driven at the speed of 65km/h in a slalom course of 30m intervals, the EMGs of 5 subjects were measured as well as the relative acceleration in the car body. Figure 1 show RMS value of EMG signal of SCM muscle of all subjects. The RMS of the EMG in the modified car is significantly smaller than the normal car.

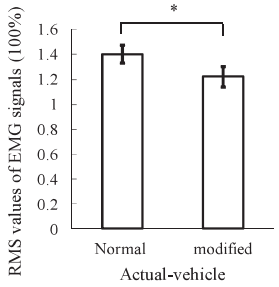


Fig. 1. RMS values of the EMG signals for SCM muscles in the test car experiments (mean ± S.D., and two-sample paired t-test: *P < 0.05 and n = 5).

The motion of the test car in the slalom course is reproduced in the driving simulator (DS), as shown in Fig. 2. Four motions are produced by adding the relative accelerations of the normal car (normal 100%), two times of it (normal 200%), the relative accelerations of the modified car (modified 100%), and two times of it (modified 200%). The EMGs of the SCMs of 10 subjects are measured on the DS. As shown in Fig. 3, RMS value in the modified car significantly lower than the normal car (P < 0.05 and n = 10).

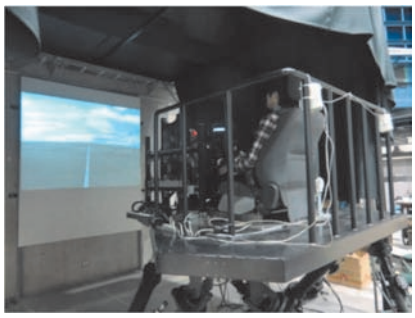


Fig.2 Photograph of the driving simulator.

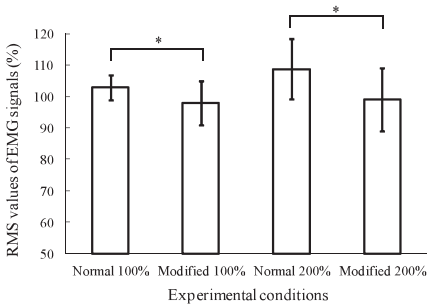


Fig. 3. RMS values of EMG signals in the DS experiments (mean ± S.D., and the two-sample paired t-test: *P < 0.05 and n = 10).

3. Human-machine interface of the controller for the automatic platooning truck

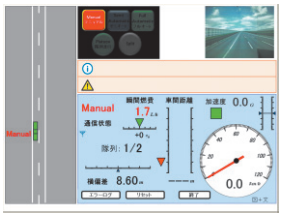
Human factors in automatic platooning are mainly about operations and conditions of driver during the processes of the formation and separation of the automatic platooning. Otherwise, it is also necessary to evaluate human-machine interface for the communication of driver and the system of the automatic platooning. As a novel technology in automobile field, a driving simulator for trucks is used for evaluate automatic platooning driving and its system considering human factors. A truck driving simulator, as shown in Fig. 4, was developed. In whole, a full-scale cabin of a real truck, steering equipment attached a servo-motor, an air seat, a sound generator based on the actual-vehicle driving of truck and control software are integrated into a driving simulator system to improve driver sense in a truck driving. TruckSim software, linked with Simulink, is connected with the host computer of DS using dSPACE. Then the Gap distance control and path following control for automatic platooning and adaptive cruise control (ACC) utilized for the actual platooning trucks, were built in the DS.

Fig. 4 The DS for the platooning truck.

For the application of the automatic platooning, three types of human-machine interface (HMI) are designed: numeric characters, graphics, and numeric characters & graphics types. Ten full-time truck drivers are cooperated in our study, for evaluation of HMI system. The mean age is 44.3 years old, license experience for truck is 15 years, driving experience of truck is 9.2 years, and driving frequency of truck is 41.2 hours/week. The subjects are asked to rank the three types of HMI system and to evaluate the information provided by the HMI system. The most popular display is that using both numeric characters and graphics, because its contents can be easily understood to master the driving conditions during the automatic platooning. The information items highly rated are control status of own truck by figure, current velocity, current gap distance, target gap distance, and number of trucks in transmission, which are closely related to safety. To the contrary, the drivers paid few attentions to the items of current acceleration, target acceleration, and instantaneous fuel economy.

(a) Numeric type

(b) Graphic type



(c) Numeric and graphic type

Fig. 5. Three types of HMI; Information is given with numeric characters in (a), graphics in (b), and both numeric characters and graphics in (c).

4. Conclusion

Two research topics are introduced. One is evaluation of driving comfort by activity of sternocleidomastoid(SCM) muscle, the other is evaluation of human-machine interface of the controller for the automatic platooning truck. In both researches meaningful remarks are derived from the DS experiments. The driving simulator will remain important as a tool to examine the human factors in the field of automobile engineering.

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Vehicle Innovations Bring Regional Community into the New Age
Fuel Cell Vehicle and Hydrogen Move to the 2015 Introduction

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ABSTRACT

Hydrogen fuel cell is the long-waited technology to improve the environment and to alternate the energy to non oil energy source. It takes more than expected but finally commercialization is announced and infrastructure preparation is in progress all over the world. Potential of hydrogen is not only fuel for the automobile but also considered to be an important long time storage media for fluctuated renewable energy. This technology may change the local community to be able to produce and consume and to control by them self rather than import and controlled by the central capital. .

1. Introduction

Mobility is the one of the most basic desire of a human being. And since the invention of automotive the human being obtained the real freedom of moving. Last one and half century automotive itself changed from coal fueled steam to current gasoline fired hybrid vehicle. If you carefully check the fuel and technologies of vehicles, evolution of technologies are also carried out by the environmental restrain. This is very similar to the evolution of life.

Coal is replaced by the liquid fuel because of the limitation of range. Manual transmission is replaced by the automatic transmission because of the comfort and convenience. Next evolution was the introduction of electric drive this was due to the high oil price and brings the hybrid electric vehicle such as TOYOTA Prius to the market.

Next evolution is expected by the sustainability of the earth and brings the new technology “Fuel cell and hydrogen” to the market.

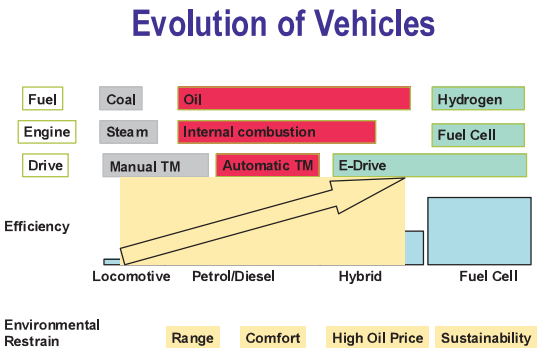

Fig. 1 Material innovation and Society

2. Progress and potential of Fuel Cell Vehicle

Hydrogen fuel cell was once a very expected technology to replace the oil burning vehicles. However engineers faced multiple difficulties to bring into the real road conditions. Day by day efforts of engineers and scientists solve the most of the problems such as durability, volume and range. then finally announced to bring the technology in to the market soon.

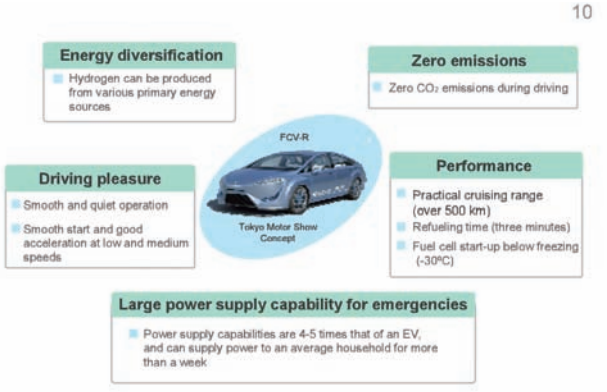

Fig. 2 Advantages of Fuel Cell Vehicle

Advantages of fuel cell vehicle are shown on figure2. In addition to the environmental performance such as zero emission, energy diversification the vehicle performance such as good drivability and slenderness are expected to realize. For the popularization of vehicle continence is very important fuel cell vehicle is now refueled within 3mininutes and is able to travel more than 500km. In addition to the normal performance it is now recognized to be an emergency power source since vehicle has a capability of generating electricity 10kw lever more than few days with stored hydrogen.

There are other zero emission vehicle and environmental friendly vehicle such as Battery Electric Vehicle (BEV) Plug-in Hybrid Vehicle (PHV). We expect those technologies will be segregated by the size and purpose of the mobility shown in figure 3.

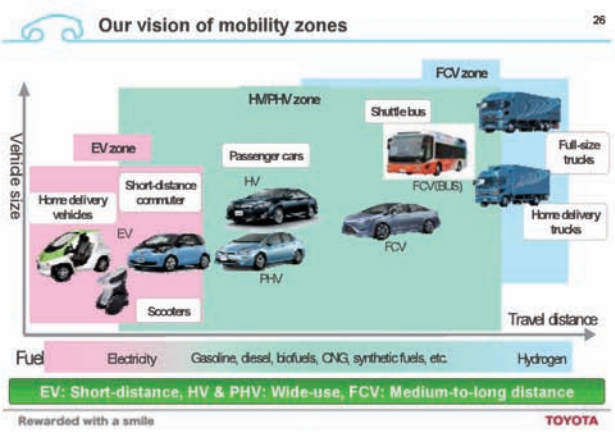

Fig. 3 Vision of Mobility Zone

3. Potential of Hydrogen

Hydrogen is already produced largely in the industry such as petroleum, chemical, fertilizer industries. Potential of those industries to provide hydrogen for early market is more than sufficient.

However recent increase of renewable energy power generation re-recognizes the potential of hydrogen as an energy vector to store the energy of this fluctuating energy source. In northern Europe hydrogen is spot light as a media to transfer the electricity to the south because of the lack of enough grid connection...

Efficiency of hydrogen just for store the electricity is lower than battery or pomp-up hydro. However the hydrogen has a big advantage of long time storage and potential of replacing more expensive/valuable fuel such as gasoline. It is now getting expected to co-grow the renewable electricity and hydrogen to accelerate carbon free world.

Smart Energy Grid to Use Hydrogen as Storage

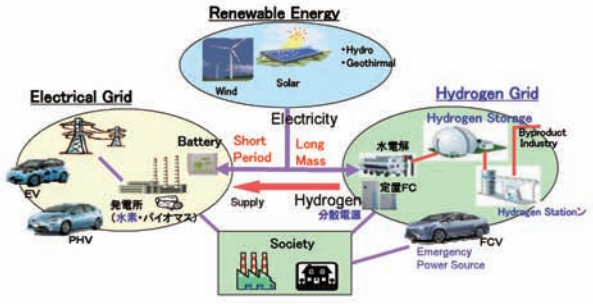

Fig. 4 Smart Grids to Use Hydrogen as Storage

4. Conclusion

Increased hydrogen usage in the society may increase the potential of regional area than ever since use of renewable enhance the regional economic balance to improve. Because of renewable energy is richer in dis centralized area either close to the sea or high mountain area rather than big city. This may lead the preferable economic condition to the local area and bring the area into self sustainable for both energy and fuel for mobility. Cheaper energy and good living condition may attract more industries and people.

5. Concluding remarks

Several car manufacture already announce introduction of fuel cell vehicle into the market, it may be the beginning of new era for the human being to enjoy the mobility of freedom without any deterioration of environment and the regional society going to the center of living life.

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Research and Development of Transport Simulation

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ABSTRACT

This presentation will aim to offer an objective review of the current trends in term of transport modeling around the world, bth in term of hoe they are applied and new models developments. As an introduction, a review of the existing modeling level will be offered with a particular emphasis on the mesoscopic level which is considered as the newcomer in this field and playing evry day a more important role in transportation planning and operation. How these different modeling levels are combined in different projects will then be described leading to a discussion about model integration and maintenance, a problem that is know facing most of the transport authorities around the world. This topic will highlight the need for a common and centralized data base of transport infrastructure representation and a brief link to a QUT research on model free databases will be established. The role of modeling to assess ITS solution will be then described with an important emphasis on V2X applications. This topic will permit to discuss about how new data sources like probe and Bluetooth can help in improving the model accuracy and trustiness. Finally, the presentation will discuss another important trend in modeling which is using it as part of an ITS solution: real-time modeling for decision support system and forecasting.

NDT-Innovations In The Automotive Industrial Sector And To Light-Weight Materials

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ABSTRACT

The challenge to produce cars with reduced weight in order to reduce then also fuel consumption and waste was in the last two decades always a driver for innovations in materials design and production. So far new materials were developed or conventional-ones were optimized there was also always the question to answer: Do we have proper NDT-technologies to characterize the quality of the optimized material components and to detect – may be now new type of irregularities – coming-up with the new materials and/or the new production technologies?

1. Introduction

Fraunhofer-IZFP is engaged in 3 industrial sectors where light-weight materials and components, on one hand are produced and on the other hand are consumed, respectively applied. In the 1st group one can find steel and other metal producing industries and the chemical industry producing polymers and polymer-based composites. In the other group we have mainly car manufacturers (automotive industry), aerospace industry and their supplying industry partners.

The here presented contribution is a selection of specific examples of Fraunhofer-IZFP solutions for the above mentioned industries which are introduced in routine practice.

2. Steel Industry

Concerning light-weight materials for car and especially car body developments the progress is by high-strength material allowing to reduce weight and therefore sheet thickness and reducing fuel consumption. This has its benefits also to reduce CO_2 and to contribute therefore against the worldwide green house effect.

2.1 NDT for high-strength steel sheets

In charge of important European steel manufacturers Fraunhofer-IZFP has developed NDT for material characterization technology [1] allowing mechanical property determination in terms of yield strength (Rp0.2), tensile strength (Rm) and texture characteristics r_m and Δr (planar and vertical anisotropy), All of these parameters have to be controlled in a very narrow scattering band concerning the properties along the length of a steel sheet (2.5 km coil length) and the full width.

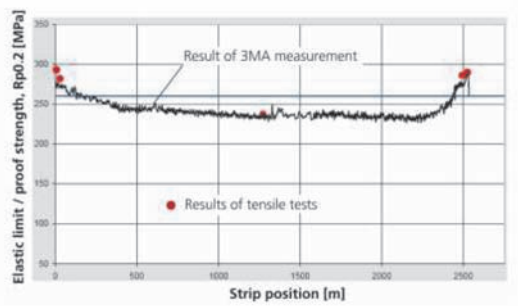

Fig. 1 Yield strength Rp0.2 predicted by micromagnetic NDT [2]

Fig.1, as example, documents the NDT materials property prediction by micromagnetic NDT [2] of which the prediction accuracy is in the range of ~ 10% compared with destructive techniques.

2.2 Cast Iron with lamellar and vermicular graphite

To reduce the weight of the power supply unit the car combustion engines cylinder crankcases can be made of cast iron with vermicular graphite (GJV), because this material in a Diesel engine allows a higher loading pressure even by reduced wall thickness. However, the service live of machining tools is substantially smaller during processing an engine block made from GJV compared with a block from cast iron with lamellar (flake) graphite (GJL) [3].

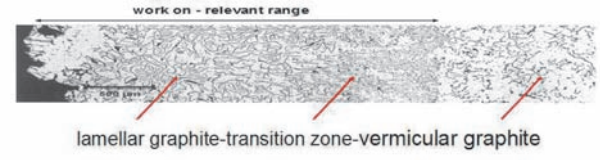

Fig. 2 Microstructure gradient obtained in a cylinder region of a cast engine

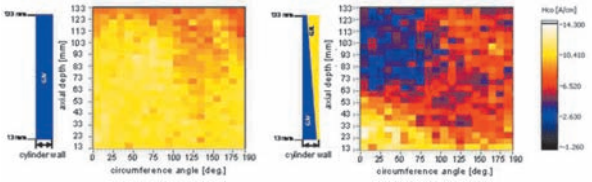

Fig. 3 Gradient of the magnetic coercivity, left hand side GJV cast cylinder block, right hand side GJV/GJL microstructure gradient

This disadvantage can be eliminated by an innovative casting technology that produces a continuous microstructure gradient in the cast iron from lamellar graphite at the inner surface of the cylinders to vermicular graphite in radial direction. By implementing some chemical additives into the core of the mold which can diffuse in the cast iron during the solidification process in the mold the gradient with a continuous transition from lamellar graphite and finally vermicular graphite is obtained. However, the technology can only be used by the casters so far the gradient quality can be characterized and monitored by NDT. Fig.2 documents in a micrograph such a gradient beginning at the left side with cast iron (inner cylinder surface) and lamellar

graphite followed by a transition region and vermicular graphite on the right side.

3MA techniques always cover a certain analyzing depth depending on the magnetizing frequency and geometrical parameters of the magnetization yoke, etc. So far the gradient has different graphite compositions within the analyzing depth, 3MA quantities should be influenced. Based on measurements at an especially designed calibration test specimen set 3MA quantities were selected to image the gradient with optimal contrast. As reference quantity to calibrate 3MA the local thickness of the GJV-layer was evaluated by using micrographs and optimized pattern recognition algorithms in the microscope. A special designed transducer head was developed to scan the cylinder surface by line scans in hoop direction and rotating the head, then shifting the head in axial direction to perform the next line scan. Fig. 3 shows as example the coercivity images derived from the tangential magnetic field strength evaluation (H_{CO}).

3. Carbon Fiber Reinforced Plastics (CFRP)

As CFRP laminates have a complex lamination structure with different fiber directions (0°, 90°, ± 45°) the production process of lamination of the prepregs is complicated and different kind of quality limiting structure irregularities can occur. Therefore NDT after production is a need as well as in aerospace industries in-service inspection of the highly stressed components. As the structures are very often sandwich like where in between two CFRP plates honeycomb structures are embedded the inspection tasks are much more difficult.

However, new developments in NDT have brought progress in the inspection applications.

3.1 Eddy current testing

As CFRP has electrical conductivity the material can be inspected using eddy current (EC) technology [4]. Fig. 4 shows images of the eddy current impedance obtained by an automated scan with an EC-transducer. Frequency range of the equipment is between 10 Hz and 10 MHz. A multi-frequency approach can be performed by time-multiplexing and different typical structural defects can be detected optimal at different frequencies.

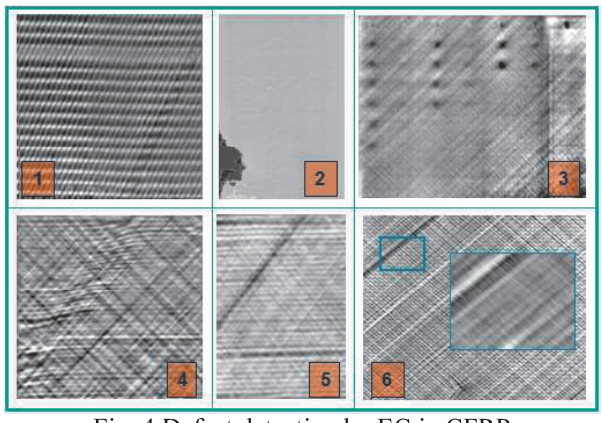

Fig. 4 Defect detection by EC in CFRP

So far direction sensitive transducers are applied angular oriented defects are detected (missing rovings (1, 5, 6), foreign body embedding (here test pieces, fuzzy balls, 3), delaminations (2), and ondulations (4).

3.2 Thermography

Flash pulsed thermography [5] can detect impact damage which by human eye is not detectable. Fig. 5 shows a thermal image of such damage in a CFRP plate

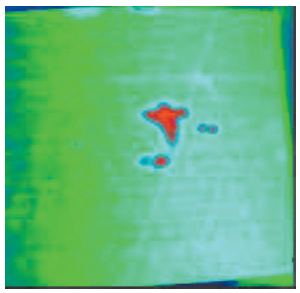

Fig. 5 Impact damage detection by pulsed thermography, field of view 60 mm × 60 mm

4. Conclusions

NDT has developed new technology to inspect light-weight materials. Successful applications were presented to

- high strength steel material property determination
- to the characterization of light-weight steel casting
- to EC and thermal CFRP inspection.

In the oral contribution also results to ultrasonic testing and imaging and X-ray CT will be discussed.

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Compact-Sizing of Optical Topography Technology (NIRS)

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ABSTRACT

There are several neuro-imaging methods, however, most of them need specialized facilities and high maintenance cost. Recently the need for measuring in the daily-life-like environment is increasing, and Hitachi succeeded to develop compact-sized Optical Topography (OT) units. Compact-sized units will realize the measurement in the various environment efficiently and economically .In this symposium, I will explain the basic technology of NIRS and potential future expansive usage.

1. Introduction

21st century is so called as neurotechnology era, while 20th century is called as physics era. Since the world faces globalization, there is an increasing need to know human itself better. In many case in the past, the way to know how people are feeling and thinking, are the subjective evaluation methods, such as questionnaire sheet or group interview. But recently many noticed that subjective evaluation methods have certain limitation, because it needs a verbal interpretation between the questioner and respondent. For knowing how people feels and think, there are some new solutions created, such as behavior measurements, brain function measurements, and etc.

In the past, in order to measure brain function, it is first necessary to prepare a specialized measuring room which needs a large initial investment as well as maintenance fee. Some measurement tools must fix the examinee's body tight.

What is highly required in the market is the tool measureable in the daily-life-like environment. Hitachi believe that OT technology would be one of the closest and best applicable solution, compared with other brain measurement tools.

2. Method

1) Background of development

OT Technology was developed by Hitachi's Central Research Lab. in 1995, and in 2001, the first medical grade product was introduced by Hitachi Medical Corporation.

Compact-sized product was developed and introduced from 2010, and there are several types of products available now.

2) Basic Principle of OT

OT technology is based on very weak near-infrared light around 800nm, and it can be used safely from neonates to seniors. Measurement system consists of the combination of irradiation sensor and detection sensor. The sensors are designed to be positioned at 3cm distance in square. The irradiated light from the surface of head skin goes inside of the brain and scatters, and a portion of light path, going up to 2 to 2.5cm depth and then come back to the surface of the head (Fig. 1).

The light around 800nm is known as a very good wavelength to measure human body, which goes through the skin, bone, and human tissue, but is absorbed by hemoglobin.

When a part of brain becomes active, it needs more oxygen and glucose. Oxygen is carried by hemoglobin, and when the brain activity becomes higher, the increase in hemoglobin also occurs. The brain activity refers as an increase or decrease of the returned light intensity. When the brain activity becomes higher, the increase in hemoglobin occurs and the decrease of returning light intensity occurs. On contrary, when the brain activity becomes lower, the decrease of hemoglobin occurs and the increase of returning light intensity occurs[1].

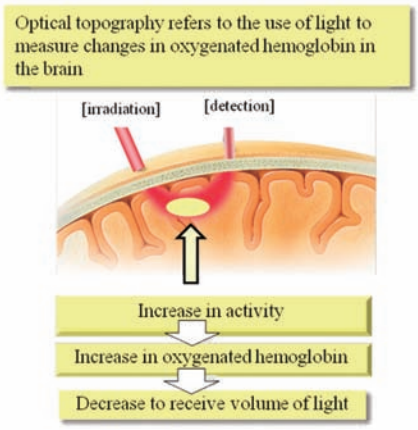

Fig.1 Mechanism of measurement

3) Comparison of measurement technologies

Compared with other measurement technologies, OT has certain merits to be usable in the daily-life-like environment. First, it can be designable as transportable and also wearable. Secondary, it is not affected by the outside radio noises, since the measurement is not electric wave, but near infrared light. The drawback of OT is that it is not possible to measure the deep portion of brain, but the surface of the brain (cerebral cortex part). And also spatial resolution is 3cm, which is wider than fMRI. Nevertheless OT is best fit to measure human's brain activity in cerebral cortex in the daily-life-like environment (Fig.2).

	Signal	Measurable in daily life like condition	Compact Sizing	Simultanous measurement	Realtime measurement	Easiness to wear
EEG	nerve	△	◎	◎	○	○
MEG	nerve	×	×	△	×	×
fMRI	Blood Volume Change(deoxy)	×	×	×	△	×
Optical Topography NIRS	Blood Volume Change	○	◎	◎	○	○

Fig. 2 Comparison of measurement technology

3. Development of Compact-Sized OT

Hitachi has developed 2 types of Compact-Sized OT, which are available commercially in research field. Those 2 models are specialized for forehead measurement.

1) Wearable Optical Topography (WOT series)

WOT's design target is that the unit should be measureable in the daily-life-like environment, so mobility is one of the most important design concept. It employs non-fiber optics ergonomic design, newly developed 2-wave-length built-in laser capsule, rechargeable built-in battery, and wireless LAN for non-cable connection to the host control computer. In addition, new probe design was adopted and soft touch style probe was realized (Fig. 3) [2].

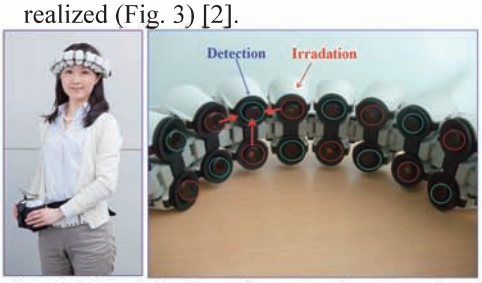

Fig. 3 Wearable form factor and new probe design

Since it employs wireless LAN, Wearable OT's another merit is to measure multiple persons simultaneously. Currently, up to 4 persons measurement becomes possible (Fig. 4), and it is effective to measure people's communications (Fig. 5), interactions, and mass data collection at one time[3].

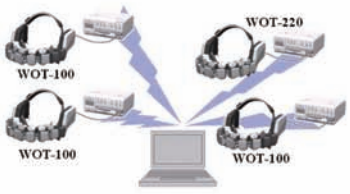

Fig. 4 Wireless System

Fig. 5 Scene of Communication measurement

2) 2 Channel NIRS(HOT121)

Furthermore, the smaller form factor HOT121 was developed to be able to wear headset by examinee itself and start measurement in the very short time. HOT121 measures 2 points of forehead, targeting working memory area (Fig. 6).

Fig. 6 Design of HOT121

Later than HOT121, by the joint research effort with Tohoku University and Hitachi, 1-channel Wireless Proto-Type System was developed (Fig.7). This Proto-Type System enabled up to 20 persons measurement simultaneously at one time.

Fig. 7 Proto-Type System of 1-channel

4. Concluding remarks

By Compact-sized OT hardware, the measurement scene will expand wider.

In the future, by the wireless communication technology, measurement scheme may lead to collect more data and do analysis in almost realtime (Fig. 8).

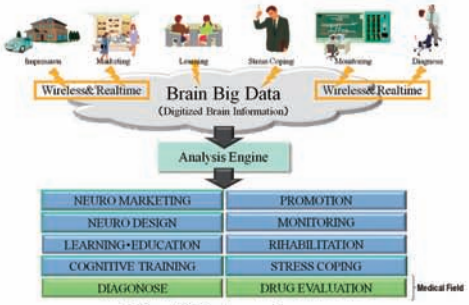

Fig. 8 Future Image

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Understanding the Triple Helix Model and the Finance of Innovation

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ABSTRACT

Governments increasingly partner with corporations, universities and research institutions in an effort to build knowledge-intensive and high tech clusters. These 'triple helix' collaborations generally ignore the importance of financial capital and financially driven incentives. Since the main purpose behind the triple helix approach is to solve economic, social and environmental problems, the policy focus should be on building venture capital ecosystems. New sources of capital, such as joint venture capital funds, crowd funding, online venture capital platforms and partnerships offer new opportunities for governments.

1. Introduction

What should governments and policymakers do to stimulate innovation and entrepreneurship? One way to do it is to encourage the launch and development of start-up companies. But, how should governments support these innovative startup companies? Is there a role for governments in the finance of innovation? There isn't an easy answer. For instance, it has often been argued that governments can only play a very limited role in spurring innovation and entrepreneurship (Lerner, 2009[1]; Hwang and Horowitt, 2012[2]). It is here where the 'venture capital ecosystem' plays a crucial role. Clearly, venture capital (provided by private parties as well as the government) is necessary to support the further growth and development of these companies (Gompers and Lerner, 2001[3]; Mazzucato, 2013[4]).

In order to stimulate innovation, policymakers mainly focus on creating environments in which governments increasingly partner with large corporations, universities and knowledge and research institutions. These triple helix collaborations are, among other things, directed to the establishment of knowledge-intensive service clusters in which the structure and dynamics of interactions among the different actors drive the transfer of knowledge and provide other resources that increase the potential for innovation, growth and value creation. The triple helix approach has proven successful in that it has led to the formation of formal and informal networks of entrepreneurs and other economic actors, thereby increasing the availability of human capital and, more importantly, social capital.

2. Methods

We assess the triple helix model by an analysis of the most innovative regions in the world. Consider Brainport in the Netherlands. Brainport is a business location that is centered around Eindhoven in the Netherlands. it was established as a triple helix cluster. This initiative is considered very successful in terms of R&D spending, the production of patents and job creation. In 2011, companies invested EUR 2.1 billion in research and innovation, which resulted in the production of 42% of the total patents (approximately 1,100 patents) that were registered in the Netherlands. More than 60,000 industry jobs were created in the region. In terms of benchmarking the success of Brainport, the triple helix approach has arguably generated an ecosystem for innovation that belongs to the best in the world. In 2011, the Intelligent Community Forum named Eindhoven the 'Intelligent Community of the Year'. What is perhaps more important is that Forbes Magazine has ranked Eindhoven as the most inventive city in the world (with 22.6 patents for every 10,000 residents) in 2013 (Pentland, 2013[5]). To put this number in perspective, in the second-ranked San Diego, which is considered the world leader in the clean technology economy, this number is 8.9 patents for every 10,000 residents.

Despite the clear benefits of the triple helix model, there is a recognized concern that the Brainport hub may not realize its full potential (European Commission, 2013[6]). Experts increasingly point to a missing fourth helix (and sometimes even fifth helix): the citizens or user communities (also called the 'civil society') and the 'natural environments of society' (Carayannis, Barth and Campbell, 2012[7]). There is something to the quadruple or quintuple helix model. The unique collaboration among academia (research), industry and government focuses on the creation of an engaging and stimulating environment for open innovation and knowledge transfer activities. However, the model does not include the drivers for knowledge production, innovation and growth. This is where the civil society (fourth helix) and natural environment (fifth helix) come into play. It is argued that these elements are necessary to provide incentives to the 'triple helix actors' to drive economic, social and environmental innovations to the market faster and more effectively (Curley and Salmelin, 2013[8]).

Still, there are problems with pushing the quadruple or quintuple helix models too far. First, the extended innovation models prove difficult to implement, because they heavily rely on the actors' willingness and ability to think and act beyond their own functional boundaries (European Commission, 2013[6]). Second, the models arguably put too much emphasis on the interrelations of human capital and social capital in the process of innovation and collaboration, thereby ignoring the importance of financial capital and financially driven incentives (The Economist, 2013[9]). These financial incentives are necessary to accelerate growth and

achieve market leadership. Venture capitalists and other risk capital providers can and must play a crucial role not only in the area of knowledge transfer and innovation, but also as 'social impact' investors that attempt to solve global economic, social and environmental problems, such as global warming and healthy aging (Bennett, 2012[10]; Martin, 2013[11]). This brings us to the challenges that policymakers and governments face in building a venture capital ecosystem.

3. Results and Discussion

The creation of a venture capital ecosystem remains one of the biggest challenges for governments. There are several reasons for this. Most traditionally structured venture capital firms have (with a few notable exceptions) delivered uninspiring returns (Mazzucato, 2013[4]; Mulcahy, 2013[12]). This has not only led to a significant decrease in the number of venture capital funds, but has also moved many of them towards the less risky financing of already profitable later stage companies or companies founded by so-called serial entrepreneurs with considerable track records. Clearly, this development has created an 'investment gap' in the funding of early to mid-stage companies in Europe (see Figure 1). The decreasing number of venture capital funds and their propensity to move to later stages of funding has contributed to the emergence of a 'liquidity gap' in the venture capital ecosystem (see Figure 1). This gap is tied to the significant increase in the time that elapses between the inception of the company, the first involvement of risk capital providers and their ultimate exit.

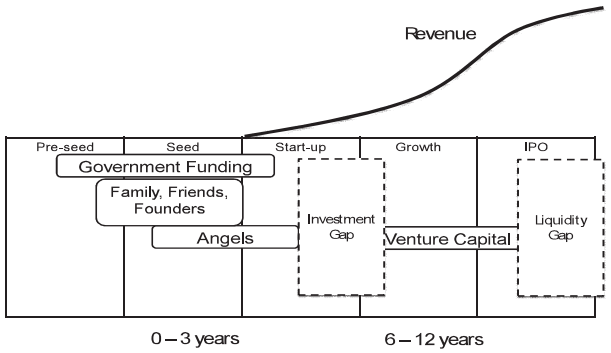

Fig. 1 Gaps in the Venture Capital Ecosystem

Policymakers and governments usually intend to bridge the gaps in the venture capital ecosystem by (a) creating a legal, fiscal and economic environment that is conducive to venture capitalists and (b) providing direct or indirect venture capital in the form of debt and equity. By doing so, governments hope to replicate the success of the world's most successful ecosystem: Silicon Valley. We are all aware of the success stories of entrepreneurs that started their businesses – and developed their innovative ideas with the help of venture capitalists – in garages and basements and built them into global market leaders. The Silicon Valley model, however, is not easily replicated (Hwang and Horowitt, 2012[2]). It appears that providing (access to) venture capital is not sufficient. Policymakers should focus on the specific characteristics of Silicon Valley: the personal interactions among both public and private capital providers that turn innovative ideas into vibrant start-up companies. However, there is good news. Although venture capital has drawn most attention from policymakers in many countries, the venture capital ecosystem is currently evolving. In particular, we observe new breeds of risk capital providers, such as corporate venture capital funds and crowd funding.

4. Concluding remarks

Policymakers have long been committed to create an environment in which high-potential growth companies are able to flourish into large, world-leading companies in a relatively short period of time. Seeing the importance of developing a venture capital ecosystem where innovative firms can prosper, governmental efforts should be geared towards supporting the market-based initiatives that have already emerged to cover the 'gaps' in the venture capital cycle (both in the early and later stages). Again, we will analyze and assess the world's most innovative clusters to get a clearer understanding of the financial and personal factors that drive the venture capital ecosystem.

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Innovation, University Entrepreneurship and the Role of Triple Helix

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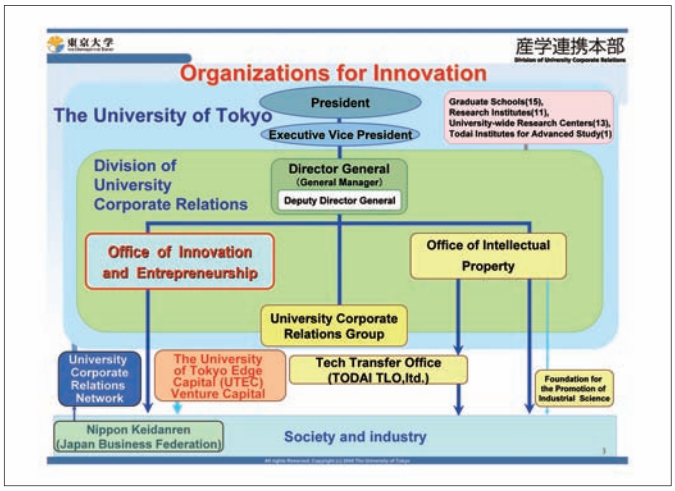
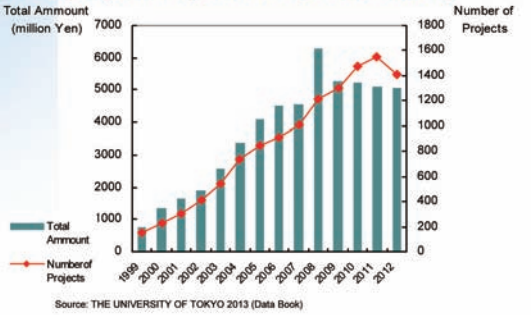
ABSTRACT

In the early 2000s government policymakers acknowledged the importance of innovation in restarting the economy and identified the national universities as a driver for increasing entrepreneurship and innovation. The universities were made independent from the national government and given the mandate to disseminate and utilize their research for the benefit of society. The University of Tokyo provides an example of how these goals have been implemented over the last ten years through entrepreneurship education, university-industry collaborations, start-up support, and seed funding.



東京大学 産学連携本部

Collaborative Research Projects at the University of Tokyo (primarily with the private sector)



Source: THE UNIVERSITY OF TOKYO 2013 (Data Book)

東京大学 産学連携本部

Promotion of University Entrepreneurship

- Consultation
  - Offer one-stop advisory services to the university's researchers, students and spin-off entrepreneurs
- Mentoring
  - The University of Tokyo "Mentors (UT Mentors)"
  - External network of professionals (VCs, Attorneys, Accountants, Bankers, Analysts, ….)
  - UT Venture Squares
    - Network with the entrepreneurs who are UT graduates
- Venture Capital
  - Offer seed money to spin-off ventures
    - The University of Tokyo Edge Capital (UTEC)
  - Offer hands-on assistance for university-spin-offs in developing businesses
- Incubation
  - Offer facilities and assistance to university start-ups
    - The UT Entrepreneur Plaza
- Education
  - ***UT Entrepreneurship Dojo*** **for the entire schools**
  - ***Innovation and Entrepreneurship*** **at Graduate School of Engineering**
  - ***Entrepreneurship*** **at School for Engineering**

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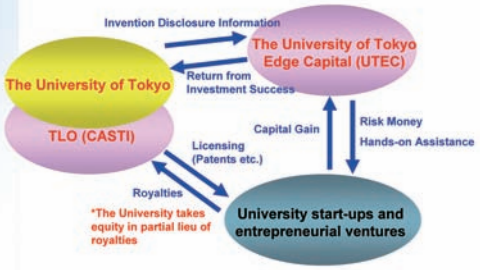
University Entrepreneurship Ecosystem in the University of Tokyo



東京大学 産学連携本部

UT Entrepreneur Dojo

- Started in 2005
- Recognized as one of the most important educational initiatives at the University
- 150-200 students are enrolled every year
- 6-month and three-phase entrepreneurship educational program
  - April-June: Lectures & Development of Business Ideas
  - July-August: Seminars & Writing of Business Plans
  - September-October: Mentoring & Training Camp
  - Mid October: Business Plan Competition
- Sponsored by DUCR, UTEC (Venture Capital) and UT TLO (Technology Licensing Organization)
- Student exchange program with Peking University
- UTEC is ready to offer initial capital if the business plan developed by a student team is feasible enough

東京大学 産学連携本部

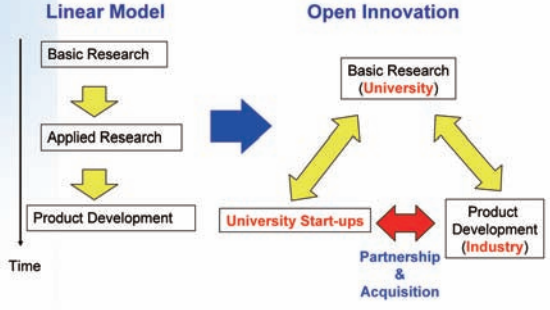
UT Entrepreneurship Education Program & Business Plan Competition

Profile of Enrolled Students: 2005~2013 Total

	Freshman & Sophomore	Junior & Senior	Graduate School	Total
Science & Engineering	48	275	797 (50.6%)	1,120 (71.2%)
Humanities & Social Science	60	245	147	452 (28.8%)
計	108 (6.9%)	520 (33.1%)	944 (60.1%)	1,572 (100.0%)

東京大学 産学連携本部

"Paradigm Shift" in Innovation System



東京大学 産学連携本部

Market Capitalization of the Leading Japanese and the U.S. Corporations (Trillion JPY)

JAPAN	U.S.A.
Toshiba (1904) 2.3	Johnson & Johnson (1886) 25.5
Hitachi (1910) 3.7	General Electric (1892) 25.1
Takeda Pharmaceutical (1925) 3.9	IBM (1911) 23.8 trillion JPY
Toyota (1937) 22.9	Microsoft (1975) 29.9
Canon (1937) 5.1	Apple (1976) 42.4
Sony (1946) 2.2	Google (1998) 30.9

Note: ( )Year of Incorporation (Foundation), As of May 21, 2013 $1=102.7 JPY

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東京大学 産学連携本部

Exits of Venture-Backed Companies in the U.S.A.

Year	Total M&A Deals	M&A Deals with Disclosed Value	Total Disclosed M&A Value ($M)	Average M&A Deal Size ($M)	Number of IPOs	Total Offer Amount ($M)	Average IPO Offer Amount ($M)
2004	349	188	16,043.8	85.3	94	10,481.6	111.5
2005	350	163	17,324.7	106.3	57	4,482.4	78.6
2006	377	164	19,034.8	116.1	57	5,117.1	89.8
2007	379	168	29,460.0	175.4	86	10,326.3	120.1
2008	351	119	13,775.4	115.8	6	470.2	78.4
2009	273	92	12,525.6	136.2	12	1,642.1	136.8
2010	445	129	18,404.4	142.7	74	7,432.5	100.4
2011	467	166	24,081.8	145.1	53	9,921.9	187.2

Source: Thomson Reuters & NVCA *Venture-Backed Liquidity Events

11

東京大学 THE UNIVERSITY OF TOKYO 産学連携本部 Division of University Corporate Relations

Thank you for your attention!

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東京大学 産学連携本部

DR. SHIGEO KAGAMI

Professor, General Manager – Office of Innovation and Entrepreneurship Science Entrepreneurship, Division of University Corporate Relations (DUCR), The University of Tokyo.

Dr. Kagami is a graduate of Hitotsubashi University (BA in Commerce, 1982), and gained his MBA from IMD (Lausanne Switzerland, 1989), and completed his doctoral work in corporate governance at Weatherhead School of Management, Case Western Reserve University (2000).

Before he joined The University of Tokyo, Dr. Kagami was a consultant at Boston Consulting Group (1982-1986), a founding partner of Corporate Directions Inc. (CDI, 1986-1997), and Partner of Heidrick & Struggles International (2000-2002). At the University of Tokyo, he became Associate Professor, Pharmaco-Business Innovation Course at Graduate School of Pharmaceutical Sciences, and he had been Professor and General Manager – Science Entrepreneurship and Enterprise Development (SEED), Division of University Corporate Relations (DUCR) from 2004 until the end of March 2013. Professor Kagami has become General Manger of the Office of Innovation and Entrepreneurship, a newly created organization as a merger of two offices at DUCR; Office of Development of Collaborative Research and Office of SEED.

Professor Kagami's responsibilities include 1) Development of large scale research collaboration projects with the industry for innovation, 2) Entrepreneurship education program and student business plan competition for the University, 3) Management of incubation facilities for university start-ups, 4) Relationship management with The University of Tokyo Edge Capital (UTEC) as a board member (~June 2013), and 5) Consulting and mentoring for the University researchers and students for their start-up initiatives.

13

Can Functional Brain Imaging Prompt Innovations in Next-generation Automobiles?

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ABSTRACT

Information about cognitive processing that occurs when an automobile is being driven can be obtained using neuroimaging techniques. Such information will certainly be advantageous in the near future for automobile design, given that automobiles are more than mere tools for transportation; they're a man-machine interface. Therefore, it would be in the best interest of engineers to invest in some knowledge of recent neuroimaging techniques from cognitive neuroscientists, and to at least comprehend the advantages and disadvantages of those techniques. In this symposium, I will discuss the possibility of applying neuroimaging techniques to the R&D of next-generation automobiles.

1. Introduction

Recent advancements in neuroimaging techniques enable us to visualize brain activity during various kinds of cognitive activities. We believe the utilization of information from human cognitive activity is certain to directly contribute to innovations made for the next-generation automobile. Recent automobiles and, of course, those of the future are emphatically acting as a man-machine interface, directly connecting one's intention to move with the mechanical systems of the automobile.

Functional magnetic resonance imaging (fMRI) is one of such techniques which is able to measure changes in brain activity. One of the significant advantages of the fMRI technique is that it can make visualization with relatively high spatial resolution of whole brain networks involved in specific cognitive function(s), and even access those structures located in deeper parts of the brain. However, a few restrictions apply to fMRI experiments. One is that fMRI experiments must be done in a MRI scanner room and the subjects must be put inside a MRI scanner. The MRI system is very large and heavy. Another restriction is that, since the MRI system uses string magnetic power, metals with electrically conductive parts cannot be used within or near the MRI scanner.

Near infrared spectroscopy (NIRS) is another neuroimaging technique. It records activity at the surface of the cerebral cortex by measuring related changes in the concentration of oxygenated hemoglobin (oxy-Hb) and deoxygenated hemoglobin (deoxy-Hb). The advantage of NIRS is that it can be used in daily life situations. For example, it can measure the temporal course of cortical activity while a person actually drives a car. Nevertheless NIRS only can measure the activity of the brain's surface and nothing can be known about what is happening in deeper structures. In addition, its spatial resolution is very low- only several centimeters.

2. An example of an fMRI experiment

As mentioned, one cannot bring metals and electric parts close to the MRI scanner. Nevertheless, one can present any visual and auditory stimuli inside of the MRI scanner through a projector and a pair of MRI compatible headphones. The subject's head must be fixed on a head rest, but he/she is free to move his/her hands and feet during the MRI scans, as long as those movements do not cause any movement of the head.

We previously ran an experiment to measure brain activity when detecting hazardous situations while driving. In this experiment, we placed an accelerator and a brake pedal at the end of the MRI scanner bed and, through the projector, presented several video clips of different driving situations (Fig. 1). Subjects were asked to imagine they were driving their own car and to step on the brake when they came upon a hazardous situation. We then calculated brain activation at the time subjects moved their right foot from the accelerator. In addition, the activity of the activated areas was compared with the subject's score for individual sensitivity to hazard detection, which was measured by psychophysical tests on a different day.

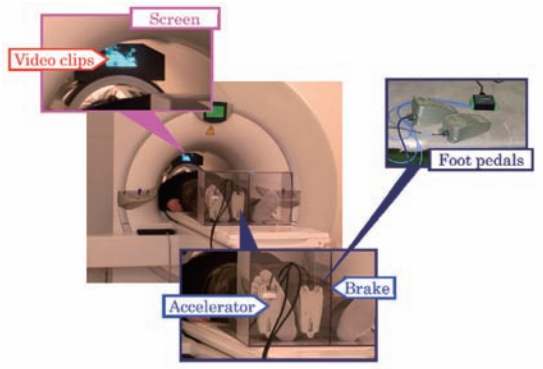

Fig. 1 An example of the experimental set-up for fMRI

The results indicate that a brain network consisting of the premotor cortex of the left hemisphere, the posterior parietal, and the occipital cortices of the bilateral hemispheres are involved in hazard detection. The activity of the left premotor cortex was shown to be related to the sensitivity of one's hazard detection abilities (Fig. 2).

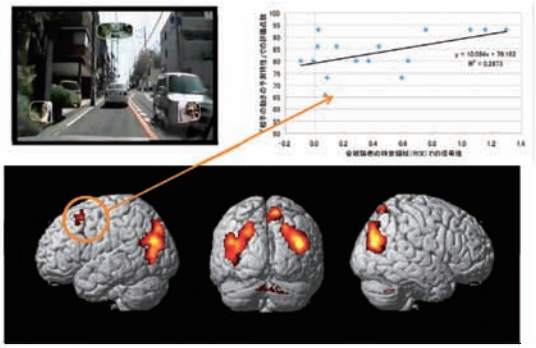

Fig. 2 Brain areas involved in hazard detection

This study gives us the following idea for developments in future automobiles. If we could continuously monitor the brain activity of the left premotor cortex using some device while one is actually driving, we can estimate one's ability to detect hazards as they occur, and then use that information to control the driving system of the automobile.

3. An example of NIRS experiment

We measured the activity of the dorsolateral prefrontal cortex (DLPFC) while cars were being driven using a prototype of the wearable optical topography (WOT) system (Hitachi Ltd., Tokyo, Japan) based on NIRS (Fig. 3). The DLPFC is known to play a key role in cognitive functions directly related to safe driving, such as attention, inhibition, decision making, etc.

A probe unit of the WOT system can be adjusted to fit on the head of a subject, and a processing unit can be strapped to the subject's body. Therefore, we can monitor changes in cortical activities while subjects are driving cars, or even riding motorcycles, in daily life situations.

Fig. 3 A prototype of the wearable optical topography (WOT) system

In our previous preliminary experiments, the activity of the DLPFC in healthy adults was measured while the adults drove cars in a closed driving course using the WOT. While driving cars with manual transmission, only the right DLPFC showed high activation. While driving cars with automatic transmission, the DLPFC of both hemispheres did not show any activation. It is interesting to note that driving a kart activated the bilateral DLPFC.

The left DLPFC showed activation only while a kart was being driven. Activation of the left DLPFC is often related to verbal tasks requiring executive processing. The drivers probably used a logical and/or verbal approach when considering how to handle the kart. In contrast, it has been argued that executive demand increases activity in the right DLPFC for spatial working memory processing. Thus there may be a greater requirement for spatial working memory when driving cars with manual transmission and karts. Cognitive load was relatively low when driving a car with manual transmission.

In general, the rate of age-related decline in measures of cognitive functioning will be less pronounced for people who are more mentally active, or, equivalently, the cognitive differences among people who vary in level of mental activity will be greater with increased age. When we design specific cars for our elderly population, we may have to consider designing cars that lend a hand to those with lower mental activity.

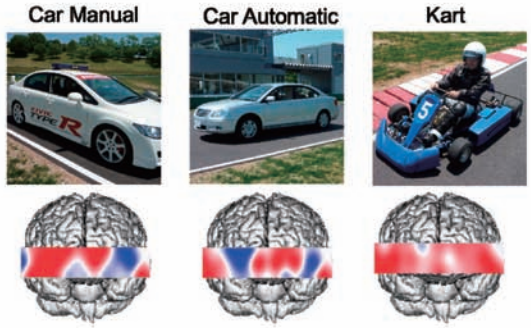

Fig. 4 Typical patterns of cortical activity when driving cars

4. Concluding remarks

We believe that applying what is known about cognitive functions through neuroimaging techniques to the R&D of next-generation automobiles can bring forth a new perspective. Creating a platform for discussion between cognitive neuroscientists and car engineers would surely be fruitful for innovation.

Alzheimer's disease: from pathology to therapeutics

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ABSTRACT

Amyloid β peptides are the most characteristic neuropathological protein deposited in the brains of patients with Alzheimer's disease, which is implicated in its pathogenesis and deemed as the prime target for the disease-modifying therapy. In this talk, the molecular pathology of Alzheimer's disease, the most frequent cause of dementia in the elderly and often linked to traffic accidents, will be discussed in relation to the efforts to develop mechanism-based therapeutics for this devastating disease.

Deposition of amyloid β peptides (Aβ) as senile plaques is the most characteristic neuropathological feature of Alzheimer's disease (AD), which is implicated in its pathogenesis and deemed as the prime target for the disease-modifying therapy (DMT) [1] (Figure 1). Aβ deposition is determined by the production and clearance. Aβ is produced by sequential proteolytic cleavages by β- and γ-secretases. γ-Secretase, harboring presenilins (PS) as the catalytic center, forms the C terminus of Aβ that determines its propensity to aggregate: missense mutations in PS genes cause familial AD by altering the preferred γ-secretase cleavage sites in a way to increase production of pathogenic Aβ42 species [2,3]. γ-Secretase forms a hydrophilic pore within the membrane lipid bilayer, which enables the unique mode of intramambrane proteolysis to form Aβ, and inhibitors of β- and γ-secretases with different targets and mode of action are being developed. Aβ immunotherapy facilitates the clearance of Aβ from brain parenchyma through the activities of anti-Aβ antibodies with different characteristics. Efforts to clinically develop the DMTs for AD, including establishment of imaging and fluid biomarkers that surrogate the AD pathology through clinical studies like AD Neuroimaging Initiative (ADNI) and Japanese ADNI are currently underway.

J-ADNI was started in 2008, aiming at conducting a longitudinal workup of standardized neuroimaging, biomarker and clinico-psychological surveys [4] (Figues 2). The research protocol was designed to maximize compatibility with that of US-ADNI, including structural magnetic resonance imaging analysis for the evaluation of brain atrophy, fluorodeoxyglucose and amyloid positron emission tomography, cerebrospinal fluid sampling, *APOE* genotyping, together with a set of clinical and psychometric tests that were prepared to maximize the compatibility to those used in the North America. Japanese ADNI has recruited 545 participants (239 amnestic mild cognitive impairment (MCI), 152 normal aged and 154 early AD). A number of significant results, including the predictive values of amyloid markers (i.e., amyloid PET and CSF Aβ42) for conversion of MCI to AD, are being obtained and analyzed. ADNI activities world-wide will establish the rigorous quantitative descriptions of the natural course of AD in its very early stages. The data, as well as the methodologies and infrastructures, will facilitate the clinical trials of disease-modifying therapies for AD using surrogate biomarkers that will enable the very early treatment of AD, which will further be supported by J-ADNI2 focusing on preclinical AD population as well as early and late MCI.

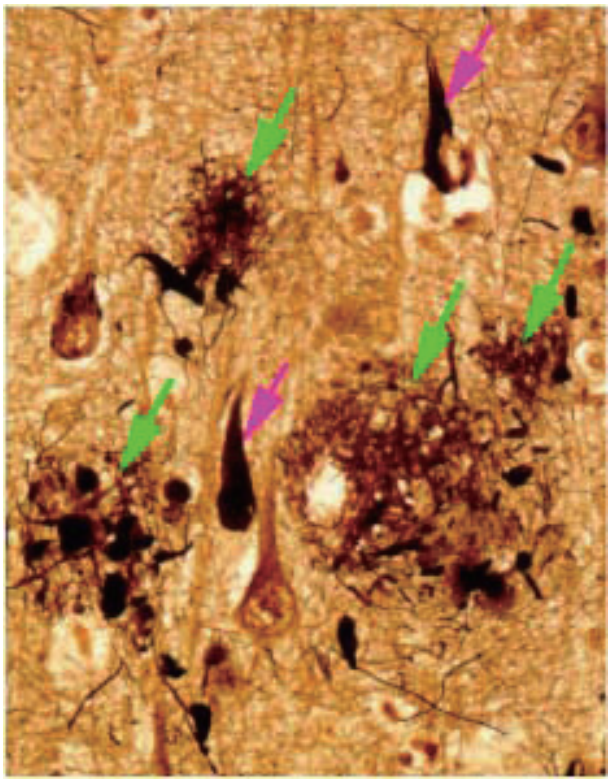

Figure 1. Neuropathology of Alzheimer's disease Green and pink arrows denote senile plaques (amyloid deposits) and neurofibrillary tangles, respectively.

AD and other types of dementias sometimes cause traffic accidents by wrong-way driving. Current status as well as causes of this type of traffic accidents will also be discussed.

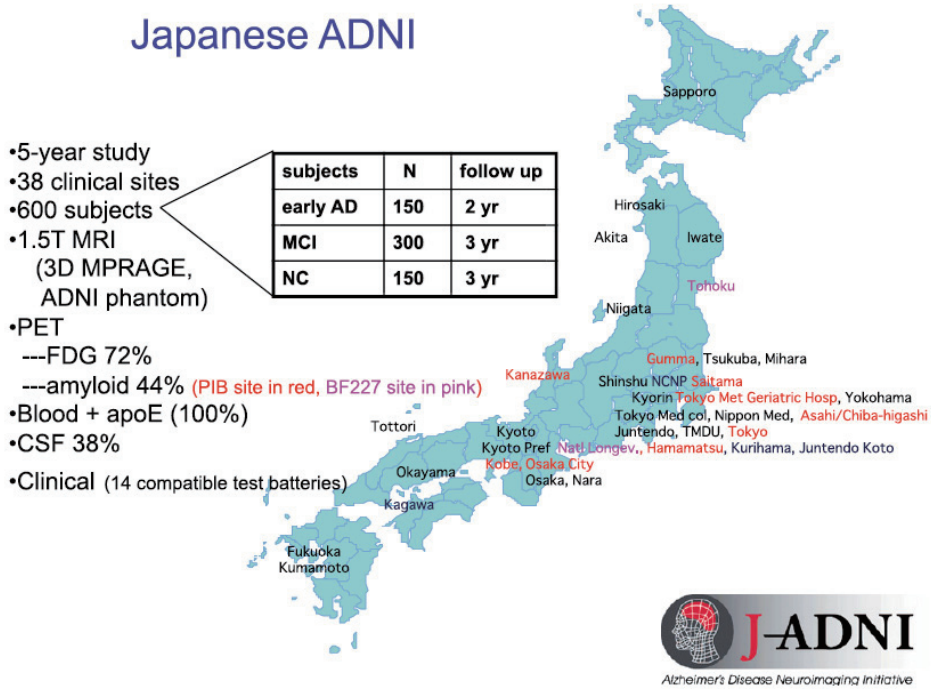

Figure 2. Overview of J-ADNI

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The Japanese Next Generation Vehicle Strategy: A Successful Strategy to Achieve CO_2 Emission Reduction and Global Green Vehicle Leadership

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ABSTRACT

Japan has long committed itself to a Low Emission Vehicle (LEV) policy to reduce greenhouse gas emissions as well as to maintain the viability of its automotive industry. For more than ten years, Japan has been implementing a series of programs supported by a multitude of well-designed policy measures. The rapid growth in next generation vehicle sales suggests these efforts are paying off and have led to significant declines in CO_2 emissions within the transport sector. Government implementation of two new action plans will encourage further advances in technologies for next generation vehicles that could obviate the need for fossil fuel engines.

1. Introduction

In early 2000s, Japan started to implement a series of low emission vehicle policies to promote the widespread use of fuel efficient, low emission vehicles (LEVs) in Japan. The government was committed to reduce greenhouse gas emissions and believed that one path toward that goal was to increase the number of high fuel efficient, low emission vehicles on the road. The policy initiatives began when there were relatively few LEVs and fuel supply facilities for serving LEVs were very limited.

- In 2000, the total number of LEVs in use in Japan was only about 600,000 vehicles, and the number of eco-stations was about 230.

2. Implementation of the First Two Low Emission Vehicle Action Plans in 2001 and 2004

Japan implemented "Prime Minister Koizumi's "Low Emission Vehicle Diffusion Action Plan" in 2001 and the "the World's Most Advanced Low Emission Vehicle Society Action Plan" in 2004. Both action plans called for 10 million "low emission vehicles" and 50,000 fuel cell vehicles on the road by the end of FY2010.

- LEVs included low emission gasoline vehicles, CNG vehicles, hybrid vehicles, hydrogen vehicles, methanol vehicles, and fuel cell vehicles.

To promote their plans, Japan deployed a multitude of creative policy measures. For example, Tokyo established a pool of $460 million in incentives to encourage the purchase of LEVs and devised an innovative classification system to determine the level of tax cuts for which a vehicle qualified. Vehicles received one to three stars depending on how much lower the vehicle emission was relative to the current standard, with "three star" vehicles receiving the greatest tax cut. Similarly, vehicles were provided with a certification sticker bearing a percentage number, such as 10, 25, or 50 percent, depending on how much higher the vehicle's fuel efficiency was relative to current and future standards.

This ingenious incentive system effectively shaped both current and future market demand. Tokyo did not need to enforce specific standards, but instead defined a road map that linked future market incentives to increasingly stringent standards. Responding to these incentives, many automakers pledged by 2005 to have 80 to 100 percent of their domestic vehicles qualify for three star emissions standards and bear the highest fuel efficiency ranking certificate. At the same time automakers invested in new technology to meet future standards. Tokyo thus was able to attain higher emission and fuel efficiency standards easily and faster.

Tokyo set vehicle emission and fuel economy goals that far exceeded any standard in the world. Tokyo also compiled a plan for new nitrogen oxide (NOx) and particulate matter (PM) standards for 2005 that were about equal to the Euro IV emission standards placed in force in 2005. Tokyo also has implemented a revised Vehicle NOx/PM Law that would encourage replacement of most trucks, buses, and diesel vehicles, thereby improving the chances for cleaning up NOx and PM pollution in 12 years.

- Incentives included subsidies at the time of vehicle purchase, reduction in the vehicle acquisition tax, and the annual vehicle tax, as well as the reduction in corporate tax and property tax. There were also reverse financial incentives. Owners of older vehicle models paid a greater annual vehicle tax, which created an additional incentive to replace them with new LEVs. Low interest loans were also available for corporate purchasers.

3. Assessment in 2007 Indicated Mixed Results

The two Action Plans triggered a marked increase in gasoline powered LEVs (but did not succeed in reducing CO_2 emissions). The goal of 10 million vehicles on the road was achieved in 2005, five years earlier than planned. Total number of LEVs in use was 16.5 million in 2007, a 26-fold increase since 2000. In 2000, LEVs were less than 1% of the total vehicle fleet but were 13% in 2004 and 22% in 2007.

Hybrid vehicles also increased about 8-fold. Growth

was initially slow but became robust starting in 2004. This outcome pointed to an important lesson, namely that technology advances in vehicles would radically alter buyer behavior. In the case of hybrid LEVs, the increase was triggered by the introduction in 2004 of the more technologically advanced, more fuel efficient 2nd generation Prius.

- The government assessed that the increase in hybrid vehicles was due to its inherent commercial appeal and that government subsidies for the vehicle were no longer necessary. It discontinued subsidies for hybrid vehicles in March 2007.

Sales of other LEVs, such as CNG vehicles, methanol vehicles, hydrogen combustion vehicles, and fuel cell vehicles, were unremarkable. CNG vehicles achieved a modest, 3.7-fold increase but methanol vehicles declined to the point of nearly fading away. Fuel cell vehicles and hydrogen vehicles did not perform well at all. Fuel cell vehicles were too costly and not viable for practical use.

- The government viewed methanol vehicles to be commercially uncompetitive and policy support was discontinued. It appears that the government might have dropped hydrogen combustion vehicles from its policy support as well.

4. Lessons Learned from the Outcome of 2007

The goal of 10 million LEVs was met, and the inventory of LEVs increased. But no significant reduction in CO_2 emissions was achieved.

Gasoline LEVs have a limited ability to cut greenhouse gas emissions because the vehicles still burn fossil fuel. Moreover, efficiency improvements in these vehicles encouraged owners to drive their cars more, undercutting reductions in CO_2 emissions. The government recognized that the key to building a fleet of LEVs that met CO_2 emission reduction goals would require a significant shift away from fossil fuels. It also recognized that R&D on next generation vehicle technology must be promoted because the future vehicle fleet would be based on technology advances derived from non-gasoline LEVs.

5. Implementation of Next Two Action Plans in 2008 and 2010

Japan implemented the "Low Carbon Society Construction Action Plan" in 2008. The Plan called for one out of two new vehicles sold by 2020 to be next generation vehicles (NGVs), which would include hybrid vehicles, electric vehicles, plug-in hybrid vehicles, fuel cell vehicles, clean diesel vehicles, and CNG vehicles. The government aimed to reduce greenhouse gas emissions by 60-80% by 2050. Japan subsequently launched the "Next Generation Automobile Strategy 2010." The Plan stipulated that 20 to 50% on the road should be NGVs by 2020 and 50-70% by 2030. It called for up to 1% of that number to be fuel cell vehicles by 2010 and up to 3% by 2019. Japan continued the same policy measures as before with minor modifications as needed.

6. Outcome as of 2011 Positive

The outcome, as of 2011, shows that the policies have achieved encouraging results. The rate of increase in sales of NGVs is greater than for gasoline LEVs. Sales of gasoline LEVs increased by 40% from 2007 and 2011, but NGVs increased five-fold during the same period.

Electric vehicles and hybrid vehicles both increased substantially. The increase was primarily due to technology advancements. Electric vehicles increased 11-fold due to introduction of two new vehicles, Mitsubishi i-MiEV and Nissan Leaf. Hybrid vehicles increased 5-fold, due to introduction of the 3rd generation Prius in 2009.

- As a result, NGVs comprised 3% of total vehicles in use.

The increase in NGVs in the vehicle inventory notably contributed to a decline in CO_2 emissions. After peaking in 2001, CO_2 emissions in Japan's transport sector steadily declined. It registered 267 million tons in 2001, 245 in 2007 and 230 million tons in 2011—well below the 2010 emissions target for the fourth consecutive year.

7. Challenges Ahead: Japan's Overall CO_2 Emissions Must Be Lowered

While CO_2 emissions in the transport sector have declined, total greenhouse gas emissions in the overall Japanese economy rose to 1,307 million tons in 2011, 3.6% above the 1990 level or 9.6% higher than the target. This is because, following the 2011 earthquake and tsunami, Japan's consumption of fossil fuels increased due to thermal power generation, which outweighed the reductions in emissions from the transport sector and a decline in greenhouse gas emissions from the manufacturing sector caused by decreased production due to the natural disaster. Faced with this challenge, Tokyo is now determined to achieve reductions in emissions that are 6 percent below the 1990 target.

8. Outlook - Japan will Likely Achieve its CO_2 Emission Target as well as Remain the Global Green Car Leader

The past record suggests that Japan's automakers will continue to aggressively reduce emissions and improve fuel efficiency and create breakthrough technology for NGVs, ultimately obviating the need for fossil fuel engines. Consequently, it seems likely that Japan will remain the global green vehicle leader and hold that position as long as it maintains its strong R&D focus on advancing NGV technologies.

NH_3-DeNO$_x$ Performance of the Composite [Fe-Beta + Fe(Mn)MCM-48] Catalyst: Combining SCR Activity and NH_3 Oxidation Activity for NH_3 Slip Removal

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1. Introduction

Diesel engine vehicles are becoming widespread due to their higher fuel efficiency and lower CO_2 emissions compared to gasoline engine vehicles. However, in view of future legislation of efficient NO_x abatement from the diesel exhaust gas becomes a challenging task, which requires more effective methods of exhaust gas purification. In general, NO_x abatement can be achieved by using a catalytic system comprising zeolite-NH_3-DeNOx catalyst (e.g., Fe-Beta or Cu-Beta) followed by NH_3-slip catalyst. The latter usually contains noble metal components such as Pt or Pd, which are quite expensive.[1] In this study, we made an attempt to replace noble-metal catalyst with mesoporous Mn-containing FeMCM-48.

2. Method

2.1. Catalyst preparation

Microporous Fe-Beta catalyst was prepared by incipient wetness impregnation of H-Beta (Si/Al = 12) with an aqueous solution of $Fe(NO_3)_3{\cdot}9H_2O$ followed by calcination at 550°C in flowing air. The estimated Fe content by atomic absorption spectroscopy was found to be ~ 0.7 wt%.

Mesoporous Mn-modified FeMCM-48 catalyst, designated as Fe(Mn)MCM-48 (Si/Fe = 60) was prepared hydrothermally as per the procedure reported earlier[2] with $Fe_2(SO_4)_3{\cdot}H_2O$ having trace amounts of Mn. The nominal iron content of the sample was 1.5 wt%.

Composite [Fe-Beta + Fe(Mn)MCM-48] catalysts were prepared by thorough mechanical mixing of both Fe-Beta and Fe(Mn)-MCM-48 powders in agate mortar followed by pelletization using hydraulic die. The Fe-Beta : Fe(Mn)MCM-48 component ratio was varied from 1 : 1 to 5 : 1.

2.2. Catalyst characterization

The catalysts thus prepared were systematically characterized by various analytical and spectroscopic techniques such as XRD, BET surface area, DRUV-VIS and ESR. The characterization data indicated that Fe cations in Fe-Beta are located in (exchangeable) cationic positions and the amount of iron oxide species is negligible. On the other hand, the characterization data for Fe(Mn)MCM-48 clearly indicate isomorphous substitution of trivalent iron into tetravalent silicon in the framework structure.

2.3. Catalytic tests

Fe-Beta, Fe(Mn)MCM-48, and the composite [Fe-Beta + Fe(Mn)MCM-48] were tested in NH_3-DeNO$_x$ using a fixed-bed reactor with a feed gas containing 600 ppm NO, 700 ppm NH_3, 10 vol% O_2, 6 vol% H_2O, balanced with N_2 at GHSV = 270,000 h^{-1}. An FTIR GASMET-4000 analyzer was used for the reaction product analysis. Note that the reaction was carried out under NH_3 excess (100 ppm above reaction stoichiometry) for evaluation of NH_3-deNO$_x$ and NH_3-slip removal efficiency.

3. Results and Discussion

Fig. 1(A) depicts the XRD of Fe(Mn)MCM-48. The diffraction pattern shows all the reflections characteristic of cubic MCM-48 structure.[2,3]

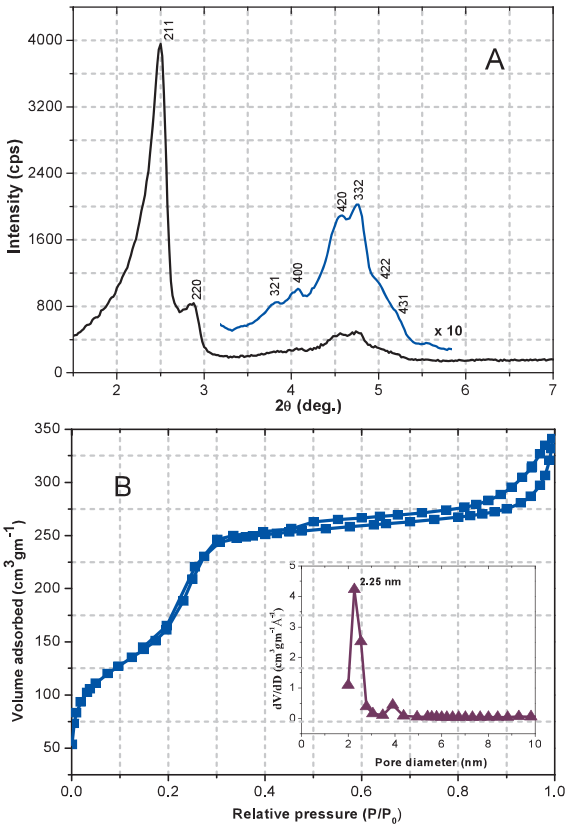

Fig. 1 (A) XRD pattern; (B) N_2 sorption isotherms of Fe(Mn)MCM-48

Specific surface area and pore-size distribution were obtained respectively by BET and BJH methods. Fig. 1(B) presents the N_2 adsorption–desorption isotherms which show typical type IV pattern with a sharp inflection in the range 0.2–0.3 (P/P_0) corresponds to capillary condensation with uniform mesopores (inset). Further, the isomorphous substitution of trivalent iron in the tetrahedral framework positions was supported by DRUV-VIS and EPR studies (not reproduced here).

Catalytic tests of the plain Fe(Mn)MCM-48 (not shown here) revealed significant activity of the catalyst in NH_3 oxidation, while its activity in NO_x selective catalytic reduction was marginal. It was found that the NH_3 oxidation activity of FeMCM-48 can be additionally boosted by modification with Mn, and hence Mn-modified FeMCM-48 sample, viz., Fe(Mn)MCM-48, was used for the preparation of the composite [Fe-Beta + Fe(Mn)MCM-48].

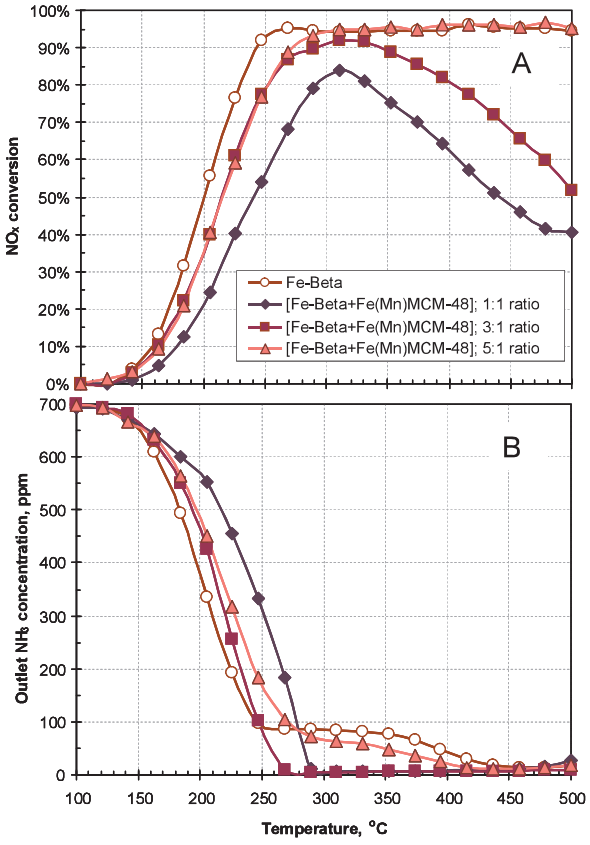

Fig. 2 NH_3-$DeNO_x$ performance of Fe-Beta zeolite and the composites [Fe-Beta + Fe(Mn)MCM-48] with different component ratio. (A) – NO_x conversion; (B) – outlet NH_3 concentration

NH_3-$DeNO_x$ performance of the composite [Fe-Beta + Fe(Mn)-MCM-48] catalysts having different component ratios are compared in Fig. 2(A). Efficiencies of the catalysts in NH_3 slip removal are compared in Fig. 2(B). [Fe-Beta + Fe(Mn)MCM-48] with 1 : 1 weight component ratio demonstrates efficient NH_3 slip removal, however its oxidation activity appears to be excessive, as indicated by the downward bending of NO_x conversion profile at ~ 300°C. This bending originates from unfavorable NH_3 over-oxidation over Fe(Mn)MCM-48 leading to undesirable NO formation and NH_3 depletion.

Variation of Fe-beta /Fe(Mn)MCM-48 component ratio allows us to minimize the unfavorable NH_3 over-oxidation and to balance activities in NH_3-$DeNO_x$ and NH_3-oxidation. The favorable performance was attained for the composite catalysts with 3 : 1 and 5 : 1 ratios. The data suggest that the performance can be optimized further by careful adjustment of the component ratio.

4. Conclusion

The data on NH_3-$DeNO_x$ performance of the composite [Fe-Beta + Fe(Mn)MCM-48] catalyst indicated that the favorable NO-SCR activity and the efficient NH_3 slip removal can be attained within the wide temperature range. The performance of the composite catalyst can be optimized by variation of Fe-Beta and Fe(Mn)MCM-48 ratio.

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Li-ion Battery Module for Small Electric Vehicles

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ABSTRACT

Li-ion Battery is superior in a characteristic with a high energy density and long cycle life. We try to use these good points and exchange lead acid battery for Li-ion on the small electric vehicles. We report on the development battery module for two kinds of different electric vehicles. As a result, we understand that Li-ion battery influenced the vehicles to be light-weight, and the life of the battery became long.

1. Introduction

The Li-ion battery has been developed as a power supply for a mobile-phone and a small video, notebook-sized personal computer since 1990. It has spread to the most mobile devices recently. A zero-emission design of the State of California atmosphere resources station was announced in the latter half of 1980's, and the development of a fuel cell and the battery car started the application to a movement body, and a car using a lead acid battery and the Ni-MH battery was produced experimentally then. The large-sized Li-ion battery has been developed recently. So, we experimented on the battery exchange to small electric vehicles using the large-sized Li-ion. We report this result.

2. Method

We try to battery exchange from lead acid battery to Li-ion battery on the small electric vehicle. Case-A is use for "COMVOY-88" by MITSUOKA-Motor Company. Case-B is use for "COMOS" by TOYOTA-Body Company. A lead acid battery is used both vehicles. Table 1, 2 shows battery exchange data. Figure 1 is a photo of batteries.

Li-ion cell specification is

Case-A
- Cathode material is Li(Mn/Ni/Co)O2
- Anode material is Carbon
- Rated voltage is 3.6V
- Rated capacity is 15AH
- Weight is 530g
- Dimensions 148x210x6.5mm
- Energy density is 100Wh/kg
- Case is can type

Case-B
- Cathode material is LiMnO2
- Anode material is Carbon
- Rated voltage is 3.7V
- Rated capacity is 10AH
- Weight is 270g
- Dimensions 120x207x6.1mm
- Energy density is 140Wh/kg
- Case is laminating type

Table 1. Case-A "COMVOY-88" battery exchange data

COMVOY-88	Lead Acid	Li-ion
Battery	12V-70Ahx6S	21Sx4P
	72V-70AH	75V-60Ah
Vehicle Weight	236kg	
Battery Weight	129kg	56kg
50km/h run	43.5Ah(62%)	53.0Ah(88%)
	48km	68km
30km/h run	48.8Ah(70%)	58.0Ah(97%)
	67km	102km
Battery cycle life	1.5 years	4years over

Fig. 1 Photo of the Vehicle and Battery in case-A
Lead Acid type (L)/Li-ion type (R)

Table 2. Case-B "COMOS" battery exchange data

COMOS	Lead Acid	Li-ion
Battery	12V-60Ahx6S	21Sx4P
	72AV-60AH	75V-40Ah
Vehicle Weight	284kg	
Battery Weight	126kg	30kg
Battery Capacity	60Ah at 0.2C	40Ah at 0.2C
	43Ah at 1C	39Ah at 1C
Distance per change	50km	55-60km
Battery cycle life	1.5-2.0 years	6years

Fig.2 Lead acid battery in case-B

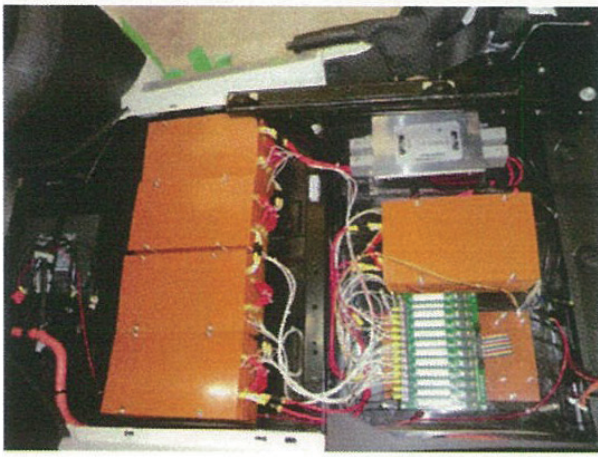

Fig.3 Li-ion battery in case-B

Fig.4 EV " COMS " with Li-ion Battery

3. Results and Discussion

Li-ion battery becomes 25V by 7 series. This voltage is same as two lead acid battery series. It is the same voltage that lead acid battery is 6 years and Li-ion battery is 21 series. The weight energy density of the Li-ion is 3 times of the Lead acid, and large weight loss is possible. In this experiment, light weighting from 70kg to 100kg was possible with small electric vehicles for single passenger.

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Research and Development of Tribological Techniques for Automotive Parts

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ABSTRACT

According to the prevention of global warming and the energy saving policy, the diversification of fuels (bio diesel, ethanol, etc.) for vehicles and the growth of market share of electrical and hybrid vehicles have been increasing. In this paper, a unique in-situ analysis technique and a typical achievement in the fuel tribology related to automotive parts were described as a 1st topic. And as a 2nd topic, tribological and electrical behaviors of a metal containing Diamond-Like Carbon nanocomposite coating deposited on an electrical contact material were discussed.

1. Introduction (topic 1)

As an industrial application, Diamond-Like Carbon (DLC) has been used in various components. Especially, in the automotive application, DLC is used in variety of conditions such as dry, E/G oil and fuel. However, the optimum structure of DLC has not been clarified in each environmental condition.

Recently, we have developed an in-situ system to observe the behavior of lubricant during friction by combining the fast-scan Fourier transform infrared attenuated total reflection (FTIR-ATR) spectrometer with the friction equipment as shown in Figure 1 [1]. In this study, we will report the experimental data of structural changes of DLC in various conditions as measured using the in-situ observation system.

2. Experiment (topic 1)

The infrared spectra were obtained by two experiments, annealing test and in-situ friction test. The annealing test was conducted at 500°C for 2hr. Table 1 shows the test condition for in-situ friction test.

3. Results and Discussion (topic 1)

Figure 2 shows the infrared spectra after annealing at 500°C. We have assigned bands of DLC with some papers (e.g. [2]). The spectra after anneal test shows the large change at ca. 1100 cm-1 which represented the aroma structure and ca. 1600 cm-1 corresponding to sp2 conjugated C=C. It is clarified the graphitization and aromatization are caused by the high temperature.

The intensity of the band at 1600 cm-1 and the friction coefficient obtained by using in-situ observation system are shown in Figure 3. In the running-in region, the intensity of sp2 band obviously increases. The intensity of aroma band also increases during friction. However the behavior of sp1 band intensity is difference between anneal test and friction test. The sp1 band intensity decreases as the temperature rises. In contrast, that intensity increases during friction (Table 2).

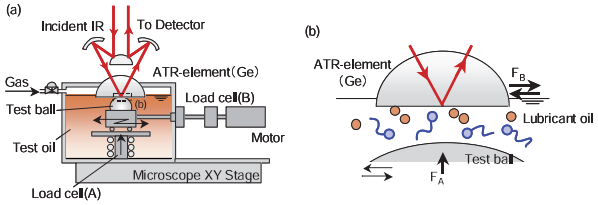

Fig. 1 Schematic diagram of in-situ observation system

Table 1. Experimental conditions

Specimen	a-C:H (on S45C Cylinder)
Speed	0.5mm/s
Load	55N (125MPa)
Time	6hr

Table 2. Structural changes of DLC for each test

	Aroma	sp1C-C	sp2C=C	sp3CH_3
Annealing	+	-	+	-
Friction	+	+	+	-

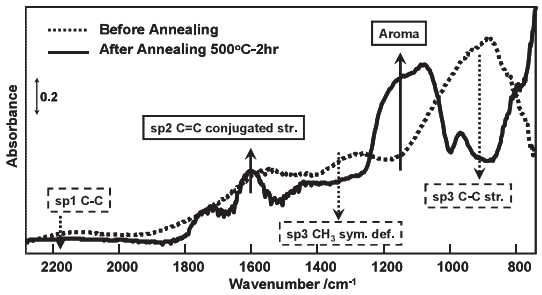

Fig. 2 Infrared spectra after annealing

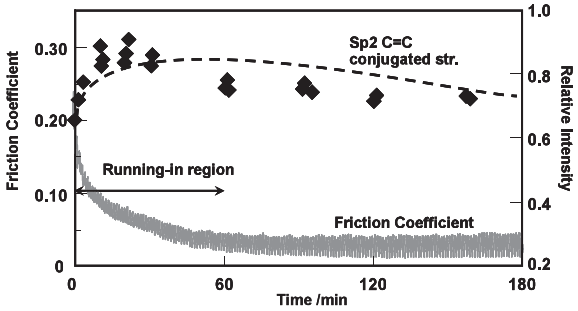

Fig. 3 Time dependence of band intensity and COF

4. Summary (topic 1)

The structural changes of DLC under friction were researched. The experimental results clearly show that friction induces the structural changes of DLC.

5. Introduction (topic 2)

Demands for innovative technology on electrical contacts in vehicles have been increasing with the growth of market share of electrical and hybrid vehicles. Reducing the electrical contact resistance (ECR) and the coefficient of friction (μ) are the major technological issues. In this study, tribological and electrical behavior of a copper containing Diamond-Like Carbon (Cu-DLC) nanocomposite coating deposited on a brass (Copper-Zinc alloy) substrate was investigated.

6. Experiment (topic 2)

Experimental materials and conditions are shown in Table 3. A hybrid deposition process, coupling plasma enhanced chemical vapor deposition and DC magnetron sputtering of a copper target, was used for the deposition of the Cu-DLC [3]. A brass ball was used as the counterpart of the Cu-DLC. The tribological and electrical contact behavior was investigated by using a ball-on-plate linear reciprocating tribometer. The four-terminal method was used for the measurement of ECR between the ball and the plate during the tribo-test. A combination of an uncoated brass plate (the substrate of the Cu-DLC coating) and a brass ball was performed for comparison purpose.

7. Results and Discussion (topic 2)

Figure 4 and Figure 5 show the typical ECR, μ responses of each material combination, respectively.

In the case of the uncoated brass plate, ECR was initially around 50 milliohms but it decreased down to 1.0 to 2.0 milliohms after few cycles. The initial value of μ was approximately 0.3 and it increased rapidly to around 0.8 after few cycles. After, the variations of ECR and μ around these average values were relatively wide.

In the case of the Cu-DLC, while initial value of ECR was hundreds of milliohms, it gradually decreased with cycles and reached 1.5 to 2 milliohms after 600 cycles. μ started below 0.35 and decreased progressively, and stabilized around 0.25, also after 600 cycles. Observation of worn surfaces of the different number of sliding cycles reveals that a tribofilm was built up on the sliding surface of the ball, and it grew as the sliding cycle increased, consisting mainly of copper according to energy dispersive X-ray spectroscopy. The Cu-DLC coating on the plate wore gradually and delamination of the Cu-DLC was observed at 450 cycles. Around this number of cycles, ECR started decreasing, suggesting that such decrease resulted from the delamination of the Cu-DLC coating. After less than 1000 cycles, the Cu-DLC was almost worn out. However, detrimental effects could not be observed either on ECR or on μ. So the tribofilm on the ball should have a key role in achieving and preserving these good electrical and tribological characteristics.

8. Summary (topic 2)

The electrical contact resistance and the coefficient of friction behavior of a Cu-DLC nanocomposite coating deposited on a flat brass substrate with a brass ball combination were investigated. A Cu-rich tribofilm was built up on a brass ball by sliding with a Cu-DLC deposited on a brass substrate. This tribofilm provides the good tribo-electrical characteristics.

Table 3. Experimental materials and conditions

Materials	Ball (φ6.35mm)	Brass	
	Plate (20 x 20 x t0.5mm)	Brass (uncoated)	Cu-DLC (brass substrate)
Conditions	Normal load	1N	3N
	Track length	0.8mm	
	Frequency	0.5Hz	
	Electrical current	0.2Amps	
	Sliding cycles	up to 2000	
	Atmosphere	Ambient air (20-25 °C, 25-35%RH)	

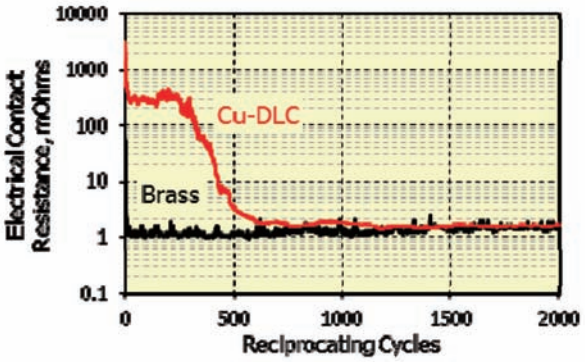

Fig. 4 Electrical contact resistance

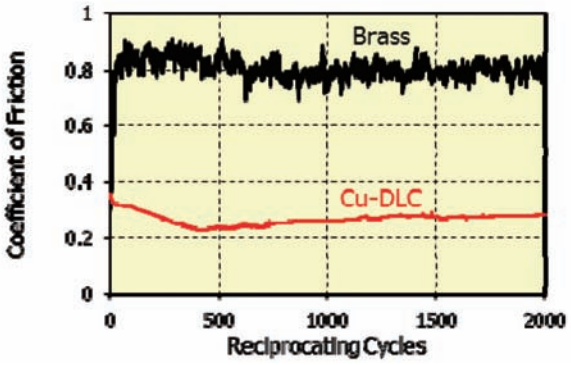

Fig. 5 Coefficient of friction

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Starved Lubrication: Contribution of Laser Surface Micro-Texturing

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ABSTRACT

To prevent the occurrence of wear and the increase in friction in case of lubricant starvation between two surfaces in contact, this study demonstrates experimentally the possibility to create oil feeding in the high pressure zone, by controlling the micro-topography of the surfaces. Thanks to a femtosecond laser, micro-cavities are generated on the surface and locally increase the lubricant film thickness.

