Next Generation Automobiles
in Miyagi

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

Published October, 2016

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 and presenting materials for

- International Conference "Global/Local Innovations for Next Generation Automobiles" on October 11 & 12, 2016
- Joint Session of Thirteenth International Conference on Fluid Dynamics (ICFD2016) OS18: "Global/Local Innovations for Next Generation Automobiles" on October 12, 2016

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

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(For recovery from Tohoku Disaster)
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"Global/Local Innovations for Next Generation Automobiles"

Program and presenting materials for
International Conference
"Global/Local Innovations for
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and
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Fluid Dynamics (ICFD2016)
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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 mission in areas devastated by the Great East Japan Earthquake in March 2011, given the tough economic conditions. Over the past five years, we have overcome numerous difficulties with the cooperation and support of industry, academia, the government, banks, and residents in the affected communities.

Thanks to your great support, most of the devastated areas have begun to recover to their previous state, but the region is still under reconstruction and challenges remain.

We intend to continue development in the future by facing challenges one by one and by strengthening the bonds between us—the importance of which was recognized in the aftermath of the earthquake.

In this situation, the automotive industry is widely considered to be a major center of opportunity because of its economic impact. All over the Tohoku region and especially in Miyagi prefecture, expectations for the automotive industry are great. 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) was begun in July 2012. This project was established to advance the reconstruction and revival of the Tohoku region through the development of new products and systems, based on the collaborative efforts of industry, academia, and government. This collaboration has been strengthened by the diverse R&D activities at Tohoku University, a leader in national and international education.

Tohoku University is a research-oriented university and has been involved in numerous collaborative efforts with big business and to a lesser degree with smaller, local businesses. As one might assume, the development of local businesses is of great importance. Since June 2012, we have held a wide variety of events: hosting a research information session for local business people, holding over fifty lectures for manpower training, arranging visits for local business people to more than forty laboratories, encouraging our researchers to tour local companies at their invitation, and promoting poster presentations by all the laboratories that have joined the project. These events broke down the barriers separating the university from local businesses and as a result a number of new collaborative activities have emerged.

In this year's international conference, we will focus on progress toward the introduction of research and technology and progress since the Great East Japan Earthquake and future prospects. Our project members include a wide range of individuals from Tohoku University laboratories, from research groups in Miyagi Prefecture, and from regional companies. These are people who have desperately labored to restore the damage done by the earthquake and the tsunami, and they are still endeavoring to do so. We would like to share with people from all over the world the new technologies and products that were created by overcoming these very great difficulties, helped in no small way by the immeasurable power of human beings to confront adversity and reach beyond themselves to achieve their goals. We hold this year's international conference with such a desire.

Katsuto Nakatsuka, Director

Akira Miyamoto, Chairman of Research Promotion Committee

Contact

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Next Generation Automobiles Division

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Research Promotion Committee

Miyamoto Laboratory
New Industry Creation Hatchery Center, Tohoku University

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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"

Organizers: A. Miyamoto (Tohoku University), P. Kapsa (Ecole Central de Lyon),
M.C. Williams (AECOM, USA) and K. Nakatsuka (Intelligent Cosmos Research Institute)

Joint Session of Thirteenth International Conference on Fluid Dynamics (ICFD2016)
OS18: "Global/Local Innovations for Next Generation Automobiles"

Date:	October 11th & 12th, 2016
Conference Site:	Sendai International Center, Sendai, Japan
Registration Fee:	Free
Website:	http://www.miyagicar.com/
	http://www.ifs.tohoku.ac.jp/icfd2016
Presentation materials:	http://www.miyagicar-en.com/download/

Tuesday, October 11

10:50 **Opening Remarks: Akira Miyamoto, Philipe Kapsa, Mark C. Williams, and Katsuto Nakatsuka**

Session1: Progress of cutting-edge technologies

11:00- 11:20 **THE EVOLUTION OF HONDA'S ELECTRIC DRIVE SYSTEMS AND THE COMPANY'S LATEST TECHNOLOGIES**
Minoru Noguchi, Honda R&D Co., Ltd., Japan

11:20-11:50 **The Power of Text Mining**
Jan Vom Brocke , University of Liechtenstein, Liechtenstein

11:50-12:10 **System engineering - the strategic tool for sustainable development**
Wolfgang G. Winkler, HAW Hamburg, Germany

12:10-13:00 Lunch Meeting / Sakura 1

Session2: Approaches to the development of technologies

13:00-13:20 **Mechanism analyses of tribological phenomena in automotive parts**
Ryoichi Honbo, DENSO CORPORATION, Japan

13:20-13:40 **Psyochological evaluation of driving-fun**
Hiroko Kamide, Nagoya University Institute of Innovation for Future Society, Japan

13:40-14:00 **Microporous/Mesoporous-based Automotive Exhaust Catalysts: Performance, Characterization and Development**
Selvam Parasuraman, National Centre for Catalysis Research, India

14:00-14:05 Break

Session3: Progress since the Great East Japan Earthquake and Future Prospects

14:05-14:35 **Building knowledge Network**
Toshio Kato, Intelligent Cosmos Research Institute, Japan
Tatsuya Watanabe, Prospine Co., Ltd., Japan
Tsutomu Iwama, Industrial Technology Institute, Miyagi Prefectural Government, Japan

14:35-14:55 **Breakdown of Safety Myth in Mega-scale Systems**
- The accident of Fukushima Daiichi nuclear power plant -
Shigenao Maruyama, Tohoku University, Japan

14:55-15:15 **Microstructure and Mechanical Properties Evolution of Biomedical Co-Cr-Mo Alloys Produced by Manufactured by Electron Beam Additive Manufacturing**
Akihiko Chiba, Tohoku University, Japan

15:15-15:35 **High Value Manufacturing for Automobile Applications**
Tsunemoto Kuriyagawa, Tohoku University, Japan

15:35-15:55 **Regional Innovation by Advanced Mobility System Research & Development**
Fumihiko Hasegawa, Tohoku University, Japan

15:55-16:15 **Miyagi Prefecture's Restoration and Reconstruction Efforts**
Shigenori Mita, Chief, Promotion office for the automobile industry,
Miyagi Prefectural Government, Japan

16:15-16:20 Break

Session3: Progress since the Great East Japan Earthquake and Future Prospects-2

16:20-16:30 **Progress: IWATE Regional Innovation Area for Next Generation Mobility**
Takashi Imaseki, Sub Project Director, Iwate Industry Promotion Center, Japan

16:30-16:40 **Development of the nondestructive evaluation technique and novel functional materials for security, safe and energy saving society**
Hiroyuki Miki, Tohoku University, Japan

16:40-16:50 **Supercritical Fluid Technology toward Sustainable Society**
Hiroshi Inomata, Tohoku University, Japan

16:50-17:00 **The frontier of Wireless Power Transmission**
Hidetoshi Matsuki, Tohoku University, Japan

17:00-17:10 **Ceria-Based Mixed Conductors for Gas Separation and Storage**
Hitoshi Takamura, Tohoku University, Japan

17:10-17:15 **A Compact, Lightweight and Millimeter-Accurate GPS Logger**
Naoto Miyamoto, Tohoku University, Japan

17:15-17:20 **Road standard and facilities**
Motomune Kataoka, Tohoku University, Japan

17:20-17:25 **Humidity Sensors for the Next Generation of Automobiles**
Patrick A. Bonnaud, Tohoku University, Japan

17:25-17:40 **Discussion Time**

18:00 ------- Move to the Westin Hotel by Taxi -------

18:30-20:30 **Worldwide Leaders Dinner Party of Next Generation Automobiles** / the Westin Hotel Sendai

Wednesday, October 12

ICFD Joint Session OS18

9:00- 9:30 **OS18 -1** **Status of Fuel Cell Technologies for the Transportation and Energy Industry**
Mark C. Williams, AECOM, USA

9:30-10:00 **OS18 -2** **Japan's Energy Choice: Renewables or Nuclear**
Noriko Hikosaka Behling, Author/Analyst, USA

10:00-10:30 **OS18 -3** **Tribology approach for next generation automotive engines**
Philippe KAPSA, École Centrale de Lyon, France

10:30-10:40 Break

Session4: International Frontier Technologies

10:40-11:00 **Rare earth materials technology towards next generation automobiles**
Dongfeng Xue, Changchun Institute of Applied Chemistry, Chinese Academy of Sciences, China

11:00-11:20 **Evolution of U.S. Driverless Vehicle Policy**
Thomas Behling, CENTRA Technology Inc., USA

11:20-11:40 **Giant micro-photonics for engine ignition and sensing**
Takunori Taira, Institute for Molecular Science, Japan

11:40-12:00 **Smart Society 5.0 Enabled by MEMS**
Shuji Tanaka, Tohoku University, Japan

12:00-12:50 Lunch Meeting / Sakura 1

Session4: International Frontier Technologies-2

12:50-13:10 **MEMS (Micro Electro Mechanical Systems) and open collaboration**
Masayoshi Esashi, Tohoku University, Japan

13:10-13:50 **Present and Future of Batteries for Electric Vehicles**
Osamu Yamamoto, Mie University, Japan

Session5: Poster Presentations

13:50-14:40 **Oral presentations for poster**
Shunsuke Tatsumi, Tohoku University
Hiroyuki Kosukegawa, Tohoku University
Hideyuki Takahashi, Tohoku University
ABU UBAIDAH BIN SHAMSUDIN, Tohoku University
Kenta Aoyagi, Tohoku University

Akihiro Hayakawa, Tohoku University
Ryuichi Kobayashi, Tohoku University
Takayuki Nihei, Tohoku University
Kyosuke Ueda, Tohoku University
Mitsuru Sato, Tohoku University
Takeshi Chiyokubo, Industrial Technology Institute, Miyagi Prefectural Government
Masashi Mizukami, Tohoku University
Akichika Kumatani, Tohoku University
Masahiro Nishizawa, Tohoku University
Hitoshi Soyama, Tohoku University
Takenobu Hongo, ASTER Co., Ltd.
Li Guanqiao, Tohoku University

14:40-15:20 **Poster presentations**

Session6: Challenge for the Future

15:20-15:40 **Multi-Fuel Engine Project**
Kazuhiko Kami, HANA ENGINEERING JAPAN, Japan

15:40-16:00 **Modern Drivetrain Lubricaiton Demands**
Yoshiaki Higuchi, Lubrizol Corporation, Japan *on behalf of Timothy Newcomb

16:00-16:20 **Architectured polymer based materials for energy conversion**
Jean-Yves CAVAILLE, INSA Lyon, France

16:20-16:50 **General Discussion**

Concluding Remarks : Akira Miyamoto, Philippe Kapsa, Mark C. Williams and Katsuto Nakatsuka

17:00 ------- Move to Akiu Hot spring Resort by Shuttle Bus -------

18:00-20:00 **Worldwide Leaders Dinner Party of Next Generation Automobiles/**
Hotel Sakan, Akiu Hot springs

Poster Presentations

Academic Presentation

Academic Presentation
Research and Technology at the Tohoku University

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

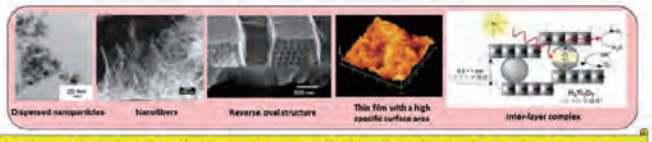
The Development of Innovative Three-way Catalysts via Solvothermal Reactions

SATO-YIN 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

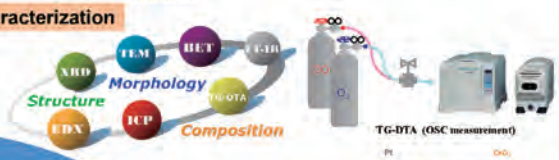
To solve problems ...

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

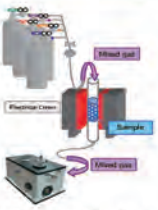
Development of innovative automobile exhaust gas purification catalyst by precisely controlling the morphology and composition

Synthesis

Characterization



Three-way catalysts (TWCs) performance evaluation

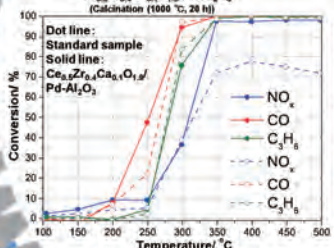


FT-IR (Automobile exhaust gas purification measurement)

Innovative automobile exhaust gas purification catalysts

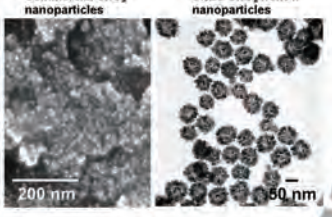
Ceria-based catalyst performance evaluation

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



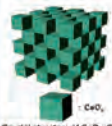
Performance was improved by the composition control !

Non-ceria catalyst performance evaluation



Performance was improved by the morphology control !

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

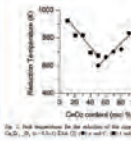


Crystal structure of CeO_2: Cubic

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

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

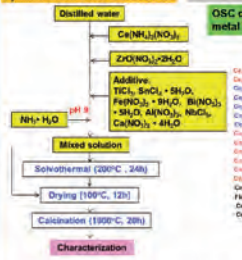
Ce^{4+} is small to form the fluorite structure



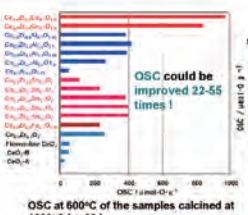
R.D.Monte, J. Alloy Comp., 275-277, 877 (1998).

Ion	R coordination (VIII) (nm)	Ion	R coordination (VIII) (nm)
Ce^{4+}	0.097	Ti^{4+}	0.087
Zr^{4+}	0.084	Sn^{4+}	0.077
Ca^{2+}	0.112	Nb^{5+}	0.071
Fe^{3+}	0.077	Bi^{3+}	0.071
Fe^{2+}	0.087	Co^{3+}	0.068
Al^{3+}	0.058	Co^{2+}	0.083

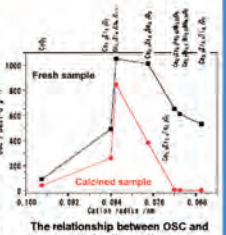
Synthesis of ceria-based solid solution



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

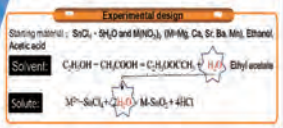


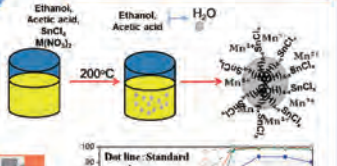
The relationship between OSC and incorporated cation radius

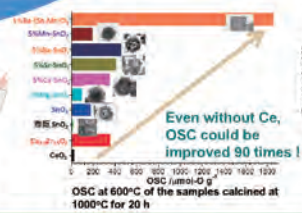
Oxygen storage capacity (OSC) of CeO_2, could be improve 22 times by co-doping Zr and Sn into CeO_2, which is a well know automotive co-catalytic material. It was possible to reduce the consumption of Ce more than 30%.

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

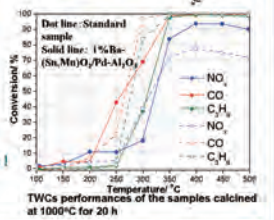
Non-ceria automobile exhaust gas purification catalyst– M-SnO_2







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: shuyin@tagen.tohoku.ac.jp

Professor Tsugio SATO

Professor Shu YIN

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

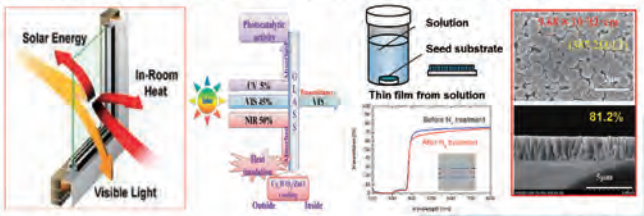
Creation of Functional Materials by Environmental Friendly Processes

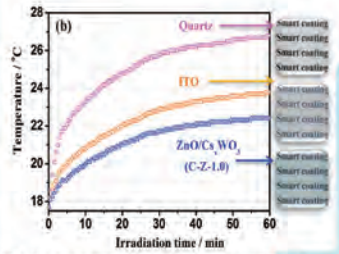
SATO-YIN Lab , IMRAM, Tohoku University

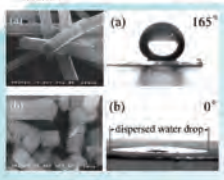
MEXT TOHOKU ECONOMIC FEDERATION Tohoku University 宮城県 七十七銀行 ICR

Promoting the Creation of Functional Materials via Eco-materials Processing

Solution process such as novel solvothermal reaction was developed for the efficiently synthesis of metal oxide nano-particles or micro-particles with controllable size and morphology. We have studied the new functionality of metal oxides related to their unique morphology. Creation of multifunctional eco-materials and research on their novel applications related to environmental harmony, high-efficiency energy utilization, and human -oriented functionality are carried out.



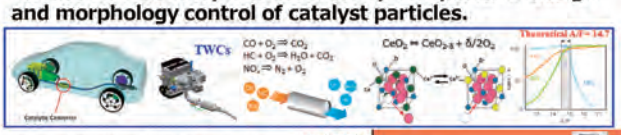


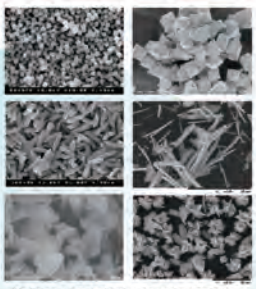


Multifunctional thin films and their novel applications

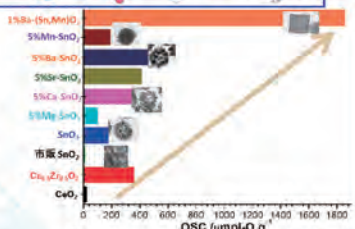
Development and Functionality Improvement of Novel Co-catalyst for Automobiles

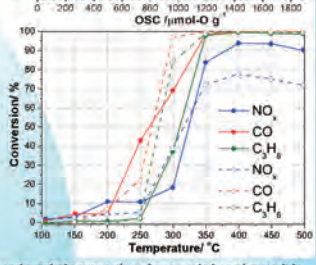
Automobile exhaust gas purification catalysts with various composition of ceria –based and non-ceria-based materials are developed. Excellent oxygen storage and release functionality are realized by composition design and morphology control of catalyst particles.



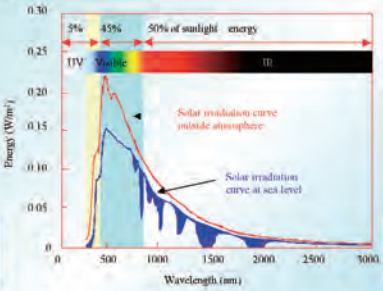


Various morphologies of ceria particles



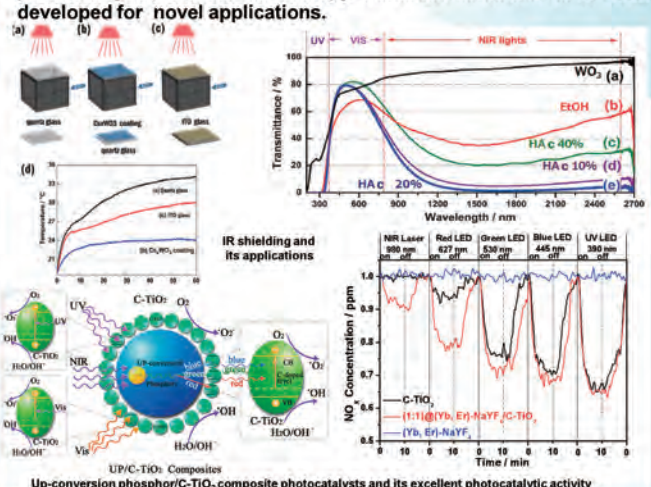


OSC and catalytic properties of non-ceria based materials



Advanced Functionality of Light-responsive Material

Solar energy is composed of about 5% of the UV light, 45% of visible light and 50% of the infrared light. The research has been developed with the aim of optical-function improvement and its engineering applications of the materials for each light wavelength. Smart window materials with ultraviolet / infrared shielding function, photocatalysts, bio-thermal therapy treatment materials have been developed for novel applications.



Up-conversion phosphor/C-TiO$_2$ composite photocatalysts and its excellent photocatalytic activity

New Developments of Environmental Harmony Functional Materials; Promoting of International Collaboration

The 1st International Symposium on Environmental Harmony Materials (ISEHM2016, Chair: Prof. Tsugio SATO) was held on March 2-4 (2016) at Tohoku University and hotel Iwanumaya. About 60 experts and participants from 5 countries, including China, Thailand, Indonesia, Australia, and Japan joined the symposium, exchanged the information about novel applications of environmental harmony functional materials, promoting of global cooperation.

Human- and Environment-Friendly Supercritical Fluid Technology

Tohoku University / Research Center of Supercritical Fluid Technology

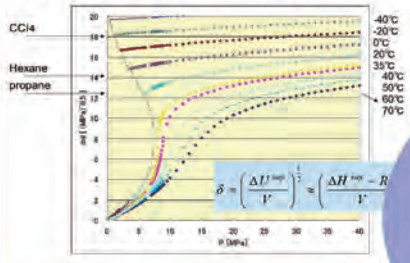
Features of Supercritical Fluid (SCF)

SCF can control widely and continuously its density and related solvent properties by temperature and pressure.
➔ Object oriented solvent circumstances

General features of supercritical fluids

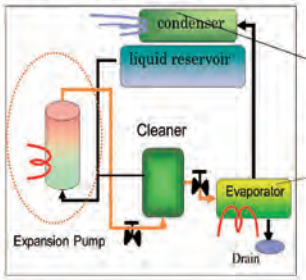
Property	Gas	SCF	Liquid
Density [kg/m^3]	0.6~2	300~900	700~1600
Viscosity [10^{-5} Pa•s]	1~3	1~9	200~300
Diffusivity [10^{-9} m^2/s]	1000~4000	20~700	0.2~2
Kinematic Viscosity [10^{-7}m^2/s]	100	1～10	10

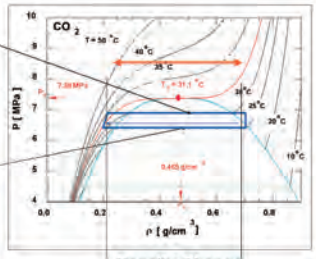
溶解度パラメータ CO_2 （Solubility parameter）



Cleaning, Drying, Recycling Technology

Dissolving/removing technology in confined space by using high diffusivity and low surface tension which cannot be attained by liquid solvents.





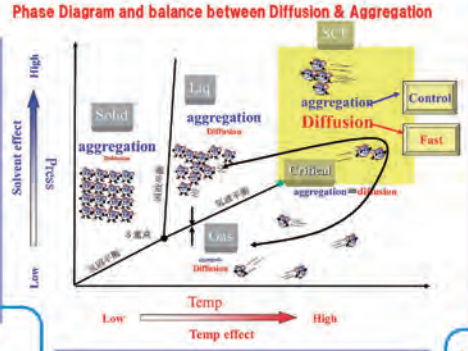
Density Change

Thermally Driven Pumpless Solvent Circulating System

Dry cleaning

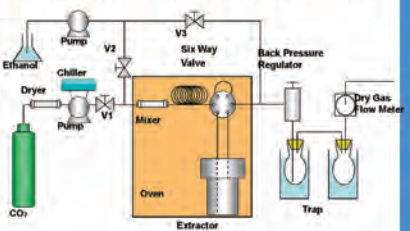
High performance filter regeneration

Phase Diagram and balance between Diffusion & Aggregation

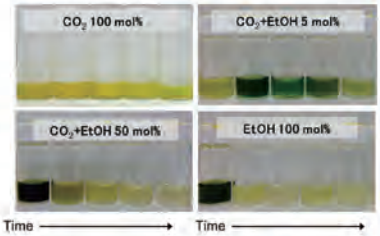


Safe/Secure Separation Technology for Biomass and Natural Resources

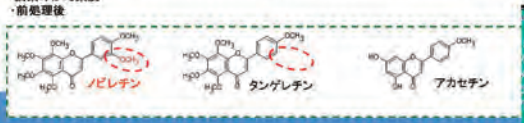
Fractionation and concentration of bioactive compounds by controlling solubility and partition coefficient of SCF solvents



Orages
(肥後温州)

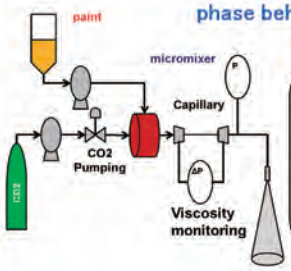


摘果みかん果皮
・前処理後



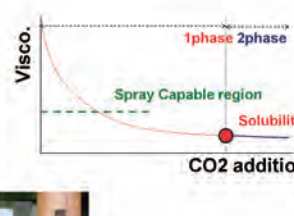
Low VOC Emission SCF CO_2 Spray Painting System

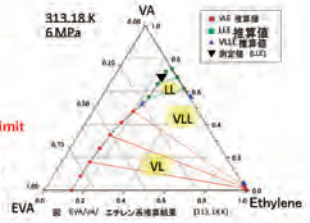
Utilizing ScCO2 penetrating and dissolving capability against polymers together with phase behaviors and plasticizing effects



CO2 painting

- lower the viscosity by mixing with paint in micromixer
- Reduce the dilluent
- Very fine atomization by high pressure spray
- Promote the fine atomization by re-evaporation of dissolved CO2 in liquid droplets.
- Very low drying energy





Now fundamental and application researches on SC-Water and SC-CO2 technologies have been undergoing for separation, material production, reaction processes.
URL: www.che.tohoku.ac.jp/~scf

Super-Critical Fluid Technology

Tohoku University / Research Center of Supercritical Fluid Technology

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

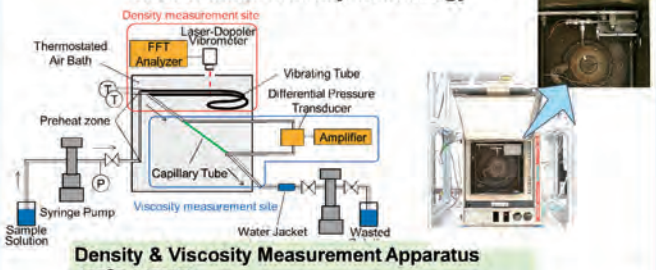
Situation just after the Earthquake

SCF researches request for us to do experiments under pressures. Therefore most of equipment were originally designed/built by our group, which had a severe damage and became out –of-use. ➔ repair and rebuild ….

Shift to calculation/modeling research from experimental studies in 2011

Change the concept in designing the experimental apparatus for fundamental data measurements

More compact and module design
Measure the important data by ourselves
Environment-friendly technology



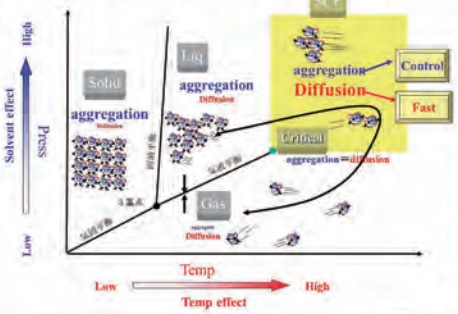
Density & Viscosity Measurement Apparatus
400℃、40MPa

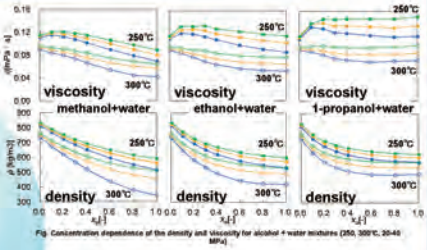
Property Prediction by Equation of State

$$y_2 = \left(\frac{p_2^{sub}}{\phi_2 P}\right)\exp\left[\int_{p_1^{sub}}^{p}\frac{v_2^S}{RT}dp\right]$$

$$y_2 = \exp\left[\frac{-\Delta H_{fus}^m}{RT_m}\left(\frac{T_m}{T}-1\right)-\frac{v_2^L(\phi_1)^2}{RT}(\delta_2-\delta_1)^2\right]$$

Phase Diagram and balance between Diffusion & Aggregation





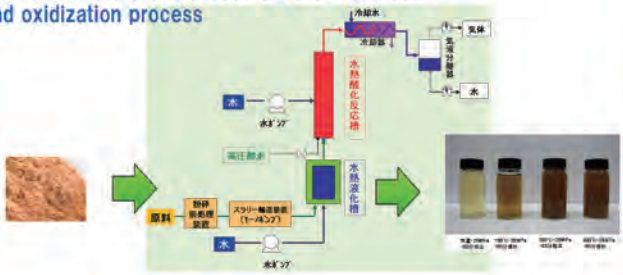
Sub-& Super-critical Water technology

Natural resource・・・・・hydrolysis, glucoside reaction
Polymer ・・・・・・・・・・・depolymerization, chemical recycle
Inorganic particles・・・hydrothermal reaction
Super heavy oils・・・・reduction of coking

Utilizing unused food resources by using of high temperature water

Pasting of yellowtail bone and meat in HT water with high speed cutter

High temperature and pressure water liquefaction and oxidization process



Sub-& Super-critical CO_2 technology

Natural resource・・・・Safe/Secure Separation
　　Tuning of solvent power
Polymer ・・・・・・・・・・Plasticization, high penetration
Cleaning, Catalyst・・・Low surface tension,
　　High diffusivity and volatility