1. Introduction

The ability of a fluid to separate two surfaces in contact under severe mechanical conditions is outstanding. However, the persistence of this protective film will be challenged in case of inadequate contact feeding in lubricant, that is to say when starvation occurs. Although various experimental [1,2] and numerical [3] studies have focused on starvation and replenishment mechanisms under stationary conditions, only little work has taken into account transient conditions.

The goal of this paper is to evaluate the contribution of a laser micro-textured surface to maintain a lubricating film and to prevent wear. We also analyze the onset of partial starvation based on an effective feeding volume in the convergent zone. The consumption of this volume leads to severe starvation regime.

2. Experimental

In this context, starvation mechanisms in elastohydrodynamic regime were experimentally investigated in pure rolling, in rolling/sliding and also reciprocating conditions for fluid viscosity ranging from 50 to 3000 mPa.s. Thanks to a ball/disk tribometer [4] with an optical interferometric system, the convergent, contact and outlet zones are simultaneously visualized (see Figure 1), and the film thickness distribution and the friction force in the high pressure zone under controlled contact kinematics are measured.

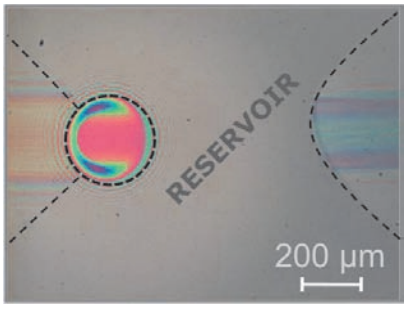

Fig.1 EHL contact. The air/lubricant meniscus is clearly visible in the inlet zone. The flow direction goes from right to left.

Occurrence of starvation will be discussed in terms of film thickness, location of the air/lubricant meniscus and friction.

3. Results and discussion

Severe starvation occurs when an effective volume of lubricant in the convergent zone is consumed: the film thickness decreases and the friction force simultaneously increases. We show that starvation process is function of two time scales. For short time, inferior to 1s, the film thickness and the location L_M of the air/lubricant meniscus are correlated as shown in Figure 2. For longer times, few hundreds of s, a progressive diminution of the film thickness down to few nanometers in the contact zone results from the lubricant deficit induced by the ratio leakage/flow rates. This decrease of the film thickness causes the occurrence of wear in the contact. In presence of a laser micro-textured surface, the shearing of the lubricant entrapped in the micro-geometries is able to provide a local increase of the film thickness, protecting the mating parts. The ability to diminish wear is governed by the density and the depth of micro-texturing.

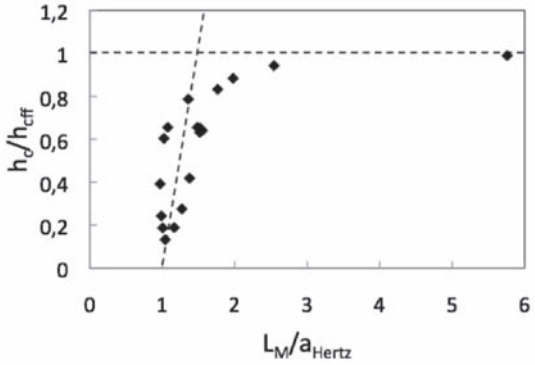

Fig.2 Correlation between the central film thickness h_c and the location of the air/lubricant meniscus L_M.

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Traffic Management Future

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ABSTRACT

The economic development in the last 100 years have been mainly enabled by the improved mobility options for persons and goods due to the development of efficient vehicles and provision of transport infrastructure for road, rail, air, maritime and inland waterways. Whilst the number of vehicles today excessively increased beyond one billion adverse effects occurred on safety, efficiency, sustainable use of natural resources, environment and economy. The development of new technologies mainly will allow new regimes in traffic management will to reduce the negative impacts towards a more sustainable mobility of persons and goods.

1. Introduction

Mobility supported by engines has started around 200 years ago with development of steam driven locomotives for transportation of persons and goods. Around 50 years later Maritime transportation changes from wind driven vehicles towards engine driven with similar propulsion principles. Again 50 years later a new generation of engines with ignition principle could be built much smaller and less weight applicable for road vehicles and finally about 30 years later this type of engine have been applicable also for a new generation of aircrafts. In parallel to the development of vehicles it was also necessary to develop a dedicated transportation infrastructure for rail, road, maritime and air transportation (Rail tracks, dedicated roads for road vehicles, ports and air ports). This (technological) development has built the basis for the economic development globally but also was building the basis for the motorized armed forces where the mankind has suffered dramatically in the last 100 years also globally.

2. Technological Development

The technological development induced the production of a huge number of vehicles – specifically in the last five decades-we now can see around the globe. Today we account about 1bn road vehicles, about 180mio rail vehicles, about 80mio ships all sizes and more than 10mio aircrafts requiring an adequate infrastructure to be operated. The investment on transport infrastructure in the last 5 decades has been enormous in all countries and is expected to grow even further due to aging of infrastructure and the demand to extend their capacity to balance the demand. Beside all financial effort we experience a decreased efficiency in transportation and still a much too high number of fatalities and injuries due to accidents in transportation. The European Commission counts the economic loss due to inefficient traffic (traffic jams, loss of workforce by delays, etc.) to about 120bn€ annually and economic loss on social level due to fatalities and injured person to about another 130bn€ annually. Similar figures have been reported from the USA on their economy. Today's most urgent demand beside the significant reduction of GHG emission induced by transport is to increase efficiency and safety in transportation on short notice.

Therefor the organisation of transport (generally addressed as traffic management) on all modes need to be carefully analysed and measures to be identified to improve safety and efficiency specifically in view of the most recent technologies emerged in the last 2 decades.

3. Advances in Traffic Management

Analysing the principles in organizing traffic on the different mode in a general manner one can easily conclude two diverse regimes.

1., A strictly centralised regime as for rail and air traffic – 'the vehicle is only allowed to move with dedicated (individual) advise from a central management point (via signal or message) and

2., A so-called 'decentralized' regime, as there is only an indirect way to impact vehicle movement (e.g. via traffic lights, road side signs, etc.) – 'the vehicle move on the command of the driver more or less independent from centralized advise only steered by some general rules (not addressing each vehicle individually)'.

The first regime applies for rail traffic management and air traffic management, the second regime applies for road traffic management and for maritime and inland waterway traffic management.

In view of the most recent technological developments on all transport mode - the so called 'co-operative systems' - one can see a significant change in organizing traffic for the near and long term future. The key enabler for this 'co-operative systems' in transport are the automated exchange of messages between vehicles (V2V) and between vehicle and infrastructure (V2I). Based on the experience we have made so far in the developments of the last decade globally we will need an additional element to organize traffic in a safe and efficient manner. This element is the 'autonomous function' to allow the vehicle to drive automatically within a limited sphere.

4. Summary

Due to the increasing technological capability of electronic systems based on efficient data capture by sensors, fast processing of mass data and automated data/message exchange between vehicles and infrastructure (e.g. DSRC, GNNS, digital maps, etc.) new ways to 'organise' traffic can be developed. Introducing the 3 elements (V2V, V2I, and autonomous function) will consequently influence the above

mentioned divers ‘traffic management regimes’ to a new harmonised single approach on traffic management equally applicable to all mode of transport (road, rail, air traffic, maritime and inland waterway traffic). This will allow manage traffic in an integrated way across all modes without traffic jam and respect to utmost utilisation of infrastructure capacity while increasing safety of transportation with the goal for zero accidents on road, rail, air and waterways maritime transportation.

Tribology for the Future: Biomimetism and Surface Engineering

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ABSTRACT

While Mechanics can be considered as the science permitting the solids to support forces by contacts, Triblogy is the science, which permit the motion of solids. Tribological processes are always dissipative; a friction force is opposed to the motion and then creating an energy loss. As a consequence, engineers are always trying to lower the friction force in order to decrease the energy losses. This objectives associated to a search of increasing the lifetime of mechanical systems are in fact a challenge for the future Tribologists. Considering some systems from the nature can help to find some interesting ideas for surface engineering.

1. Introduction

The word Tribology was defined in 1968 but the "tribology" fact is very old. As soon as men for their daily activities used the contact between solids and motion, the tribological problems were present: friction force and wear, with their negative consequences.

At first, Tribology was not considered as a problem but people optimize the tribological systems step by step by performing simple dedicated experiments. An example is shown Fig. 1.

Fig. 1 Already at the Egyptian time lubrication was used to decrease the friction force. (transporting the statue of Ti – from a tomb at Saqqara – 2400 B.C.)

Then, people realize that contact between solids and friction exists and that friction and wear is a consequence of the interaction between the surfaces of matting solids. More sophisticated experiments where then developed in order to have information on friction and wear.

After that, the society was more and more developed for mechanical systems and tribological problems were more and more studied. It was then considered that material nature is important for the behavior and performances of tribological systems.

Surfaces appear after this period to be also a determinant factor… and then scientists were studying more and more the surfaces in order to find some way to improve their behavior (Fig. 2).

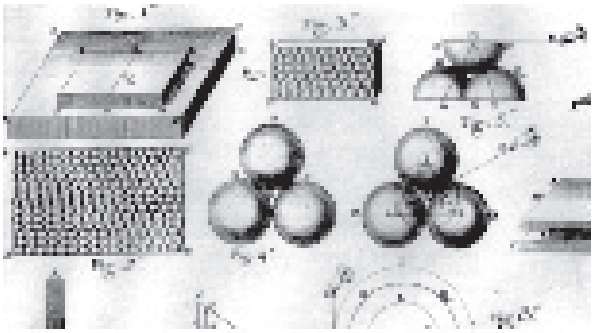

Fig. 2 In 1737 Tribologists begin to consider that the surface topography is an important parameter for friction processes. Belidor, a French scientist, represented the surface geometry using some ideal spheres.

The more simple was first to develop surface treatments in order to modify their mechanical properties; then various surface heat treatments were invented to form at the surface of metals some ompound with higher mechanical properties than the substrate. After, more complex strategies were developed to protect a solid surface by a coating with particular nature, structure and properties (see an example Fig. 3). Consequently, the tribological behavior is considered to be related to the behavior of coated surfaces. Of course, the adherence of the coatings appeared to be very important. In this period, very numerous coatings were investigated: hard coatings, soft coatings, multilayer coatings, composites coatings… always now, this strategy of protecting a sliding surface by a coating is under investigation in order to develop new and high-performence solutions.

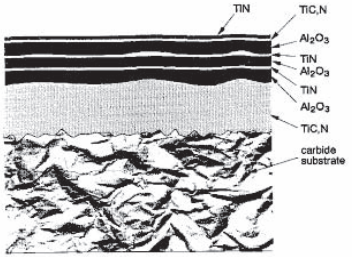

Fig. 3 An example of a multilayer coating for protecting cutting tools (cross section observed with a SEM).

More recently, surface topography was a parameter becoming of the first interest. Studies are trying to understand the relationships between surface topography and friction force and surface damage (Fig. 4). Machining surfaces with conventional machines was investigated: it becomes important to know what is the effect of machining parameters on the characteristics of the machined surface. Particular surface treatments such as sand blasting where used to modify the surfaces.

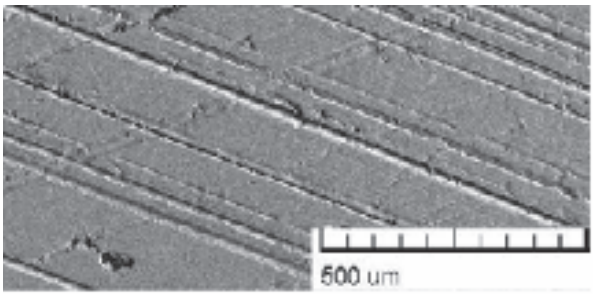

Fig. 4 Surface topography used for the sliding internal surface of diesel engine liners. Scratches with various sizes, which can act as lubricant reservoir and wear particles retainer, compose the particular roughness, manufactured by Honing.

With the development of machining technologies, scientists try to manufacture textured surfaces at a scale being smaller and smaller. Currently, the femto second laser can be considered as one of the most sophisticated machine tool for modifying surfaces; it can be used to create networks of very small holes in order to improve the behavior of surfaces in lubricated conditions (Fig. 5).

In a parallel way, the nature was in fact also optimizing the things in order to adapt them to a function. The structure, the materials and the surfaces are naturally designed in order to present the desired function: adherence, friction noise, mechanical resistance, wettability, colors, … many examples can be considered for this (Fig. 6).

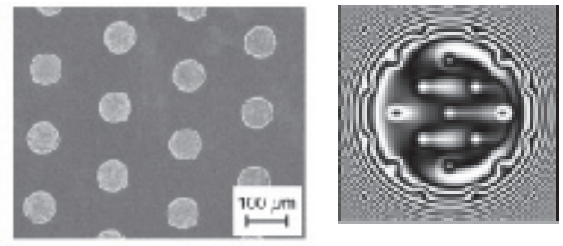

Fig. 5 Laser texturing can be used for tribology: creation of small dimple on a surface (left). This particular topography modifies the lubricant film formation in the case of elastohydrodynamic lubrication (right: result of modeling the film thickness).

(PhD of L Mourier, ECL - 2006)

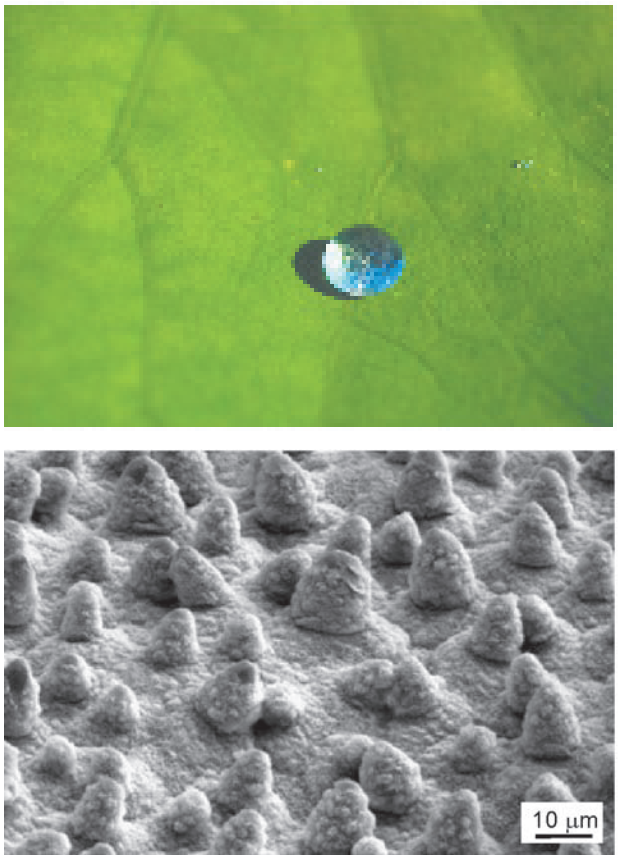

Fig. 6 Observation of a water drop on a Lotus leave (top) showing the super hydrophobicity created by the roughness and nature of surface (SEM picture, bottom).

Then, scientists and tribologists considered the idea of biomimetism. They try in fact to imitate the nature to have some particular function. But now, it is very important to think about the real challenges in the field of Tribology.

2. Future Trends in Tribology

Nowadays, Tribologists have developed a lot of effort to understand tribological processes with the use of high-performent equipements and complex modeling. Predictions are then more and more present but it is always necessary to continue theses efforts.

The present challenges are to develop mechanical systems with high output (low friction losses) and long lifetime. In the field of automotive industry, this challenge has also to be completed by considerations on production costs, recyclability and ecology.

With these aims, surface modifications represent a very attractive strategy. The development of new surface coatings and new surface topography is always a key problem for the future. We have for this to consider not only scientific progress in the field of surface science but may be interesting ides can be found in the nature to optimize a surface for a given purpose.

Synthetic Biofuels From Biomass

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ABSTRACT

The importance of biofuels is growing rapidly in Germany and world-wide. This is reflected in steadily increasing research activities in both academia and industry, as well as in an increasing number of joint ventures comprising several institutions. Thus, not only the extent of publications on this highly dynamic topic is strongly increasing but also the public interest due to its obvious socioeconomic relevance. First generation biofuels such as bioethanol and biodiesel are state of the art today. However it is obvious that neither the quantity nor the quality are sufficient to meet the production potential and the standards expected. The second generation currently under development aims at the use of lignocellulosic feedstocks by-produced in agriculture and forestry. Third generation biofuels are issued in diverse research activities ranging from microbial fuels or algal fuels.

1. Introduction

The bioliq® project at the Karlsruhe Institute of Technology (KIT) aims at large scale production of synthetic second generation biofuels from biomass (BTL, biomass to liquids). The bioliq process concept has been designed to overcome scientific challenges and engineering problems, which arise when low grade, residual biomass shall be used to a large extent in a BTL process. Biomass such as straw, hay or residual wood usually exhibit on the one hand low energetic densities, thus limiting collection area and transportation distances. On the other hand, the production of synthetic fuels requires large scale production facilities in accordance with economy of scale considerations. In the bioliq process, biomass is pre-treated in regionally distributed fast pyrolysis plants for energy densification. The products, being pyrolysis char and liquid condensates, are mixed to form stable, transportable and pumpable slurries also referred to as biosyncrude. Biomass is thus energetically concentrated allowing economic transport also over long distances. In industrial plants of reasonable size, the biosyncrude is gasified in an entrained flow gasifier at a pressure slightly above that of the following fuel synthesis. In the bioliq pilot plant synthetic fuels are produced via methanol as an intermediate. The process requires a gasification pressure of up to 80 bar.

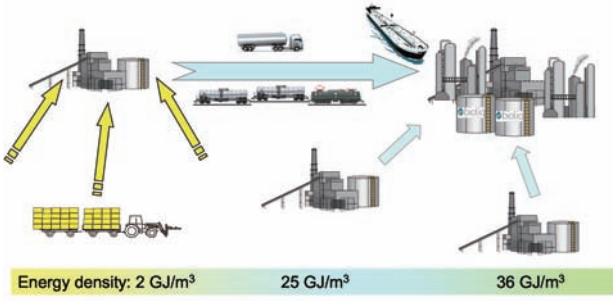

Fig. 1 bioliq concept

On site of KIT, a pilot plant is constructed for process demonstration, to obtain reliable mass and energy balances, for gaining practical experience, and to allow for reasonable cost estimates. The fast pyrolysis plant, already in operation, has a biomass feed capacity of 500 kg/h (2 MW(th)). A twin-screw reactor, equipped with a pneumatic heat carrier loop with sand as the heat carrier medium is the main technical feature of the plant. The biosyncrude is prepared in a specially designed colloidal mixer and stored in stirred container tanks. To prevent from potential sedimentation, the content of the tanks is continuously circulated.

The further process steps have been mechanical completed and commissioned separately in 2013. The high-pressure entrained flow gasifier is designed for 5 MW_{th} (ca. 1 t/h) slurry feed and can be operated at up to 80 bar. The burner is equipped with a twin fluid injection nozzle using oxygen and steam as atomization and gasification media. A 1 MW_{th} burner fed with natural gas is used for process stabilization, e.g. when using low calorific fuels or slurries with a wide and varying specification range. The pumps are designed to feed suspensions with up of 5 Pas viscosity, the burner nozzle is designed for a maximum viscosity of 1 Pas. The gasifier is specifically designed for lower fuel calorific values in the range of 13 - 25 MJ/kg. For adjustment of viscosity the biosyncrude can be heated up to 120 °C in the feed line to the burner nozzle. The gasifier is operated in slagging mode and is equipped with an internal cooling screen, particularly suited for conversion of ash rich feeds and fast start up and shut down procedures. Ethylene glycol slurries with char can be used as model fuel for scientific research. Ash and flux can be added to the fuel feed flow in order to adjust slag melting behavior.

The raw synthesis gas is purified and conditioned by a high pressure hot gas cleaning system, consisting of a hot gas filter with ceramic filter elements, a fixed bed adsorption for HCl and H_2S removal and a catalytic converter for decomposition of nitrogen and sulphur containing trace compounds. Afterwards, CO_2 and water are separated. The purified synthesis gas is then converted to dimethylether in a one-step synthesis process, which is converted in a subsequently following reaction into gasoline. A ZSM-5 zeolite-type of catalyst is used here. In all reactors, a new heat pipe based system is used for heat exchange, providing nearly isothermal conditions in the catalyst bed and improving process control.

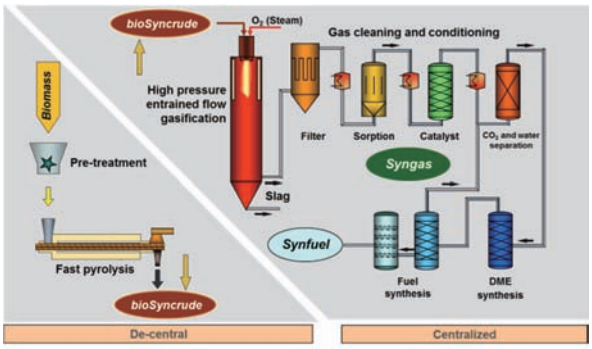

Fig. 1 bioliq process scheme.

Based on mass- and energy balances, an economic analysis of the whole process chain has been performed and will be worked out in more detail when experimental data from the pilot plant become available. Depending on the plant configuration and the selected production scenario and synthesis concept, overall process energy efficiencies from biomass to fuel between 34% and 42% have been estimated.

The process development is embedded into a coherent R&D framework, allowing for scientifically based operation and further development. Process development units for pyrolysis, gasification, gas cleaning and synthesis are utilized to increase the fundamental understanding of the underlying processes, to obtain representative product materials and process data, to develop technical improvements and new process variants, which then can be tested in the pilot plant.

Fig. 2 bioliq pilot plant at KIT.

Acknowledgements

The bioliq pilot plant is constructed and operated in cooperation with partners from chemical engineering and plant construction industries: Lurgi GmbH (Frankfurt), MAT Mischtechnik GmbH (Immenstadt) MUT advanced heating GmbH (Jena), and Chemieanlagenbau Chemnitz GmbH (Chemnitz). Financial support is provided by the Germany Ministry of Agriculture, Food, and Consumer Protection (BMELV) and the state Baden-Württemberg und the European Development Fund.

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VEHICLE TECHNOLOGY & ENERGY CENTRE
Canadian Applied Research Experience at Red River College

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ABSTRACT

Red River College, a recognized Canadian college leader in applied research, has demonstrated capabilities and expertise in vehicle technology and the use of renewable fuels – with an emphasis on performance in extreme climates, especially cold. Local, national and international partners have collaborated on vehicle-related product and prototype development, fleet demonstrations, testing and evaluation, and the use of renewable or zero/low emission fuels (such as biodiesel, hydrogen, and electric/hybrid technologies). A case study will illustrate the College's integrated research, education and training approach to *Mobility from "Green Energy"*.

1. Introduction

Red River College's integrated approach to research, education and training approach for *Mobility from "Green Energy"* has resulted in extensive experience in advanced transportation and energy-related applied research over the last decade.

In close proximity to the geographic centre of North America, the College's main campus is in Winnipeg, Manitoba, Canada (on approximately the 50th parallel) and can experience extreme temperatures in both the summer (35ºC) and winter (-35ºC). The opportunity to evaluate fuels and technologies in a cold climate environment has encouraged research on vehicles which use renewable and alternate fuels.

Cold climate and/or renewable fuels are often key elements in many applied research activities [1] such as the Red River Raycer (solar car); Hybrid Hydrogen Internal Combustion Engine and Hydrogen Fuel Cell bus demonstrations; Plug-in Hybrid Electric (passenger) Vehicle fleet conversion, demonstration and evaluation; diesel highway coach prototypes to meet new emission requirements; Compressed Natural Gas heavy vehicle winter performance evaluation; and development, demonstration and evaluation of an all-electric battery transit bus prototype. These projects complement the $2,400,000 (CDN) investment by the Government of Canada in vehicle technology research infrastructure.

In 2011, the Province of Manitoba provided $645,000 to establish the Electric Vehicle Technology & Energy Centre. EVTEC is a virtual centre which complements and supports provincial policy [2] concerning sustainable transportation. EVTEC serves to test and demonstrate electric vehicle technologies, while allowing the College to enhance applied research, education and training, as well as to raise public awareness of electric vehicle (EV) technology. EVTEC's startup was catalysed by a three-year, $3,000,000 international collaboration to develop an all-electric transit bus and charging system. Subsequent initiatives have led resulted in a $10,000,000 investment for a five vehicle, four-season, four-year demonstration under regular urban transit system operating conditions.

2. Discussion

Nearly 98% of Manitoba's electricity is generated from renewable hydro power, which is a key driver to pursue EV technology. In late 2010 Manitoba and Mitsubishi Heavy Industries of Japan signed a Memorandum of Understanding with the objective of exploring renewable energy development opportunities; including the electrification of transportation and recharging infrastructure, as well as battery-storage technologies.

An international consortia was created and brought together the Province of Manitoba, Manitoba Hydro, Mitsubishi Heavy Industries (MHI), New Flyer Industries (NFI) and Red River College to undertake the development of an all-electric battery transit bus, including the related charging infrastructure, with the ensuing research to be carried out through EVTEC. Anticipated benefits of the "Zero Emissions" bus are:

- only two tonnes of greenhouse gas emissions (from a renewable supply), compared to 108 tonnes for a diesel-electric hybrid and 162 tonnes for conventional diesel;
- assurance of a long-term renewable fuel supply;
- overall energy efficiency improvements, including electrification of ancillary accessories and improved drive train efficiency; and
- longer life and lower maintenance requirements due to reduced maintenance when compared to conventional engines, transmissions and accessories, coupled with longer drivetrain life.

Within one year, the prototype "Zero Emissions" bus (Figure 1), which integrates lithium ion battery packs from MHI in a NFI Xcelsior chassis, was operational. The batteries provide direct current power to a nominal 650-volt system, using an air-cooled 120 kWh battery which is ultimately targeted to be a comparable weight range as the engine and fuel on a diesel bus. The prototype has a range of 80 kms/four hours in typical stop-and-go transit operation, and is the first of its kind in Canada. The prototype has near zero emissions, although a bio-diesel heater is required in winter operation to heat the interior of the bus.

Fig. 1 Electric battery transit bus prototype – June 2012

Manitoba Hydro has completed installation of a first generation On Route Rapid DC charger with a dual module output design which is targeting 300 to 500 kW.

Initial validation and testing of the prototype vehicle over a two-year period in Winnipeg has begun, operating primarily on a private route shuttling Manitoba Hydro employees between its current and former head office locations. [3] Initial in-field prototype operating performance test results indicate:

- an overall average energy consumption of 133.kWh/100km;
- HVAC consumption of 32 to 45 kWh/100 km at 35°C ambient; and
- sound (noise) output ranging from 50 dBa at idle (all systems operational) to 61 dBa when at full-throttle acceleration.

The additional energy requirement for winter heating of the interior when using electric heating will drive energy consumption to over 300 kWh/100 km. This high consumption limits available range and increases charging frequency, which in turn limits battery life and increases costs. An alternative is catalytic diesel or bio-diesel heaters with 85 to 90% thermal efficiency.

In late October, 2012 New Flyer Industries was awarded $3.4 million by Sustainable Development Technology Canada to work with the other members of the consortium, as well as Winnipeg Transit; to develop and deploy four additional prototypes and a high capacity charging system by the end of 2013. A four-year evaluation period, while in revenue service, will follow to assess the high capacity charging station, battery capacity and component life and reliability. Red River College is working directly with Mitsubishi Heavy Industries and New Flyer Industries on the integration of the battery packs for two bus prototypes.

In summary, through the combined efforts of the consortium partners, one prototype has been completed and four others are under development. Validation testing of the first prototype has completed its first year. A rapid DC charger for on route use has been deployed. NFI has demonstrated the prototype across North America; and was awarded a contract by the Chicago Transit Authority for two battery electric buses, as well as electric hybrids to other properties.

3. Conclusions

Initiatives such as EVTEC directly complement and support Province of Manitoba policy concerning sustainable transportation; and enable electric vehicle applied research and innovation amongst Manitoba's transportation sector; enhance electric vehicle education at the College and in the region; and increase public awareness of EV technology. [4] Opportunities for future study include the repurposing of ground vehicle batteries for stationary applications, determination of appropriate business models, and the availability of commercial-grade, high-capacity, fast-charging infrastructure, and passenger EV end-of-life.

With a strong industry network and a history of partnering with to conduct practical applied research projects, the College is applying its successful model of supporting innovation to enhance and improve vehicle performance, reduce emissions and integrate the use of renewable and/or alternate fuels. The pursuit of *Mobility from "Green Energy"* has advanced vehicle technology and renewable energy research, development, testing and manufacturing capabilities in Manitoba.

4. Acknowledgements

Red River College greatly appreciates the generous support provided by the Government of Canada (including the Department of Foreign Affairs and International Trade, the Natural Sciences and Engineering Research Council of Canada, the National Research Council of Canada and Western Economic Diversification), the Province of Manitoba (the Council on Post-Secondary Education, Manitoba Innovation Energy and Mines, and Manitoba Entrepreneurship Training and Trade) and local, national and international industry partners such as Atomic Energy of Canada Limited, the Centre for Emerging Renewable Energy, Kraus Global Industries, Manitoba Hydro, the Manitoba Vehicle Technology Centre, Motor Coach Industries, Mitsubishi Heavy Industries, the Natural Gas Vehicle Alliance of Canada, New Flyer Industries, Persentech, the University of Manitoba and the City of Winnipeg. The dedication and effort of the faculty, staff and students at Red River College enable these partnerships.

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RED RIVER COLLEGE VEHICLE TECHNOLOGY & ENERGY CENTER
Applied Research Project Selection: "Student & Staff Centered"

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ABSTRACT

Red River College has become an identifiable forerunner in applied research activities within the motive power field. With the focus upon development of technicians for the future, Red River College and its staff have been actively involved in the integration of applied research activities to enhance current curriculum content. Through selective project involvement, Red River College has seen the learning activity within the programs expand and more proactive thinkers return in subsequent apprenticeship training levels.

1. Introduction

There has been a conscious effort to structure an integrated approach to applied research activities within the various programs delivered within the Transportation Heavy Apprenticeship Trades division (THAT) of Red River College (RRC). This approach has allowed for the enhancement of learning opportunities for both students and staff that previously weren't available to them.

Beginning in 2006 THAT division of RRC; has been actively involved in applied research activities with the support of the Applied Research & Commercialization (AR&C) department of RRC and a wide variety of industry and government stakeholders. The division has been focused on three major themes of research activity.

- Cold Weather Testing
- Alternative Fuel Vehicles
- Emission Testing

Within these areas the division has been successfully able to expose both students and staff to new technologies and involve all parties in using the research as an active component of the student's studies and for staff development.

With a student centered approach to project selection, we have found that this selective process has had a major effect on the students ability to become better prepared for the technological change they will be exposed to when in industry. From the staff perspective, it has been found that the willingness to pursue expanded research activities internally has also grown such as that of the original bio-diesel project (fig. 1). Case in point; is the current Bio-diesel reactor that is nearing completion and is a joint venture between five separate departments within the college (fig. 2). The interest has spilled beyond the divisions preverbal borders and has other areas of the college now seeking to become involved in applied research. As a group that is made up of technicians and technologies, the desire to expand ones knowledge base comes natural to most staff.

Fig. 1 Original bio-diesel reactor from Red Deer College

Fig. 2 New high capacity PLC equipped reactor (June2013)

2. Discussion

Situated near the geographic center of North America, Manitoba has for many years played host to manufacturers when testing the performance of their vehicle in a region of extreme temperature ranges. With temperatures that will vary seasonally from $+35^0$C to -35^0C and at times beyond both of these values, the climate facilitates data acquisition that may not be achievable in a real world situation anywhere else.

As a result, the applied research that occurs here is very often focused on out three themes of research activity preferences. The College and THAT division has fast become a recognizable institution that provides opportunities for its students and industry partners (Mongeon, 2008).

The division has found that while cold weather has been the catalyst to bring in a project, most projects are based upon validating alternative fuels or propulsion systems. These two areas are closely tied to the fundamental business of the institutions training mandate. As such, the projects fit the criterion for project selection in almost every case. The projects we have been involved with or are currently involved with are varied. Our current list of applied research activities that have been completed or are in progress are as follows:

- EPA Certification for engine and induction system installation for Bus Transportation industry (2007 standards).
- Hydrogen Hybrid cold weather testing.
- Hydrogen production and distribution.
- Hydrogen Fuel Cell Bus project.
- PHEV conversion and service.
- Power Generation Unit assembly project for use in arctic environment.
- Electric bus battery assembly project.
- Electric bus battery design and assembly project.
- EPA Certification for engine and induction system installation for Bus Transportation industry (2010 standards).
- CNG cold weather testing and report submission for Transport Canada.
- Bio-diesel production and vehicle testing.
- Bio-diesel reactor design and commissioning

All of these projects have been well received by the students and staff with no shortage of volunteers to participate in almost every project. It is important to mention that many of these projects are done when faculty are instructing with students (to enhance the learning) or in their non-contact period. When staff participates in their non-contact hours they do so on a purely voluntary basis.

3. Conclusions

With the numerous projects that the division has had the opportunity to be involved in, we have all gained a tremendous amount value from our participation. The support that the college administration, supporting departments such as AR&C, the Province of Manitoba, the Government of Canada and Industry stakeholders and participants from both Canada and abroad, have all given immeasurable opportunities to our students. The growth that the division has experienced to date is only to be out shadowed by our future growth potential. The applied research activity that we have been exposed to has had a major impact on the culture of the division and has become contagious. With the support of AR&C I would expect continued opportunities for our students and staff and future technicians.

4. Acknowledgements

Red River College greatly appreciates the generous support provided by the Government of Canada (including the Department of Foreign Affairs and International Trade, the Natural Sciences and Engineering Research Council of Canada, the National Research Council of Canada and Western Economic Diversification), the Province of Manitoba (the Council on Post-Secondary Education, Manitoba Innovation Energy and Mines, and Manitoba Entrepreneurship Training and Trade) and local, national and international industry partners such as The Centre for Emerging Renewable Energy, Kraus Global Industries, Manitoba Hydro, the Manitoba Vehicle Technology Centre, Motor Coach Industries, Mitsubishi Heavy Industries, the Natural Gas Vehicle Alliance of Canada, New Flyer Industries, Persentech, the University of Manitoba and the City of Winnipeg.

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Modeling, Simulation, Analysis and Control of Freeway Traffic Corridors

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ABSTRACT

This talk describes a set of modeling, simulation and analysis tools for planning and executing traffic operations management strategies in freeway corridors. These tools were originally developed to provide quick and quantitative assessments of the benefits that transportation management center control policies can provide, in order to decrease congestion in a freeway traffic corridor. The tools are based on macroscopic models, which run at a significantly faster rate than conventional microsimulation models, and are easily and reliably calibrated using traffic data collected from existing infrastructure mainline loop detectors. The tools are now being used in the development of a decision support system for active traffic management of freeway corridors in order to perform short-term traffic density and flow forecasts and to evaluate possible traffic management strategies.

1. Introduction

Vehicular traffic congestion remains one of the major worldwide sources of productivity and efficiency loss, wasteful energy consumption, and avoidable air pollution. This talk describes a set of modeling, simulation and analysis tools for planning and executing traffic operations management strategies in freeway corridors and their use as part of a real-time decision support system [1]. A freeway corridor typically comprises a 40-kilometer freeway segment on a highly populated urban area, together with its adjoining major urban streets or arterials. The movement of vehicles in a corridor is regulated by programmable field control elements including arterial intersection signals, ramp-metering signals, and message signs that announce emergency conditions, set speed limits and tolls, and provide driver information. Traffic data is primarily collected through inductive loop detectors buried roughly every kilometer along the freeways' payment, as well as detectors located in some of the major corridor arterials.

2. Model calibration, imputation and sensor fault detection and handling

The modeling, simulation and analysis tools that will be described in this talk utilize a self-calibrated Cell Transmission Model (CTM) [2] traffic macroscopic simulator. This simulator relies on a well-accepted theoretical model of traffic flow; it is parsimonious and does not require parameters that cannot be estimated from traffic data; and has been tested for reliability on several freeways [3]. Moreover, it is fast, running several hundred times faster than real time, which can be used with real-time measurements and statistically predicted short term future traffic demands to keep track of the current freeway traffic state, as well as make short-term predictions.

We first present system identification, fault detection and fault handling methodologies for automatically building calibrated models of freeway traffic flow. The algorithms that are presented work with loop detector data that are gathered from California freeways. The system identification deploys a constrained linear regression analysis that estimates the so-called fundamental diagram relationship between flow and density at the location of a given sensor.

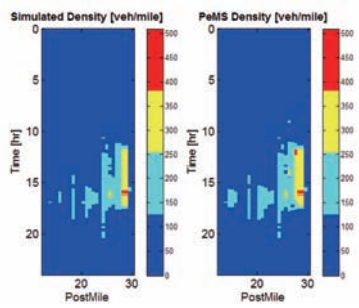
Subsequently, we present an imputation algorithm for estimating the ramp flows in a freeway network [4]. We use measurements along the freeway - flows and densities collected by the existing loop detectors, to estimate the flows entering and exiting the system using ramps. The algorithm is based on the Link-Node Cell Transmission Model (CTM), which describes the traffic dynamics along the freeway, once the on-ramp demands and the off-ramp split ratios are provided as inputs. The model based imputation algorithm estimates the on-ramp flows and off-ramp split ratios that match the observed mainline measurements of density and flow. We employ a two-step procedure in the algorithm. In the first step, we find an effective demand parameter (which captures the aggregate input into a freeway section), by matching the model-calculated densities with the observed densities. This step employs an adaptive iterative learning algorithm, which continuously updates the effective demand parameter across iterations until sufficient convergence is achieved. In the second step, the effective demand parameter is split into the on-ramp flows and off-ramp split ratios using flow measurements. In this step, we derive the ramp flows using a linear program with an objective that minimizes the error between the model calculated flows and detector measurements. Finally, we demonstrate the application of the algorithm with a synthetic example and also using real life data from Several California freeway sections.

A fault detection algorithm, which has been developed to facilitate the automatic model building procedure, is also discussed in this talk. CTM models

require consistent observations along the modeled freeway section for an accurate calibration to be possible. When detectors are down or missing, the model has to be modified to a less accurate representation, in order to conform with a configuration where a sensor is assigned to each cell of the model. In addition, on most California freeways the ramp flows in and out of the mainline are not observed. Since the estimation of these unknown inputs to the system also hinge on healthy mainline data, the identification of faulty mainline sensors becomes crucial to the automatic model building process. The model-based fault detection algorithm presented herein analyzes the parity between simulated and measured state, along with estimated unknown input profiles. Subsequently, it makes use of look-up table logic and a threshold scheme to flag erroneous detectors along the freeway mainline.

A fault-handling algorithm that accompanies the fault detection aims to revert the model to its original configuration after the aforementioned modifications are made to the model due to missing or bad sensors. Using a relaxed model-constrained linear optimization, this algorithm seeks to fill in the gaps in the observations along the freeway that are a result of poor detection. This method provides a reconstruction of the unobserved state that conforms to the rest of the measurements and does not produce a state estimate in a control theoretical sense.

The identification of fundamental diagram parameters and the estimation of unknown ramp flows produce a complete model. Simulated densities and measurements contour plots along the freeway provide an important visual inspection tool to assess if the model is able to replicate the congestion patterns and important bottleneck locations on the freeway.



In these contour plots, the horizontal axis is the spatial coordinate whereas the vertical coordinate axis corresponds to the time of day in hours. The plots show a single day, i.e. a 24-hour period. The traffic flows from right to left in these particular plots. The color palettes next to the plots define the color vs value matching for the contours. This example shows a calibrated 23-mile stretch of eastbound I-80 on August 15h, 2008 for a 24 hour time range.

3. Coordinated Ramp Metering and Variable Speed Limits

A computationally efficient model predictive controller for congestion control in freeway networks is presented in this talk. The controller utilizes a modified Link-Node Cell transmission model (LN-CTM) to simulate traffic state trajectories under the effect of ramp metering and variable speed limit control and compute performance objectives. The modified LN-CTM introduced here simulates freeway traffic dynamics in the presence of capacity drop and ramp weaving effects. The objective of the controller can be chosen to represent commonly used congestion performance measures like total congestion delay measured in units of vehicle hours. The optimal control formulation based on this modified model is non-convex making it inefficient for direct use within a model predictive framework. Heuristic restrictions and relaxations are presented which allow the computation of the solution using optimal solutions of a sequence of derived linear programs. Mainly, the freeway is cleverly divided into regions, and limited restrictions are placed on solution trajectories to allow us to derive computationally efficient control actions. In the absence of capacity drop, this solution strategy provides optimal solutions to the original optimal control problem by solving a single linear program. The properties of the solution are discussed along with the role of variable speed limits when capacity drop is present/absent. Examples are provided to showcase the computational efficiency of the solution strategy, and scenarios are analyzed to investigate the role of variable speed limits as a congestion control strategy.

The use of these tools as part of a decision support system for a freeway traffic management system will be discussed in this talk.

Acknowledgements

The research presented in this talk was supported by the California Department of Transportation (Caltrans) and the National Science Foundation.

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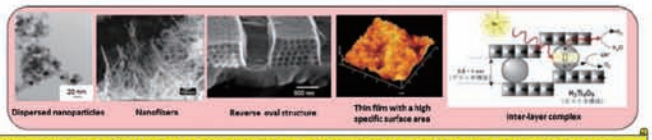
The Development of Innovative Three-way Catalysts via Solvothermal Reactions

Tsugio Sato Lab, Institute of Multidisciplinary Research for Advanced Materials (IMRAM),Tohoku University

MEXT · TOHOKU ECONOMIC FEDERATION · Tohoku University · 宮城県 · 七十七銀行 · ICR

Property improvement of ceramic materials by controlling composition and morphology

- Soft chemical reaction
- Synthesis of functional ceramic materials
- Improving the function of ceramic materials which can contribute to energy saving, environmental conservation and human health



Solvothermal reaction: An effective environmentally friendly soft material synthesis process, which can improve function of ceramics by controlling composition, structure and morphology.

●Challenge
- Improved performance for strict emission regulations and environmental safety
- Reducing the amount of Ce and development of non-ceria catalyst to overcome rising prices of Ce

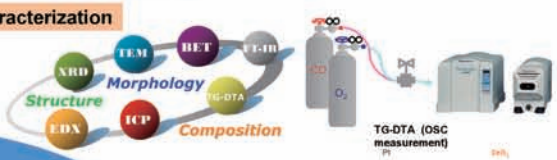
To solve problems ...

Enhance the oxygen storage capacity (OSC) of CeO_2 by controlling composition and morphology → · Improve catalytic performance · Substitute Ce or reduce the using of Ce

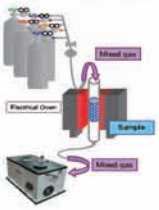
Development of innovative automobile exhaust gas purification catalyst by precisely controlling the morphology and composition

Synthesis

Characterization



Three-way catalysts (TWCs) performance evaluation

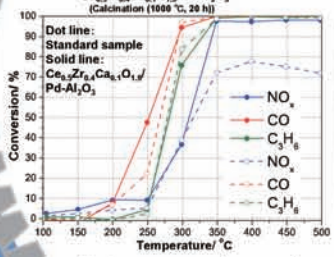


FT-IR (Automobile exhaust gas purification measurement)

Innovative automobile exhaust gas purification catalysts

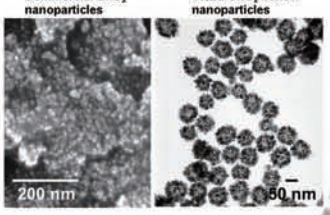
Ceria-based catalyst performance evaluation

$Ce_{0.5}Zr_{0.4}Ca_{0.1}O_{1.9}/Pd\text{-}Al_2O_3$ (Calcination (1000 °C, 20 h))



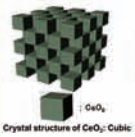
Performance was improved by the composition control !

Non-ceria catalyst performance evaluation



Performance was improved by the morphology control !

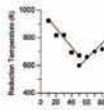
Ceria-based automobile exhaust gas purification catalyst— $Ce_{1-x-y}M_xZr_yO_z$



MO_8 oxide ideal $r(M^{n+})/r(O^{2-})=0.732$

CeO_2 $r(M^{n+})/r(O^{2-})=0.703$

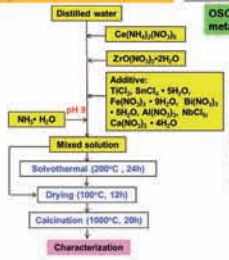
Crystal structure of CeO_2: Cubic Ce^{4+} is small to form the fluorite structure



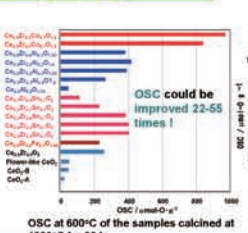
R.D.Monte, J. Alloy Comp., 275-277, 877 (1998).

Ion	8 coordination ionic radius (nm)	Ion	8 coordination ionic radius (nm)
Ce^{4+}	0.097	Tl^{3+}	0.067
Zr^{4+}	0.084	Sn^{4+}	0.077
Ca^{2+}	0.112	Nb^{5+}	0.071
Fe^{3+}	0.072	Bi^{3+}	0.071
Fe^{2+}	0.087	Co^{3+}	0.068
Al^{3+}	0.059	Co^{2+}	0.083

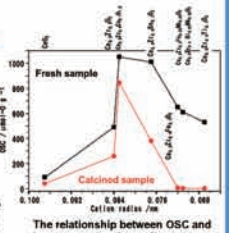
Synthesis of ceria-based solid solution



OSC can be improved by co-doping of small metal ions (< radius of Zr^{4+})



OSC at 600°C of the samples calcined at 1000°C for 20 h

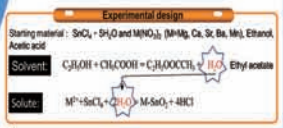


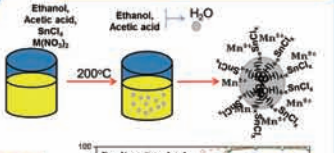
The relationship between OSC and incorporated cation radius

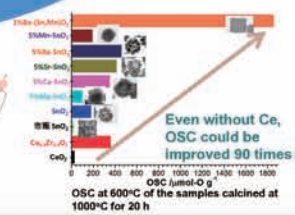
Oxygen storage capacity (OSC) of CeO_2, could be improve 22 times by co-doping Zr and Sn into CeO_2, which is a well know automotive co-catalytic material. It was possible to reduce the consumption of Ce more than 30%.

Q. Dong, S. Yin, T. Sato, *Chem. Lett.*, 41, 12501252 (2012); *RSC Adv.* 2, 12770 (2012); Catalysis Sci & Tech, 2, 2521 (2012).

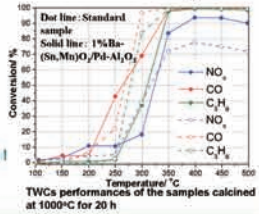
Non-ceria automobile exhaust gas purification catalyst— $M\text{-}SnO_2$







OSC at 600°C of the samples calcined at 1000°C for 20 h



TWCs performances of the samples calcined at 1000°C for 20 h

Message to Company

Innovative automotive exhaust gas purification catalysts were developed using general-purpose elements. The preparation of new material that can reduce or completely substitute rare element Ce can be expected. We are very interesting in research cooperation with company !

Katahira 2-1-1, Aoba-ku, Sendai 980-8577 TEL&FAX: 022-217-5597 / E-mail: tsusato@tagen.tohoku.ac.jp

Professor
Tsugio SATO

Associate professor
Shu YIN

Assistant professor
Qiang DONG

Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

Supercritical Fluid Technology

—Cleaning, Functional material preparation—

Research Center of Supercritical Fluid Technology,
Tohoku university, Graduate School of Engineering

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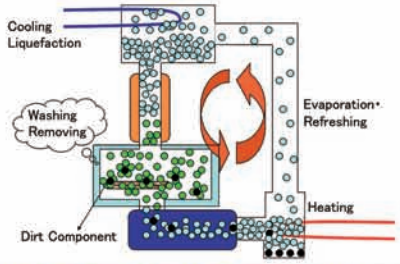
Cleaning& Drying using SC-CO_2



Utilization of large density change with temperature gradient

Pump-less, Thermal Circulation & Solvent refreshing

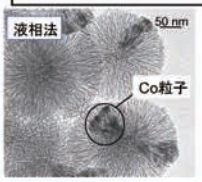
No drying process
No solvent remaining
Applicable to
- water-prohibit materials
- Very fine structured materials
- Hybrid materials

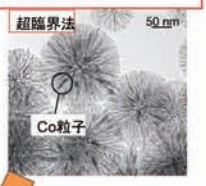
Ex; *Cloth Dry cleaning,*
Fine metal devices
HEPA Filters, etc

Catalyst Preparation by Supercritical Fluid

Previous Works : Metal Doping on Porous Silica

	Liquid Solvent	SCF Solvent
Diffusion	Low	High
Surface tension	High	Low
Penetration	Low	High
Drying	Aggregation	No need





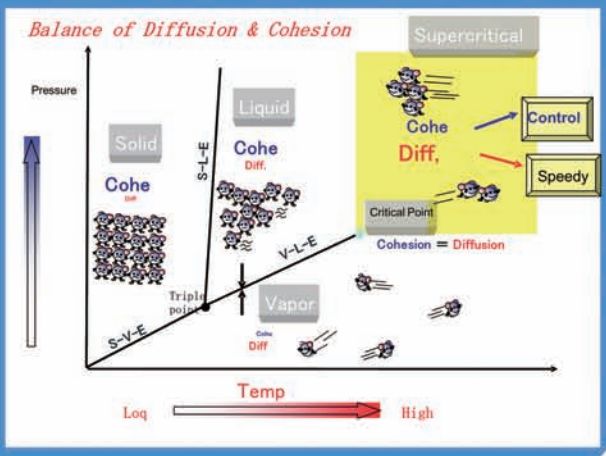
Efficient Utilization of micro pores
High dispersion of metal particles

High Penetration Ability

Particles Aggregation Control during Drying Process

Specific Feature of SCF
High diffusivity,
Low surface tension & viscosity

Dissolve Metal Complex, Penetrate into porous media



Applying to Automobile Exhaust -Rh/CeO_2-

Prediction of Adsorption in Porous Materials

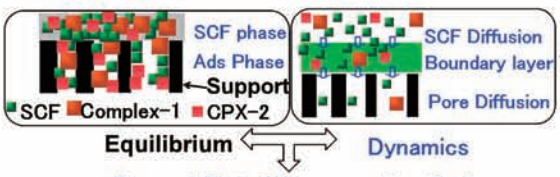
Catalyst Preparation by SCF

Precursor Dissolution
→ Adsorption on Support →Calcine

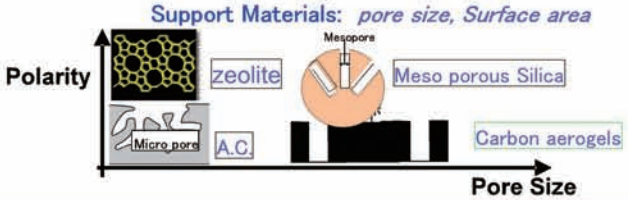
For Designing・

Adsorption Behavior Prediction
- Equilibrium
- Dynamics (adsorption/desorption rate)

Development of Prediction Methodology for equilibrium, dynamics and support materials



Support Materials: *pore size, Surface area*



CeO_2・・・
Oxygen Storage Capacity
→ Doping Precious Metal
→ Increasing OSC value

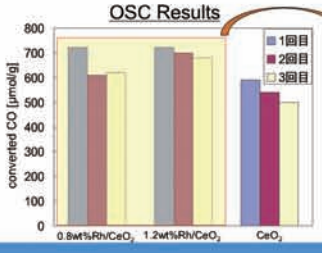
Preparation of Rh/CeO_2 by SCF doping
↓
Test its OSC performance

TEM Observation

EDX showing the existence of Rh
But, TEM cannot detect Rh particles

Highly dispersion of very small Rh particles ??

OSC Results



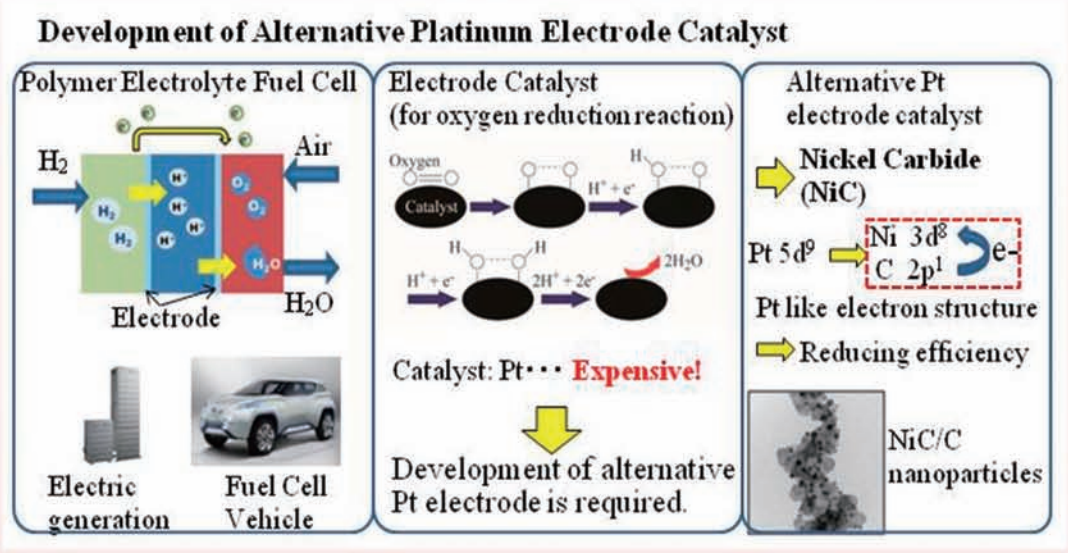
Rh Doping increases OSC

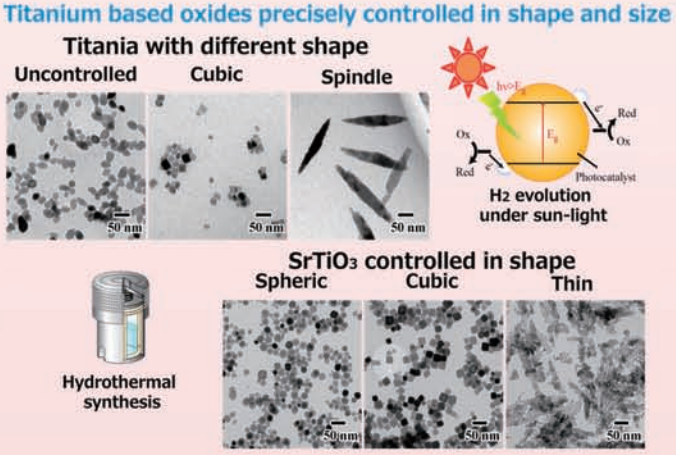
Rh-Support Interaction plays am importance role

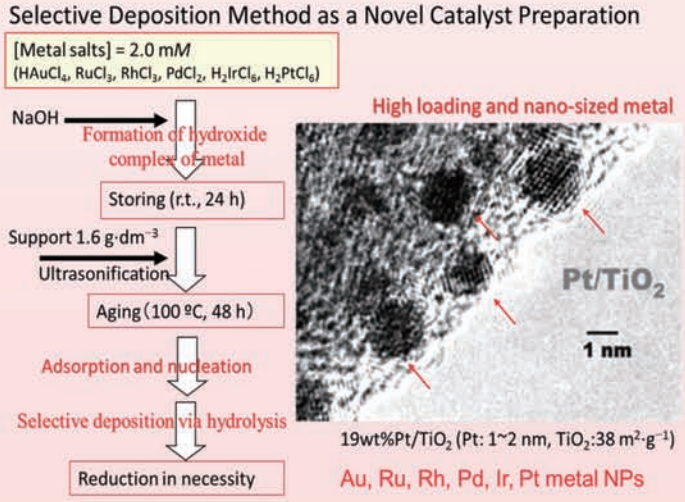
Extending this method to Other metals on CeO_2-Al_2O_3

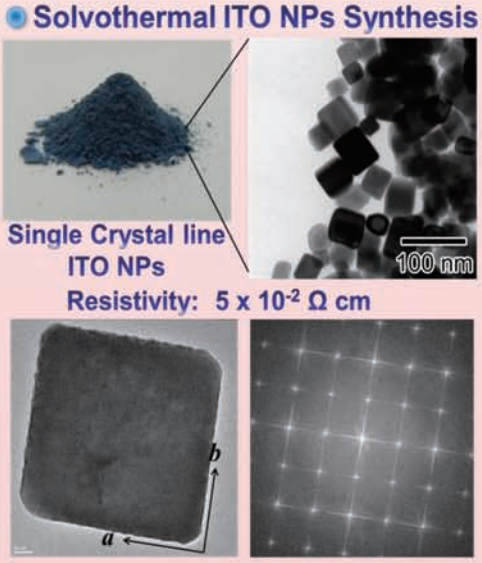
Synthesis of Hybrid Nano-Particles and Application to Functional Materials

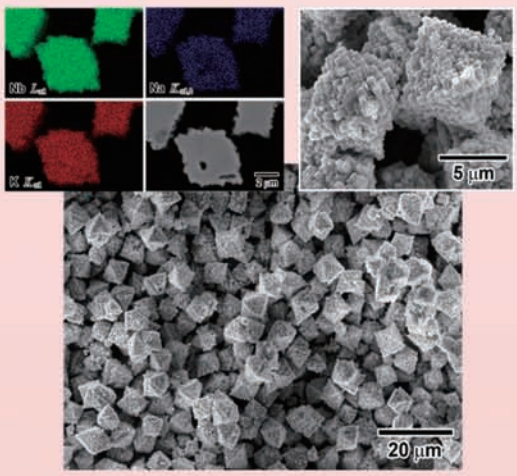
Institute of Multidisciplinary Research for Advanced Materials, Tohoku Univ.
Muramatsu Laboratory
mura@tagen.tohoku.ac.jp











Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

Fabrication and OSC Property of Oriented Fe-based Complex Oxide Grains by Microwave Irradiation

○T. Nakajima, J. Fukushima, Y. Hayashi, H. Takizawa
Graduate School of Engineering, Tohoku University

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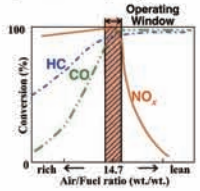
1. Research Background

TWC : Three-Way Catalyst and Promoter

Three-way catalysts (TWCs) remove the pollutants such as carbon monoxide (CO), nitrogen oxide (NO_x), and hydro carbons (HC_s) in automobile exhaust gas.

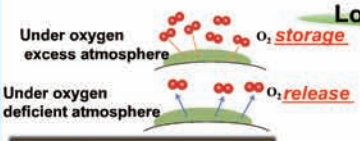


It is absolutely imperative to *suppress the air to fuel ratio* in order to remove the pollutants efficiently.

problem

Expensive precious

Low OSC property under 500˚C



Requirements

- Rare earth free OSC materials
- High OSC performance under 500˚C

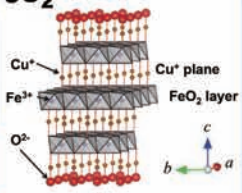
2. Research Target and Method

Delafossite-type $CuFeO_2$

- Composition of Cu^+ and Fe^{3+} without rare earth element
- Oxygen storage/release behavior start in low temperature ranges

Space group : *R3c* layered structure

$CuFeO_2 + \delta/2O_2 \longrightarrow CuFeO_{2+\delta}$



Crystal structure of delafossite-type $CuFeO_2$

Experimental condition

Temperature : 500～1000 ˚C
Time : 10 min
Atmosphere : N_2 or Air
☆ comparison : electric furnace

Starting materials Cu_2O, γ-Fe_2O_3

Grinding・Pelletization

2.45 GHz Microwave Irradiation

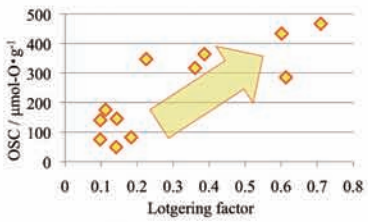
Characterization

Expectative effect...

Promotion of *anisotropic grain growth*

Influence OSC property

OSC measurement at 500˚C



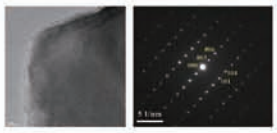
Maximum OSC value : 466 μmol-O/g

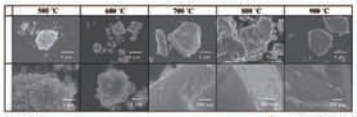
Phase stability and OSC rate during oxygen uptake-release behavior was promoted

Anisotropic $CuFeO_2$ synthesized by microwave irradiation shows high OSC value as compared to conventional heating samples.

3. Results

TEM and SEM observation

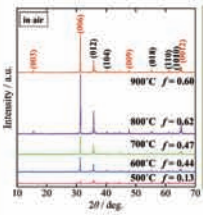




isotropic → *anisotropic*

$CuFeO_2$ grains have *layered structure* when prepared at high temperature.

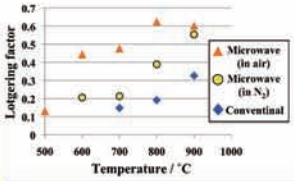
XRD analysis



The degree of orientation, *f*, calculated from equation (1)

$$f = \frac{P - P_0}{1 - P_0} \quad (1)$$

f : Lotgering Factor
$P = \sum I_{(00l)} / I_{(hkl)}$
P_0 : *P* value of oriented sample for randomly
Non-orientation $f = 0$
Complete orientation $f = 1$



Microwave heating promoted *anisotropic grain growth*.

4. Discussion

Anisotropic grain growth

The cause of anisotropic grain growth by microwave processing

difference of *microwave penetration depth*

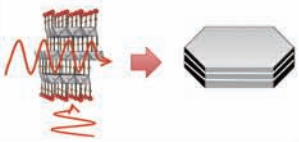
The depth of microwave penetration

$$\delta = \frac{1}{\sqrt{\pi f \mu \sigma}}$$

f : Frequency of microwave [GHz]
μ : Magnetic permeability [H・m-1]
σ : Electrical conductivity [S・m]

Mechanism of anisotropic grain growth

	Penetration depth
c-axis	Shallow
ab-plane	Deep



5. Conclusion

☆ Microwave heating promoted *anisotropic grain growth* based on intrinsic layered structure.

☆ Anisotropic $CuFeO_2$ samples synthesized by microwave irradiation show *high OSC value*.

Address : 6-6-07 Aoba Aramaki, Aoba-ku, Sendai, 980-8579, Japan
E-mail : takizawa@aim.che.tohoku.ac.jp

Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

New catalyst for automobile using organic-inorganic Hybrid nanoparticles

New Industry Creation Hatchery Center, Tohoku University
Adschiri laboratory

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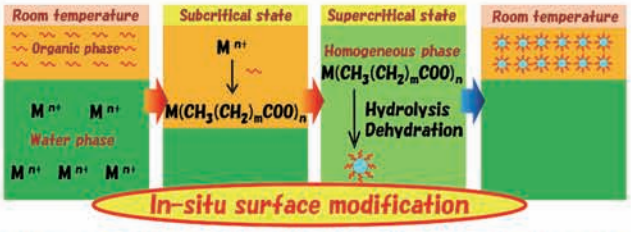
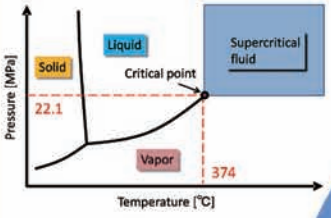
What is supercritical fluid?



We can create nanoparticle and modify organic molecules on the surface simultaneously



Supercritical fluid has gas like diffusibility and liquid like solubility

How to create nanoparticle?

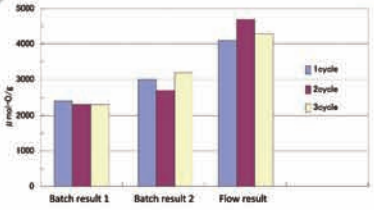
Determination of reaction temperature, pressure, pH condition etc. by batch type reactor

Create nanoparticle continuously by flow type

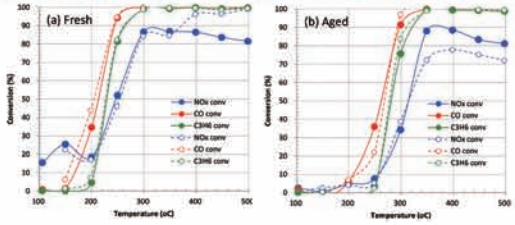
10t/year
Substantiation instrument (Momi-cho GIGA)

Middle type instrument (Momi-cho)

Table type compact instrument (Momi-cho mini)

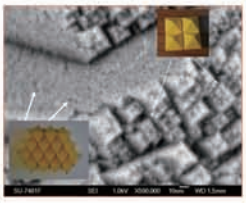


OSC results by Zirconium – Iron nanoparticles

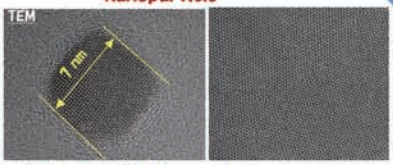


Results of the conversion of exhaust gases

Filled circle: new nanoparticle
Open circle: CeO_2 conventional catalyst



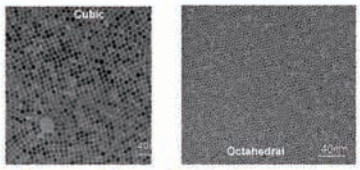
We can control the structure of nanoparticle



Surface modification nanoparticle

mono-dispose CeO_2 nanoparticle

Increase modifier concentration

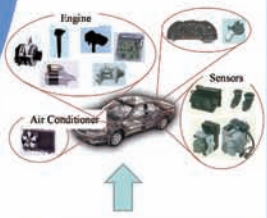


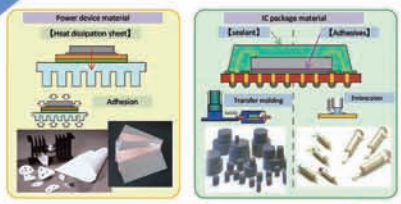
No surface modification CeO_2 nanoparticle (in water)

Surface modification CeO_2 nanoparticle hexane)

Nano particle can dissolved in several organic solvent if we use organic agent which has different type of functional group

Example of creation nanoparticles





How to use nanoparticle for Automobiles

Message

- Let's create a new material of a car using nanoparticle -

In Adschiri laboratory, we are investigating new material using the hybrid organic-inorganic nanoparticle.

Please contact us, if you are interest.

Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

Synthesis of Ceria Nanoparticle-Assembled Hollow Mesoporous Silica Composite Particles

*Haruyuki Ishii, Saki Ito, Daisuke Nagao, Mikio Konno**
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Introduction

Nanoparticles
- (positive) High catalytic activity derived from nano-size effect
- (negative) Low thermal stability, Aggregates and Sintering

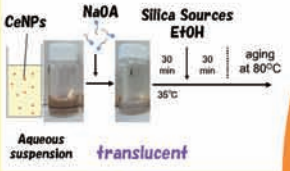
Assembling of Nanoparticles
- Novel properties different from nanoparticle itself
- Higher catalytic activity

This Study
- Silica coating of nanoparticle assembly
- Catalytic evaluation of obtained particles for automotive three-way catalyst

Methods

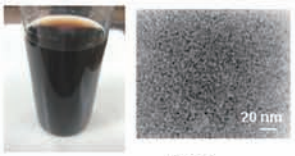
Ceria nanoparticles (CeNPs)
- Aqueous precipitation of a cerium salt in the presence of trisodium citrate

Particle synthesis
- mixing of sodium oleate (NaOA) with CeNPs, followed by addition of silica sources



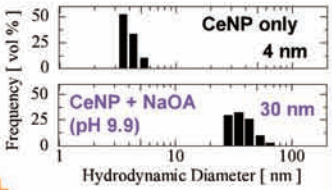
Self-assembly formation in CeNP-NaOA suspensions

Characterizations of CeNP



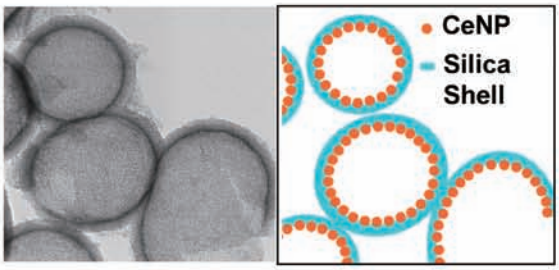
-Well-dispersed suspension
-Particle size: 3 ± 0.3 nm
-Fluorite structure (determined by X-ray diffraction)

DLS measurements of CeNP-NaOA suspensions



-Dispersion size increased after NaOA addition (pH 9.9).
-A self-assembly can form in the CeNP-NaOA suspensions at pH below 10.
- There was no change in the dispersion size at pH more than 10.

As-synthesized particles contain
-Hollow assembly of ceria nanoparticles
-Mesoporous silica shell

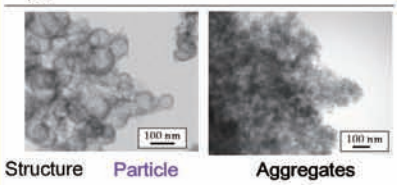


H. Ishii *et al., Colloids and Surfaces A, in press.*

Applications
- Automotive three-way catalyst
- Catalyst for CO oxidation

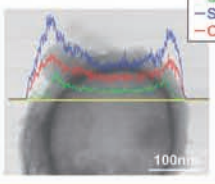
Particle Syntheses & Characterizations

TEM images of obtained samples



-Particle shapes were obtained in the CeNP-NaOA suspension at pH 9.9, whereas aggregates formed in that at pH 10.7.
-Self-assembly formed in the suspension is key for the particle formation.

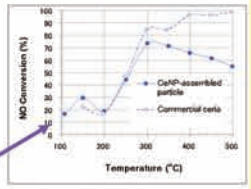
EDX analyses



-The distributions of Ce and Si corresponded to the thin layer of black dots and the light gray outer shell, respectively.
-On the particle surface, peaks of the three elements were observed. → Hollow structure
-After calcination, the particle had meso-pore and CeNPs inside particle had same crystalline size as that in CeNPs as before.

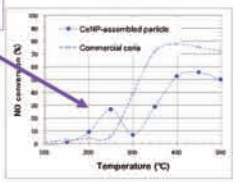
Catalytic activities

Fresh Sample



Effect of nano-size? or nanoparticle assembly?

Aging at 1000 ℃ for 20 h



Three Way Catalyst
Ceria + γ-alumina with 2.5 % palladium (Pd) (mixing weight ratio: 1:2)

Reaction Gas
Mixed gas with similar composition to exhaust gas.

Conclusion

-A catalytic particles that contain hollow assembly of ceria nanoparticles with mesoporous silica shell were obtained in aqueous synthesis with sodium oleate.
-The uses of nanoparticles and nanoparticle assembly can be effective for improving catalytic activity.

Prof. Mikio Konno

Associate Prof. Daisuke Nagao

Assistant Prof. Haruyuki Ishii

Konno Laboratory Members

Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

Catalysis for conversion of next-generation resources

Keiichi Tomishige
Department of Applied Chemistry, School of Engineering, Tohoku University

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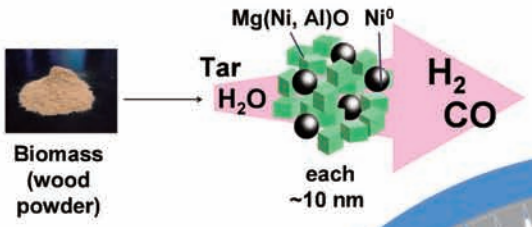
Production of syngas from biomass

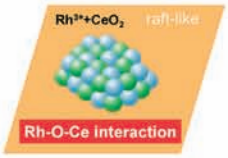
Biomass + O_2 or H_2O → H_2 + CO

Combination with FT synthesis accomplishes BTL (Biomass To Liquid) process.

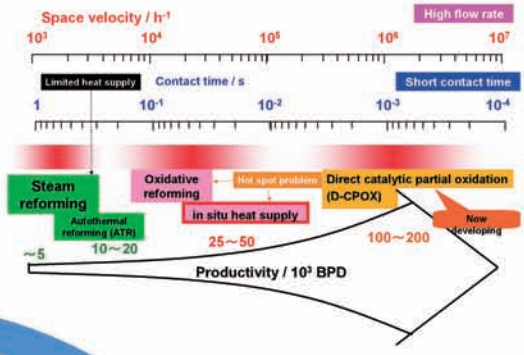
Ni-oxide nanocomposite catalysts



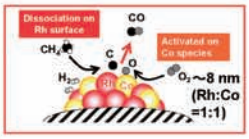
Rh-CeO_2 interface



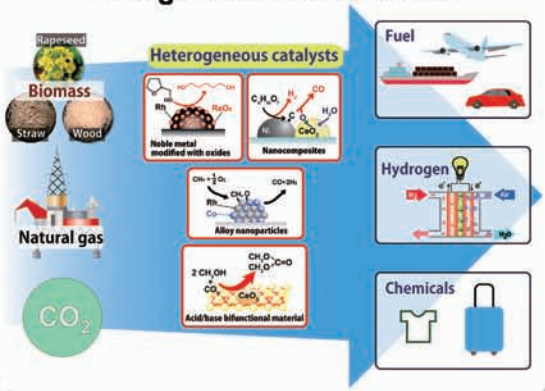
Production of syngas from natural gas



Rh-Co alloy particles for D-CPOX

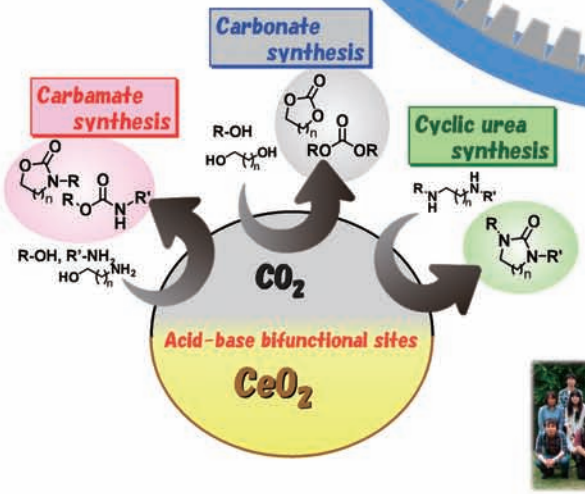


We are developing new catalysts for upgrading next-generation resources.

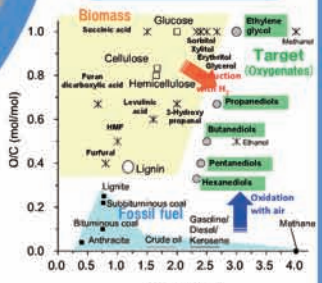


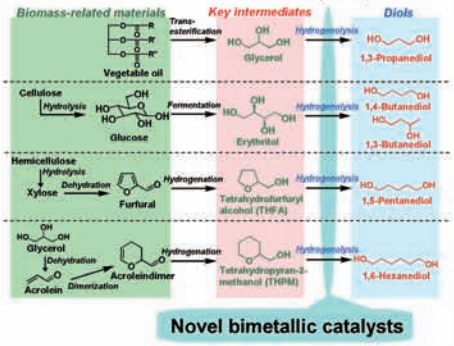
Production of chemicals from CO_2

We discovered that acid-base bifunctional material such as CeO_2 can activate CO_2.



Production of chemicals from Biomass





Novel bimetallic catalysts

Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

Next-Generation Advanced Mobility System

Fumihiko HASEGAWA, Masahiro NISHIZAWA, Kazunori OHNO, Shigeyuki YAMABE, Yusuke HARA, Hidetoshi MATSUKI
New Industry Creation Hatchery Center, Tohoku University
Aramaki Aoba, Aoba-ku, Sendai, Miyagi 980-8579

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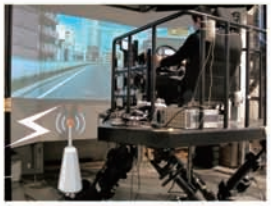
The automotive technology studies and development base

The demonstration place is a new campus in Tohoku University.



Driving simulators

Energy information

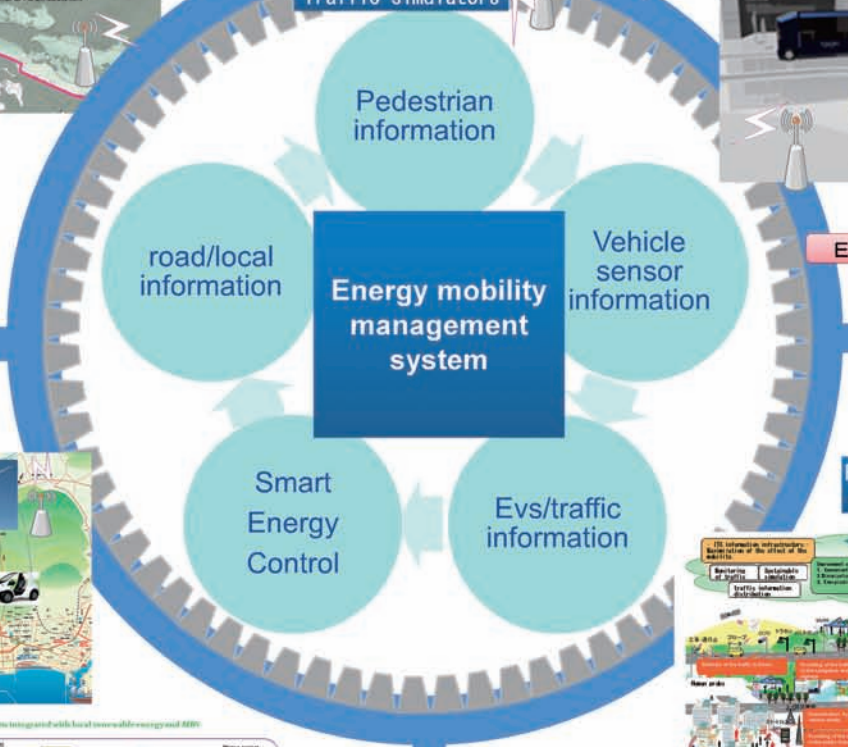
Information Displays

Small EV

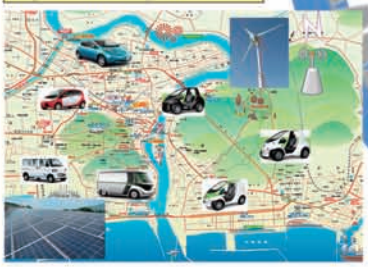
EV buses

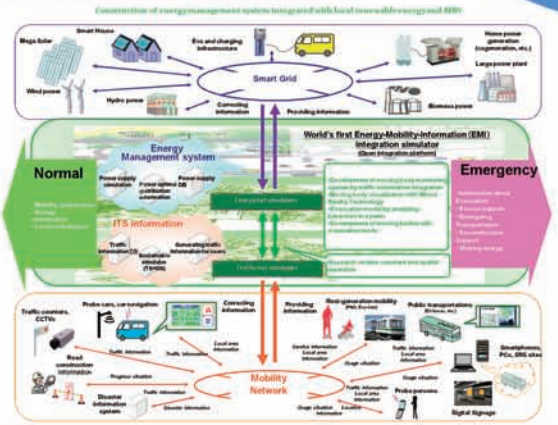
ITS information infrastructures

Traffic simulators



Experimental implementation





Function of integrated system

Social mode change for emergency state

Ordinary state

Emergency state

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Aramaki Aoba, Aoba-ku, Sendai, Miyagi 980-8579

http://mobility.niche.tohoku.ac.jp/
mobility-office@niche.tohoku.ac.jp
+81-22-795-4740

Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

Motor Technology for Next Generation Automotive

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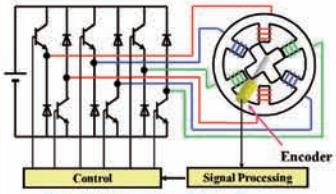
Tohoku University, 6-6-05 Aoba, Aramaki, Aoba-ku, Sendai, Japan

MEXT TOHOKU ECONOMIC FEDERATION Tohoku University 宮城県 七十七銀行 ICR

HIGH PERFORMANCE ELECTRIC MACHINE

Switched Reluctance Motor

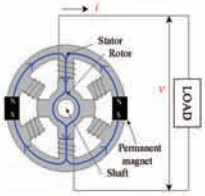


High Reliable & Rare Earth Free

Planetary type Magnetic Gear

Contactless High Power Transmission

PM Reluctance Generator

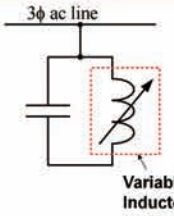


High Power without Rare Earth Magnet

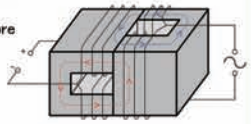
We are studying about High Performance Rare-Earth Free Motor/Generator and Planetary type Magnetic Gear for Contactless High Power Transmission.

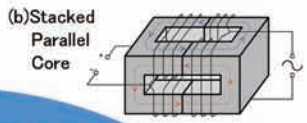
Motor Bench for In-Wheel Motor

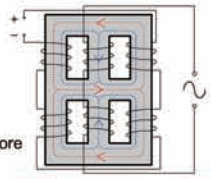
HIGH QUALITY POWER CONVERSION & CONTROL



We are studying about electrical controlled Variable Inductor to solve the problem of power quality and reduced voltage fluctuation of the power system.



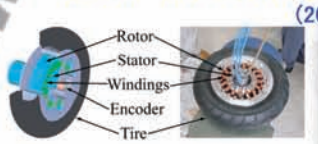


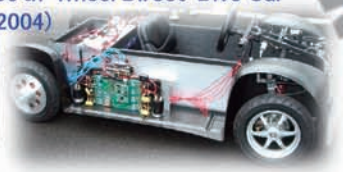


Field Test of Variable Inductor

NEXT GENERATION ELECTRIC VEHICLE

World 1st Rare-Earth Free In-Wheel Direct-Dive Car (2004)

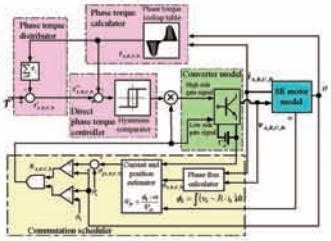




World 1st Success of Driving with 3D Structure Rare-Earth Free In-Wheel Direct-Drive Motor (2012)

Fully Digital Controlled Inverter

Computing Room



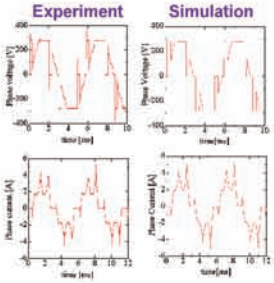
Novel Torque Control for SR motor

We are studying about Control Method to reduce torque ripple and get high efficiency of SR motor.

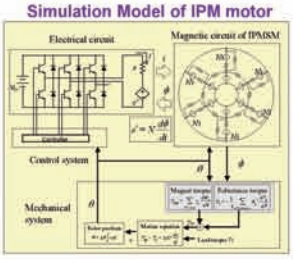
Motor Simulation by Magnetic Circuit Method

We are studying about Simulation Method to motor drive system using Magnetic Circuit Method. Proposed Simulation Method enables high speed and high accuracy simulation integrated with electric circuit, control, and mechanical system.

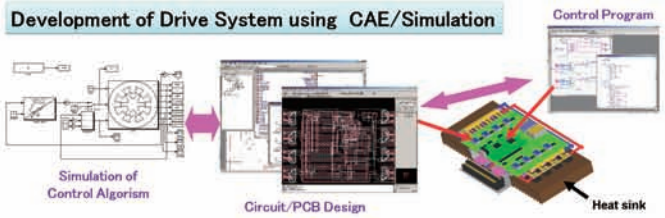
Experiment Simulation



Simulation Model of IPM motor



Development of Drive System using CAE/Simulation



POWER ELECTRONICS & CONTROL

ANALYSIS & SMULATION

Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

Recycling Technologies for End of Life Vehicles

Takashi Nakamura, Etsuro Shibata, Atsushi Iizuka
Institute of Multidisciplinary Research for Advanced Materials, Tohoku University

MEXT TOHOKU ECONOMIC FEDERATION Tohoku University 宮城県 七十七銀行 ICR

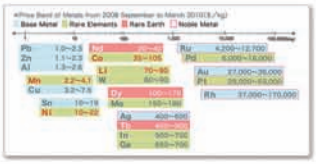
Many materials are used in various components for automobiles, which bring the advanced performance to advanced cars like EHV. miner rare metals are essential substances for high performance automobiles, while their supply chains have been recently unstable and their price change is strongly intense. Recycling of miner rare metals from the ELVs is one of the good ways to secure their supplies. In our laboratory, several research works on recycling technologies of miner rare metals from ELVs are under research, as well as on recycling of other materials from ELVs.

Miner Rare Metals Used in Vehicles

Several miner rare metals are contained in materials of the important automobile components.

Fig.1 Miner Rare Metals Application for Automobiles

Fig.2 Price of Metals



Demand of Li will be rapidly grown, and it is supposed that this rapid demand growth is caused due to growth of electric vehicles. Furthermore, the demand of Li will exceed the supply in 2020.

Table1. Supply and Demand Forecast of Li

year	2010	2015	2020
Supply(kilo-ton)	137	166	214
Demand(kilo-ton)	90	144	313
For Automobiles	5	40	186
For Others	85	104	127

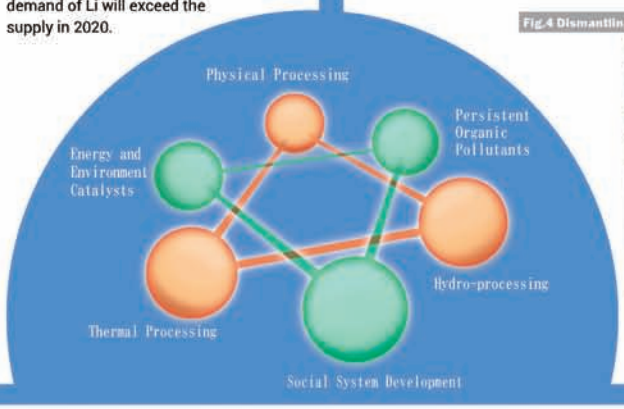
Recycling on Automobile Components

In Japan, ELVs are disassembled based on the automobile recycling law, and disassembled components are reused as used components, or are supplied to material recycling.