Supercritical impregnation for supported catalyst preparation

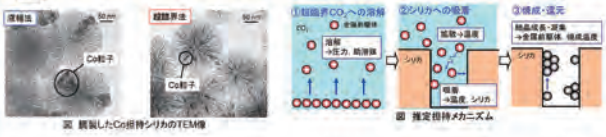
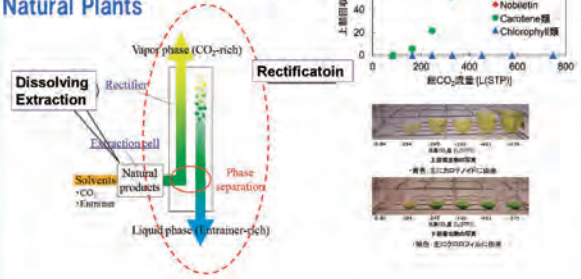


図 調製したCo担持シリカのTEM像　　図 推定担持メカニズム

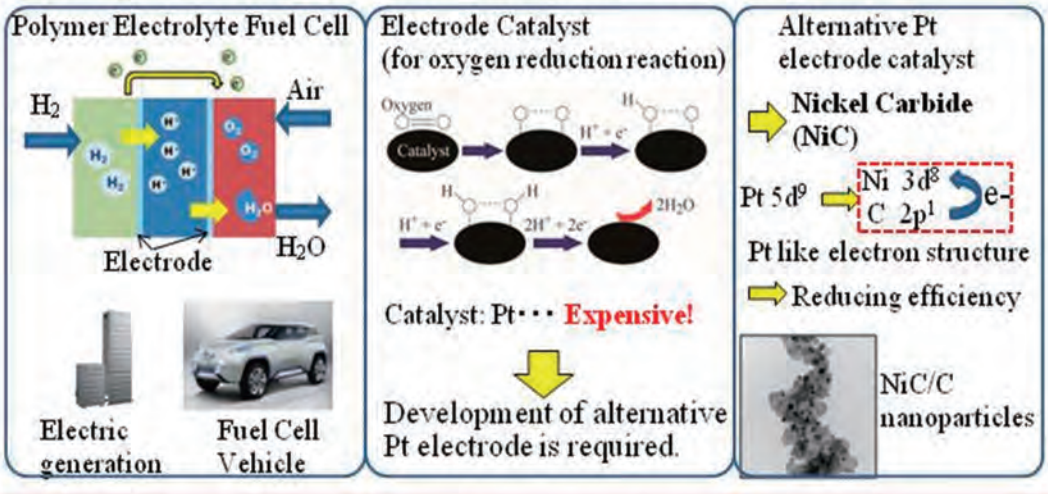
Extraction & Fractionation of Natural Plants



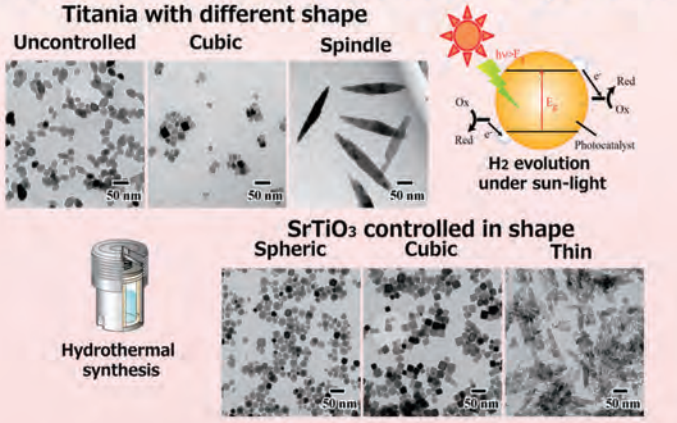
Synthesis of Hybrid Nano-Particles and Application to Functional Materials

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

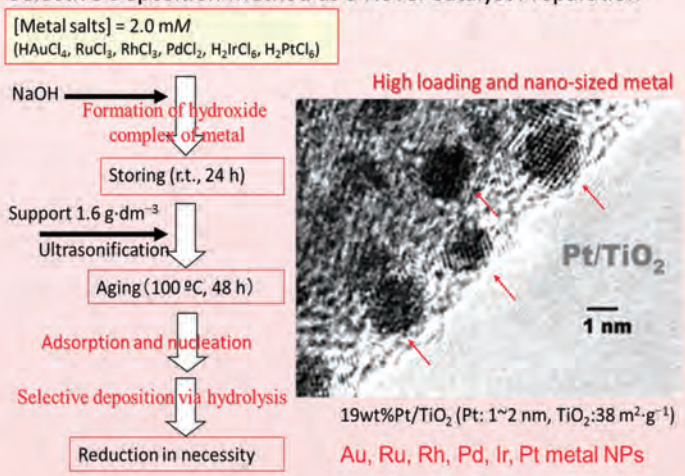
Development of Alternative Platinum Electrode Catalyst



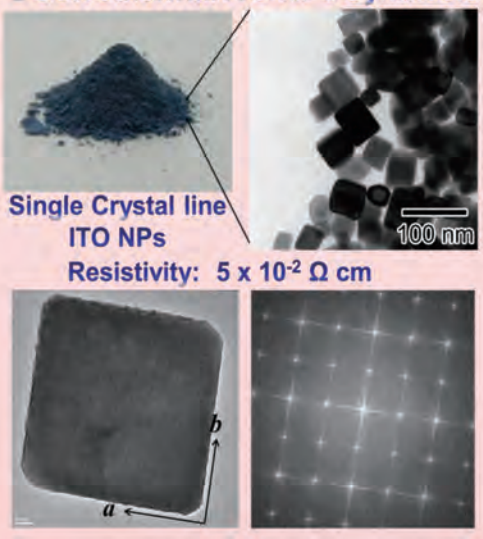
Titanium based oxides precisely controlled in shape and size



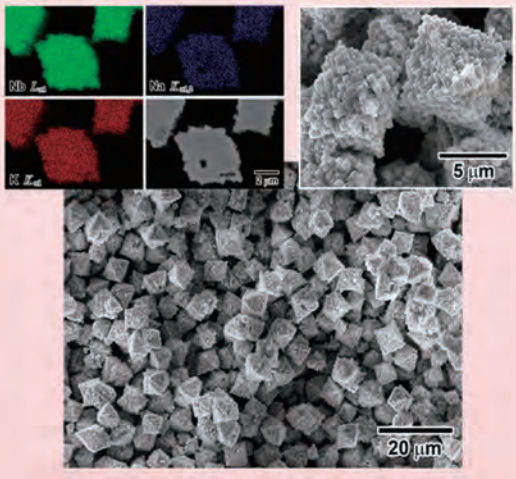
Selective Deposition Method as a Novel Catalyst Preparation



Solvothermal ITO NPs Synthesis



Hydrothemal Synthesis of $NaNbO_3$ Fine Particles as Piezoelectric Device



Synthesis of Hybrid Nano-Particles and Application to Functional Materials

Muramatsu Lab., IMRAM Tohoku University

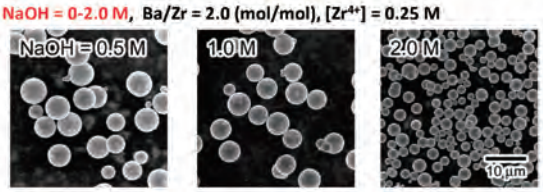
MEXT TOHOKU ECONOMIC FEDERATION Tohoku University 宮城県 七十七銀行 ICR

Preparation of $BaZrO_3$ Nanoparticles

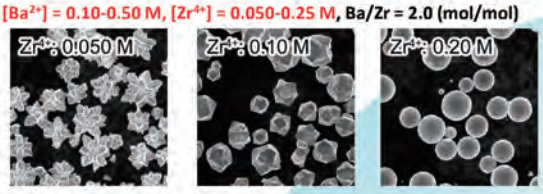
Ternary catalyst carrier for vehicle: High NOx purification ability

Control of size and shape

NaOH = 0-2.0 M, Ba/Zr = 2.0 (mol/mol), [Zr^{4+}] = 0.25 M



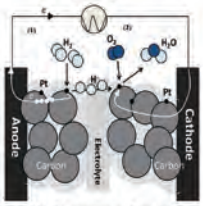
[Ba^{2+}] = 0.10-0.50 M, [Zr^{4+}] = 0.050-0.25 M, Ba/Zr = 2.0 (mol/mol)



K. Kanie,et al., *New J. Chem.*, 38, 3548-3555 (2014).

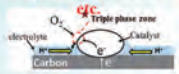
Development of Alternative Platinum Electrode Catalyst

PEFC



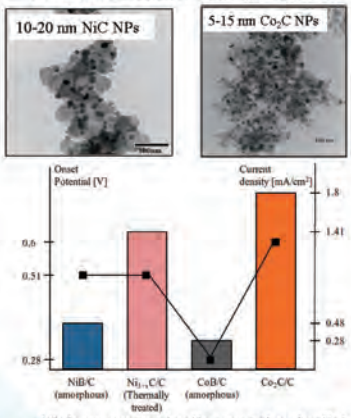
High current density
Low working temperature
Fast response

Application:
Household generator, Mobile battery, etc.



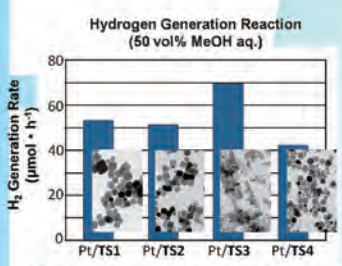
Oxygen is reduced on the triple phase zone. The efficiency is low. → A large amount of Pt is necessary.

Non Platinum catalyst is strongly required.



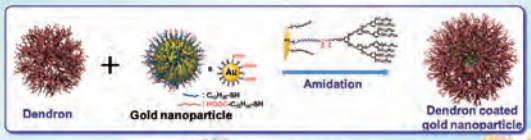
High oxygen reduction onset potential.
High durability.

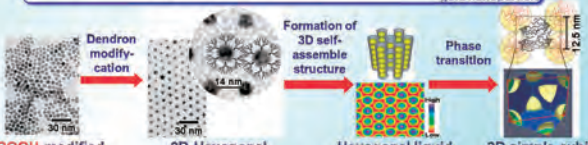
Shape Effect of $SrTiO_3$ NPs on Photo Catalytic Activities



T. Kimijima, et al., *Applied Catalysis B: Environmental*, 144, 462-467 (2014). *Materials Transactions*, 55, 147-153 (2014), *CrystEngComm*, 16, 5591-5597 (2014).

Organic-Inorganic Hybrid Nanoparticles



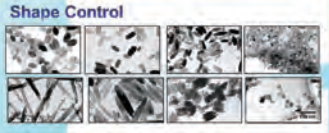


COOH-modified gold anoparticles → 2D-Hexagonal assembly → Hexagonal liquid crystal superlattice → 3D simple cubic liquid crystal phase

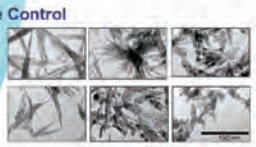
K. Kanie *et al., J. Am. Chem. Soc.*, 134, 808 (2012).

Shape and Size Control of TiO_2 Nanoparticles by Gel-Sol Method

Shape Control



Size Control

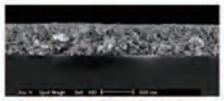


ITO Nanoparticles Prepared by Solvothermal Synthesis and their Properties

Large scale synthesis apparatus (2 L)

ITO nano-ink

Surface roughness of ITO film prepared by spin coat



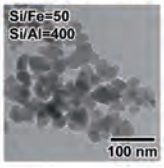
Cross-section image of ITO film

Photographic image of discharged ITO nano-ink by ink jet system

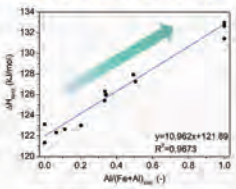
- Film thickness < 100 nm
- Transmittance > 90%
- Haze < 1%
- Resistance value: ~10^{-2} Ω cm

Preparation of (Fe, Al)-MFI Zeolite Nanoparticles

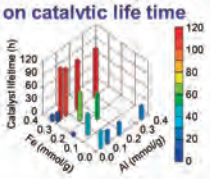
(Fe, Al)-MFI Zeolite Nanoparticles

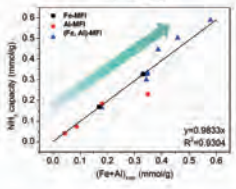


Catalytic Activity of (Fe, Al)-MFI on DTO



Effect of the composition on catalytic life time



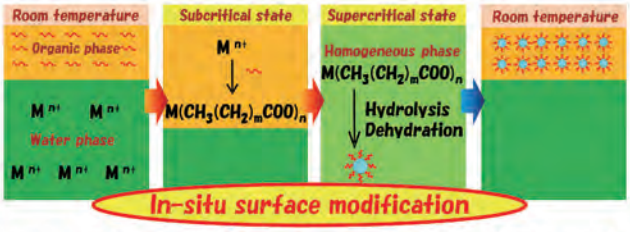


New catalyst for automobile using organic-inorganic Hybrid nanoparticles

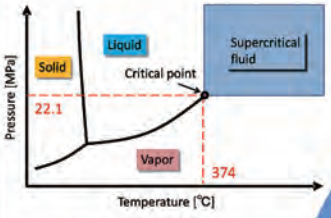
New Industry Creation Hatchery Center, Tohoku University
Adschiri laboratory

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

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?

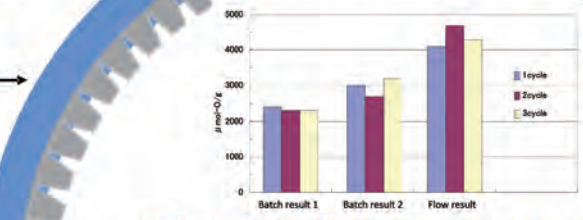
Determination of reaction temperature, pressure, pH condition etc. by batch type reactor

Create nanoparticle continuously by flow type

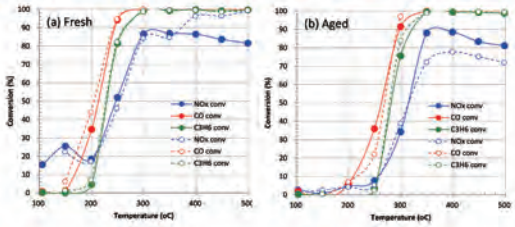
10t/year
Substantiation instrument (Momi-cho GIGA)

Middle type instrument (Momi-cho)

Table type compact instrument (Momi-cho mini)

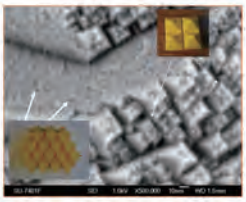


OSC results by Zirconium – Iron nanoparticles

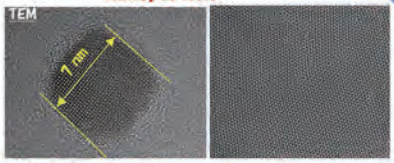


Results of the conversion of exhaust gases

Filled circle: new nanoparticle
Open circle: CeO_2 conventional catalyst



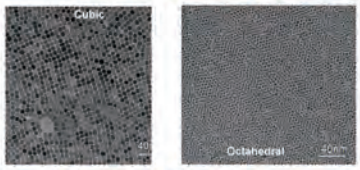
We can control the structure of nanoparticle



Surface modification nanoparticle

mono-dispose CeO_2 nanoparticle

Increase modifier concentration

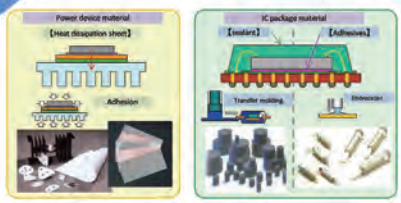


No surface modification CeO_2 nanoparticle (in water)

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.

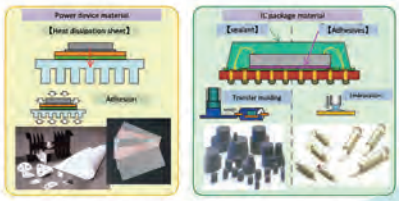
Supercritical Nanomaterials Technology

New Industry Creation Hatchery Center, Tohoku University
Adschiri laboratory

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

Earthquake occurring

Invention of supercritical method to synthesize organic-inorganic nanoparticle creation of new hybrid nano materials.



Thermal conductive and electro-resistive material

Scale-up 10t / year
(Momi-cho GIGA)

After the earthquake

Consortium "Supercritical nanomaterial technology" for technology transfer from TU to industries.
(More than 70 companies are participated)

Lecture for consortium members

Work shop for consortium members

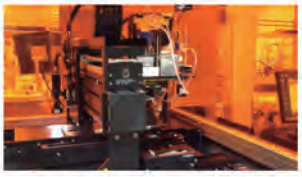
Exhibition

Success and development

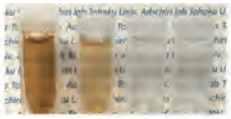
New National Projects

・Low temperature waste heat recovery through endothermic catalytic reactions (NEDO Advanced Research Program for Energy and Environmental Technologies)

・On-demand 3D additive manufacturing of structural functional materials and 3D devices through the creation of fluidic materials. (SIP / Innovative Design)



3D printing system using fluidic materials



Low temperature reaction with supercritical catalyst

Future plan

In addition to automobile catalyst

・New material for automobiles
・Create fluidic materials
(For artificial tooth, Li-battely etc.)

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

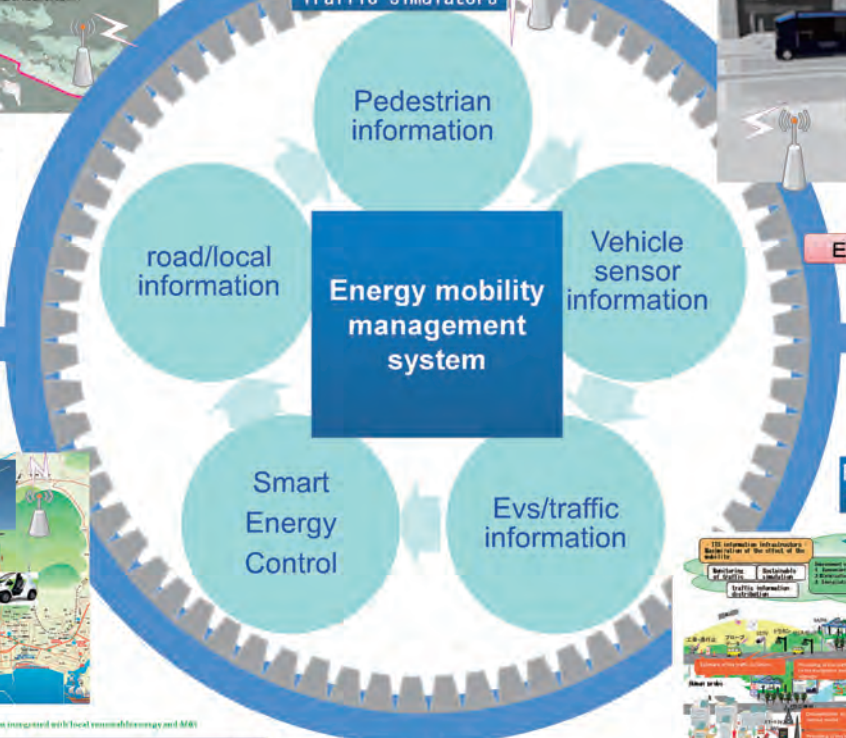
Information Displays

Small EV

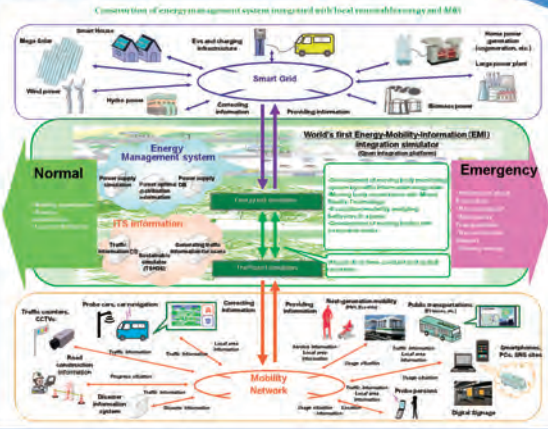
ITS information infrastructures

Traffic simulators

EV buses



Experimental implementation



Function of integrated system

Social mode change for emergency state

Ordinary state

Emergency state

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http://mobility.niche.tohoku.ac.jp/
mobility-office@niche.tohoku.ac.jp
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Progress Since the Great East Japan Earthquake and Future Prospects

Development of the Next-Generation Advanced Mobility-System Technology for New Industry Creation in Local Areas

Fumihiko HASEGAWA, Masahiro NISHIZAWA, Kazunori OHNO, Shigeyuki YAMABE, Motomune KATAOKA, Masato SHIRAKATA, Takahiro SUZUKI, Hidetoshi MATSUKI
New Industry Creation Hatchery Center, Tohoku University
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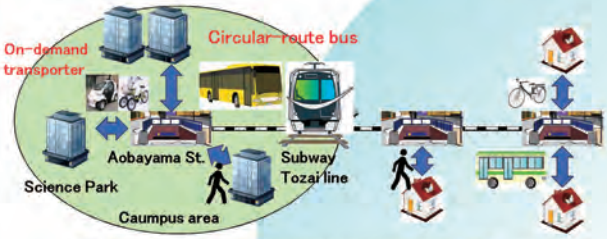
Demonstrative researches of the next-generation advanced mobility system

Tohoku univ. aobayama campus in sendai city



Transportation system in aobayama campus

Establishment of the resilience base for local area

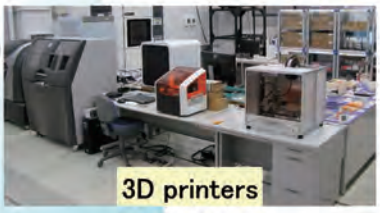
Miyagi Restoration Park in tagajo city


Driving simulator

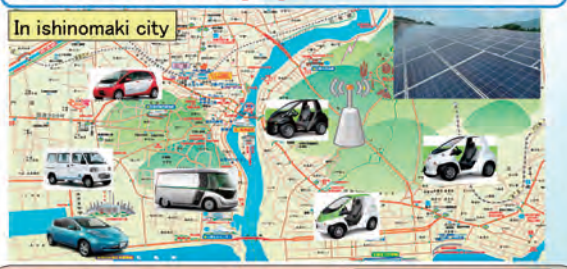

Motion capture

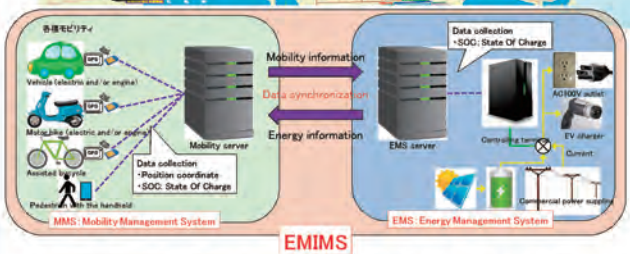

Battery evaluator


EMC room


3D printers

Social implementation of next-generation advanced mobility system





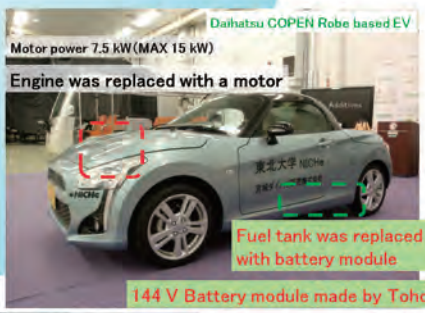
EMIMS


Autonomous driving


Wireless charging

Implementation examination of the leading technology

Realization and industrialization of technology



144 V Battery module made by Tohoku Univ.


Battery production line


Laminate-type Li-ion battery cell

e seven Japan. Ltd

Energy Lab.Ltd.


Li-ion battery module

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

Vehicle and Driver evaluation technology for the next generation mobility

New Industry Creation Hatchery Center(NICHe), Tohoku University
Associate Professor Shigeyuki YAMABE,
Professor Fumihiko HASEGAWA and Professor Takahiro SUZUKI

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What driving simulator does is

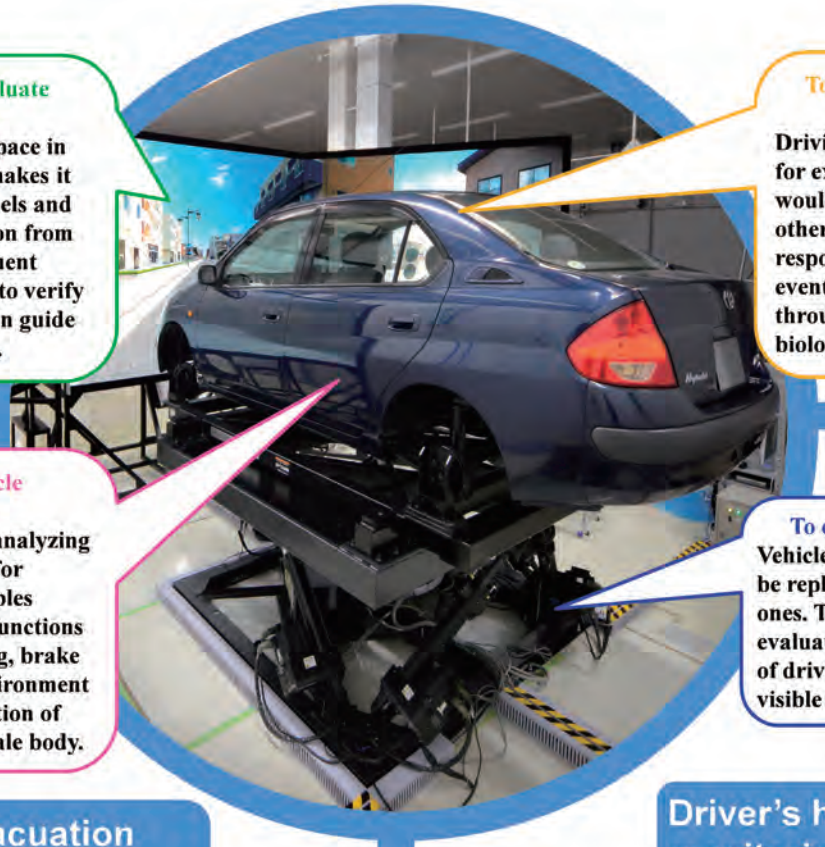
To reproduce real vehicle motions with real car cabin on motion device of 6 axes (X: front/back, Y: right/left, Z: up/down; roll, pitch, yaw)

<SPEC>

	X	Y	Z	Roll	Pitch	Yaw
Operation range	-200mm～+180mm	-190mm～+190mm	–190mm～+230mm	-12deg～+12deg	-12deg～+11deg	-11deg～+11deg
MAX velocity	300mm/s	300mm/s	300mm/s	20deg/s	20deg/s	20deg/s
MAX acceleration	4.9m/s²	4.9m/s²	4.9m/s²	-	-	-

To preliminarily evaluate infrastructure
Construction of virtual space in various infrastructures makes it easy to find layout of panels and signs for better recognition from drivers and analyze frequent accident zones as well as to verify effectiveness of evacuation guide paths toward restoration.

To evaluates driver's response
Driving simulator is useful for experiments which would be dangerous otherwise. Drivers' response to hazardous events can be evaluated through drive actions and biological signals.

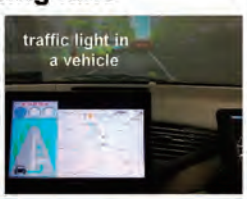


To evaluates vehicle characteristics
CarSim, vehicle motion analyzing simulator, incorporated for vehicle control. This enables evaluation with desired functions such as automatic driving, brake assist, camera-based environment sensing as well as evaluation of cabin layout with real scale body.

To evaluates simulator
Vehicle on the simulator can be replaced with different ones. This enables simulator evaluation for better reality of driving operation and visible images.

Emergency evacuation procedures by a vehicle at the earthquake disaster

- Proposal of emergency evacuation by driving on opposing lane
- Evacuation drills in the simulator



Driver's health monitoring system

- Measurement system to determine from constant monitoring (EEG, ECG, and bloodstream et al.) of various biosignal signal of the driver.

Construct of system which can perform health checks while riding in the vehicle

Administrator :
Associate Professor
Shigeyuki YAMABE
yamabe@niche.tohoku.ac.jp

Efforts to elderly support from the mobility

New Industry Creation Hatchery Center(NICHe), Tohoku University
Shigeyuki YAMABE, Associate Professor

Measure for preventing wrong-way driving

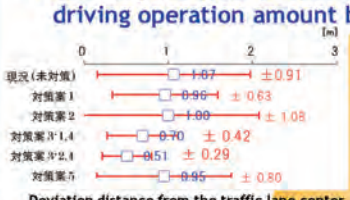
- The number of the discovery of wrong-way driving on the expressway is maximum in the past
- About 70% of the driver is more than 65 years old

Not be able to show the effect of wrong-way driving measures

The driving simulator is utilized for a quantitative evaluation

- Reproduce some proposed measures of wrong-way driving in a virtual space (Kahoku IC)

- Quantify the good proposed measures from the driving operation amount by the elderly over 65



Deviation distance from the traffic lane center

◆Validated countermeasure is introduced into the actual at Kahoku IC.◆

New tricyclic mobility development

- At the Great East Japan Earthquake, There were a lot of elderly people who had difficulty in evacuating on foot

Concept is the vehicle for be able to ride on riskless and accustomed.

Handle yaw angular velocity

- We shown steering stability the trike for the running mode (pedal, assist, EV) is changed.

◆Get the type approval by the third type, and then sell on the market◆

Method of non-evacuation guidance

- Many people chose vehicles to escape from the coast side. Although it was a principle to evacuate on foot, people repeated usage of cars
- There is no precedent of the evacuation training during the vehicle ride

Actual evacuation at the time of the Great East Japan Earthquake is verified in the driving simulator.