Fig.3 Utilization of Disassembled Components from Scrapped Vehicles

Fig.4 Dismantling of Electric Motor in Electric Vehicle

In case of magnet recycling from a motor, de-magnetism of magnet is essential. Recycling of Nd and Dy from Neodymium Magnet is at present under research.



Research Works on Recycling Technology

At **NAKAMURA Laboratory** in Institute of Multidisciplinary Research for Advanced Materials, Tohoku University, the following research works on recycle processing technology are at present implemented, in order to accomplish recycling-oriented society.

1 High Efficiency Rare Elements Extraction Technology Area Project

(supported by Ministry of Education, Culture, Sports Science and Technology,)
In order to recover miner rare metals efficiently from disposed electronics devices, recycling technology is under research, which contains physical separation and soating, chemical extraction and engineering technology.

2 Research on High-Temperature Processing Technology

In order to develop new natural resources of miner rare metals and non-ferrous base-metals like copper, fire smelting technology of seafloor hydrothermal deposits is under research.
Also, the environment-friendly refining technology of rare earth metal is developed.

3 Research on Hydrometallurgical Processing Technology

In order to develop new resources of non-ferrous base-metals and miner rare metals, new mineral dressing and refining technologies are under research, for example, arsenic removing from copper smelting and boron removing from Nd-Fe-B magnet recycling proccesss.

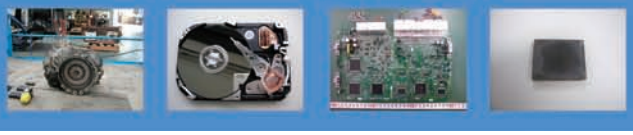
About the Concept "Urban Mine"

Prof. Nanjo, a professor at the Research Institute for Mineral Dressing and Metallurgy (a forerunner of the current Institute of Multidisciplinary Research for Advanced Material) at Tohoku University, pointed out the importance of metal recycling and also the importance of miner rare metals for the Japanese industries. This is the concept "Urban Mine". Therefore, with Tohoku University at its hub we will establish the 'science of metal cycles' integrating the knowledge from the areas of the 'extraction and separation' area, the field of quantum chemistry, , as well as reaction analysis, and aim for its application in the collecting and recycling of minor rare metals from urban mines.

Contact Information

Nakamura. Laboratory
http://www.tagen.tohoku.ac.jp/labo/nakamura/en/

High Efficiency Rare Elements Extraction Technology Area
http://tohoku-timt.net/rare-elements/en/



Automation of physical distribution and traffic using robot technology

Tadokoro, Ohno, Takeuchi, Okada/Konyo, Nagaya Lab.
Graduation School of Information Sciences, Tohoku University

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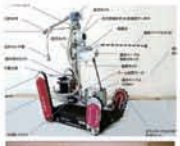
Heightened needs for the robot technology



- Use of robot technologies for decommissioning process of Fukushima Daiichi nuclear power plant.
- Automation of the physical distribution in a factory or an industrial complex
- Automation of conveyance of drug, charts and meals in hospitals
- Safe driving cars for patients and elder persons using robotic technologies

Market size prediction of robots in 2020
(Fuji economic intelligence 2012.05)

- World market of industrial robots : $6.6 billion
  166.2%up from 2011
- Domestic market of service robots: $ 1.3 billion
  751.6%up from 2011

Core technologies for autonomous robots

System integration
Robotic system is built according to target tasks and on-site demands, by combining the following key technologies .

Sensing
- 3-D measurement
- Environmental recognition

Probabilistic logic
- Recognition & planning
- Localization

Control
- Actuator control
- Motion generation

Robotic Technologies for Safety, Security and Welfare of the Life

Disaster Response Robots (Active scope camera, Quince, Search and rescue dog)

Pedal-driven wheel chair

Autonomous unmanned carrier

Autonomous driving electric vehicle

Autonomous quad rotor






Problems for autonomous driving in outdoor environment

1. Weather and bad road surface condition

2. Obstacles: Peoples & cars

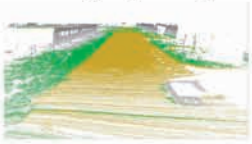
3. Laws

Collaborative project:

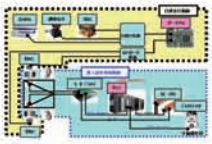
Development of autonomous unmanned carrier in snowy region

Hardware development

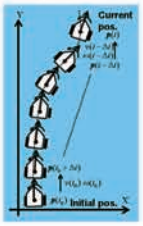

3-D mapping using LIDAR



System integration



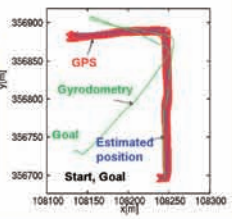
Precise & robust localization using Bayes filter



$$p(\mathbf{x}_i \mid \mathbf{z}_{1:i}, \mathbf{u}_{0:i-1}) = \eta\, p(\mathbf{z}_i \mid \mathbf{x}_i) \int p(\mathbf{x}_i \mid \mathbf{u}_{i-1}, \mathbf{x}_{i-1})$$

Correction Estimation

Correction Using External Sensor	Estimation using internal sensor
・LIDAR	・Odometry
・Ultrasonic	・IMU
・Millimeter wave	・Optical flow
・GPS	



Recommendation of collaborative project

Our lab. can support development of next-generation robotic products.

Our robotic technologies

Your unsolved applications

Development of product accepted in the world

Message for company persons

We have the know-how of advanced sensing technology, control technology, and position estimate technology, which are required for automation. These know-how can help company to make next-generation robotic products. Please contact us if you are interesting in our researches!

Contact : Satoshi TADOKORO (Professor)
TEL: +81-22-795-7025
Address: 6-6-01 Aramaki Aza Aoba, Aoba-ku, Sendai-shi, Miyagi, Japan
URL: http://www.rm.is.tohoku.ac.jp
Email: staff@rm.is.tohoku.ac.jp

Tad Lab

System Robotics Laboratory

Department of Bioengineering and Robotics
Graduate School of Engineering
Tohoku University

Coordinated Motion Control of Multiple Robots

Control algorithms for coordination of multiple manipulators, multiple mobile robots, and multiple mobile manipulators, multiple mobile dual manipulators for handling a single object in coordination have been developed in our laboratory and have been applied to real issues so far.

iCART(Intelligent Car Autonomous Robot Transporters)

Mobile Dual Manipulators Coordination

Multiple Robots Coordination

Manipulation of a rigid object (1989)

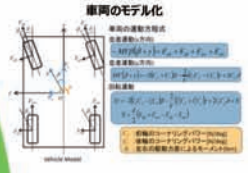
Manipulation of a flexible object (1995)

Parts Assembly By Dual Manipulators (1994)

Next Generation of Advanced Vehicle Control System

Most of conventional control systems of a vehicle have been developed for grip driving. In order to broaden the driving condition, we are developing an advanced vehicle control system which controls a vehicle with drift. An experimental system using a model car has been developed and has shown that the proposed system could control a vehicle with drift condition.

Design of New Control Systems



System Robotics

for creating transformative robotics technology, and integrating it into our society

A robot is a system, which consists of hardware, such as sensors, actuators, and mechanisms, and software, which controls these hardware devices so that the robot performs desired intelligent functions. The robotics is one of the key technologies for solving today's issues of the glove and the aging society.

System robotics is a new field of robotics dealing with issues in real environments and to give solutions for them. Several prototypes of real world robots have been designed and developed based on robot technologies developed in our laboratory.

Human Power Augmentation System (1993)

Mobile Robot Helper (1997)

Human-Robot Interaction

PaDY (Parts/tools Delivery to You Robot)

Concept of PaDY

Partner Ballroom Dance Robot (2005)

A human power augmentation system, a mobile robot helper, and distributed mobile robot helpers have been developed based on the robot helper concept in our laboratory. A dance partner robot has been developed as a research platform for human-robot collaboration. PaDY has been developed as a co-worker robot for an assembly process in an automobile production system and has shown the effectiveness of the concept.

Partner Robot

Passive Intelligent Walker

Assistive Technology

Wearable Walking Helper

Advanced Power assisted cycle chair

Wearable Walking Assist System & Intelligent Passive Cane

Assistive robot systems, such as a passive intelligent walker, a wearable walking assist system without using EMG signal, an advanced power assisted cycle chair, etc., have been developed in our laboratory. Intelligent passive systems driven by servo brake systems, such as the passive intelligent walker, have been developed based on the Passive Robotics principle.

Motion Support System

Professor : Kazuhiro Kosuge
Telephone : +81-22-795-6914
Address : 6-6-01 Aoba, Aramaki, Aoba-ku, Sendai 980-8579, JAPAN
URL : **http://www.irs.mech.tohoku.ac.jp/**

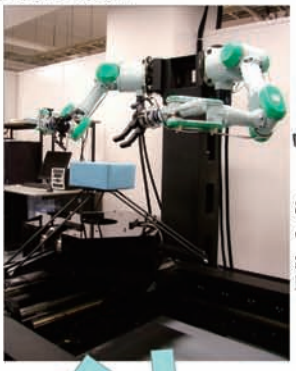
Joint research and development proposals of new real-world robot systems for solving real-world issues based on our advanced and transformative robotics technologies are welcome.

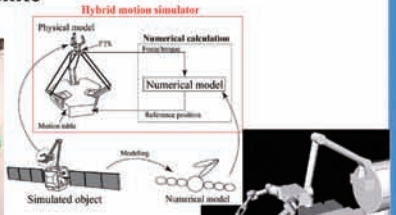
Applying Robot Technologies to Design of Next-Generation Car

MEXT TOHOKU ECONOMIC FEDERATION Tohoku University 宮城県 七十七銀行 ICR

Space robot teleoperation & Microgravity simulator

Teleoperation between a satellite and the earth

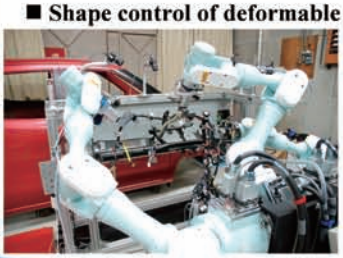




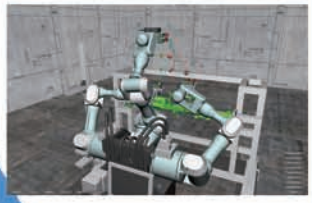
Simulation of robot operation in micro gravity environment with hardware-in-the-loop simulation

Automatic assembly of wire-harness with robot

- Assembly task planning with CG based simulator
- Vision based measurement of wire-harness
- Shape control of deformable object

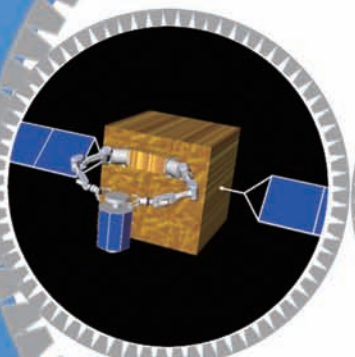


Robot system designed for automatic assembly of wire harness in automobile plant

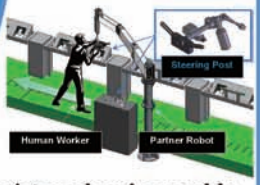


CG based simulator used for task planning

Make a Robotic car!



The kit car under development



Assist workers' assembly

Drifting experiment

- Development of steer-by-wire system
- Driving state estimation using on-board sensors
- Driving assistance utilizing car dynamics

Research on driving assistance

Tested in a practical assembly line

Developed robot

Partner robot in automobile assembly line

Contact
Person in charge: Prof. Masaru Uchiyama
TEL: +81-022-795-6970 FAX:+81-022-795-6971
Address: 6-6-01 Aoba-yama, Sendai 980-8579, Japan
URL: www.space.mech.tohoku.ac.jp

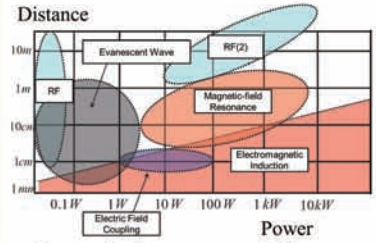
Frontier of Wireless Power Transmission

Graduate School of Biomedical Engineering & Graduate School of Engineering, Tohoku University
Matsuki & Sato Laboratory

MEXT | TOHOKU ECONOMIC FEDERATION | Tohoku University | 宮城県 | 七十七銀行 | ICR

Wireless power transmission (WPT)

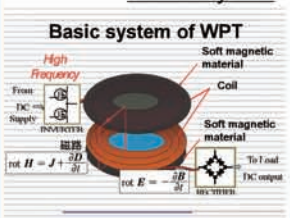
Wide range power (about 1 mW～ 150 kW)
Adapt to every needs for contactless power supply



Transmission power and distance of WPT system

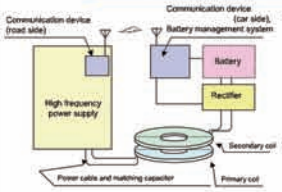
High Efficiency, High Power based on LC-booster method

Our laboratory constructs high performance (efficiency & power level) wireless power transmission(WPT) system with high-Q receiver coil called LC-booster.
We design LC-booster system for many types of application, not only electric vehicle but also medical and consumer devices.



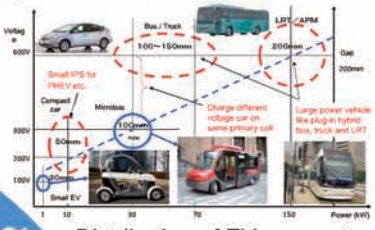
Example of basically WPT system

Flexible WPT system with LC-booster for Electric Vehicle (EV)



- WPT system can transmit (charge) power wirelessly to EV when parking and running.
  - →Cable less power supply, Downsizing battery, Car weight reduction
  - →Improve environmental performance of EV
- Transmitting Power: ～150kW
  - →Apply to compact car, truck, bus, train

WPT system for EV charging



Distribution of EV parameter

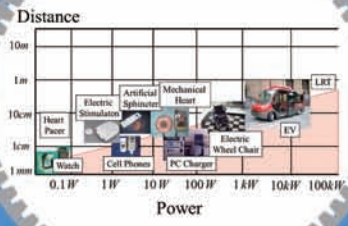
WPT coil for Electric Bus (30kW)

Integration of Medical and Engineering

～Future of Wireless Power Transmission～

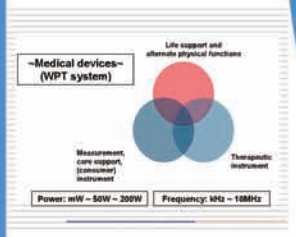
Optimized WPT system for each load

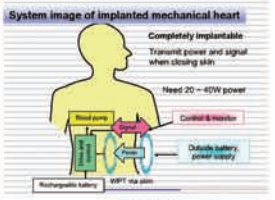
LC-booster, Wireless power rooter, Flexible charging



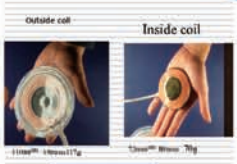
Highway IPS system

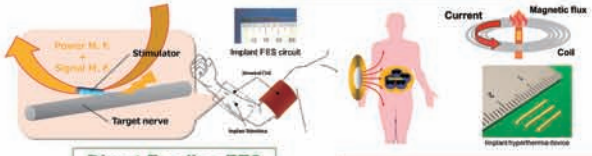
Future of Energy Transfer





WPT system for mechanical heart

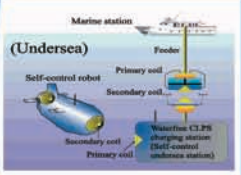




Direct Feeding FES
Treatment for spinal cord injury, Reconstructing exercise function

Soft-heating Hyperthermia
Advanced cancer therapy

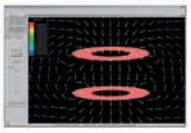
WPT system for implantable medical devices



WPT system for Underwater
Underwater robot, Underwater energy network

Advanced Assistive Vehicle
Intelligent power conditioning

3D magnetic field simulation about WPT coil



WPT system for consumer and industrial equipment

For companies

～Call for joint research and technical development～

WPT technology is a most important 10 technology in future 100 years. Wireless and ubiquitous power supply can innovatively develop new products. Our laboratory will help your development with stored data and know-hows. Please notice if you need our assistance.


Prof. H. Matsuki


Assoc. Prof. F. Sato


Assist. Prof. T. Takura


Research fellow T. Sato

Contact
Officer: Assoc. Prof. Fumihiro Sato (Prof. Hidestoshi Matsuki)
E-mail : fsato@ecei.tohoku.ac.jp
URL : http://www.ecei.tohoku.ac.jp/matsuki/

Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

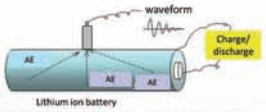
Development of In Situ Measurement Techniques for Lithium-ion Batteries

Naoaki Kuwata, Yoshiki Iwai, Yasutaka Matsuda, Junichi Kawamura
Solid State Ion Physics, Research Center for Sustainable Science & Engineering,
Institute of Multidisciplinary Research for Advanced Materials, Tohoku University

MEXT TOHOKU ECONOMIC FEDERATION Tohoku University 宮城県 七十七銀行 ICR

Doctor of a battery: degradation diagnosis

Acoustic emission (AE) from lithium battery




Li-ion battery for mobile phone


Li-ion battery for laptop (18650-type)

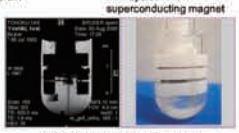

AE measurement system


AE signals from lithium battery (fracture of SnO anode)

MRI of lithium battery (Magnetic resonance imaging)

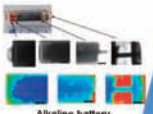

MRI of human brain


MRI system with superconducting magnet


MRI of a model lithium ion battery

X-ray picture

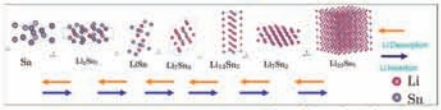

Li-ion battery


Alkaline battery

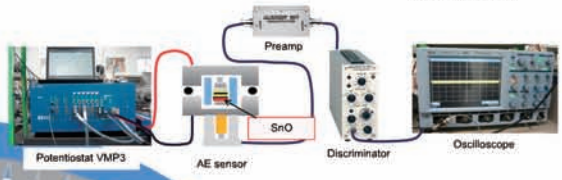
Degradation detection of the lithium battery by acoustic emission (AE)

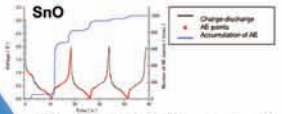
Large reversible capacity; 800 mAh/g ⇨ Anode material for next-generation

Fracture of SnO anode during charge/ discharge can be detected *in situ* by AE measurement.

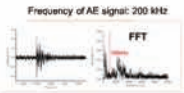


Volume expansion > 400% ⇨ Degradation due to the fracture of electrode



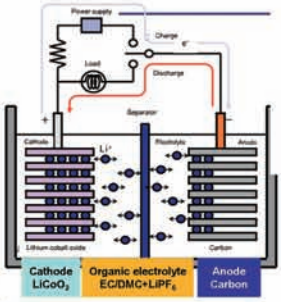


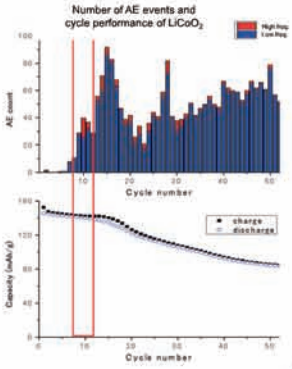
- AE signals are detected for lithium extraction at 1st cycle.
- Different waveforms were observed several regions.



⇨ Fractures of SnO cause 200 kHz AE signals

Application of AE measurement: $LiCoO_2$ cathode

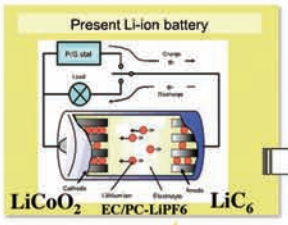




Relationship between AE signal and capacity fading is found.

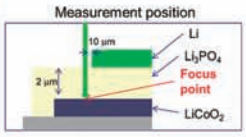
Solid-state thin-film battery

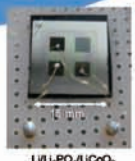
Thin-film battery fabricated by pulsed laser deposition (PLD)

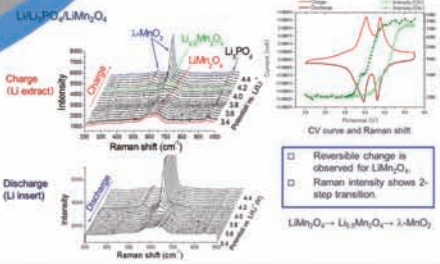



Fire accident of Li-ion battery (Organic liquid electrolyte)

In situ Raman spectroscopy



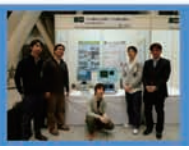

Li/Li3PO4/LiCoO2 thin-film battery



In situ techniques for monitoring Li-ion batteries

We investigate solid state ionic conductors and application for Li-ion battery on the basis of solid state ionics. Several *in situ* techniques have been developed for monitoring the degradation of Li-ion batteries.

We have collaborated with companies by acoustic emission, PLD, thin-film solid electrolyte, micro Raman spectroscopy, etc. We are grateful if you can collaborate with us.



Professor Junichi Kawamura

Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

Development of Thermal Barrier Coating for Black Automobiles

Hiroki Gonome[1], Mehdi Baneshi[2], Junnosuke Okajima[3], Atsuki Komiya[3], Shigenao Maruyama[3]
[1] Graduate School of Engineering, Tohoku University, Sendai, Miyagi 980-8579, Japan
[2] School of Mechanical Engineering, Shiraz University, 71936-16548, Iran
[3] Institute of Fluid Science, Tohoku University, Sendai, Miyagi 980-8577, Japan
E-mail of corresponding author: hiroki1006@pixy.ifs.tohoku.ac.jp

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Background

Car paint

http://image4.kurumaerabi.com/

Dark color is popular for car.

Disadvantage
- ✓ **High absorption** against sunlight
- ✓ Increasing **indoor temperature**
- ✓ Increasing **cooling load** demand

Too much energy usage

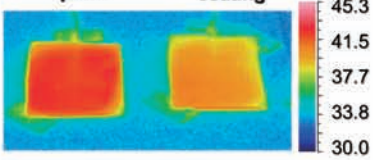
Environmental problem

Greenhouse effect

http://is92zfrf.edu.glogster.com/climate-change-polar-bears-by-jessica-gaalema/

Cool black-color coating

Typical black paint | CuO coating | °C



Visual and infrared images

Experimental evaluation

Reflectance measurement

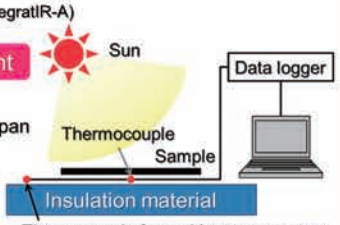
- M. Baneshi, et al., *JQSRT*, 113, (2012), 594.
- H. Gonome, et al., *ASME/JSME 2011 8th Thermal Engineering Joint Conference*, (2011), AJTEC2011-44622.

VIS region
- UV-VIS spectrometer (Shimadzu UV-2450)
- Integrating sphere (Shimadzu ISR-2200)

NIR region
- FTIR (Shimadzu IRPrestige-21)
- Integrating sphere (Shimadzu IntegratIR-A)

Temperature measurement

Place
IFS, Tohoku University, Japan



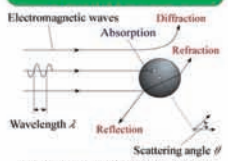
Schematic of the temperature measurement

Exposure experiment

Design

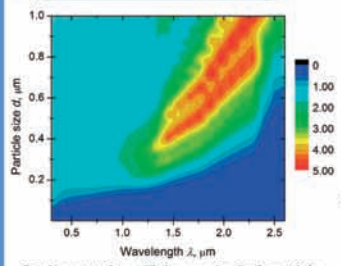
- M. Baneshi, et al., *JQSRT*, 110, (2009), 192.
- M. Baneshi, et al., *J Therm Sci Tech-JPN*, 4, (2009), 131.
- M. Baneshi, et al., *JQSRT*, 112, (2011), 1197.

Nano scale radiation effect



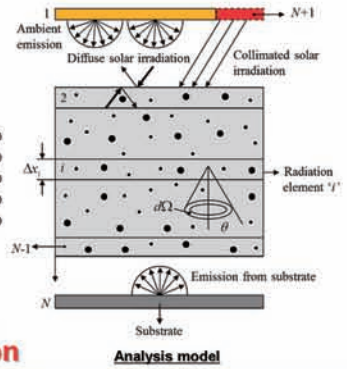
The interaction of a small particle and radiation

- Shape
- Size
- Material
- Clearance



Back-scattering efficiency of a CuO particle

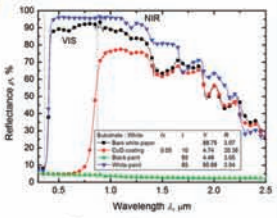
Theoretical optimization



Analysis model

Result

- Baneshi M., et al., *JQSRT*, 113, 594-606, 2012.
- Gonome H., et al., *JQSRT*, Corrected proof, 2013.



Measured reflectances

Measured temperatures of the coating

	Temperature [°C]
CuO coating	61
Typical black paint	82

Cool & Dark was achieved.

For company

- *Our group can design several color paint and optimize thermal performance.*
- *If you have any problem about the control of optical and thermal properties, please ask us!*

Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

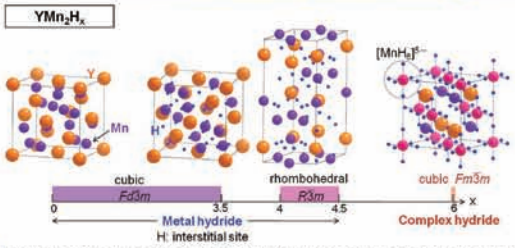
Development of Novel Hydrogen Storage Materials

Institute for Materials Research / WPI Advanced Institute for Materials Research, Tohoku University
Orimo Laboratory

MEXT · TOHOKU ECONOMIC FEDERATION · Tohoku University · 宮城県 · 七十七銀行 · ICR

The special property of YMn_2 hydrides...

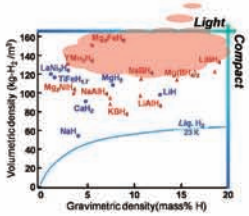
Transition from Metal hydride to Complex hydride



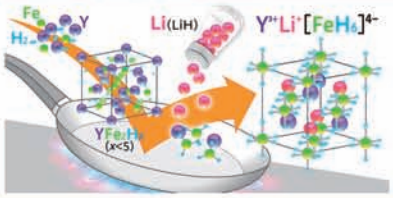
Extend to general transition metal hydrides

Charge neutrality in complex hydrides should be considered

- Hydrogen/metal ratio rise through the transition of hydrogen bonding state
- Apparent advantage of *complex hydrides*: high hydrogen density



Adding lithium to synthesize novel hydrides of general transition metal



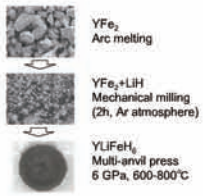
Although YFe_2 has the same crystal structure with YMn_2...

YFe_2 —hydrogenation→ $Y^{3+}Fe^{2+/3+}[FeH_6]^{4-}$ ×

YFe_2 —Li, hydrogenation→ $Y^{3+}Li^{+}[FeH_6]^{4-}$ ○

Research on the fundamental property and transition of hydrogen bonding state

For developing hydrogen storage materials and fuel cell



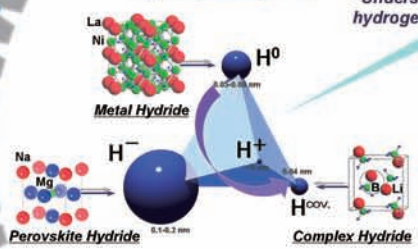
Subject:
Low pressure synthesis is necessary

* $YMn_2 \rightarrow YMn_2H_6$ one step reaction: 170 MPa H_2 is needed...[1]

Subject:
Characterize the novel hydride.

Hydrogen diagram

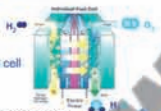
"Understanding the transition of hydrogen bonding states in hydrides."



Unique synthesis methods

Efficient analysis instruments

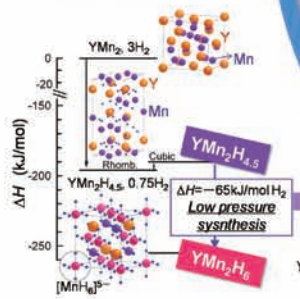
"Exploring the undiscovered properties in hydrides."



Advanced energy devices

- ✓ High density hydrogen storage materials
- ✓ High energy density electric power storage materials
- ✓ Superconductivity

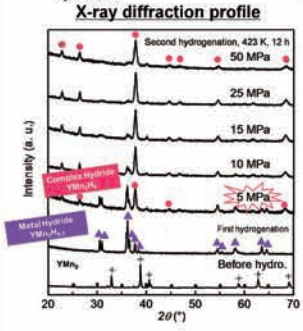
First-principles calculation [2]



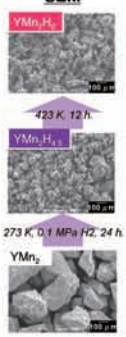
As a result... YMn_2H_6 is synthesized under 5 MPa H_2

Synthesis:

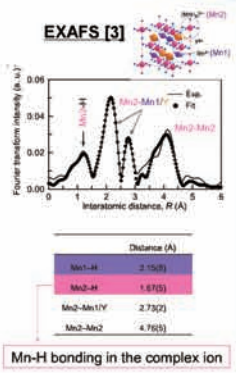
X-ray diffraction profile



SEM



EXAFS [3]

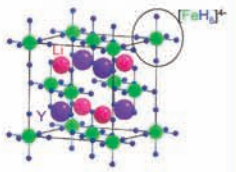


	Distance (Å)
Mn1–H	2.15(3)
Mn2–H	1.67(5)
Mn2–Mn1/Y	2.73(2)
Mn2–Mn2	4.76(5)

Mn-H bonding in the complex ion

[1] V. Paul-Boncour, S.M. Filipek, M. Dorogova, F. Bourée, G. André, I. Marchuk, A. Percheron-Guégan, R.-S. Liu, *J. Solid State Chem.* 178 (2005) 356.
[2] M. Matsuo, K. Miwa, S. Semboshi, H.-W. Li, M. Kano, S. Orimo, *Appl. Phys. Lett.* 98 (2011) 221908.
[3] M. Matsuo, D. Matsumura, Y. Nishihata, G. Li, N. Hiyama, S. Semboshi S. Orimo, *Appl. Phys. Lett.* 100 (2012) 044101.

First-principles calculation



Structural properties
F-43m (No. 216), a=6.851 Å

Atom	Wyckoff notation	x	y	z
Fe	4a	0	0	0
Y	4c	1/4	1/4	1/4
Li	4d	3/4	3/4	3/4
H	24f	0.2377	0	0

Experimental results [4]

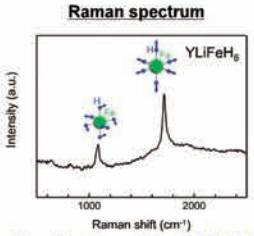
Vibrational mode — *Structural characterization*

Optical Γ-point phonon frequencies

Mode	Frequency (cm^{-1})				
A_1 (R)	1787				
E (R)	1778				
T_1	364	931			
T_2 (R, IR)	208	248	765	1044	1677

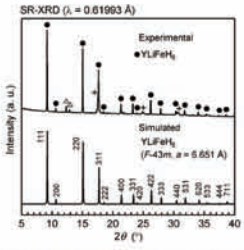
R: Raman active IR: IR active

Raman spectrum



Covalent bonding in $[FeH_6]^{4-}$ is detected

SR-XRD



$YLiFeH_6$ structure is confirmed

[4] M. Matsuo, H. Saitoh, A. Machida, R. Sato, S. Takagi, K. Miwa, T. Watanuki, Y. Katayama, K. Aoki, S. Orimo, *RSC. Adv.* 3 (2013) 1013.

Exploring and understanding the transition of hydrogen bonding states in hydrides

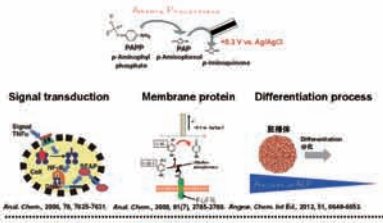
To synthesize novel hydrides for advanced hydrogen storage materials

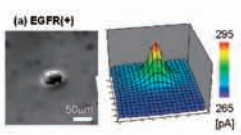
Nanoscale Imaging of Living Cells using Nano-Scanning Electrochemical Microscopy

Advanced Institute for Materials Research,Tohoku University
Matsue Lab

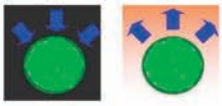
MEXT TOHOKU ECONOMIC FEDERATION Tohoku University 宮城県 77 七十七銀行 ICR

Cell function evaluation using scanning electrochemical microscope



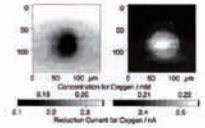


Electrochemical imaging of membrane protein

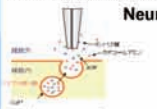


Imaging of respiration and photosynthesis activity

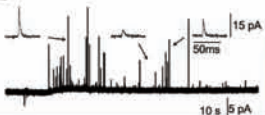
Anal. Chem., 1999, 71, 4637-4641.
Anal. Chem., 2001, 73, 3751-3759.
Anal. Chem., 2003; 75, 2154 - 2158.



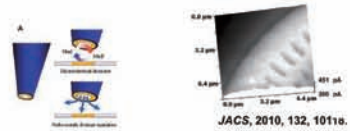
Neurotransmitter detection



Proc. Natl. Acad. Sci. USA, 2012, 109, 11540-11545.
Angew. Chem. Int. Ed., 2011, 50, 9638-9642.



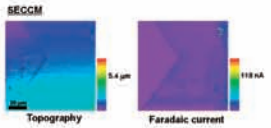
Localized Electrochemical measurement

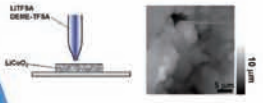


JACS, 2010, 132, 10118.

Anal. Chem., 2009, *81*, 5

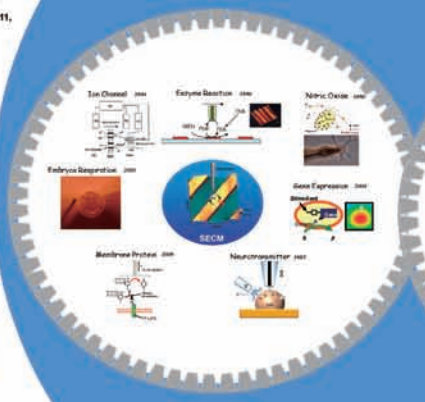
Battery material Topography measurement

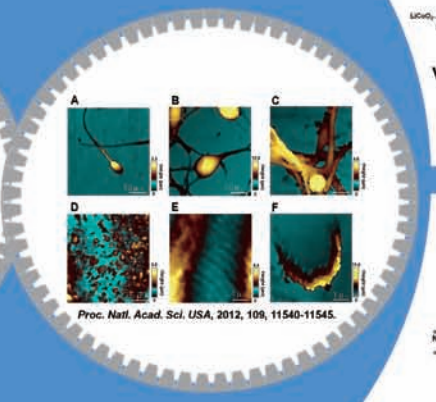




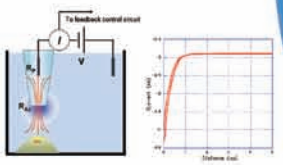
Visualized LCO Topography

Realization of localized electrochemical measurement using nanoelectrode



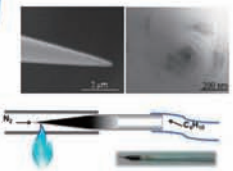


Proc. Natl. Acad. Sci. USA, 2012, 109, 11540-11545.



Scanning ion-conductance microscope

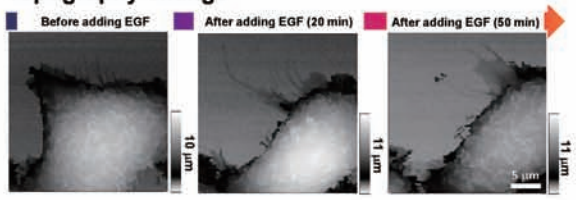
Phys. Chem. Chem. Phys., 2010, 12, 10012-17.



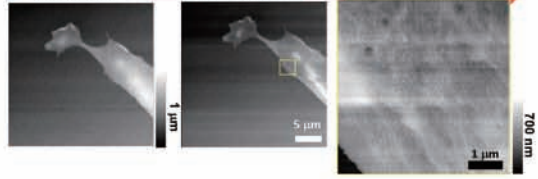
Fabrication of Carbon nanoelectrode

Proc. Natl. Acad. Sci. USA, 2012, 109, 11540-11545.
Angew. Chem. Int. Ed., 2011, 50, 9638-9642.

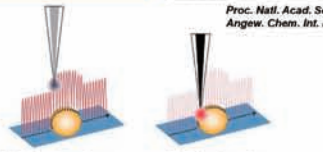
Topography change

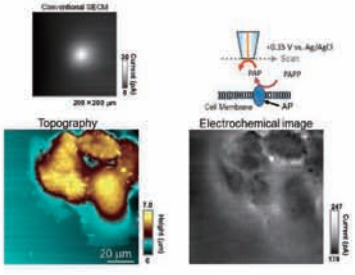


High resolution topography image



Living cell imaging using scanning ion-conductance microscope





Nano electrochemical imaging using carbon nanoelectrode

Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

Energy Conversion Devices Based on Solid State Ionics

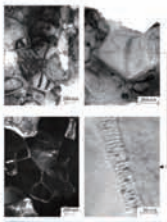
H. Takamura
Graduate School of Engineering, Tohoku University

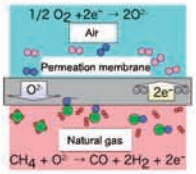
MEXT TOHOKU ECONOMIC FEDERATION Tohoku University 宮城県 七十七銀行 ICR

Hydrogen Production using Oxygen Permeation Membranes

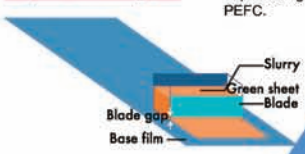
Oxygen permeation membranes for hydrogen production.

	Composition	Flux μmol·cm⁻²·s⁻¹	Temp. °C	Ref.
BSCF	$Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.2}O_3$	8.6	875	Shao *et al.*, 2001
LSGF	$La_{0.7}Sr_{0.3}Ga_{0.6}Fe_{0.4}O_3$	8.2	1000	Ishihara *et al.*, 2002
PSAF	$Pr_{0.7}Sr_{0.3}Fe_{0.8}Al_{0.2}O_3$	8.2	1000	Takamura *et al.*, 2002
Ceria-MFO	(Ce, Sm)O_2–15vol%$MnFe_2O_4$	10.0	1000	Takamura *et al.*, 2002
LBSFI	$(La_{0.9}Ba_{0.1})_2Sr_{0.1}(Fe_{0.8}In_{0.4})O_5$	10.6	1000	Aizumi *et al.*, 2004





- Sm-doped CeO_2 –$MnFe_2O_4$ Nano composite
- 10 μmol·cm⁻²·s⁻¹ (=13.4[STP]cc·cm⁻²·min⁻¹)
- 10 sheets with dimensions of 5 cm x 5 cm are capable of producing H_2 for 1 kW PEFC.



Mass Production of Functional Materials by Tape Casting

All-Solid-State Lithium Battery using $LiBH_4$–based electrolytes


Mobile phones
6.7Wh, 43g

Electric vehicle (from Nissan)
24kWh, 294kg


Stationary UPS (from GS Yuasa)
10.8kWh, 340kg

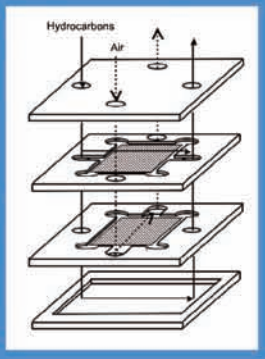
- Large scale, high capacity batteries are demanded.
- In such the large scale battery, the risk of fire is serious.

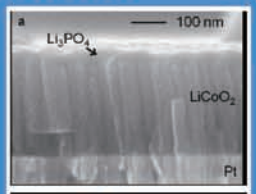
Solution → **All-solid-state lithium battery**
Solid electrolytes are used instead of flammable organic solvent.

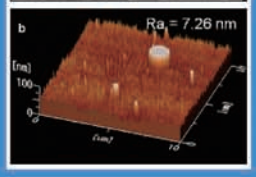
Conventional LIB
- Organic solvents are volatile and flammable.

All-solid-state LIB
- Solid electrolyte
- Higher safety
- Wide temperature range

Applications of Solid State Ionics Materials to Energy Conversion

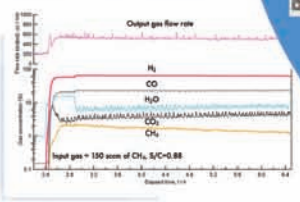






Actual performance

CH₄ reforming properties



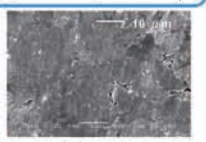
- Simultaneous process of O_2 separation and H_2 production
- Compact & High efficiency

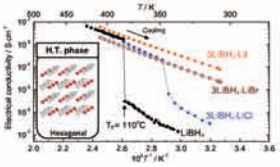
Membrane reformer

- Interface between cathode and electrolyte is key issue
- 30 cycles of charge-discharge are confirmed.

All-solid-state LIB

High σ_{Li} and plasticity : $LiBH_4$

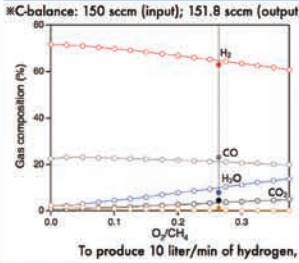


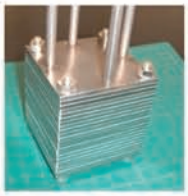


CH₄ reforming properties

No. of modules	CH_4 (sccm)	Air (sccm)	Temp. (°C)	S/C	jO_2 (μmol/cm² s)	CH_4 conv. (%)	CO selectivity (%)	H_2 selectivity (%)
1	150	500	780	0.88	3.3	96	84	89

※C-balance: 150 sccm (input); 151.8 sccm (output)



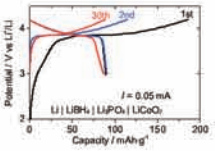


To produce 10 liter/min of hydrogen, stack of 20 modules is required.

Intermediate layer between $LiBH_4$|$LiCoO_2$

Intermediate lyaer Li_3PO_4
Thickness ≈10 nm
Prepared by PLD

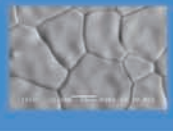
working!

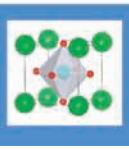


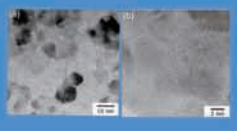
For those who are interested

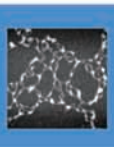
Our focus: Material design of solids in which ion is highly mobile, and its application to energy conversion & storage

Application : Fuel cells, Secondary batteries, Sensors










Tohji Laboratory: Development of functional nano-eco materials for energy and environment in the environmentally benign systems

Professor: Kazuyuki Tohji, Associate Professor: Hideyuki Takahashi, Assistant Professor: Shun Yokoyama

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Research Targets

The researches of Tohji Laboratory focused on how to develop the well defined nano materials and how to utilize these materials to our life. Especially, we develop the synthesis and utilizing methods for useful nano material which utilize the surface properties, such as alloy and/or oxide-sulfide hybrid catalysts and electric integration materials, and for energy materials to solve the global environment problems, such as thermoelectric alloy nanoparticles. Moreover, the application of novel photocatalysts, called as stratified photocatalysts, to effective hydrogen generation system and environmental catalysts is researched. Our research objectives can be classified as follows.

Natural energy conversion materials
(A-1) Photocatalysts with specific morphology
(A-2) Thermoelectric alloy nanoparticles
(A-3) CIGS alloy nanoparticles for solar cell
Functional nano-eco materials
(B-1) Uniform and well crystallized alloy nano materials
(B-2) Well defined electric integration nano materials
(B-3) Precise control of nano catalysts for fuel cell
Utilization of the precise control for metal complexes condition
(C-1) Novel extraction methods of rare metals

Among these, (A-1) and (B-1) are Introduced in this poster.

Photocatalysts with specific morphology: Stratified Photocatalysts

The direct conversion of solar energy into storable energy in the form of hydrogen will provide not only clean energy but also solve the environmental problem caused by the discharge of CO_2 from the consumption of fossil fuel. Therefore, various researchers vigorously synthesized the high performance photocatalysts to show the effective splitting water and investigate the reaction mechanism. Many researchers succeeded to generate the hydrogen and oxygen gas from water with the ratio of 2:1, however, it is also true that the reaction rate is low and also cost for the total system construction as compared to the hydrogen generation from fossil fuel degradation is high. This is considered to originate from the degree of the decomposition potential of the reactants (water) which need relatively large energy (c.a. 1.3eV). On the other hand, H_2S can be easily decomposed, since it has low potential (0.298eV).

Thus, photocatalytic decomposition of H_2S is considered as an efficient route to produce new energy (hydrogen) compared with the splitting of water. Moreover, decomposition of H_2S by using solar energy and photocatalysts may gives us the candidate for the solution of environmental problems, since quite large amounts of energy was consumed for the decomposition of H_2S which evolved from the distillation of fossil fuel. Among the various semiconductor materials, only the sulfide type photocatalysts, such as ZnS, can act stably in the H_2S solution condition, while metallic and/or oxide type photocatalysts are sulfurized. Moreover, capsule like morphology is considered to effective, since catalytic reaction is progressed only on the surface of photocatalysts.

These consideration indicate that effective hydrogen generation can be achieved by the combination of "H_2S as the reactant", "sulfide type photocatalysts", "capsule like morphology", and "solar energy". Thus, photocatalytic decomposition of H_2S into H_2 by using these type photocatalysts gives us the efficient route for the conversion of natural energy into clean energy (H_2).

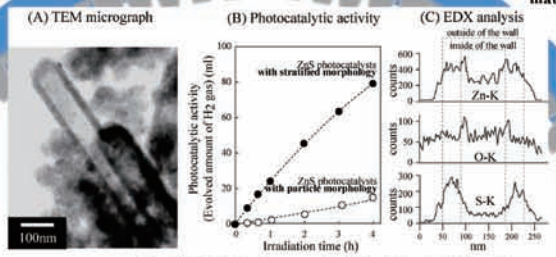

Fig.1 (A) TEM micrograph, (B) photocatalytic activity and (C) EDX analysis of stratified ZnS photocatalysts

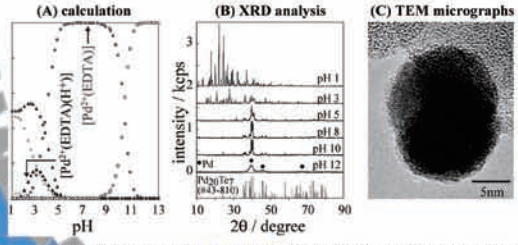

Fig.2 (A) Results of calculation for Na_2PdCl_4 - H_4EDTA system, (B) XRD analysis of synthesized materials and (C) HR-TEM micrographs of uniform and well crystallized $Pd_{20}Te_7$ alloy nanoparticles synthesized by obeying to this method

Many attempts to prepare the alloy and metallic nanoparticles by various methods have been reported. However, in spite of the objective to obtain alloy materials, the as-prepared metallic nanoparticles often exhibited inhomogeneous compositions and multi-crystalline structures, which does not adequate for the industrial applications, such as catalysts and electronic devices. Depending on the synthesis conditions, alloy catalysts with various structures and compositions can be prepared. As a consequence, undesirable by-products may co-exist, or the entire catalytic activity may be reduced through catalytic reactions due to the formation of compounds with various surface structures and compositions other than those of objective alloy. Thus, the synthesis method for "uniform" and "well-crystallized" alloy nanoparticles should be developed.

Metallic nanoparticles are well known to be easily synthesized in the liquid phase by the reduction of metal ions and/or complexes by many traditional methods. In this system, various metal salts and metal complexes are formed simultaneously and their consequent reduction gives rise to a mixture of various kinds of particles, such as single metal, alloy nanoparticles, etc. In other words, the concomitance of various ions and/or complexes in the starting solution leads to uncontrolled reduction, consequently followed by the formation of undesired mixtures of metal particles caused by the differences in reduction rates of different metal complexes that originated from different precursory metal species that existed in the solution. Finally, the as-prepared alloy nanoparticles have various crystal phases and/or inhomogeneous structures. Thus, in order to synthesize uniform and well-crystallized alloy nanoparticles, the reduction rates of metal species in the starting solution should be made equal. Therefore, the idea based on the predicted concentration of metal complexes in an aqueous solution as a function of pH was introduced for the particle synthesis system.

Uniform and well crystallized alloy nano materials

Staffs

Professor: Kazuyuki Tohji

Assistant Professor: Shun Yokoyama

Associate Professor: Hideyuki Takahashi

This method can applicable to various materials. So, if you have some questions, please contact to us.

Our address

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Nanocrystalline Li_2MSiO_4 and Li_2MPO_4F (M=Fe, Mn, Ti and Co) cathode materials synthesized via supercritical process

M K Devaraju and Itaru Honma
Institute of Multidisciplinary Research for Advanced Materials, Tohoku University, Sendai, Japan.

Energy Materials

Goal: High Energy Density Nanostructure Cathode Materials

High-energy density (gravimetric and volumetric) cathode materials is equivalent to high-capacity (per Kg), high-potential, high packing bulk density cathode materials

Li_2MSiO_4 very interesting cathode materials

The extraction/insertion of 2-Li ions can lead to the delivery of 333mAh/g capacity according to the following scheme:

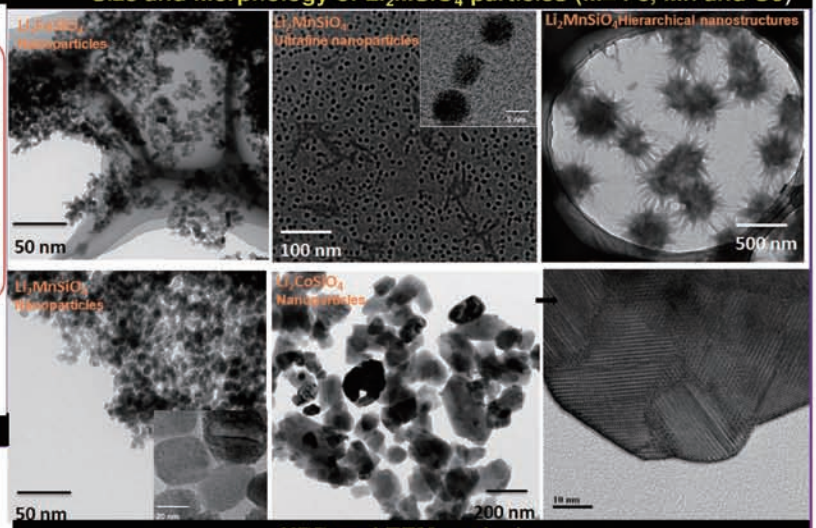
$Li_2Mn^{2+}SiO_4 \longrightarrow Mn^{4+}SiO_4 + 2Li^+ + 2\bar{e}$

Strong covalent Si-O bonds can be good for safety, high thermal stability

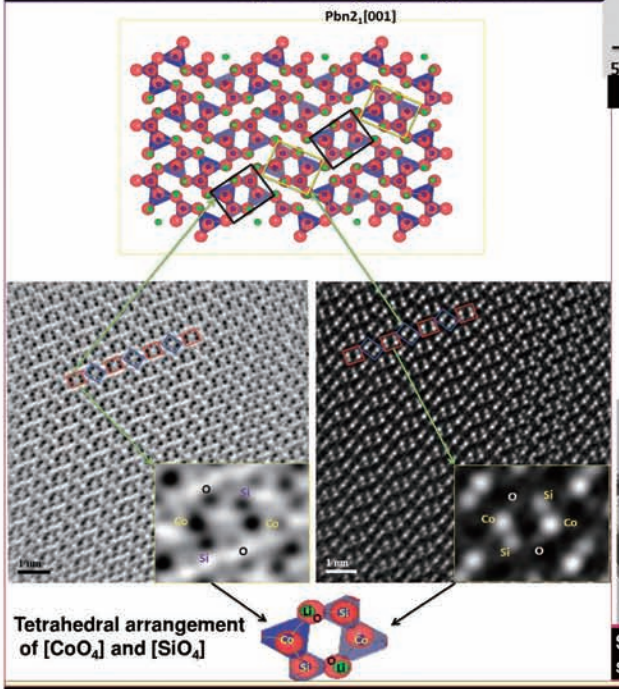
Li_2MPO_4F

1-D chains of metal octahedra interconnected by polyanion tetrahedra, Li^+ afford open pathways for 3-D ion transport

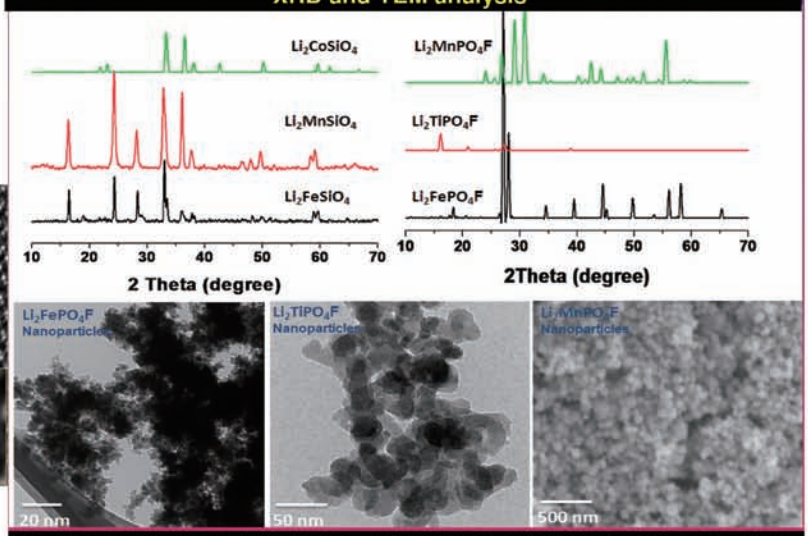
Size and Morphology of Li_2MSiO_4 particles (M= Fe, Mn and Co)



ABF and ADF analysis of Li_2CoSiO_4 particles

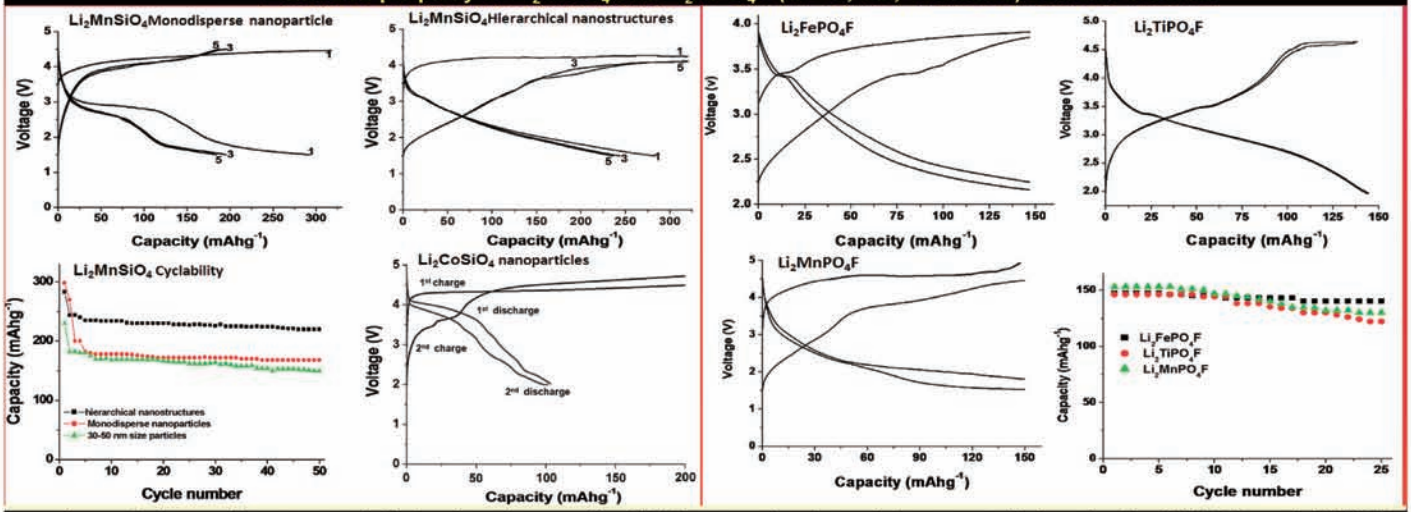


XRD and TEM analysis



Size and morphology of electrodes were controlled by changing the solvent and surfactants ratio . Single phase cane be synthesized via supercritical fluid process

Electrode property of Li_2MSiO_4 and Li_2MPO_4F (M=Fe, Mn, Ti and Co) cathode material



In conclusion, we have successfully developed supercritical fluid process for size and shape controlled synthesis of Li_2MSiO_4 and Li_2MPO_4F cathodes. The nanocrystals of Li_2MPO_4F and Li_2MSiO_4 cathode materials showed excellent electrode property, Li_2MnSiO_4 cathode showed capacities of nearly two lithium ion. Hence, the process can produce high quality cathodes for Li-battery.

Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

Green Nanodevice by Super Low Damage Process

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[1]Institute of Fluid Science, Tohoku University, Japan
[2]WPI-AIMR, Tohoku University, Japan
[3]Japan Science and Technology Agency (JST), CREST, Japan

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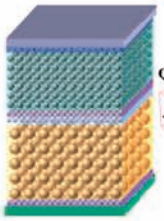
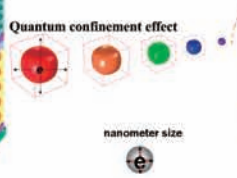
Quantum Dot Solar Cell

Theoretical conversion efficiency >60%



Quantum confinement effect



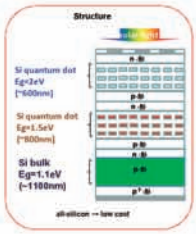
Quantum dot solar cell

nanometer size

electron confinement

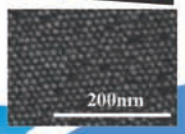
electron tunneling

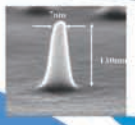
Low recombination probability of electron and hole
Multiple bandgaps
Electron and hole can move by tunnel effect



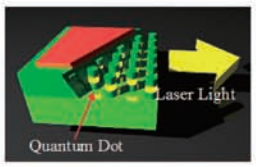
Solar spectrum can be efficiently utilized by only one material

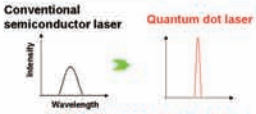
Bio-template ultimate top-down process



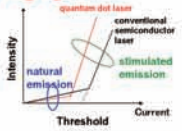


Quantum Dot Laser





Narrow peak width, high gain



Low threshold

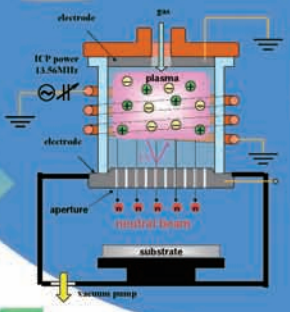
Ultralow-damage neutral beam process

Biomolecules
Bottom-up Process
Bio-template technology

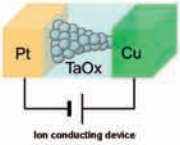
Low-damage
Top-down Process
Neutral beam technology

Low-power-consumption semiconductor devices

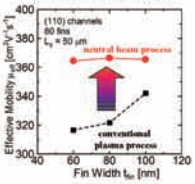
- 3-dimensional MOS transistor
- Ion conducting devices
- Graphene transistor
- Germanium transistor
- Single electron transistor

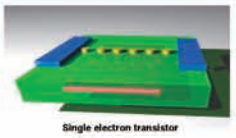


3-dimensional MOS transistor

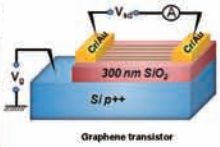


Ion conducting device





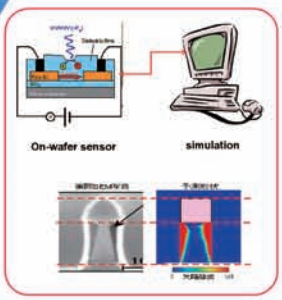
Single electron transistor



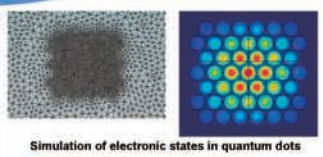
Graphene transistor

Development of low-power-consumption devices with low environmental footprint

Simulation for processes and devices



Prediction of plasma process damage



Simulation of electronic states in quantum dots

Message for industry

We are developing innovative green nano-devices to realize generation, storage, and saving of energy, by utilizing our original ultra-low-damage neutral beam processes. We established an industry-academia consortium on solar cell, secondary battery, fuel cell, and energy optimized integrated system in April 2013. We aim researches to be industrialized.

Prof. Seiji Samukawa

http://www.ifs.tohoku.ac.jp/samukawa/index.htm

IER | Core Technology Consortium for Advanced Battery Devices | ナノ・マイクロクラスター

Core Technology Consortium for Advanced Energy Devices

Seiji Samukawa[1,2] and Tomohiro Kubota[1]
[1]Institute of Fluid Science, Tohoku University, Japan
[2]WPI-AIMR, Tohoku University, Japan

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Outline

Since the Great East Japan Earthquake, the development of new clean and renewable energy sources and the realization of efficient and smart stand-alone energy systems using the best mix of energy have been urgently sought.

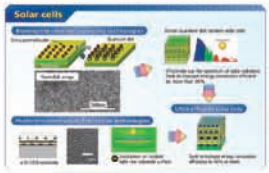
Therefore, we intend to support the reconstruction of the Tohoku area and the renewal of Japan, and to contribute to the establishment of an energy-technology nation, through the realization of state-of-the-art core battery technologies (solar cells, secondary batteries, fuel cells) and their energy optimization integrated systems.

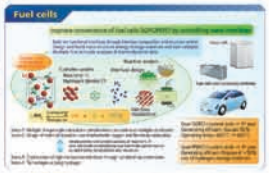
Our efforts will be realized through open innovations in an industry-academia collaboration setting with a vertically-integrated group of companies. The innovations are based on nano-structure interface control technologies, which Tohoku University has been accumulating for many years.

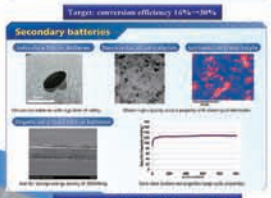
Features

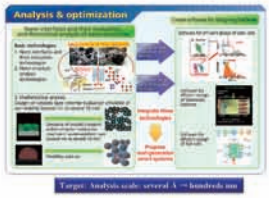
1. Unique consortium aiming at establishment of *optimized nano-energy system* created as a fusion of solar cells, secondary batteries, and fuel batteries.
2. Strategic research and development by gathering technologies from *vertical integration type firms* based on nano-interface material structure control technologies accumulated specifically by the university.
3. Restoration to society, job creation, and national profit increments by *strengthening TLO*.
4. We propose our own intellectual property strategy of "*Patent Marché*" for the gathering of technologies.
5. For the cultivation of world-class human resources, we propose *soulful human resource exchange systems between firms and the university*. (Practical cultivation and exchange of human resources).
6. For support of the basis of the battery industry, a facility-sharing system "*Coin operated type battery manufacturing device*" is constructed based on the Sendai Material Valley.

Research and Development

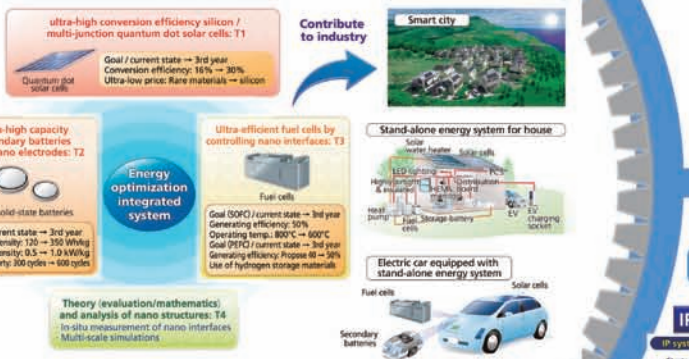








Our Target



http://www.ifs.tohoku.ac.jp/consortium/eng/index.html
consortium@Sammy.ifs.tohoku.ac.jp

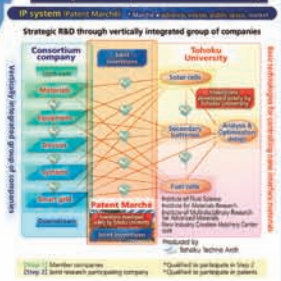
Organization

Members

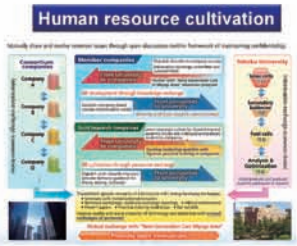
Director	Institute of Fluid Science (IFS) and Advanced Institute for Materials Research (AIMR), Professor	S. Samukawa
Solar cells	Institute of Fluid Science (IFS) and Advanced Institute for Materials Research (AIMR), Professor	S. Samukawa (Leader)
	Nagoya University Professor and Tohoku University Visiting Professor,	N. Usami
	Institute of Multidisciplinary Research for Advanced Materials, Professor	I. Honma
Secondary batteries	Institute of Multidisciplinary Research for Advanced Materials (IMRAM), Professor	I. Honma (Leader)
	Advanced Institute for Materials Research (AIMR) and Institute for Materials Research (IMR), Professor	S. Orimo
	Advanced Institute for Materials Research (AIMR), Lecturer	A. Unemoto
Fuel cells	Institute for Materials Research (IMR), Lecturer	M. Matsuo (Leader)
	Advanced Institute for Materials Research (AIMR), Institute for Materials Research (IMR), Professor	S. Orimo
	Institute for Materials Research (IMR), Researcher	T. Ikeshoji
	Institute of Multidisciplinary Research for Advanced Materials (IMRAM), Professor	K. Amezawa
Analysis and optimization	Institute of Fluid Science (IFS), Associate professor	T. Tokumasu (Leader)
	Institute of Fluid Science (IFS), Assistant professor	K. Shimoyama
	Institute of Multidisciplinary Research for Advanced Materials (IMRAM), Professor	K. Amezawa
	New Industry Creation Hatchery Center (NICHe) , Professor	A. Miyamoto
Research Management Group	Institute of Fluid Science (IFS), Associate Professor,	T. Kubota (Leader)
	Institute of Fluid Science (IFS), Visiting Professor,	Y. Nakano
	Tohoku Techno Arch Co. Ltd., Manager of Technical Department	A. Ishiyama

Open Innovation

IP System (Patent Marché)



Human resource cultivation



Equipment sharing program

Membership application

Prospective member companies are welcome to apply to the Consortium at any time.
A company applies to the Consortium by applying to "provide academic guidance." Download the Academic Guidance application form and academic guidance contract sample form from the "Member Application" webpage. Complete and submit the application.
If a consortium company is interested in joint research, please submit a joint research application form.

See: http://www.ifs.tohoku.ac.jp/consortium/eng/application.html
http://www.ifs.tohoku.ac.jp/consortium/jpn/application.html (Japanese)

Contact information

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http://www.ifs.tohoku.ac.jp/consortium/jpn/ (Japanese)

Contract-related Reception Desk
Accounting Section, Institute of Fluid Science, Tohoku University
TEL: +81-22-217-5305 / FAX: +8122-217-5311
mail: keiri@ifs.tohoku.ac.jp
Address: 1-1, Katahira, 2-chome, Aoba-ku, Sendai, 980-8577, Japan

Manufacturing Technology of Automotive Power Semiconductors

New Industry Creation Hatchery Center, Tohoku University
Fluctuation Free Facility

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Radical Oxidation and Nitridation

Oxidation : Oxide film formation on Silicon

$Kr + e \rightarrow Kr^* + e$
$Kr^* + O_2 \rightarrow Kr + 2O^*$
$Si + 2O^* \xrightarrow{R.T.} SiO_2$ {(O* Radical reaction) (On any crystal orientation surface)}
Current: $Si + O_2 \xrightarrow[\text{Thermal energy}]{1000°C} SiO_2$ {(O_2 Molecular reaction) (Only on (100) silicon surface)}

Kr : Krypton
O : Oxygen
Si : Silicon

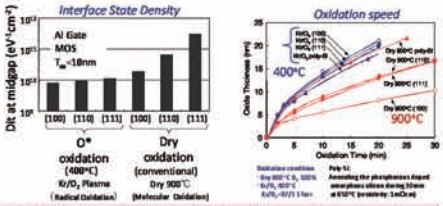
Nitridation : Nitride film formation on Silicon

$Xe + e \rightarrow Xe^* + e$
$Xe^* + NH_3 \rightarrow Xe + NH^* + H_2$
$3Si + 4NH^* \rightarrow Si_3N_4 + 2H_2$

Xe : Xenon
NH_3 : Ammonia
Si : Silicon

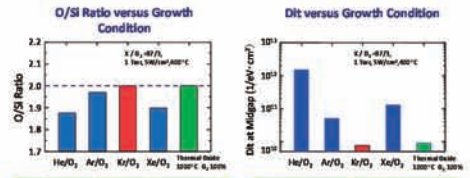
★The technology that the students study at the university becomes available on the practical production site.
★Very high integrity SiO_2 and Si_3N_4 can be formed on any crystal orientation silicon surface with the same formation speed.
★Very expensive gases (Kr, Xe) ⇒ Complete reuse and recycling system
99.9% for Kr, 99.99% for Xe

Film Properties Fabricated by the Plasma Oxidation



Radical oxidation has been confirmed to exhibit same formation speed on any crystal orientation silicon surface, i.e., LSI can be fabricated on any crystal orientation silicon surface and very high performance power device IGBT can be fabricated.

Film Properties fabricated by the radical oxidation method

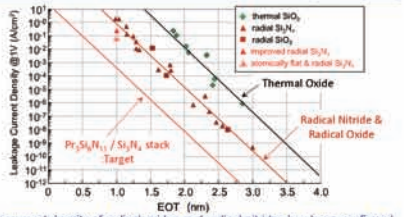


Complete Stoichiometric Structure SiO_2 for Kr/O_2

Very Low Interface Trap Density for Kr/O_2

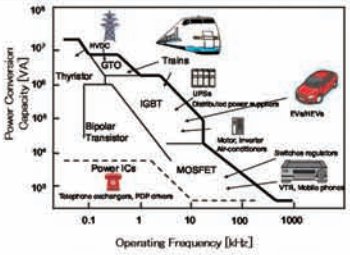
In Kr / O_2 gas combination, there generate O* radicals only while O_2^+ and O_3 are generated in other gas combinations. O* radicals can move freely in oxide films even at low temperature such as 400°C, resulting in complete oxidation of Si.

Leakage Current (@1.0V) as a Function of Equivalent Oxide Thickness



Leakage current density of radical oxides and radical nitrides has been confirmed to decrease down to less than 1/1,000 compared to that of thermal oxides. Integrity of $Pr_3Si_6N_{11}$(k=30) can be drastically improved by introducing new plasma equipment such as 915 MHz Metal Surfacewave Excitation Plasma (MSEP)

Application of Power Semiconductors

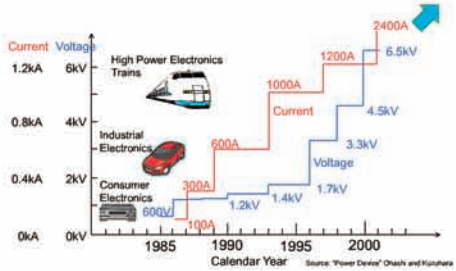


Used Area of Si Power Semiconductors

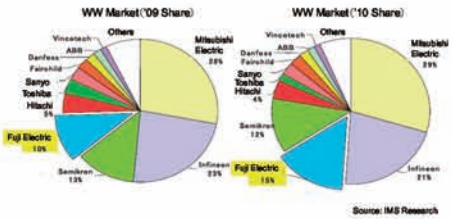
Structure and Electrical Properties of Major Power Semiconductors

	Diode	Cyristor	GTO	BJT	MOSFET	IGBT
Junction Structure						
Circuit Symbol						
ON-state voltage [V]	1.8	2.5	3.5	2.5(series)	50(1Ω)	2.5
Switching time [μs]	–	400	25	18	0.35	<1
Rated voltage[V]	4000	4000	4500	1200	500	600~6500
Rated current[A]	1600	3000	3000	600	50	50~2400

Progress of IGBT toward High Voltage and Large Current



IGBT Market Share



IGBT Products of Fuji Electric Co., Ltd.

For Consumer Electronics (eg. Room Air-Conditioner)

600V / 15A,20A,30A

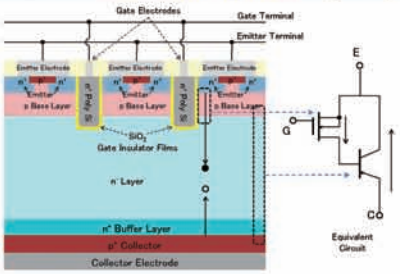
For High-Voltage Inverter (eg. Solar/Wind Power Generation)

1200V / 600 – 1400A
1700V / 650 – 1400A

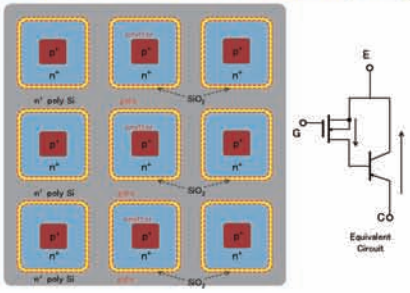
1200V / 600 – 3600A
1700V / 600 – 3600A
3300V / 650 – 1500A

Source: Fuji Electric website

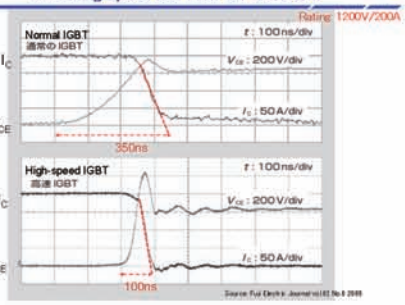
Cross-Section View of IGBT



Plane View of IGBT Emitter and Gate Electrodes



Switching Speed and Turn-off Waveform



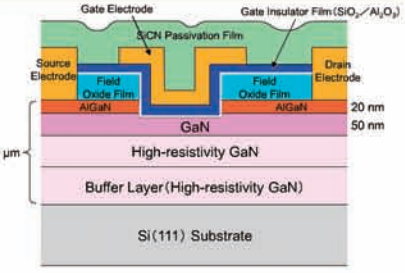
Physical Property of Si and Wide Band Gap Semiconductors

	Si	3C-SiC	6H-SiC	4H-SiC	GaN
Band gap[eV]	1.1	2.2	3.0	3.3	3.4
Relative dielectric constant	11.8	9.6	9.7	10	9.5
Electron mobility[$cm^2/V \cdot s$]	1350	900	370	1000	1200
Breakdown field[$10^6 V/cm$]	0.3	1.2	2.4	3.0	3.3
Electron saturation velocity[$10^7 cm/s$]	1.0	2.0	2.0	2.0	2.5
Thermal conductivity [W/cm·K]	1.5	4.5	4.5	4.5	2.1

AlGaN/GaN/(111)Si Power Semiconductors

⇨ Depth of the n- drift region is 1/10 of the Si device at the same maximum rated voltage
⇨ ON-state voltage is less than 1/1000 of the Si device

AlGaN/GaN/(111)Si Power MOSFET



Features of the Proposed GaN Power Semiconductors

☆ Gate Insulator Film
SiO_2(60nm) / Al_2O_3(3nm) / GaN
⇨ Introducing Al_2O_3 prevents Ga diffusion

☆ SiCN Passivation Film
Adding 10% C(carbon) in Si_3N_4 minimizes stress on the GaN ⇨ Current increases

☆ Integrated Control Circuit
Radical oxidation/nitridation enables CMOS transistors fabricated on Si(111) substrate

☆ We Recommend that Power Device is GaN, and Its Controller is Integrated on Si(111) Substrate

Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

Development of Al doped $Ca_3TaGa_3Si_2O_{14}$ piezoelectric crystals

T. Kudo[1], Y. Yokota[2], M. Sato[3], K. Tota[3], K. Onodera[2,3], S. Kurosawa[1,2], K. Kamada[1], A. Yoshikawa[1,2]
1.Institute for Materials Research, Tohoku University 2. New Industry Creation Hatchery Center, Tohoku University
3. TDK corporation E-mail : t_kudo@imr.tohoku.ac.jp

MEXT TOHOKU ECONOMIC FEDERATION Tohoku University 宮城県 七十七銀行 ICR

Introduction

Sensing in the engine section oxygen sensor for the lean burn systems

⇨ Combustion pressure sensor

	Quartz	PZT	Langasite-type crystal
Curie temperature(℃)	573	~300	>1300
Piezoelectric constant(pC/N)	2.0	~300	4 - 7
Electromechanical coupling factor(%)	10	30 - 70	~ 15
Mechanical quality factor	> 10^5	100 - 900	10^3 - 10^5

Advantage of Combustion sensor

- Increasing the combustion efficiency
- Decreasing the amount of the NO_x and CO_2 emission

Langasite-type crystals with high properties have been expected for the elements in the sensor device.

Problems

High cost of manufacturing the langasite-type crystal

In 1980s, $La_3Ga_5SiO_{14}$ (LGS) was developed.

⇩ La free

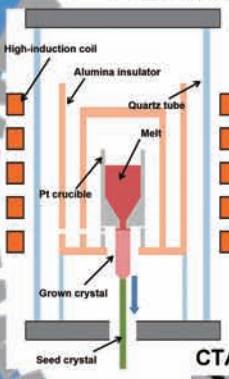
After 1998, $Ca_3TaGa_3Si_2O_{14}$ (CTGS), $Ca_3NbGa_3Si_2O_{14}$ (CNGS) has been developed.

Motivation

To reduce amount of Ga ion in the crystal, Al doped CTGS crystal with various Al concentrations were grown.

Key Technology

- Crystal growth by μ-PD method
  - Materials screening with fast growth rate
- Langasite-type piezoelectric crystals
  - High piezoelectric properties at high temperature
  - Low crystal impedance
- Al doped CTGS crystals
  - Reductions of manufacturing cost and amounts of rare metals



CTAS crystal

Experimental

Crystal Growth by μ-PD method

Liquid-solid interface during crystal growth

Starting material: $CaCO_3$, β-Ga_2O_3, α-Al_2O_3(>4N) and SiO_2(>3N)

The powders were mixed as nominal compositions of $Ca_3Ta(Ga_{1-x}Al_x)_3Si_2O_{14}$ [x = 0, 0.2, 0.4, 0.6, 0.8 and 1].

The mixed powders were sintered at 1200° C for 12 hour in air three times.

Sintered powder was set in Pt crucible.

The crucible was heated in air up to melting point by high-frequency induction coil.

⇩

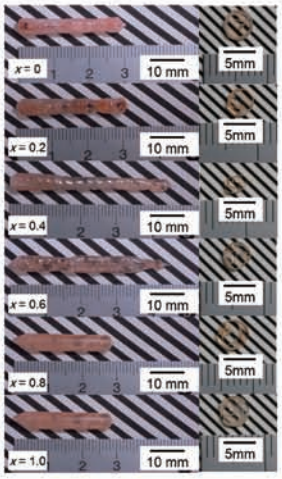
Crystal growth was performed by pulling down the melt
Seed crystal: LTG crystal with *a*-axis
Growth rate is 0.5 mm/min.

Evaluations

X-ray diffraction (XRD)
Scanning electron microscope (SEM)
Electron probe micro-analyzer (EPMA)

Results & Discussions

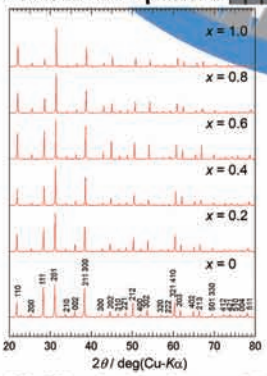
$Ca_3Ta(Ga_{1-x}Al_x)_3Si_2O_{14}$ crystals grown by μ-PD method



Insides of the crystals had high transparency.

There were some cracks in the crystals due to high temperature gradient during crystal growth.

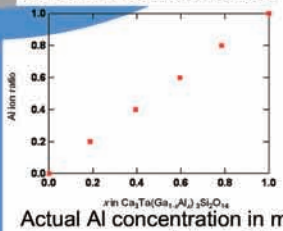
Powder XRD pattern



All diffraction peaks were identified by langasite-type structure.

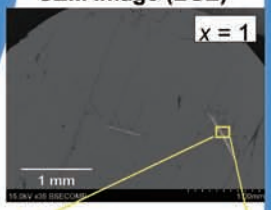
Lattice parameters were systematically decreased with Al concentration

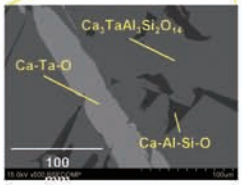
Actual Al concentration



Actual Al concentration in main phase was consistent with nominal composition.

SEM image (BSE)





- Main phase was almost same as nominal compositions.
- There were some impurity phases in the periphery areas.

Future plans

Investigation of congruent composition and suitable growth condition to obtain Al doped CTGS crystals without inclusion and crack.

Nanotechnology Platform : Structural Analysis

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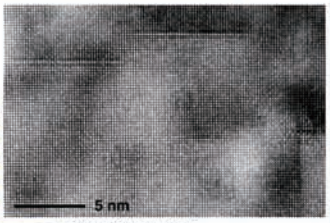
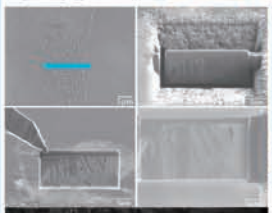
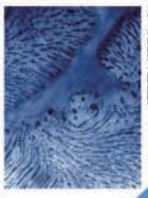
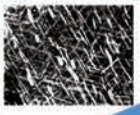
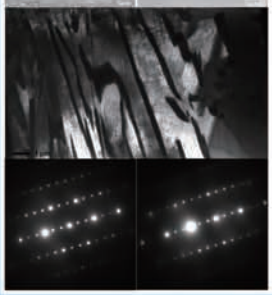
IMR

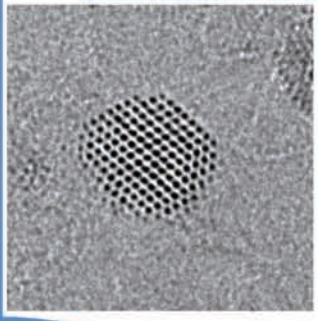
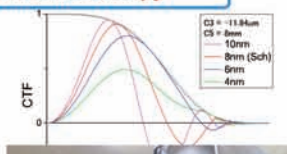
Institute for Materials Research

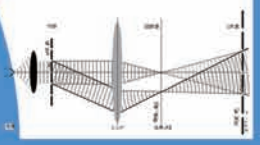




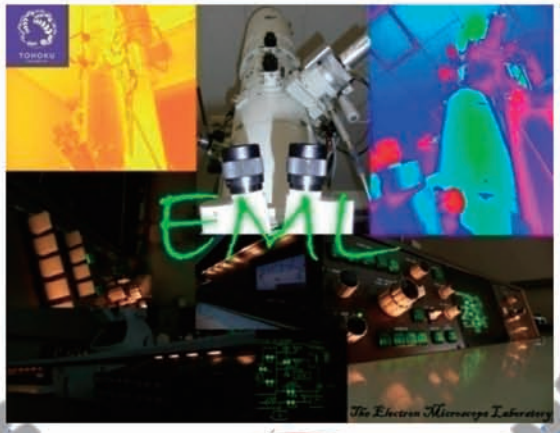
Art of Advanced Electron Microscopy

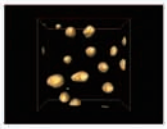



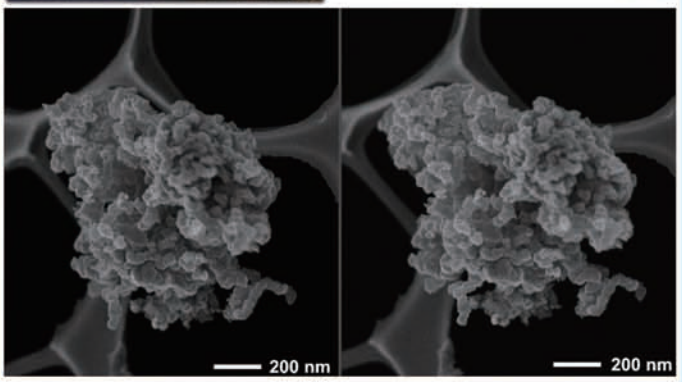
CENTER FOR INTEGRATED NANOTECHNOLOGY SUPPORT

CINTS

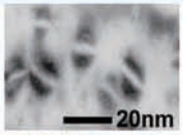


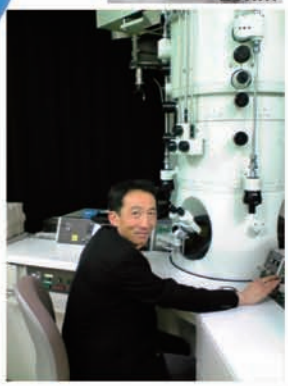
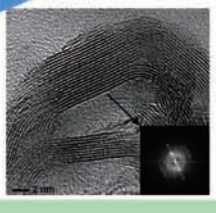
Materials for Environment





Materials for Safety



Center for Integrated Support for Nanotechnology is open to researchers in industries and academia. Our mission is to help understand the property of materials to ensure their functionality and usability through state-of-art characterization techniques.

http://cints-tohoku.jp/
cintsoffice@rpip.tohoku.ac.jp 022-217-6037

Ultra-low Friction Technology Area, Tohoku Innovative Materials Technology Initiatives for Reconstruction (TIMT)

Kazue Kurihara (WPI-AIMR & IMRAM, Tohoku University)

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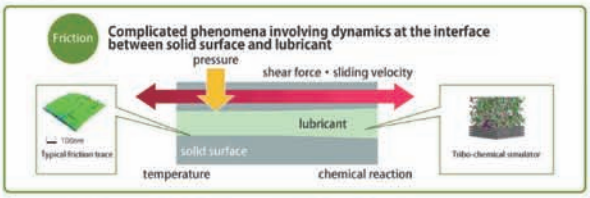
Friction Technology

Friction-reducing technology plays an important role in energy efficiency in automobile engines and many other mechanical systems.
(e.g. friction losses in automobiles amount to 20% of the total energy loss)

Major fuel efficiency improvement through optimized lubrication technology at nano-interfaces

We develop optimized ultra-low friction technology based on nano-scale measurements and theoretical explanations of friction mechanisms through fusion of mechanics and chemistry/materials science.