◆Proposal of evacuation training from during the vehicle ride◆

- It's forbidden to escape guidance from the system (There are risk of secondary disasters)
- I think about a method to have the elderly person who is behind with circumstantial judgment and the recognition evacuate by own decision making

◆Proposal of information presentation utilizing the driver psychology in emergency◆

Driver Health Monitoring

- Case falling into operation not maintained by the sudden poor health has increased
- Sleepiness by the taking drug (EPS, the elderly)
- Constant monitoring during the vehicle ride

◆Construction of the in-vehicle health exam system◆

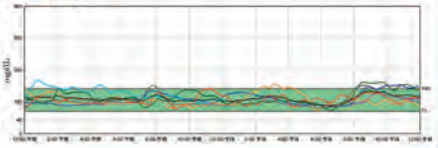
Such as a sitting on the seat, a the seat belt, a hold the wheel, you have maintained the same position during driving

The biological signal of the driver can be easily measured

(brain waves, heart rate, blood flow, sweating etc.)

- We measured blood glucose level during driving. (There is more than 7 million people Including diabetes spare group.)

Prevent the loss of consciousness from the blood glucose level change during driving



Next Generation Advanced Mobility System Research Project Tagajo Center

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

Miyagi Reconstruction Park

Operational Body : Miyagi Organization For Industry Promotion (Public Interest Incorporated Foundation)

Foundation : October 2011

Facility Scale : Seven Buildings/Approximately 39,000 ㎡

Outline : Sony Corporation Sendai Technology Center offered some of its facilities that had suffered flooding damaged caused by the Great East Japan Earthquake and had then been left unused due to the corporation's downsizing free of charge for 10 years. Miyagi Reconstruction Park is one of the largest incubation centers in Asia, making full use of the excellent infrastructure of the industrial giant.

Tagajo Center

Next Generation Advanced Mobility System Research Group of New Industry Creation Hatchery Center at Tohoku University has been working on creating a new industry and employment. Especially, the development of a new regional traffic system by electric vehicles and the "industry-academia" collaborations with small and medium sized companies have been conducted as our important research projects, by using a driving simulator or using a lithium ion secondary battery manufacturing line at Tagajo Center in *Miyagi Reconstruction Park*.

MOTION CAPTURE

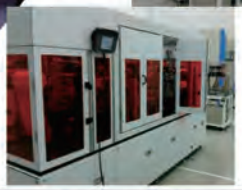
NEW TRICYCLE MOBILITY

DRIVING SIMULATOR

3D PRINTER

ELECTRIC VEHICLE

CONVERTED EV



LITHIUM ION SECONDARY BATTERY MANUFACTURING LINE

Activity of Tagajo Center

Since 2012, approximately more than 400 groups (about 5,000 people) from a variety of fields have visited Tagajo Center. Visitors can see the latest researches such as a driving simulator and electric vehicles and can learn how to put new technologies into practical use and create new industries and employment. Joint researches by utilizing the facilities at Tagajo Center are being advanced all the time.

Chairman and Vice-chairman of Japan Business Federation (2014)

Prime Minister (2013)

Toyota Honorary Chairman (2014)

Japan International Cooperation Agency (2013,2014)

Next Generation Advanced Mobility System Research Project
LITHIUM ION BATTERY MANUFACTURING LINE

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

Lithium Ion Battery Development at Tohoku University

Next Generation Advanced Mobility System Research Group of New Industry Creation Hatchery Center at Tohoku University is working on the new traffic system making which are put automatic runs focusing on an electric car. We recognized the importance of the battery and start on development personally.

The important thing for a battery is , the temperature stability, easy to handle , and high charge ability. We make the system it becomes stable long, and that a battery can be supplied to an area.

Industry-academia Common Platform

We build the battery manufacturing line which becomes a platform of the industry-academia common lithium ion battery production in Miyagi Reconstruction Park.

This platform can supply the large lithium ion battery which considered regional characteristics.

Line Corresponding to Small Quantity

A lithium ion battery manufacturing line generally is large in scale and doesn't point to production of small quantity.

We're aiming at the manufacturing line which can meet the various demands for quick charge correspondence.

Dry-Room-Less

A lithium ion battery manufacturing line is usually performed in the dry room. The running cost as well as the initial investment is expensive and it may become a heavy burden for a manufacturer. We're aiming at manufacturing line without dry room.

Battery manufacturing process

※※主要工程のみ記載

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

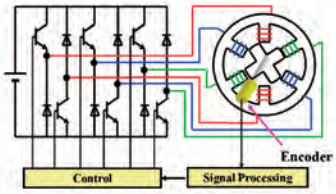
Motor Technology for Next Generation Automotive

Hiroki Goto, Kenji Nakamura, Osamu Ichinokura
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

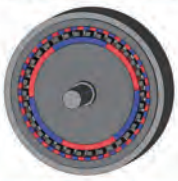
HIGH PERFORMANCE ELECTRIC MACHINE

Switched Reluctance Motor



High Reliable & Rare Earth Free

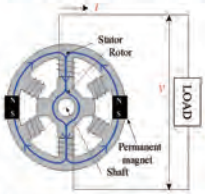
Planetary type Magnetic Gear



Contactless High Power Transmission

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

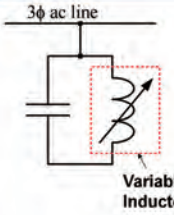
PM Reluctance Generator



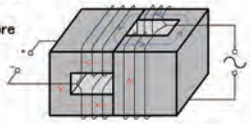
High Power without Rare Earth Magnet

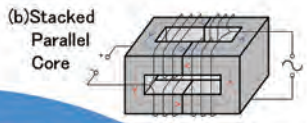
Motor Bench for In-Wheel Motor

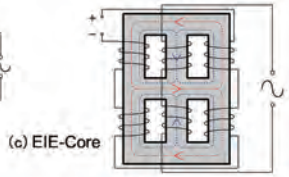
HIGH QUALITY POWER CONVERSION & CONTROL



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



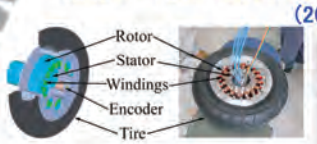




Field Test of Variable Inductor

NEXT GENERATION ELECTRIC VEHICLE

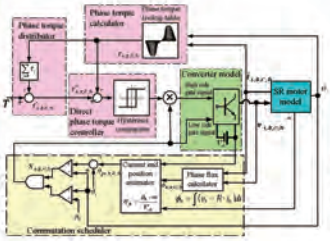
World 1st Rare-Earth Free In-Wheel Direct-Dive Car (2004)



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

Fully Digital Controlled Inverter

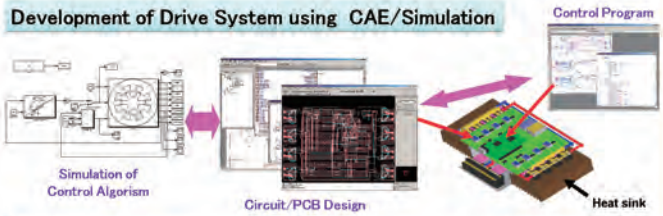
Computing Room



Novel Torque Control for SR motor

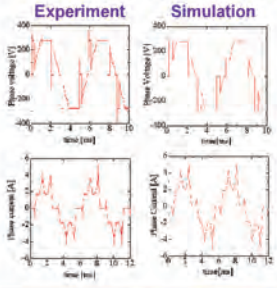
We are studying about Control Method to reduce torque ripple and get high efficiency of SR motor.

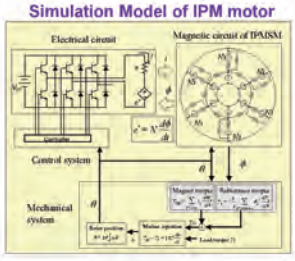
Development of Drive System using CAE/Simulation



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.





POWER ELECTRONICS & CONTROL

ANALYSIS & SMULATION

Progress Since the Great East Japan Earthquake and Future Prospects

Technology of Design, Analysis and Control for High Efficiency Motor / Generator and Power Transmission / Distribution Device

Hiroki Goto, Kenji Nakamura, Osamu Ichinokura
Tohoku University, 6-6-05 Aoba, Aramaki, Aoba-ku, Sendai, Japan

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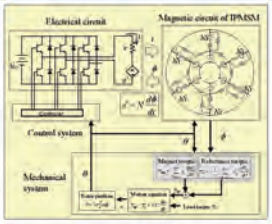
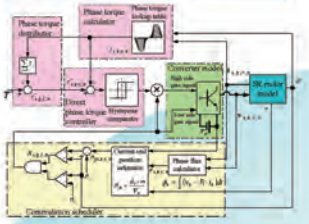
Analysis, Design and Control of Rare-Earth Free Motors

For the widespread use of electric vehicles, rare-earth free motors which are capable to stable supply at low cost are required. We have focused Switched Reluctance Motor(SRM) as one of the rare-earth free motors. To improve the performance of SRM, we develop a high-speed high-accuracy analysis method and several optimal control methods. In addition, we have verified the performance of prototype electric vehicles actually using SRMs in our laboratory.

Motor Simulation by Magnetic Circuit Analysis



Torque Control Method for SR Motor



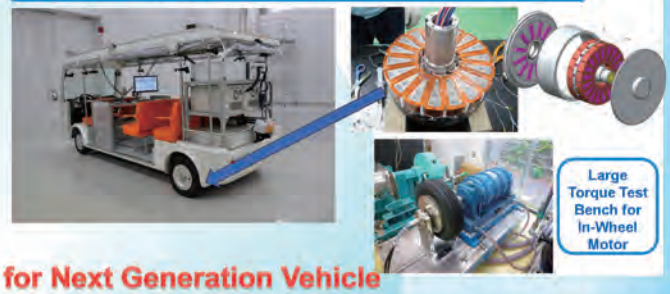
Small In-Wheel Electric Vehicle

Improvement of Performance and Usefulness of SR Motor by New Structure

For the convenience improvement of SR motor for electric cars, we developed an In-Wheel SR motor with built-in inverter just to be attached to a vehicle. In addition, for torque density improvement, we developed axial-flux structure of SR motor that high-density implementation of the winding is possible. This achieved the same level as the torque density of rare-earth magnet motor and we really put it on a micro bus and succeeded in a driving test.

Inverter Integrated In-Wheel SR Motor

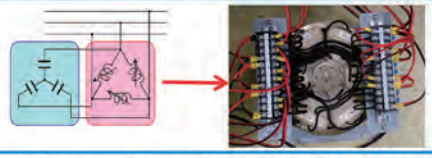
World 1st In-Wheel Axial-Flux SR Motor for Electric Vehicle



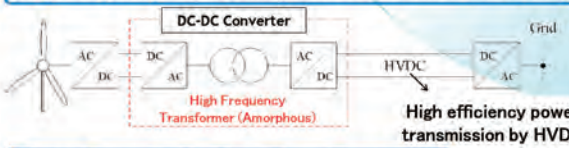
Large Torque Test Bench for In-Wheel Motor

From High Performance Motor for Next Generation Vehicle To Development of Green Energy Society

Variable Inductor for Power Stabilization (JST Project)

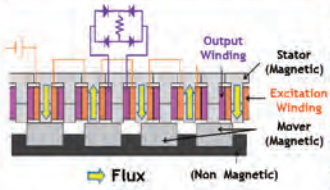


High Frequency Power Amorphous Transformer (NEDO Project)



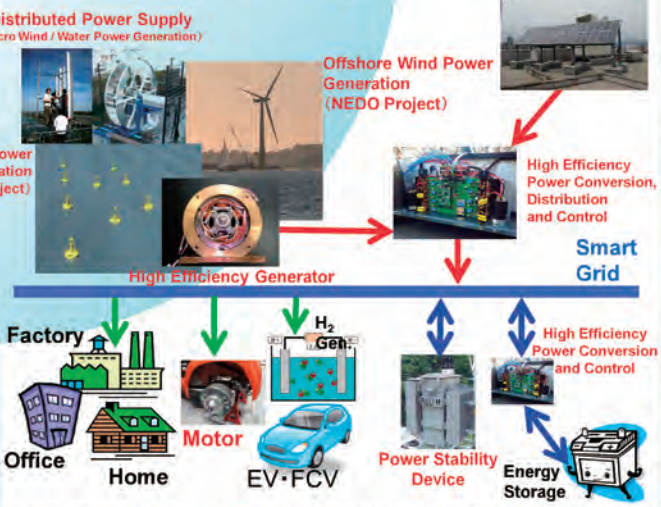
High efficiency power transmission by HVDC

Linear Generator for Wave Power Generation



We are spreading our research field such as variable inductor for controlling the voltage change of power grid by renewable energy generation, high frequency transformer to realize HVDC (High Voltage DC transmission) to efficiently connect large-scale offshore wind farm to land grid, and new structure linear generator which is suitable for wave power generation.

New Structure Generator and High Efficiency Device for Power Transmission and Distribution



We will continue to research the further high efficiency and high performance of motor, generator, and electricity stabilization device. In addition, by establishment of high efficiency and low-cost control, power transmission and distribution technology, we go toward to development of sustainable green energy society from generation to use of renewable energy source such as solar cell, offshore wind, wave power, micro hydroelectric.

Development of Green Energy Society




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.

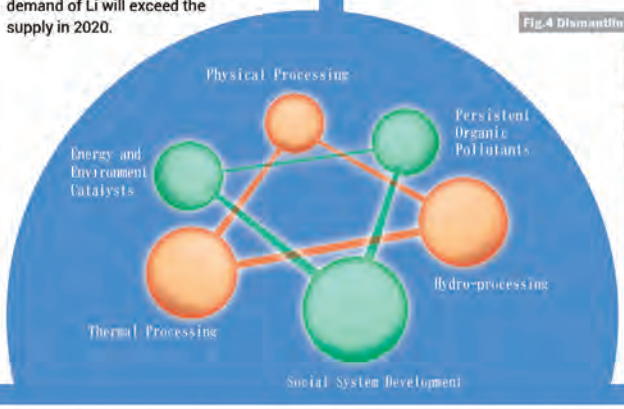
Fig.1 Miner Rare Metals Application for Automobiles

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

How to Use the Disassebled Parts

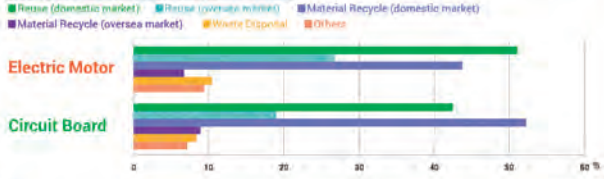


Fig.4 Dismantling of Electric Motor in Electric Vehicle

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/

Towards constructing the resource-recycling society

Tohoku University IMRAM
High Efficiency Rare Elements Extraction Technology Area
Project Leader, Prof. Takashi NAKAMURA

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Rare Elements support high-technology

Rare Elements in Automobiles

Rare Elements in Electronics

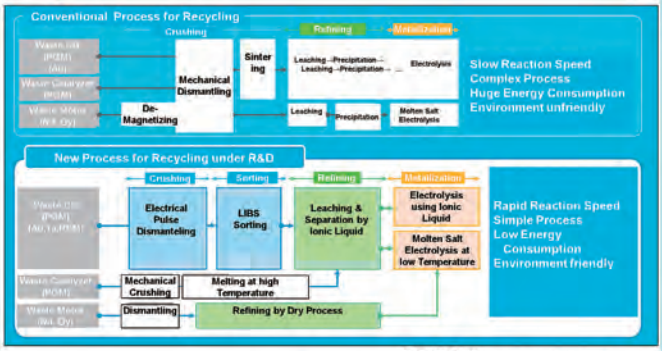
Problems on Rare Elements Resources

- Resources of rare elements unevenly destribute in a few countries.
- Therefore, their prices fluctuates intensely byinternational relations.

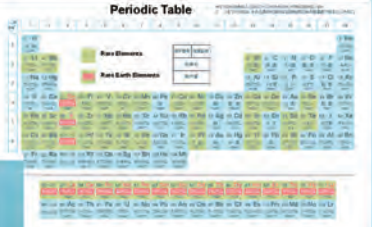
Uneven Distribution of Rare Elements Resources

W	In two countries	94%
Mo	In one country	93%
Nb	In two countries	98%
Pt	In two countries	92%

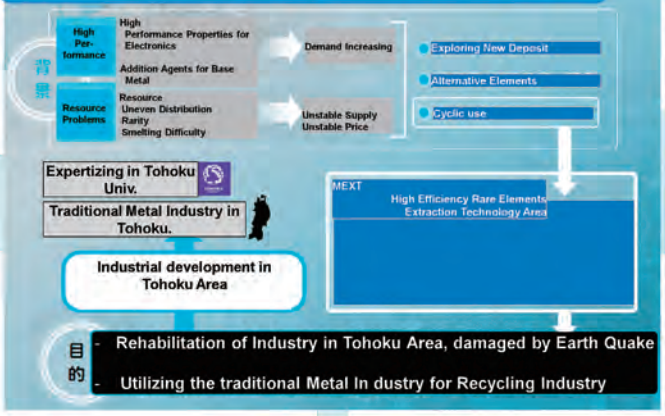
Recycling Process under Research



Periodic Table



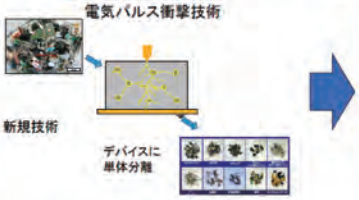
Background of the Research Project

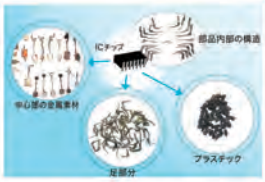


Epoch-making Technologies

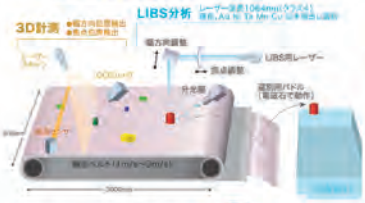
Electrical Pulse Dismanteling

電気パルス衝撃技術





LIBS Sorting Machine



Leaching & Separation by Ionic Liquid

Regional Corporation, Development of Recycling Industry

- Establish the Recycling System (Local Governament, Local Firms)
  - Site Tour in other Area

  - Seminar for Local Recycling Firms
- Technical Support for Loval Firms

- Information Exchange through International Symposium

System Robotics Laboratory

Department of Robotics
Graduate School of Engineering
Tohoku University

Distributed Cooperative Control System of Multiple Robot

In our laboratory, we have proposed a leader-follower type of distributed cooperative control system by mobile multiple robots for carrying large and heavy object that cannot be conveyed by a single robot. In this system, by increasing the number of robots, it is possible to increase easily the weight capacity of the entire system. We are currently conducting research to develop the vehicle transport system as an improvement of this system.

Parts Assembly
By Dual Manipulators

Intelligent Car Autonomous Robot Transporters

Multiple Robots Coordination

Mobile Dual Manipulators Coordination

Partner Robot

In order to integrate robotic technology into society, it is necessary to conduct a research to realize a dependable robot which can serve as a partner. To realize a partner robot, the robot must somehow be able to understand human. In our laboratory, we are studying a closer bilateral communication between human and robot through the research and development of the dance partner robot which dances ballroom dance with a human dancer.

Assembly Task Partner Robot

Co-worker robot

Human Robot Coordination

Human-Robot Interaction

Partner Ballroom Dance Robot

System Robotics

Aiming for creation and deployment of robot technology, and integration to society

In our laboratory, we focus on the research and development of fundamental technology to create dependable robots which are later being used in daily life, as good partners for human beings.

To be able to use the robot in the real world, just the development of the robot by itself is insufficient. The robot as a system must be integrated into society.

Therefore, rather than developing robots as a jumble of mere devices and components, we create the underlying technology that coordinates rational algorithms supported by logic, allowing these robots to perform the required functionalities, so that we can integrate these robots into society.

Power Assisted Cart

Assistive Technology

Bin-picking Robot

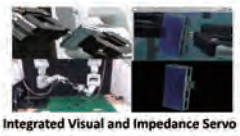
Universal Manipulation

System Robotics Lab.

Wearable Walking Helper

Power Assisted
Cycling-wheelchair

Stable Power Augmentation



Integrated Visual and Impedance Servo

Universal Hand with 2 D.O.F.

Demand of power assistive system is increasing to improve QoL and to ensure labor population with the declining birthrate and with the growing proportion of elderly people. Comfortable operability and advanced safety are required for the system to support a human appropriately. In our laboratory, we developed a power assisted cart to reduce the workload and a power assisted cycling-wheelchair for rehabilitation.

Assistive systems

Industrial robot was invented about 60 years ago with the aiming at realization of universal automation. However, the current robot is not universal at all, and it needs the peripherals customized to each work. Plus, we need to integrate it as a system. We have been studying the universal manipulation technology which can work skillfully like human without any customization.

Universal Manipulation

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/

We would like to joint research with the company and organization which want to utilize such fundamental technology and deployment technology in the industrial world.

System Robotics Laboratory

Department of Robotics
Graduate School of Engineering
Tohoku University

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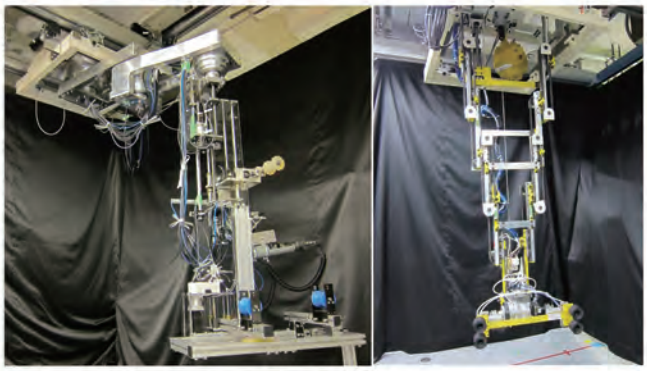
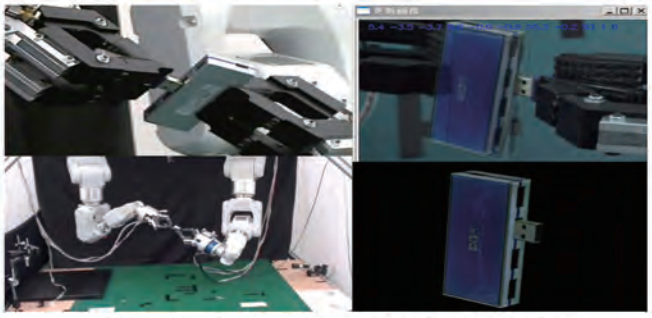
Co-worker Robot

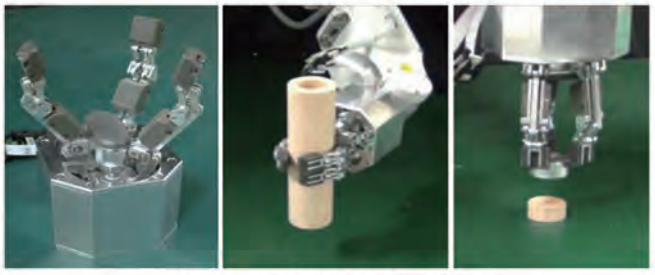


PaDY Concept: Assembly Task Partner Robot

Universal Manipulation

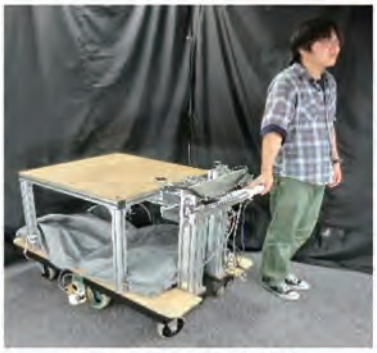


Integrated Visual and Impedance Servo



Universal Hand with 2 D.O.F.

Assistive System



Power Assisted Cart

Power Assisted Cycling-wheelchair

Ttansformative Robotics

Bin Picking Robot

Human-robot Collaboration

In our laboratory, we focus on the research and development of fundamental technology to create dependable robots which are later being used in daily life, as good partners for human beings.

To be able to use the robot in the real world, just the development of the robot by itself is insufficient. The robot as a system must be integrated into society.

Therefore, rather than developing robots as a jumble of mere devices and components, we create the underlying technology that coordinates rational algorithms supported by logic, allowing these robots to perform the required functionalities, so that we can integrate these robots into society.

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

Development of Thermal Barrier Coating for Black Automobiles

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[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

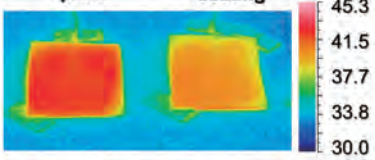
Environmental problem

Greenhouse effect

http://s922sfrt.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

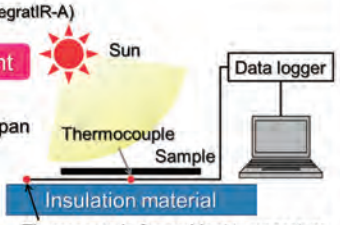
- M. Baneshi, et al., *JQSRT*, 113, (2012), 594.
- H. Gonome, et al., *ASME/JSME 2011 8th Thermal Engineering Joint Conference*, (2011), AJTEC2011-44622.

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



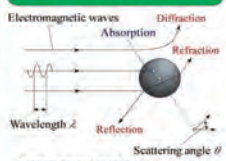
Schematic of the temperature measurement

Exposure experiment

Design

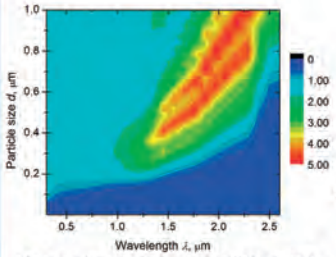
- M. Baneshi, et al., *JQSRT*, 110, (2009), 192.
- M. Baneshi, et al., *J Therm Sci Tech-JPN*, 4, (2009), 131.
- M. Baneshi, et al., *JQSRT*, 112, (2011), 1197.

Nano scale radiation effect



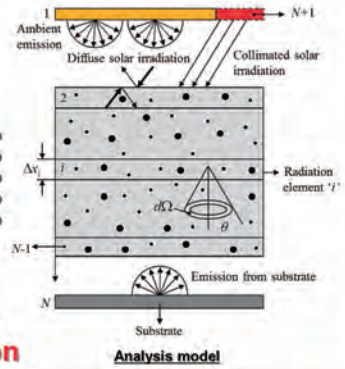
The interaction of a small particle and radiation

- Shape
- Size
- Material
- Clearance



Back-scattering efficiency of a CuO particle

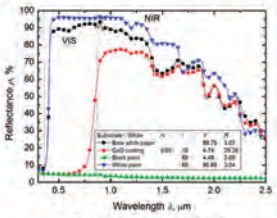
Theoretical optimization



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!*

Progress Since the Great East Japan Earthquake and Future Prospects

Radiative energy control for energy saving

Heat Transfer Control Lab.(Maruyama/Komiya/Okajima Lab),
Institute of Fluid Science

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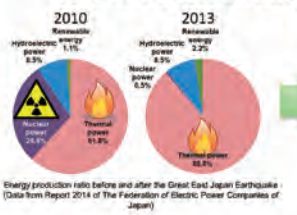
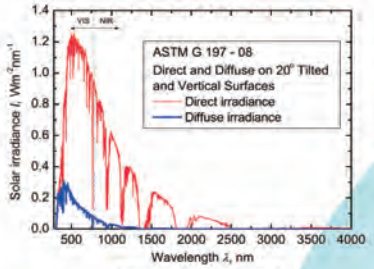
Energy issue after the Great East Japan Earthquake



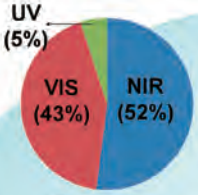
Energy production ratio before and after the Great East Japan Earthquake (Data from Report 2014 of The Federation of Electric Power Companies of Japan)

Energy saving and promotion of natural energy utilization

Control of Solar Energy



Spectral solar irradiance

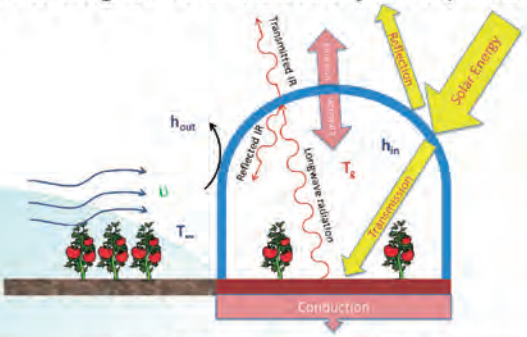


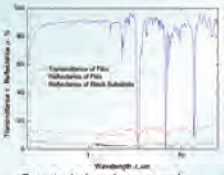
Energy ratio

The radiative energy control appropriate to each application is required.

Radiative heat transfer in covering material for green house

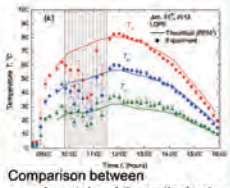
We clarified the spectral properties of glass and plastic film for green house. We estimated the temperature inside the green house theoretically and experimentally.