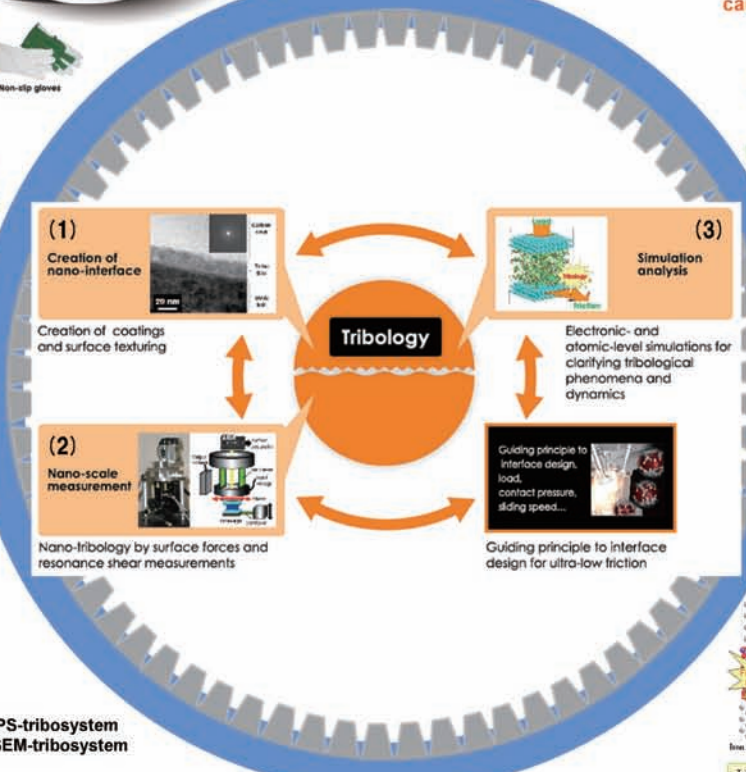
- **Economic influences of tribology (study of friction) is about 2 % of GDP**
- **Friction problems at contact interfaces of machines cause mechanical deterioration, damage and short life.**

control of friction/wear

Improvement of energy efficiency on mechanical systems

Guarantee of stable quality, high reliability and long life.

Innovation in Tribology



Research Topics

(1) Development of In-situ Analysis Systems of Friction/Wear and Optimized Design of Nano-interfaces realizing ultra-low friction

In-situ XPS-tribosystem & In-situ SEM-tribosystem

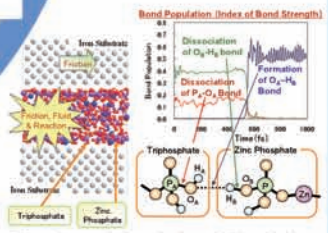
Construction of
-creation technology and argument of optimized design for nano-interafce realizing ultra-low friction
-platform for in-situ analysis of friction/wear

(2) Measurement Technology for Nano-level Elucidation of Friction & Interfacial Phenomena

surface forces apparatus(SFA)
Nano shear resonance apparatus(RSM)

Optimized design of interfaces/lubricating oils that exhibit low-friction
Establishment of the foundation for analysing nano-tribology

(3) Development of Tribo-Simulator for Analyzing Chemical Reactions on the Interface under Friction



Electric- and Atomic-Level Simulations for clarifying Tribo-Chemical Reactions

Establishment of design principals of tribo-materials/interface by Tribo-Simulator

This project aims to elucidate phenomena of friction on oil, water and solid lubrication using nano-technology and science through collaboration of mechanical and material researchers with industrial engineers. They intend to develop ultra-low friction technology based on their studies.

Collaborating Companies:

AKROS Co., Ltd, ASAHI KASEI CORPORATION, Kao Corporation, KYODO YUSHI CO., LTD, DENSO CORPORATION, TOYOTA MOTOR CORPORATION, TOYOTA MOTOR EAST JAPAN, INC, Hitachi, Ltd.

Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

Development of Non-destructive Evaluation Technology and Functional Friction Materials for Safety/Relief and Energy Saving

Institute of Fluid Science, Tohoku University
Takagi / Uchimoto / Miki Laboratory

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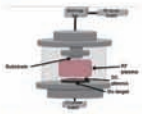
Development of functional thin film containing nanocluster metals

Development of technique of mixing nanocluster metals

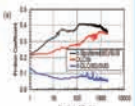
To develop the apparatus for fabricating materials utilizing plasma process

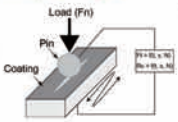


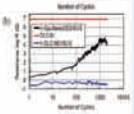
Conceptual diagram of fabricating film

Development of electro-conductive friction element

The technique, which makes contact to the object which moves without preventing a motion, is one of the required technique for a motor, a switch, etc.



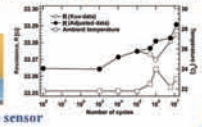




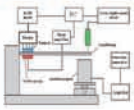
Conceptual diagram of contact monitoring

Development of thin film fatigue sensor

To use constructs of airplanes and bridges in safety, to understand the fatigue condition of the materials is important. Our lab develops novel fatigue sensor using hard carbon films.



Developed fatigue sensor

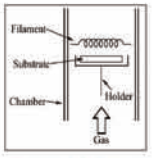


Conceptual diagram of fatigue testing

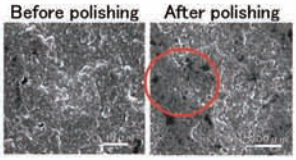
Development of low friction / low wear diamond coating

Fabrication of "polishable" diamond film

Fabrication of diamond film by utilizing hot filament chemical vapor deposition method



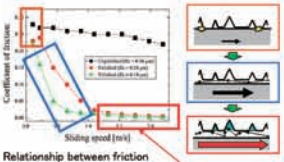
Rubbing both films



Polished diamond film has partially flat surface.

Materials: hydrocarbon gas, hydrogen gas

Friction velocity dependence



Relationship between friction coefficient and velocity

Super low friction !

Perspectives

We succeed in fabricating diamond film on some parts of cylindrical surface, targeting linear motion bearing. We try to fabricate diamond film on the complex surface.

Linear motion bearing prototype

Laboratory Challenges

Safety and relief by diagnosis

Energy saving by low frictional lubrication

Research activities of non-destructive evaluation

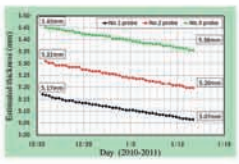
Non-destructive evaluation of casting iron

Evaluate various structure of cast irons by non-destructive testing methods such as eddy current testing, nonlinear eddy current testing, potential drop method.

1. Hardness (ferrite/perlite ratio)
2. Graphite structure
3. Structure of chill

Monitoring of pipe wall thinning under high temperature condition by electromagnetic acoustic resonance

Probe installed on pipes



- Possible to evaluate thickness under high temperature condition at 165°C
- Error of measurement of thickness is the order of 10 μm

Equipment of our lab

Analysis & Evaluation

- SEM/EDS
- XRD
- DSC
- Vibrating sample magnetmeter
- Hardness tester (Brinell, Vickers)
- Fatigue tester / tensile tester
- AFM/MFM
- Nanoindenter

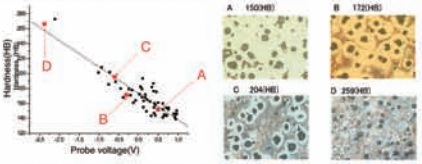
Material process

- Fabrication apparatus for diamond
- Fabrication apparatus for diamond-like-carbon
- Electrical furnace

Non-destructive evaluation

- Ultrasound flaw detection
- Electromagnetic non-destructive evaluation apparatus

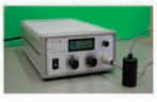
Evaluation of hardness of ductile cast irons by eddy current testing



Possible to evaluate hardness in nondestructive way

Eddy current hardness tester

Possible to measure Brinell hardness and Vickers hardness of cast irons by putting a probe on specimens.



IFG Institute of Field Generation

To corporations

Our lab researches low friction solid lubricant system and multi-functional sensor by using carbon-based thin film, targeting clarification of mechanism and application.

We also researches cracking in metallic materials and evaluation of structure. If you would like us to evaluate, please contact our lab.

Contact address:

Tel: +81-22-217-5298 (weekdays: 10:00 ~ 18:00)
Fax: +81-22-217-5298
Email: web-asel@wert.ifs.tohoku.ac.jp

Manufacturing industry based on science and technology to establish a safe and secure society

Shoji Project
New Industry Creation Hatchery Center, Tohoku University

MEXT | TOHOKU ECONOMIC FEDERATION | Tohoku University | 宮城県 | 七十七銀行 | ICR

Local strain measurement and fatigue strength evaluation by means of copper plating and EBSD method

Copper plating method:
utilizes recrystallization behavior in the copper thin film on the fatigue damaged surface depending on its cumulative strain amplitude

Electron backscatter diffraction method:
can obtain information about crystalline orientation and lattice direction in microscopically in the electron microscope

Crack path
(surface after removable of copper plate)

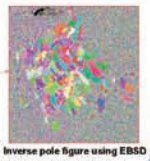
Crack path
(surface after removable of copper plate)

Crack path after fatigue test and strain measurement using copper plate

In addition to local strain, macro&micro
- metal structure
- hardness distribution

are evaluated so that preferential crack path and degree of degradation are evaluated

Analysis region on copperplate



Inverse pole figure using EBSD

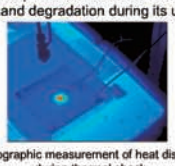
Estimation of strain amplitude and its distribution

Estimation of stress amplitude in nugget is possible during cumulative fatigue damage

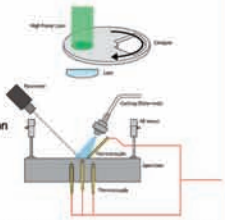
Development and evaluation of reproducing test for thermal fatigue cracking of metallic mold

・Improvement of production efficiency by preventing of accidental breakage & evaluation of residual life
・Illustration of degradation process by elucidation of surface/interface reaction and transport process

Aiming to propose methodologies for prevention of degradation in actual production site, clarification of influencing factors is carried out with proposed reproduction test.
We investigate microstructural change and surface film formation behavior by heat treatment in manufacture process. Evaluation of the relationship between those results and quality of product and degradation during its use is carried out



Thermographic measurement of heat distribution during thermal shock



Schematic diagram of thermal shock fatigue testing machine
(Local heating and cooling by laser beam and water splay)

Laboratory reproduction of thermal fatigue cracks on metal mold

Promotion of manufacturing industry supported by most advanced science and technologies

Early recovery support of Tohoku region with next generation automobile industry as core industry

"Promotion of shear of advanced facilities project" supported by MEXT
Platform of safety and security (region federated)
Iwate Univ., Fukushima Univ.

Establishment of a safe and secure society
Next generation automobile manufacturing industry supported by science and technology

cooperation

Shared use the state-of-the-art facilities for problem-solving

Illusidation of surface-interface phenomena
Aging degradation and damage during manufacturing process

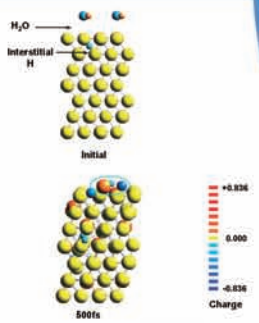
Casting・molding technology, ultra high precision machining technology

Human resource development
Small-group professional education for Mid-level member of society

Innovations for Next Generation Automobiles

International center of excellence in aging degradation research

Expert group



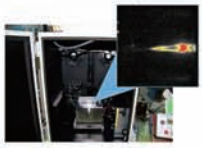
Dissociation of water and subsequent penetration of negative charged hydrogen atom into Fe-Cr binary alloy

Accelerated dissolution of iron by water dissociation and hydrogen atom penetration at iron oxide and water interface

・Evaluation of dissociation of water and hydrogen formation & penetration process by means of quantum molecular dynamics (QCMD) simulation

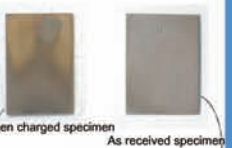
・Illustration of contribution process of hydrogen by in-situ measurement & evaluation of oxidation process

Degradation of structural material exposed to severe environments, especially for high temperature water is investigated through
- international cooperative researches
- development of instrumentation and measurement system for operating plant
- development of advanced analysis technique

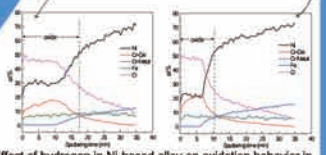


Evaluation of radical distribution by emitting light measurement with radical former using ultrasonic vibration

Build up behavior of hydrogen on metal surface



Hydrogen charged specimen
As received specimen



Effect of hydrogen in Ni-based alloy on oxidation behavior in high temperature water

Evaluation of oxidation behavior for different penetration paths of hydrogen

・Combination of surface analysis and tests in environment using specially designed fixture promotes evaluation of accelerated oxidation behavior
・Investigation of synergetic effect of of hydrogen with vacancy, dislocation, grain boundary and segregation

Unique behavior of hydrogen in metal and accelerated oxidation of the metal

Approaches

・Establishing technologies supported by fundamental science which could be a **basis of safe and secure** in various components, structures and society's infrastructure.

・Developing **Casting・molding technology, ultra high precision machining technology** and **surface integrity assessment** for safe and secure in manufacturing process.

・**Promoting of manufacturing industry and early recovery support of Tohoku region with next generation automobile industry as core industry**, that supported by most advanced science and technologies.

文部科学省地域イノベーション戦略支援プログラム　次世代自動車宮城県エリア

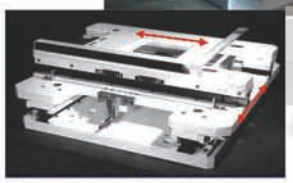
Creation of Advanced Mechanical Systems by Control of Nanointerface

Laboratory of Nanointerface Engineering, Department of Nanomechanics,
Graduate School of Engineering, Tohoku University, Japan
Adachi-Takeno Lab.

MEXT　TOHOKU ECONOMIC FEDERATION　Tohoku University　宮城県　七十七銀行　ICR

Creation of surface and interface for high friction and anti-wear
~ R&D of highly functionalized friction-driving actuators ~

Friction-drive ultrasonic motors or surface acoustic motors make it possible to achieve highly accurate positioning than ever.



We realized positioning system that increase accuracy 3 times than before and make the electron beam lithography device half in size by controling the wear at the driving point.

Creation of surface and interface for low friction
~ R&D of eco mechanical systems ~

Water or nitrogen gas make it possible to realize mechanical systems without oil.

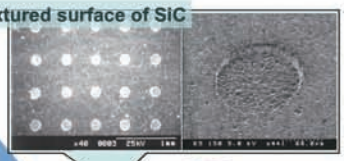
Water is lubricant in next generation

Multiple texturing on SiC surfaces allows us to realize very low friction of μ=0.0002 under 20 MPa contact pressure.

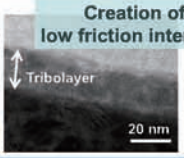
Inert gas is lubricant in next generation

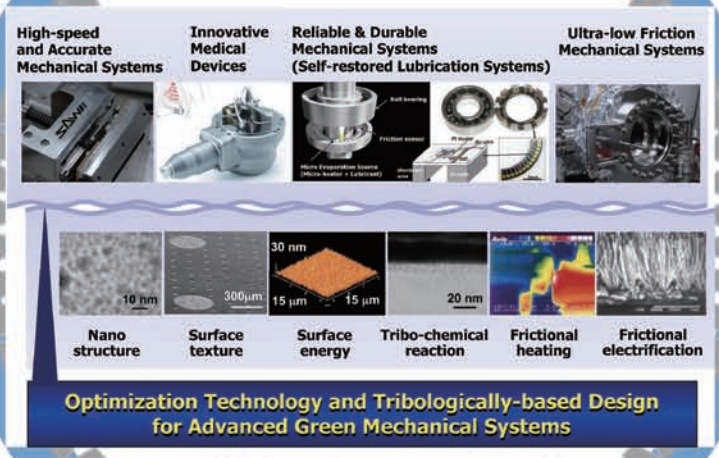
Hard thin coating can achieve friction of μ=0.004 under dry friction condition by the control of ambient.

Textured surface of SiC



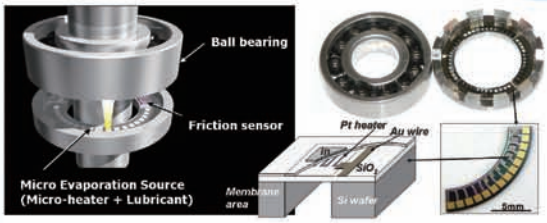
Creation of low friction interface





X-ray CT scan system

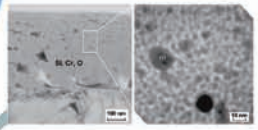
In-situ restoration system of solid lubricant can allow us to achieve semi-parmanent life-time of mechanical systems.



Self-controlling system for restoration of solid lubricant coating allows us to achieve high degree of silence that cannot be achieved before.

Creation of surface & interface for guarantee of low friction vibration for long time
~ R&D of silent medical mechanical systems ~

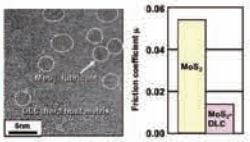
Nanointerface for low friction



Bottom-up approach

Nanocomposite coating mimicking Low friction nanointerface

Bottom-up type approach from nano-interface layer for low friction technology



Development of nanointerface optimizing technology for creation of low friction nanointerface.

- **Material design & creation**
  Control of nanostructure
- **Surface design & creation**
  Surface texturing and surface free energy
- **Design of contact condition & creation**
  Control of running-in and friction charge

Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

New Solid-State Joining Processes for Automotive Industry

Hiroyuki Kokawa, Yutaka S. Sato, Hiromichi T. Fujii
Department of Materials Processing, Graduate School of Engineering, Tohoku University, 6-6-02 Aramaki-aza-Aoba, Aoba-ku, Sendai 980-8579, Japan

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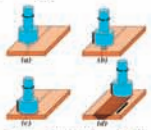
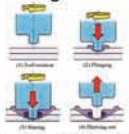
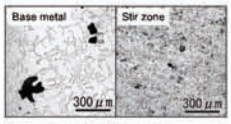
Fundamental study on FSW and FSSW

Friction stir welding (FSW)
Seam joining by solid state stirring of inconsumable rotating tool
Friction stir spot welding (FSSW)
Spot joining that utilizes friction stir welding


Friction Stir Welding (FSW)


Friction Stir Spot Welding (FSSW)

Research topics
- Joining mechanism
- Relationship between joint property and microstructure
- Microstructural evolution and control
- Dissimilar welding for iron and titanium

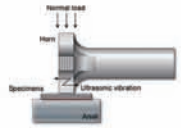


Application of FSW into cast alloys
Elimination of cast defects
Homogenization of microstructure
Enhancement of toughness and fatigue strength

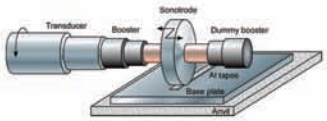
Al/Fe dissimilar FSSW
Multi-material structure

Fundamental study on USW and UAM

Ultrasonic welding (USW)
Solid state joining technique using ultrasonic energy
Ultrasonic additive manufacturing (UAM)
Additive manufacturing that utilizes ultrasonic seam welding

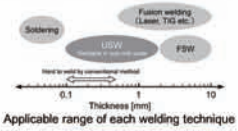


Ultrasonic Welding (USW)

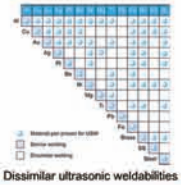


Ultrasonic Additive Manufacturing (UAM)

Research topics
- Similar and dissimilar ultrasonic welding
- Property evaluation and microstructural analysis
- Joining mechanism
- Development of UAM technique



Applicable range of each welding technique

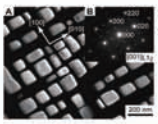

Dissimilar ultrasonic weldabilities

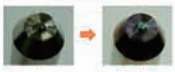
Novel joining technology and joining mechanism

Development of sound joint by novel joining technologies in poorly weldable materials and understanding of joining mechanism and phenomena

- Multi-material design of industrial components
- Energy saving and environmental load reduction


High stiffness FSW machine in Tohoku Univ.


Novel Co-based alloy FSW tool developed in Tohoku Univ.

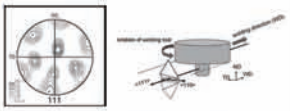

No damage after FSW
✓ Al alloy like surface quality
✓ Excellent joint properties

FSW in dual phase range
✓ 1.8 times as strong as base metal
✓ Higher ductility than base metal

✓ Defect free joint
✓ Fractured at base metal in tensile test

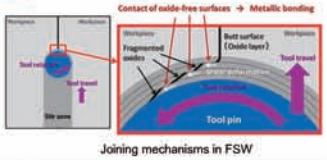
High grade joining of steels and Ti alloys


Analysis of oxide layer behavior during FSW by electron microscopy

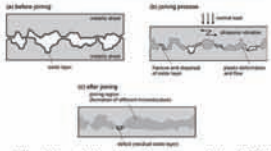

Understanding of materials flow during FSW by crystallographic analysis

Forefront microstructural analysis

Joining mechanism and phenomena



Joining mechanisms in FSW


Physical and chemical phenomena during USW

Challenges in solid state joining

~ Would you try the leading-edge joining technologies using FSW and USW? ~

Kokawa lab. is one of the handful research institutes where FSW is possible in steels and Ti alloys. USW has also been studied intensively in recent years. Feel free to ask questions!!

Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

Advanced Manufacturing Technology Utilized Nano-Precision Machining

Nano-Precision Mechanical Fabrication Laboratory,
Dept. of Mech. Systems and Design, Grad. Sch. of Eng., Tohoku Univ.

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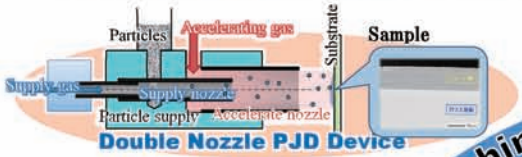
Energy storage!!
Powder Jet Deposition (PJD) for Creation of Secondary Batteries for Automobiles

Silicon negative electrodes — *Compared to Carbon*
- ✓5 times larger storage
- ✓High-temperature resistance

Vacuum-free/Room-temperature process — High deposition rate

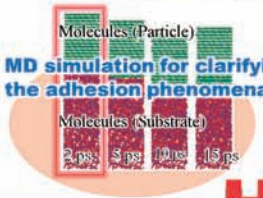
Advantages of Powder Jet Deposition (PJD)

Widely applicable technique to various materials



Double Nozzle PJD Device

SPH Simulation for clarifying the phenomena during collision



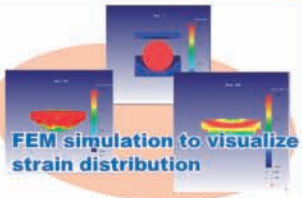
MD simulation for clarifying the adhesion phenomena

Safety and security!!
High-speed High-quality Aspherical Glass Lens Molding

Objective of usage of glass lenses
- ✓For using under severe conditions
- ✓Long-term usage
- ✓Miniaturizing of mount space

To realize Safe and Secure Next generation automobiles

Development of Aspherical Glass Mold Press Equipment



FEM simulation to visualize strain distribution

Profile analysis for nonisothermal molding press

Aspherical Molding Die Fabricated by Precision Grinding

Glass mold press Laser machining Nano precision cutting Ultrasonic machining Powder jet machining
"Safety, Security, Comfort and Energy-saving" Elements for Next Generation Automobiles

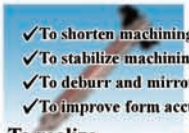
Devices Installed in Next Generation Automobiles

High Value Manufacturing

Form + Function

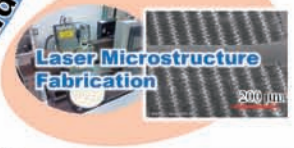
Functional surface

To realise:
- ✓Dirtproof, antireflective front window
- ✓Non-slip tires



- ✓To shorten machining time
- ✓To stabilize machining precision
- ✓To deburr and mirror-finish
- ✓To improve form accuracy

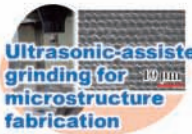
To realize
- ✓Omission of finishing
- ✓Super-high-pressure fuel injector



Laser Microstructure Fabrication

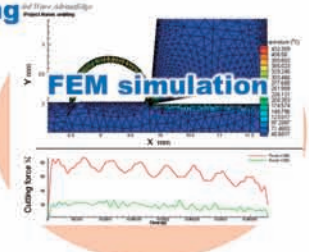
Ultrasonic Electrolytic grinding

Ultrahigh Precision Cutting for Fabrication of microgrooves



Ultrasonic-assisted grinding for microstructure fabrication

World first
3-dimensional ultrasonic-assisted machining



Energy saving!!
Ultrasonic Hybrid Machining for Manufacturing of Ultrahigh Pressure Fuel Jet Injector

Comfortable life!!
Creation of functional surfaces by various precision machining methods

For realizing "hopeful" advanced machining technology...

Our laboratory has been conducting researches to establish new machining principles and their scientific clarification, and to realize practical use on the basis of industry-academic-government circles.

Professor Tsunemoto KURIYAGAWA
TEL: +81-22-795-6949, FAX: +81-22-795-7027
Email: tkuri@m.tohoku.ac.jp

LAB

Development of Innovative Casting Technology

Graduate School of Engineering
Department of Metallurgy, ANZAI Lab.

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Microstructural Control of Ni Alloys

Ni alloys: excellent high-temperature strength, corrosion resistance

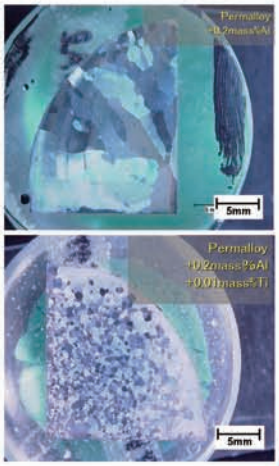
Center segregation in columnar structure

⇩ Decreasing of properties

Fine equiaxed structure is needed

⇩

Realization by elemental addition



Numerical Analysis of Macro Segregation

Background

◆Production method of special alloy

Ingot making: difficult to control quality

Macro-Segregation ⇒ Channel segregation

For optimization of operating condition

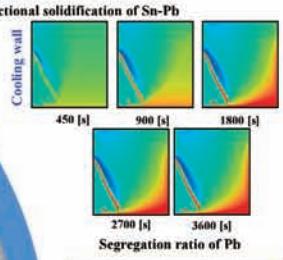
- With Computer Aided Optimization (CAO)
- Reproduction of segregation in ingot of Lab.

Purpose

Development of method of macro segregation simulation
Study for formation mechanism of channel segregation

Numerical result

Directional solidification of Sn-Pb



Segregation ratio of Pb

Reproduction of channel segregation

Anzai Laboratory

Development of Innovative Casting Technology for Making High Quality Automobile Parts

Research Topics
- Development of Casting Process Simulation
- Semi-Solid Casting
- Fluidity of Metals
- Casting Simulation using Particle Method

Members
- Professor : Koichi Anzai
- Associate Professor : Masayuki Itamura
- Assistant Professor : Naoya Hirata
- Secretary : Mai Sato
- DC Students : 3
- MC Students : 7
- BC Students : 6
- Others : 3

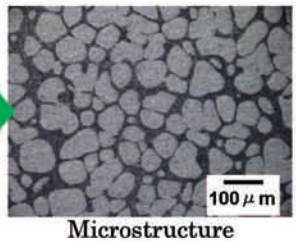
Semi-Solid Slurry Making Method

Rheocasting
- Reduction of air entrapment, shrinkage
- Excellent mechanical property
- Long life of die

Cup method
- Able to make slurry easily

Metallic vessel

AC4CH slurry



Microstructure

Casting Simulation using Particle Method

Result of interaction analysis of heat transfer and shrinkage using particle method

Particle method
- Movable computational element
- Interaction analysis: easy

⇔ ***Conventional method***
- High calculation speed
- Fixed computational grid
  → Low flexibility of shape
- Interaction analysis: difficult

Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

Effect of Build Angle on Tensile Property of Inconel 718 Fabricated by Electron Beam Melting (EBM) Process

Shi-Hai Sun, Yuichiro Koizumi, Tsuyoshi Saito, Yun-Ping Li, and Akihiko Chiba
Institute for Materials Research, Tohoku University

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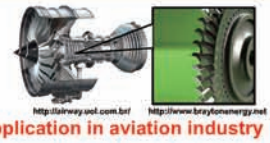
Introduction



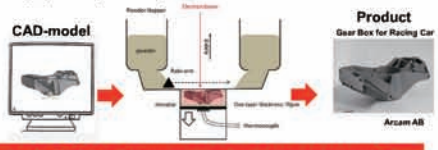
- **Inconel 718 Ni-based Superalloy**

Advantage: • High mechanical strength • High corrosion resistance → application in aviation industry

Disadvantage: • Low machinability • Low castability → Low productivity (diffcult to apply to automobile)

- **Electron Beam Melting (EBM) : 3D-printer for metals**

Metal parts with any shape can be produced by only CAD model & Metal powder without using mold.



Is the of the EBM-built IN718 alloy parts strong enough?

Objective To investigate the microstructures and high temperature tensile properties of Inconel 718 rods fabricated by EBM in various directions.

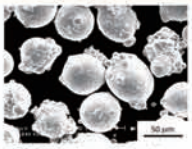
Experimental

Raw material (Gas atomized powder)

Chemical composition of Inconel 718 powder (mass %)

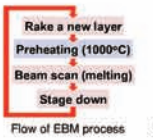
Ni	Cr	Mo	Nb	Ti	Co	Al	C	N	Fe
53.5	19.4	2.97	4.88	0.84	0.10	0.48	0.036	0.0077	Bal.

Particle size : 45~150 μm (74 μm ave.)


SEM image of powder particles.

EBM process

- Equipment : Arcam EBM A_2X
- Preheating temp. : 1000˚C
- Layer thickness : 70 μm
- Scan way : x-y scanning
- Scan speed : ~ 600 mm /s



Flow of EBM process


Scanning direction


Preheating

Heat treatment

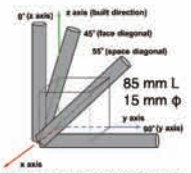
Solution treatment at 980˚C for 1 h → Water quench (WQ)
→ 1st aging at 720˚C for 8h → 2nd Aging at 620˚C for 8h → WQ

Tensile test

Temperature : 650˚C Strain rate : 1.5×10^{-4} s^{-1}

Microstructure analysis

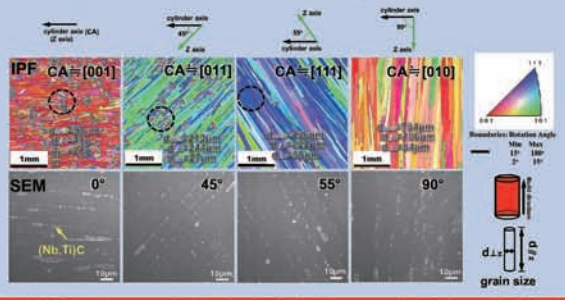
SEM-EBSD, EPMA



Schematics of of rods fabricated.

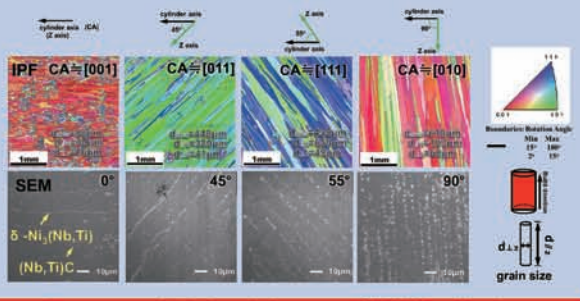
Results & Discussion

Microstructure of as-EBM-built samples



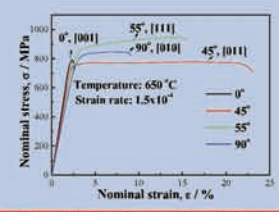
As-EBM-built rods are strongly cube-oriented in both the beam scanning direction and build-diretiaon.

Microstructure after heat treatment



The textures were maintained even after heat treatment. δ-Ni_3(Nb,Ti) precipitated.

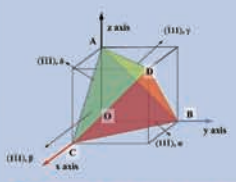
Effect of build-direction on tensile property



Comparison of strenghth and eleongation.

Sample	0.2% YS (MPa)	UTS (MPa)	Elongation %
0°	790	799	0.53
45°	756	783	20.8
55°	840	947	12.8
90°	787	852	6.4
HIP[3]	1018	1140	3
Wrought[3]	860-1000	1000-1200	12-19

The rod EBM-built in space diagonal direction (55˚ sample) is as strong as the wrought conterpart.

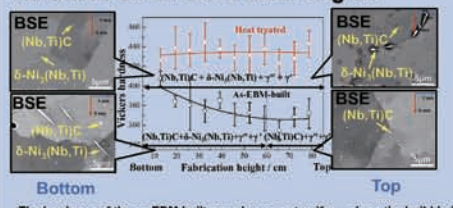


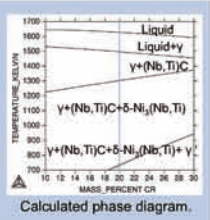
Schmid factor μ of perfect dislocation in {111}<110> slip system.

	0˚-sample	45˚-sample	55˚-sample	90˚-sample
Maximum μ in α	0.408	0	0.272	0.408
Maximum μ in β	0.408	0	0.272	0.408
Maximum μ in γ	0.408	0.408	0.272	0.408
Maximum μ in δ	0.408	0.408	0	0.408
Maximum μ in all the variants	0.408	0.408	0.272	0.408

The build-direction dependence of strenghth can be attributed to the crystal orientation dependence.

Hardness on different build heights



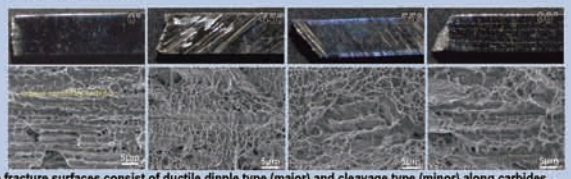


Calculated phase diagram.

The hardness of the as-EBM-built sample was not uniform along the build-height.

Uniform and higher hardness can be obtained by aing heat treatment to form δ-Ni_3(Nb,Ti) intermetallics.

Fracture surface



The fracture surfaces consist of ductile dinple type (major) and cleavage type (minor) along carbides.

The strenghth can be further improved by controlling carbon content to avoid fracture along carbides.

Conclusions

- The cylinder axes were oriented near [001], [011], [111] and [100] directions in samples whose cylindrical axes were deviated from z axis by 0˚, 45˚, 55˚, and 90˚, respectively.
- Carbides were aligned along the built-direction. Plate-like δ- Ni_3(Nb,Ti) precipitates were formed in the bottom part of the as-EBM-built samples owing to the long holding time.
- The hardness became uniform along the built height after heat treatment and was higher than that of as-EBM-built one.
- The 55²sample exhibited the highest UTS among the samples built in different orientations.
- Crack propagates along grain boundaries owing to stress concentration caused by precipitates on the grain boundaries.
- The built condition for 0²sample was not appropriate, and the unmelt particle lead to the low ductility.

Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

Suppression of Crack Initiation of Metallic Materials by Using a Cavitating Jet in Air

Hitoshi Soyama and Osamu Takakuwa, Tohoku University

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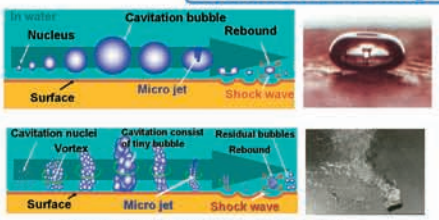
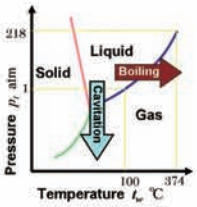
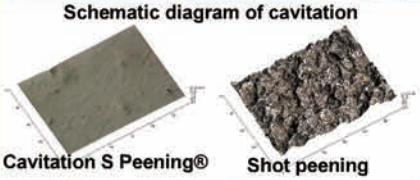
Cavitation S Peening®

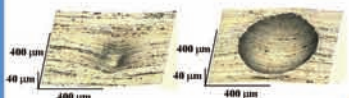


Schematic diagram of cavitation

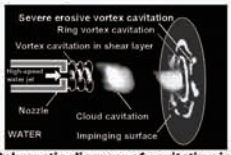




Cavitation S Peening® | Shot peening

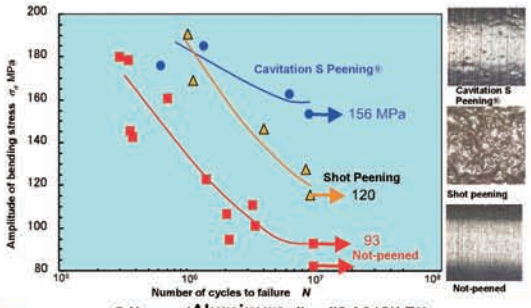


Cavitation S Peening® | Ball indentation



Schematic diagram of cavitating jet

Improvement of Fatigue Strength of Metallic Materials

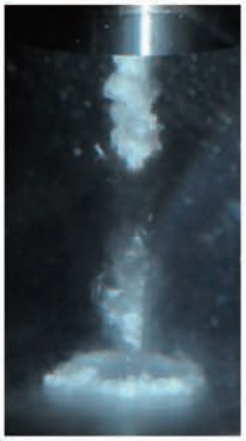


S-N curve (Aluminum alloy JIS AC4CH-T6)

Improvement of fatigue strength of gear demonstrated using a power circulating type gear tester (Carburized SCM420H)

Surface modification by using cavitation impact

Cavitation S Peening®



Cavitating jet in water

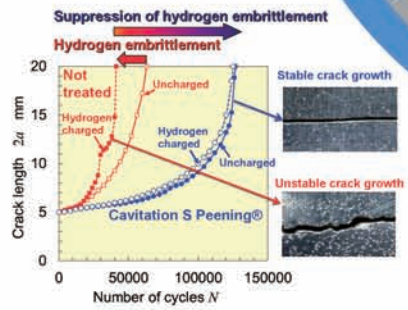
Cavitating jet in air

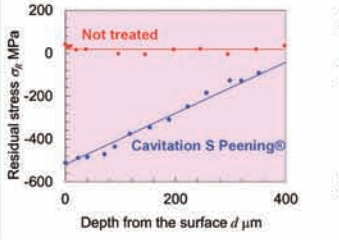
Suppression of Hydrogen Embrittlement

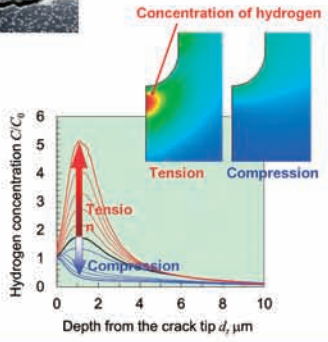
Introduction of compressive residual stress

⇒Suppression of hydrogen adoption

⇒Suppression of hydrogen embrittlement

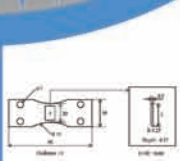




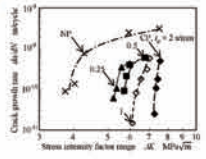


Evaluation of Materials Properties

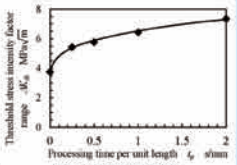
Load controlled plate bending fatigue test machine developed by Soyama Lab.



Geometry of specimen with notch



Relation between ΔK and da/dN in decremental step load test



Increase of ΔK_{th} by Cavitation S Peening®

Conclusions

In order to make clear the mechanism of improvement of fatigue strength by cavitation peening, the effect of cavitation peening on crack initiation and the threshold stress intensity factor range were evaluated. It was concluded that the cavitation peening reduced crack propagation but also suppressed the crack initiation.

H.Soyama et al., Use of Cavitating Jet for Introducing Compressive Residual Stress, *Journal of Manufacturing Science and Engineering, Trans.ASME*, Vol.122, 2000, pp.83-89.
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O.Takakuwa and H.Soyama, Suppression of Hydrogen-Assisted Fatigue Crack Growth in Austenitic Stainless Steel by Cavitation Peening, *International Journal of Hydrogen Energy*, Vol. 37, No. 6, 2012, pp. 5268-5276.
H.Soyama, Effect of Nozzle Geometry on a Standard Cavitation Erosion Test Using a Cavitating Jet, *Wear*, Vol. 297, 2013, pp.895-902.

Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

Ultra Low Power Consumption Display for Next Generation Automotives: Spatially Imaged Iris-plane Head Up Display

(Uchida Lab. New Industry Creation Hatchery center Tohoku Univ.)

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1, Introduction

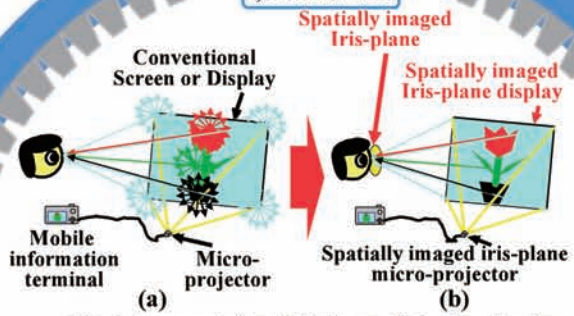


Fig. 1 A concept of spatially imaged iris-plane display
(a) a conventional display (b) a spatially imaged iris-plane display

A conventional display diffuses optical rays from screen or surface of display to free space shown as Fig. 1 (a). But only rays which pass through the pupil of which diameter is 2~8mm of human's eyes are used. The most part of rays are not used. Namely the most energy of displays goes to waste. We omitted this wasted energy and newly developed ultra low power consumption display.
A novel concept of this display is that display gathers rays of displayed images near eyes of observer in spatial and angular luminance uniformity shown in Fig. 1 (b). We call this area to which rays gather spatially imaged iris-plane. Only in this area observer can observe displayed image. Therefore the most part of rays are used and ultra high efficiency is achieved.

On the other hand observation area is limited. This trade-off is a dilemma of high efficiency and wide observation area. To solve this dilemma we introduce eye-tracking system. An eye-tracking system detects the position of observer's eyes. According to this detected position of observer' eyes a display changes the direction of rays and shifts spatially imaged iris-plane to the position of observer. When an observer moves a spatially imaged iris-plane tracks observer's eyes. By this method a dilemma of high efficiency and wide observation area is solved.

2, Principle, method, and structure

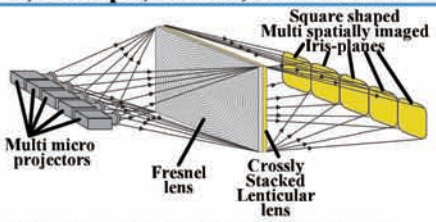


Fig. 2 Multi-view display using multi spatially imaged iris-plane technology

Spatially imaged iris-plane display is based on the technology of multi-view display. We have researched on multi-view displays [1]-[3]. Fig. 2 shows a structure of our multi-view display using multi spatially imaged iris-plane technology. By this technology the square shaped multi spatially imaged iris-planes are formed side by side in space. There is no overlap and no gap between the adjacent iris-planes. An eye-tracking system detects the position of observer's eyes and selects iris-plane in which observer's eyes exist by selecting multi projectors. Therefore ultra low power consumption display with wide observation area is achieved.

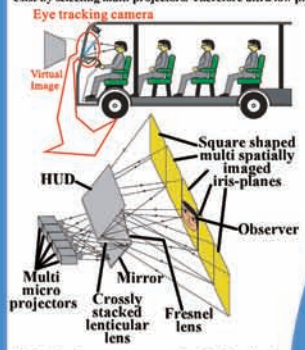
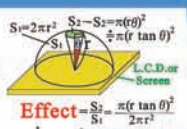


Fig. 3 Ultra low power consumption head up display by multi spatially imaged iris-planes and eye-tracking system

$S_1=2\pi r^2$ $S_2-S_2=\pi(r\theta)^2$ $\frac{1}{2}\pi(r\tan\theta)^2$



$$\text{Effect}=\frac{S_2}{S_1}=\frac{\pi(r\tan\theta)^2}{2\pi r^2}=\frac{1}{2}(\tan\theta)^2=1/10\sim1/100$$

Fig. 4 Effect of low-power -consumption

Effect of low power consumption is $(\tan^2\theta)/2$ shown in Fig. 4, where θ is limited diffusion angle. This is a ratio of solid angles. S1 means a solid angle of all directional uniform diffusion in case of a conventional display or screen. On the other hand S2 means a solid angle of limited uniform diffusion in case of spatially imaged iris-plane display. Therefore S2/S1 means effect of low power consumption. Our target is 1/10~1/100. Moreover for good see-through HUD our display uses normal glass plate of which a reflective coefficient is 4%. And so in order to realize low power consumption of 1/10 on condition of 4% at a reflective coefficient effect must be needed $(1/10)\times(1/25)=1/250$. On this condition we set diffusion angle 5.1 degrees because of $(\tan^2\theta)/2=1/250$.

3, Experiment

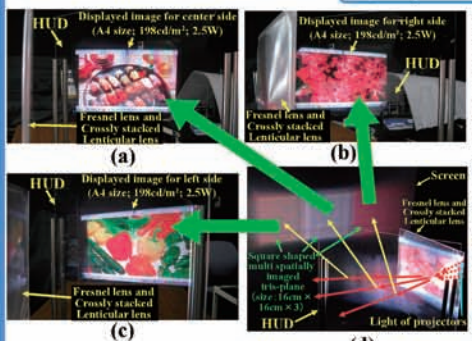


Fig. 5 An experiment and results of ultra low power consumption multi-view HUD
(a) Center side, (b) Right side, (c) Left side, (d) Multi-view HUD

Fig. 5(d) shows an experimental set-up of three-view HUD as shown in Fig. 3. In spatially imaged iris-plane an observation screen is set as shown in the upper side of Fig. 5(d). On this screen three square shaped spatially imaged iris-planes are successfully imaged side by side with no cross-talk and no gap. This is the ideal condition of eye-tracking system. Fig. 5(a), (b) and (c) show observation results of displayed images from within corresponding three spatially imaged iris-planes. It is confirmed that no cross-talk and instantaneous switching of displayed image at boundary between iris-planes. Displayed image size is A4 and luminance is 198cd/m2. Power consumption of a normal A4 size liquid crystal display is 40W. Compared with this the power consumption of our display is 2.5W. Namely ultra low power consumption of 1/16 is successfully achieved. In case of direct view shown in Fig. 2 ultra low power consumption of 1/400 is successfully achieved.

4, Ultra Low Power consumption HUD on EV bus

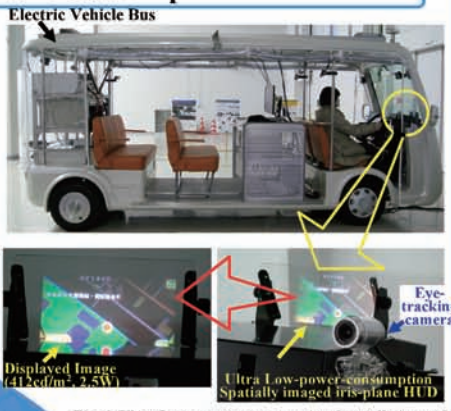


Fig. 6 Ultra Low-power-consumption Spatially imaged iris-plane HUD mounted on Electric Vehicle Bus and Displayed image

Fig. 6 and 7 show our HUD and an eye-tracking system mounted on EV-Bus. This HUD is 5-view HUD shown in Fig. 3 and range of each view is ±5 degrees. Namely total range is ±25 degrees. For practical use this range is enough. Luminance is 412cd/m2 and power consumption is 2.5W. Ultra low power consumption of 1/16 compared with a normal liquid crystal display is successfully achieved. An eye-tracking system detects the position of observer's eyes at processing speed of 50 frames per second and selects projectors to move spatially imaged iris-plane. Therefore smoothly eye-tracking by spatially imaged iris-plane is successfully achieved as shown in Fig. 7.

5, Eye-tracking system

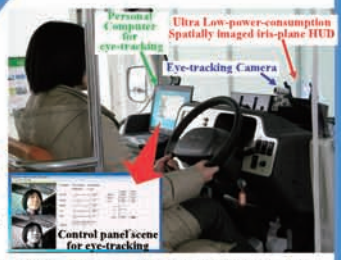


Fig. 7 Ultra Low-power-consumption Spatially imaged iris-plane HUD and Eye-tracking system mounted on Electric Vehicle Bus

6, Conclusions

Low power consumption is more and more important for next generation motives. For this purpose we proposed and developed a spatially imaged iris-plane HUD. By this novel HUD ultra low power consumption of 1/16 compared with a normal liquid crystal display is successfully achieved. Moreover by direct view type ultra low power consumption of 1/400 is successfully achieved. We believe that this display will strongly contribute to realization of ultra low power consumption HUD for next generation automotives.

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References
[1] T. Kawakami, B. Katagiri, T. Ishinabe, T. Uchida "High-Resolution Multi-View Projection Display With a Quantized-Diffusion-Angle Screen" Journal of Display Technology , Vol.8, No.9, p.496-504, September 2012
[2] T. Kawakami, B. Katagiri, T. Ishinabe, T. Uchida, "Multiple Directional Viewing Projection Display Based on the Incident-Angle-Independent, Diffusion-Angle-Quantizing Technology" IEEE IAS annual meeting 2011, 2011-ILDC-382 (2011)
[3] Takahiro Ishinabe, Tohru Kawakami, Noriyuki Takahashi, Tatsuo Uchida "High-resolution autostereoscopic 3-D projection display with a space-dividing iris-plane shutter" Journal of the Society for Information Display 18/8, 2010 ,pp583-588.


Tatsuo Uchida
Guest Professor


Yoshito Suzuki
Specially missioned Professor


Tohru Kawakami
Guest Associate Professor


Mutsumi Sasai
Industrially, Academically and Governmentally Associated Researcher

Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

Image Sensing Technology Breaking the Limit of Pixel Resolution

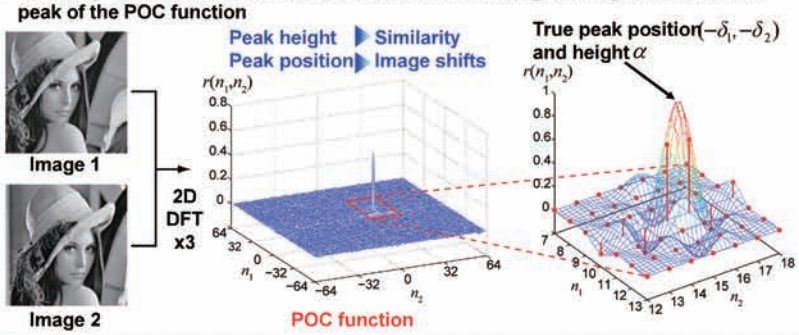
Graduate School of Information Sciences, Tohoku University, Japan
Prof. Takafumi Aoki, Assoc. Prof. Naofumi Homma and Assis. Prof. Koichi Ito

MEXT TOHOKU ECONOMIC FEDERATION Tohoku University 宮城県 七十七銀行 ICR

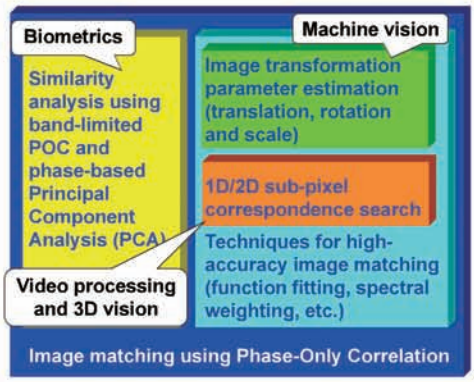
We present fundamentals of Phase-Only Correlation (POC) --- a technique for high-accuracy registration of 1D, 2D and 3D signals using phase information of discrete Fourier transform. Since 1990s, our research group has developed a novel technique of phase-based image matching for fingerprint verification and industrial machine vision. We have recently proposed an efficient image correspondence algorithm using POC, which can find pairs of corresponding points between the given two images with sub-pixel accuracy. This allows us to apply the POC technique to a wide range of applications, including smart image sensors, microscope image analysis, passive 3D vision, automotive image processing, image-based human interface, biometrics authentication, and medical image analysis.

Phase-Only Correlation (POC)

- A high-accuracy image matching technique using the phase components in 2D Discrete Fourier Transforms (DFTs) of given images
- Similarity and displacement estimation between two images using the correlation peak of the POC function



High-Accuracy Image Matching Technology




3D reconstruction from multi-view images

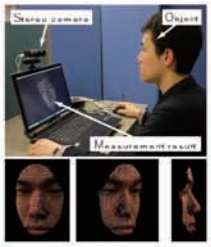

Projector-camera system

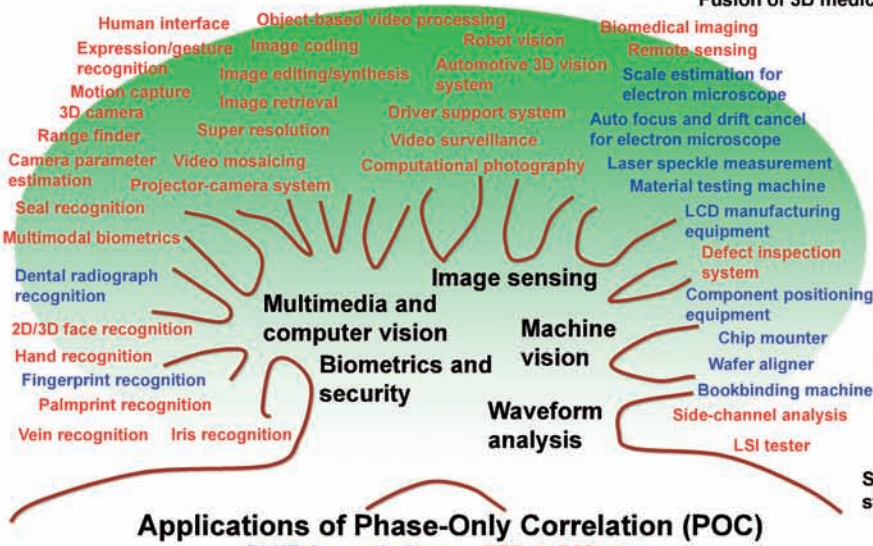

Automotive 3D vision for driver assistance


Fusion of 3D medical data and 2D face image


3D human capture


Universal image recognition sensor


Real-time 3D measurement system




Side-channel attack standard evaluation boards

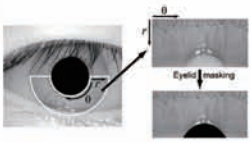
Applications of Phase-Only Correlation (POC)

BLUE: in practical use RED: in R&D stage

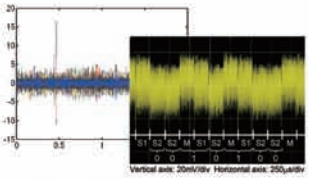

2D/3D face verification system

Dental radiograph recognition


Palmprint verification for mobile phones



Iris recognition


Waveform analysis against cryptographic circuits

Aoki Laboratory,
Graduate School of Information Sciences, Tohoku University, Japan
Web: http://www.aoki.ecei.tohoku.ac.jp/

Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

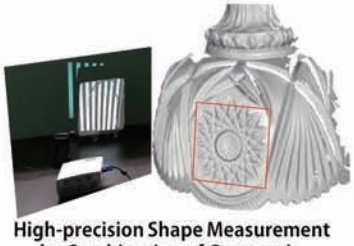
Future Created by Computer Vision

Okatani Lab.
Graduate School of Information Sciences, Tohoku University

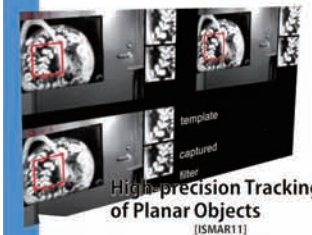
MEXT TOHOKU ECONOMIC FEDERATION Tohoku University 宮城県 七十七銀行 ICR

Basic Research

Optimization of Markov Random Fields [CVPR12, CVPR13]



High-precision Shape Measurement by Combination of Geometric and Photometric methods [CVPR12]

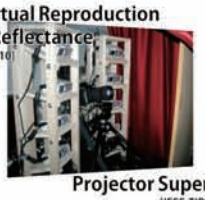


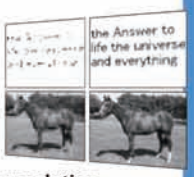
High-precision Tracking of Planar Objects [ISMAR11]

Mechanism of "Miniature Scene Photographs" [CVPR07]

Applications

Projector-based Virtual Reproduction of Surface Reflectance [CVA10]





Projector Super-resolution [IEEE-TIP09]

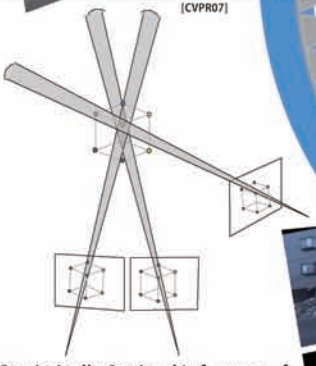
Easy Calibration of Multi-projector Displays [IJCV09]

Image Compensation of Hand-held Projectors [ACCV10]

"Gaze-reactive" Displays

Future World Shaped By Computer Vision

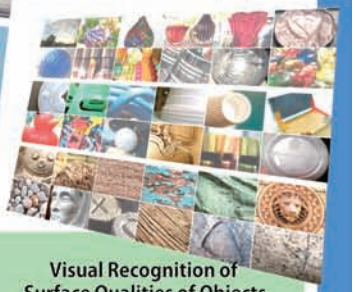
Statistical Mathematics and Numerical Computation + Physics-based Vision



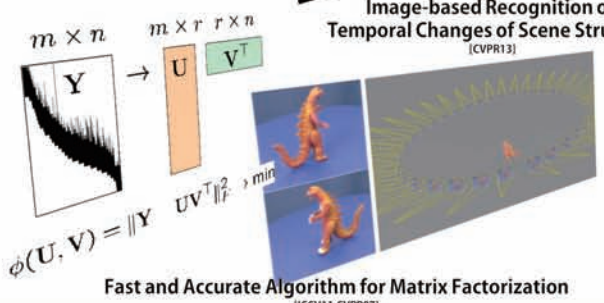
Statistically Optimal Inference of Multi-view Geometry and Numerical Computation [CVPR09,ICCV09]

Image-based Recognition of Temporal Changes of Scene Structure [CVPR13]

Image Archiving of Great East Japan Earthquake and Its Appications



Visual Recognition of Surface Qualities of Objects



Fast and Accurate Algorithm for Matrix Factorization [ICCV11,CVPR07]

Contact:
Email: okatani@vision.is.tohoku.ac.jp
http://www.vision.is.tohoku.ac.jp/

Functional Brain Imaging Prompts Innovations in Next-generation Automobiles

Department of Advanced Brain Science, IDAC, Tohoku Univ.

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Our Seeds: Neuroimaging Facilities

Our laboratory have been managing all kinds of neuroimaging equipment. <= unique and rare


3T-MRI for Human


200-channel MEG


192-channel EEG


Multi-channel NIRs


7T-MRI for Rat


EEG for Rat


Handy EEG


Wearable NIRs


2-channel NIRs

A Message to Industrial Circles

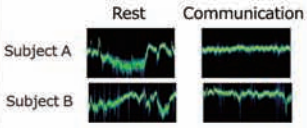
~Visualization of brain function is now ready for your R&D. Let's join us.~

We believe our new original system, which can estimate quality of communication and/or sympathy etc., will bring forth a new perspective for your developments.

A New Ultra-small NIRs System

- Total weight: 90g
- Radio transmission (currently using Zigbee)
- Enable simultaneous recording from 20 subjects

Neural activities of the dorsolateral prefrontal cortex show synchronization when participants make a well established communication.



Reformation of Convivial Society by Visualization of Communicative Activities and Sympathy

Seeds of Our University

Ultra-small NIRs system

- Real time and simultaneous measurements from multiple subjects under daily circumstances

- Synchronization of brain activities among different individuals when established good communication

Qualitative Measurements of Human Communicative Activities

Industries making products that correlate human communication

E.g. Automobile, Construction, IT, Electrical, Education, Welfare, etc.

Current social problems;
Declining birth rate and super ageing populations

↓

Social Isolation

Conception of collaborations; Reformation of convivial society which enables mutual aid.

R&D for social systems enable better communicative activities among different generation.

Examples of industrial enterprises

①Mobility which can produce good communication with driver and passengers

②Ultra-productive meeting system which can engage intense brainstorming.

③Social network services which can mediate better communication and understanding among different generation and people with different cultural backgrounds.

Establishment of Minimally Invasive Cell Therapy for Diabetes by Introducing Interdisciplinary Approach

Kimiko Watanabe and Masafumi Goto
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E-mail goto@niche.tohoku.ac.jp

ABSTRACT

Arteriovenous malformation (AVM) is appropriately treated with total pancreatectomy (TP) with islet autotransplantation (IAT). We performed this treatment for three AVM patients and had good outcomes in two of the patients. Further optimizations based on a systematic evaluation of clinical experiences are needed to improve the outcome and safety of this promising approach. The roles of Collagenase G (ColG) and Collagenase H (ColH) during pancreatic islet isolation remain controversial, possibly due to the enzyme blends used in the previous studies. We revealed that ColH is crucial, while ColG plays only a supporting role, in rat islet isolation.

1. Introduction

The pancreatic islet transplantation has strong social impact in many of the advanced cell transplant therapies, and is the ideal "minimum invasive" treatment for the severe diabetic patients who are suffering with controlling the blood glucose levels (Fig. 1). However, multiple organ donors are still needed in order to cure a diabetic patient. Therefore, establishment of minimally invasive cell therapy for diabetes by introducing interdisciplinary approach could be necessary to make islet transplantation a standard treatment. Our chief objective is to construct the center of medical cell-engineering therapy as successful examples in Tohoku University.

2. Method

(1) Clinical Experiences in the treatment of pancreatic arteriovenous malformation (AVM) by total pancreatectomy (TP)

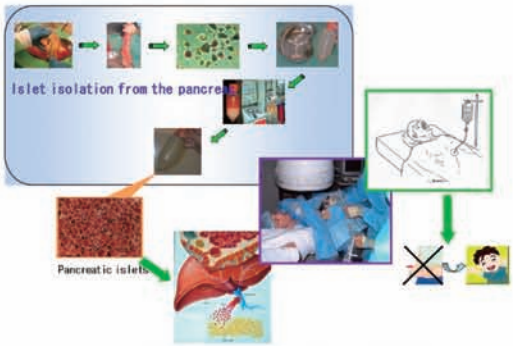


Fig. 1 Islet isolation and transplantation

with islet autotransplantation (IAT) Most AVM cases have pancreatic bleeding due to portal hypertension and the rupture of abnormal vessels and AVM is thought to correlate with pancreatitis. To prevent diabetes induced by TP, three male AVM patients underwent TP with IAT.

(2) Collagenase H is crucial for isolation of rat pancreatic isles Rat pancreases were digested using thermolysin, together with collagenase G (ColG), collagenase H (ColH), or ColG/ColH (n=9, respectively). An immunohistochemical analysis, *in-vitro*-collagen digestion assay, and mass spectrometry were also performed to examine the target matrix components of the crucial collagenase subtype.

3. Results and Discussion

(1) Clinical Experiences in the treatment of AVM by TP with IAT
The numbers of isolated islets and total tissue volume were 355,270 islet equivalents (IEQ) and 5.7 mL (patient 1), 244,758 IEQ and 16.0 mL (patient 2), and 310,238 IEQ and 1.0 mL (patient 3). Many larger clusters derived form a cystic lesion were detected in patient 2. Thus, we had to stop patient 2's transplantation when half of the islets were transplanted. Fig.2 shows the postoperative courses of the patients. The blood glucose levels were well controlled using low-dose insulin injection in patients 1 and 3. The blood glucose of the recipients was well maintained without hypoglycemia, and a substantial level of fasting C-peptide was observed under a low dose of daily insulin supplementation (1).

(2) Collagenase H is crucial for isolation of rat pancreatic isles The islet yield in the ColG/ColH group was highest (4,101 ± 460 islet equivalents). A substantial number of functional islets (2,811 ± 581 islet equivalents) were obtained in the ColH group, whereas no islets were retrieved in the ColG group (Fig. 3). To examine the role of the collagenase subtypes, ColG and ColH were sequentially injected into the pancreatic duct of rats. An additional injection of ColG following an initial injection of ColH led to a slight increase in the islet yield (Fig. 3). On the contrary, no beneficial effects were observed following an additional injection of ColH (Fig.3). Mass spectrometry demonstrated

that ColH reacts with collagen-I and III (data not shown). In the immunohistochemical analysis, both collagen-I and III were located in exocrine tissues, although collagen-III was more pronounced (data not shown). The collagen digestion assay showed that collagen-III was more effectively digested by ColH than by ColG (2).

4. Concluding remarks

We are convinced that technical innovation through these projects contributes much more to the activation of medical industry based upon cell therapy.

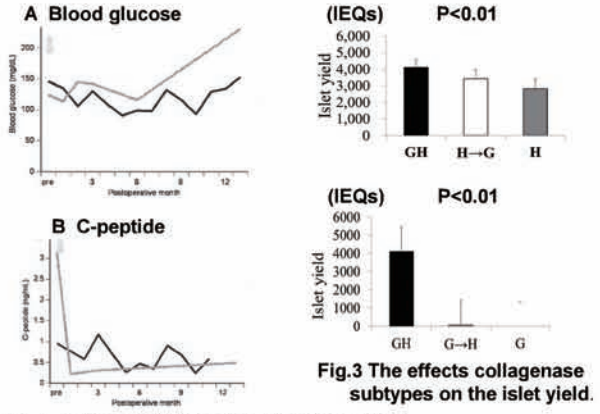


Fig.3 The effects collagenase subtypes on the islet yield.

Fig. 2. A blood glucose, B, serium C-peptide after TP with IAT in patients.
solid line: patient 1, dashed line: patient 3

(These figures were cited from Cell Transplantation, Jun 13, 2013 (Epub ahead of print) .)

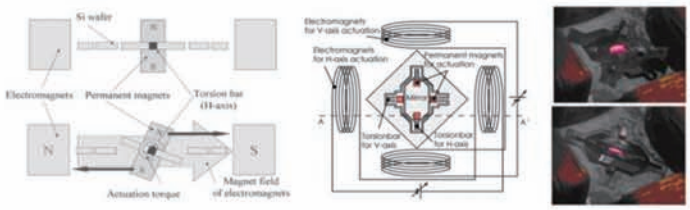
On the other hand, most of us use the motor car and spend amounts of time in a car. In the United State, estimates suggest an additional 42 accidents/year as a result of mild and moderate hypoglycemia in people with insulin-treated diabetes. Therefore, safely driving for people with diabetes requires the development of in-vehicle medical monitoring. **Therefore, in the motor car project, we would like to produce an innovative car in order to reduce the risks of medical mishaps behind the wheel.**

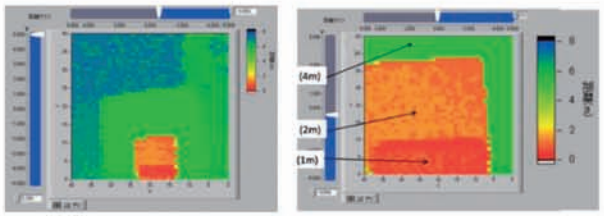
MEMS Based Safety Systems for Automotive

Masayoshi Esashi (WPI-AIMR, Tohoku Univ.)

1. Range finder with zooming function using optical scanner

(collaboration with Toyota motor, Toyota Central Research Lab. and Ricoh)

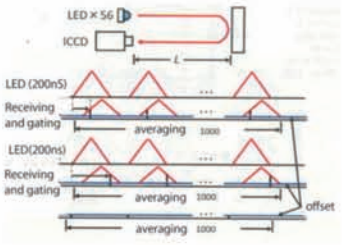


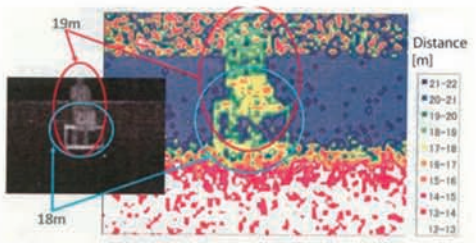


(a) Non-resonant 2D galvanic optical scanner (b) Obtained range image with zooming function

W.Makishi, Y.Kawai and M.Esashi, Magnetic Torque Driving 2D Micro Scanner with a Non-Resonant Large Scan Angle, Trans.IEEJ, 130-E, 4 (2010) 135-136

2. Range finder using LED pulse and image intensifier camera with shutter



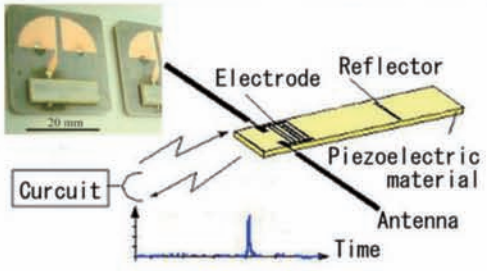


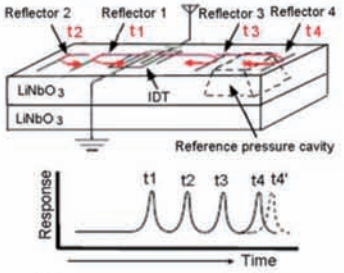
(a) Principle (b) Experimental setup (c) Experimental result

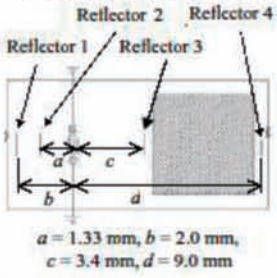
Y.Nakano, Y.Kawai, N.Ikegami and M.Esashi, Time-of-flight Range Finder Using LED Light Source, 2010 IEEJ Convention, Tokyo, (March 17-19, 2010) 1-116 p.132 (in Japanese)

3. Wireless SAW sensor for tire pressure monitoring

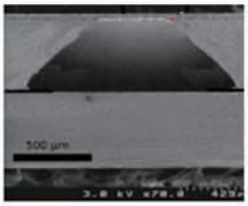
(Collaboration with Nissan motor)

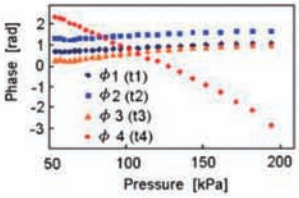


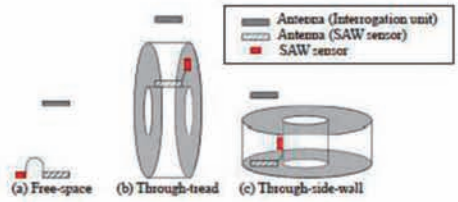




(a) Principle of SAW wireless sensor (b) Structure of SAW wireless pressure sensor







(c) Diaphragm (d) Experimental result of pressure measurement (e) Measurement scheme

S.Hashimoto, J.H.Kuypers, S.Tanaka and M.Esashi, Design and Fabrication of Passive Wireless SAW Sensor for Pressure Measurement, Trans.IEEJ, 128-E, 5 (2008) 231-234

Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

Thermal Imaging using Temperature Sensitive Paint

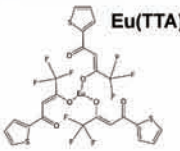
Takashiro Tsukamoto and Shuji Tanaka
Tohoku University

MEXT TOHOKU ECONOMIC FEDERATION Tohoku University 宮城県 七十七銀行 ICR

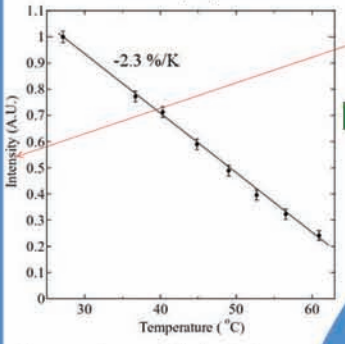
Temperature Sensitive Paint (TSP)

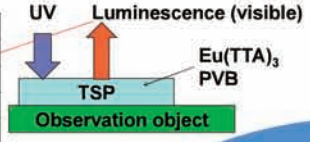
The Intensity of luminescence from the TSP is modulated by the temperature of TSP.

The TSP consists of $Eu(TTA)_3$ as a luminescent material and PVB as a matrix.



A normal CCD/CMOS camera with microscope (without high-cost Ge optics)
→ Low cost, high resolution





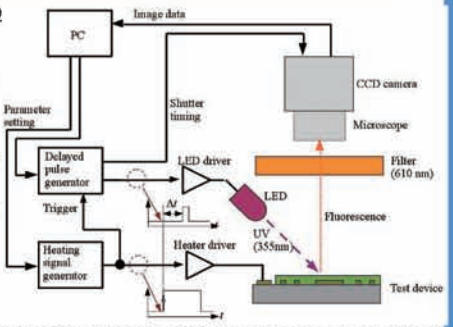
Temperature coefficient of intensity (TCI) from the TSP.

Temperature distribution → Optical image

High speed, and high resolution thermal imaging

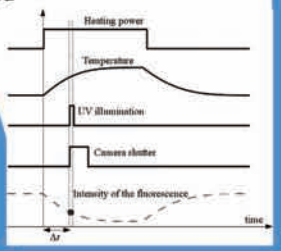
Experimental setup

LED drive signal is generated by a delayed-pulse generator, which is synchronous to an operation signal of a device under test. The luminescence is captured by a CCD camera with an optical filter.



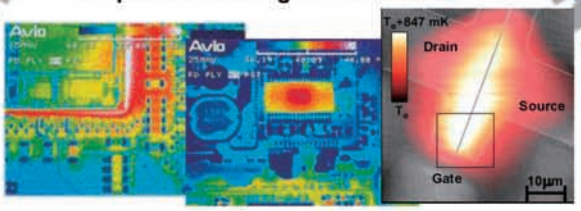
UV flashing method (for high speed imaging)

TSP is exited by a short-pulsed UV light.
A momentary luminescent image is captured by a slow-scan CCD camera



Non contact thermal imaging

Temperature sensing of microdevices



Requirements

High resolution … Usually in a μm scale
High speed … Thermal time constant is small
Non-contact … Don't disrupt an observation object
Low cost … Applicable for a wide variety of applications

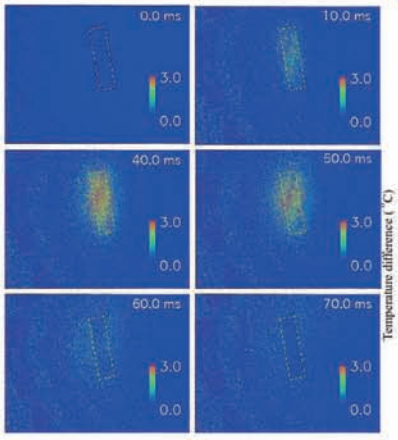
TSP is one of the candidates for the micro thermal imaging with high spatial, temporal and temperature resolutions

Obtained thermal images

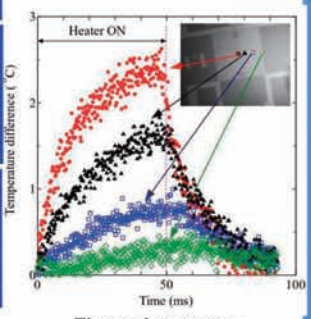
$$\Delta T(x,y) = S^{-1}\left(\frac{I(x,y)}{I_0(x,y)} - 1\right)$$

S : TCI
I : Luminescence
x, y : Address of the picture

Spatial resolution : 39 μm
Temporal resolution : 0.2 ms
Temperature flucsutaion : ±0.2°C



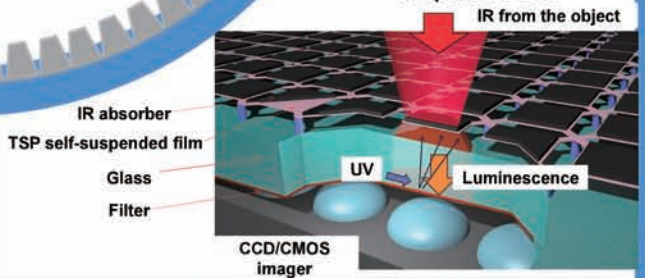
Thermal images at the each time step.



Thermal response.

Novel Thermal imager

Novel low-cost thermal Imager using TSP.
○ High thermal isolation.
→ High sensitivity
○ Easy to fabricate.
○ No electric wirings.
→easy for packaging.
→Low cost
×Response is slow



Conclusion

A novel thermal imaging method with high spatial, temporal, and temperature resolution was developed. The obtained spatial, temporal and temperature resolutions were 39 μm, 0.2 ms and ± 0.2°C, respectively. A novel thermal imaging device using self-suspended TSP was proposed.

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Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

Production of Low-Cost and Highly Functionalized Titanium by Controlling the Light Elements

Takayuki Narushima and Kyosuke Ueda
Department of Materials Processing, Graduate School

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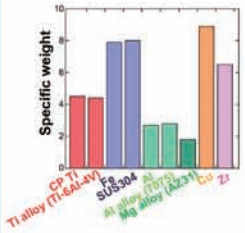
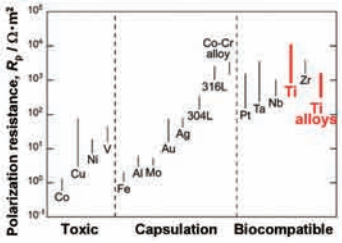
Titanium: *Wonder metal*

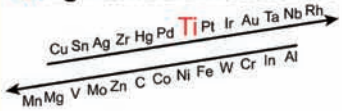
- Low specific weight
- High specific strength



- High biocompatibility



- High corrosion resistance

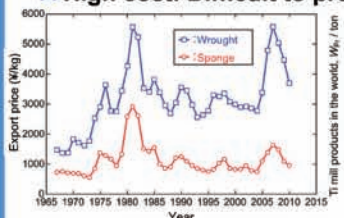


Applications for…

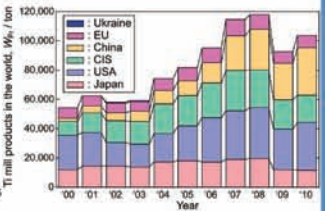
- Space aeronautics
- Medical devices
- Military
- Chemical plants

Disadvantages of Titanium

- ✕ High cost: Difficult to produce



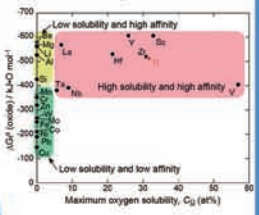
Price: 2-3 times higher than stainless steels
10 times higher than Al alloys



Amount of deposit of titanium ore: High
→Low products: Categorize to Rare Metals

Light elements

Titanium: Chemically reactive
→Ex: Oxygen will not only form oxide layer on Ti surface but also easily dissolve into Ti at high temperatures



Light elements in titanium

Oxygen, Hydrogen, Nitrogen, Carbon

- High affinity
- High solubility
- Interstitial
- Abundant

Alloy designing
Strength・elongation・ductility, Anisotropy, Elasticity, Workability, Shape memory・super elasticity

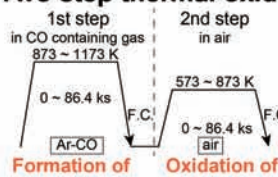
Surface designing
Corrosion resistance, Biocompatibility Photocatalytic activity, Wear resistance

Microstructure controlling
Transformation, Precipitation/dissolution, Grain refinement, Temporary alloying

Refinement process
Process of reduction and melting, Energy saving, Recycle, Purification

Improving photocatalytic activity by anatase formation

Two step thermal oxidation



Formation of Ti(C,N) layer
Oxidation of Ti(C,N) layer

Formation of Anatase layer

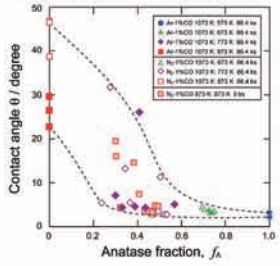


Fig. Effect of anatase fraction in TiO_2 layer on the water contact angle under UV irradiation.

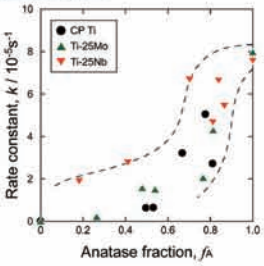


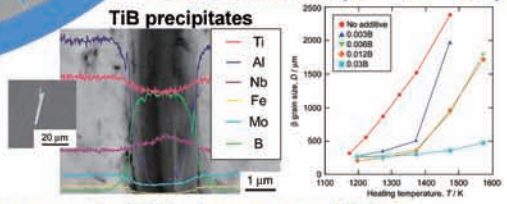
Fig. Effect of anatase fraction in TiO_2 layer on the rate constant of degradation of methylene blue under UV irradiation.

Photocatalytic activity under UV irradiation

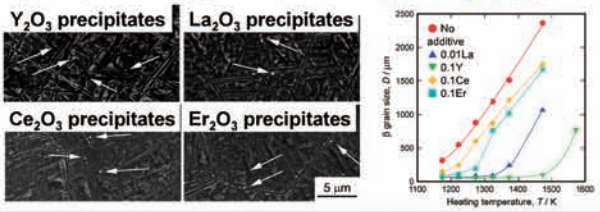
Microstructure control of Ti alloys using micro alloying

Grain refinement of Ti alloys by pinning using fine precipitates

Boron addition (Ti + B = TiB)



Rare-earth (RE) elements addition
(2RE (in Ti alloy) + 3O (in Ti alloy) = RE_2O_3 (s))



Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

Potential of Alternative Fuel Vehicles: Analysis of Disaggregated Cost Benefit

Lab. of Shunsuke. Managi,
Graduate School of Environmental Studies, Tohoku University

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Cost-Benefit Analysis

Costs

1.Alternative vehicle Cost

Differences between the purchase and running costs of alternative vehicles and ICEs vehicles

2.Infrastructure for Alternative vehicles

Construction and operating costs for alternative vehicle diffusion

Benefits

1.Emission reduction effects

The reduction levels of CO2 and NOx emission

2. Resource-saving effects

The reduction levels of gasoline usage

Scenarios

1. Scenarios in CO2 reduction costs

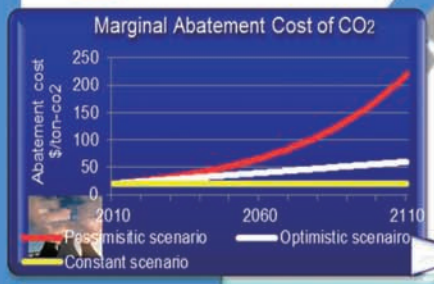
Exponentially increasing cost
Linear increasing cost
BAU-pattern increasing

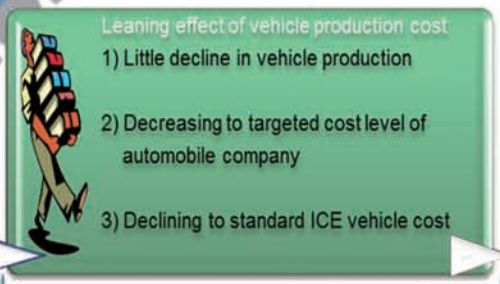
2. Scenarios in learning effects in vehicle production

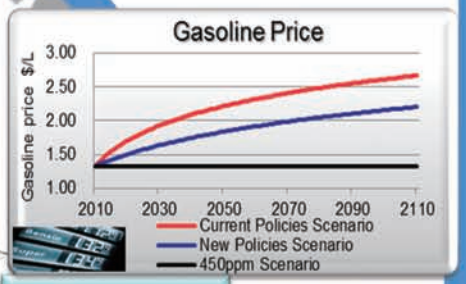
Little decline in vehicle production
Decline to the targeted cost level of automobile company's
Decline to the standard ICE vehicle cost

3. Scenarios in gasoline prices

Prices under Current policies
Prices under New policies
Prices under 450ppm

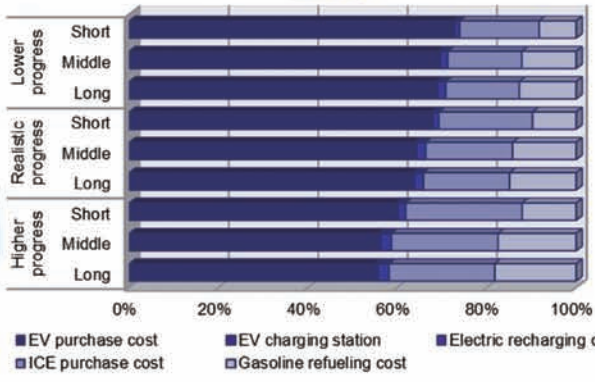






Cost | **Cost-Benefit Analysis** | **Benefit**

Simulations w/ Scenarios based on Questionnaire & Public Data



e.g. The result of EV diffusion scenario cost

Contact

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Associate Professor ,Graduate School of Environmental Studies
Tohoku University
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·Research Interest

Green innovation, Sustainable development
Investment evaluation, Adaptation to disaster

Multiscale, Multiphysics Modeling/Simulation for Next Generation Automobiles: Catalysts, Tribology, and Batteries

New Industry Creation Hatchery Center, Tohoku University
Akira Miyamoto, Nozomu Hatakeyama, Ai Suzuki, and Ryuji Miura(Miyamoto Lab)

MEXT TOHOKU ECONOMIC FEDERATION Tohoku University 宮城県 七十七銀行 ICR

Multi-level Tribology Simulator for Material Development to Realize Long-life, High Reliability, Energy Saving Automobiles and Mechanical Systems

Development of Multilevel computational chemistry

Quantum mechanics → Electronic calculation → Molecular orbital

Molecular dynamics

Atomistic/ Mesoscopic calculation

Continuum dynamics

Macroscopic/ Practical scale calculation

Development of New Academic Domain between Chemistry and Mechanical Engineering

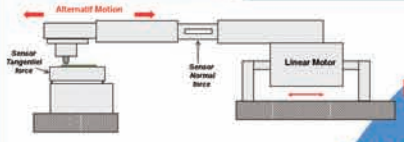
Application to the Medical Engineering

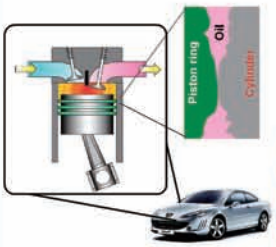
Contribution to the Development of Next Genaration Automobiles for Sustainable Society

Friction-free technology :

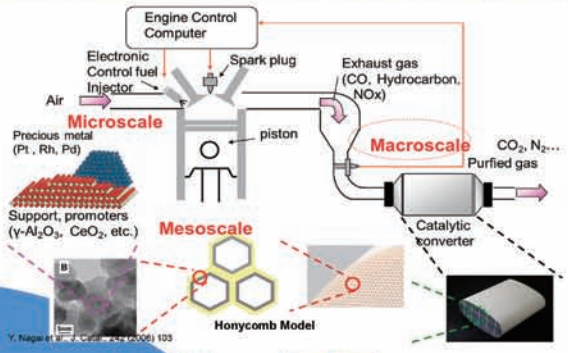
Super low mileage car

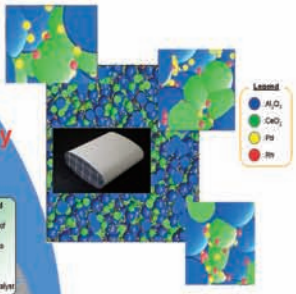
Long-term Stability of Sliding Parts : Trouble Free Technique





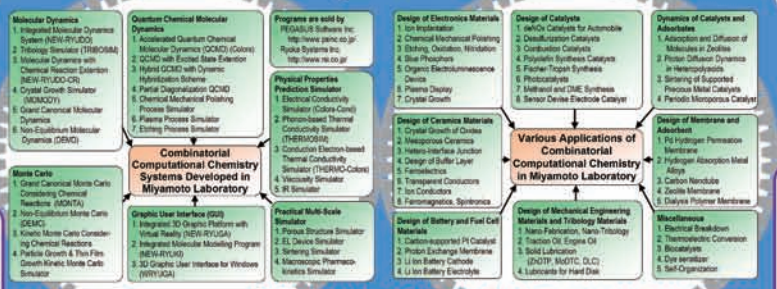
Multiscale, Multiphysics Simulator for the Development of Practical Automotive Catalysts



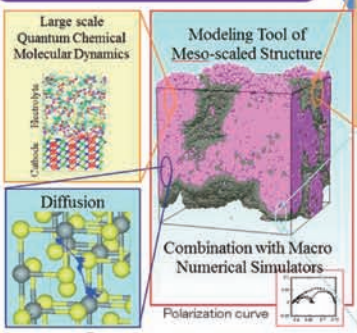


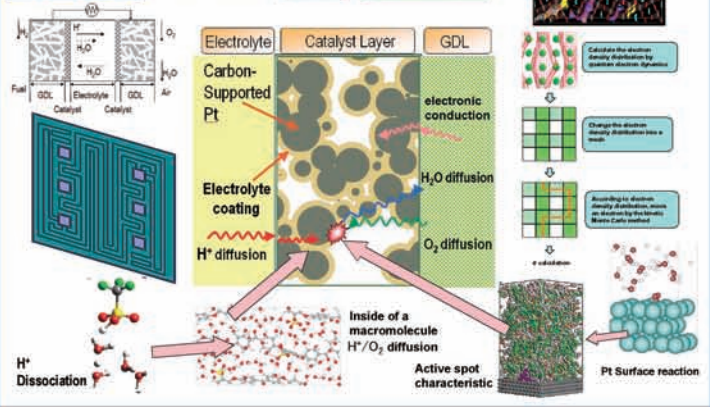
Automotive Parts Company
Automobile Company
Machinery Company
Chemical Company
Heavy Industry Company
Oil Company
Electric Power Company
Gas Company
Software Company
Pharmaceutical Products Company
Water Treatment Company

Achievements of Collaborative investigation with Various Domestic / Foreign Companies using our Original Software



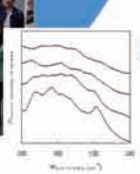
Multi-level Battery Cell Simulator Supporting the Development of Li-ion Battery, Fuel Cell and Solar Cell for Next Generation Automobiles

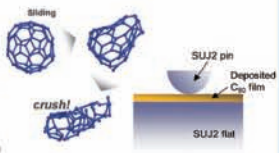




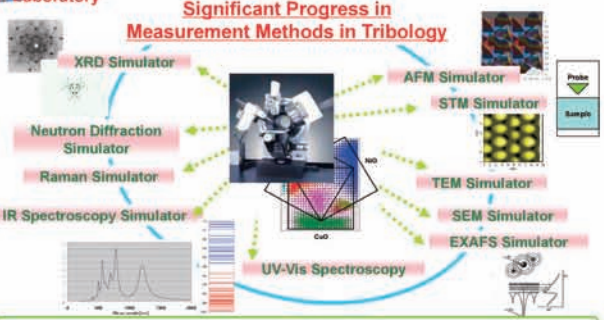
Integrate the Measuring and Modeling Technologies to Improve the Surface and Interface Structural Analysis for Practical Material Development

Powerful Support for Industry-University Cooperation by Professors, Research Staffs, Technical Assistants and Programmers in our Laboratory





Significant Progress in Measurement Methods in Tribology



"Realistic" Atomic/Molecular Structure Construction from Multi-level Computational Methods

Message to Global/Local Companies

We hope to realize global/local innovations for next generation automobiles by collaborating with our practical multiscale, multiphysics modeling/simulation methods developed through many industrial collaborations.

Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

Drag Reduction Mechanism of an Automobile with Inside-Fin Tires

Shigenori Hashida[1], Koji Shimoyama[1], Shigeru Obayashi[1], Masataka Koishi[2] and Yuji Kodama[2]
[1]Institute of Fluid Science, Tohoku University, Japan
[2]Yokohama Rubber Co., Ltd., Japan

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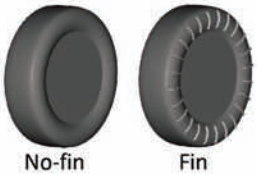
1. Introduction

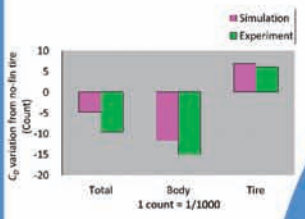
Aerodynamic Drag of an Automobile

- Accounts for 50 % of running resistance at 60 km/h
- Affected by the appearance (owner's preference)



Fin Tires

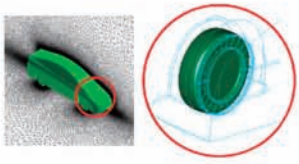
✓ Expected to reduce drag without sacrificing appearance
✓ Demonstrated to be effective for drag reduction in experiments and numerical simulations
x Do not clarify its detailed mechanism yet

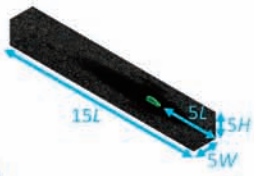


2. Method

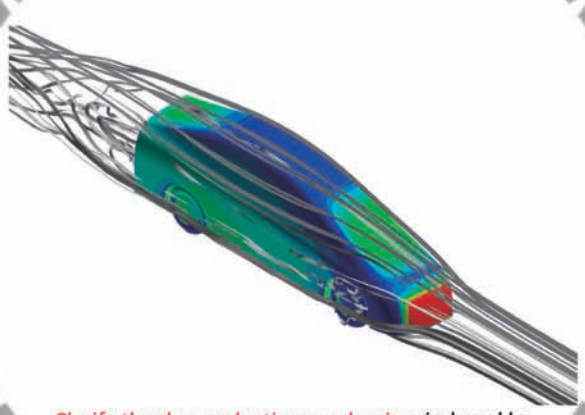
Flow solver	FrontFlow/red
Governing equation	Incompressible Navier-Stokes equations
Sub-grid scale model	Standard Smagorinsky (Constant: 0.15)
Pressure-velocity coupling	SMAC method
Time integration	Implicit Euler method
Spatial discretization	Cell-vertex finite volume method > Second-order central difference (95 %) > First-order upwind difference (5 %)

Model: Wind tunnel model (1/4 the size of a real car)
Velocity: 20 m/s, $Re = 2.1\times10^5$ (based on the tire diameter)





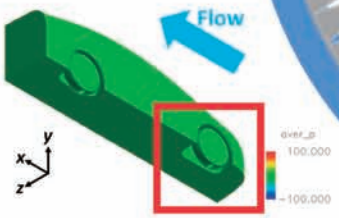
Research Objective

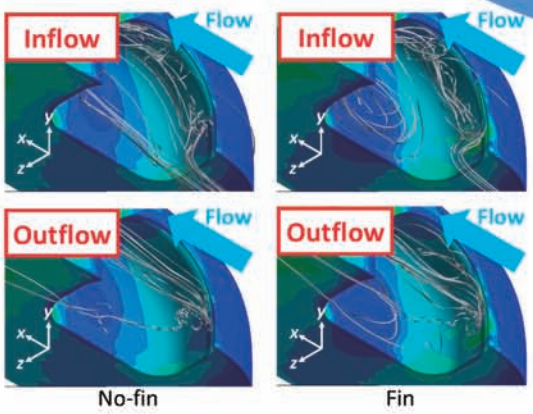


Clarify the drag reduction mechanism induced by fin tires through the numerical simulations for
1.No-fin tire model
2.Fin tire model

3. Result

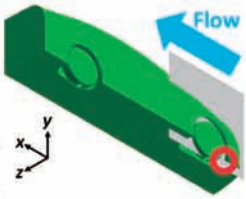
Streamlines

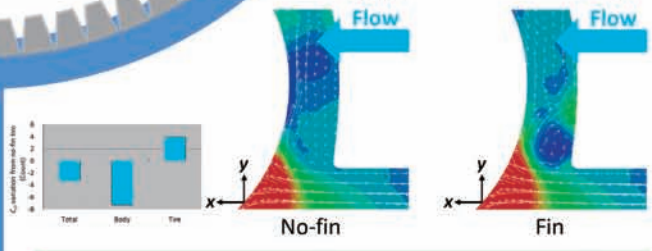




3. Result

Velocity vectors





4. Conclusions

- The fins enhance the interaction between the flow along the tire rotational direction and under-floor flow
- This interaction increases the pressure acting on the front part of the wheelhouse

Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

A Concept of Automobiles Aerodynamic Testing using the 1-m MSBS in Tohoku University Low Turbulence Wind Tunnel

Yasufumi Konishi, Hideo Sawada, Shigeru Obayashi
Institute of Fluid Science, Tohoku University, Aobaku, Katahira 2-1-1, Sendai, Miyagi, Japan.
konishi@edge.ifs.tohoku.ac.jp

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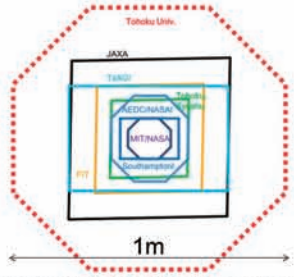
Introduction

MSBS

The Magnetic Suspension and Balance System is the model supporting device without any supporting rod or wire..
It **can also measure the fluid dynamic force.**



the comparison of the size of MSBS

Features:

1. The interference problem between fluid and a mechanical supporting system is eliminated.

2. It can simulate model motion with 6 D.O.F and measure the aerodynamic force on it.

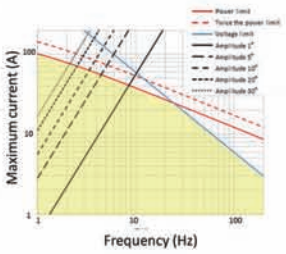
3. New MSBS in Tohoku Univ. Low Turbulence Wind Tunnel (LTWT) become the largest one.

Automobiles aerodynamic testing

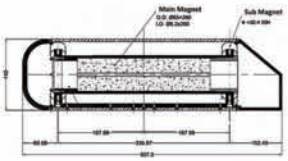
A postural change of the automobile can be simulated by exciting a **unsteady motion** by MSBS.

In excitation motion, the left side of the equation of motion (2) cannot be negligible. At low frequency cases, the second deviation can be estimated by the second-order numerical difference and the low-pass filter.

for example the available yawing motion on the Ahmed model considered becomes as shown in a figure. And because of no support needed, **the MSBS can make more complex motion** to a model, such as a pinching with rolling and so on.



Availablete yawing motion



Designed Ahmed model for MSBS

specification

length:0.5075 m
width:0.1891 m
hight:0.140 m
clearance:0.01344m
mass:10.8kg
Ixx:0.024kgm², Iyy:0.120kgm²
GC: 6.1mm down stream
Re= 1.25 × 10⁶, drag: 9.2N
(coil current drag coil : 30A
lift coil : 81A)
at 40m/s

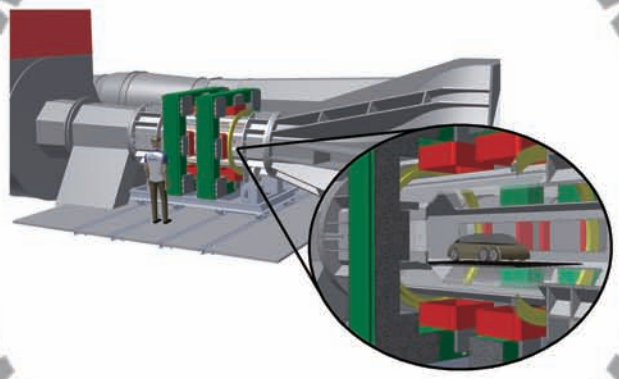


Image of Automobile aerodynamic test using the 1-m MSBS

Basic concept of MSBS

Equation of motion

$$\frac{d(mv)}{dt} = F_{aero} + F_{gravity} + F_{magnet} \quad (1)$$

$$\frac{d(I\cdot\omega)}{dt} = N_{aero} + N_{gravity} + N_{magnet} \quad (2)$$

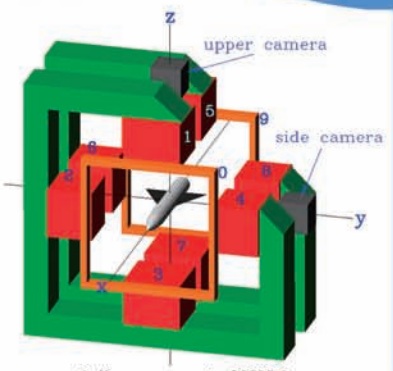
If the position and magnetic force are measured , unknown aerodynamic force can be evaluated.

Position is measured by five line sensor mounted outside of the upper and side walls

Magnetic forces can be evaluated from the following expressions:

$$F_{magnet} = (M\cdot\nabla)H,$$
$$N_{magnet} = M\times H,$$

$$F_x = M_x\frac{\partial H_x}{\partial x} + M_y\frac{\partial H_x}{\partial y} + M_z\frac{\partial H_x}{\partial z},$$
$$F_y = M_x\frac{\partial H_y}{\partial x} + M_y\frac{\partial H_y}{\partial y} + M_z\frac{\partial H_y}{\partial z},$$
$$F_z = M_x\frac{\partial H_z}{\partial x} + M_y\frac{\partial H_z}{\partial y} + M_z\frac{\partial H_z}{\partial z},$$
$$N_x = M_yH_z - M_zH_y,$$
$$N_y = -M_xH_z + M_zH_x,$$
$$N_z = M_xH_y - M_yH_y$$



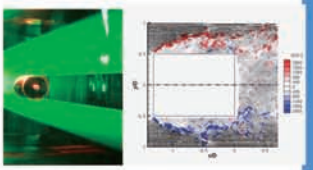
Coil arrangement of MSBS

PSP and PIV

New measurement techniques such as Particle Image Velocimetory (**PIV**) and Pressure Sensitive Paint (**PSP**) will be available as **optical measurements.** It is **not easy to access the interesting area** because measurable area is limited **in the past MSBS system.**

Our Solution

- **3D PIV system will be equipped to test section.**
- **MSBS can move forward and backward** in test section independently.



Example of PIV measurement
Around a circular cylinder

Concluding remarks

A summary of the 1m MSBS in Tohoku Univ. LTWT and advantages in automobile aerodynamic tests are described. We believe that tests at the LTWT test section equipped with the 1-m MSBS play an important role in future at automobile aerodynamics.

Industrial Presentation
Technology and business introduction of local companies

宮城県 Miyagi Prefectural Government

ITIM

Automotive Industry Support using ITIM's Open Equipment

Industrial Technology Institute, Miyagi Prefectural Government (ITIM)

MEXT | TOHOKU ECONOMIC FEDERATION | Tohoku University | 宮城県 | 七十七銀行 | ICR

EMC evaluation for car electrical components

Anechoic chamber and shielded room are open for use by automotive businesses. EMC evaluation based on international standards, shown below, are provided.

CISPR25 radiated emissions

Bulk current injection (BCI) test

CISPR25 conducted RF emissions

※We also provide electrostatic discharge immunity test

Shock test machine

Testing more than 1000G of shock with duration of msec is possible. Durability against shock for car electrical and mechanical components is possible to evaluate.

Model	AVEX SM-110-MP
Half-sine Amplitude & duration	30G,18msec～1000G,1msec
Max. shock amplitude	5000G
Max. speed	1.0m/s Peak
Dimensions of test table	W410×D410mm
Max. loading weight	90kg

- Shock direction is changed by altering fixing direction.
- Simultaneous acceleration measurement is possible by use of 3 sensors.

※We can give advise about a structure of test jigs.

Mission of ITIM

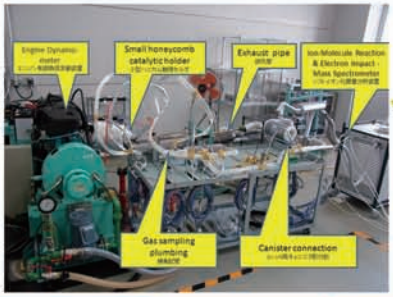
Industrial Technology Institute, Miyagi Prefectural Government

For the purposes of contributing to the promotion of local industry and aim for enhancing the support of businesses opened to local areas, we uphold an operational policy of one stop solutions based on trust, promptness, friendliness, safety, and assurance through utilization of the institute's knowledge and technical resources (facilities and technicians).

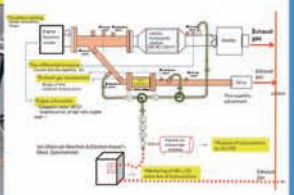
Catalyst property evaluation

This system allows us to evaluate the properties of the small honeycomb catalyst .

	Maker, model	Main specifications
Engine Dynamo-meter	TOKYO METER CO., LTD. GWE-110/150R	Engine : 1NZ-FE, 1.496 L (which is put on Allion made in Toyota Motor CO., LTD.)
Ion-Molecule Reaction & Electron Impact - Mass Spectrometer	V&F Analyse- und Messtechnik GmbH, AirsenseCompact	Gas consumption : 100ml/min Lower detection limit : ppb Response time :20msec
Gas chromatograph and mass spectroscopy /Headspace Preconcentrator	Entech Instruments Inc., 7100A Agilent Technologies Inc., (GC)7890A(MS)5975C	3-Stage preconcentrator Detector : MS and two FID(Flame Ionization detector) Lower detection limit : ppt
Exhaust Gas sampling plumbing	NISHIKAWA KEISOKU CO.,LTD.	The Silonite Coated Tubing made in Entech Instruments Inc.
Diagnostic tester	DENSO CO., LTD. DST-2	Trouble diagnostic software for Toyota cars

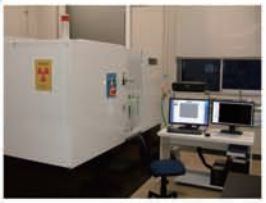


- Small Honeycomb size : D25.4×60mm
- Ion-Molecule Reaction & Electron Impact - Mass Spectrometer enables the simultaneous and synchronous monitoring of NOx, CO, and hydrocarbons(Toluene, Propylene etc.) .
- GC/MS is used to analyze C_2 to C_{11} hydrocarbons (Ethylene, propylene, 1-butene, n-hexane, benzene, toluene, etc.) in automobile exhaust gas.



X-ray CT

※Computed Tomography

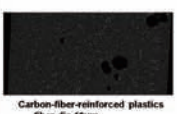


This system allows us to inspect the three-dimensional inner structure of automobile parts non-destructively, for example aluminum die-cast products, electronic parts, molding parts etc..

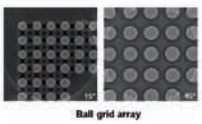
	Microfocus X-ray CT System
Manufacturer, Model	Comscantecno.Co.Ltd ScanXmate-D225RSS270
X-ray generator	Open tube/Transmission head Voltage 20～225kV (variable) Focal spot size Min, 4μm
Detector	Digital flat panel Pixel size(Pitch) 127μm/254μm Active area 235mm(H)×186mm(V)
Sample size	300dia.×300mm H , weight 15kg

	X-ray Inspection System
Manufacturer, Model	Comscantecno.Co.Ltd ScanXmate-RAA110TSS48
X-ray generator	Open tube/Directional head Voltage 20～110kV (variable) Focal spot size 3μm/5μm(selectable)
Detector	Image intensifier, 4 / 2.5 inch selectable
Sample size	Width/depth/height 400/350/50mm Weight 2kg

Aluminum sample size 30×30×10mm



Carbon-fiber-reinforced plastics fiber dia.10μm, sample size 20×20×10mm



Ball grid array





Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

Company Policy

【Progress with creation and service】
The interaction of light with the magnetic and electronic freezes influctuation of space. We aim to develop technologies to measure and control with high accuracy.

Kudo Electronic Corporation

An accelerator・synchrotron・superconductivity・research facility high-precision constant current power supply

Kudo Electronic Co., Ltd.

Main office Nishitaga Taihaku-ku Sendai・・・Natori place Iinozaka Natori-shi

http://www.kudo-denki.co.jp/

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Analog and digital fusion

We challenge to find future technique, and we have never ever give up making new stuffs for our future.

・よりダイナミックで、さらにシビアーに!

Since 1956 to now, our company have been supporting from Tohoku University. Technology very improved from analog generation. From this improved technology, we use this for an elementary particle, accelerator science of radiation, and big science in the field of nuclear fusion. Those technologies use at the research facility in Japan and out of Japan.

Moreover, we use this technologies for heavy particle cancer treatment, medical field of MRI etc... And, the field of semiconductor ion implantation, too.

We established control stability of the DC current and voltage 0.1 ppm, so our next challenge is 0.02 ppm.

POWER ELECTRONICS

10.000.000. =0.1 PPM
High-precision control technology

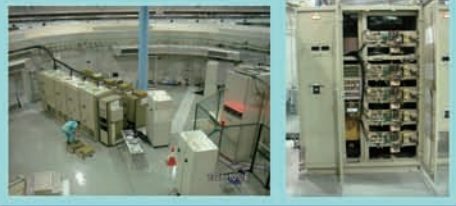
Feedback & Computer Technology

Tohoku Uni science department AVF Cyclotron magnet power supply other 45 units update

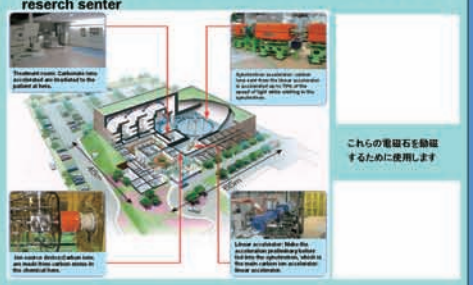
Kyushu synchrotron radiation research facility
Electromagnet, power supply One set（218 units）
March 2004

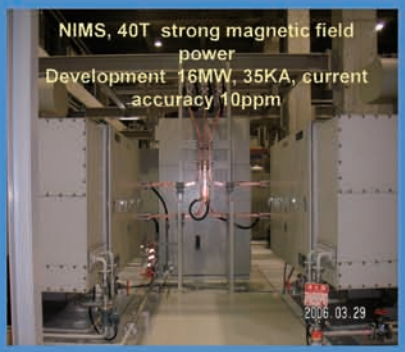
Ring system great capacity electromagnet & constant current power system group
IGPT switching method current stability: 10ppm
300kw*1 100kw*3 20kw*3

300kw/ Deviation electromagnet
IGBT/ Internal power source



2008年
The power supply in the Gunma heavy ion cancer therapy reserch senter





SP-series stabilized power supply

≪small high-precision DC switching power≫

2KW

0.02-0.001% current stability So suitable for the electromagnet excitation
1KW～30kW class unit power

Kudo corp・EV experiment group

- Joint research with Tohoku University next generation mobile system study group
- The Ministry of Economy, Trade and Industry " IT fusion consortium research and development project"
- Joint research with Tohoku Uni and Ishinomaki sensiyu Uni
- 4 employees organize the project
- Commercialization of next-generation electronic vehicle
- If you're interested in our industrialization, please contact us


Honda "Beat" decomposition


In- Wheel Motor


12V50AH 4 battery


Test Drive


Tagajo Reconstruction Park


EV eco-run race

Industrial labor-saving machinery・Hikichi Seiko automatic machine

～We help customer's "solution annoyances, production reform &improvement, and efficiency～

Hikichi Seiko Co., Ltd.

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■Company Info

◇name： Hikichi Seiko corporation
◇Place: "main Offices" 2-8-28, Fukiage,Iwanuma- city,Miyagi-pref,989-2436 JAPAN
◇President： Masayoshi Hikichi
◇Fuoudation: May 3,1979
◇Capital: 30 million yen
◇Employee： 65people
◇Certification: ISO9001、ISO14001、&AS9100(challenge)、
◇Approval & license : general construction industry・machinery & equipment installation work

■Overview of Business

◇Business info： ・industrial labor- saving machinery・tooling, design & manufacture of various devices ・prototype, precision parts processing
◇The main delivery equipment ：
◆assembly equipment (line equipment, discrete systems)
◆Inspection equipment ◆cleaning equipment
◆Transport equipment
◆others-Automated equipment,various devices etc...
◇Major clients:
・Toyota Eastern group
・Panasonic
・Toray Engineering
・Seiko- Insutsuru
・electrical , electronics companies
・Food related companies
・Aircraft companies

◇Main Offices

"Engendering & mechanical design department"
・Making concept illustration form customer's offering
・Line equipment, a single machine, fixtures etc. All design

"Technology & control department"
・Use PLC, and make soft & hard design
・response coordination of articulated, Scala, single axis of each robot manufactures

"Manufacturing & machining department"
・We put the data in the automatic machine, and we can finish up all at one place.
・We really good at single item processing, and quick response and delivery. The challenge is cost & technology.

"Manufacturing unit assembly & adjustment department"
・Assembled, measurement data takes a stack accuracy
・The installation adjustment , check the final products
・We support the installation anywhere (domestic & international)

◇Taiwa brunch

・We express support for our ustomers .
・24 hours support for production facilities of our customer.

■Hikichi Seiko' sDNA

■To the employee's book
・The figure what is company's goal
・Knowledge as a society person & company people
・Sprits & motivation
・Self- growth & realization
・Responsibility ・・・

◆Management Philosophy
◆Survive the hard time
Employees knowledge:
38 Articles

■5S Thoroughness
◇5S:"organizing , tidy, cleaning, cleanliness, and disciple"
Theses things made better company
・Our company think about 5S and do these things once a week.
～ We can't say " it is enough to do" because there are other companies higher than us ～

■Development & spilt of challenge
・Even in the difficult cases, we never give up! We think so deeply.
・We challenge higher level, and improve ourselves.
◇Try to up technology capabilities and resilience, and in response to the needs and expectation !!!! Of course, after all …we get win & trust.

■Efforts of industry- academia government collaboration

◇Participation in the institution & organization
・Miyagi industry association
・Miyagi industrial Promotion Organization
・Miyagi prefecture industrial Technology center
・Miyagi automotive industry Promotion Council
・Toyota East Japan group
・Innovation appreciation create conference
・Machine Vision study group
・Next generation vehicles Miyagi area

■Main a Machine Tool

・As a Machine vision research meeting theme, people guide us for good development.

◆Original product development
◇Curved mirror surface for visual inspection robot
・We have established a special optical head to the articulated robot . It is a movement close to the movement of people.

・At 2011, we had received certificate from <Excellent Technology> " Miyagi Sugure MONO"

みやぎ 優れMONO
"SUGURE MONO"

To a company making "only one"

Tohoku Electronics Co., Ltd.

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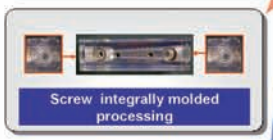
Injection molding

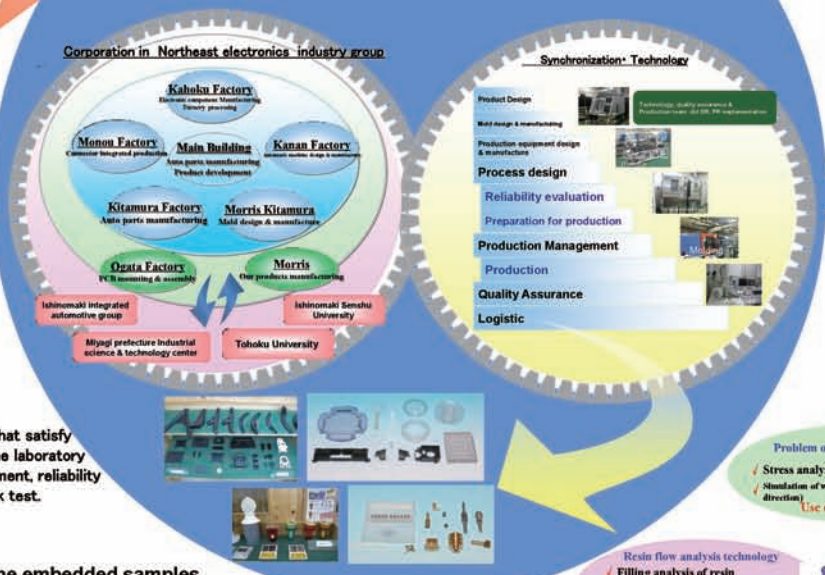
- Set 3D CAD, the optimum conditions using flow analysis.
- Realization of the secondary processing less devised mold structure based on the product shape.



Environmental Products
Union technology of secondary batteries & solar

Even if cut off the power supply, it will start the production of electric power itself by any cases.

Simultaneous engineering
synchronization technology



Quality & reliability evaluation

For reliability and performance ensure that satisfy our customers, we have carried out in the laboratory with a variety of test and analysis equipment, reliability testing on a regular basis, the benchmark test.

Analysis & failure analysis

We observe cross section of the embedded samples.

The main holding facility

Molding machine, processing machine, measuring instrument

1 Small molding machine (7～10t)
2 Injection molding machine (45～180t)
3 Injection molding machine (220～350t)
4 Injection molding machine (450～550t)
5 Vertical injection molding machine (20～40t)
6 NC electrical discharge machine
7 Wire electrical discharge machine
8 Vertical machining center
9 Machining center
10 CNC automatic lathe
11 Three- dimensional measuring device
12 Image measurement system
13 Measuring instrument shape and Contour surface roughness

Test & analysis equipment

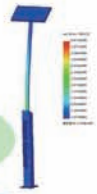
14 Thermostatic bath
15 Tank constant tempter & humidity
16 TCR tank
17 Pressure cooker
18 Thermal shock testing machine
19 strength test equipment (Pull, Compression, Bending, peel test)
20 Soldering test equipment
21 DC regulated power supply
22 Solder bath
23 Electron Microscope
24 Atomic absorption spectrophotometer
25 X-ray fluorescence film thickness meter

Software

26 3D CAD (SolidWorks)
27 3-D CAD/CAM system (CAM-TOOL, CADCEU)
28 2D/3D CAD system (2001PLUS)
29 Resin flow analysis software (3D TIMON)
30 Optical simulation software (Zemax)
31 Analysis simulation software (Femtet)

Proposal of solutions

We propose quickly to our customer about the best solution of customer's use condition.



Problem of stress relationship
- Stress analysis of the pole section
- Simulation of wind load (wind speed, wind direction)

Use of stress simulator

Resin flow analysis technology
- Filling analysis of resin
- Holding pressure cooling analysis, mold cooling analysis
- Warp shrinkage deformation analysis

Use of injection molding CAE

Optical design & analysis technology
- LED model analysis
- Analysis of the light guide plate

Use of optical analysis CAE

Customer

To everyone in the company

We aim to improve the technical capabilities for the future with local companies.

◆A focus on the manufacture of electronic components & automotive parts production through integrated with community- based.

◆We run in QCD speed from product design to mold equipment.
◆Accumulation of our technology satisfy customers expectation.

Human resources education


The executive staff training


The executive staff training


In- house training


Presentation in a company

Strategic Regional Innovation Support Program by MEXT: Next Generation Automobiles/ Miyagi Area

In a Development Early Stage the Proposal of the Die-Casting Form which Considered Quality Cost by Original Casting Technology

IWAKI DIECAST Co., Ltd.

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Semi-solid Die-cast Process

Outline of Manufacturing process

How to cast after making melted hot water half-solidification(slurry), comparing with casting from perfect melted hot water, it is little stickiness, it becomes a detailed and uniform organization, the product which called for high resisting pressure, high intensity and high toughness is possible.

Slurry

Casting

Processing

Section

Throw in

Knife cutting of slurry

Comparison of solidification structure

MIM (Metal Injection Molding)

Outline of Manufacturing process

MIM is finished after fabricating a metal particulate powder by injection machine, degreasing and sintering, post-processing accept necessity.

Injection machine

Thermoplasticity binders | Metal particulate powder

Mix and knead

Fabrication

Remove binder

Sintering

Sizing

Post-processing

Product

Continuous sintering furnace

Headquarters・Factory
51-2 Yamazaki, Washiashi, Yamamoto
Watari, Miyagi, Japan 〒989-2204
***TEL* +81-223-37-3322**
FAX +81-223-37-3720
E-MAIL info@iwakidc.co.jp

IWAKI DIECAST

Main Facilities Machinery

The Best our Ability to Construct Factory Line; Pursuing Automation, Energy Saving and User-Friendly

The production line of Iwaki always holds the latest level of a time, the result of original now-how and joint research with an apparatus equipment maker is employed everywhere.
At a casting process, a supervising system and a multifunction robot which foreknows and prevents failure and poor product beforehand are introduced, the production line is automated mostly. And, the utility tunnel which stored the automatic hot water distribution system of an encapsulated type, home generation of electricity facilities for energy saving, compressor or conveyer is prepared.
Furthermore, a factory function is raised even to the highest level, it still continues making an effort to investigation of factory full automation that aims at high quality, high efficiency, low cost, the stable product supply, and realization of comfortable work environment.

Processing Factory

Mold Automated Warehousing

Impregnating Apparatus

Die-Cast Machine

Automation

Main Facilities Machinery

IWAKI DIECAST

Die-cast Model design Proposal System

Outline of Manufacturing Process of Mold and Die-Cast Products

The biggest problem of technology that supports modern high-mix low-volume production system is how to supply confirmed high accuracy molds on a timely manner, and construct a high efficient production system at low cost.
IWAKI designs casting with brand-new technology as a pure-play company focused on die-cast manufacturing. After we hear customer's request, we offer design of casting which can use easily. You'll be satisfied with both quality and cost phases.

Die-cast Model design Proposal System

Color anodized

Kyowa Aluminum Industry Corporation

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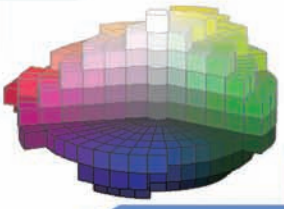
Color anodized

We reproduce wide range of color
Provides the color from your request
Our color reproduction is using proprietary technology



Hard anodized color

We can do hard anodized color
We can balance a vivid decoration and advanced durability

Alumite treatment

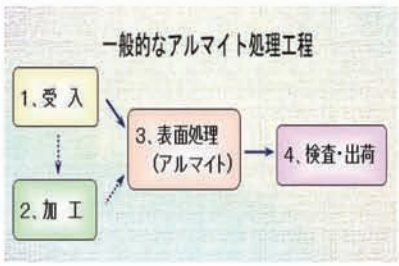
Color ・Hard anodized

Manual line

Normal anodized tank×1 tank
4,000(W)×900(L)×800(H)
Hard anodized tank×1 tank
1,200(W)×900(L)×850(H

Automatic line

Normal anodized tank×4 tank
2,200(W)×900(L)×1,150(H)
Hard anodized tank×1 tank
2,200(W)×900(L)×1,150(H



Greeting from The President

Since 1988, we have been aiming to improve the quality of surface treatment of aluminum products.

Even towards the 22 century, Aluminum is a necessary material to spend a good life for the comfortable environment for us.

We'll continue to challenge to the new generation.

We believed that we provide to our customers as soon as possible, and to serve the community for our future.

The President
Kouzo Inoue

Plating Business

Toho Plating corporation

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Toward Tomorrow

Manufacturing technology in Japan, we have been sweeping all over the world by the management and capacity development prowess. A key foundation technology is industrial surface treatment technology.

Current production in Japan has relocated overseas, " plating industry" in the country in the future must continue on the path of future high-precision and high-quality.

We'll make an effort to improving the technical capabilities, quality of power and environmental power for our future " manufacturing"

Surface treatment processing type list

Plating classification	Plating method	Plating bathtub	
Chemical conversion coating	Fully automatic equipment	chromium chemical conversion coating (trivalent)	
	Manually operate equipment	zinc phosphate coating.	
		copper oxide coating	
		coating on other materials such as Fe, Cu, SUS, etc.	
Zinc plating	Fully automatic equipment (static)	zincate bath (10,000 litres)	
		colored chromate (trivalent)	
		black chromate (trivalent)	
	Manually operate equipment (rotation)	2 bathtubs	zincate bath (1,680 litres)/ colored chromate (trivalent)
			black chromate (trivalent)
		3 bathtubs	zincate bath (750 litres)/ topcoat
Tin-zinc alloy plating	Semi-automatic equipment (static)	neutral bath (1,400 litres)/ colored chromate (trivalent)	
	Fully automatic equipment (rotation)	neutral bath (4,600 litres)/ colored chromate (trivalent)	
	Manually operate equipment (rotation)	neutral bath (3,100 litres)/ colored chromate (trivalent)	
Zinc-nickel alloy plating	Fully automatic equipment (static)	zincate bath (6,600 litres)/ colored chromate (trivalent)	
	Manually operate equipment (rotation)	zincate bath (1,300 litres)/ colored chromate (trivalent)	
Zinc-steel alloy plating	Manually operate equipment (static & rotation)	zincate bath (500 litres)/ colored chromate (trivalent)	
Hard chromic plating	Manually operate equipment	3 bathtubs	fluoride bath: 1,300 litres x 1bathtub
			1,200 litres x 2bathtubs
			beef bath: 1,300 litres x 1 bathtub
Electroless nickel plating	Manually operate equipment	4 bathtubs	electroless nickel bath: 100 litres x 2 bathtubs
			200 litres x 2 bathtubs
		electroless nickel composite plating (Ni-P-PTFE, Ni-P-B)	
Tin plating	Manually operate equipment (rotation)	luster acidity bath: 200 litres	
		sensglous acidity bath: 200 litres	
		dull luster acidity bath: 200 litres	
Decoration chrome plating	Manually operate equipment	copper-nickel-chrome, W nickel-chrome	
Passivation film coating	Fully automatic equipment	nitric acid bath: 250 litres	
	Manually operate equipment	nitric acid bath: 87 litres	
Alunite coating	Manually operate equipment	oxalic acid bath: 1,000 litres (hard plating)	
		sulfuric acid bath(hard plating, soft plating, coloring	
Painting	Fully automatic equipment	4 bathtubs	teflon coating x 3 bathtubs, solvent painting x 1 bathtub
	Manually operate equipment	teflon coating, common painting (solvent, waterborne)	
		cationic electrodeposition painting (black)	
Polishing	Buffing lathe		
	Semiautomatic short blast equipment		
Others		copper strike bath, nickel strike bath, copper pyrophosphate bath, etc.	

Company Info

Name of company

Toho plating corporation

Address

31-2 Nishigaokaaza Ooaza Murata Shibata-gun Miyagi prefecture

TEL.0224(83)5557

FAX.0224(83)2786

E-mail toho@soleil.ocn.ne.jp

President

Hiroo Shimada

Capital Stock

20 Million

Business info

Surface processing industry (Electricity plating, painting)

Employee

60 people

To form a technology

Our company get "ISO 9001:2008" and "ISO140012004".

We bring a system which is international standards with an Emphasis on quality management.

Our manufacture products that require high precision, such as sensors and automotive fuel supply system, high corrosion resistance, high durability. It can respond to large-lot mass production from small-lot short-term delivery.

In addition, we have taken a system that can reflect the know-how of development to mass production management place a dedicated department for newly developed products.

From Yamagata, we aim to technological innovation of noise filter coil

UENO CO., LTD.

http://www.uenokk.co.jp/

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What's Noise filter coil?

To prevent a malfunction of electrical products, electric components, which is cut the noise intrusion from power line, is included into the electricity most of the products.

Toroidal type
Common mode choke coil

We have been producing Toroidal coil by hand!

Ueno Coil

Revolutionize the world of noise filter coil

We developed new coil

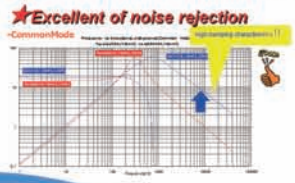
Ueno Coil horizontal type
◆Suitable for thin products◆

Ueno Coil vertical type
◆Reduce the footprint of a circuit board◆

Lineup of the 3-phase coil for a high tension current!

Merit of Ueno Coil

★Excellent of noise rejection



Winding time is just 10 seconds!!

Winding in 10 seconds by the high-speed automatic winding.
We did the man-hour reduction of about 90% compared with the Toroidal.

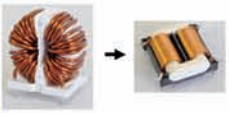
Winding directly to the closed magnetic circuit core

This is a new method that winding directly to closed magnetic circuit core!
Inductance improved about 20 % compared with open magnetic circuit core!

No short layers!

Tension of the coil is law at the time of the winding.
There are no short layers because of the single- phase winding.

From Toroidal to Ueno Coil



Company Overview

Name	UENO CO., LTD.
Name of Representative	President and Representative Director: Ryuichi Ueno
Date of Establishment	January 1982
Capital	412.7 million yen
Sales	37 million yen (May 2011)
Business Content	Design and manufacturing of noise filter coils, smoothing choke coils
Production Sales	Production volume (monthly production): 8,000,000 units

★ Major Awards ★

- Nikkei Manufacturing Award [Nikkei BP special award](2008年)
- Tohoku New Business Award(2009年)
- Selected as 300 companies manufacturing small & midium sized enterprises a healthy 2009(2009年)
- Manufacturing Nippon Grand Tohoku Bureau of Economy, Trade & industry director Award(2009年)
- Ministry of Education Award Science & Technology award [Technology sector](2010年)
- Ymagata Prefectural Industrial Award(2011年)

Ueno's challenge " Toroidal coil automatic winding machine"

We have developed an automated production system of the Troidal coil of the one and only in the world, and has been producing 20 million or more in total in Mikawa plant in Yamagata prefecture.

Compared with hand made, characteristics are more stable such as air conditioning. It is used in a variety of areas.

Attention !

Application of Ueno coil to the electronic vehicles

- Charger・Power feeding equipment
- DC-DC converter
- Inverter
- Defogger

Application such as Normal mode choke coil

- Car navigation・Audio
- Wiper
- Power window

Ueno coil is also used solar power.

To all of the companies

～We provide a coil fitted in your products!

Ueno CO., Ltd. develop and provide the noise-filter coils that are coping with customers' needs by powerful staff members, materials, facilities, such as simple anechoic chamber, and domestic plants of speedy trials.

Contact info: 0235-64-2351 Ueno production manager Watanabe
E-mail : info@uenokk.co.jp Home page :http://www.uenokk.co.jp/

We'll make Zinc alloy, Aluminum, Die-cast prototype, Casting parts machining of 500g or less!

Corporation Horio Factory

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3Keystones to make LOWER COST basis in industrial operation

Mold / High-Tech / Casting / Automation

1 Mold Technique - Accuracy Keystone

The Mold has Rich-Functions in a Compact Body! That Helps Usability.

- Compact Mold can be carried by one hand. To make Molds are Low Cost & Quick Turn
- By Discerning Mold, Accomplished Over 1 Million Shots Mold Life.
- By Using a Mold Multiple way, can Produce Various Kind of Products.
- By Coating Mold adv. of friction bush, Making High-Quality Products and Long-Life Mold.
- Creating Standard Mold Die Set which fits to a Die-Cast Machine's Cassette Base.
- Equipped Mold Release Spray Function

real size

Easy-to-Use ! Multiple Function

- Able to Carry by One Hand
- Low Cost
- Quick Turn
- Mold life : over 1 Million shots

2 Die-Cast Technique - Casting Keystone

The Technique of No Burr in Parting ! That Helps 'Must-be' Quality.

- Accomplished Mass-Produce by 5t Compact Die-Cast Machine, Not large-machinery
- High-Shot Produce by 5t Die-Cast Machine
- Accomplished High-Quality Parts Production by Creating Processing Conditions Standard
- Simplified Mold Description by Cassette System that can be replaced by Whole Set
- By In-House Products, Making Low-Cost / Double the Life of Wearing Parts of Die-Cast Machine
- Nozzle-Touch Mold Injection Prevents Drip-offs
- Equipped In-House Eject Mechanism to Die-Cast Machine (Zinc Materials)
- Purchasing Zinc Materials by Direct Deal, Not from Trading Companies

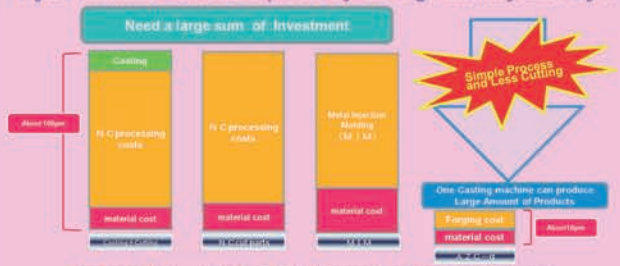
3 Automation - Self-Manufacture Keystone

Responsive Technique; Clued-up Attention to Improve ! That Helps Quick Turn.

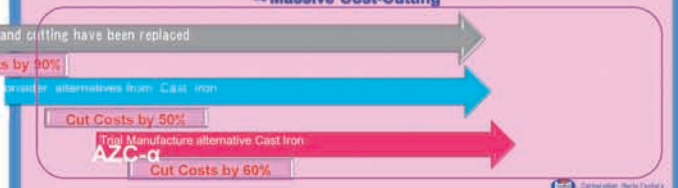
- Automatized Hand-Processing Operation Line
- Combined Full & Semi-Automatic Screw Cutting
- Equipment not for one use, but for versatile
- Automatized Chuck Device for visual-aspect Chuck
- Automatized Finishing Bore

Birth of High-Intensity Die-Cast Zinc Alloy !

If your materials would be improved by our High-Intensity Zinc Ally ...

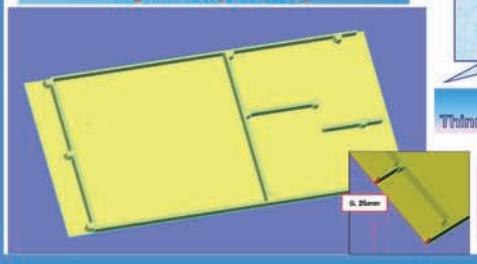


Alternate Current materials to Expensive High-Intensity one ⇒Massive Cost-Cutting



Challenge of Hot Chamber Die-Cast !

Suggesting Thin-Wall Molding by High-Intensity Zinc Alloy



Ultra Thin-Wall test piece (Challenge making chassis of Smartphone)

Completa! Thinness of case; 0.25mm

Aluminum / Magnesium ⇒0.4mm

High-Intensity Zinc Alloy⇒0.25mm

Contributing to Thinner Wall of Mobile devices like Smartphone

High-Intensity Zinc alloy A Z C-α Efficiency

Comparing with ZDC-2, about Double Strength

Composition and performance of AZC-α

1.Chemical composition(%)

Material name	Al	Cu	Mg	Cd	Pb	Fe	Sn	Si	Mn	Mech metal	Zn
AZC-α	7.85-8.55	3.00-3.30	0.03-0.06	≦0.002	≦0.003	≦0.075	≦0.001	–	–	0.03-0.07	Residue

2.Physical properties

Material name	Density kg/m³	Conductivity %IACS	Coefficient of thermal expansion ×10⁻⁶/℃	Solidification temperature range℃	Thermal conductivity W/m·k	Specific heat J/kg·k	Liquidity 630℃ (mm)	Poisson's ratio	Specific gravity	Remarks
AZC-α	6300	28	23	405-380	115	835	280	0.295	6.3	

3.Mechanical properties

Material name	Tensile strength (MPa)	Breath (%)	Longitudinal modulus elasticity (Gpa)	Charpy impact (J/cm²)	Fatigue strength (1×10⁴ 循環Mpa)	Hardness(HB)	Pull 0.2% proof stress(Mpa)	Elongation at break(%)	Potential difference(mV)	Remarks
AZC-α	500	5	93	100-120	180		500	–	–	

Low Cost Manufacturing Comes True by Zinc Die-Cast Parts Casting

Points

- Proposing Engineering to Customers to Derive Better benefit from Manufacturing of New Part at Low Cost
- Supplying Optical Pickup Parts 30% Market Share of Global
- Own-Design Auto Fabrication Technology, Possible to Manufacture
- Own-Design Mold, Possible to Manufacture

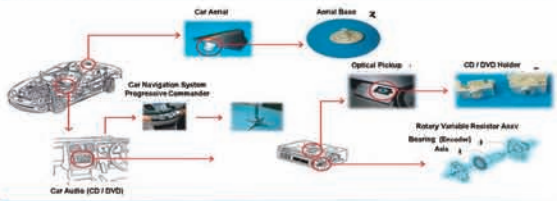
Zinc Die-Cast Parts ((Example of Application)

Technical Content

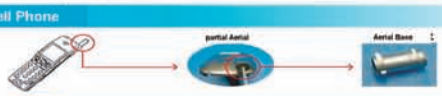
Products which were Created from Encounter with our Customers

Product Line : Optical Pickup Parts (DVD, Blu-ray) , Aerial Parts, Home Appliance Parts, Communication Device Parts, Industrial Device Parts

Vehicle installation



Cell Phone



By Zinc Die-Cast

Making Low-Cost Manufacturing Comes True

- Low-Cost Manufactured Mold Multiple Functioned Compact body Can be Carried by One Hand
- Attain Customer Satisfaction Auto Fabrication Technology
- High-Shot Produce by 5t Die-Cast Machine

〒987－1103 21-2 Takachiyaichi Kitamura Ishinomaki-shi Miyagi prefecture
Corporation Horio Factory
tel0225－73－2488 fax0225－73－3271
e－mail: info@horioss.co.jp

Corporation Horio Factory

Challenge to The State- Of –The Art Image Processing & Next Generation Vehicles

Tohto C-tech Corporation

http://www.tctec.co.jp

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— Obstacle detection on the road —

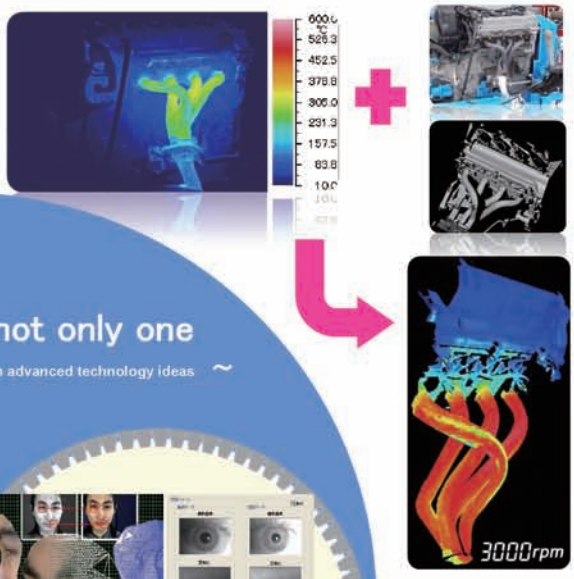
3-D measurement by stereo camera

This system detects obstacles on the road such as vehicle and people. Processing three-dimensional measurement from stereo images, it detects the road surface. If there are some objects higher than road surface, these are detected as obstacles.

— 3dimensional heat measurements —

「3dimensional measurement」×「Temperature distribution measurement」

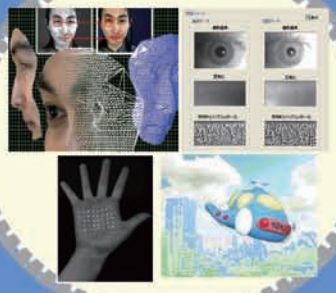
This system can synthesize thermal image and three dimensional data to process three-dimensional temperature distribution data. Using this system, you can detect accurate relationship between spacial position and temperature. For example, You can apply this system to heat test or product evaluation of thermal design.



Point of view is not only one

～ We will help you to solve problems with advanced technology ideas ～

Toto C-tec



System development in the middle of society

AUDIO, smart phone
etc…→Bluetooth／USB／BUS

- Power window／Sliding door
- Auto air conditioner
- keyless entry
- Push engine start

▼Technology component
- Power supply/ Mechanical device control
  System power control, motor control, such as D/D converter control
- Various IC control
  LCD control IC control, Backlight control (FL,LED) etc….
- Model based development
  MATLAB/Simulink, Auto coding／Auto test

—Automotive embedded software development —

Car navigation, body control system ECU

C-tec kun

—Business Area—

Image processing Solution	Embedded system solution	Parallel & speed-up solution
Problem-solving (algorithm Review)	MATLAB/Simulink Model-Based Development	Porting
Prototype development & joint research		Consulting
System development	Software Outsourcing	Software outsourcing

To every customers

～Have you troubled by the image processing system ？～

We're utilizing the state-of- the- art image matching technology with guidance from Tohoku University Professor Takafumi Aoki. Using synthesize of some of image information with different nature such as X-ray, infrared, advanced three-dimensional measurement, we achieve defect inspection system, the abnormal temperature measurement and so on.




Venture Capital for Innovation in Tohoku

Tohoku Innovation Capital Corporation (TICC)

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■ Company Information

- Company's name Tohoku Innovation Capital Corporation ("TICC")
- Address 1-1-1 Honcho Aoba-ku Sendai-shi Azur SENDAI F16
  <Tohoku Uni. Office> 6-6-40-407 Aoba aza Aramaki Aoba-ku Sendai-shi (inside the T-Biz)
- Business Investment and management support to venture companies, and management of the venture capital funds
- Establishment October 2003
- Paid up Capital 70 million yen
- Number of staff 11 people
- Board members
  President Ko Kumagai (ex President, Nikko Capital)
  Executive Vice President Kazuyuki Igarashi (ex JAFCO)
  Director Shiro Takahashi (ex Representative, Sony Sendai technology center)
  Director Shoichi Noguchi (Professor emeritus, Tohoku Uni.)
  Auditor Akio Nishizawa (Professor, Toyo Uni.)
  Advisor Yasutaka Iguchi (President, Miyagi Organization for Industry Promotion)

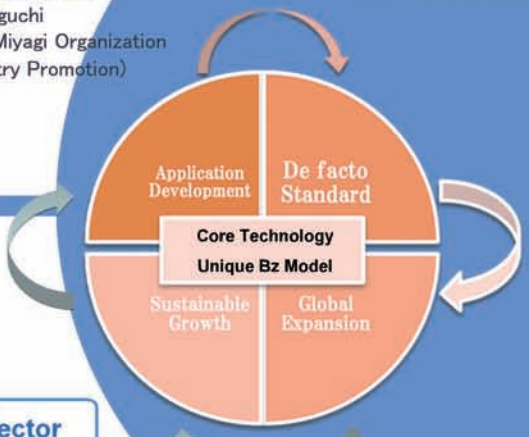
■Funds under management

・Tohoku Incubation Fund
Established March 25, 2004
Fund total 31.8 billion yen

・Tohoku Growth Fund
Established August 31, 2006
Fund total 35.8billion yen

・TICC University Alliance fund
Established June 22, 2007
Fund total 10.11billion yen

Support growing companies seeking global expansion based on the core technology



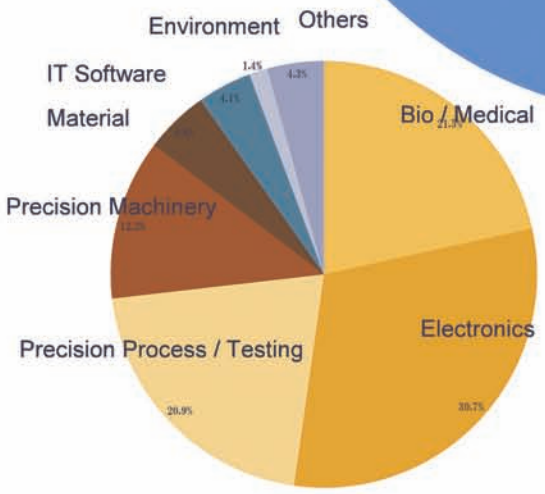
Growing Businesses

- Leading edge technology based on universities/research institutes
- Unique business model
- Application development with high added value to potential demands in various industries
- Adoption by global leading companies aiming to be de facto standard
- International expansion
- Sustainable high growth with profitability

Financial/management support

TICC
- Risk capital
- Business development
- Management support
- International expansion

■Portfolio by Sector



■Building a global network

- It is important for expansion into emerging markets in East Asia.
- In order to support the overseas expansion of investment companies, TICC is conjunction with research and development institution with overseas.
- First of all, signed with MOU with following two institutions

◆(Taiwan) Industrial Technology Research Institute(ITRI)
◆(Korea) Korea Technology Venture Foundation(KTVF)

To potential limited partners

~For "Tohoku Revival Fund" (Our New fund)~

It is our mission that through our investment activities, various technology-potential in Tohoku is commercialized as ventures, develops successfully as sustainable international businesses, and contributes to vitalize regional economy. Now we are launching 4th investment fund until mid of 2014.

Contributing to the filed of Automotive Electronics with Optical Technology

HAMAMATSU PHOTONICS K.K.

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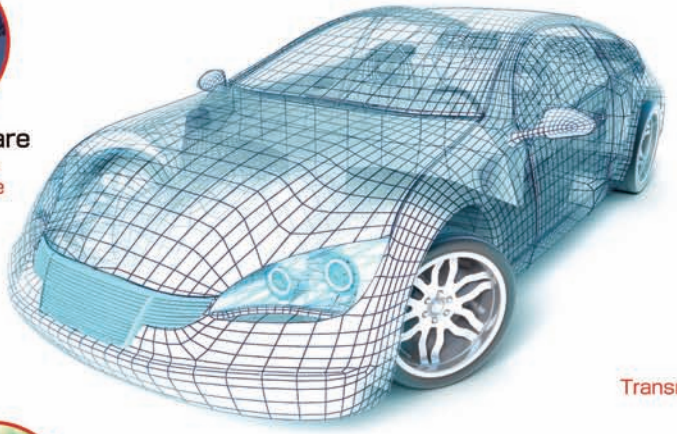
Hamamatsu Photonics' Automotive Solutions

We contribute to safety, comfort, and energy-saving driving for vehicle drivers using our forefront optical technology.

Sense the Glare
Si Photodiode
Photo IC Diode



Sense the Sun
Si Photodiode
Sun Sensor Assembly

Sense the Music
Transmitter Photo IC/ Receiver Photo IC

Sense the Rain
Si Photodiode
Infrared LED

Sense the Distance
APD,
Image Sensor for Distance Measurement
Pulsed Laser Diode

Sense the Corner
APD, Si PIN Photodiode
Image Sensor for Distance Measurement
Infrared LED, Pulsed Laser Diode

Sense the Angle
Photo IC, Encoder Module
MEMS Mirror

Products for Manufacturing Processes

Hamamatsu Photonics has a line of products which support manufacturing.
Please feel free to contact us for more details.

- Surface Reforming
- Thickness Measurement
- UV Coating
- UV Gluing
- Laser Welding
- Spectrophotometry
- Electrostatic removal
- Nondestructive Inspection
- Micro/Minute Pin Hole Detection
- Imaging Measurement

HAMAMATSU
PHOTON IS OUR BUSINESS

HAMAMATSU PHOTONICS K.K.

Established	September 29, 1953
Capital	34,928 Million Yen (As of end of Dec., 2012)
Number of Employees	3,045 (as of end of Sep., 2012)
Main Product Lines	Photomultiplier Tubes, Imaging Devices, Light Sources, Opto-Semiconductors, Imaging and Analyzing Systems
Domestic Center	Headquarters, Main Factory, MitsueFactory, Shingai Factory, Toyooka Factory, Tenno Glass Works, Joko Factory, Miyakoda Factory, Central Research Laboratory, Tsukuba Research Laboratory, Industries Development Laboratory, Tokyo Branch Office, Sendai Sales Office Tsukuba Sales Office, Tokyo Sales Office, Chubu Sales Office, Osaka Sales Office, Nishinihon Sales Office
Global subsidiaries	America, Germany, France, UK, Sweden, Italy, China

www.hamamatsu.com

Create our future

～Contribute to people and company with our products by credible technique～

Miyagi-Kasei Co,.LTD

MEXT　TOHOKU ECONOMIC FEDERATION　Tohoku University　宮城県　七十七銀行　ICR

Company information

◆Information
- ☐Name　Miyagi-Kasei Co.ltd
- ☐Address　15-4, Kitazawahankinzawa, Ichihasama, Kurihara, Miyagi
- ☐CEO　Akihiko Oyama
- ☐Date of Foundation　April 1987
- ☐Paid in capital　¥20 milions
- ☐Number of Employees　40 employees
- ☐Certification　ISO9001
- ☐Permits and Licences

◆Business Outline
- ☐Manufacture and Marketing for FRP products
  - ・Car Components（Bumper, Body, Air Deflector for Truck, Camper, Covering Panel, Temporary Toilet, Vessel, Playground Equipment, Rest of general FRP products）
  - ・Lent and Marketing for Construction Material（Temporary Toilet, House, Shower House, Supply for an Event）
  - ・Construction Work（Construction of lining and sealing, Insulation, etc.）

◆Main Customer
- ☐ Automobile
  - ・ICL, Mitsuoka Mortor, Lotas, FirstCustom, Fatra Styling, KLC
- ☐ Construction
  - ・Housing Manufacturers , Constructor, Lent Company for constriction machine

◆Group Company
- ☐Haipura-Kasei, Co.LTD

Company Principle

Contributing to our society and people by means of creating newer and valuable products.

Improve our ability and personality to produce and innovative superior products for the benefit of all.

Main Factory Description

Gross Area
6，８００㎡
- Molding factory area　６７１㎡
- assembling factory area　２０５㎡
- finishing factory area　１９７㎡
- resting &warehouse area　１９７㎡
- Office area　１１３㎡

Forming Technique for FRP

①Hand Lay up molding

②Spray-up molding

③Light RTM molding

④Infusion molding

Method of molding

① Hand Lay up molding
Paste glass and resin into mold by hand

② spray-up molding
Spray glass and resin by spray molding machine

③ Light RTM molding
Set glass fiber into rough forming die, and put resin in it.

④ Infusion molding
Set glass fiber and put resin by vacuum drawing

Our effort for new technique

Development of noninflammable transparency

Construction (Bulding material for inside and outside)
Aviation and Space (Aircraft)
透明性
Vehicles (Trains) (Cars)
Energy (Solar light panel)

■ Glass
- ・Transparency and noninflammable
- ・Heavy and easy to brake

■ Plastic
- ・transparency and light
- ・Hard to brake
- ・Lack of noninflammable

Cover for light in the Train

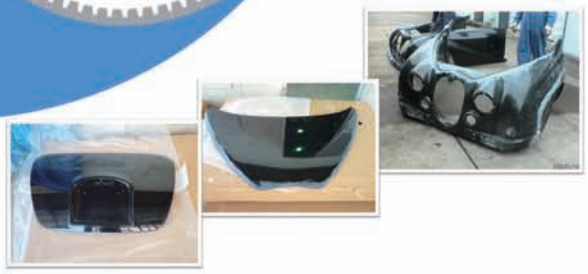
Expected lots of needs in huge field

Transparency, noninflammability and strength are related to the transactions, so it is difficult to cover together in the same time.

Advanced Industrial Science and Technology, and our GFRP try to consist and improve their noninflammability and transparency by our new combination materials

Mitsuoka mortor Viewt

FRP　Frontface
Bonnet
Trunk



Message for all

～As your partner company which create our future with new ideas &challenges～

We consider what can be useful for customers and society,
And we develop and create the products to contribute to our society.

TEL +81-(0)228-52-3931　FAX+81-(0)228-52-3933
E-mail : info@miyagi-kasei.co.jp　URL : http://www.miyagi-kasei.co.jp/

Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

We provide you the best solution with the highest technology

Daisho Denshi Co.,LTD

MEXT　TOHOKU ECONOMIC FEDERATION　Tohoku University　宮城県　七十七銀行　ICR

PROFILE

◇Company Name : Daisho Denshi Co.LTD
◇Address: 2-16-5,Denenchofu, Ota-ward, Tokyo
◇Date of Foundation : 12 September 1968
◇Paid in Capital: ¥730milions
◇CEO: Naotoshi Shinozaki
◇Main Products :Plan and Manufacture of Printed circuit board
・Planning for pattern, various simulation
・BGA board, CSP board, COB board, FC-BGA board
・Build up multilayer board, Cavity board
・BVH/IVH multilayer board
・Magic Resin Career
・Laser Metal Mask
◇Annual Revenue : 20,100milions
◇Number of Employee: 1,000
◇Main Customers : ・FUJITSU Co., LTD
・CANON Co., LTD
・J-Device Co., LTD
・SHARP Co., LTD
・Murata Manufacturing Co., LTD
・Mitsubishi Electronic Co., LTD
・Altech corporation Co., LTD
・Panasonic Co., LTD
etc.

NETWORK

Total Support System

We are flexible to your demands throughout the process for manufacturing.

6Layers Flexible-Rigid Build up

TOYOTA

CAMERA MODULE

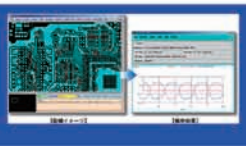
BLUE TOOTH

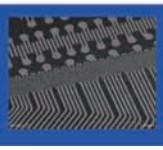
6Layers Build up

4Layers

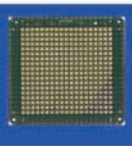
ENGINE CONTROL PARTS

We have cultivated a development and manufacturing technology, expertise and network since our foundation. Utilizing these abilities, we have created total support systems such as manufacturing, pattern planning, simulation, manufacture of tool for production, package support tool, development of inspection tools, parts package, construction for unit, assessment for reliability and so on.





Main Office : ☎ 03-3722-2151
Iwate Plant : ☎ 0191-63-5111
http://www.daisho-denshi.co.jp
DAISHO DENSHI



Using electric vehicle COMS

Car Sharing system

Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

TOYOTA TSUSHO CORPORATION
Green Mobility Business Development Dept.
81-3-4306-3174

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Excellent ideas to use eco-friendly Micro EV,"COMS"

EV Sharing
@ Community, Condominium, Workplace, Tourist area etc....

Selling points of COMS sharing system

●Remaining battery level and cruising range estimation

Display battery level & cruising range

Select "Station" ⇒
"Departure time" ⇒choose "Vehicle"

Display battery level and possible travel mileage

＊State-of-charge (SOC) is calculated by information from COMS and accumulated charging data.
＊Cruising range is calculated by remaining battery level.

Driving route search

Plot your "destination"

Route Search ⇒Battery consumption calculation

Possible to reach destination　**Unable**

Display "Estimated time of travel" and "Distance"　**Display "NG"**

＊Calculated by accumulated driving data and slope/grade information on map and driver's past driving characteristic.

State-of-charge projection after drive & estimated battery charging time display

SOC projection after drive

Calculate battery charging time & recharge level

＊Estimated SOC at the .time of car return is calculated by accumulated driving data and actual current battery level.
＊Estimated battery charging time and recharge level are calculated by accumulated charging data and CAN information from COMS.

Inflection line matching algorithm

～Advanced defect detection technique for painting on mirror surface by image processing～

By Three projects corporation

MEXT　TOHOKU ECONOMIC FEDERATION　Tohoku University　宮城県　七十七銀行　ICR

Company profile

Address：〒981-3212　15-22 4 cho-me, cho-meigaoka Izumiku Sendai, Miyagi
Established ：　March 3, 1987
Capital stock ：　10million yen
Employee ：　31 people（March,2012）
Office ：　Headquarters（Cho-meigaoka Izumi-ku）
　　Furukawa branch（Nakazato Hurukawa Osaki Miyagi）
Business info　：1. Embedded Systems
　　2. Measurement & test system development
　　3. Operational systems development
　　4. Image processing system development
　　5. digital / analog circuit design
　　6. Research & development

東北で初　ナショナルインスツルメンツ社 アライアンスパートナー（東北初）
LabVIEW認定開発者5名（東北最大規模、国内トップクラス）

※April ,2013
・1　NI certified instructor
・5　certified LabVIEW developer
・3 certified　LabVIEW associate developer

NATIONAL INSTRUMENTS Alliance MEMBER

"2010 Strategic Technology Infrastructure Support Sophisticated Business"
Adoption Projects
" Commercialization and development of image processing embedded software for enhancing visual for industrial robot"

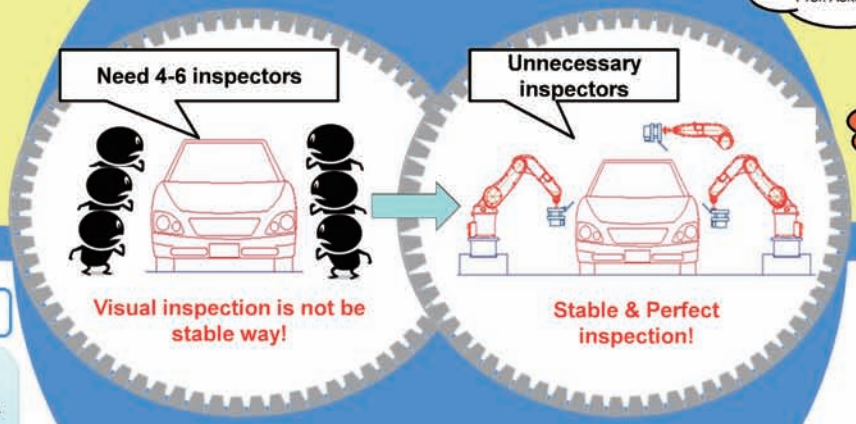
One of the project development result "Inflection line matching method"
※ As "surface inspection method and surface inspection device". The patented in January 2013.
（Patented :Number 5182833 ）

【Joint research group】(Alphabetical order)
Hikichi Seiko Corporation
Miyagi Prefectural Industrial Technology Center

【Adviser】
Tohoku University Grad school of Information Science & Technology.
Prof. Aoki

industry-academia-government – collaboration

Automatic defect inspection



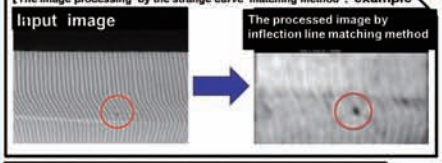
■Prevent defect outflow
■Save inspection cost

Summary of Inflection line matching method

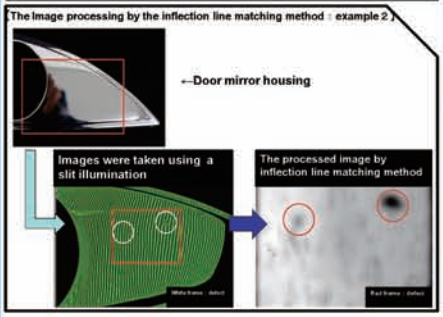
・Algorithm to highlight irregular part of the interval and the direction of the curve in the image.

< Applications >
⇒Using slit of the organic EL lightning to imprint slit on the test object to take in image.

【The image processing by the strange curve matching method：example】



【The Image processing by the inflection line matching method：example 2】



【Applications】

・Surface defect inspection of the exterior and interior automotive products

・Surface defect inspection of plating painted

・Surface defect inspection of metal processed goods

・Surface defect inspection of plastic products

・Surface defect inspection of resin processed products

Etc…Applicable to defect inspection with respect to the surface that has the property of specular reflection to the light.

※１のサンプル画像

① 検査対象物

対象物	表面状態 ゆず※1	微細痕や汚れ※2	鏡面	艶有り	艶なし
塗装（メタリック含）	×	×	○	○	×
メッキ	−	×	○	−	−
金属加工	−	×	○	−	−

② 欠陥、及び検査対象物の形状

表面状態	欠陥 線キズ	汚れ ゴミ	ゆるやかな凹凸	鋭利な凹凸（ブツ含）	検査対象物の形状 平面	ゆるやかな曲面	きつい曲面	カド	複雑な曲面
ゆず※1	×	×	×	×	×	×	×	×	×
微細痕や汚れ※2	×	−	×	×	×	×	×	×	×
鏡面	△	○	○	○	○	○	△	×	△
艶有り	△	○	○	○	○	○	△	×	△
艶なし	×	×	×	×	×	×	×	×	×

※1 欠陥とまでは見なされない程度のゆず肌（塗装表面の粗さ（ラウンド））のうち、比較的きついもの。
※2 表面を切削した時につく切削痕のきついもの（光を回折させ虹色に見える縞キズなど）や、表面光沢を失わせる汚れが、検査面全面に付いているもの。

By three projects corporation
〒981-3212　15-22　Chomeigaoka Izumi-ku Sendai
TEL:022-342-7077／FAX:022-342-7079
http://www.x3pro.co.jp/
E-Mail:sales@x3pro.co.jp

We'll provide "New familiar Hybrid"

My Car Plaza Eco Custom Division Corporation

http://www.e-rhs.com/

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Hybrid Cars Evolution to " Ultimate Eco-Car"

RHYBRID Prius α(ZVW41)


TMS2011 at Venue

LPG + Electricity + Gasoline

The evolution to the " ultimate eco-car" by the RHYBRID of the motor hybrid car is synonymous with eco- friendly cars.

The exhibitors participating in RHYBRID Priusα in 2011 Tokyo Motor Show. It was a celebration of next- generation vehicles. Many visitors had to experience abroad to see.

Active in the Nationwide "not a dream" as the vehicle realistic

RHYBRID, so called Bi-fuel LPG remodeling is a technique that can be practiced right now.
The economic efficiency and excellent environmental performance, a lot of attention from taxi operators around the country, especially in Tokyo metropolitan area, there are more than 400 taxi vehicle active currently.
As a car running daily basis, there is a running truck record of more than 300,000 km after remodeling.
There is also a truck record of introduction as official vehicles of municipal and commercial vehicles.

Adoption in local government, is due to the strong focus on LPG in case of emergency in the earthquake earlier.

Use of fuel as the "LPG"

Realistic Ecocustom=" Real HYBRID system "

RHYBRID®

Innovative Custom for Eco

Non-stop Evolution


RHYBRID Hiace(TRH224 renewal)


RHYBRID Camry(AVV50 Renewal)


RHYBRID Professional box(NCP51 renewal)

Prius series is the flagship model in our company, in order to respond to various needs, we'll continue to expand its corresponding model.
We don't think a technology that requires million people, but at present, it is in the process of evolution of automotive technology, we believe that technology that connects to the next generation.
Know-how and retrofit technology that we have is immediately transferable to bi-fuel of the LNG and CNG.
Now, it is a next generation energy issues such as Payload and infrastructure, challenge of widespread use, but when the conditions are in place, it is a technology that can immediately respond.

Our priority

"Operation and without traveling all the same and ordinary cars, and this device many not be in accident"
"We do not put on the market absolutely until convincing technically"
Feelings that we have for RHYBRID specification care is these two points. Car is to break must be somewhere during using it. However, since it is a customize car, development has been put on the maximum important so that it may not say that it broke.
It is modest as those involved in the special car, but it is the feelings that can not be bent in any way.

RHYBRID仕様車 設計・開発・施工・販売
My Car Plaza
http://www.e-rhs.com/
My Car Plaza Eco custom Division Corporation
〒028-3161 4-23-1 Kuronuma Ishidoriyacho Hanamaki Iwate
TEL:0198-45-2700　FAX:0198-45-6579
e-mail:info@e-rhs.com

Ministry of Education, Culture, Sports, Science and Technology
Area innovation strategy support program next generation car Miyagi area

Auto industry support through technology seeds

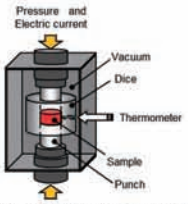
AKITA Industrial Technology Center

MEXT · TOHOKU ECONOMIC FEDERATION · Tohoku University · 宮城県 · 77 七十七銀行 · ICR

Super hard tool materials of resources strategic type

We've tackled development of hard tool materials have high hardness and high crack length. As a result, it was found that Tungsten carbide(WC) raw material of the hard metal becomes densification adding SiC. Therefore, we become able to make WC-based cemented without addicting cobalt(Co).

A prototype of burnishing reamer collaborating with companies

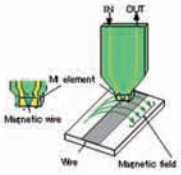


Development method of hard tool materials

A high frequency magnetic detection element

We developed MI probe measurable electric current of the wiring contactlessly from direct current to high frequency with high sensitivity. Covering all frequency band and having flat frequency characteristics, that implements 10 micron spatial resolution. This one can evaluate EMC of the whole vehicle body. Application as high frequency noise sensor, high bandwidth magnetic field sensor, and rotation sensor are capable also. So, the structures are simple and the manufacturing cost can suppress.

The measurement example by developed MI effect type magnetic probe



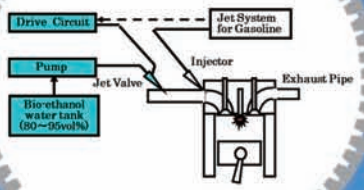
MI probe

Development and proof experiments of Dual-Fuel Vehicle

We took running tests in Solar sports line of Oogata-village.

As a result, we finished proof experiment safely without engine trouble.

It was equipped with a bio-ethanol tank in addition to the gasoline tank.



To a minimum remodeling of around engine!

DFV is the automobile can use two fuel both gasoline and bio-ethanol water coincidently. The vehicle runs by providing the two fuel from the two fuel supply systems to the engine. Accordingly, reducing carbon dioxide could be expected.

A prototype has flexibility.

The example can make simultaneous trials using two color resins.

The Rapid Prototyping technology don't need metal mold, and you can get prototype in a short time. It can raise capability to develop new products. In addition, you are able to shape prototype from three-dimensional data(STL) gained by three-dimensional CAD or 3D scanner, and the feel of shaping model and function can be evaluate.

Prototyping by digital engineering

Autoclave

The carbon fiber reinforced plastic(CFRP) has merits like lightness, high strength, high rigidity, high corrosion resistance. It is the next-generation material which expanding a substitute from conventional metal material rapidly as structure material of automobile parts. Our center aim to expand industrial utilization, by maintenance of facilities and developing technology seeds.

Composite Center

For companies

It becomes high function and low cost of automobile parts and others by the locally laser quenching technique, which is our center's technology seeds. Also, we design an improvement in productivity for automobile factories by the hardness test gripper technique for industrial robots. In this wise, we support automobile industry with seeds of technology of design, processing, and measurement based on materials engineering, mechanical engineering, and electrical and electronic engineering. For more information or any question, please contact the contact address below.

Akita Industrial Technology Center Technological innovation department
TEL +81-(0)18−862−3420 FAX +81-(0)18−865−3949 http://www.rdc.pref.akita.jp/

Highly recommended!

"LNG-DDF", Main figure in the shale gas revolution

LPG・CNG hybrid system of gas

Hana Engineering Japan Co., Ltd.

http://www.hanaeng-japan.com

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Retreat from nuclear power and the shale gas revolution

After the Great East Japan Earthquake, the extreme begun to retreat from nuclear power worldwide. Then, simultaneously the times changed not to rely on petroleum energy. That is the fuel revolution by developing of fuel gas mining technology, representative USA. The new hybrid system of motor and gas not to rely on gasoline protect the global environment, with a thermal power station makes retreat from nuclear possible, and the fuel battery car instead of electric cars.

When Japan is waved by retreat from nuclear, the shale gas revolution is in progress in the world. It advances to retreat from nuclear and protect people's life that Japan make fuel revolution as a member of the shale gas revolution.

Nowadays, if the motor hybrid based on gasoline car increase fuel efficiency 40% compared with gasoline car, development of gas hybrid by the shale gas revolution can increase fuel efficiency 30% furthermore.

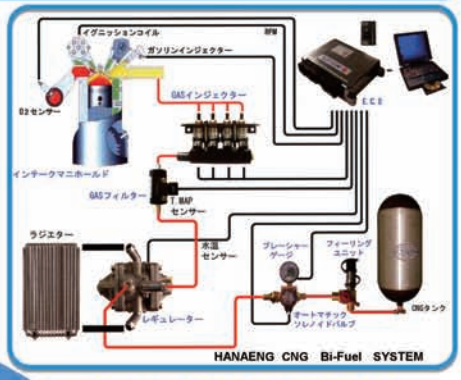
Therefore, almost hazardous wastes will be restrained, and many high environmentally cars exist in the world.

The lowering of price of automobile fuel by the shale gas revolution, automobile fuel efficiency will be able to be halved. So the spread reducing hazardous waste from cars, we can leave the precious legacy beautiful earth to offspring.

The secondary fuel system not rely on gasoline oil when earthquake

Bi-Fuel

Bi-Fuel is hybrid of gasoline and gas, when warming-up operation it uses gasoline, a few minutes later it switches to gas automatically. When the Great East Japan Earthquake gas stations ware filled of crowd, Bi-Fuel car ware able to supply at vacant gas station. Fuel efficiency rise 30 to 35%, and CO2 are cut down above 20%, Nox, PM etc. are able to reduce 50 to 70%. It uses gas: LPG, CNG.



HANAENG CNG Bi-Fuel SYSTEM

LPG・CNG gas hybrid system

We provide next generation car.

Restraining hazardous exhaust materials, CO2 decrease and fuel efficiency increase.

Gas hybrid system, the most practical, becomes the leading role of the shale gas revolution.

We provide the most practical gas hybrid cars that convert petroleum fuel car into high environmentally car as the primacy of post-oil fuel in automobile world, solving retreat from nuclear power in Japan, not being late for the shale gas revolution only once in a century or two centuries in the world.

CNG Bi-Fuel Gas Injection System

It can utilize almost gas, such as LNG, HHO.

Japanese taxies choose Prius Hybrid instead of gas powered vehicles.

For several years, Japanese taxi companies have replaced Toyota Prius with LPG auto gas car. And simultaneously, the number of taxi company convert Prius into gas hybrid boosted. Used Bi-Fuel system are occupied almost 100% by our company made.

Company profile

Company name
Hana Engineering Japan Co., Ltd.
Paid in capital 10,000,000yen
Founded October 2009 established May 2011
President Kazuhiko Kami
Head Office Tsurugaoka2-12-3,Izumi-Ku, Sendai, Miyagi, 981-3109Japan
East Japan Sales Department
HANA JAPAN first building 2F
3-1-43 Haranomachi, Miyagino, Sendai
983-0841,Japan
West Japan Sales Department
Haruhiyaketa67-2Kiyosu-shi, Aichi-ken 452-0962Japan
System hybrid department
HANA JAPAN first building 3F
Haramachi3-1-43,Miyagino-Ku, Sendai
Information center
HANA JAPAN first building3F Haramachi3-1-43,Miyagino-Ku, Sendai

Products and sales items

Gas hybrid system in general
・LPG Bi-Fuel system
・CNG Bi-Fuel system
・LPG-CNG Bi-Fuel system

Correspondence gas:
LPG,CNG,LNG,HHO, oxyhydrogen (OHMASA-GAS) biogas in general
・Plan, Design, Product;
Limousine, Adapted vehicles
・The ability test strength and stiffness of cars in general
・Operations authorized by Ministry of Land, Infrastructure and Transport and related ministries

Sales department building, view from National Route 45

The gas hybrid car's the range per one fuel filling is 10 times as long as electric car. It can reduce CO2 20 to 22% compared with gasoline, reducing hazardous wastes 60 to 90% such as Co, HC, Nox, PM, Sox, fuel efficiency can increase 30 to 40%(compared with gasoline car).

※Though "hybrid" means to have plural motor in one car, "Bi-Fuel" means the system combusts dual fuel by switching alternately, we express all of those "hybrid" to understand by general public.

Hana Engineering Japan Co.,Ltd.
East Japan Sales Department 3-1-43 Haranomachi, Miyagino, Sendai 983-0841,Japan
TEL +81-(0)50-1208-5862(representative) FAX +81-(0)22-776-5072
E-mail: hanaeng_japan@ybb.ne.jp
http://www.hanaeng-japan.com

After the Great East Japan Earthquake, the world began breaking with nuclear power generation. One only accident takes life and the health of innumerable people, and it makes towns into the death. Spread of electric car increases electrical energy consumption by 10%, it puts on the brakes retreat from nuclear. It is not enough that wealthy families install solar power system. A nominal that we are supplied from electric cars when a natural disaster, but cars are not able to at the important time. Besides, the batteries retain only several hours. Solar power system responds the case of a power failure due to a disaster, any days or any weeks. Though the problem of thermal power generations is only fire, nuclear reactor convert a hometown into dead town. Almost all regions have the possibility. The tragedy of FUKUSHIMA is not another person's problem. We contribute to retreat from nuclear with making cars using clean energy liquefied natural gas (LNG). Gas cars and electric cars. Electric cars sound smart, but we hope you to find out there are dreadful power supply source behind them. Although the nuke has called safety and reasonable, the Nuke accident of the Great East Japan Earthquake caused a great illluck, and its amount of damage is as tens or hundreds times as the cost when it was built. Now Japanese government seems to force people to pay that , we are convinced the importance of gas hybrid, because we must choose a choice to protect our offspring .

To provide our customers with the added value different from the other companies based on innovate material

NEC TOKIN corporation

MEXT　TOHOKU ECONOMIC FEDERATION　Tohoku University　宮城県　七十七銀行　ICR

Company overview

Company's name: NEC TOKIN corporation

Capital stock: 34.2 billion yen

Sales figures: 41.3 billion yen (2012)

Number of employees: Consolidated 6,014 (Domestic 1,298 international 4,716)

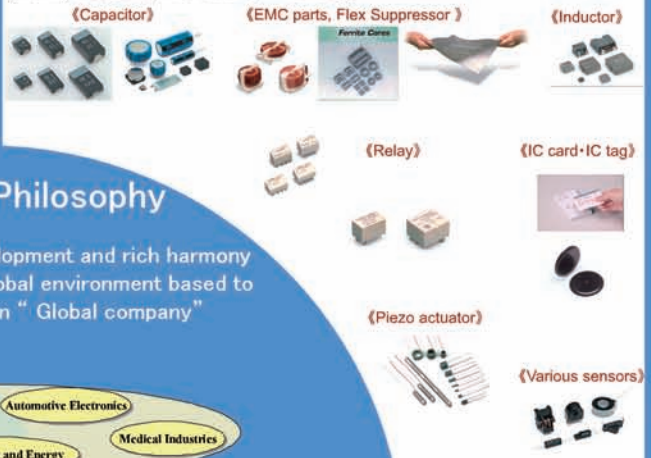
Production plants: 7 (Domestic 3, International 4)

As of March 31,2013

Factories and Products

Main product

Tantalum capacitors, Electric double-layer capacitors, EMI suppressing components, Flex Suppressor (noise suppression sheets), Power inductors, Signal Relays, Power relays, IC cards and IC tags, Piezoelectric devices, Sensors (Temperature, vibration, infrared).