Spectral absorbance and transmissivity of LDPE

Experiment for temperature measurement inside compact green house

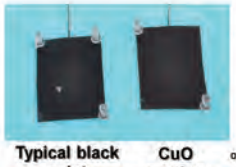


Comparison between experimental and theoretical value of temperature in green house

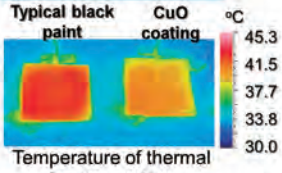
Radiative energy control

Thermal barrier coating with wavelength selectivity

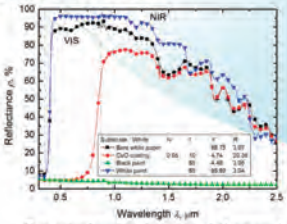
We have developed the thermal barrier coating with wavelength selectivity, which enable to keep black color and to reduce the absorption of solar light. By controlling the particle diameter and concentration in the medium, wavelength selectivity has been achieved.



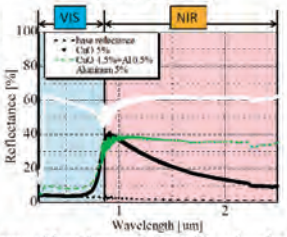
Typical black paint | CuO coating



Temperature of thermal barrier coating



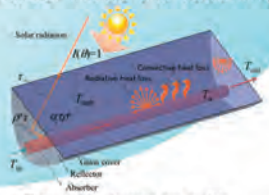
Spectral reflectance of thermal barrier coating



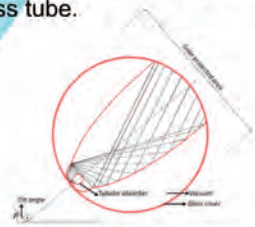
Development of thermal barrier coating with mixed particle

Development of non-imaging concentrator with low heat loss

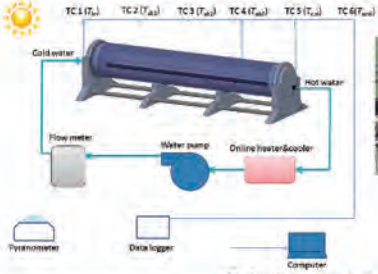
We have developed a non-imaging concentrator without tracking sun and with high concentration ratio. We have realized low heat loss by enclosing the mirror and absorber inside the vacuum glass tube.



Energy balance on solar concentrator



Ray tracing result under certain angle



Solar heating experiment

Future prospects

We studied about radiative energy control for energy saving and utilization of solar energy by controlling medium, surface and structure. Controlling solar energy on the automobile and building will make energy saving and efficient utilization of energy.

Hydrides for Energy Applications

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

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

Research Strategy

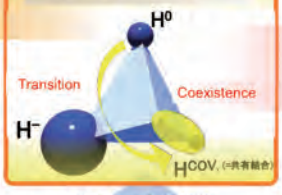
根源的探求
水素の存在状態間の"遷移"や"混在性"など

Hydrides for Energy Applications
「たくさんの水素を安全に貯める性質」、
「水素やリチウムなどのイオンを速く動かす性質」など

Application in Energy Devices
1 Hydrogen storage　2 Electrical storage　3 Superconductivity

Spread of fuel cells and eco-friendly cars, technological innovation of next generation battery and power transmission, strengthening the competitiveness of materials' researches…

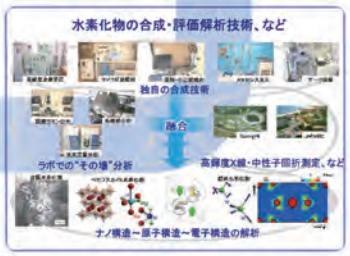
Hydrogen diagram



多様な存在状態を
体系的・一元的に捉える

Hydride	Structure	Statue of hydrogen
Metal hydride (例: $LaNi_5H_6$)		H^0 (= Neutral)
Complex hydride (例: $LiBH_4$)		$H^{COV.}$ (= Covalent)
Perovskite hydride (例: $NaMgH_3$)		H^-

水素化物中の水素は多様な存在状態をとる



1 Advanced hydrogen storage materials

POINT !

Transition from metal hydrides to complex hydrides

High-density hydrogen storage

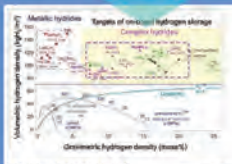
2 High energy density electrical storage

POINT !

Rearrangement of complex anions

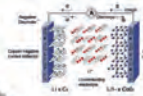
Fast Na ion conductors

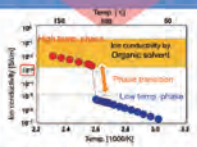
Synthesis of novel complex hydrides with High hydrogen density and Super Na ion conductivity



[Hydrogen density map]

[400km driving = 4kg H_2]





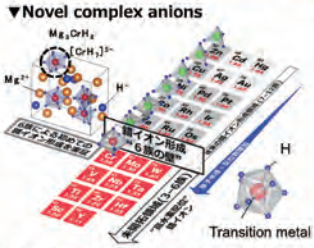
[Super ion conductivity in $LiBH_4$]

[Bulk-type all-solid-state TiS_2/Li battery]

Complex hydrides with novel CrH_7 complex anions

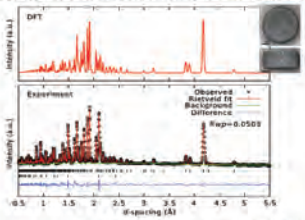
Building guideline for high-density hydrogen storage

▼Novel complex anions

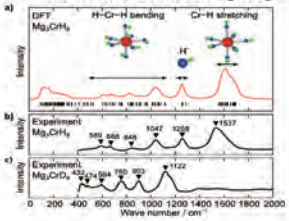


▼2015.4.10 The Science News

▼Neutron diffraction profile of Mg_3CrD_8



▼Infrared spectra of Mg_3CrD_8



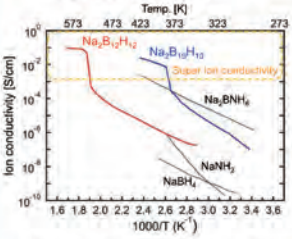
Increased hydrogen density with group 3–6 transition metals' novel complex anions having large H coordination number

S. Takagi, Y. Iijima, T. Sato, H. Saitoh, K. Ikeda, T. Otomo, K. Miwa, T. Ikeshoji, K. Aoki, S. Orimo, *Angew. Chem. Int. Ed.* **54** (2015) 5650.

Complex hydrides with super Na ion conductivity

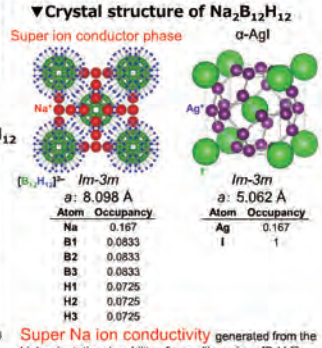
Developing the next generation Na ion battery

▼Temperature dependence of Na ion conductivity

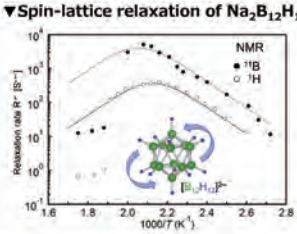


▼2014.10.31 The Science News

▼Crystal structure of $Na_2B_{12}H_{12}$



▼Spin-lattice relaxation of $Na_2B_{12}H_{12}$



Super Na ion conductivity generated from the high orientational mobility of cage-like anions $[B_nH_n]^{2-}$

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Promote the "HYDRIDE" Researches for Energy Applications

Marketing expansion of hydrogen fuel cell
（1.5trillion JPY scale till 2025）

Promoting of researches on next generation all-solid-state battery（Li, Na, Mg…）
（2 trillion JPY scale till 2017）

Progress Since the Great East Japan Earthquake and Future Prospects

Hydrides for Energy Applications

WPI Advanced Institute for Materials Research / Institute for Materials Research, Tohoku University
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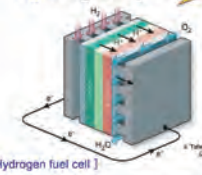
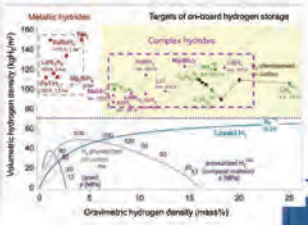
$H_2 + O_2 \leftrightarrows H_2O +$ Promote the "HYDRIDE" Researches for Energy Applications



[Hydrogen fuel cell]

Advanced hydrogen storage materials

Target:
Marketing expansion of hydrogen fuel cell
(1.5trillion JPY scale till 2025)

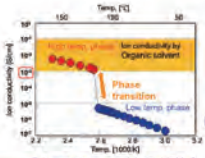


[Hydrogen density map]

[400km driving = 4kg H_2]

High energy density electrical storage

Target:
Promoting of researches on next generation all-solid-state battery (Li, Na, Mg…)
(2 trillion JPY scale till 2017)



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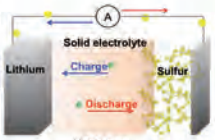
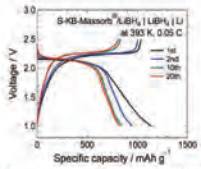


Li-S battery
S: 1672 mAh g^{-1} @ 2.2 V
Energy density ~ 2600 Wh kg^{-1}

$Li_2S_8 \rightleftarrows S_8 + xLi^+ + xe^-$ $(0 \le x \le 16)$
$xLi^+ + xe^- \rightleftarrows Li$

[Next generation all-solid state battery]

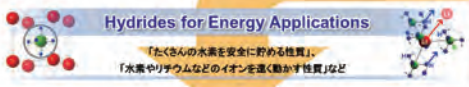


A. Unemoto et al., *Appl. Phys. Lett.*, 105 (2014) 083901.

[High stability]

Research Strategy

根源的探求
水素の存在状態間の"遷移"や"混在性"など



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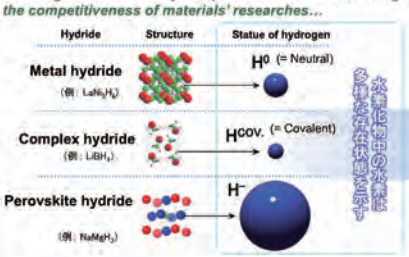
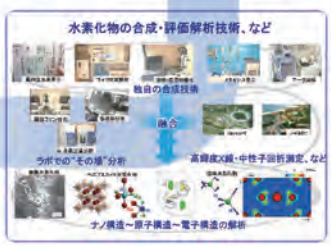
多様な存在状態を体系的・一元的に捉える





Subject:
Synthesis of Cr-contained complex hydrides with high hydrogen density

POINT !

Transition from metal hydrides to complex hydrides

↓

High-density hydrogen storage

Subject:
Synthesis of novel complex hydrides with super Na conductivity

POINT !

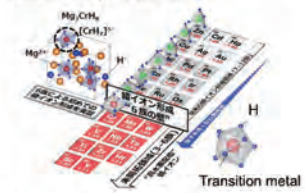
Rearrangement of complex anions

↓

Fast Na ion conductors

Complex hydrides with novel CrH_7 complex anions
➡ Building guideline for high-density hydrogen storage

▼Novel complex anions



▼2015.4.10 The Science News

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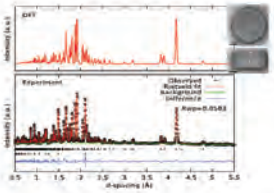

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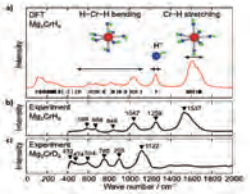

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Complex hydrides with super Na ion conductivity
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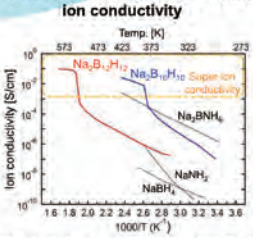
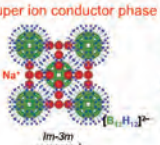


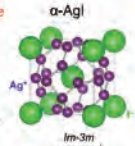
▼2014.10.31 The Science News

▼Crystal structure of $Na_2B_{12}H_{12}$

Super ion conductor phase α-AgI

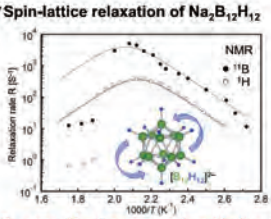


Atom	Occupancy
Na	0.167
B1	0.0833
B2	0.0833
B3	0.0833
H1	0.0725
H2	0.0725
H3	0.0725



Atom	Occupancy
Ag	0.167
I	1

▼Spin-lattice relaxation of $Na_2B_{12}H_{12}$



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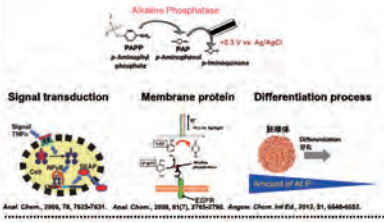
Nanoscale Imaging of Living Cells using Nano-Scanning Electrochemical Microscopy

Advanced Institute for Materials Research,Tohoku University
Matsue Lab

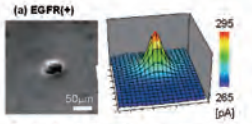
MEXT TOHOKU ECONOMIC FEDERATION Tohoku University 宮城県 77 七十七銀行 ICR

Cell function evaluation using scanning electrochemical microscope

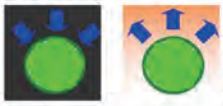


Signal transduction Membrane protein Differentiation process

Anal. Chem., 2008, 78, 7625-7631. Anal. Chem., 2008, 81(7), 2765-2768. Angew. Chem. Int Ed., 2012, 51, 6648-6653.

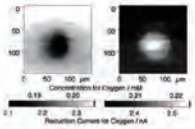


Electrochemical imaging of membrane protein

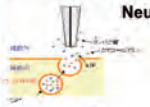


Imaging of respiration and photosynthesis activity

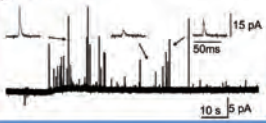
Anal. Chem., 1999, 71, 4637-4641.
Anal. Chem., 2001, 73, 3751-3759.
Anal. Chem., 2003; 75, 2154 - 2158.



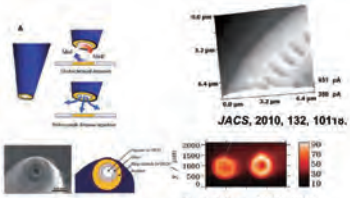
Neurotransmitter detection



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



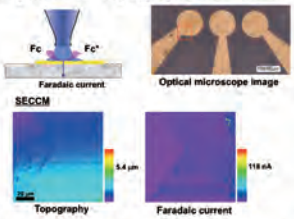
Localized Electrochemical measurement



JACS, 2010, 132, 10118.