Corporate Philosophy

We contribute to the development and rich harmony between people and the global environment based to the material innovation " Global company"

Main Markets

Digital Consumer Electronics / Automotive Electronics / Industrial Equipment / Environment and Energy / Medical Industries

Main Products

Capacitors
- Tantalum capacitors
- Electric double-layer capacitors
- Proadlizer

EMC Electro-Magnetic Components
- AC line filters, Flex Suppressor
- Power inductors, Transformers
- Magnets, Metals

Electro-Mechanical Devices
- Power relays
- Signal relays

NFS
- Near field communication

Access Devices
- IC cards and tags

Piezoelectric Devices
- Piezoelectric materials
- Piezoelectric actuators
- Piezoelectric transducers

Sensors
- Thermal sensors
- Electric current sensors
- HD haptics ・FFB

Core Technologies

Capacitors' Materials: Tantalum / Conductive polymers / Active carbon

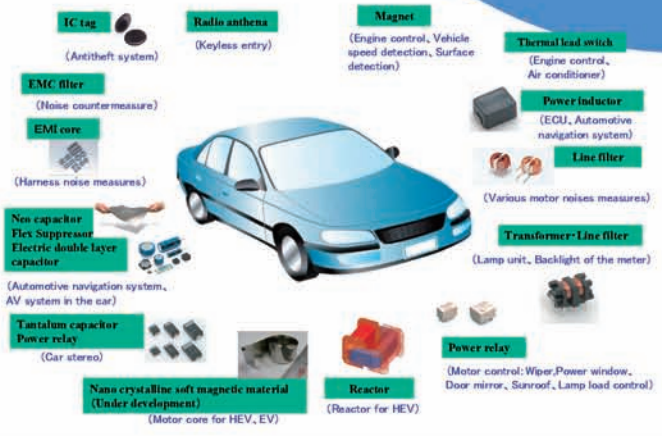
Magnetic Materials: Ferrite / Magnets / Metals

Ceramics: Piezoelectric materials

Next generation vehicles for latest items

Expansion into Car electronics market

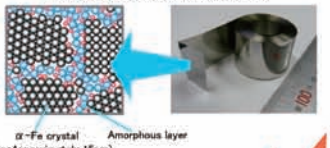
~To HEV core device the latest from various electrical parts , we'll propose a variety of solution~



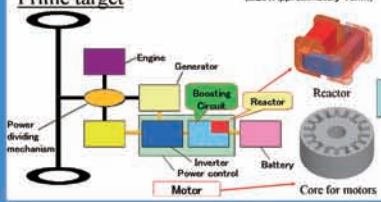
Nano crystalline soft magnetic material

What's Nano crystalline magnetic material ?

High saturation magnetic flux density &
Ultra Low Electric power loss **Nano Cristal**
Found by Prof. Akihiro Makino,
TOHOKU UNIVERSITY
We joint develop to practical use



Prime target



The contribution to the Creation of next-generation vehicles And highly efficient technology development in the Northeast

Towards a leading manufacturer of next generation

Ricoh Industry corporation Tohoku plant

MEXT TOHOKU ECONOMIC FEDERATION Tohoku University 宮城県 七十七銀行 ICR

About Ricoh Industry

■With the aim of manufacturing to provide new value creation to customers

April 2013, offering integrated part of Ricoh Co., Ltd. Production Division (Tohoku Ricoh, Ricoh Printing Systems, Ricoh Uni-techno) and series production company of three domestic, the company responsible for the domestic production of the Ricoh Group, was established as a production company.

The new company, to mobilize the power of each company so far, and not only with the product, with the aim to advanced manufacturing company that has a technology development capabilities for the next generation of new key parts, such as a new business area, the Ricoh Group to become the company's core to bolster the manufacturing of power, we will continue to strive.

《 Tohoku plant picture 》

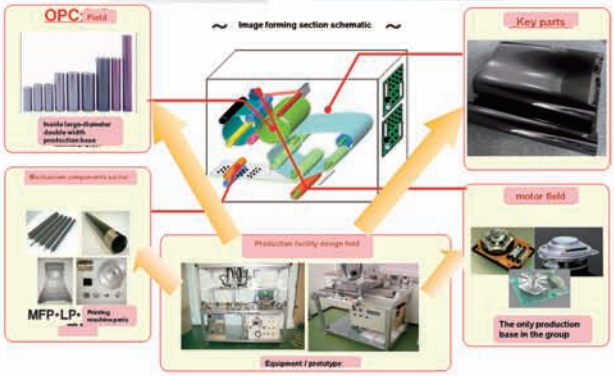
《 Ricoh brand message 》

RICOH
imagine. change.

In bringing together of imagination, we create change. We will continue to provide new value to our customers in the future.

Production items

《 printing machine》 《 copier 》



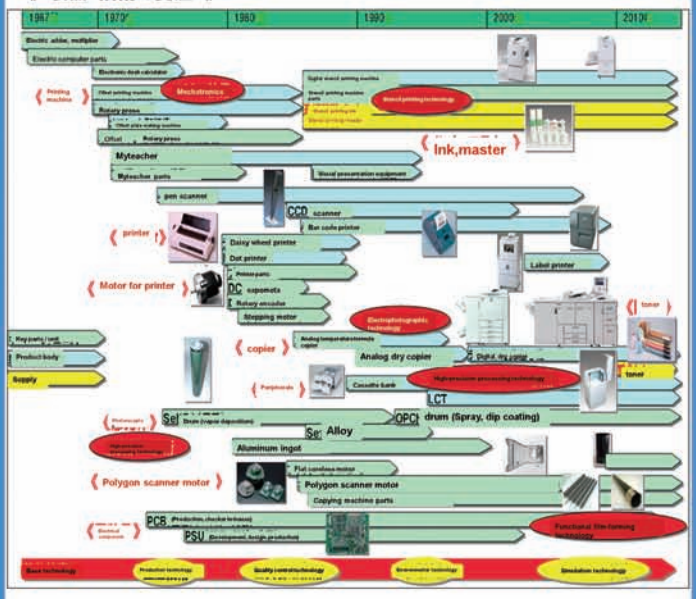
From the main body of product to parts, functions necessary for crafting gather in a northeastern establishment and I perform the action that is the concurrent that did the cooperation with the design thickly routinely, and go ahead through method of construction development, the facilities development concurrently and realize a quick mass production shift, the achievement of QCDSE, production capacity maximization.

Changes in technology (technology that has been polished)

■Production technologies that are the backbone

We always challenge the highest technology development. And, at Tohoku plant, take good care of a forward posture to go one step ahead, a new action through the production of OA apparatus connection product, main parts.

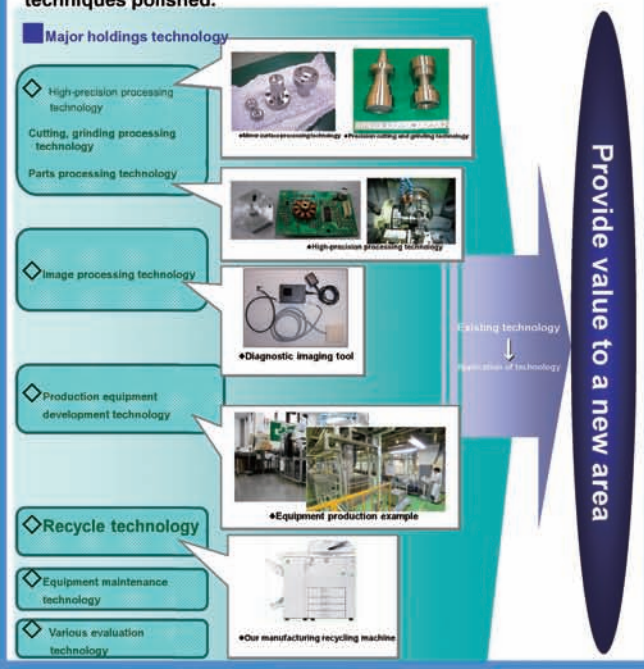
《 製品・技術の変遷 》



Aiming to create new value

■ We will continue to a new value provided to customers.

As a production function companies, not only to contribute to Ricoh group so far, and cultivate it until now from the past, we will make a new value provided to our clients on the base of the techniques polished.



Searches for five senses functional sensing

Miura sensor institute corporation

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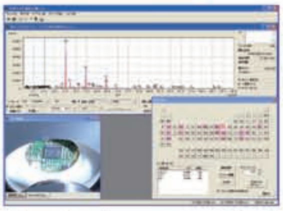
Non-contact type harmful elements detecting device

Denbee Series

The measured immediately in a non-contact harmful elements

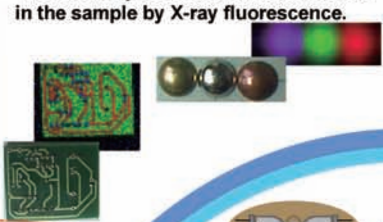
The inspection of RoHS Directive REACH



We can analyze the elements contained in the sample by X-ray fluorescence.

small

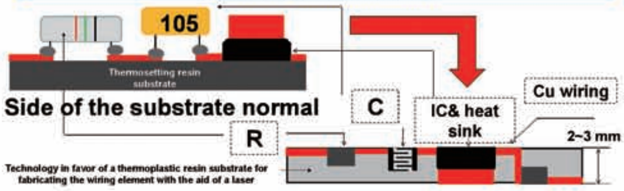
Take it everywhere



Elemental mapping

Evaluation of the sample with a diameter of 300mm!

Method included any value electric element embedded substrate manufacturing apparatus of environment-friendly

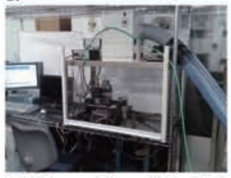


【 Feature 】

- Wiring need only the substrate thickness, the apparatus for manufacturing electrical and electronic devices.
  (Device that included fabricated embedded on the spot to the substrate wiring and parts)
- Standard values and can be formed on the spot element of the non-standard value
- Raw materials and thermoplastic resin substrate recycling
- Conductive transfer rate Cu wiring possible of the plating film equivalent
- The expensive vacuum apparatus is all-free!

:Plastic (Nihon kogyo shuppan April,2013)

Collaboration with Prof. Katsuhiko Suzuki from Sendai National College of Technology



Embedding apparatus laser assisted particle jet

Magnet sensor RTD

attached to the measuring unit

A magnet built into the sensor part, putting on and taking off of the sensor and the measured object is excellent simple, workability.

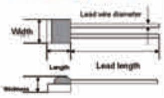
Plastic coating thermocouple line

It is superior for use in places like around the water, trash.

M 222 platinum resistance temperature detector

A temperature range is wide and is superior in long-term stability, compatibility, accuracy.

It is high-performance at only 2mm



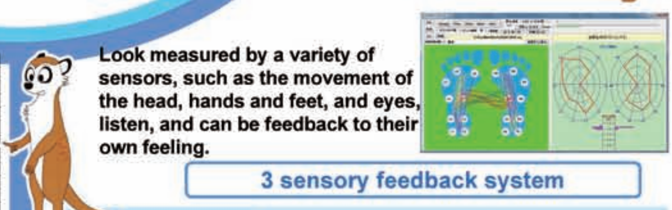
素子サイズ (mm)				
Length	Width	thickness	Lead length	Lead φ
2.3±0.15	2.1±0.2	0.9+0.3/−0.2	10±1	0.2±0.02

Name	M 222 platinum resistance temperature detector	
Nominal resistance	100Ω (when 0℃)	
Tolerance	German industry standard DIN EN 60751, class A	
Manufacturing standard	German industry standard DIN EN 60751 (IEC 751)	
Temperature range	Class A: − 50 ℃ ~ + 300℃	
Temperature coefficient of resistance	TCR = 3850 ppm/K	
Output wires	Platinum clad nickel wire	
	Connection methods: welding, welding, brazing	
Prolonged stability	Resistance value drift of 500 ℃ 1000 hours after the 0.04 percent maximum (※1)	
Vibration resistance	withstand 40G acceleration in the 10 ~ 2000Hz (※2)	
Impact resistance	withstand 100G acceleration in half sine wave of 8ms. (※2)	
Use conditions	Available only dry environment.	
Insulation resistance	20℃: 100 MΩ over ; 500℃: 2 MΩ over	
Self-heating	0.4 K/mW at 0℃	
Response time	Underwater measurements (v = 0.4 m/s):	t0.5 = 0.05 s
		t0.9 = 0.15 s
	Air measurements(v = 2 m/s):	t0.5 = 3.0 s
		t0.9 = 10.0 s
Measured current	100 W: 0.3 ~ 1.0 mA 500 W: 0.1 ~ 0.7 mA 1000 W: 0.1 bis 0.3 mA (Please consider the self-heating)	

※1 (Guaranteed range of class A is 300 ℃ ~ −50 ℃. It is the tolerance of the Class B in the case of 500 ℃ ~ 300 ℃)

※2 will change by the mounting structure of the sensor

Temperature sensor



Look measured by a variety of sensors, such as the movement of the head, hands and feet, and eyes, listen, and can be feedback to their own feeling.

3 sensory feedback system

To everyone in the company

～ Make the research and prototyping and development of measurement equipment ～

We are a research-based company. We perform the construction of the optical measurement system by the materials tester by the request from a semiconductor, the machine materials maker and a university, the research institute request, device production.

〒981-3203 1−40 2 Cho-me Takamori Izumi-ku Sendai, Miyagi 21st Century Plaza Research Center 207 room
TEL: 022-374-3207 FAX: 022-772-0640
E-mail: office@miura-sensor.jp HP: http://www.miura-sensor.jp

KTECH
K Technology Corporation

From planning, designing to manufacturing, valuation, servicing of electronic devices

K Technology Corporation

MEXT　TOHOKU ECONOMIC FEDERATION　Tohoku University　宮城県　七十七銀行　ICR

Core value &DMS concept

KTECHのコアバリュー

DMSコンセプト

お客様の課題をあらゆる面で解決する
ソリューション企業をめざして

Development & Design
開発・設計

- Design service from a development stage including mass production design,plan design,and the principle examination.

Manufacturing
製造

- Not only mere order production, we offer "manufacturing service" to cover until a process design to guarantee quality and plant development.

Service & Solution
サービス・ソリューション

- We offer technology& know-how that we have.

For example, product repair/analysis,reliability evaluation/inspection.VA/ CDsuggestion,product planning.

Core technique of the in-vehicle business

Development and design of products

・person experienced In-vehicle equipment design 50(an in-vehicle product and display apparatus)
・IMAGE PROCESSING /display technology/digital technology
・cabinet design/ packing design /Printed wiring board design

The quality system

・ISO/TS16949 A quality control system cultivated it with an in-vehicle apparatus product

facilities

・Including evaluation facilities, necessary facilities for securing of quality of the in-vehicle product are enriched.

Designer according to the product area

We provide a solution in accord with the needs of the customers.

We are design and fabrication company to support your manufacturing.

To the needs of the customer, we cope with the form that general and partial of great variety.

企画・構想 → 設計・試作 → 部品購買 → 信頼性評価 → 設備開発 → SMT実装 → Assy組立 → 出 荷 → サービス

Core technology

We have skills and experiences of wide product area and various product categories.

research project

- Application of energy and communication technology
- Bond magnet applied technology
- Supersonic wave skin sectional evaluation
- 3D Image processing & measurement
- Non-contact appearance analyzer
- Film crystal metal formation technology

Company Profile

Company name K Technology Corporation
Established April, 2005
Paid in capital 100 million yen

Net sales ¥13.0 billion (FY2011 Results)

No. of employees 634 (As of Jul 1, 2013)
Office Head Office 325 Ganbara, Kami-machi, Kami-gun, Miyagi,Japan
Tokyo Sales Office 6th Floor, Nikko Gotanda Bldg, 29-5 Nishigotanda 2-chome,Shinagawa-ku, Tokyo
Facilities area Site 205, 030 m2
Building 34, 027 m2
Scope of business Design/development, prototyping, production and services of electronic devices.
The public certification ISO/TS16949、ISO14001certification

To companies

～Please tell me the company's problem.～

We suggest differentiation and increasing competitiveness with other companies, by adding wide manufactural service from development to service "DMS(Development & Design, Manufacturing, Service & Solution) " has.

KTECH
K Technology Corporation

＜Head Office＞
325 Ganbara, Kami-machi, Kami-gun, Miyagi,Japan
TEL:+81-(0)229-64-1111 FAX:+81-(0)229-63-5652
URL:http://www.k-technology.co.jp/

＜Tokyo Sales Office＞
6th Floor, Nikko Gotanda Bldg,29-5 Nishigotanda 2-chome,Shinagawa-ku, Tokyo
TEL:+81-(0)3-6431-9067 FAX:+81-(0)3-6431-9068
Email:info@k-technology.co.jp

Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

We propose an image inspection system of world-class

Inspec Inc.

http://www.inspec21.com/

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■Company Information

Trade Name	Inspec corporation
Securities Code	6656
Listed Market	Market of the High-Growth and Emerging Stocks
Headquarters	Kakunodate, Semboku, Akita
Establishment	January, 1984
Capital	1,274 Million yen
Number of Employee	45 (As of April,2012)
Business Lineup	Development and production, the sale of the optical appearance tester of a semiconductor and the IT-related device and maintenance service.

【Headquarters】

Famous cherry blossom in Kakunodate

■Image processing technology

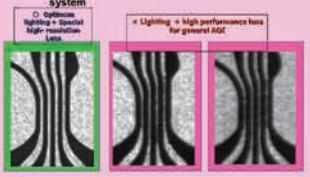
Imaging technology(camera, lens and lighting system)

17000 pixel CCD line camera

Dedicated lens

Lighting configuration example !

☆ The example of optimal imaging optical system

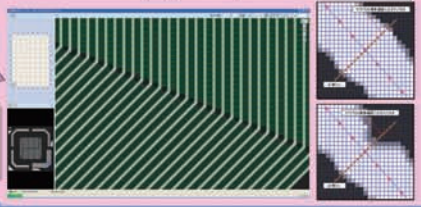


☆ Different of the captured image due to lighting conditions

Inspection algorithm (example)

☆Length measurement algorithm (most stable for the highly precise inspection of the minute pattern)

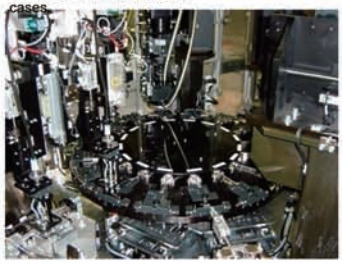
All the pattern and the space make length measurement !



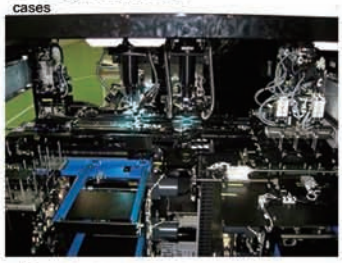
We hold all the elemental technology of the appearance tester

■Mecharonics

☆ Rotation index transport cases



☆ Straight transport index cases



☆Examination for exact dimensions screening equipment

Parts supply from parts feeder
The inspection classification of sub-micron accuracy in digital gauge
High-speed processing by the cam drive
Inspection tact: 2 seconds / 1

☆ Bamp AOI

Jeffrey tray deck to deck Jeffrey tray
Three-dimensional two-dimensional bump + front and back

Composite inspection sorter
Inspection tact: 2 seconds / 1

The image tester development that is most suitable from thorough sample inspection

Product (element crystal technology)

Substrate AOI (SX3300)

Substrate AOI (SX1000)

Tape inspection equipment (TR3000)

BGA・CSP inspection equipment
LED mold frame inspection equipment

To all of companies

How about being considered about possibility such as the collective inspection in the state that stood in line to an examination for all quantity and the tray with the image in the in-line?

If you have a problem with examination for image, please talk to us.

【Contact】 Inspec corporation　sales department　Michiaki Tomioka
TEL : (direct)0187−52−3073　FAX : 0187−54−3195
E−mail : mtomioka@inspec21.com

Supported by high technology business that value

Altech Corporation

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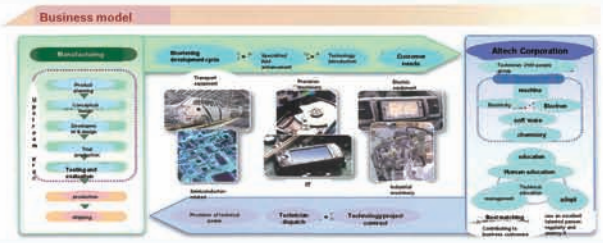
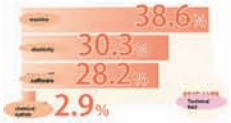
Altech Corporation

■Company Info
☐Establishment: January, 1971
☐Address: 3-7-13 Nagamachi Taihaku-ku Sendai, Miyagi
(Main building: 2-3-5 Minatomirai Nishi-ku Yokohama, Kanagawa Queens Tower C 18F)
☐Listing Classification : First section of the Tokyo Stock Exchange (code: 4641)
☐President: Soichi Ushijima
☐Capital stock: 2.3 billion 47 million yen (December,2012)
☐Employee: Consolidated 2,565／Single consolidated 2,283 (December, 2012)
☐Business contents: Trust business of the technical project (development, design, prototyping, manufacturing, evaluation)・Dispatch business of the engineer
☐Business partner: machine, electric equipment, precision equipment market, stock listing, excellent company including information processing, the communication, approximately 700 companies
☐We can cope with the receiving a contract items such as a machine tool, the examination device from software having company factory and a trust section.
＊Number of location: 19 offices nationwide

Technology area's data of Altech Corporation



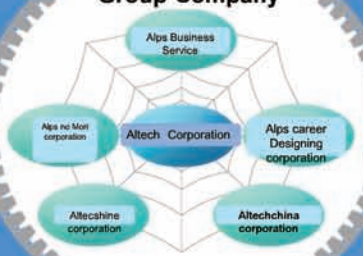
Industry client configuration



A person is the future–Next Technology Frontier

Performance of 45 anniversary

Group Company



Management philosophy

Heart to Heart

Business expansion

Growth of technician　Technology development

One push !

Participation in next-generation vehicles Miyagi area

We offer a ready-to human resources development

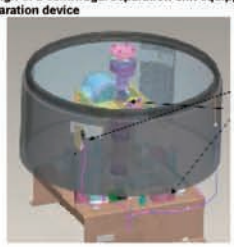
Avoiding development risk

It is most suitable in the short-term and long-term projects

Manufacturing sites that play a role in the manufacturing sector of Altech Corporation.

・Order example of test equipment

1. Cell separation equipment, centrifuge
Design of a centrifugal separation unit equipped with by a cell separation device



Unite dimension
Body : φ500 × Depth 300
Length 500 x side 500x over height 600
Centrifugal force 700G

Realization of new product development and new technology development

To all of companies

～To advance the development, the challenge of securing human resources, to training! Please consult the risk of development.～

■We aim to provide a technique that is community-based.

■Offer of technology and know-how through manufacturing.

The goal of "technology-oriented company," We aim to meet precise and quick to your needs a "manufacturing".

MG corporation

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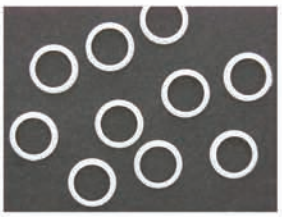
Engineering plastic modeling

Filter device
Multiple insert molding
(Assembly process omission adhesion improvement)



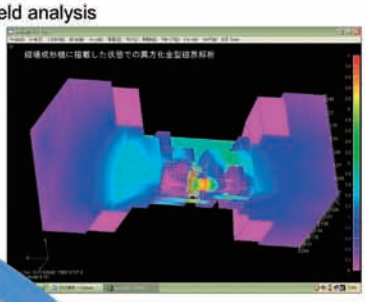
Battery parts
Thin-wall molding and ultra-high cycle molding

Automotive panel unit
- From the mold production, integrated production to molding and assembly
- Decorative processing technology, such as laser processing

Various connector

Forming & plastic magnetized

- Two-color molding and engineering plastics
- Integral molding technologies, including the shaft parts
- The magnet design and design technology magnetized by magnetic field analysis



Plastic magnet various

MG corporation
〒981-0134
6－1－8 Shirakasidai Rifu
Miyagigun Miyagi
Tel: +81-(0)22-356-5571
Fax: +81-22-356-5508

JAB CM035　ASR REGISTERED FIRM ISO9001, ISO14001
We have ISO9001、ISO14001

MG Group Worldwide Network

Product Development

We perform various research and development as well as processing of plastic.

Solar dimming street light signboard

- The power generation by solar, signs will direct the emission of dimming program when it is night.
- It can be chosen dimming pattern that matches the installation scene, and increase the catch of the eye to the sign.
- It turns on even at the time of a blackout, and the charge of the cell-phone is a signboard with the publicity possible, too.

To all of companies

It aims to develop products that make use of advanced injection molding technology, responsible for the rich life of the future.

株式会社エムジー MG Co.,Ltd.

URL : http://www.mg-japan.co.jp/

"Complete Support" for Miyagi Industry

Miyagi Organization for Industry Promotion

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Support of Industry- Academia Collaboration

Discovery → Research → Development → Commercialization → Industrialization

Miyagi Reconstruction Park

Discovery Matching

- Coordinate → The Challenge support Fund
- coordinate → Support for Public Project Proposals
- Complementary research
- coordinate → Project Creation Research Groups
- coordinate → Industry-Academia-Government Collaboration Fare

Support for Development of New Technology, Support for New Business Development

Management Entity Support

Miyagi Organization for Industry Promotion offers management entity support for competitive funds such as Supporting Industry (Assistance Project for Strategic Advancement of Fundamental Technology). In FY 2012, we offered this service for 6 projects, including ongoing projects.

Project Creation Research Group

We financially support small and medium-sized businesses and researchers who form research groups and conduct research activities to develop new businesses and technologies. In FY 2012, we provided support to 5 research groups.

Trade Referral Project(Service) for Reconstructing Business

Upon receiving requests from various laboratories at Tohoku University which are seeking help with restoring their facilities, we offer them various assistance such as referring them to manufacturers within the prefecture.

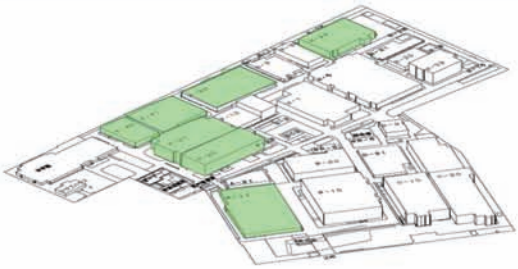
Industry-Academia-Government Collaboration Fair Miyagi

Through the presentation of research results ("seeds") of academic institutions in the Tohoku region, the fair aims to: provide a place for business matching with local companies, encourage exchange within the industry-academia-government community, start new research projects, and create new business ventures. The last fair took place on January 17, 2013 at the Sendai International Center, together with the Tohoku University Innovation Fair and the Miyagi Industrial Association Industry-Academia-Government Exchange Forum.

Miyagi Reconstruction Park

(1) Location : 3-4-1 Sakuragi , Tagajo-shi, Miyagi
(2) Property Scale : 7 buildings
Floor area : 32,602 square meters
Leasable area : 24,245 square meters
(3) Contract period : 2 years
(A separate agreement is needed after the 2-year period is over)

Facilities are leased to disaster-affected businesses and groups in order to help the manufacturing industry within the Tohoku region recover from the Great East Japan Earthquake Disaster as well as encourage the creation and development of new industries.



Analysis/evaluation, investigation, and analysis technology for next-generation automobiles

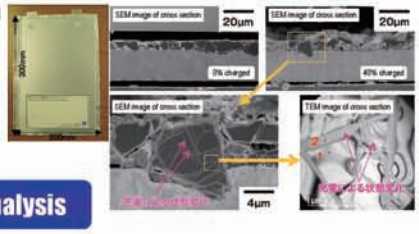
JFE Techno-Research Corporation (Tohoku Branch)

A trusted company for analysis, evaluation, investigation, and examination of materials

MEXT | TOHOKU ECONOMIC FEDERATION | Tohoku University | 宮城県 | 七十七銀行 | ICR

Next-generation battery materials evaluation

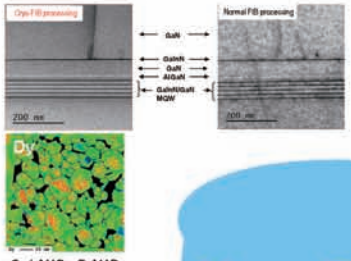
- Prototype of lithium ion cell (Dry room support)
- Charge/discharge performance evaluation
- Battery material evaluation
- Dismantled investigation
- Failure analysis



Microstructure analysis

- Evaluation and analysis of power devices and thermoelectric element modules
- Sample processing for microscopy
- Analysis of rare earth magnets
- Failure analysis of electronic components

Electron microscope, ARM200F installed in dedicated laboratory



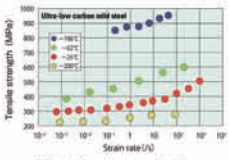
GrainMAP + DyMAP

Characterization of materials

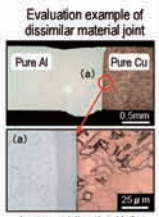
- Strength, high-speed deformation, fatigue, fracture characterization
- Damage analysis
- Corrosion test, anti-corrosion technology
- Weldability, welded joint evaluation (Laser welding technology)
- Magnetic characterization
- Steel material prototypes for testing

Fracture toughness test

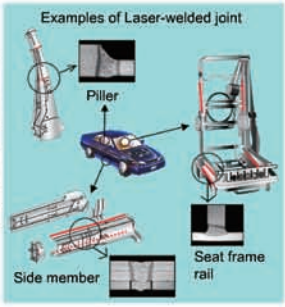
Constant load creep test facility



Effect of strain rate and testing temperature on tensile strength



Laser welding for Al-Cu dissimilar material joints [Joint strength: 80 MPa]

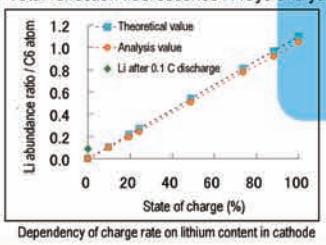


Your Best Partner for "Monodzukuri"

JFE Techno-Research Corporation is .....
A trusted company for analysis, evaluation, investigation, and examination of materials.

Trace analysis, other chemical analyses

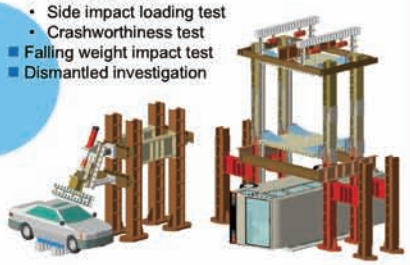
- Trace analysis, analysis of very small amounts of halogen, sulfur
- Mapping analysis by laser ablation
- Total reflection fluorescence X-rays analysis



Dependency of charge rate on lithium content in cathode

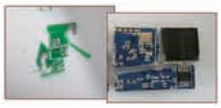
Structural performance evaluation, dismantling investigation

- Collision performance test
  - Roof crush test
  - Side impact loading test
  - Crashworthiness test
- Falling weight impact test
- Dismantled investigation



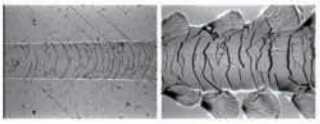
Environmental analysis

- Bad smell analysis (room air pollution) investigation
- Analysis of environmentally hazardous substances (RoHS, REACH, VOC, etc.)



Coating evaluation

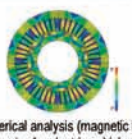
- Evaluation of coating properties of surface-treated materials,
  - Gravel meter testing
  - Coating film investigation
  - Film thickness measurement
  - Surface roughness measurement
  - Hardness measurement
- Corrosion resistance evaluation, accelerated corrosion test
  - Gas corrosion examination
  - Salt spray test



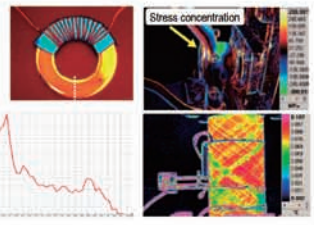
Observation of anodizing film of aluminum (section observation without vapor deposition)

Nondestructive testing /numerical analysis

- Thermal analysis of magnetic material and stress distribution measurement by infrared camera
- Defect detection and film thickness distribution measurement by imaging spectrometer (*ImSpector*)
- Stress analysis by numerical analysis
- Dry ultrasonic measurement



Numerical analysis (magnetic induction) of motor for electric vehicles



Stress distribution measurement by infrared camera, heat analysis

Contact

JFE Techno-Research Corporation
Tohoku Branch, Tokyo Office
3rd Floor, Higashi-Nibancho Square Building
4-1-25, Ichibancho, Aoba-Ku, Sendai-City,
Miyagi-Pref., 980-0811, Japan
TEL: 022-211-8280 FAX: 022-211-8281
http://www.jfe-tec.co.jp

We will support the manufacturing enterprise

The 77 Bank, Ltd.

MEXT　TOHOKU ECONOMIC FEDERATION　Tohoku University　宮城県　77 七十七銀行　ICR

Action to "industry-university co-operation government funds" cooperation

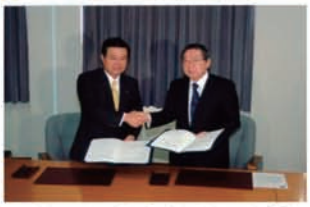
～ Cooperation with national university corporation Tohoku University～

Signed an Agreement on Cooperation with Tohoku University in January, 2007

I support problem solution about a technique and the new product development that a local company works on.

○Manufacturing individual treatment conference (technical consultation by the individual interview)

○Tohoku University laboratory tour (experience-based plan to visit the laboratory directly)



The cooperation agreement conclusion with national university corporation Tohoku University (January, 2007)

"Manufacturing individual consultation"(December,2011)

"Tohoku University lab tour" (Febrary,2013)

Tohoku University laboratory tour (February, 2013)

To everyone in the company

～ We support the "manufacturing company" by the provision of services in the financial and information surface in cooperation with an industry-academia and government agencies ～

Show of consulting and financial intermediation

"We relate to promotion of new operation of the new operation of the medium and small-sized business"

I received the authorization of "the support organization based on the ろ law such as management innovation".

(November 5, 2012 authorization)

○Business content management innovation support organizations

A delicate support in the development and implementation of business plan consultation about the business, such as matching financial and finance, business planning support, establishment support, business succession, and M & A, and analysis of financial condition.

○Management innovation support services

All branches (as long as stores offering business pertaining to the activities of loan)

To everyone in the company

～Please talk about the application support of "a manufacturing subsidy", the inquiry about "establishment of a business subsidies" and various subsidies willingly～

Profile

main building・・・3-20 3 cho-me chuo aoba-ku, Sendai

Established ・・・December 9,1878

Capital stock・・・24.6 billion yen

Employee ・・2，９２５ people

Branches ・・・142

（September 30, 2012）

77 Bank Corporation　Regional development section　Regional Development Division
〒980－8777　3-20 3 cho-me Chuo Aoba-ku Sendai
TEL：022－211－9804　FAX：022－267－5303
E-mail：chisin@77bank.co.jp

Efforts to the automotive industry promotion in Akita

Akita Prefecture Department of Industry and Labor
The Akita Center To Implement Vigorous Enterprises

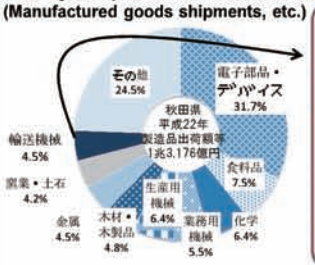
MEXT　TOHOKU ECONOMIC FEDERATION　Tohoku University　宮城県　七十七銀行　ICR

Development of Akita automotive industry promotion plan

Akita is known as an eminent agriculture prefecture, but also the integration of the electronic device industry has progressed in the manufacturing sector, we have set the automotive industry as a pillar of a new industry and establish the directionality of the action.

1. The situation of the Akita manufacturing

Industry Composition of Akita manufacturing (Manufactured goods shipments, etc.)



Attractive car company in Akita

- ○Keep about 50 percent of a share in the semiconductor field of the Toyota group.
- ○Development and production with the power supply unit of the hybrid car
- ○The sulfuric acid parent water factory of the separator nonwoven fabric for nickel hydroids batteries only in Japan
- ○Manufacture O ring for overseas makers diesels over 30 years
- ○Top share in the field of a door switch sensor
- ○Top share in the field of the car navigation embedded software

◆The leading industry of Akita is electronic device industry. Percentage is more than 30%. (The Industry composition of national electronic device industry are 6%)
◆The industry composition of transport machinery industry, Akita in less than 5% to the 19% across the country, we think that the industry has large growth potential.

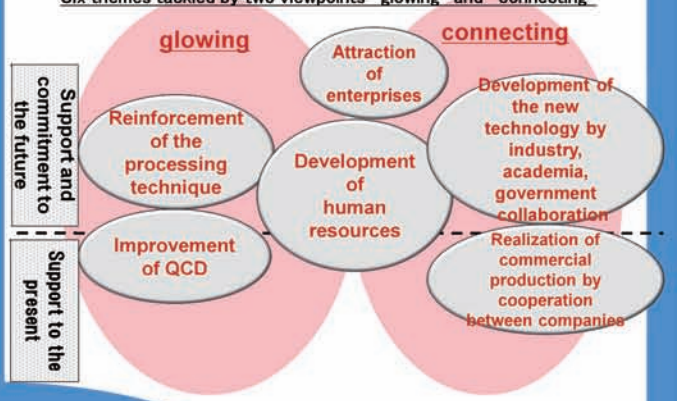
Access to a main factory

2. Figure to aim at of the plan

- ◆Improvement of QCD
- ◆Development of human resources
- ◆Reinforcement of the processing technique
- ◆Realization of commercial production by cooperation between companies
- ◆Development of the new technology by industry, academia, government collaboration
- ◆ Attraction of enterprises

Focusing on six above, All Akita Prefecture aims to become indispensable to car manufacturing in TOHOKU

Six themes tackled by two viewpoints "glowing" and "connecting"



Akita Prefecture aims to become indispensable to car manufacturing in TOHOKU!

3. Main action in the plan

(1) Support efforts to improve productivity improvement and production site(Improvement of QCD)

We carry out the guidance by the process improvement adviser intensively and improve the shop floor corresponding to a price reduction, the mass production required for the auto industry.
◆from October,2012

(2) Offered Akita automotive academy (Development of human resources)

We are training up the core talented person who can lead problem-solving of quality assurance, price reduction and mass production..
◆from August,2012(12-part series)
◆19 people 16 companies participated

(3) Seminars "Akita automobile human resource development training"

Guidance of the 2013 training course

Training Course

1. The cost management
2. QC Circle and small group activities
3. Process improvement
4. Auto parts required performance
5. Management
6. VE・VA
7. Quality management
8. Processing technique

We hold a seminar to train human resources technical capabilities, production capacity and power management required for auto industry.

Permanent exhibition of the AQUA decomposed model

- ○ 1st floor exhibition room exhibition place Akita Industrial Technology Center (4-11 Sanuki,Arayamachi,AkitaCity,Akita)
- ○ Exhibition parts Toyota AQUA (S grade) all parts (about 1,000 points)
- ○ There is no limit to limit visitors.
- ○ Contact the attendance procedures Akita Industrial Technology Center Technology Innovation Unit.

Please visit. (TEL018-862-3420)

Everyone is welcome

This exhibition is a permanent exhibition of AQUA decomposition model for the first time in the whole country.
Since we are also part loan for everyone in the company in Tohoku, Please visit.

Akita Prefecture Department of Industrial and Labor
Industrial Development Promotion Division Transportation industry group
3-1-1 Sanno, Akita City, Akita010-8570, Japan
TEL+81-18-860-2242 FAX +81-18-860-3887 E-mail induprom@pref.akita.lg.jp

Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

Next generation hydrogen production process can realize Hydrogen Energy Society

Renaissance Energy Research corporation

MEXT　TOHOKU ECONOMIC FEDERATION　Tohoku University　宮城県　七十七銀行　ICR

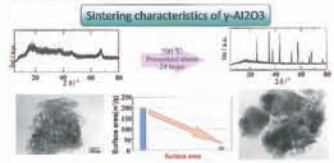
Technology 1: Heat resistant γ- alumina

Development of new carrier with a large surface area in the automotive exhaust gas condition

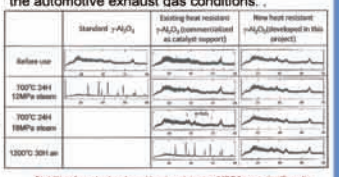
Improved heat resistance of γ-alumina

- γ-Al2O3 has a large surface, but unstable at high temperature
- γ-Al2O3 change to α-Al2O3 easily, and surface area is extremely reduced at high temperatures & humidified atmosphere.

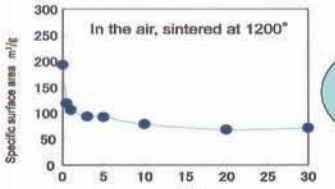
Sintering characteristics of γ-Al2O3



We succeeded in development of new catalyst support which maintain a large surface area in the automotive exhaust gas conditions. .



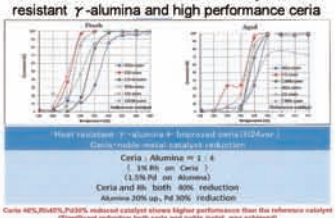
Stability of newly developed heat resistant γ-Al2O3 was significantly improved compared to the existing heat resistant γ-Al2O3.



Time-dependent change of the specific surface area of the heat resistant γ-alumina

Application to reforming catalysts for hydrogen production is promising

The noble metal and ceria reduction by heat-resistant γ-alumina and high performance ceria

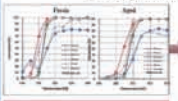


Ceria : Alumina = 1 : 4
(1% Rh on Ceria)
(1.5% Pd on Alumina)
Ceria and Rh both 40% reduction
Alumina 20% up, Pd 30% reduction

Ceria 40%,Rh40%,Pd30% reduced catalyst shows higher performance than the reference catalyst (Significant reduction both ceria and noble metal was achieved)

Technology 2:High performance ceria

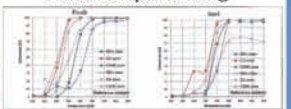
Effect of improved ceria①



Ceria : Alumina = 1 : 2
1% Rh on Ceria
2.5% Pd on Alumina

Aged catalyst shows higher performance than the reference catalyst

Effective of improved ceria②



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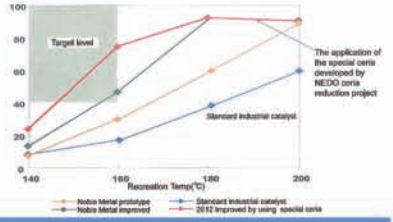
Ceria and Rh both 40% reduction
Alumina 20% up, Pd 30% reduction

Ceria 40%,Rh40%,Pd30% reduced catalyst shows higher performance than the reference catalyst (Significant reduction both ceria and noble metal was achieved)

Application to new high- performance CO shift catalyst



The hydrogen production related technique which RER holds

Seeds technologies cultivated by Tohoku University and RER

- Heat resistant γ-Alimina (Technology 1)
- High performance ceria (Technology 2)
- Catalyst performance prediction software

By prevention of sintering
・Precious metal reduction
・Ni catalyst performance improvement

The high performance CO shift catalyst developed by the application of high-performance Ceria

Improve efficiency of the catalyst development and process development

Oil / Natural gas → Desulfurization Removal of sulfur → Steam reforming $C_mH_n + H_2O \rightarrow H_2 + CO, CO_2$ Produce hydrogen by reacting steam and hydrocarbon → CO Shift $CO + H_2O \rightarrow H_2 + CO_2$ Reduction of CO in the reformed gas → Purification process

Purification process
- Chemical absorption method (remove CO2) → Ammonia Methanol
- Selective oxidation (remove CO) → PEFC
- PSA (adsorption) → Hydrogen station

Complete desulfurization: Extra high performance desulfurization Desulfuize to the level of PPb

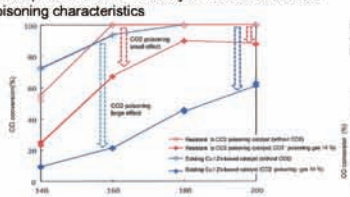
Low S/C possible / High SV possible: High performance Ru catalyst

CO conversion rate improvement: Catalyst without CO2 poisoning (Technology 3)

Energy saving of CO2 removal: CO_2 selective membrane (Technology 4)

Technology 3:CO shift catalyst with reduced CO2 poisoning characteristics

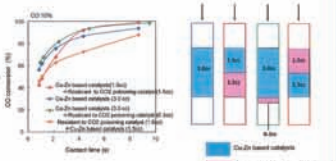
Development of CO shift catalyst with reduced CO2 poisoning characteristics



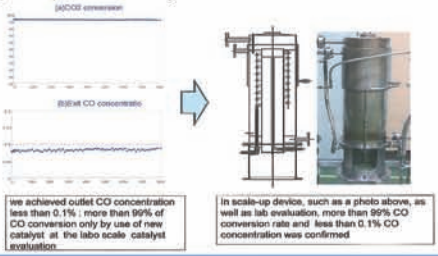
Conventional Cu-Zn based CO shift catalysts were found to be poisoned to large extent by CO2. CO2 formation is inevitable in CO shift reaction. So large amounts of catalyst was used in CO shift process.

Effect of newly developed CO shift catalyst

CO conversion rate is largely improved by using Cu-Zn based catalyst(in up stream) and newly developed catalyst with reduced CO2 poison characteristics together in downstream.



The CO reduction effect of heat exchange isothermal CO shift reactor and newly developed CO shift catalyst

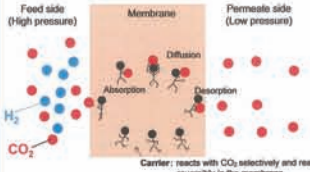


we achieved outlet CO concentration less than 0.1% ; more than 99% of CO conversion only by use of new catalyst at the labo scale catalyst evaluation

In scale-up device, such as a photo above, as well as lab evaluation, more than 99% CO conversion rate and less than 0.1% CO concentration was confirmed

Technology 4:CO2 selective membrane

CO2 Selective Membrane

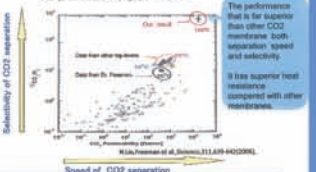


Carrier: reacts with CO_2 selectively and reacts reversibly in the membrane.

Energy of CO2 absorption to carrier covers that of CO2 desorption

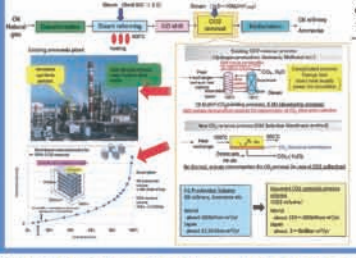
No energy consumption

Superiority of CO2 separation membrane Renaissance Energy Research



・Our CO2 Selective Membrane shows by far the best performance on both Selectivity and Permeability.

Application to Hydrogen Production w/ Reforming System



Joint venture with Sumitomo Corporation, Sumitomo chemical and Renaissance Energy Research was established to promote commercialization of CO2 membrane

2012年10月16日 日経新聞 朝刊

Renaissance Energy research can provide with one-stop service various functions required for the catalyst research, development and commercialization.

(Catalyst prototype, performance evaluation, Catalyst mass production, Pilot testing, Demonstration test, Feasibility study)

Contact : TEL : 06-6228-3111 FAX : 06-6228-3113 Email : information@r-energy.com

株式会社 岩沼精工

Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

We can deal with mass production press process, precision machine process, mold planning, production, labor saving machine planning, processing, assembling, and so on.

IWANUMA SEIKO Co,.LTD

MEXT　TOHOKU ECONOMIC FEDERATION　Tohoku University　宮城県　七十七銀行　ICR

Company Profile

NAME: IWANUMA SEIKO Co,.LTD
CEO: KOUJI CHIBA
ADDRESS: 305-3,Omatsubara Shimonogo Iwanuma,Miyagi
TEL: +81-(0)223-29-2121
FAX: +81-(0)223-29-2122
URL: http://www.iwanuma-sk.co.jp/
E-MAIL: info@iwanuma-sk.co.jp
MAIN BUSINESS: ・Mass production press
・Tool product
・Sample product
・Planning and manufacturing for production facilities
・Planning and manufacturing for mold(metal)
Paid in capital: 10,000,000 Yen
Date of foundation: April 1974
Certification: ISO9001、ISO14001
Main Customer: ・SONY Co.,LTD
・FUJITSU Co.,LTD
・SII Micro Parts Co.,LTD
・Keihin Co.,LTD
・IHI Co.,LTD
etc.

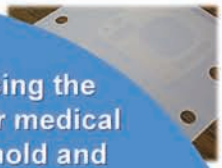
Mass production press and planning and manufacturing the metal mold

They correspond to mass production press using press processing machine(25t–110t).

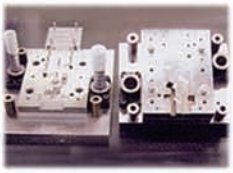
★Secondary battery for the tab

★Primary battery for tanshi

★Speaker grill for the mobile phone



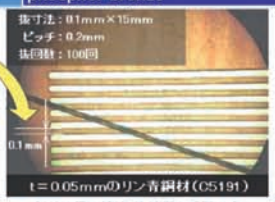
★Planning, processing and cutting-in of metal mold



We contribute to reducing the weight and down size for medical device by Light press mold and equipment technique fusion

★Slit press machine

★Example of slit process to phosphor bronze



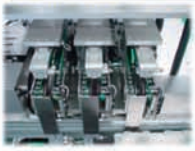
Equipment for labor saving

We contribute to the energy control by our technique

★Unloader
Tact 8sec/1sheet 200sec/
Magazine(25sheet)

★Equipment

★Magazine part



This machine can admit the semiconductor which is from a reflow furnace to the magazine

Sample processing and precision machine

Cost、Down、
Suggestion sample of precision

Technology Fusion

Laser processing, Wire discharge processing
Machining Center, Processing equipment for CNC lathe

★Minute process finishing

★Three dimensions process

★Reflective road sign and metal parts for caulking the ball

Machine for developing the new product (Support Projects)

★Press process machine development for miniature pattern precoated metal strip

★ Metal mold unit for place revision

Print pattern
R=0. 08 mm

Print pattern after bending the box
R=0. 02mm

★Developing a minute process machine (minute cutting＋minute discharging)

Process for discharging whole

φ20μm×200μm
(Super hardwood)

The precision of locating for whole with steps by front and back discharging process

Less than 1 μm

・Promote 5 themes for innovation with cooperation among industry, government and universities
・Develop and produce for original products by support project

High thermal conductivity silicon nitride substrate, heat sink material

Japan Fine Ceramics Co., Ltd.
URL http://www.japan-fc.co.jp

MEXT TOHOKU ECONOMIC FEDERATION Tohoku University 宮城県 七十七銀行 ICR

Introducing Japan Fine Ceramics (JFC)

We challenge the possibility in an original technique about metal, new material fine ceramics next to the plastic as a 100% investment company of JGC Corporation.

We made use of the electrical characteristics of the various efforts actively to manufacture and sell technology development, and application development, to meet the various needs of various cutting-edge industries.

Introduction of Fine Ceramics Product

In electronic materials Division of JFC, structure materials Division, it produces various ceramics products depending on a use.

Introduction of Electronic Materials Division products :

We produced "The high-grade alumina board" which a dielectric loss is minute small and bends it in the high frequency band, and has high strength, "The microwave dielectric board" which can plan the downsizing of the circuit, "Ceraflextime -A" which is used as turning ceramics, "Ceraflextime -8Y" superior in oxygen ion conductivity"The high heat conduction silicon nitride board" which strength was high, and raised thermal conductivity, "The film integrated circuit substrate" which we attached a film by the PVD method on these boards, and formed a circuit.

Introduction of structural material Division products :

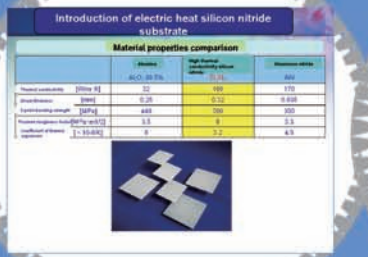
We have been produced by our original (silicon carbide, silicon nitride, alumina, Zirconia) engineering ceramic material with excellent characteristics heat resistance, wear resistance, corrosion resistance. In addition, composite materials "AMC" of metals and ceramics with (lightweight high rigidity, vibration damping) excellent properties not in the ceramic material and metal conventional materials are also produced, and to be able to meet the diverse needs of our customers are.

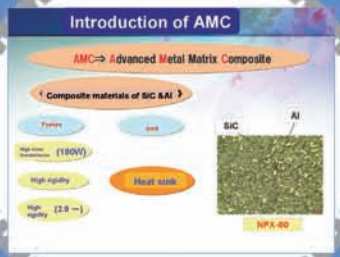
We are daily challenge and aim to material that is always better.

Introduction of high heat dissipation insulating substrate heat sink material

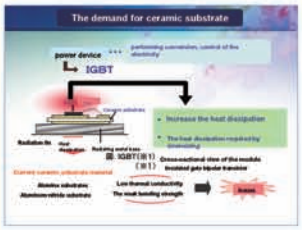
High thermal conductivity silicon nitride substrate

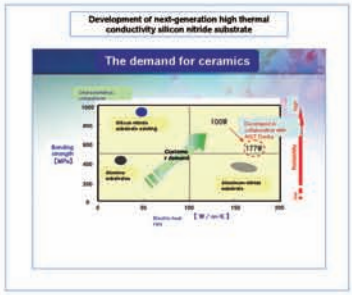
AMC (Advaced Metal Matrix Composites)





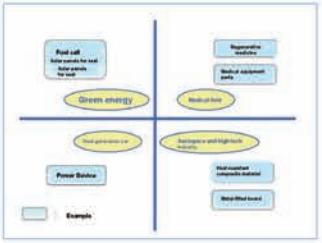
Needs of high heat radiation insulation board, heat sink materials





Technical Skill And Creation !

JFC's challenge field



To all of universities and companies

~why don't you begin an action for the next generation with us?~

Our company focus on material development.

We believe that we would like to supply the products with high originality that can be to the world from Tohoku to join forces with you.

日本ファインセラミックス株式会社
JAPAN FINE CERAMICS CO., LTD.

Engineering Department Product Development Department
Chief Shin Sato
TEL:022-378-7825 FAX:022-377-4161
Email:satousin@japan-fc.co.jp

" Iwate Center of Development for the Novel Human- and Eco-friendly Vehicles "

Regional Innovation Strategy Promotion Project

General Coordination Agency: Public Service Corporation Iwate Industry Promotion Center
2-4-26, Kita-Iioka, Morioka Iwate 0200857 Japan Tel:+81-19-631-3825 Email:mobility@joho-iwate.or.jp
http://www.joho-iwate.or.jp/mobility/index.html

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【Iwate Innovation Promotion Council for Next-generation Vehicles】
Iwate automotive industry Promotion Council, Iwate University, Iwate Prefectural University, Ichinoseki National Collage of Technology, Iwate Prefecture, Iwate Industrial Research Institute, The Bank of Iwate, Ltd., Kita-Nippon Bank, Ltd., Iwate Industry Promotion Center

Strategy formulation

Selected as Regional Innovation Strategy Promotion Area (international competitiveness regions)

【Iwate Center of Development for the Novel Human- and Eco-friendly Vehicles】
Along with further advancing technologies for auto industry ever accumulated in Iwate such as materials/metal working, electronic devices, information and communication, etc., we will promote cultivation of professional engineers and commercialization of projects through cooperation with industry, academia, local authorities and banks, to realize the persistent innovative region with prospective activities for vehicle innovation.

《Activity plan for the strategy realization》

①Establish & promote partnerships among industry, academia and local authorities
- assess potential of research institutes including universities (such as researcher, technical seeds, personnel training program, research equipment)
- assess potential of major suppliers (such as researcher, engineer, technical seeds, facilities) and their technical needs
- mediate ('Matching') company needs and technical seeds of research institutes relating to next-generation vehicle
- support networking among researchers and technical engineers
- enhance relationship between academia and local industry that are active in next generation vehicle development

②Promote research & development through cooperation with industry, academia and local authorities
- promote seeds-creating research and development relating to next-generation vehicle
- promote market needs-oriented joint research relating to next-generation vehicle among industry, academia and local authorities
- introduce and promote common utility of research equipments for the creation of next-generation vehicle innovation

③Cultivate human resources and disseminate the result
- cultivate R&D engineers with high skills who take key roles in enhancement of technological capability and competitiveness of local industry
- develop and offer new personal training programs for the creation of next-generation vehicle innovation

④Promote practical use and commercialization
- grasp market trends of next-generation vehicle and conduct survey global technological trends
- organize meeting opportunities, such as presentation meeting, briefing sessions of study seeds and technical needs, debriefing session, seminars, and networking events
- support IP management and the commercialization
- disseminate and conduct public relations of the result

support | Utilization

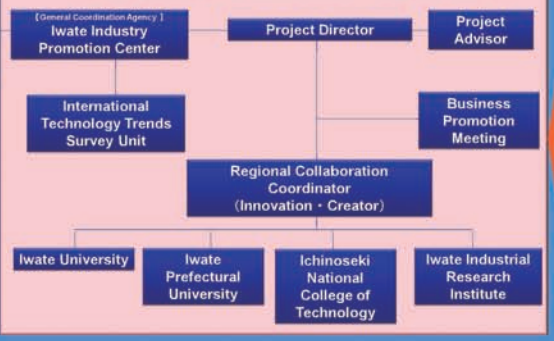
Realizing strategy through effective and comprehensive utilization of various measures of ministry (ex. Ministry of Economy, Trade and Industry) and funds from local authorities (ex. Prefectures)

《Implementing projects for strategy realization》

The Regional Innovation Strategy Support Program
(recovery assistance to The Great East Japan Earthquake disaster-stricken area),
National Government Support (Ministry of Education, Culture, Sports, Science and Technology)

① establish knowledge networks to cooperate in the region (arrange regional collaboration coordinators and support their activities)
② find researchers (invite and support their activities)
→ for the priority research area (materials/advanced processing technique, electronic device, information and communication) and promote joint researches among industry, academia and local authorities
③ develop and offer new personal training programs
→ program for individuals focused to creation of innovation (research and technology coordinator, technical expert of manufacturing and software merging EV design engineer)
④ promote sharing research facilities (arrange technical support staff and support for the public use of research equipments)

《Project Promotion System》



Committee | Assessment | External

Cultivating of human resources for the continuous next-generation vehicle innovation.

Developing new projects for next-generation vehicle continuously.

Project Vision

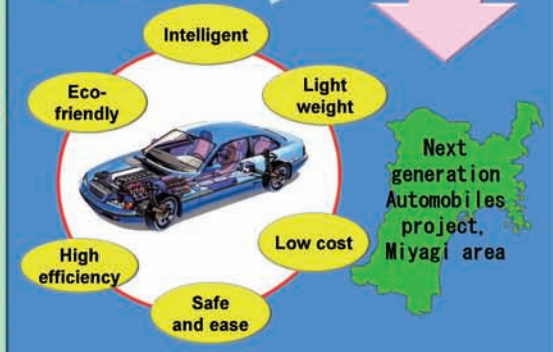
- Create advanced vehicles challenging the future after disaster of the Great East Japan Earthquake
- Realize the Center of Excellence for the development of next-generation vehicles
- Transform to the community reliable and indispensable to automakers

Realizing the recovery from the disaster of the Great East Japan Earthquake, and creating continuous innovation

From 'Study seeds-oriented' to 'Social need-oriented and problem solving innovation'

Regional technology innovation guideline (March, 2010 Iwate Prefecture)

Cooperation



Next generation Automobiles project, Miyagi area

Reinvention of Our Eco-Friendly Molding Factory

Plamoul Seiko Co., Ltd.
http://www.plamoul-seiko.co.jp/index.html

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Company Profile

Head Office 4-3-5 Takanomori, Tomiya, Kurokawa, Miyagi
981-3351, Japan TEL +81-22-348-1250 FAX +81-22-348-1244

Established October 1983
Capital Found 50 million yen
Number of Employees 37

Production Item Ultrafine Mold (for mold injection)
Molding precision electronic components (connectors, etc.)

Gas Through Gas Vent Ejector Pin
Air Through Vent Adjustment for Parts
Revo Sprue Star-Shaped Sprue
Revo Gate 3Plates Pin gate

Head Office

China Factory
Guangdong Province,
Dongguan City Changan Zhenjiang Shell Illage path Shinminami third Industrial Zone

China Factory

The Important thing in Molding is …

Immobilize Condition at Low pressure

* Low Pressure Molding can … *

- **Resource Saving**
  Saving power & Materials
- **Productivity Growth**
  Enhance capacity utilization
  Reduction of maintenance manhours
- **Quality improvement**
  Barr, gas burring, warp, deformation

Don't you have any Quality Problems with Gas / Air Inclusion which occur in Molding ?
Why don't you use GasThrough and AirThrough that will Solve your problems!!

Corporate Identity

Plamoul Seiko Creates No.1
Enterprise Reliability that based on
Developing Human Resources with a Vision

Quality Goal

The Products which made by the Mold should be All Good
Innovating Mold Structure which can Low Pressure Molding

Development Product Introduction

Certified to Miyagi Superior Products in succession for two years

Self-Developed Products
Production cycle time reduction
Improve liquidity at the molding
Production efficiency improvement
using the mold structure

2012

Degassing Pin 『 Gas Through 』

Gas Through pulling out the gas from the tip of the core pins and ejector pin

2013

Air vent device 『 Air Through 』

Air Through Development of air vent devices in dreams

Revo Gate
Can Prevent Convex凸 of 3 plates' pin gate

Revo Sprue
Allows for shorter Cool down time of sprue.

Head Office

China Factory

Council for Improvement Task of Self-Developed Products

Challenge to the frontier companies in the field of magnetic transmission

Prospine Co.,Ltd.
http://www.prospine.jp

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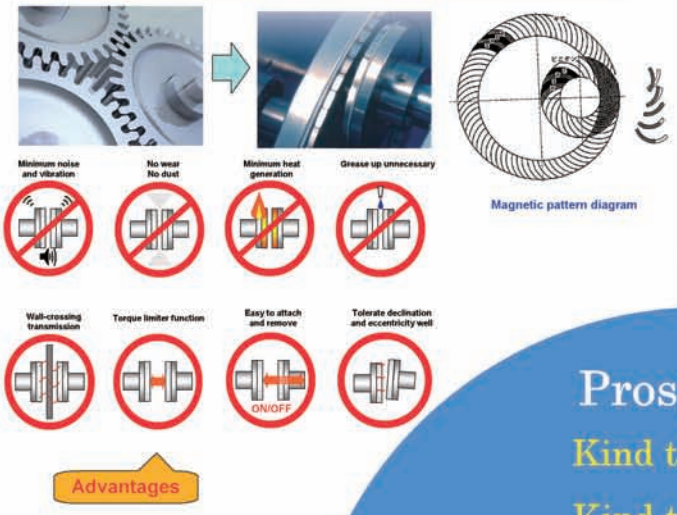
Trend toward "non-contact power transmission"



Magnetic pattern diagram

Advantages

Introduction of Prospine's original magnetic products

Magnetic gear

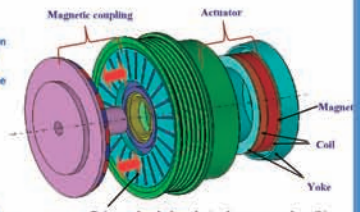
Non contact magnetic gear transmission ratio of 1:4

Orthogonal magnetic coupling

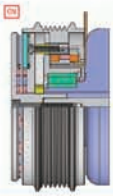
1:1 ratio magnet coupling facing a cylinder magnet and a disc magnet orthogonally (commonly known as magnetic miter)

Magnetic clutch

Position self-maintaining clutch based on non-contact mechanism: Energy saving clutch which changes the on/off actions when only applying current by turning the on/off switch.



Drive tooth yoke board: Apply current to the coil in the actuator, and turn the clutch on and off by sliding from side to side



Prospine is

Kind to people !

Kind to things !

Kind to the globe !

We continue to pursue further unit parts

Contribution to the environment and the energy saving

Non contact type clean roller

Application sample for magnetic miter and coupling

Non contact type belt conveyor

Bottom of a lake exploration robot

Applications

- Semiconductor manufacturing equipment
- Clean roller
- Robot
- Clutch & Brake
- Transmission
- Stirrer

To everyone in universities & companies

~We design and provide custom-made products according to your product specifications.~

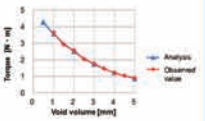
Contact: Prospine Co.,Ltd. Sales department: Ikeda , Sato

Attention !

Technology of magnetic field analysis simulation

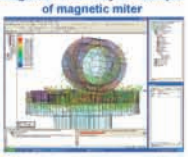
(Cooperation with Industrial Technology Institute, Miyagi Prefectural Government)

Correlate over 90%



Analysis of magnetic torque coupling and its result

Magnetic field analysis example of magnetic miter



Analysis of magnetizing yoke and the york itself

Topics

World first

Established the world's first magnetic field analysis simulation technique of the brake unit using hysteresis material !

Prospine Co.,Ltd.
117 Azashinsenkarita Tsugihashi Matsuyama Osaki, Miyagi 987-1305
TEL: 0229-55-3375　FAX : 0229-55-4350

Our Key word is Speed! We aim for competitive manufacture.
KYOYU CO.,LTD.

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Company profile

【Company name】KYOYU CO.,LTD. 【Established】May,1980 【Paid in capital】88,880,000 yen 【No. of employees】109 (As of July, 2013)
【President】Tokumi Hatanaka
【Scope of business】Precise mechanical component
The design and assembly for automatic machines
【Certification】ISO9001・ISO14001・AS9100

Tackles by local relationship

～Collaboration between Designer and Artisan and Manufacture company～

The luxurious aluminum material shaped "S" Sendai's initial are coated with Tamamushi lacquerware which has vivid colour and lustre. (Our company take charge of cutting.)

※The photo is a replica.

≪Production Design≫
The Interior Designer lives in Sendai
Mr. Kouichirou Kimura

Aerospace Business

"Combustion test apparatus specimen"

Materials : SUS・Cupper alloy
Electron beam welding(by cooperative company)
(Consent to photograph:JAXA Kakuda Space Center)
Furthermore, we deliver precise cutting products to engine makers and equipment makers.

・3D-CAD
(Installing CATIA V5)

AS 9100 BUREAU VERITAS Certification

・The international standard JIS Q 9100

KYOYU

We challenge high extra value industry, with the core technology we experienced electrical devise business.
We are skillful in hard-to-cut material and precise cutting, so manufacture products which can respond needed by customer, with the production of many kinds in small quantities.
Our slogan is "The key word is speed", we construct 24H/D,7days/W including Saturday and Sunday, standardized from parts on through to finished products. Therefore, we aim to shorten delivery time.

Core Technology

Home Information Appliances

From design to product die and mold and auto machine, based on a precise cutting technique. We are capable of being made consistent from machine processing to evaluation with 3D CAD with original Data-base.

Automobile business

"Divided punch part of stamping die"
Materials and Thickness:SPC440・t=1.0
Die condition:10process progressive die

・The first product cost is 90% or less than conventional die and mold. (For ability to change process method)
・The running cost is 50% or less than conventional die and mold.
・Using holder and blade edges materials are properly usable. (Proper materials can be used each other.)
・Blade edge can be exchanged by only removing stopper.

Controlling whole factory by production management system

In 2006-2007,we succeeded development and practical applications of low cost and excellent durability stamping used die and punch, helped by Strategic generic technology advancement support project (supporting industries).
This product was accredited as third "MONO excellent Miyagi ".

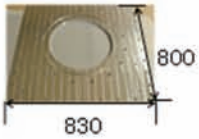
Before After

(Consent to photograph:Toyota Motor East Japan, Inc.)

Semiconductor manufacturing apparatus related business

"Semiconductor manufacturing apparatus "
Materials: A5052
Thickness: 25mm

"Product testing device "



"Proof of hard-to-cut material Large-sized processing parts"

・compound machine with 5 spindles type vertical lathe function
Processing size (MAX) φ2,000×1,440mm
・CAM Simulator
・Three-dimensional measuring machine X1,600×Y3,000×Z1,200mm
・We have ultrasonic washing apparatus.

Medical devices business

It is in development that no burrs minimization of in hard-to-cut material inserting optical components using ultrasonic vibrations, utilizing "JST revival promotion program, aligned with Tohoku University.(2012-2014)
As a processing method, we aim at cutting costs by multiple and shortening LT.

KYOYU CO.,LTD.
149-1,Shinnawashiroe, Sekine, Misato-machi,Toda-gun, Miyagi-Pref.987-0006,JAPAN
TEL:+81-229-34-2329(represent) FAX:+81-229-34-1965
URL E-Mail info@kyoyu.jp

Embossed carrier tape and electronic component manufacturing

OKURA Industry Co., Ltd.

http://www.okurainc.co.jp

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Embossed Carrier Tape deep drawing

Optimum various molded method, supported by production facilities in depth product variant-diaphragm. In addition, it supports the shape to prevent telescoping product of deep drawing.

•Shape:insertion site (20mm×22mm) deepest part(21.6mm)
•Material: A-PET (W=32mm t=0.5mm)
•Use: On-board electronics parts

• Shape:insertion site (14mm×15mm) deepest part(18.3mm)
• Material: PS (W=24mm t=0.5mm)
•Use: On-board electronics parts

• Shape:insertion site (10mm×19mm) deepest part(17.8mm)
【antiskid eqquiped】
• Material : PS (W=32mm t=0.5mm)
•Use: On-board electronics parts

Achieve a low-cost fast delivery to mass production carrier tape design, mold design and manufacture by house production facilities (line 140 in Japan and China). It also available in taping process, the final step further.

Electronic component manufacturing

Design and development - mold making - prototype - mass production - secondary processing - Packaging - Shipping We are equipped the integrated production system up.

Actual
[Integrated production of narrow-pitch micro connector

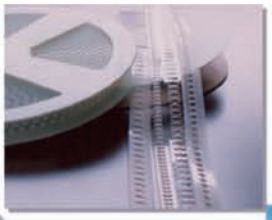
Housing unit
Precision plastic mold
Design and manufacture
processing-Terminal part
Precision press dies
Design and manufacture
processing-Assembly
(housing + terminal)

The embossed packing the finished product

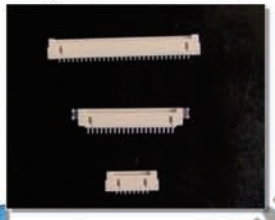
Dispatch

Special shape embossed molding technology
Precision molding technology

Embossed Carrier Tape



Narrow pitch micro connector



OKURA INDUSTRY Co., Ltd.

大倉工業(蘇州)電子有限公司

大倉電機(東莞)有限公司

Film sheet slit

Sheet slitter equipment

Including the carrier tape sheet, and cut with high precision a variety of synthetic resin / paper film and sheet. In addition to the sale of the sheet slit goods, to cope with the slitting of bringing material.

The achievement to low cost and short delivery date processing with company design, production facilities

【 Company design facilities 】

Embossed Carrier Tape Manufacturing equipment

Center hole drilling and Inline image inspection apparatus

Traverse (spiral) Winding device

Slit products

(PS、PET Sheets
※Carrier tape
W = 8～72mm
T = 0.3～0.5mm

(Paper sheet)
W = 100mm
T = 0.1mm

(Urethane foam)
W = 60mm
T = 1.5mm

HeadOfiice 〒985-0854
46-3 Niidanishi, Tagajo, Miyagi, Japan 985-0854
TEL:+81-22-368-5836
FAX:+81-22-368-5508

Matsushima Factory
131-107 Uchihibiki, Kawakudari, Higashimatsushima, Miyagi, Japan 981-0304
TEL:+81-225-87-4330
FAX:+81-225-87-4001

Naruse Factory
131-107 Uchihibiki, Kawakudari, Higashimatsushima, Miyagi, Japan 981-0304
TEL:+81-225-86-1681
FAX:+81-225-87-4641

大倉工業(蘇州)電子有限公司
中国江蘇省蘇州市高新区何山路399号
TEL:+86-(0)512-6807-5876
FAX:+86-(0)512-6807-5873

大倉電機(東莞)有限公司
中国廣東省東莞長安烏沙江貝村新南路第三工業區
TEL:+81-(0)769-8509-1910
FAX:+81-(0)769-8509-1920

SME Innovate in Next-Generation Automobiles

ASTER Co., Ltd.

http://www.ast-aster.com

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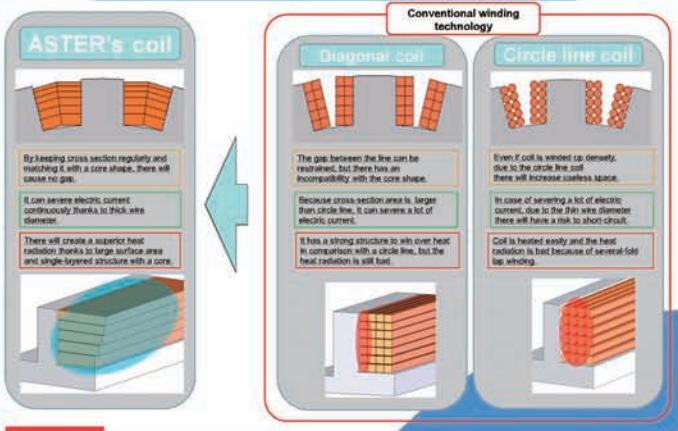
Development of the high efficiency motor (super motor)



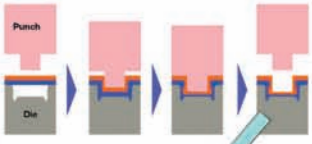
Performance

We can achieve a good balance between the compact and high power by improving space factor, heat radiation and voltage resistance.

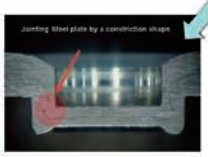
Productivity

We can product high efficiency motor with short process by using slot-in method.

Development of swage joint device for car steel plate

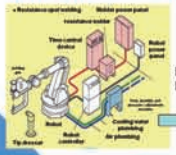


By flowing the steel plate to the die side by a punch, it can be jointed mechanically. So it is easy to joint various different kind of metal such as high-tension steel plate, stainless steel, copper, aluminum with low cost and energy conservation.

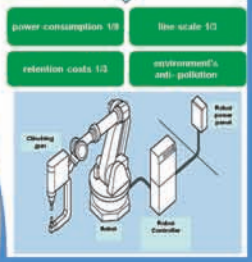


Point

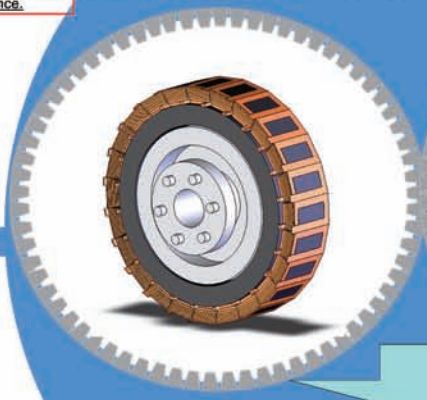
① High endurance strength to dynamic load.
② Jointing more than three pieces is possible.
③ Jointing multiple points simultaneous with 1 shot is possible.
④ Board thickness is available from minimum 0.2mm to maximum 4.0mm.



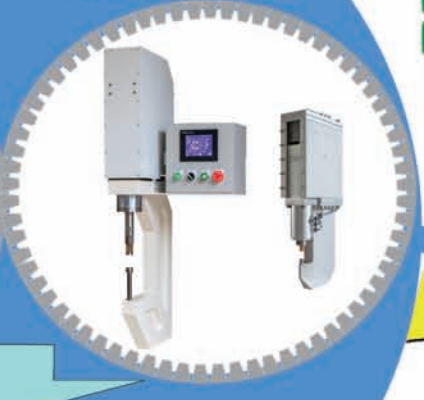
From an existing spot welding line to swage joint line



Power train section



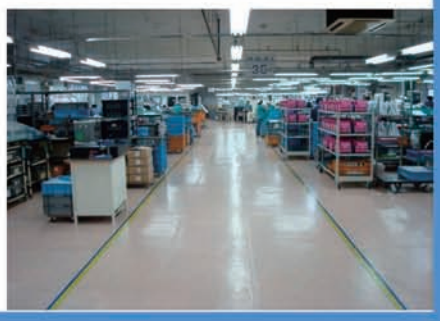
Body section



We propose to next generation automobiles in full scale

Company profile

- Company name　ASTER Co., Ltd
- Established　January 2010
- Paid in capital　5,000,000 yen
- Employees　70 persons
- President　Takenori Hongo
- Business description
  - Car-related parts production
  - Production and sale of the industrial equipment device
  - Production and sale of LED lighting equipment
  - Production of beauty equipment
- Certification　ISO 9001
- Ministry of Economy, Trade and Industry
  SME advanced manufacturing certification　2 times (in 2012 and 2013)
- Number of patent applications　5 applications
  (including one application of international patent)
- Number of design registration　1 registration



LED light

Desk lighting　Spoon Light series
Fluorescent tube lighting　EnaBlight series
High-intensity lighting（25W～1000W）　Takumi series

We are developing above 3 series according to application. Regarding Takumi series, wide range of needs for custom-made from factory lighting to shipboard lighting are available.

Contact　Mail furuyayt@ast-aster.com
Tel 0182-24-1377 (rep.)　Fax 0182-24-0611

Now is made for the future

Automotive Components and Systems

Perfecting the Art of Electronics

ALPS

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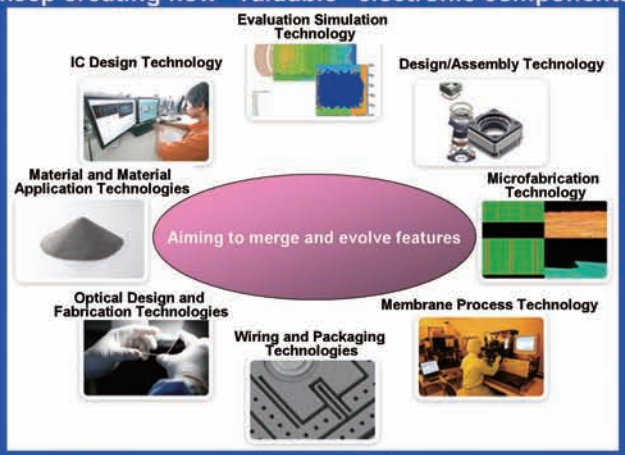
Business Fields

Human Machine Interface (HMI) Products

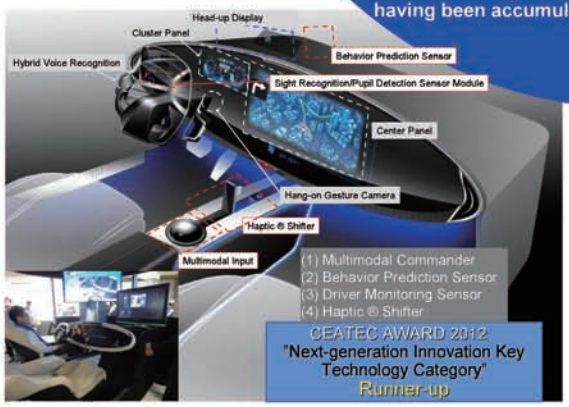
immersion
TouchSense™ Technology Licensed by Immersion Corporation

Evolving and merging unique technologies to keep creating new "valuable" electronic components



ALPS keeps creating "valuable" products that are unrivaled in the industry by merging "process technology" and "material technology" that support functional devices as well as uniquely evolved "mechatronics technologies" having been accumulated for many years.

With newly proposed "value" merging advanced technologies with proven functional devices, ALPS' "Next Generation Premium CockPit" won the Runner-up at CEATEC JAPAN 2012.



Next Generation Premium Cockpit

Vehicle Interior Interface Products

Head Office: 1-7, Yukigaya-otsukamachi, Ota-ku, Tokyo, 145-8501 Japan
Furukawa Plant: 6-3-36, Furukawanakazato, Osaki-city, Miyagi-pref 989-6181 Japan
Phone: +81 229-23-5111 Contact: Masami Terakubo, Business Planning Department
http://www.alps.com

Perfecting the Art of Electronics

ALPS

Efforts for Embedded Industrial Promotion of Miyagi Prefecture

META: Miyagi Embedded Technology Association

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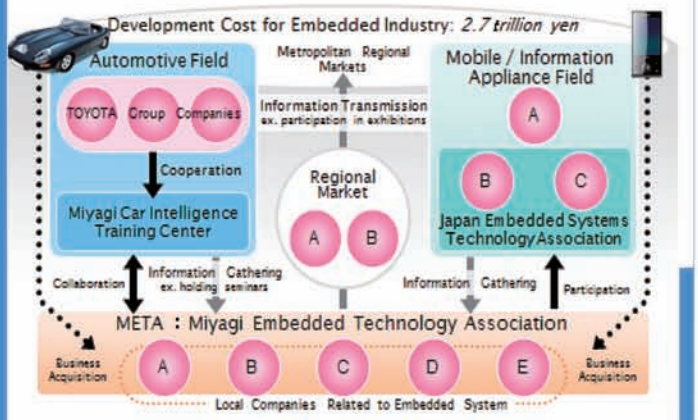
① META: Miyagi Embedded Technology Association



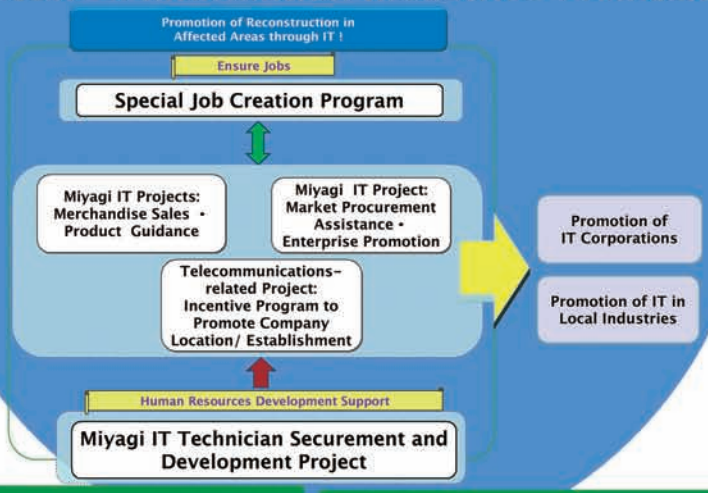
② Technical Show & Exhibition Support

ET2012 TOHOKU Pavilion Display For 7 Consecutive Years

At the Yokohama Embedded Technology Exhibition we have exhibited the "TOHOKU Pavilion" in cooperation with numerous embedded technology-related companies and organizations in the Tohoku (northeast Japan) region.
8 companies participated from the Miyagi Embedded Technology Association and we have made presentations for 7 consecutive years. Approximately 5,851 visitors have come to the pavilion.

One-Stop Service by Miyagi Prefecture's Information Industries Promotion Division

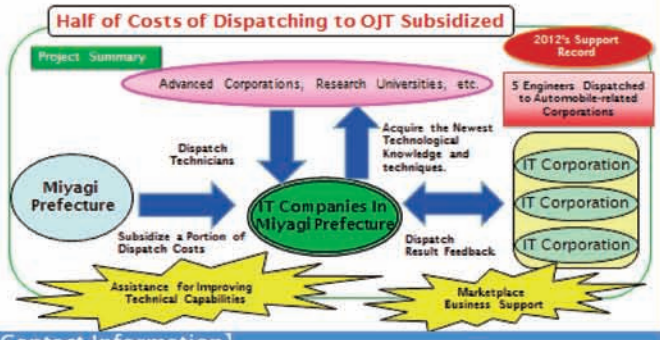
"Towards Recovery! Never Give Up Miyagi!



③ Dispatch OJT Support Project

We support the dispatching of technicians to universities and advanced corporations (Ex Automobile-related corporations, Tohoku University) to have them acquire the newest techniques and technical knowledge .

Can Supply a Maximum of 2 million Yen per Business



④ Human Resource Development Support

Cultivating Miyagi IT technicians for careers in the prospective high-growth industries of advanced electronics and automobiles

1. Enterprise support in developing human resources: Training at the Industrial Technology Institute, Miyagi Prefectural Government

1) Primary Level: Trainees learn basic technical skills necessary for the development of new employees
2) Intermediate Level: Trainees learn technical skills for business solutions
3) Embedded System Technical Seminar: Contents of seminar include the latest information required by companies.

2. Developing practical, advanced human resources: Miyagi Embedded Technology Association (META)

1) Hold human resource development seminars for those entering the auto industry and other fields.
2) Hold "Kumikomi-Tekijuku" practical exercise course via satellite to support Miyagi development of "System Architect" embedded software development
3) Hold "co-design implementation exercises" (Kansai Cooperation) for implementation and design reinforcement of technicians corresponding to the fusion of hardware & software

3. Miyagi Car Intelligent Human Resources Development Center

Develop the next generation automobile industry workforce by fostering comprehension and skills in hardware , automobiles, electronics market dynamics and IT electronics, marketplace dynamics, IT and more

4. Local Human Resources Development (Special Job Creation Program)

Human resource development in diverse fields -software, embedded tech., animation, mobile, etc.

【Contact Information】
META : Miyagi Embedded Technology Association
(Organizer : NEC Software Tohoku, LTD.)
1-10-23, Ichibancho, Aoba-ku, Sendai, Miyagi 980-0811
TEL: 022-215-5653　Fax: 022-215-5665
Email: kumikyo@kumikyo-miyagi.org

Information Industries Promotion Division
Miyagi Prefectural Government
Miyagi Prefectural Government Office (3F government office)
3-8-1, Honcho, Aoba-ku, Sendai, Miyagi 980-8570
TEL: 022-211-2479　Fax: 022-211-2496
http://www.pref.miyagi.jp/soshiki/jyoho-i/

Pursuing the Ultimate Cross-media Advertising

ADOX
Digital Image Creations

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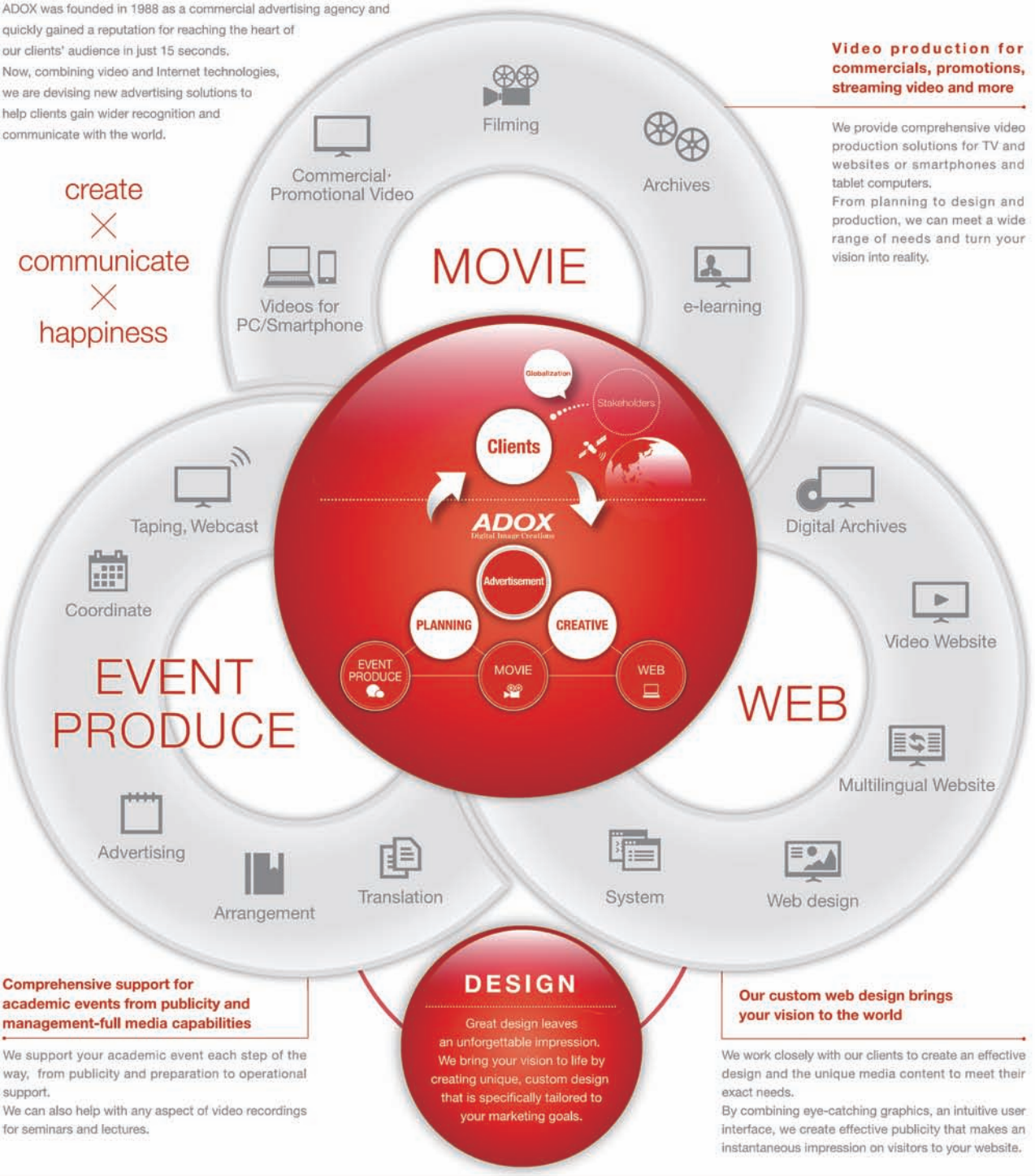
ADOX was founded in 1988 as a commercial advertising agency and quickly gained a reputation for reaching the heart of our clients' audience in just 15 seconds.
Now, combining video and Internet technologies, we are devising new advertising solutions to help clients gain wider recognition and communicate with the world.

create
×
communicate
×
happiness



Video production for commercials, promotions, streaming video and more

We provide comprehensive video production solutions for TV and websites or smartphones and tablet computers.
From planning to design and production, we can meet a wide range of needs and turn your vision into reality.

Comprehensive support for academic events from publicity and management-full media capabilities

We support your academic event each step of the way, from publicity and preparation to operational support.
We can also help with any aspect of video recordings for seminars and lectures.

DESIGN

Great design leaves an unforgettable impression. We bring your vision to life by creating unique, custom design that is specifically tailored to your marketing goals.

Our custom web design brings your vision to the world

We work closely with our clients to create an effective design and the unique media content to meet their exact needs.
By combining eye-catching graphics, an intuitive user interface, we create effective publicity that makes an instantaneous impression on visitors to your website.

≪ Contact us ≫
ADOX Co., Ltd. | SENDAI: Aioi Nissei Dowa Insurance Sendai Ichiban-cho bldg, 2-8-10 Ichiban-cho, Aoba-ku, Sendai, 980-0811, JAPAN
TOKYO: F&F Royal Bldg, 2-4-6 Kanda-Awajicho, Chiyoda-ku, Tokyo, 101-0063, JAPAN
TEL +81-22-261-9481
WEB SITE http://www.adox.co.jp MOVIE SITE http://cue-tv.net/

Development of Industrial & Creative Vitality

Kazuhiko Yashima
Miyagi Industrial Association
Industrial Technology Institute, Miyagi(ITIM) 2-2 Akedori Izumi-ku Sendai 981-3206, Japan
E-mail: yashimak@tiger.odn.ne.jp

ABSTRACT

Miyagi Industry Association aims to contribute to the development and activation of the prefecture industry. We boldly to solve social issues by accurately reflect the trend of the times and support through various business towards the performance improvement of the member companies.
"Miyagi Association human resources network services" and
Outgoing business of *"Miyagi Sugure MONO"* are parts of our business.

1. Introduction

Our company was established at Miyagi in 1986 as the incorporated association. Member is included 421 companies, in it regular member is 356 companies and supporting & special member is 65 companies.

Purpose of establishment is contributed to the vitality and creative sound development of the prefecture industry. This is by that the industry in Miyagi and the people of industrial related industries attempt strengthening the management base, sophistication of the technology and development of new market , through Industries, Scale, Exchange cross-regional, and Promoted diligent study.

2. Method

Activities

Miyagi Industry Association aims to contribute to the development and activation of the prefecture industry. We boldly to solve social issues by accurately reflect the trend of the times and support through various business towards the performance improvement of the member companies.

Promotion of industry-university cooperation

Since its establishment, it has been a very active by providing a forum for technology providers and exchange information with researchers and institutions of many universities in Miyagi Industry Association.

Exchange among personnel in industry

Universities, technical colleges, research institutes, government officials and many people play a industry of Miyagi brings together, industry exchange meetings, which began in order to trigger the industry collaboration, has been held with the participation community of over 300 people twice a year.

Study and research of the Technology Trend

Every year, we introduce the trend of latest technology by inviting lecturers from various fields, and hold workshop participants and instructors can exchange opinions. Also, visited the research organizations and companies inside and outside the prefecture, it continues to provide a forum for study.

Business development and product development from Miyagi

we are recruiting new product development from Miyagi once a year. Organizing the exhibition, review Board and the presentation of the award-winning, it has made support for the expansion project results by business opportunity and providing a field of creation, in addition to the introduction for the national products and technologies of Miyagi development.

Cross-industrial association

Business content of members is very widely as mining, construction, manufacturing, electricity, gas and water supply, transport and telecommunications, wholesale and retail trade, finance and insurance, information and communications industry, service industry at large subject, also it becomes the classification of more than 50 at medium subjects. It also promote inter-regional exchanges, we are back up powerfully aggressive approach in order to build partnerships with companies operating in the Northeast.

Strengthening the management base and awareness of management and management's

What is sought to management and the administrator is the sensitivity to the corresponding ad hoc in addition to rebuilding the strategy of a long-term view from a high place. To grasp the changes of the times, we have to help to strengthen the management foundation and enlightenment of consciousness by implementing seminars and symposiums for the purpose of exercise of strong corporate sentiment and respond appropriately.

Recommendations to the government and Cooperation with related organizations

The cooperation in facility planning of national and prefectural governments for Industry Development, and if necessary, to hold a government-industry meeting with the government officials, it has to reflect the voice of the Association for the administration. Also it seeks to promote regional and training of human resources in conjunction, for example, to carry out various events with related organizations.

Provision of information

We issue on a regular basis, "Miyagi Industry Association report" in order to deepen ties with members. The post event information and guide member companies, we provide the latest information on their website. Also issued a membership list once a year, and we use as a resource of public relations of mutual members. In addition, the report in a timely manner each committee activity, we continue calling for active and Challenge of every members.

3. Results and Discussion

"Miyagi Association human resources network services"

"Miyagi Industry Association Human Resources Network Service" was started as human resources support services for members, in order to survive the turbulent times to strengthen the cooperation between companies of the members of the Miyagi Industry Association, from April 2010.

In this service, it is the purpose that adopt effective excellent human resources and increasing the corporate power to win the competition to the problem and worries about human resources member companies face, by streamlining and centralizing the contact. This network will be able to centralize between companies of personnel relations, than function as a platform of Miyagi Industry Association member's company.

Overview of services

(1) Recruitment Services (mid-career)
(2) re-employment support services
(3) College Recruiting Service

As the three pillars of these, through it supports a full range of recruitment and the introduction of a wide range of human resources, you will be able to tie in to the adoption of excellent regular employees who companies seek.

HUREX Corporation is responsible for secretariat. In cooperation with human resources affiliated companies (As Toyo Work Co., Ltd., Trust Tech Co., Ltd., job station Co., Ltd., etc.) ,we are going to quickly provide information on human resources to member companies.

In the *"Miyagi Association human resources network services"*, by building a system that member companies of all to enjoy this service, we hope that it will lead to acquire new members of Miyagi Industry Association.

Outgoing business of "Miyagi SugureMONO"

We have decided to start the outgoing business "Miyagi Sugure MONO" as a new initiative to identify and develop and promotion to become the industry united the industrial products with excellent. We accredit to "Miyagi Sugure MONO" products that meet strict criteria of 10 categories quality, technology, safety and security, and the environment from the industrial superior products produced in the prefecture. Then the outgoing continuously towards the inside and outside of the prefecture from Miyagi, we hereby declare that they would create a "Miyagi Sugure MONO" towards the customer value creation.

みやぎ
優れMONO

1. We will send out " Sugure MONO" that is superior processes and systems also customer quality is ensured.
1. We will send out "Sugure MONO" that has innovation and novelty also technology that evaluates to a customer is actualized.
1. We will send out " Sugure MONO" that is evaluated commitment to safety and environmental also plays its responsibilities to protect the global environment.

the exhibition, review Board and the presentation of the award-winning

4. Concluding remarks

Currently, there under the harsh conditions, Miyagi Association has come to a turning point. Be realized Industry Association of true independent is urgent state of affairs. Increase in before, the members participating in the activities of the Association actively, we believe that it will change the Industry Association of attractive as "Members, by members, for members".

Now is the time to return to the origin of the Miyagi Industry Association establishment. We are fully aware of the spirit that has claimed the articles of incorporation, to discuss a lot with everybody, the pooled the wisdom, and we would like to work on issues.

International Presentation

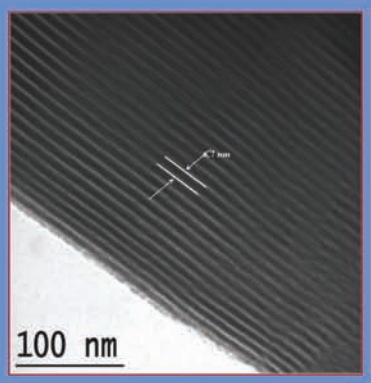
Hydrogen Storage / Solar Hydrogen / Fuel Cell / Exhaust Emission

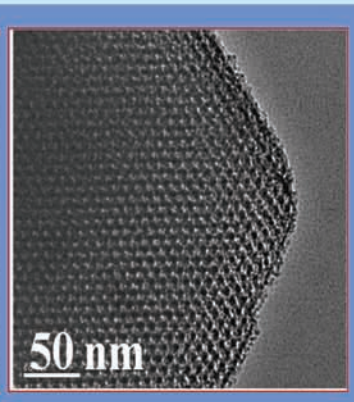
NANOPOROUS AND NANOSTRUCTURED MATERIALS

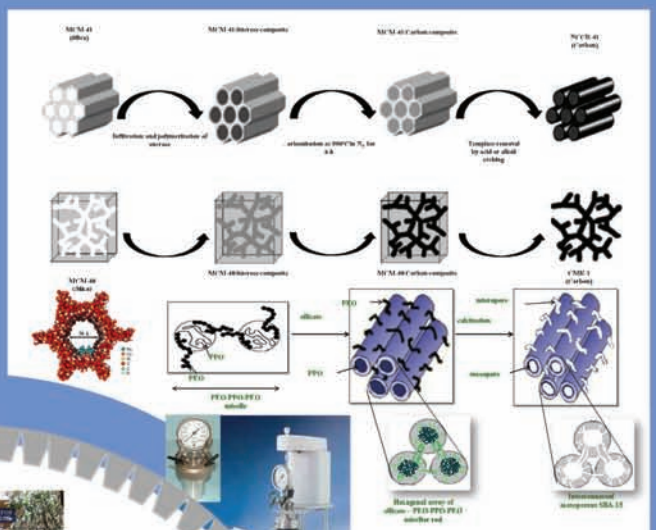
National Centre for Catalysis Research (NCCR)

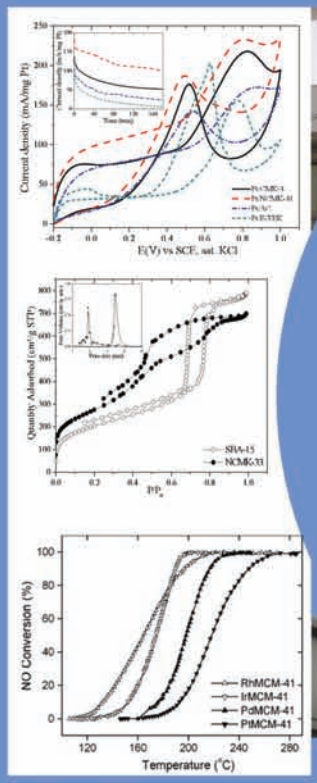
Indian Institute of Technology-Madras, Chennai 600036, India

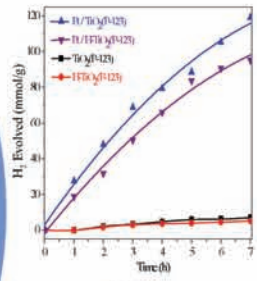
Supported Mesoporous Silica / Carbon / Titania as Photocatalyst / Electrocatalyst / Automotive Exhaust Catalyst

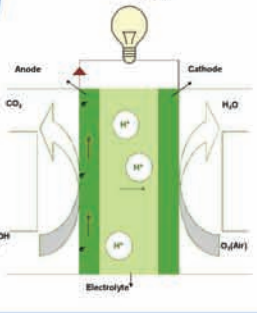


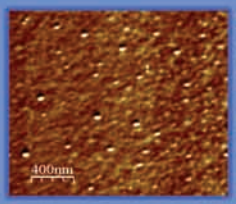


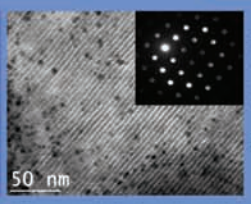


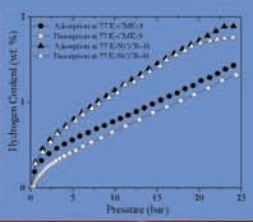


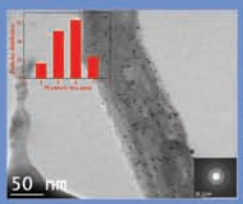










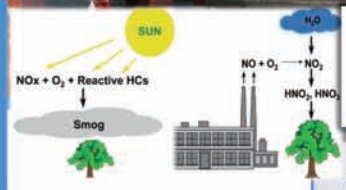


Catalyst (20 wt% Pt/Carbon)	Pt Crystallite size, (nm)		EAS (m^2/g)	Onset potential (V)	Current, i (mA/mg Pt)		Activity loss (%)		i$_f$/i$_i$
	XRD	TEM			0.9 V	0.7 V	1 h	3 h	
Pt/NCCR-41	4.7	5.5	62	0.76	84	156	44	63	1.50
Pt/CMK-3	4.2	3.6	84	0.82	103	178	41	68	1.33
Pt/SBA-15	4.0	3.7	90	0.88	154	251	24	35	1.39
Pt/NCCR-11	4.8	5.0	71	0.74	91	170	44	73	1.56
Pt/CMK-1	5.2	4.8	65	0.75	73	169	38	73	1.44
Pt/E-TEK	3.7	3.0	84	0.82	64	130	73	85	0.72

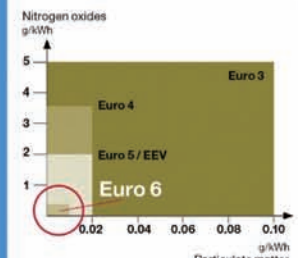
NH_3-DeNO$_x$ performance of the composite [Fe-Beta + Fe(Mn)-MCM-48] catalyst: Combining SCR activity and NH_3 oxidation activity for NH_3 slip removal

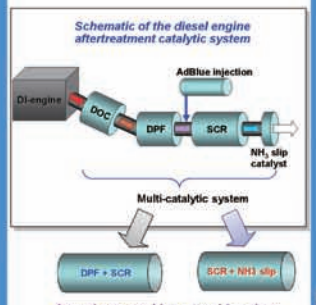
Zelinsky Institute of Organic Chemistry, Moscow, Russia; Indian Institute of Technology-Madras, Chennai, India

Alexandr Y. Stakheev, Dmitry A. Bokarev, Alina I. Mytareva, Rajesh K. Parsapur and Parasuraman Selvam



C. Baukal
Metal Finishing
103, 2005, 18
NO_x Effects





Attractive to combine several functions in a single catalyst brick

TARGET

- ✓ Good soot oxidation performance
- ✓ High NH3 DeNOx activity (including T_{react} < 250°C)
- ✓ NH3-slip function is desirable
- ✓ Limited volume

How NO_x is Controlled?

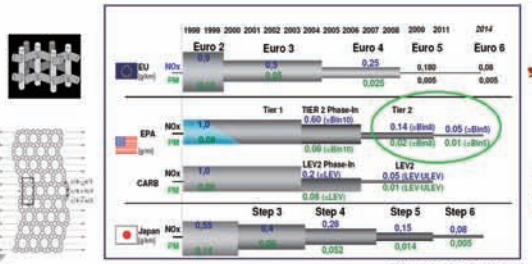
Catalytic Reduction of NO_x to N_2

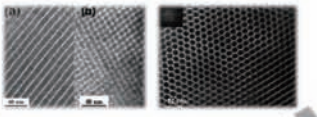
- *Selective Non-Catalytic Reduction (SNCR)*
  - Requires high temperature (T >1000°C)
- *Selective Catalytic Reduction (SCR)*
  - The most promising technique!
- *Dry Sorption*
  - Can't be used for automobile!

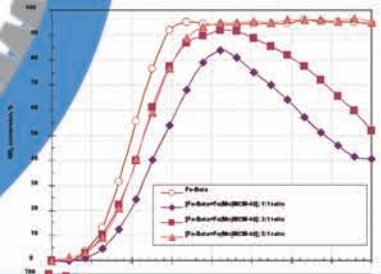
Selective Catalytic Reduction of NO_x

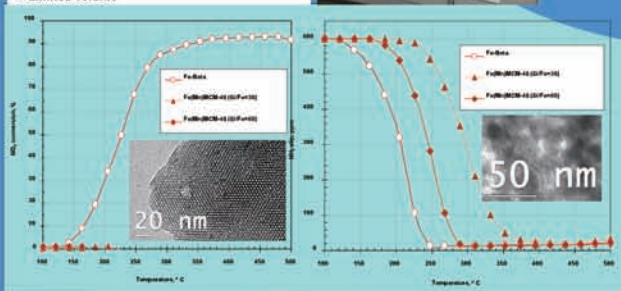
- Selective catalytic reduction of NOx by ammonia (NH3-SCR):
  $4\ NH_3 + 4\ NO + O_2 \rightarrow 4\ N_2 + 6\ H_2O$
- Selective catalytic reduction of NOx by hydrocarbons (CxHy-SCR):
  $2\ NO + C_xH_y + (x + y/4 - 1)\ O_2 \rightarrow N_2 + x\ CO_2 + (y/2)\ H_2O$

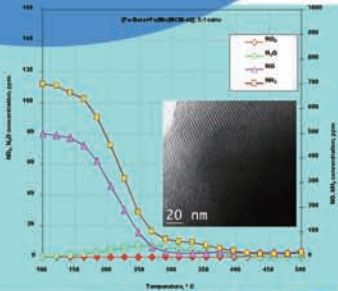
Zeolite-based catalysts promoted by transition metals are considered as the most promising catalysts for NH_3-SCR. They demonstrate favorable DeNO$_x$ activity in the Standard and especially in the Fast SCR reactions.

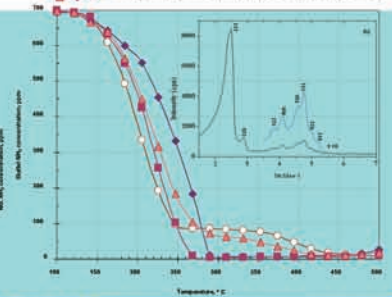








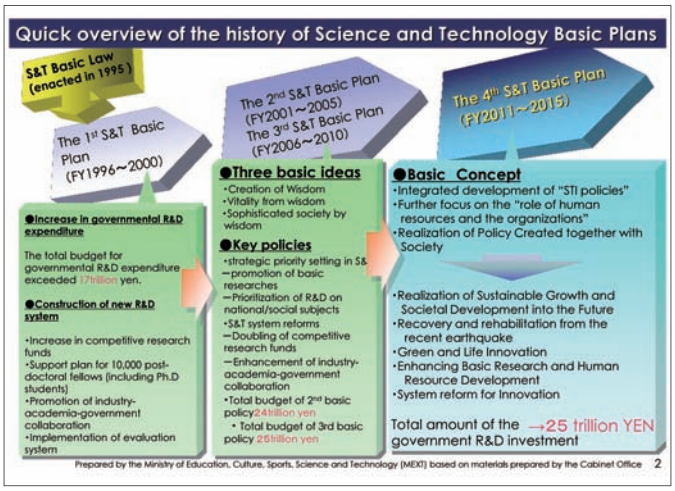


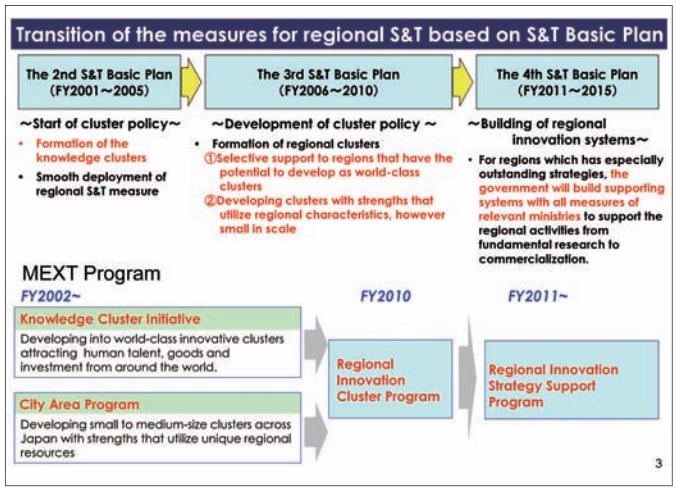


"Worldwide Leaders Meeting on Global/Local Innovations for Next Generation Automobiles" on November 28, 2013

Regional Innovation Cluster Policy of MEXT

Hiroki Takaya
Director for Regional R&D Promotion, University-Industry Collaboration and Regional R&D Division,
Ministry of Education, Culture, Sports, Science and Technology (MEXT)





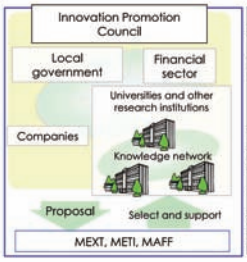
1. Background of regional science, technology and innovation in Japan
2. Regional Innovation Strategy Support Program (RSSP)
3. Future direction of regional science, technology and innovation in Japan
4. Activities toward globalization of regional clusters

4

Regional Innovation Strategy Support Program (RSSP)

FY2014 budget request : a portion of 26,481M JPY

"Regional Innovation Strategy Promoting Regions" with excellent visions toward the creation of regional innovations as
→ Jointly designated by MEXT, the Ministry of Economy, Trade and Industry (METI) and the Ministry of Agriculture, Forestry and Fisheries (MAFF)
Among these regions, those with especially outstanding strategies will receive seamless support from these ministries to help the regions realize their innovation strategies comprehensively and efficiently.



1. Region-led activities
For promoting region's strategy, region should establish "Innovation Promotion Council" formed by local government, universities, industries and financial sector etc.
- decide on a regional innovation strategy
- self-funding and self-management

2. Select "Regional Innovation Strategy Promoting Regions" by ministries
"Regions focused on strengthening international competitiveness"
"Regions focused on advancement of research function/industrial concentration"

3. Support selected regions with all measures of relevant ministries

5

MEXT's support menu -Regional Innovation Strategy Support Program (RSSP)

◇Concentration of researchers who play core roles in regional innovation strategies

◇Development and implementation of human resource development programs toward the realization of regional innovation strategies

◇Establishment of knowledge networks of universities and other research institutions

◇Support for sharing of research facilities and equipment among local universities and other research institutions

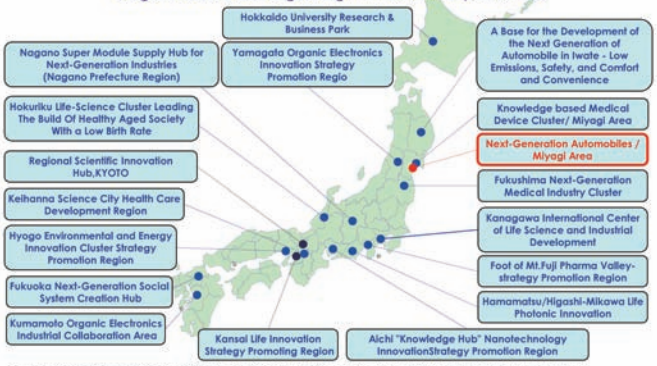
◇Reinforcement the R&D capabilities of local companies by dispatching researchers

【Other ministries' support menu 】
- **Ministry of Economy, Trade and Industry (METI) -**
  ◇Formation of business network ◇R&D for business phase
  ◇Construction for industrial concentration
- **Ministry of Agriculture, Forest and Fisheries (MAFF) -**
  ◇R&D for application agriculture, forestry and fisheries
- **Ministry of Internal Affairs and Communications –**
  ◇R&D for application ICT

6

Regional Innovation Strategy Promoting Regions

(Regions focused on strengthening international competitiveness)

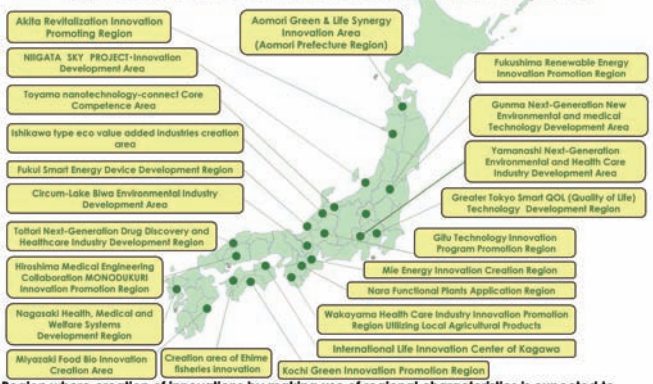


Regions where local universities possess internationally outstanding technology "seeds" or companies are concentrated to offer powerful potential to attract human resources, materials and funds from all over the world

7

Regional Innovation Strategy Promoting Regions

(Regions focused on advancement of research function/industrial concentration)



Region where creation of innovations by making use of regional characteristics is expected to offer potential to explore overseas markets in the future

8

Results of Cluster Initiative by MEXT

Total amount of investment (FY 2002-2012)

○127 Project (75 Regions) 120 billion JPY

Typical Results (FY 2002-2011)

●Global Type(Knowledge Cluster Initiative)

○Patents
Domestic 3,064
International 647
○Articles
Domestic 3,501
International 8,320
○Practical use (commercialization, incorporation, etc.) 2,238
○Sales of related products approximately 56.7 billion JPY

●City Area Type(City Area Program)

○Patents
Domestic 1,097
International 124
○Articles
Domestic 1,396
International 2,277
○Practical use (commercialization, incorporation, etc.) 1,688
○Sales of related products approximately 37.0 billion JPY

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10

Japan Revitalization Strategy -JAPAN is BACK-

(Cabinet decision on 14th June, 2013)

Overview(ABEnomics)

The first "arrow" bold monetary policy

The second "arrow" flexible fiscal policy

The third "arrow" Growth Strategy "Japan Revitalization Strategy"

Through the implementation of the three "arrows," including this Growth Strategy, among other measures, Japan aims to achieve around 3% nominal gross domestic product (GDP) growth and around 2% real GDP growth, on average, over the next ten years.

Overall Structure (Three Action Plans)

I. Industry Revitalization Plan
1. Accelerating structural reform program (Vitalizing industries)
2. Reforming the employment system and reinforcing human resources capabilities
3. Promoting Science, Technology and Innovation
4. Becoming the world's leading IT society
5. Further strengthening Japan's international competitiveness as a business hub
6. Innovation of small and medium-sized enterprises (SMEs)

II. Strategic Market Creation Plan
Theme 1: Extending the nation's "healthy life expectancy."
Theme 2: Realizing clean and economical energy demand and supply
Theme 3: Building safe, convenient and economical next-generation infrastructures
Theme 4: Building regional communities that use their unique local resources to appeal to the world

III. Strategy of Global Outreach

11

Comprehensive Strategy on Science, Technology and Innovation

(Cabinet decision on 7th June, 2013)

Key Points

- Change the way of thinking, and conduct **exit-oriented problem-solving policy management** focusing on the contribution of the results of science, technology and innovation to the realization of an ideal economic society
- Create **"the world's most innovation-friendly country"**
- Reinforcing headquarter functions of the Council for Science and Technology Policy (CSTP)

Overall Structure

Chapter 1 Toward Establishing a Nation on Science, Technology and Innovation

Chapter 2 Challenges to Be Addressed by Science, Technology and Innovation

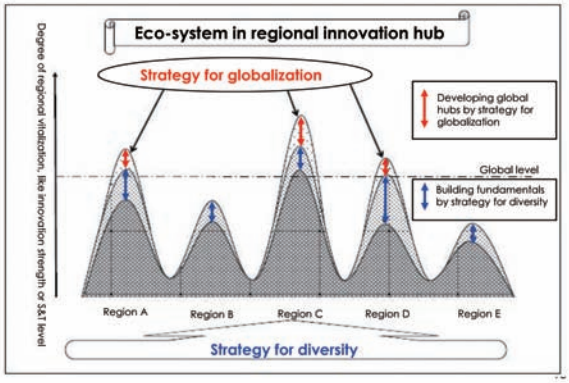
I. Realization of a Clean and Economic Energy System
II. Realization of Healthy and Active Aging Society as a Top-runner in the World
III. Development of Next Generation Infrastructures as a Top-runner in the World
IV. Regional Revitalization Taking Advantage of Regional Resources
→Developing mechanisms for the creation of innovation coming from regions
V. Early Recovery and Revitalization from the Great East Japan Earthquake

Chapter 3 Creating Environment Suited for Science, Technology and Innovation

Chapter 4 Reinforcing Headquarter Functions of CSTP

12

The Balance between diversification and focusing



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Future direction of regional science, technology and innovation in Japan

- More expansion/development of regional diversity
- Making a best use of regional resources for national problem-solving
- Strategical goal setting, acquiring global markets and standards
- Matching between seeds/needs for radical innovation
- Sharing experience among deferent fields/countries
- Pursuing win-win relationship

14

Center of Innovation (COI) Program

FY2014 budget request : a portion of 26,481M JPY

Objectives of the Program

Focuses on vision-led, challenging and high-risk R&D projects, elaborating on the future social visions in next 10 years in such a way to deliberate "how should we change" or "how should the society change".
For realizing the visions, the government takes risk and subsidizes innovative projects which have never been achieved but will generate great economic and social impacts on our society by disruptive innovation.

Features of the Program (Vision-led R&D projects)

◆Setting the visions to lead ideal society and lifestyle which come after the latent future needs, and specifying innovative R&D project themes foreseeing 10-year-ahead future.
◆Under the leadership of the highly-specialized management team, striving to break out of the paradigm, and supporting under-one-roof R&D with the collaboration of academia and industry.

Framework
COI STREAM Governing Committee
Setting Visions
Visionary Team
→Establishing innovative themes →Monitoring the management of each center
Project Leader from Industry
R&D Leader from Academia

Vision1 Realization of Happiness
Vision2 Innovative Thinking
Vision3 Sustainable Urban Development

Vision-led R&D project

Toward FY2014

【COI Centers】
○Expanding the vision-led COI center
○Newly establishing research tool based COI center

【Regional network centers】
○Newly establishing regional COI centers

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Super Cluster Program (New Cluster Program)

【Background】

- Losing opportunities for creating new markets in spite of plenty of cutting edge technologies.
- Weak in integration/ systemization of elemental technologies
- Weak in making global-strategy for marketing.
- Fruits of regional R&D activities are dispersed to be integrated.

【Concept of program】

- Establish the country-led global super-clusters by choosing, focusing and matching the fruits on social and market needs.
- Appoint Strategy-Director (SD) in each cluster. SD implements strategies and manages R&D activities, and makes business model.

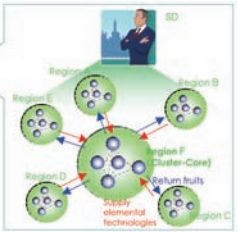
Win both in technology and market

Global/ emerging market creation
Provide solutions for social needs
Regional vitalization

Creation of Super-Cluster

Concentration and best matching based on social and market needs

Image of Super-Cluster



【Support from MEXT】

- Invite and accumulate relevant researchers
- Additional research-and-development
- Training program for entrepreneurship and innovation
- International cooperation

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Advanced Regional Innovation Policy

☐Cluster Network for synergy

-domestic

-foreign (sister cluster)

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【MEXT's activities】

Japan-France Seminar "Clusters : the Ingredients of Success"

MEXT and Embassy of France in Japan held the Japan-France joint seminar in order to share example of success and subjects between clusters of both countries

DATE : 29th November, 2012
PLACE : Embassy of France in Japan, Tokyo, Main Conference Room

About 50 persons participated.
Through the presentations of cluster policies and cluster activities from each country, we deepened the understanding and built a network for each other. It became a foothold towards future cooperation.

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【MEXT's activities】

Japan and Canada: Global Cluster Collaboration Forum

MEXT and Embassy of Canada in Japan held the Japan-Canada Collaboration forum in order to share example of success and subjects between clusters of both countries

DATE : 5th October, 2012
PLACE : Embassy of Canada in Japan, Tokyo

Opening Remarks

Dialogue I: Present State of Cluster Collaborations - Presentations

Dialogue II: Sector-Specific Clusters – Presentations

-Aerospace
Mr. Mamoru Imuta, Gifu Research & Development Foundation
Dr. André Bazergui, CRIAQ
-Medical/ Biotechnology
Dr. Yoshihiro Yoneda, Osaka University
Dr. Steve West, Nordion
-ICT
Mr. Eisaku Otsuru, Fukuoka Industry, Science & Technology Foundation
Dr. Arthur Carty, University of Waterloo WIN

Discussions – Break-Off Groups in Sectors

Aerospace Medical/ Biotechnology ICT

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【MEXT's activities】

2013 Canada 3.0 Conference

- MEXT and 2 clusters in Miyagi participated
- Meeting and global panel discussion were carried out

DATE: 3rd – 5th May,2013
PLACE: Toronto and Ottawa

【2013 Canada 3.0 Conference】

Roundtable meeting

Site visit

Prof. A. Miyamoto (Tohoku University) visited Waterloo Center for Automotive Research

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【MEXT's activities】

Sweden – Japan Cluster Seminar "Cluster as method to foster and accelerate innovations"

MEXT and Embassy of Sweden in Japan held the Sweden-Japan joint seminar.

DATE : 4th October, 2013
PLACE : Embassy of Sweden in Japan, Tokyo, Alfred Nobel Auditorium

Contents:
- Presentation about cluster policies
- Q&A to participating cluster leaders
- Short presentations from 10 clusters
- Panel discussion

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【MEXT's activities】

Switzerland-Japan Symposium

Switzerland - Japan Symposium 2013
"Fostering innovation together"
150 Anniversary of Diplomatic Relations between Switzerland and Japan
DATE : 29-30th October, 2013
PLACE : Hotel Belvédère, Spiez, Switzerland

Prof. A. Miyamoto introduced Miyagi Cluster at poster session

Topics of the Symposium :
- Life Science I: Biotech, Pharmaceuticals
- Life Science II: Med. tech./Robotics, Health Food in Context of Ageing Technologies
- Nano-materials and Innovative Surfaces
- Energy: Photon induced processes and Efficacy and New Building Technologies incl. Wood

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CLUSTER

Thank you for your attention!

URL : http://www.mext.go.jp
http://www.mext.go.jp/english/science_technology/1303792.htm

24

VisLab's latest Autonomous Driving challenges: from intercontinental to urban tests

Alberto Broggi
PhD
VisLab, The Artificial Vision and Intelligent Systems Lab.

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Parco Area delle Scienze 181/a, Bldg 1, I-43124 PARMA, Italy
E-Mail: broggi@vislab.it - www.vislab.it

Abstract

VisLab has been active in the field of intelligent vehicles for the last two decades: after the first test (2000+ km in semi-autonomous mode in 1998), VisLab designed and realized the perception system of TerraMax, the largest entry in the DARPA Challenges, which was the only vehicle that reached the end of the DARPA Grand Challenge with vision as primary sensor. In 2010 VisLab conceived and realized the longest ever test for autonomous driving: 13,000 km from Italy to China. On July 12, 2013, VisLab tested urban driving in a real environment for the first time ever with nobody behind the steering wheel: BRAiVE, VisLab's most advanced intelligent vehicle, drove in downtown Parma, negotiating two-way narrow rural roads, pedestrian crossings, traffic lights, artificial bumps, pedestrian areas, and tight roundabouts.
The presentation discusses current trends and the evolution of ADAS (Advanced Driving Assistance Systems) and also presents VisLab's vision on environmental sensing for intelligent vehicles.

Alberto Broggi

Prof. Alberto Broggi received the Dr. Ing. (Master) degree in Electronic Engineering and the Ph.D. degree in Information Technology both from the Universita` di Parma, Italy. He is now Full Professor at the Universita` di Parma and the President of VisLab, the Artificial Vision and Intelligent Systems Laboratory. As a pioneer in the use of machine vision for automotive applications and on driverless cars, he authored of more than 150 publications on international scientific journals, book chapters, refereed conference proceedings. He served as Editor-in-Chief of the IEEE Transactions on Intelligent Transportation Systems, 2004-2008; he served the IEEE Intelligent Transportation Systems Society as President for the term 2010-2011. He is recipient of two ERC (European Research Council) prestigious grants.

VisLab's latest Autonomous Driving challenges:
from intercontinental to urban tests

Alberto Broggi
VisLab - University of Parma, Italy
broggi@vislab.it

Tohoku Univ, Sendai, JP – Nov 28, 2013

Outline

- Short presentation of VisLab
- VisLab's technology
  - Approach and key ideas
- Real road experiments

VisLab

VisLab

23 people as of Nov 2013

VisLab Expertise

- Perception
  - Multispectral Vision (Daylight, Near/Far IR)
  - Single or multiple vision sensors (Monocular, Stereo, Motion Stereo, Tetravision, data fusion)
- Data fusion (laser, radar, vehicle data)
- Real Time, multithreaded software environment

VisLab Peculiarities

- Long experience on the field with:
  - Real prototypes: cars, trucks, off-road, mining, road construction, maritime, military
  - Different companies and governmental institutions worldwide

VisLab's Autonomous Vehicles

1998


2007


2005


2009

...not only cars

VisLab approach and technology

VisLab concept and business model
compared to other research centers/companies

Main Challenges

- Driverless technology:
  1. Environmental sensing
  2. Intelligent decision
  3. Vehicle actuation
- Product
  - Cost, Integration, Robustness, Redundancy, Security,...

Main Challenges

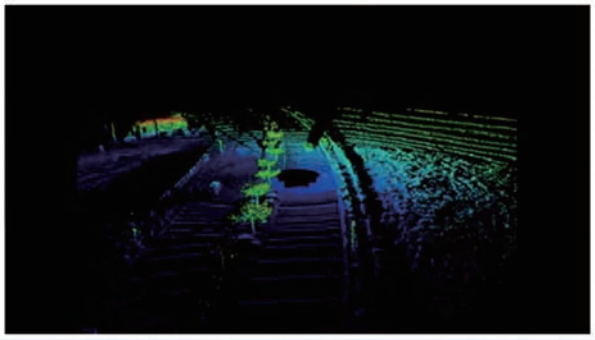
- Driverless technology:
  1. Environmental sensing
  2. Intelligent decision
  3. Vehicle actuation
- Product
  - Cost, Integration, Robustness, Redundancy, Security,...

Two solutions

Sensing: VisLab's approach

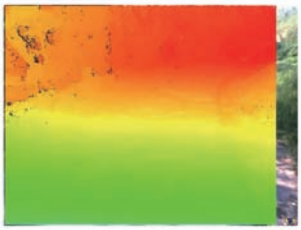
- VisLab's approach is based on:
  - low-cost and
  - highly integrated sensors

LIDAR-based sensing



Vision-based sensing

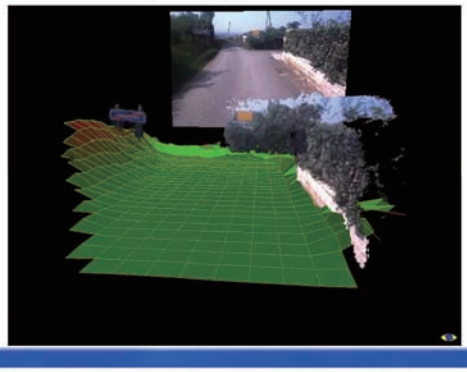
- Stereo vision
  - with a *'smart'* algorithm



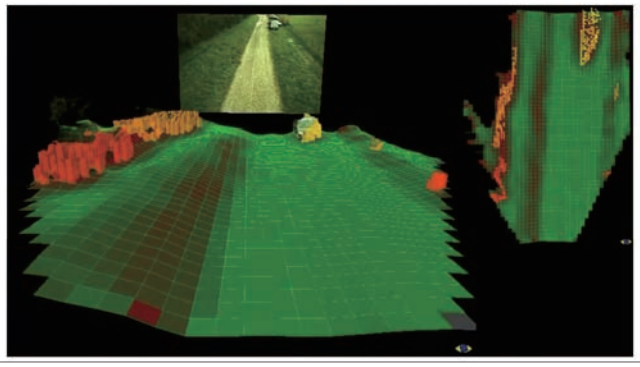
3D vision

- Performance example:
  - 640x480 pxl @12.5Hz -> 3.800.000 pixels/s
  - Stereo processing (with 90% density) delivers ~3.500.000 distance estimations per second

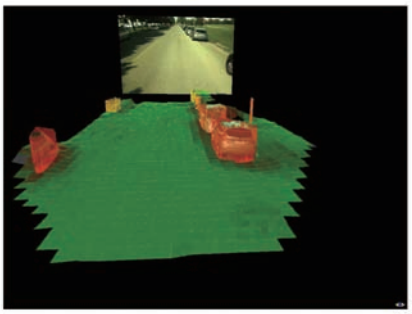
Terrain Mapping



Obstacles & Free Space

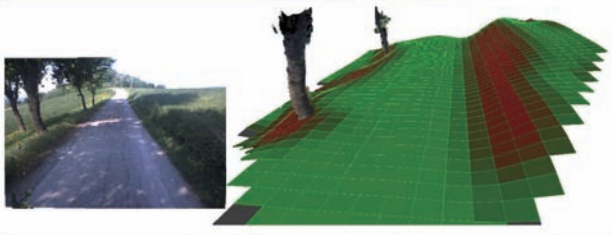


3D World Perception



Online calibration

VisLab stereovision technology



Current VisLab technology

Preview of VisLab research

- FPGA-based 3D processing
  - ✓25fps @ 640x480 pxl (~6M 3D point/s)
  - 15, 20, 40cm baseline
  - Ethernet/CAN output

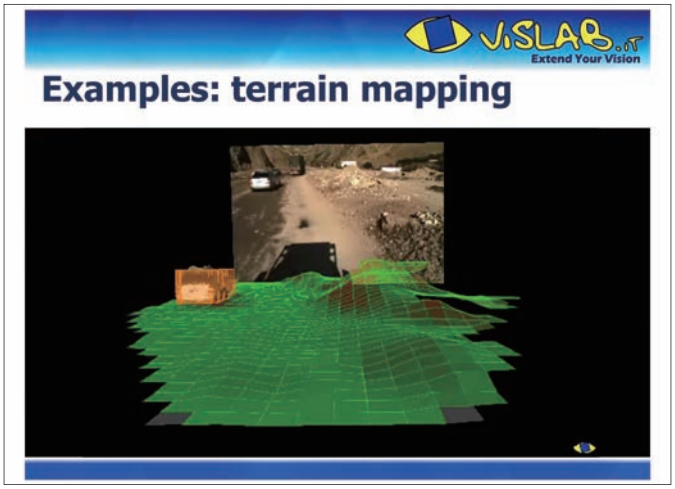
Road experiments

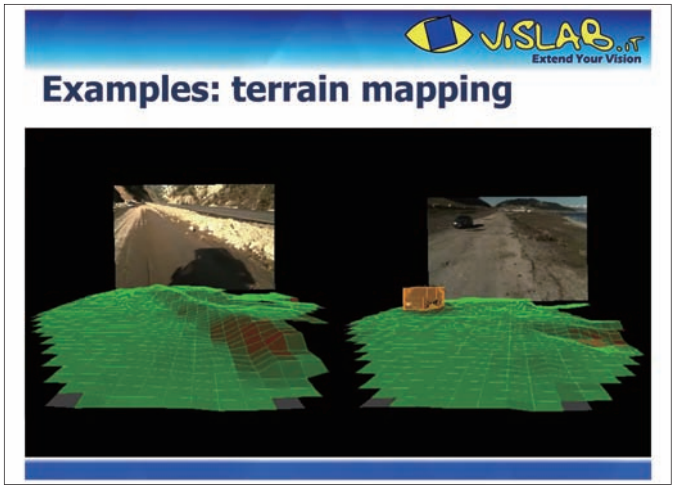
Testing with BRAiVE

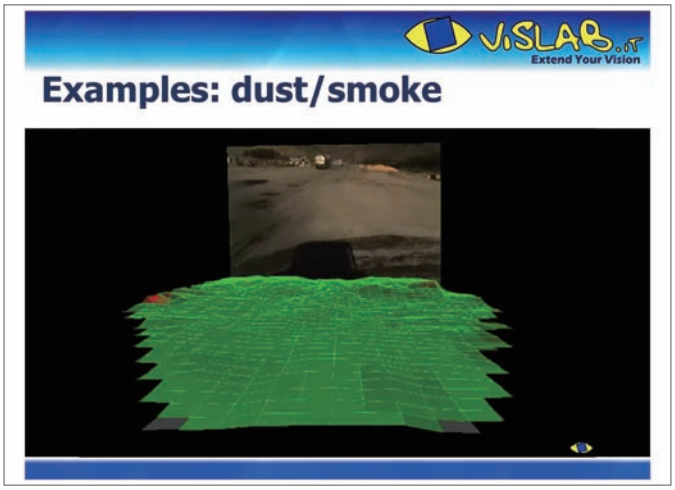
- Perception to be further tested...

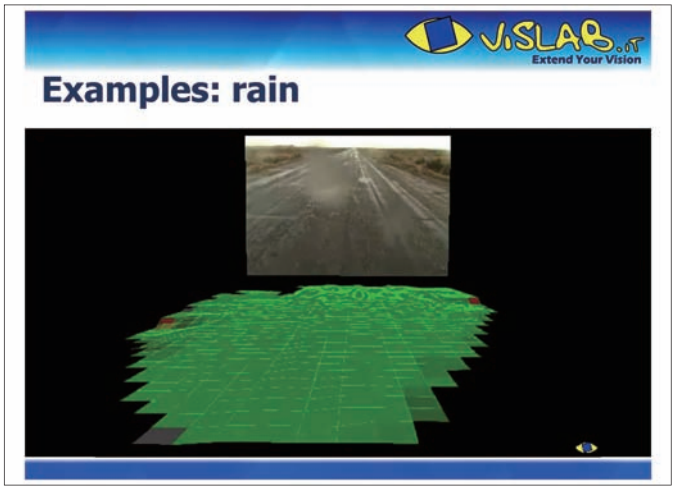

13.000 km,
three months,
no driver


ViSLAB.it
Extend Your Vision
Examples: traffic

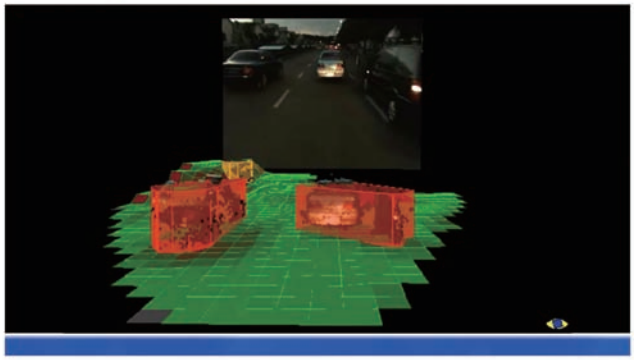

ViSLAB.it
Extend Your Vision
Examples: terrain mapping


ViSLAB.it
Extend Your Vision
Examples: terrain mapping


ViSLAB.it
Extend Your Vision
Examples: dust/smoke


ViSLAB.it
Extend Your Vision
Examples: rain

Examples: traffic in the dark



PROUD Car Test 2013

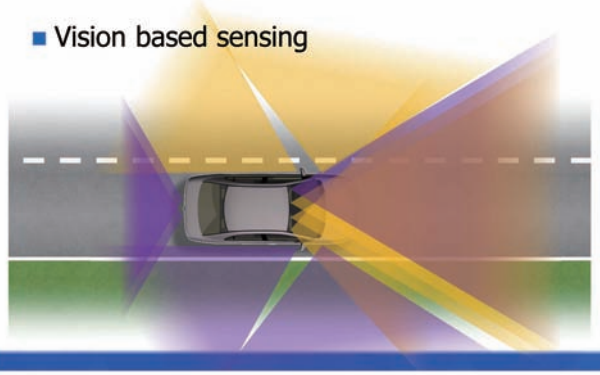
Public Road Urban Driverless-Car Test 2013

July 12, 2013, downtown Parma, Italy

The Vehicle, the Test, the Approach

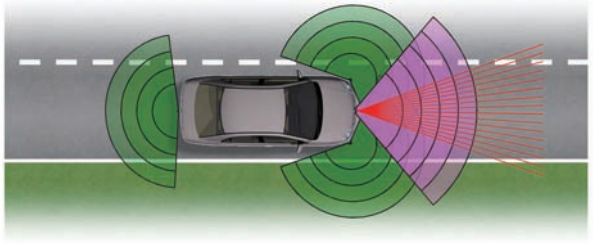
The BRAiVE Vehicle

- Vision based sensing



The BRAiVE Vehicle

- Laser based sensing

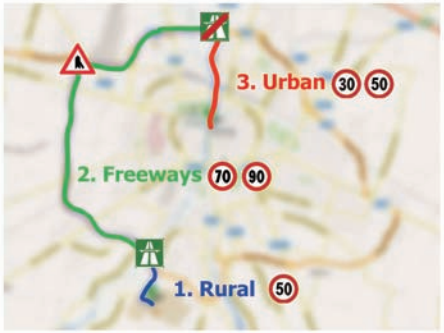


The BRAiVE Vehicle

- Internal configuration

The Test Scenario

The Test Scenario

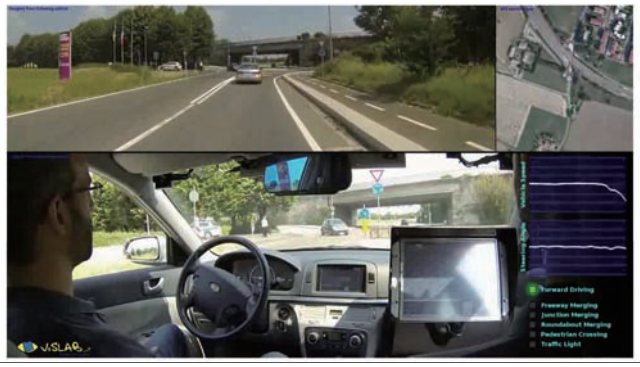


The Test Scenario

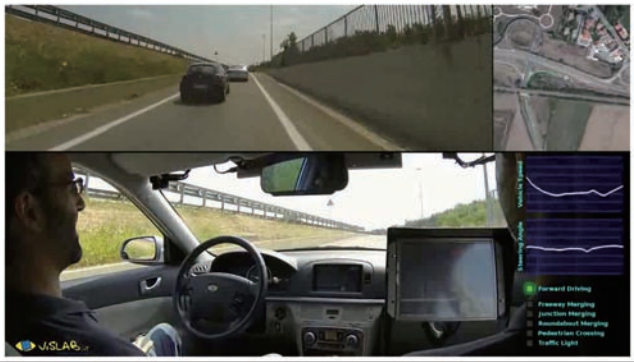
Urban area

- 5 roundabouts
- 7 pedestrian crossings
- 1 traffic signal
- 1 tunnel
- 1 give way
- 2 speed bumpers

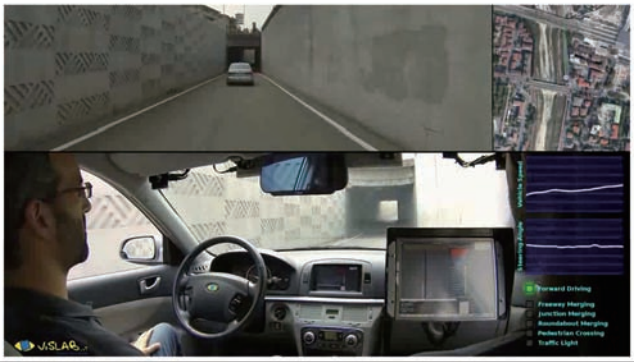
Examples



Examples



Examples



Examples

Results

- About 13 km (3km in urban area)
- Driven in about 18 minutes (at 11am on a working day)
- No human interventions

- Is autonomous driving solved?

New Test Vehicle

- Vision to replace 3D laserscanner for low-cost, 360 all-round perception
- Vision to replace precise GPS

VisLab's latest Autonomous Driving challenges:
from intercontinental to urban tests

Alberto Broggi
VisLab - University of Parma, Italy
broggi@vislab.it

Tohoku Univ, Sendai, JP – Nov 28, 2013

Katsuto Nakatsuka

Project Director

Next Generation Automobiles / Miyagi Area

Next－Generation Automobiles／Miyagi Area

Katsuto Nakatsuka, Project Director

My idea for bring regional innovations in Miyagi Area

○Make the knowledge networks of researchers and social needs networks of enterprises, then share the use of new facilities and equipment among members.

—basic structure—

1. Find the exact needs concerning to the usage of automobile in the targeted region, and design their specification. If suitable type of automobile is not found, regional enterprises prepare it themselves.

Example1. New transport system around a metro- station. Prof.Hasegawa will describe an example.

Example2. Reconstruction of agriculture and fisheries industry in a sea side area invaded by Tsunami, is hopefully designed to separate the working and residence zones.

A new transportation system for going and coming of workers is essential there. The specifications of automobile and system management under the given economic conditions should be carefully examined. This kind of discussion is going on.

2. Examination of LNG-DDF engine is being conducted by the collaboration of three regional companies(Poster No.67). The technologies of the enterprise leader are high-and-wide, and their time schedule of experiments is unexpectedly short.

In my opinion, the collaboration of enterprises has possibilities to link to high-speed technology development, different from large-scale cooperation system in big companies.

Mark C. Williams
Director, Research
URS Corporation

My Idea: Sunlight, Natural Gas, Electric Grid Future of Transportation

Dr. Mark C. Williams
Director, Research
URS Corporation
Visiting Professor, Tohoku University
November 28, 2013

Future of Transportation and Energy

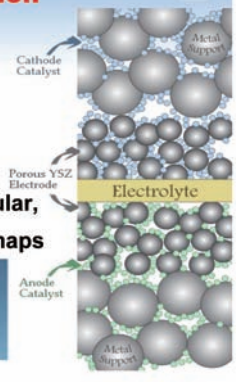
PRIMARY ENERGY	FUEL	INFRASTRUCTURE	TECHNOLOGY	CUSTOMER
NG(H2O)	H2, Liquid fuels	None today for H2 and NG	ICE,PEFC	Autos/long distance
NG	CNG	None today for NG	ICE, SOFC	Autos/intermediate distance
Light (H2O, CO2)	H2, NG, Liquid fuels	Everywhere	ICE,PEFC,SOFC	Autos/all distances
Light	Electricity	Sunlight	Electric motor	Autos
NG Light Hydro Geothermal Wind Biomass	Stationary Electricity	Electric grid	Electric car	Autos/short distance

Priority Research

- Light (solar performance and cost) - transportation and stationary
- Energy Storage
  - Natural gas on-board storage
  - Battery (performance and cost)
- Waste heat recovery
- H2 fuel cells for transportation
- Natural gas fuel cells for transportation
- H2 and fuel production directly from water, CO2 and light
- H2 and liquid fuels indirectly from water, NG and energy (light, thermal)

Natural Gas Fuel Cells for Transportation

- **Natural gas fuel cells**
  - Direct methane
  - Internal reforming
- **Complete re-look**
- **Metal-supported planar or tubular, intermediate temperature, perhaps SOFC-type**
  - Durability
  - Efficiency



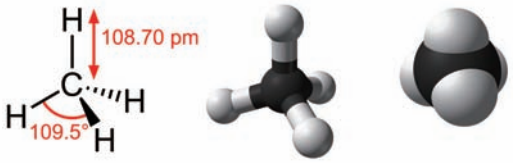
Types of Energy and Energy Conversion

- **Primary Energy – Propulsion (exclude coal and nuclear) directly**
  - Oil - Cars
  - Natural Gas – Cars
  - Solar – Cars
- **Primary Energy – Fuel or Stationary Electricity (Battery or rails)**
  - Coal - Fuel or electricity – Oil, NG, H2 or electric cars
  - Biomass – Fuel or electricity - Oil, NG, H2 or electric cars
  - **Nuclear – Fuel or Electricity - H2 or electric cars**
  - Solar - Fuel or electricity – H2 or electric cars
  - Wind – Fuel or electricity – H2 or electric cars
  - Hydro - Fuel or electricity – H2 or electric cars
  - Geothermal - Fuel or electricity – H2 or electric cars

We will always have natural gas (methane) on this planet

We benefit from the chemical energy extracted from sunlight on this planet
- Coal, petroleum and natural gas are stored chemical energy from the past

As long as there is life and sunlight, we will always have natural gas on this planet in the future
- Methane from human (ADG) and plant and animal and plant residues and wastes captured from sunlight are available



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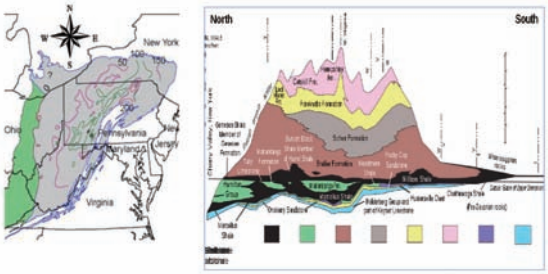
Marcellus Shale: PSU estimates possible 4,400 Tcf

("Got gas, lots". *Pittsburgh Tribune-Review*. 2008-11-05.)



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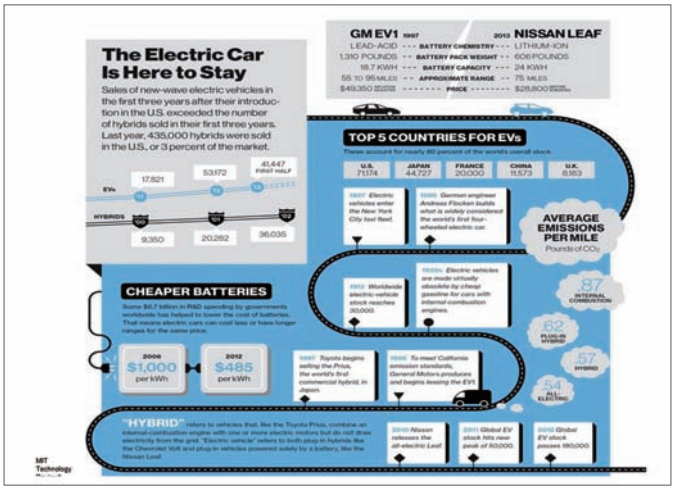
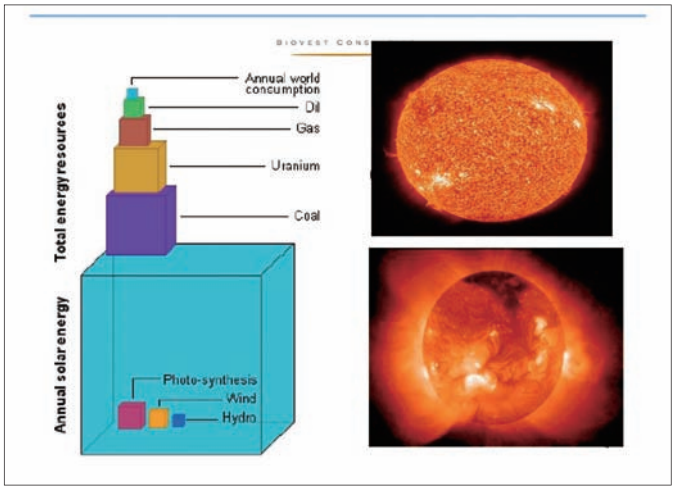
CNG Vehicles

- **Currently, the only natural gas light-duty vehicle manufactured in the U.S. is the Honda Civic ($26,000 list price; 24 city/36 hwy/28 combined gasoline equivalent mpg).**
- **Only roughly 110,000 of the 12 million CNG vehicles worldwide are in the U.S., including aftermarket conversions.**
- **There are roughly 250 million registered passenger vehicles in the US (EIA)**
- **Cost to convert vehicles to NG is estimated $12,500 to $22,500 depending on the vehicle, engine, size of CNG tanks needed, and who does the converting (Green Car Journal, 2011)**
- **Need to develop SOFC Vehicles**

8





Solar Vehicles

- **With the SEV solar system, the Toyota Prius can operate up to 30 miles per day in electric mode thus improving fuel economy by up to 34-60%.**
- **Power density: Power from a solar array is limited by the size of the vehicle and area that can be exposed to sunlight.**
  - » While energy can be accumulated in batteries to lower peak demand on the array and provide operation in sunless conditions, the battery adds weight and cost to the vehicle. The power limit can be mitigated by use of conventional electric cars supplied by solar (or other) power, recharging from the electrical grid.
  - » triple hybrid vehicle—the PHEV that has solar panels as well to assist

- **Cost: While sunlight is free, the creation of PV cells to capture that sunlight is expensive. Costs for solar panels are declining.**

Transition to Future

- **Future**
  - Future is world without stored oil, nuclear, coal
  - Ultimately going real time using energy directly from sunlight (direct solar) for grid and transportation
    and
  - Indirectly from sunlight (wind, hydro, natural gas (chemical energy from biological sources) for grid and transportation
    or
  - Fusion – mini-suns – energy of nucleus E=MC²
- **Transition**
  - We are depleting all stored energy
  - We are moving toward real time energy consumption
  - Local Transportation
    - Electrification of local transportation battery and NG vehicles
    - Many fuels, one electrical grid
    - Automobile possibly integrated with local electrified rail
  - Long distance transportation
    - Light
    - Fuel (NG)
    - Liquid fuel (NG feedstock and light energy) – military and air

- **Greater local monitoring, control and interdependence**
  - One System – Energy, Housing and Transportation
  - Need social planning and demand-side management (reduction in energy use)
    - How many people?
    - How much/where they travel?
    - Where/how they choose to live?

The Questions

- **How do we prepare for the Future of Transportation and Energy proposed?**
- **How long is the transition period from current policy of using stored energy to direct solar and renewable? 50 years? 150 years?**
- **What to we do in the transition period? R&D where?**
- **How do we transition population, energy resources and environment peacefully during the limited transition time available?**
- **What should the World Energy Policy be?**
- **I have said nothing about the environment**

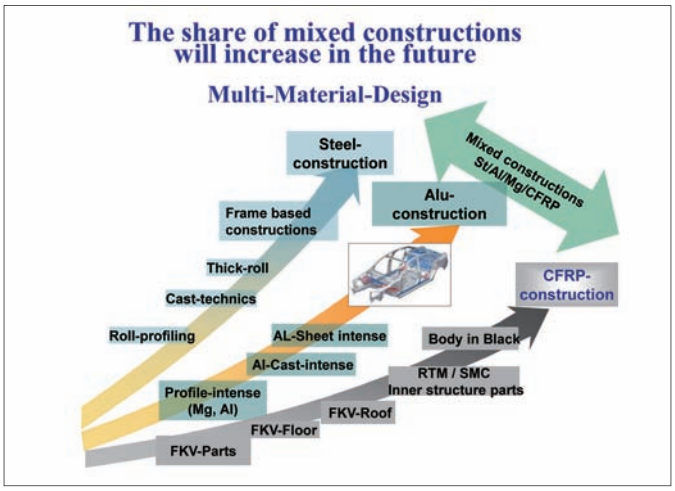
Types of Primary Energy

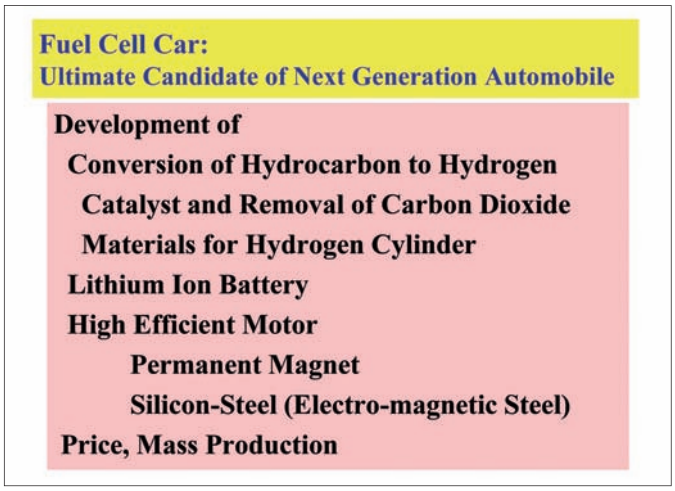
- **Primary Energy (Stored and Realtime)**
  - Oil
  - Coal
  - Natural Gas
  - Biomass
  - Nuclear
  - Solar
  - Wind
  - Hydro
  - Geothermal

Yasutaka Iguchi

Chairman

Board at Miyagi Organization for Industry Promotion



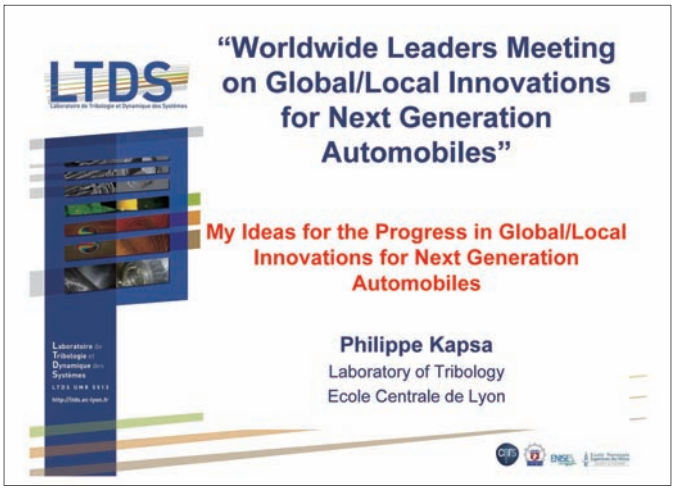


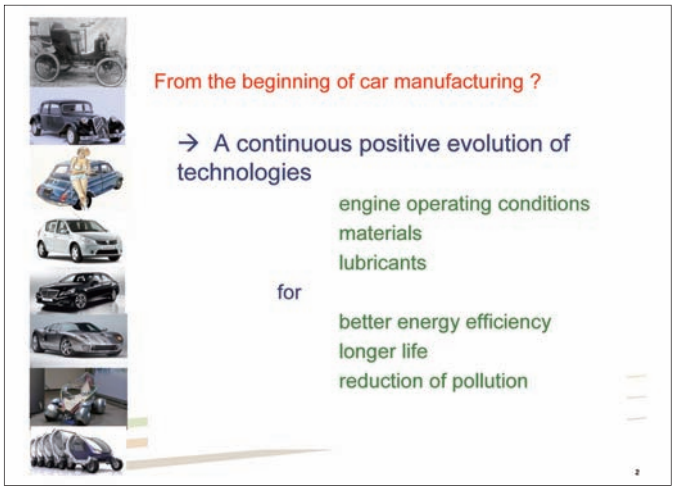
Philippe Kapsa

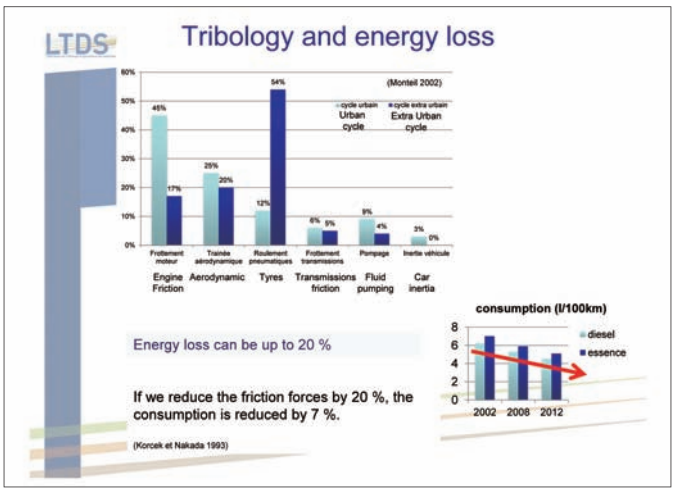
Senior, Researcher, CNRS

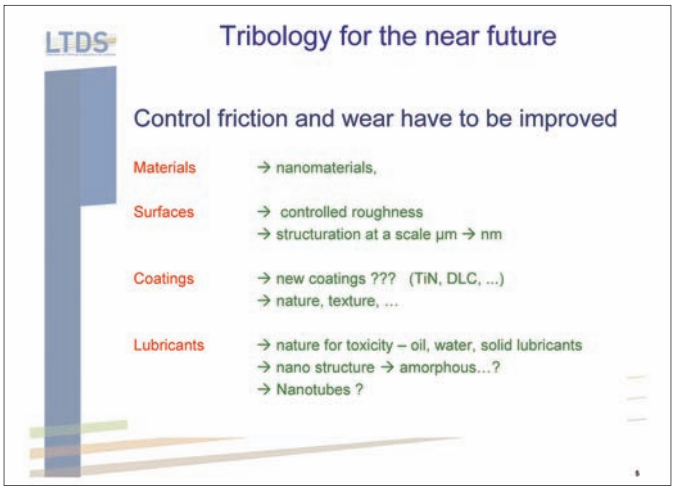
Laboratoire de Tribologie et Dynamique des Systèmes UMR CNRS 5513

Ecole Centrale de Lyon









Tokuta Inoue
Senior Research Fellow
Tohoku University

Lessons from the history of Toyota

Tokuta Inoue
Senior Research Fellow, Tohoku University
(Toyota Genesis Research Institute)

Innovation for next generation automobile

- Product innovation
- Production method innovation
- Business model innovation

KIICHIRO Automatic Loom

- When I was busy making a design, I heard a "Hmm" right by my ear. " That's an interesting looking design. You like this sort of thing. So, if you want to do research on the automatic loom, you can". At last I was given permission by my father to do research openly"
- "One stage shuttle changer" was invented which was superior to Sakichi's old idea of "Two stage shuttle changer"
- This new idea was patented (Pat. No. 65156) and transferred to Platt Brother's & Co

KIICHIRO-Toyoda-Platt Agreement

- Second trip to west
- Doubt about the future of the Automatic Loom Business
- The Toyoda – Platt Agreement
- Appraisal of TOYODA Type G Loom
- Decline in Platt Brother's assembly technology

KIICHIRO-"Just-in-Time"

- "Making sure you don't have too many or too few. In other words, making sure one doesn't use too much effort and time for producing a specific item. No waste and no surplus. When a part moves down the assembly line, you have to make sure you don't keep it waiting. I think it's important that every part be ready just in time. I believe this is the first principle in improving efficiency"

KIICHIRO-His courage, challenge and creation

- Kiichiro took greatest pride in being textile machine engineer.
- But he was more than that.
- As soon as he had doubts about the future of the textile machine business, he showed a courage in making a shift to the completely unknown business of making automobile as a founder of TOYOTA motor corporation based on the "Five Main Principles of TOYOTA"
- He was an innovative person who, not intoxicated by his initial success, did not shrink from the enormous task of pioneering major change

Thank you for your attention

Roberto Horowitz and Thomas West
Directors
Partners for Advanced Transportation Technology
University of California, Berkeley

Mobility Management:

Maximize:
- Human productivity/convenience
- Environmental sustainability
- Urban livability

Roberto Horowitz and Thomas West
Directors
Partners for Advanced Transportation Technology
University of California, Berkeley

Airport air traffic jams are not tolerated

Demand and supply of service is **tightly** managed
- reservations, coordination, collaboration

Surface traffic jams are common place

Demand and supply of service is **loosely** managed
- Little reservation, coordination, collaboration

Mobility - a valuable asset

- Needs to be intelligently facilitated, shared and managed
- Consumes precious resources
  - Energy
  - Human productivity (time, effort, stress, etc.)
  - Land and infrastructure resources
- Produces undesirable byproducts
  - Pollution (CO_2, smog, noise)
  - Congestion, poor urban livability

Mobility - a valuable asset

- Needs to be intelligently facilitated, shared and managed
- Management and control of a large-scale, complex, highly distributed and uncertain system.
- **Maximize:**
  - **Environmental sustainability**
    - minimize energy consumption, pollution production
  - **Human productivity and convenience**
    - minimize wasted time, physical and psychological hardship, and travel time arrival variability
  - **Urban livability**
    - minimize congestion, land usage and growth of transportation infrastructure (roadways & parking lots VS gardens & parks)

It's all about the data!

- **The extraction of data for the good of the cause**
  - Data from fleets, buses, taxis
  - Mobile devices – Mobile Millennium
  - Infrastructure sensors
  - Social networks like Twitter, Facebook
  - Collaborative applications like Waze
  - Data from your personal vehicle
  - V2V and V2I communication
  - Data from autonomous vehicles
- **Data + Analytics = Information**
  - Investment selection
  - Performance
  - Management
  - Traveler information
  - Traveler collaboration
  - Acquiring 3rd party data, quality, fusion

CALIFORNIA PATH

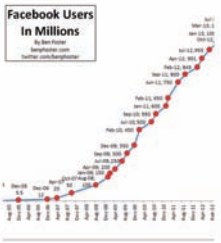
Information could be plentiful…

- Traveler information is everywhere
  - Travel times on changeable message signs
  - Media
  - Mobile devices
  - Navigation devices include best routing to avoid traffic
  - Infrastructure sensors
- **Traffic forecast**
  - **Analogous to weather, can we predict travel conditions?**

CALIFORNIA PATH

Social media and collaboration will be big!

- Number of connected social network users exceeds 1.2B on Facebook alone
- Mining for traffic data on Twitter and other social media has begun
- Social has started to change travel behavior



CALIFORNIA PATH

Social media and collaboration will be big!

- Number of connected social network users exceeds 1.2B on Facebook alone
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waze

CALIFORNIA PATH

Travelers will collaborate…

- Traveler information will be integrated into our lives
  - Coordination with our daily calendars
- We will make smarter decisions about our travel
  - Drive, take transit, telecommute, change schedule to leave earlier or later
    - First with selfish motivation, later for the common good
- Thousands of web applications will assist
  - Parking, routing, rideshare, transit schedules, air quality, etc.

waze

CALIFORNIA PATH

Business and the government…

- Businesses will collaborate as well
  - Workplaces will offer greater flexibility, incentives for doing the right thing
  - Insurance companies will help define travel
    - Reward/punish financially, already doing so with "pay as you drive"
- The government is here to help!
  - Manage information collection and distribution
  - Manage infrastructure resources
  - Provide incentives (rewards for smart travel choices)
  - Provide disincentives (should we be charged for travel at the worst times, or for the carbon footprint we leave?)



Vehicle Improvements

- Your car will be much safer
  - Cooperative Adaptive Cruise Control
  - Run off the road warning
  - Collision warning and avoidance
  - Car to car communication
- Connected in every way
  - Connected car
- More environmentally friendly
  - Eco-Routing, Eco-Driving
- Will transmit/receive data and information


Vehicle Improvements

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$600 BILLION ANNUALLY BY 2020.

Vehicle Improvements

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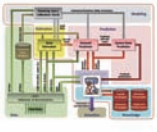
Automated cars are coming…




Coordination is essential ! Example: Connected Corridors

- **Next Generation of Integrated Corridor Management (ICM)**
- "Faster than Real Time" Decision Support
  - Data/information
    - Shared by consumers, other
  - Ultra fast macro-simulation modeling
  - Traffic prediction
  - Instant playbooks
- Crowd sourcing, social networking
- Incentives
- Demonstration in greater Los Angeles area
  - Caltrans, MTA, Cities



Coordination is essential !

Extend coordination and collaboration from
traffic management to ***mobility management***

- Utilize vehicle to vehicle (V2V) and vehicle to infrastructure (V2I) communication.
- Utilize social networking and real-time sharing and collaboration tools.
- Enhance performance and convenience of automated and autonomous vehicles.
- Enhance real-time response of rail and transit services, taxis and commuting and car sharing services.
- Enhance real-time information dissemination and coordination of mobility choices.

Solving Coordination and Collaboration Challenges

- Can mobility demands and conditions be accurately forecasted?
- Centralized VS distributed decision making?
- Will decentralized collaboration lead to instability?
- How can we best manage mobility information dissemination and resources allocation?
- How can we effectively manage a large-scale, decentralized an uncertain system?

Thank You

Roberto Horowitz and Thomas West
Directors
California PATH
University of California, Berkeley
horowitz@berkeley.edu
tomwest@path.berkeley.edu

Hideomi Koinuma

Visiting Professor

Tokyo University

Proposal of Multi-brid car @Sendai conf. on future automobiles 20131127

H. Koinuma, Tokyo University, Tsukuba University, Comet Inc. Ltd.,

○ Question:

-Can the car keep a main player in future society, judging from life (health) , energy, environment and business ?

○ Basic concept

- What is a transporter superior to Hybrid, EV, and PHV cars ?
- How can we save money and time to compensate weight gain and muscle loss caused by constantly relying on car ?
- Assist warming up from inside the body instead of energy consuming electric heater to overcome a serious weak point of EV in cold areas
- Heat is a lower grade energy, since it inevitably accompanys loss in conversion.

→ **Multi-brid car assisted with man power**

○ Design concept of car innovation

- Renewable energy
- Implementation of health care units with sensing devices and athletic functions that can work also at emergency
- Drive with hands only and let feet free for physical training: Add athletic room function to driving car.

Multi-brid car (MBC)

** *New concept car equipped with health care and athletic gym function.***

Why ? EV has a serious weak point for deployment in cold local areas, if the air-conditioning, especially heating, is driven by the battery.

What is MBC ? Man power is not so big (100~600 W), but it can help not only battery charging but also warm up his body from inside.

How, who, where, and when ? Install bicycle-type electric power generator at driver's and passengers' seats. People can work and relax as they like under monitoring their health care sensors.

Thus, automobile can be an athletic room, in addition to transportation tool.

Fig. 1 Bicycle type human power electric generator : 200 ~600 W Prof. Hatta @ Kochi Inst. Tech

Osamu Okada

President

Renaissance Energy Research Corporation

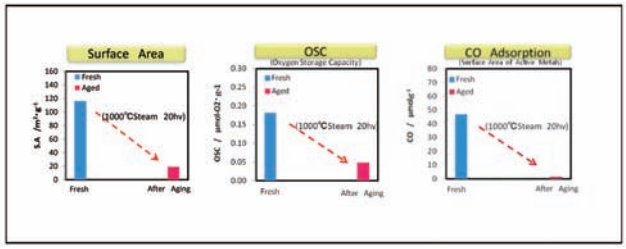
INNOVATIVE MATERIALS
FOR NEXT GENARATION AUTOMOBILES

1. Heat-resistant γ -alumina

2. High Performance Ceria

Osamu Okada
President
Renaissance Energy Research Corporation
Visiting Professor
Tohoku University

Problem of Conventional Three Way Catalyst for Automobile Deactivation by Surface Area Reduction ⇐ Sintering of catalyst career (γ -Al_2O→α -Al_2O_3)



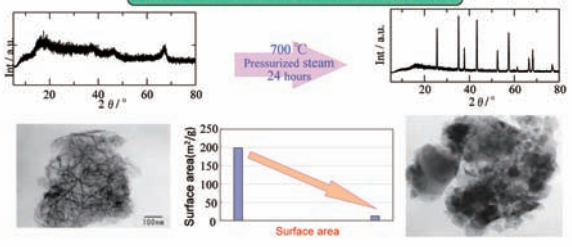
Prevention of Sintering is Important

Development of new carrier with a large surface area in the automotive exhaust gas condition

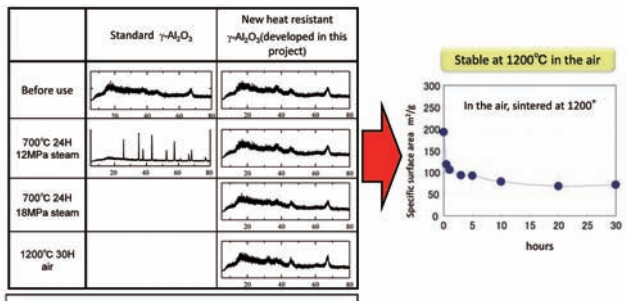
Improved heat resistance of γ-alumina

- γ-Al2O3 has a large surface, but unstable at high temperature
- γ-Al2O3 change to α-Al2O3 easily, and surface area is extremely reduced at high temperatures & humidified atmosphere.

Sintering characteristics of γ-Al2O3



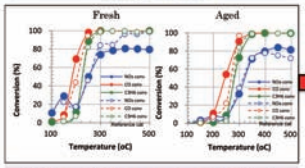
We succeeded in development of new catalyst support which maintain a large surface area in the automotive exhaust gas conditions..



Stability of newly developed heat resistant γ -Al_2O_3 was significantly improved compared to the existing γ -Al_2O_3.

Effect of improved ceria

Result of the high Performance Ceria Obtained in 2011

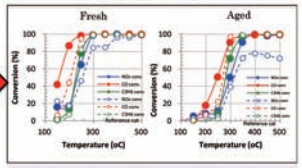


TWC result of Improved ceria (2011ver.)
(reference catalyst composition)

Ceria : Alumina = 1 : 2
1% Rh on Ceria
2.5% Pd on Alumina

Aged catalyst shows higher performance than the reference catalyst

Result of the high Performance Ceria Obtained in 2012



TWC result of Improved ceria (2012ver.)
(reference catalyst composition)

Ceria : Alumina = 1 : 2
1% Rh on Ceria
2.5% Pd on Alumina

Fresh, Aged catalysts show higher performance than the reference catalyst

Improved Three Way Catalyst for Automobile

(Based on the results of NEDO PJ(2011) & METI PJ(2012))

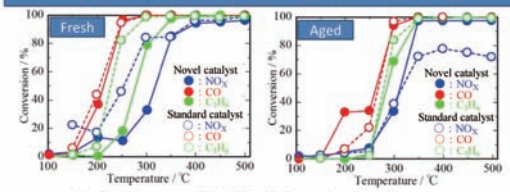
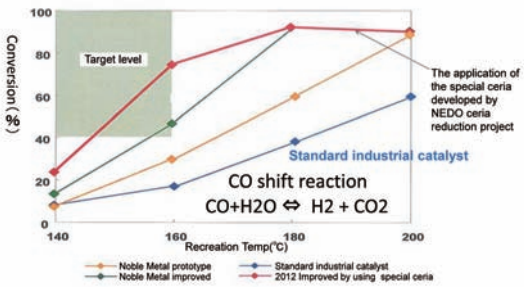


Fig. Conversion curves of C_3H_6, CO and NO_x over the novel catalysts.

Standard catalyst 1%Rh/CeO_2 : Pd/Al_2O_3 = 1 : 2
Novel catalyst Rh/Improved ceria : Pd/Novel heat resistance Al_2O_3 = 1 : 4
Ceria (−40%), Pd (−30%) and Rh (−40%)

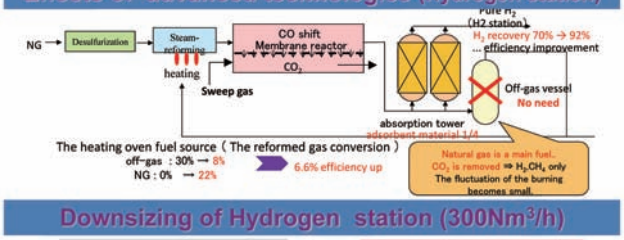
Significant reduction both ceria and noble metal was achieved using combination of Heat resistant γ- alumina and high performance ceria

Application of newly developed ceria to CO shift catalyst

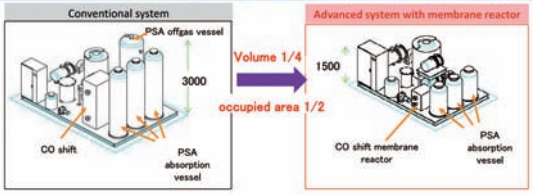


CO shift catalyst is very important catalyst in hydrogen production process.
Using newly developed special ceria, we succeeded in Improving low temperature activity of CO shift catalyst.
Improved CO shift catalyst can reduce CO to the lower level than conventional CO shift catalyst and can improve energy efficiency of Hydrogen production process.

Effects of advanced technologies (Hydrogen station)



Downsizing of Hydrogen station (300Nm³/h)



Conclusion

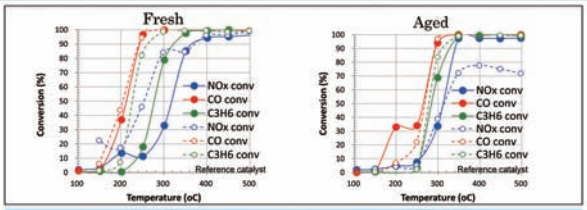
・We succeeded in developing in high performance Three Way Catalyst (TWC) for automobile

Next step is

1) Commercialization of high performance TWC including large scale production of High performance ceria & Heat-resistant γ-alumina

2) Application of such innovative materials to new area
   ① Catalysts for Hydrogen Production Process
   ② Oxidation catalyst for diesel engine automobile

Reduction of both noble metals and ceria by heat-resistant γ -alumina and high performance ceria



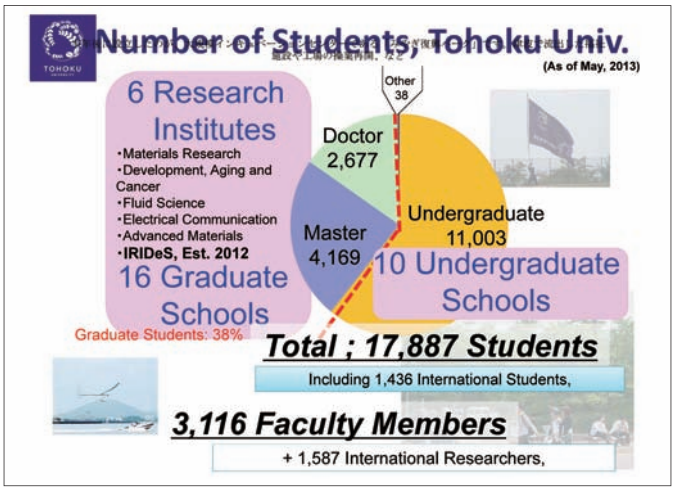
Heat resistant γ -alumina + Improved ceria (2012ver.)
Ceria・noble metal catalyst reduction

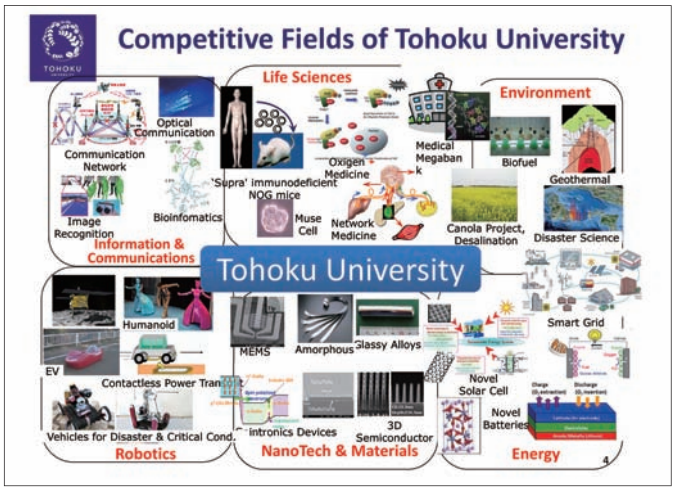
Ceria : Alumina = 1 : 4
(1% Rh on Ceria)
(1.5% Pd on Alumina)
Ceria and Rh both 40% reduction
Alumina 20% up、Pd 30% reduction

Significant reduction both ceria and noble metal was achieved

Next-Generation Advanced Mobility System
-Promotional activities supporting local industries-

Prof. Fumihiko Hasegawa
Deputy Director, New Industry Creation Hatchery Center, Tohoku University





2013

New Industry Creation Hatchery Center, NICHe:

Partnership between Industry and University

NICHe Main Building | Fluctuation Free Facility * | NICHe Building, Annex

Fluctuation Free Facility: FFF, Clean Rooms for Innovative Semiconductor Manufacturing System

5

NICHe in AOBAYAMA Campus

<Address>
6-6-10 Aobe Aramaki Aobaku Sendai
Miyagi 980-8579 JAPAN

6

About NICHe

Partnership between Industry and University

Established in 1998

Planning & Management of Collaborative Research Projects to Provide Solutions for Industry & Society

20 Research Projects
JPY 2.9B Budget with 232 staff, including 156 Researchers,
as of Oct. 1st, 2013

NICHe Guideline for Projects

1, World Leading Research
2, Predetermined Period, 3 to 5 Years Typical
3, Needs Oriented & Large-Sized Project with Industry & Government
4, External Funding

Missions of NICHe, R&D and Industrialization

Advanced R&D to Create New Industry
Innovative R&D to Strengthen Key Industry
Leading - Edge R&D for Tohoku Univ. Start-Ups

Mission Proposal & Continuous Accomplishment

Attract Private Sector to the Region

New Employment Opportunity in Local community

Advanced Mobility System Research

Demonstration in Aobayama

Miyagi Reconstruction Park

Driving Simulator

Contactless Power Transmission

Robotics

Autonomous Driving

EV: Passenger, Transit Bus, Bike

9

New Integrated Research at Tohoku Univ.

Innovation Tech. Research Group toward Low-Carbon Society
Basic Research

Intelligent Information System Research Center, IIS
Applied Research

Since 2008 Spring

Next Generation Mobility System Research Group
Prototyping, Demonstration & Evaluation

Integration of Basic Research at TU, from
Mechanical, Electrical, Electronics, Information, Material, Chemical, Civil Engineering to Economics etc.
Development of Safer & More Eco-friendly Mobility System
Proposal: Logistics & Energy Management System from a viewpoint of Mobility

Key Words
1, Low Carbon Emission Tech.: Lightweight, pneumatic resistance, Friction, energy saving
2, Safety Function: Visibility, Display, Sensing Tech., Autonomous Driving, Traffic Control
3, Power Train: Ultra Efficient Powertrain System, Internal Combustion Engine, HCCI, HV, EV)
4, Manufacturing Technology: Welding, Robotics, Design, Material

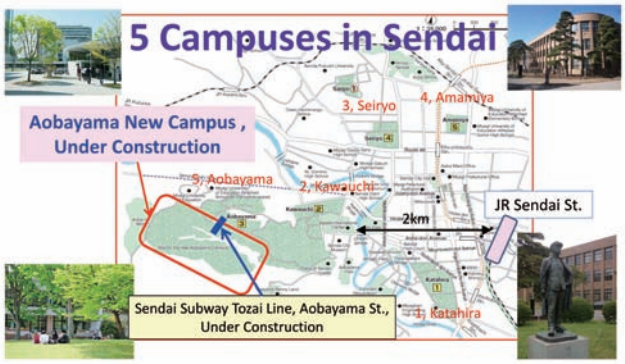
Collaboration

Local Businesses

Improve

Establish Integrated Center of Excellence for Next Generation Mobility System

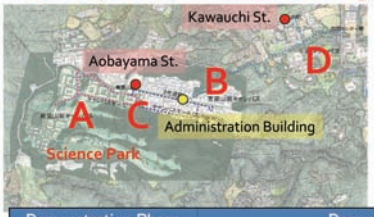
Mobility in Aobayama New Campus, Tohoku University



Aobayama New Campus & Subway Tozai Line

Up to 10 thousands Commuter, Only One Subway Station

No Transportation in New & Existing Aobayama Campus



Demonstration Phase	Demonstration Area
2013FY ~ Vehcle Development	Campus Mall Zone, Aobayama New Campus (A)
~2015 FY Pilot Study 1	(A) Aobayama, New Campus & East Zone (B) Determine the best way to the Mobility in Aobayama
Pilot Study 2	(C) (D) Aobayama & Kawauchi Stations and Other Campuses

12

NICHE

Subway Station: As a Hub for Next Generation Mobility

E-Bus, EV Sharing and Management

Bike Sharing

Co-creating Optimum Mobility with Community

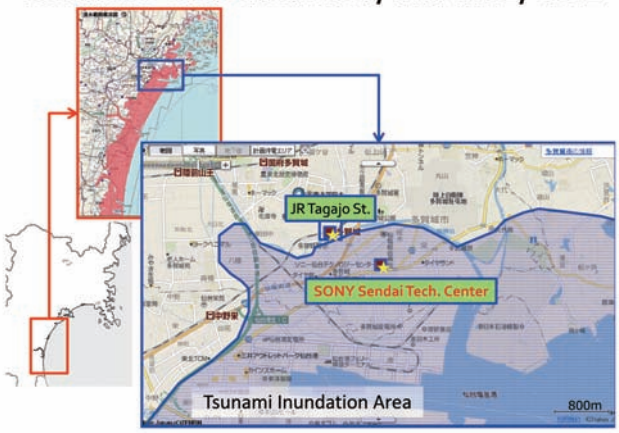
Experience of Advanced Mobility

13

Contribution to Local Community

1, Miyagi Fukko, Reconstraction Park
2, Traffic Control, Safety, User-friendly
3, Evacuation at the time of disaster or Emergencies
4, Energy Supply in the Event of Electric Outage

Tsunami Devastated Area, March 11, 2011



Miyagi Fukko, Reconstruction Park

Industry – University - Government Collaboration Hub for Regeneration of Local Industry from the Disaster, est. Apr. 2011

Some of the Tsunami Exposed Buildings at SONY Sendai Tech. Center are Rented to Local Industry, Government, Academic Institution etc.
Total Floor Space: 39,000m², Free of Charge for 10 Years

Restoration Support : Office, Factory, Warehouse etc. for Affected Local Companies

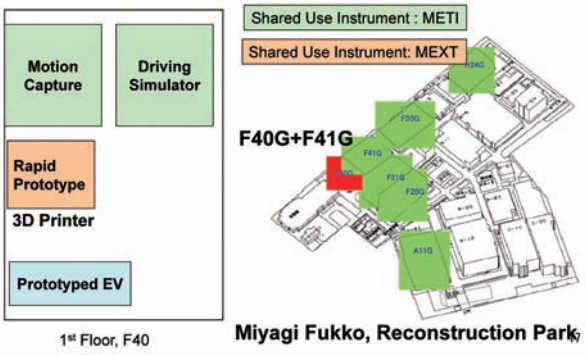
Support Reconstruction Activity : Prototyping and Demonstration for Industry – University - Government Collaboration

Established from the Cooperation of Miyagi Prefectural Government, Sendai City, Tohoku Economic Federation & Tohoku Univ.

Prototype, Demonstration & Evaluation for Semiconductor, Next-Generation Mobility, Robotics, etc. through Collaboration of Major/Local Companies & Tohoku Univ.

Shared Use Large-Size Instruments Installed

Hub for Collaborative Research Activity for Next-Generation Mobility in Devastated Area



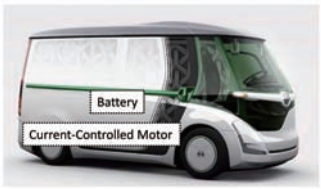
Autonomous Urban Traffic by Small Size EV

Automated Next-Generation Mobility in Urban and Tsunami Devastated Costal Area

Photo 1 Photo 2

EV for Energy Management;

Energy Combined with Mobility

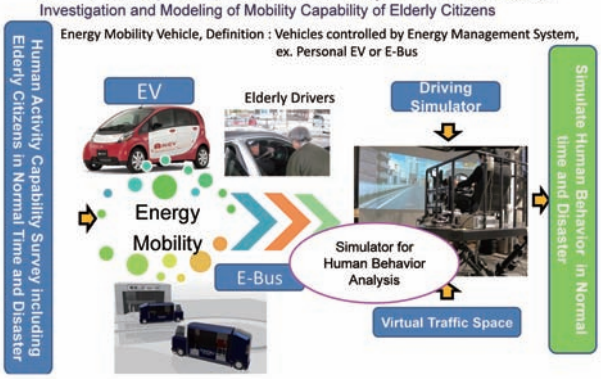


E-Bus

Small Size EV for Demonstration

R&D: Human Behavior Analysis at Advanced Mobility

Simulator Development for Human Behavior Analysis in the time of Disaster
Investigation and Modeling of Mobility Capability of Elderly Citizens



For Disaster Prevention and Mitigation

Should Evacuate on Foot, Some by Car without Thinking, Others Have to by Car

-> Provide Optimum Information Through Traffic Simulation and Earthquake Drills,

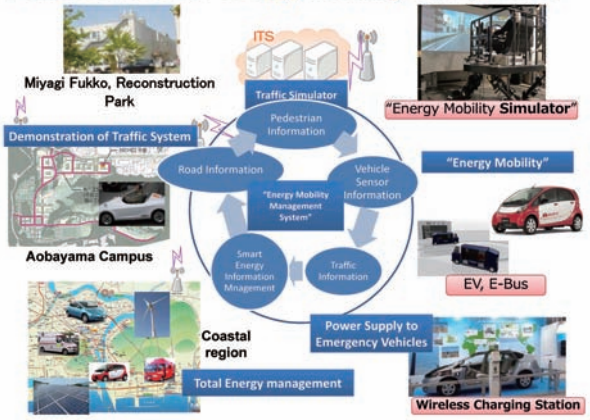
Assessment of Feeding Station and Road Construction for Efficient Evacuation from Disaster

-> Contribution for Disaster Mitigation Town

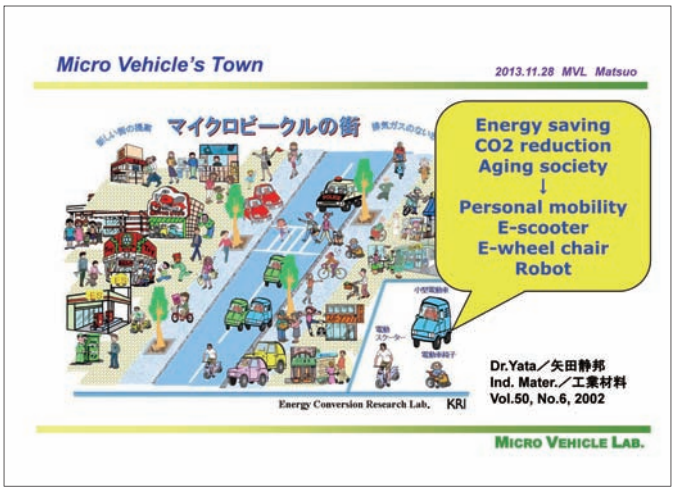
Utilize EV and Large Amount of Secondary Battery in the time of Disaster

-> Contribution to Optimum Distribution of Electricity

Demonstration of "Energy Mobility Management"



Hiroshi Matsuo
President
Micro Vehicle Lab. Ltd.



Thomas Behling
Executive Director
CENTRA Technology, Inc.

Next Generation Vehicle Control Concepts

How to Determine Which is Best:
Autonomous, Autonomous with V2V Cooperation, or I2V Remotely Piloted Vehicles

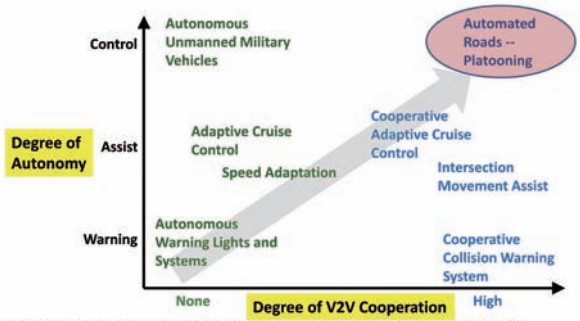
1/31/2014 1

Remotely Piloted Operations Are Practical Where Traffic is Light

But Requires Expensive Human Control

1/31/2014 3

Autonomous Vehicle Control with Cooperation is a Good Alternative



Based Upon "Self Driving Cars: the Next Revolution" by KPMG LLP and the Center for Automotive Research (CAR), 2013

1/31/2014 4

But Autonomous Control Systems Must Deal with the Unexpected

- Control must be robust for individual vehicle and for cooperating vehicles
- Single Vehicle example: if a ball were to roll into the path of a vehicle, a driver would expect that a child could follow. Car based sensors and algorithms need to anticipate such events
- Multiple Vehicles (V2V) scenario: sensor failure during vehicle cooperation scenario could lead to "who do you trust?" issue

A Simple Example of Multiple Vehicle V2V: Cars "A" and "B" Approach Intersection

- You are in Car A
- What is the protocol ?

Car B Status	Car B systems OK	Car B has system fault
Driver in Car	Standard traffic rules	Standard traffic rules with alert
Driverless	Driverless traffic rules	Special conditions

Scenario 2

Scenario N

How to Determine Best Concept

Start with customer/driver needs; examples:

- Reduce time that driver is engaged in commuting (car acts like a train, giving driver time for other tasks)
- Add new time-saving functionality: operate car autonomously to pick up and deliver passengers (a robot chauffeur)
- Driverless city to city transport that provides a low stress alternative to airplane/trains, freeing time for other tasks

Issues to be Worked

- What is the best form of vehicle control for these goals?
- How can effectiveness of control concepts be measured?
- What are the first steps that should be taken to answer these questions?

Some First Steps

1. Assess utility of existing traffic models for their applicability to key driver needs discussed above, e.g., do the models work only for freeway traffic—can they handle dense urban traffic with pedestrians?
2. Inventory data sets that are available for freeway or dense urban traffic and assess their utility for addressing driver needs
3. Break down three exemplar needs discussed above into journey segments that could be modeled.
4. Identify gaps in models and data for simulating journey segments
5. Prepare work plan for data gathering and for model development to assess journey segments. For example, existing data sets could be enhanced with observed data of traffic in city neighborhoods.
6. Prioritize journey segments for simulation analysis
7. Use data and models to identify and assess various traffic scenarios for key journey segments, (e.g., urban traffic at intersections with traffic lights and heavy rain).
8. For the scenarios, examine driver/driverless interactions or pedestrian/driverless interactions and relative effectiveness of vehicle control systems (autonomous or autonomous with some V2V or I2V coordination).
9. Catalogue and create taxonomy for unique classes of vehicle interactions
10. Develop test scenarios for validating vehicle interactions, V2V and I2V communication needs, safety, reliability, resilience under adverse conditions

Masato Hisatake
Visiting Professor
Tohoku University

Co-Creation = Innovation

Collaboration with Commitment

Coordination

Communication

Community

1

Cambridge History
A few decades might be needed

- 1969 Mott Report
- 1970 Cambridge Science Park (by Trinity College)
- 1978 Acorn
- 1985 "Cambridge Phenomenon"
- 1988 St John's Innovation Centre (by St John's College)
- 1990 ARM
- 1998 Amadeus Capital
- 2000 Plastic Logic

2

Cambridge Model
Bottom-up, largely unplanned

- "Constructive chaos –there is no one group that 'organizes' Cambridge. New initiatives are continuously springing up –some succeed and some fail.
- This may be perceived as inefficient, but does result in a highly entrepreneurial environment." (*Cambridge TechnopoleReport* (2008), p5)
- To realize an innovative culture is also another innovation. (designed and/or evolved)
- Various initiatives are awaited, including further empirical study.

3

St.Jone's Innovation Centre

- http://www.eeda.org.uk/destinationgrowth2009/speakers/461.asp
- Various support for tenants
- Very flexible terms and conditions

- Mr. David Gill managing director

4

COMPANIES: TIME-SERIES MAP

Key Components of Entrepreneurial Eco-system

(出所)Yupar Myint
The Role of Social Capital in Venture Creation in Cambridge

5

HUMAN NETWORK

Entrepreneur Selection

Chris Abell
Hermann Hauser
Alex van Someren
Daniel Roach
Gerald Avison
Jack Lang
Stephen Bunting
Alan Munro
Robin Saxby
Andy Hopper
Alan Goodman
Gordon Edge
Andy Richards
Bob Pettigrew
David Cleevely
Chris Evans
Richard Friend
Andrew Dames
Mark Bodmer
Stan Boland
Alan Barrell
Matthew Bullock
Walter Herriot

(出所)Yupar Myint
The Role of Social Capital in Venture Creation in Cambridge

6

HAUSER FORUM

- £8m donation (Dr. Hermann Hauser)
- £2m grant from EEDA, capital revenue swap
- West Cambridge site

- Gates Computer Lab, Cavendish, IfM…
- HQ for Cambridge Enterprise, pre-incubator
- Major seminar and lecture spaces; open café

- Vision of 'open innovation' leading player
- open January 2010, 5 year funding

- X-Forum

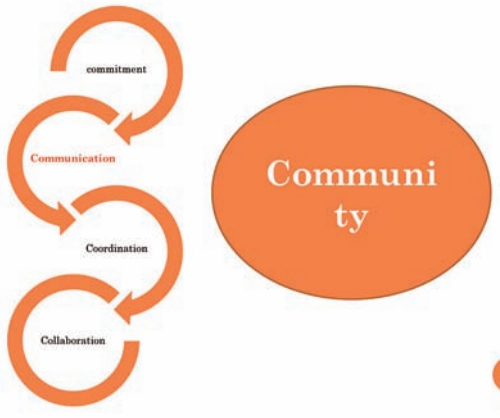
7

IS THIS A "CHALLENGE" ?

- "Most of all, though, I think the challenge for Cambridge is that
- **there are so many events going on -you list a tiny fraction -that one simply cannot attend even a substantial fraction of them, regardless of interest.**
- **And for those actually doing innovation (rather than just talking about it), long hours and great commitment are the norm, and one doesn't go to non-essential evening events when one is flat out building tomorrow -one picks and chooses very carefully indeed."**

(Dr Laura James, Cambridge TechnopoleBlog, 14 September 2009)

8



9

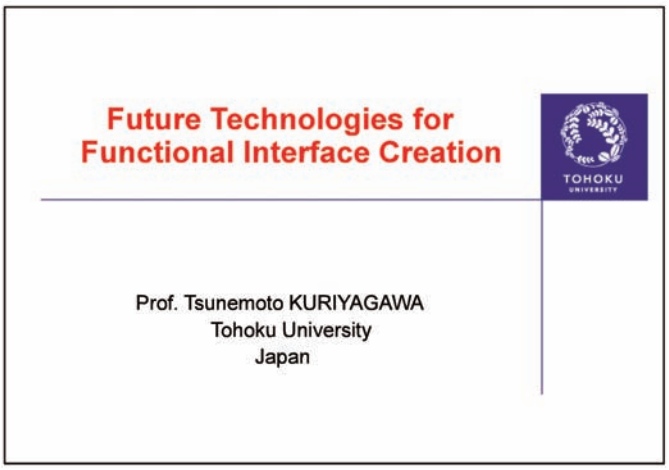
Why don't' you talk about what you really thinking or at least feeling?

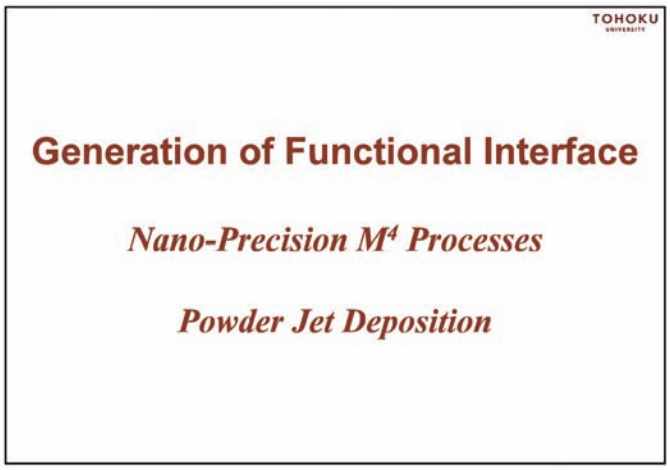
Why don't we enjoy "muddling through"?

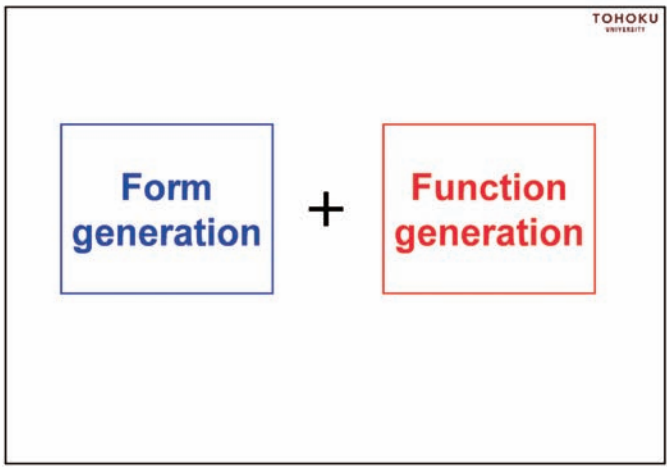
THANK YOU!

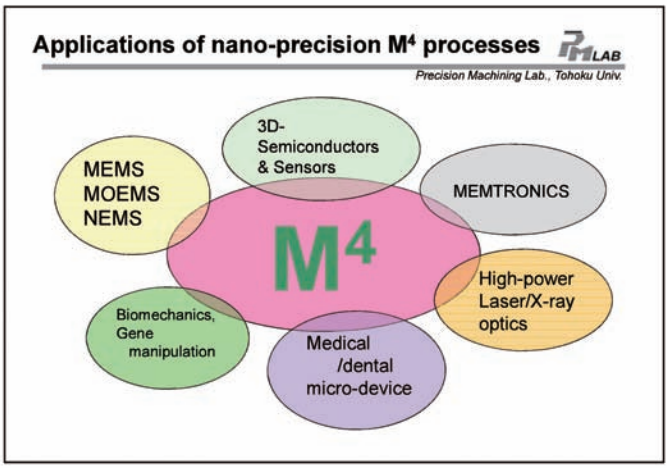
10

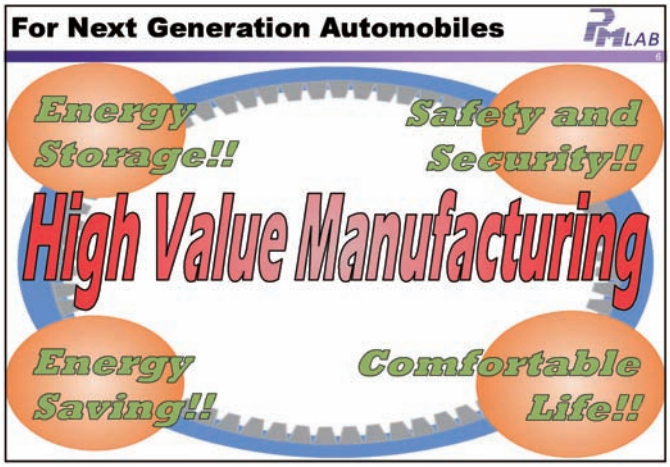
Tsunemoto Kuriyagawa
Professor
Department of Mechanical Systems and Design, Graduate School of Engineering
Tohoku University

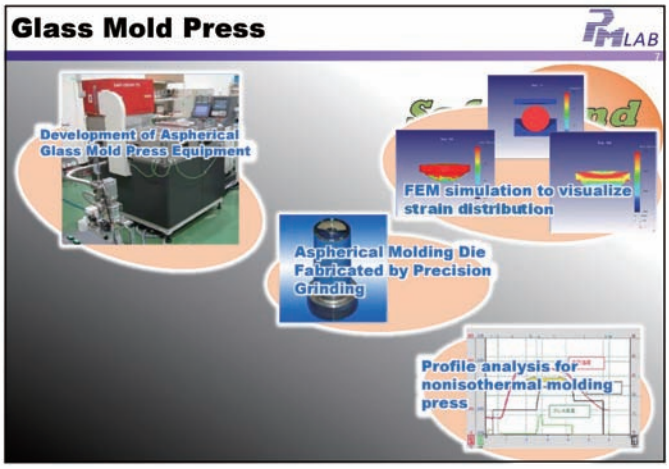


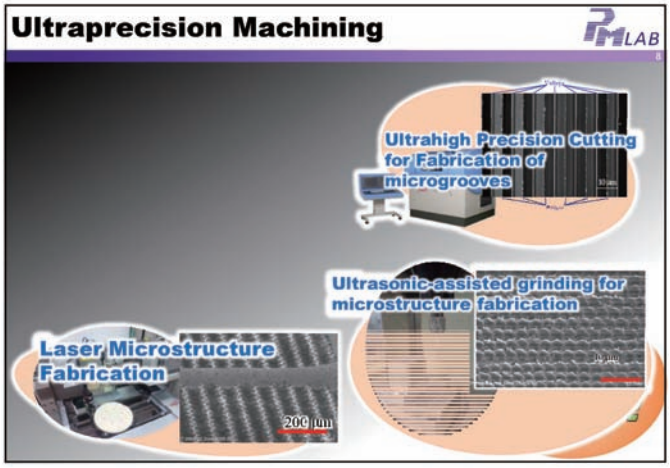


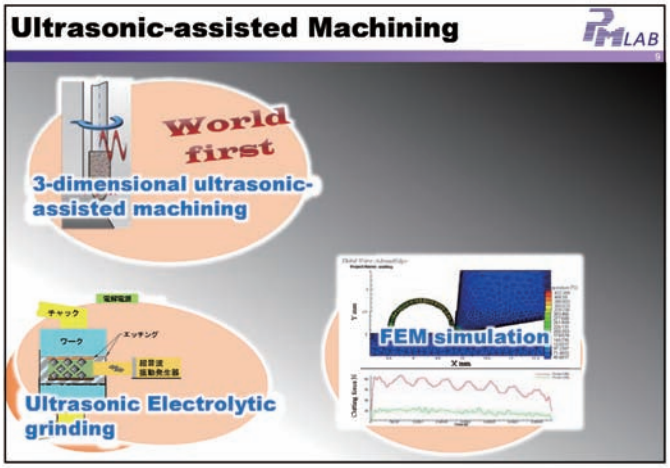


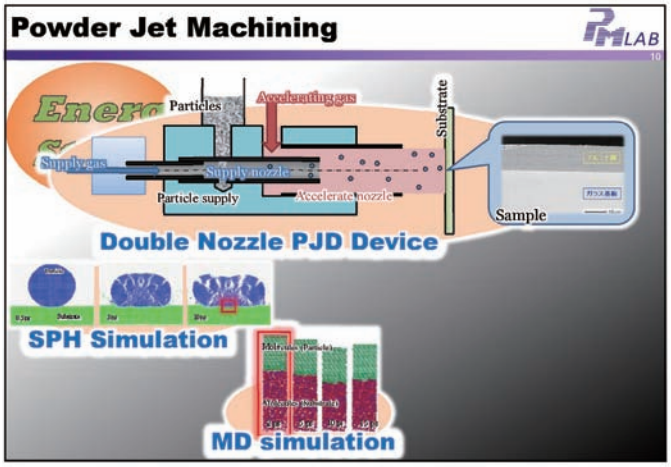

Applications of nano-precision M4 processes
PM LAB
Precision Machining Lab., Tohoku Univ.
MEMS
MOEMS
NEMS
3D-
Semiconductors
& Sensors
MEMTRONICS
M4
High-power
Laser/X-ray
optics
Biomechanics,
Gene
manipulation
Medical
/dental
micro-device

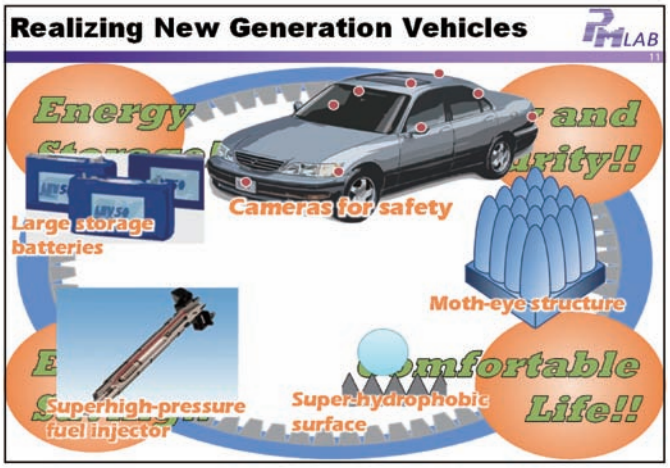

For Next Generation Automobiles
PM LAB
Energy
Storage!!
Safety and
Security!!
High Value Manufacturing
Energy
Saving!!
Comfortable
Life!!


Glass Mold Press
PM LAB
Development of Aspherical
Glass Mold Press Equipment
FEM simulation to visualize
strain distribution
Aspherical Molding Die
Fabricated by Precision
Grinding
Profile analysis for
nonisothermal molding
press


Ultraprecision Machining
PM LAB
Ultrahigh Precision Cutting
for Fabrication of
microgrooves
Ultrasonic-assisted grinding for
microstructure fabrication
Laser Microstructure
Fabrication
200 μm

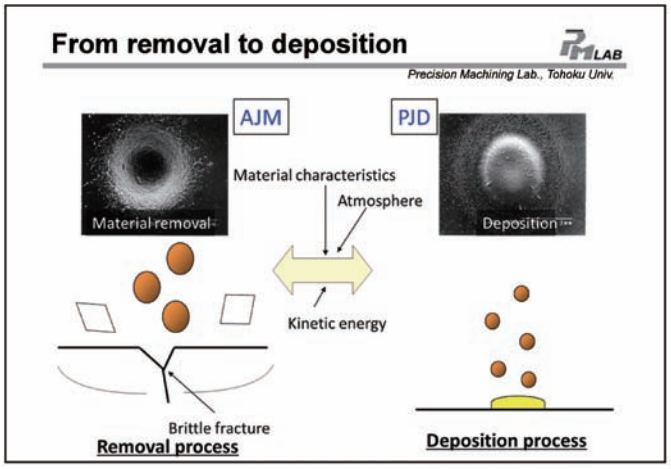

Ultrasonic-assisted Machining
PM LAB
World
first
3-dimensional ultrasonic-
assisted machining
FEM simulation
Ultrasonic Electrolytic
grinding

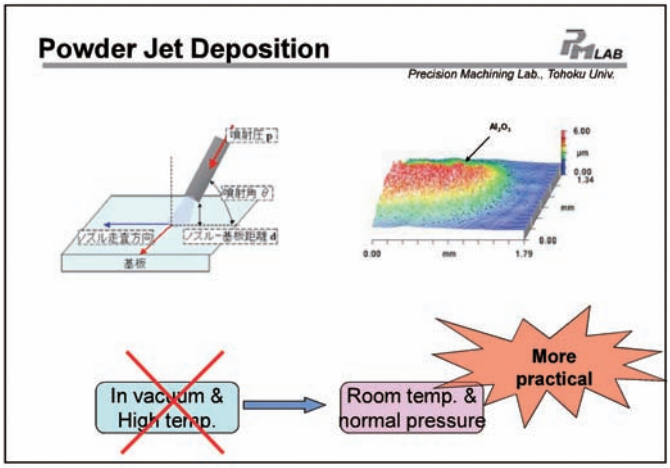

Powder Jet Machining
PM LAB
Particles
Accelerating gas
Substrate
Supply gas
Supply nozzle
Particle supply
Accelerate nozzle
Sample
Double Nozzle PJD Device
SPH Simulation
MD simulation

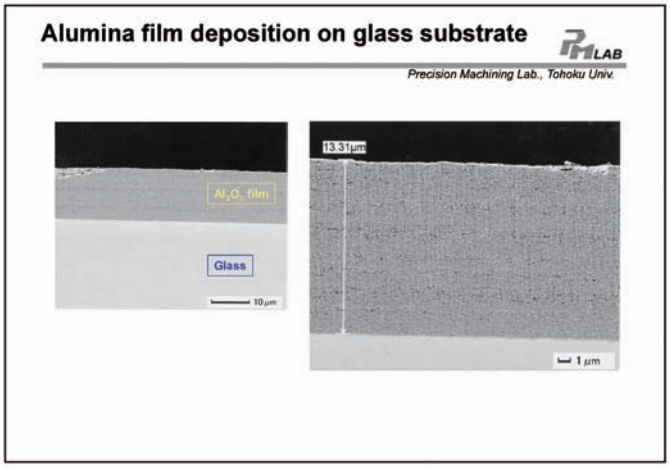

Realizing New Generation Vehicles
Energy
and
rity!!
Large storage batteries
Cameras for safety
Moth-eye structure
Superhigh-pressure fuel injector
Super-hydrophobic surface
omfortable Life!!


TOHOKU
Unique Process for Film Deposition


TOHOKU
Powder Jet Deposition


From removal to deposition
Precision Machining Lab., Tohoku Univ.
AJM
PJD
Material removal
Deposition
Material characteristics
Atmosphere
Kinetic energy
Brittle fracture
Removal process
Deposition process


Powder Jet Deposition
Precision Machining Lab., Tohoku Univ.
In vacuum & High temp.
Room temp. & normal pressure
More practical


Alumina film deposition on glass substrate
Precision Machining Lab., Tohoku Univ.
Glass
13.31μm

Creating a functional interface

PM LAB
Precision Machining Lab., Tohoku Univ.

1. Metal
   - electric circuit board, interconnection
   - sensor
2. Ceramic
   - fuel cells, charging battery
   - large LD display for future generation
   - photocatalyst film
3. Diamond
   - low-friction sliding surface
   - abrasion proof interface
4. Bio-ceramics
   - hydroxyapatite film coating
   - artificial bore

Room temperature
Atmosphere pressure

Low-melting materials
Plastic materials

Conclusions

PM LAB
Precision Machining Lab., Tohoku Univ.

Generation of Functional Interface
will induce a big potential in manufacturing.

- **Nano-precision M⁴ processes**
  have a big potential for generation of a functional interface.
- **Powder jet processes**
  have many unique and effective applications.

Thank you very much.

Tsunemoto Kuriyagawa, Dr.

Professor:
Nano-Precision Mechanical Fabrication Laboratory
Department of Mechanical Systems and Design

Tohoku University

Tel: +81-22-795-6948
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Aramaki Aoba 6-6-01, Aoba-ku,
Sendai 980-8579, Japan
http://www.pm.mech.tohoku.ac.jp
e-mail: tkuri@m.tohoku.ac.jp

Kazuhiro Kosuge

Professor

Department of Bioengineering and Robotics Graduate School of Engineering

Tohoku University

My Ideas for Developing Innovative Next Generation Automobiles

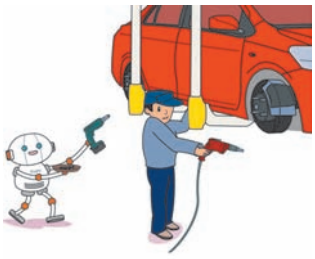
Kazuhiro Kosuge
Department of Bioengineering and Robotics
Graduate School of Engineering
Tohoku University

Outline

- Start with something different
- Innovative ideas through Systems Integration
- Environment

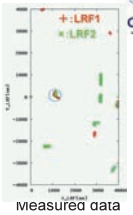
Partner Ballroom Dance Robot

Automobile Assembly Line

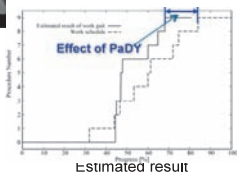


- If a robot could provide the worker with necessary parts and tools when he/she needs them, the worker could concentrate on the assembly tasks.
- What the worker has to do is to assemble delivered parts using delivered tools to accomplish the work.

Evaluation Experiment



Measured data



Estimated result

The worker's motion necessary for picking parts/ tools has been reduced.

The worker could finish his tasks earlier than the work schedule.

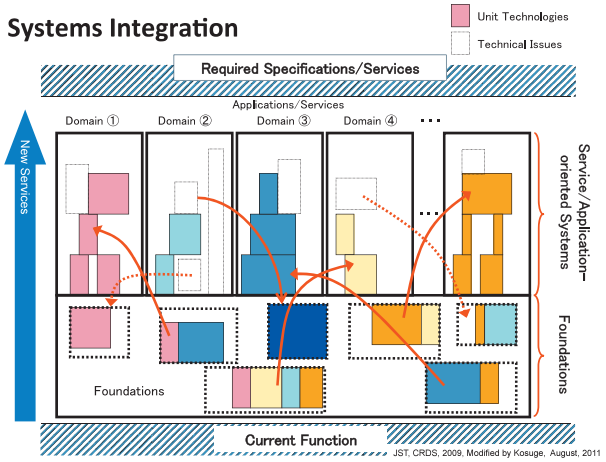
Control of a Vehicle

Control of a Vehicle with a Large Side Slip Angle

Outline

- Start with something different
- Innovative ideas through Systems Integration
- Environment

Systems Integration



Outline

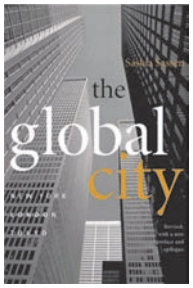
- Start with something different
- Innovative ideas through Systems Integration
- Environment

Why the Internet could Have Evolved so much and Created Innovations?

- The internet could have evolved so far because the internet allows hackers to do something different.

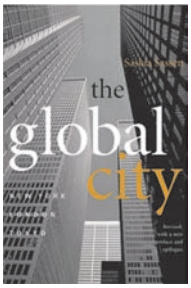
Why the Global City has its Prosperity?

- Global cities have some space in which different people could come into and could do something different.



For the Development of Innovative Next Generation Automobiles

- We need a legal environment, which encourages/allows us to do experiments for the next generation automobile.
- Innovation could happen in an environment which has a similar structure as the global city.
- Without the environment, which allows us to do something innovative, we could not have innovative activities.



Conclusions

- Start with something different
- Innovative ideas through Systems Integration
- Legal environment

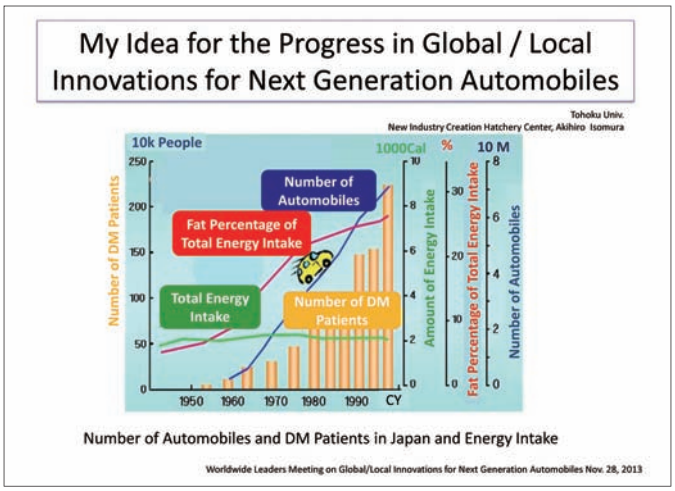
and a **Passion**

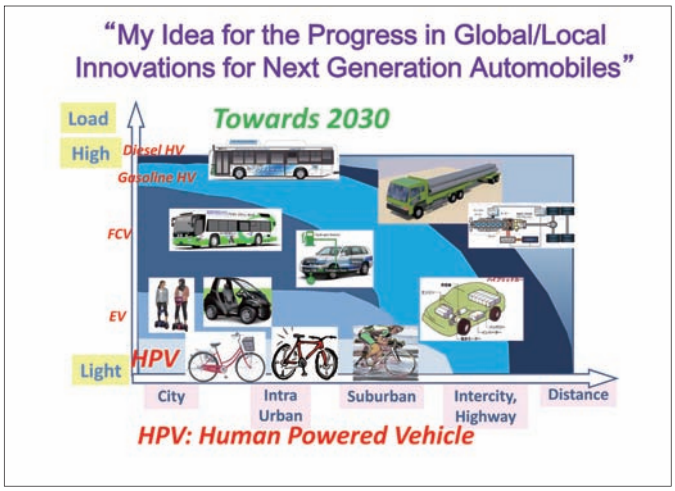
Akihiro Isomura

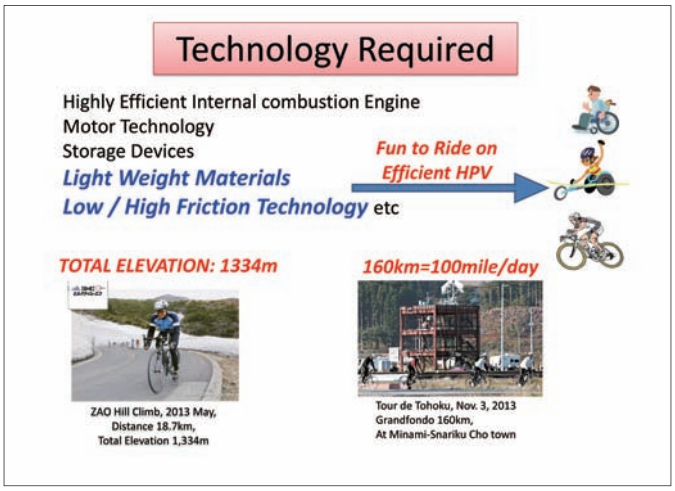
Specially-appointed professor

New Industry Creation Hatchery Center

Tohoku University





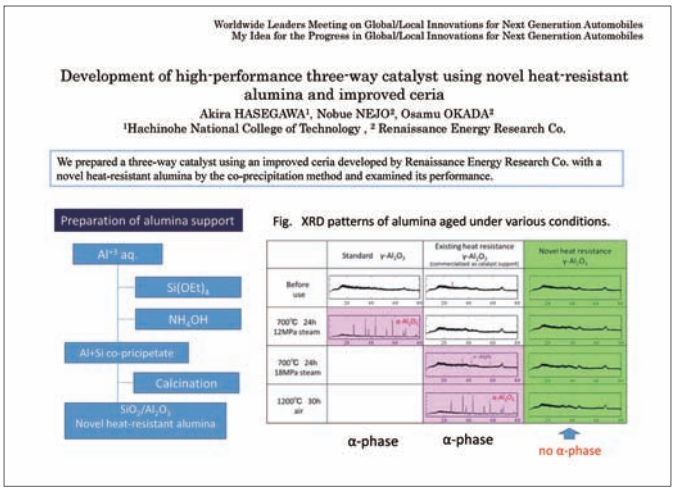


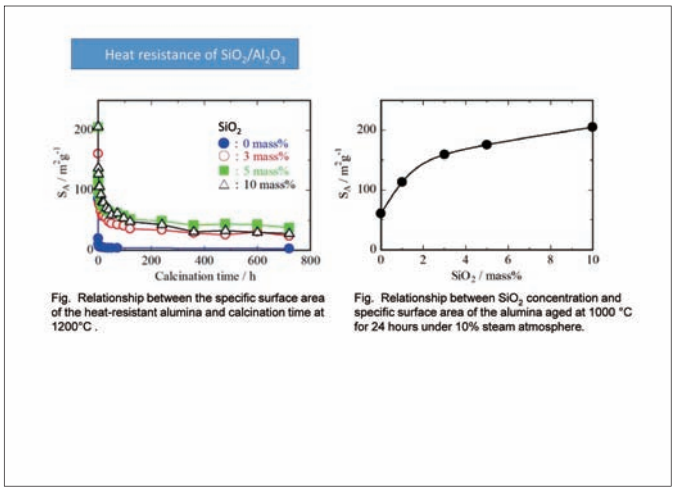
Akira Hasegawa

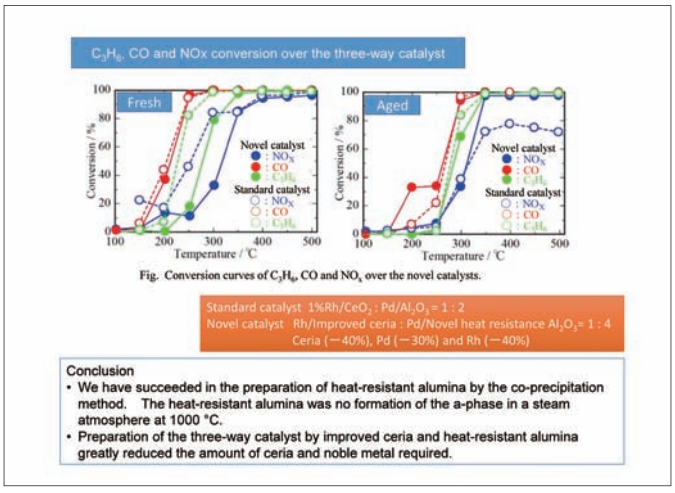
Associate Professor

Department Chemical and Biological Engineering

Hachinohe National College of Technology







Toshio Kato

Regional Cooperation Coordinator

Next Generation Automobiles / Miyagi Area

Worldwide Leaders Meeting on Global/Local Innovations for Next Generation Automobiles on Nov. 28, 2013 at Sendai International Center

"My Idea for the Progress in Global/Local Innovations for Next Generation"

My Idea is: IP Bank

Toshio Kato

Regional Cooperation Coordinator
Next Generation Automobiles-Miyagi Prefecture

Intelligent Cosmos Research Institute
t-kato@icr-eq.co.jp

For Innovation, IP is inevitable.

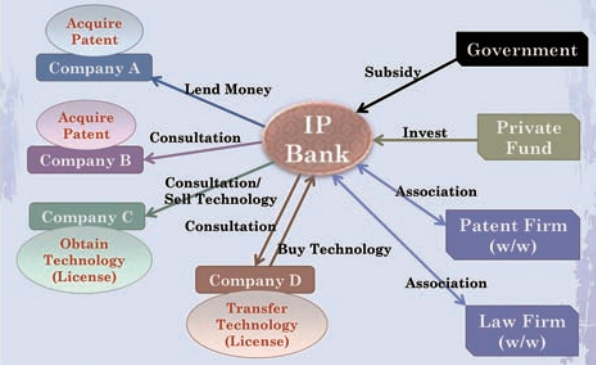
- Technology Revolution
  - Compete with Technology and take lead in Industry; or
  - Widely spread Technology and grow Industry
- Protect Technology in the form of "IP"

Everyone says "Yes, I understand IP is important for innovation but:"

- I need money to acquire a patent;
- I need help in acquiring a patent;
- I need help in obtaining a technology license or buying technology; or
- I need help in licensing or selling my technology (invention/K.H./ patent application/patent).

"One-Stop Solution" for all of the above, that is the "IP Bank"!

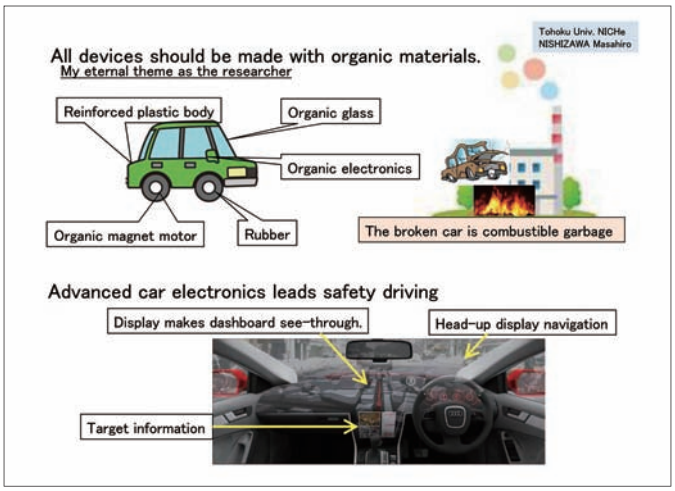
Idea of "IP Bank"

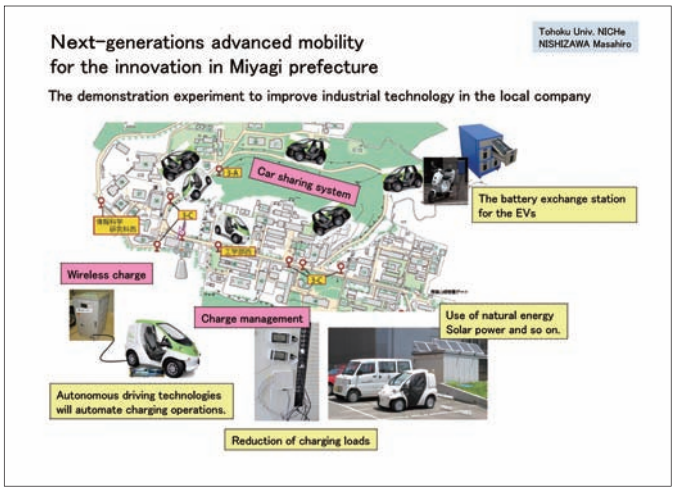


Thank you for listening!

Toshio Kato
t-kato@icr.-eq.co.jp

Masahiro Nishizawa
Associate Professor
New Industry Creation Hatchery Center
Tohoku University





Naoto Miyamoto
Associate Professor
New Industry Creation Hatchery Center
Tohoku University

My Idea for the Progress in Global/Local Innovations for Next Generation Automobiles

Audio Entertainment Device in Self-Driving Cars

Naoto Miyamoto
Tohoku University

- Lost-time by traffic congestion in Sendai
  - 102.7 Million person・hour/year (20 min/person・day)

Autonomous Driving

- Lost-time becomes free-time
  - Take a rest
  - Chatting
  - Entertainment & Hobby ☺
  - Working...

Portable DJ

Since space is limited, device size must be compact and easy-to-use.

MONSTER

Sales Promotion Marketing Advertisement

http://www.monsterproducts.com/godj/

東北大学
TOHOKU UNIVERSITY
Semiconductor Digital Circuit

FAUDIO
The Future Audio Company
Audio Software Design

Our Product Features and Goal

- Real-time BPM analysis
- Various effects
- Digital cross-fader
- Autonomous DJ playback

Promotion videos and demo movies are available at http://www.monsterproducts.com/godj/

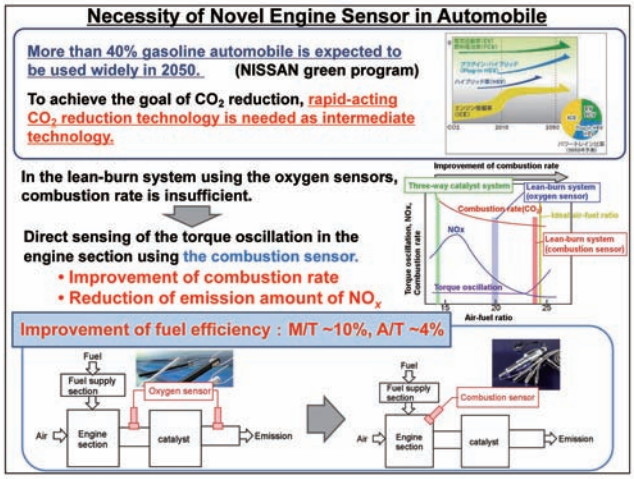
- We hope we create a novel audio entertainment equipment for the next generation autonomous vehicles.

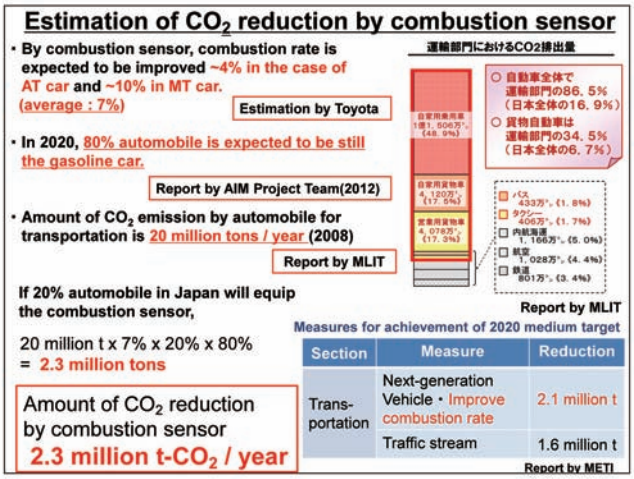
Yuui Yokota

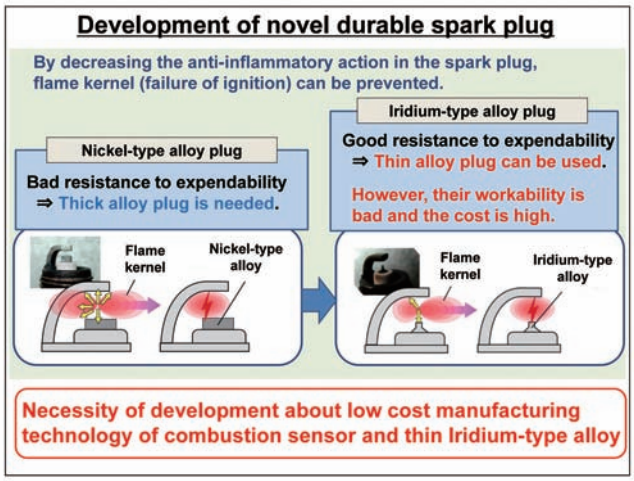
Associate Professor

Research Laboratory on Advanced Cristal Engineering in IMR and NICHe

Tohoku University





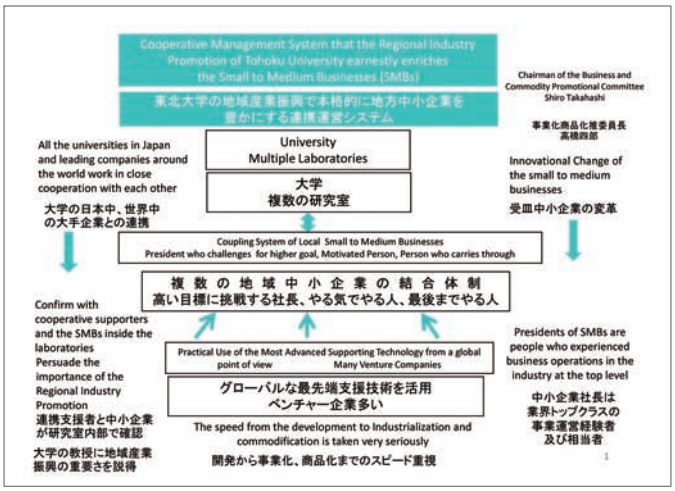


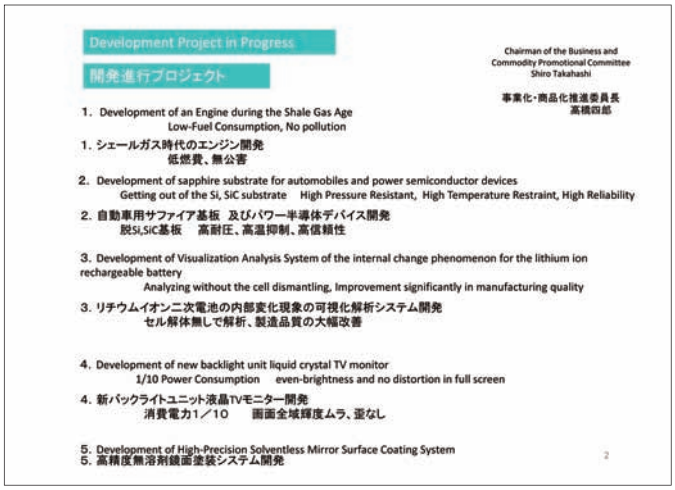
Shiro Takahashi

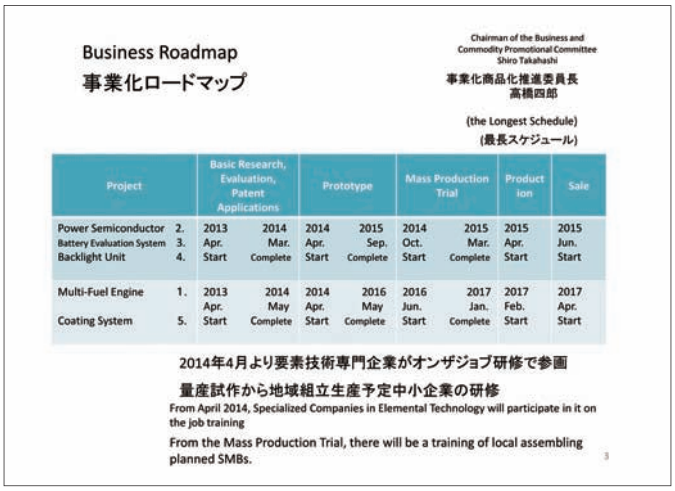
Chairman

Business and Commodity Promotional Committee

Next Generation Automobiles / Miyagi Area





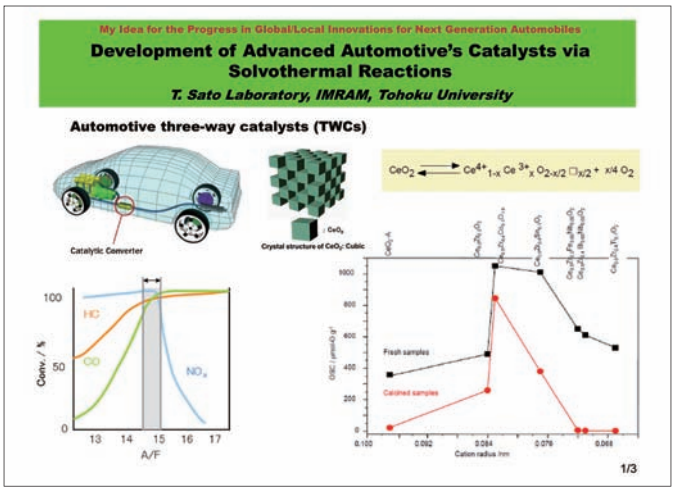


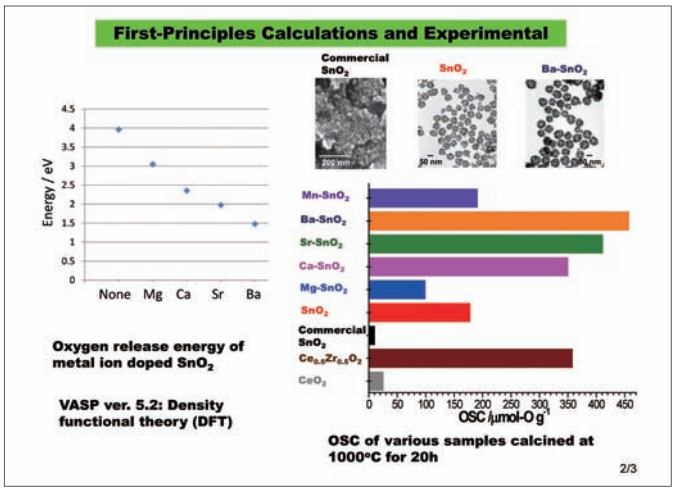
Tsugio Sato

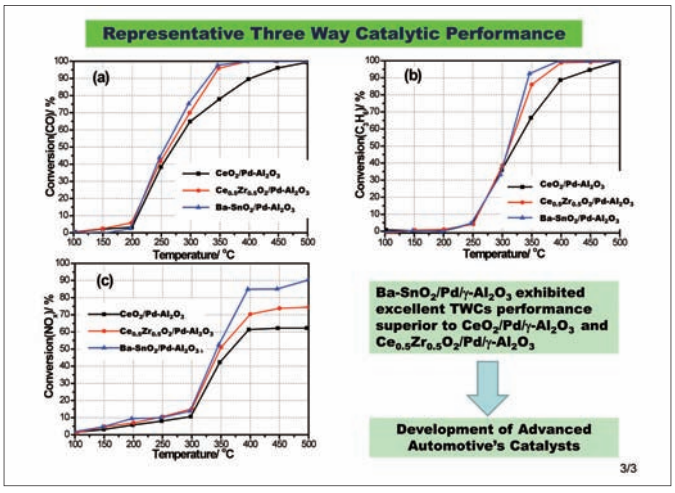
Professor

Institute of Multidisciplinary Research for Advanced Materials

Tohoku University





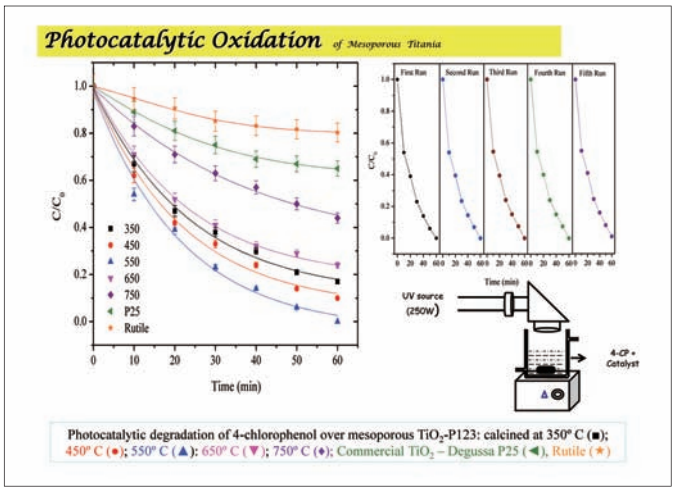


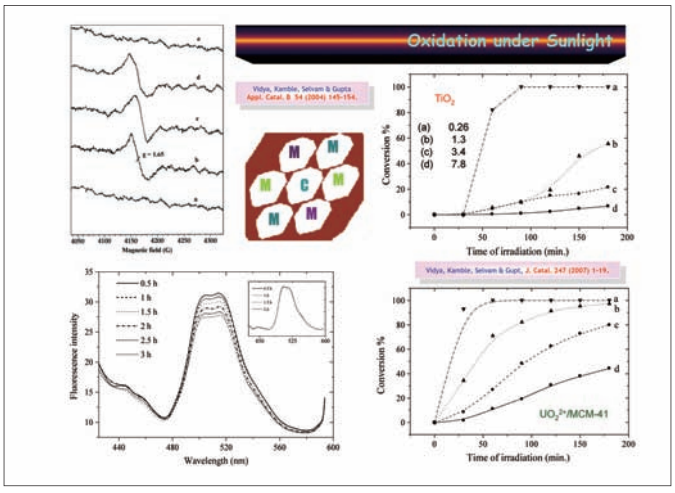
Parasuraman Selvam

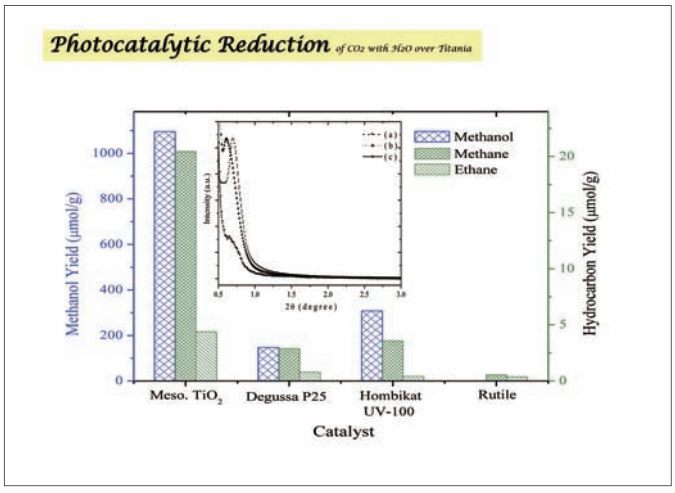
Professor

National Centre for Catalysis Research and Department of Chemistry

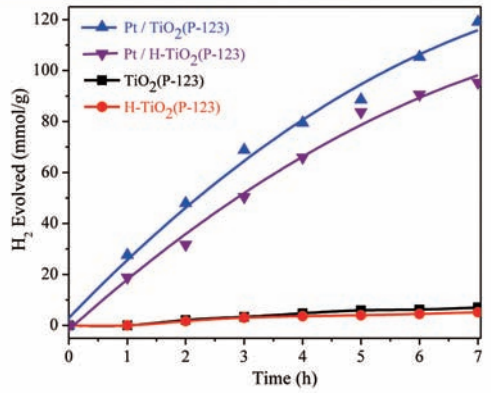
Indian Institute of Technology-Madras, Chennai 600 036, India



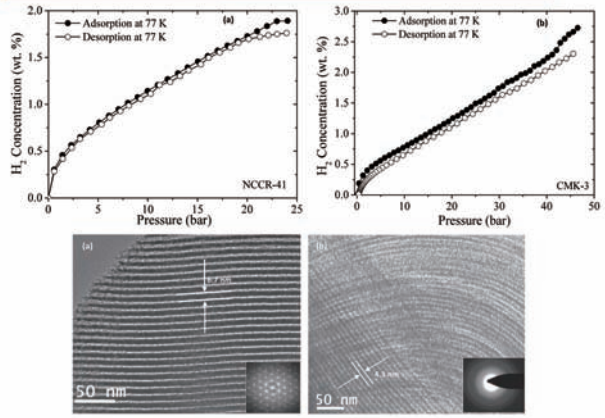




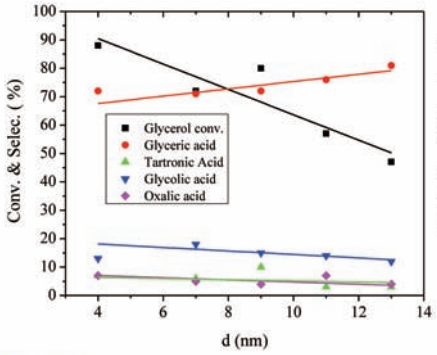
PHOTOCATALYTIC WATER SPLITTING / HYDROGEN PRODUCATION



HYDROGEN STORAGE IN MESOPOROUS CARBONS



Biomass Conversion into Fuels and Chemicals

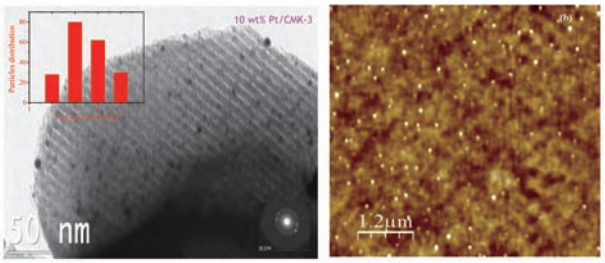


[a]Reaction conditions:

glycerol = 0.3 M, glycerol/Au = 500 mol/mol, Glycerol/NaOH = 4 mol/mol,

water = 10 ml, T = 60°C, pO_2 = 7 atm, t = 5 h.

P. Selvam, IIT-Madras



20 wt% Pt/CMK-3	Average crystallite size (nm)		Pt / α_c (Å)	Pt content / ICP-AES (wt %)	Current density (mA/cm²)	Current density (mA/mg Pt)	I_{f_p} / I_{r_p}
	XRD	TEM					
Para-formaldehyde	4.3	4.5	3.92	20.6	53	185	1.33
Ethylene Glycol	5.5	6.0	3.90	17.6	43	165	0.76
Sodium borohydride	6.0	6.0	3.91	18.5	40	157	1.57
Hydrogen	18.5	20.0	3.93	21.2	32	104	1.55

Fuel Cell Electrode Materials

National Centre for Catalysis Research,
Indian Institute of Technology - Madras, Chennai, India

N.D. Zelinsky Institute of Organic Chemistry Russian Academy of Science, Moscow, Russia

Environmental catalysis

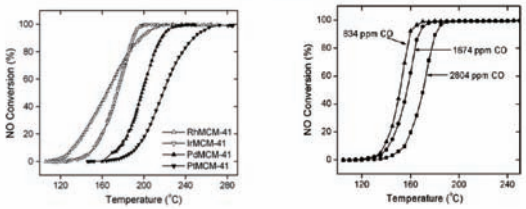
$DeNO_x$ and related processes

Zeolites, Ag-catalysts, oxide catalysts (Ce-containing), CombiCats

Hydrocarbon abatement

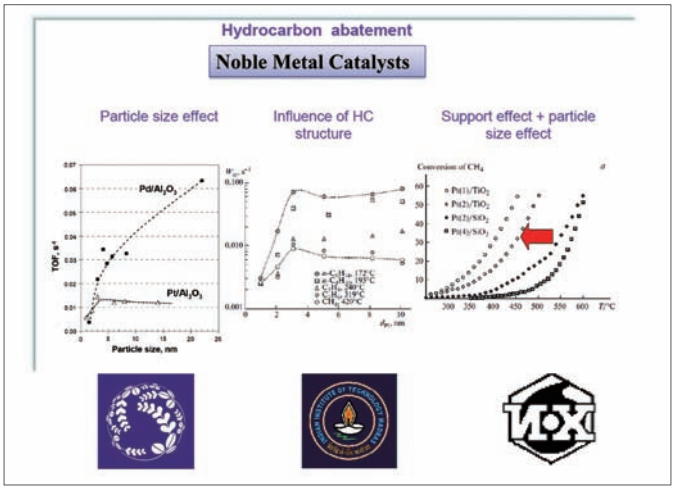
Pt, Pd, Mn/CeZr, etc

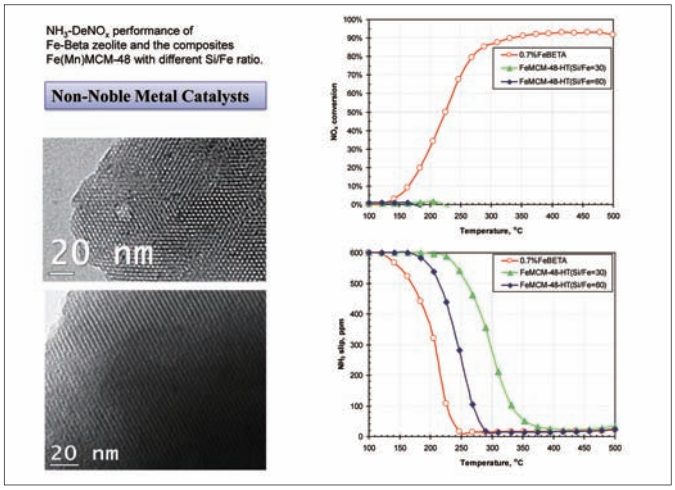
Noble Metal Catalysts



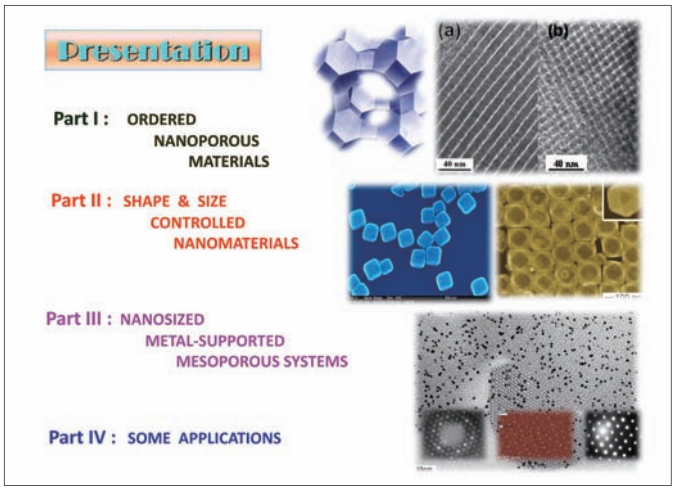
Temperature conditions for NO conversion on Rh, Ir, Pd, and Pt catalysts.

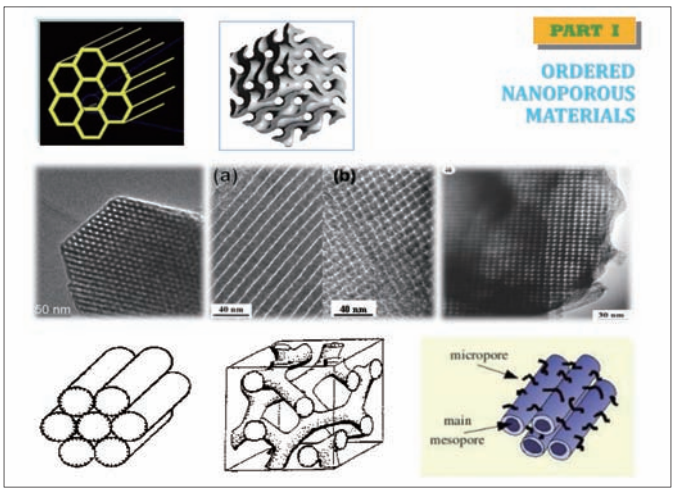
Catalysts	Activation energy	NO conversion		
	NO* dissociation (kcal/mol)	25%	50%	100%
RhMCM-41	6.6	146°C	164°C	210°C
IrMCM-41	7.7	163°C	174°C	198°C
PdMCM-41	9.0	188°C	198°C	240°C
PtMCM-41	13.0	205°C	220°C	270°C

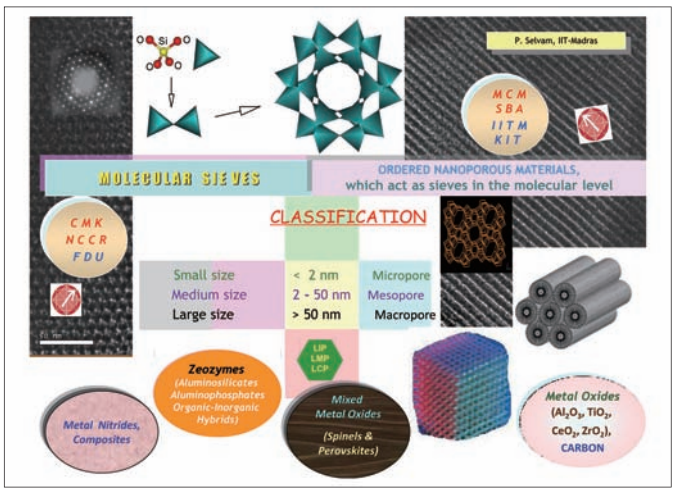

Hydrocarbon abatement
Noble Metal Catalysts
Particle size effect
Influence of HC structure
Support effect + particle size effect
Pd/Al2O3
Pt/Al2O3
Particle size, nm

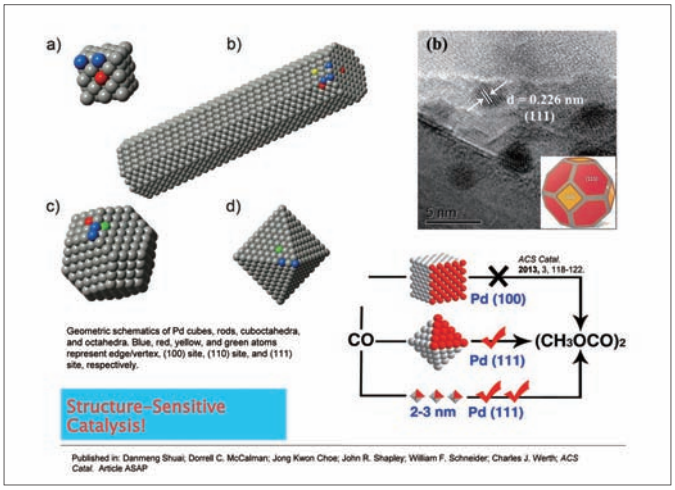

NH3-DeNO2 performance of
Fe-Beta zeolite and the composites
Fe(Mn)MCM-48 with different Si/Fe ratio.
Non-Noble Metal Catalysts
20 nm
20 nm
0.7%FeBETA
FeMCM-48-HT(Si/Fe=30)
FeMCM-48-HT(Si/Fe=60)
Temperature, °C

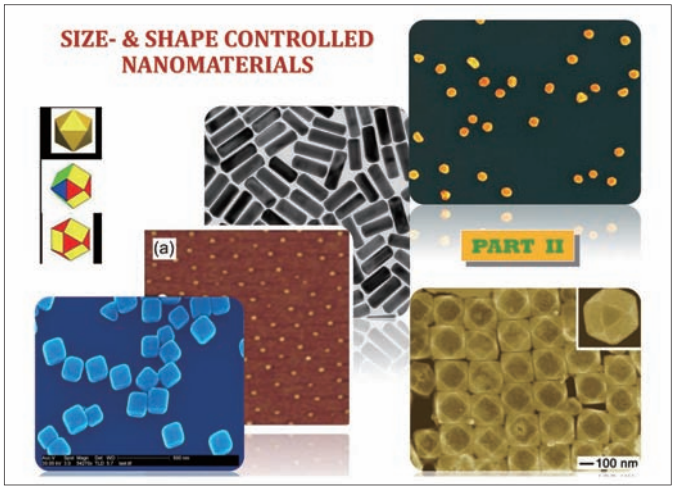

FOCUS
New Materials / Catalysts including Nano- & Nanoporous Materials
Energy Conversion Processes
Energy Storage and Production
Environmental Remediation
50 nm
100 nm

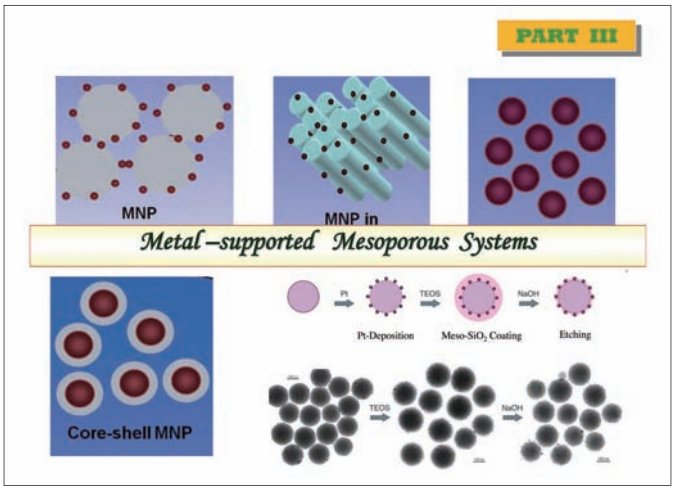

Presentation
Part I : ORDERED NANOPOROUS MATERIALS
Part II : SHAPE & SIZE CONTROLLED NANOMATERIALS
Part III : NANOSIZED METAL-SUPPORTED MESOPOROUS SYSTEMS
Part IV : SOME APPLICATIONS
(a)
(b)

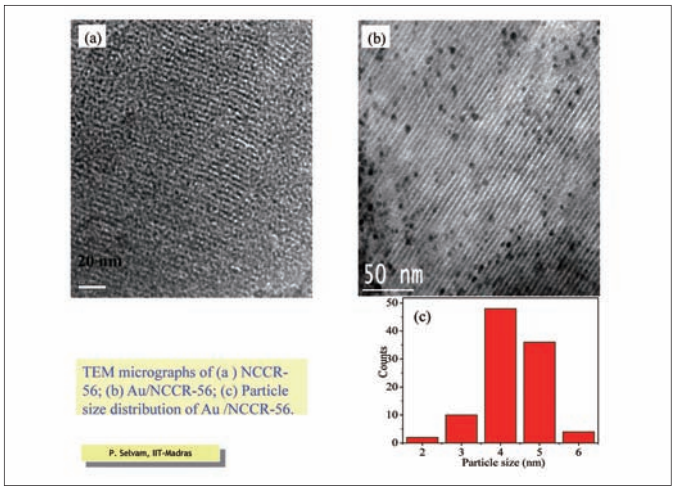

PART I
ORDERED NANOPOROUS MATERIALS
(a)
(b)
micropore
main mesopore


P. Selvam, IIT-Madras
MCM
SBA
IITM
KIT
MOLECULAR SIEVES
ORDERED NANOPOROUS MATERIALS, which act as sieves in the molecular level
CLASSIFICATION
CMK
NCCR
FDU
Small size
Medium size
Large size
< 2 nm
2 - 50 nm
> 50 nm
Micropore
Mesopore
Macropore
Zeozymes
(Aluminosilicates
Aluminophosphates
Organic-Inorganic Hybrids)
Mixed Metal Oxides
(Spinels & Perovskites)
Metal Nitrides, Composites
Metal Oxides
(Al2O3, TiO2, CeO2, ZrO2),
CARBON


a)
b)
(b)
d = 0.226 nm
(111)
5 nm
c)
d)
ACS Catal
2013, 3, 118-122
Pd (100)
CO
(CH3OCO)2
Pd (111)
2-3 nm Pd (111)
Geometric schematics of Pd cubes, rods, cuboctahedra, and octahedra. Blue, red, yellow, and green atoms represent edge/vertex, (100) site, (110) site, and (111) site, respectively.
Structure–Sensitive Catalysis!
Published in: Danmeng Shuai; Dorrell C. McCalman; Jong Kwon Choe; John R. Shapley; William F. Schneider; Charles J. Werth; ACS Catal. Article ASAP


SIZE- & SHAPE CONTROLLED NANOMATERIALS
(a)
PART II
100 nm


PART III
MNP
MNP in
Metal–supported Mesoporous Systems
Core-shell MNP
Pt
TEOS
NaOH
Pt-Deposition
Meso-SiO2 Coating
Etching
TEOS
NaOH


(a)
20 nm
(b)
50 nm
(c)
Counts
Particle size (nm)
TEM micrographs of (a) NCCR-56; (b) Au/NCCR-56; (c) Particle size distribution of Au /NCCR-56.
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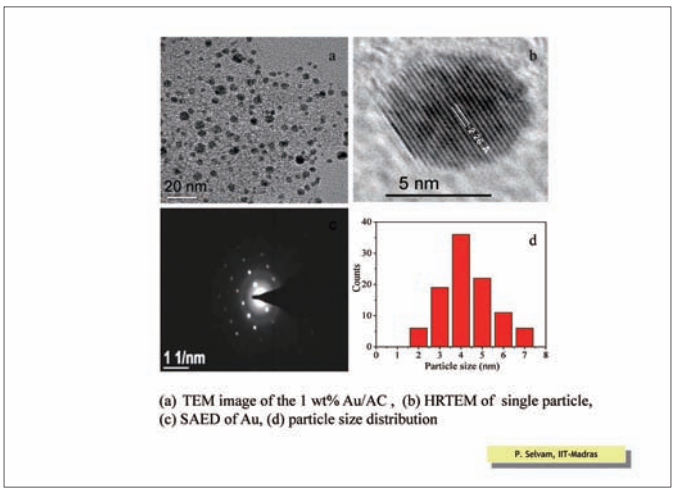
a
20 nm
b
5 nm
c
1 1/nm
d
Counts
Particle size (nm)
(a) TEM image of the 1 wt% Au/AC , (b) HRTEM of single particle, (c) SAED of Au, (d) particle size distribution
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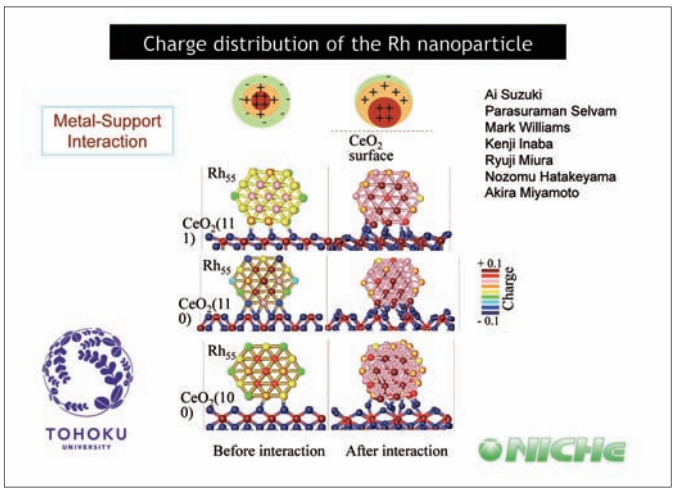
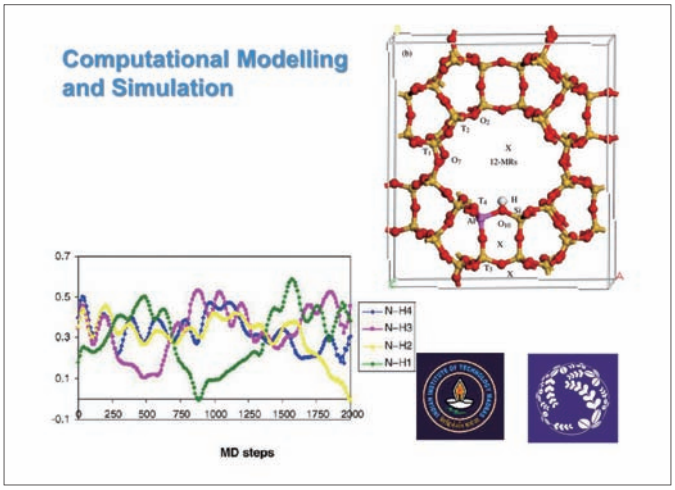

Charge distribution of the Rh nanoparticle
Metal-Support Interaction
CeO2 surface
Rh55
CeO2(11 1)
CeO2(11 0)
CeO2(10 0)
+0.1
Charge
-0.1
Ai Suzuki
Parasuraman Selvam
Mark Williams
Kenji Inaba
Ryuji Miura
Nozomu Hatakeyama
Akira Miyamoto
TOHOKU UNIVERSITY
Before interaction
After interaction
NICHE


Computational Modelling and Simulation
12-MRs
N–H4
N–H3
N–H2
N–H1
0.7
0.5
0.3
0.1
-0.1
0
250
500
750
1000
1250
1500
1750
2000
MD steps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DST
SHELL
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Thank You !