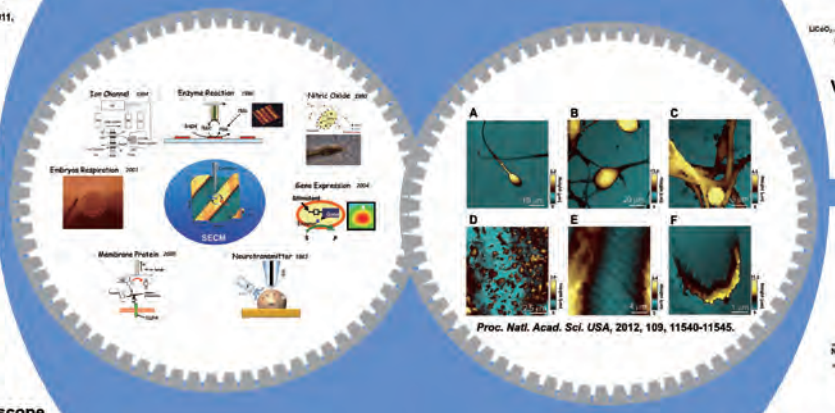
Anal. Chem., 2009, *81*, 5

Battery material Topography measurement



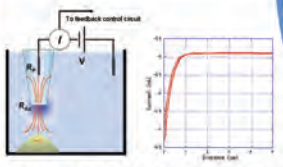
Visualized LCO Topography

Realization of localized electrochemical measurement using nanoelectrode

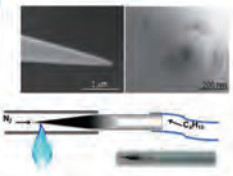


Proc. Natl. Acad. Sci. USA, 2012, 109, 11540-11545.

Scanning ion-conductance microscope



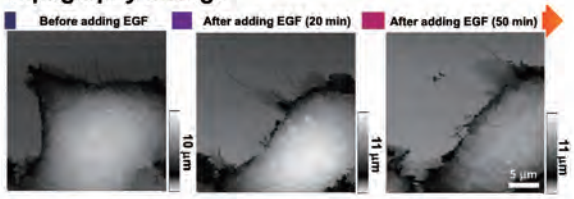
Phys. Chem. Chem. Phys., 2010, 12, 10012-17.



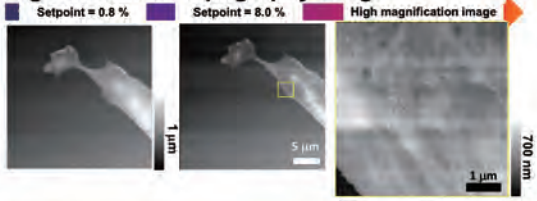
Fabrication of Carbon nanoelectrode

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

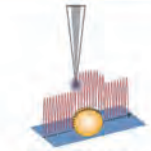
Topography change

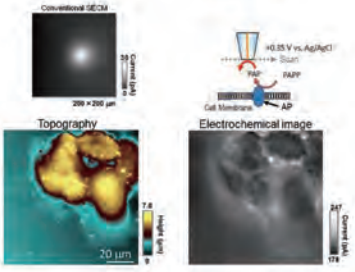


High resolution topography image



Living cell imaging using scanning ion-conductance microscope





Nano electrochemical imaging using carbon nanoelectrode

Development of Nano-Scanning Electrochemical Cell Microscopy for Analyzing Ion Transport in Lithium-ion Batteries

Advanced Institute for Materials Research, Tohoku University
Matsue Lab.

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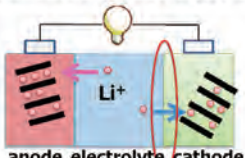
Motivation

Lithium-ion battery (LIBs)



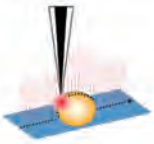
Toward High performance LIBs:

high output-voltage
and high capabilities

Key:

➢ high ionic transport at interface between electrode & electrolyte

Develop electrochemical microscope to understand ion transport at interface with nanometer resolution

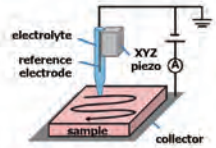


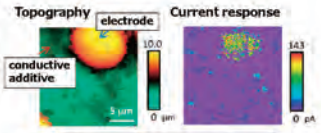
Key Technique

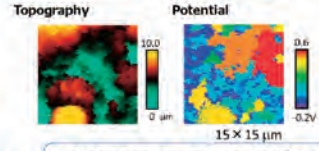
nanoSECCM (scanning electrochemical cell microscopy)

Y.Takahashi *et al.*, Nature Communications 5 5450 (2014).

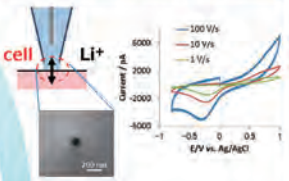
➢ Visualization of ion transport:
Topography and Electrochemical response







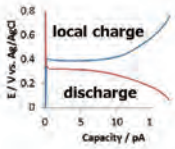
➢ Electrochemical measurement through a meniscus (cell)



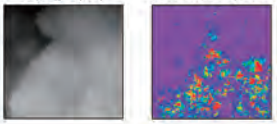
Realization of nano-scale imaging and local electrochemical measurement for lithium-ion batteries

nanoSECCM

Nanopipette



Topography　Current response

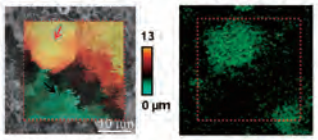


Practical Electrode

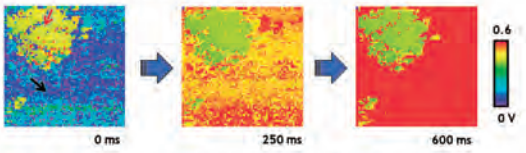
Composite electrode

$LiFePO_4$ + PVdF + acetylene black

SEM and Topography　EDS (oxygen)

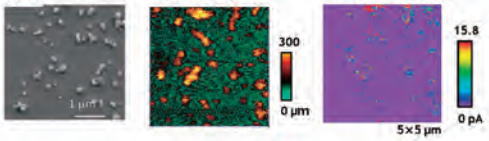


Potential Images during discharge state (above area)



Single particle measurement with nanometer resolution

SEM　Topography　Current response

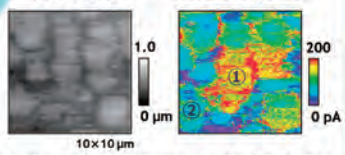


Model Electrode

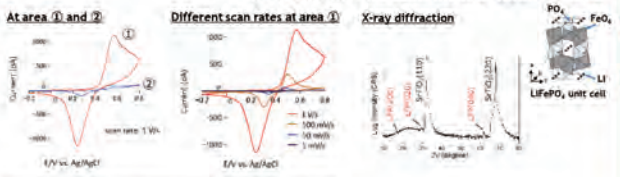
Thin films electrode

$LiFePO_4$ polycrystalline thin film

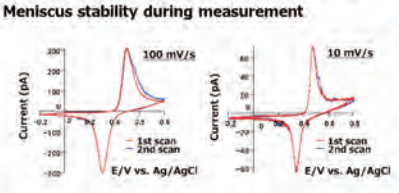
Topography　Current response



Electrochemical measurement at localized area



Meniscus stability during measurement



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).

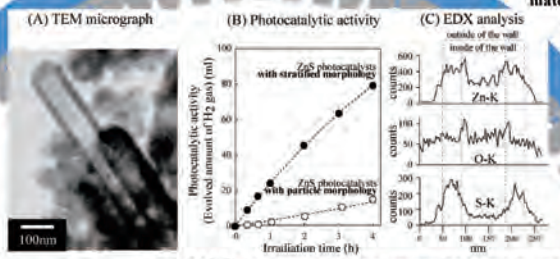

Fig.1 (A) TEM micrograph, (B) photocatalytic activity and (C) EDX analysis of stratified ZnS photocatalysts

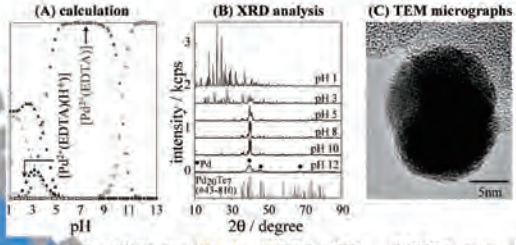

Fig.2 (A) Results of calculation for Na_2PdCl_4 - H_4EDTA system, (B) XRD analysis of synthesized materials and (C) HR-TEM micrographs of uniform and well crystallized $Pd_{20}Te_7$ alloy nanoparticles synthesized by obeying to this method

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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Progress Since the Great East Japan Earthquake and Future Prospects

Tohji Laboratory: Effective utilization of conversion EV and solar power generation

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

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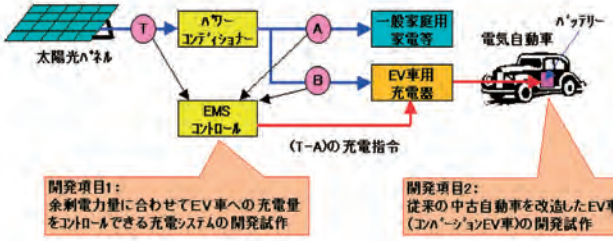
Objective

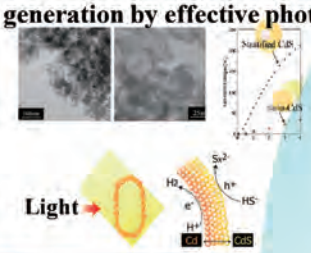
Conversion EV　Solar power generation

Concepts



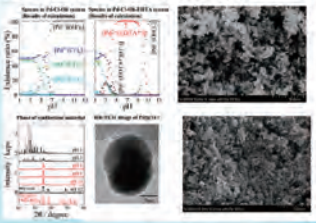
Combination between conversion EV and solar power generation

Material development ：Hydrogen generation by effective photocatalysts



Re-charging system of solar cell power generation

Material development ：Uniform and well crystalized solar cell material synthesis

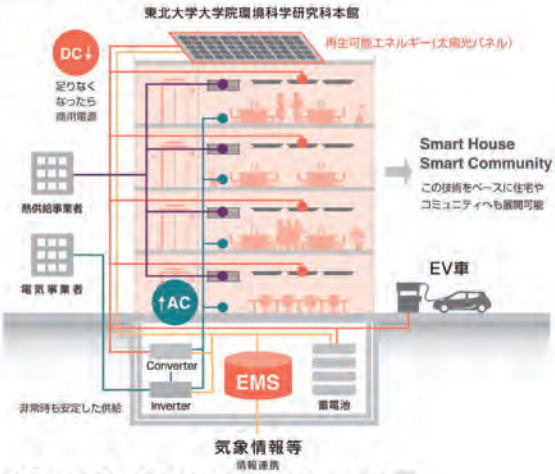


Contribution for low environmental impact and low energy consumption society

Expansion of car technology

DC/AC hybrid smart-building

Self-consumption system of solar cell generated electric power.



⇒Expand to the house and community
⇒Develop the energy to EV
⇒Upgrading the EV stand through
⇒Development the DC information appliance
⇒Expand to the control system of direct current appliance

Attractive design

Projection mapping for the rack of large scale Li-ion battery

Constitution for attraction

Multipurpose system for power feeding

DC outlet

Strategic Regional Innovation Support Program by MEXT "New Generation Automobiles / Miyagi Area"

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

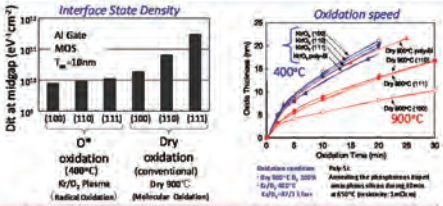
Nitridation : Nitride film formation on Silicon

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

Xe : Xenon
NH_3 : Ammonia
Si : Silicon

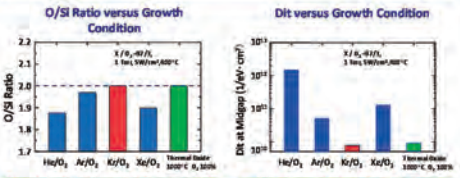
★The technology that the students study at the university becomes available on the practical production site.
★Very high integrity SiO_2 and Si_3N_4 can be formed on any crystal orientation silicon surface with the same formation speed.
★Very expensive gases (Kr, Xe) ⇒ Complete reuse and recycling system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

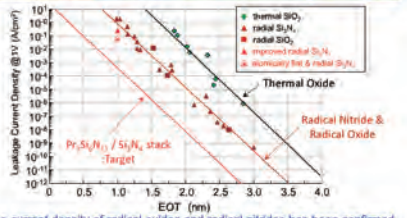


Complete Stoichiometric Structure SiO_2 for Kr/O_2

Very Low Interface Trap Density for Kr/O_2

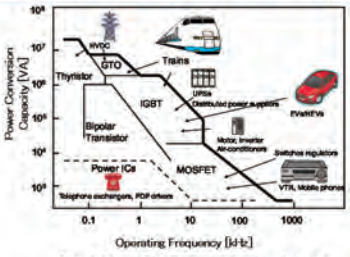
In Kr / O_2 gas combination, there generate O* radicals only while O_2^+ and O_2^- are generated in other gas combinations. O* radicals can move freely in oxide films even at low temperature such as 400°C, resulting in complete oxidation of Si.

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



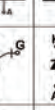
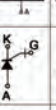
Leakage current density of radical oxides and radical nitrides has been confirmed to decrease down to less than 1/1,000 compared to that of thermal oxides. Integrity of $Pr_2Si_3N_{11}$(k=30) can be drastically improved by introducing new plasma equipment such as 915 MHz Metal Surfacewave Excitation Plasma (MSEP)

Application of Power Semiconductors

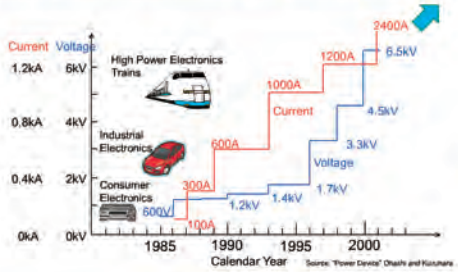


Used Area of Si Power Semiconductors

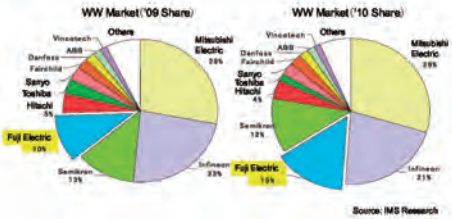
Structure and Electrical Properties of Major Power Semiconductors

	Diode	Cyristor	GTO	BJT	MOSFET	IGBT
Junction Structure						
Circuit Symbol						
Off-state voltage [V]	1.8	2.5	3.5	2.5(saturation)	5(0.1Ω)	2.5
Switching time [μs]	–	400	25	18	0.05	1
Rated voltage [V]	4000	4000	4500	1200	500	600~4500
Rated current [A]	1500	3000	3000	600	50	50~2400

Progress of IGBT toward High Voltage and Large Current

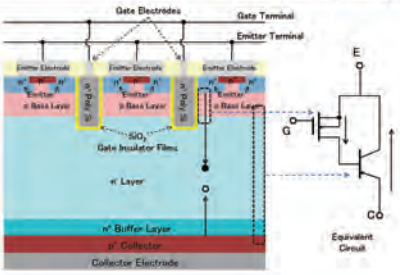


IGBT Market Share

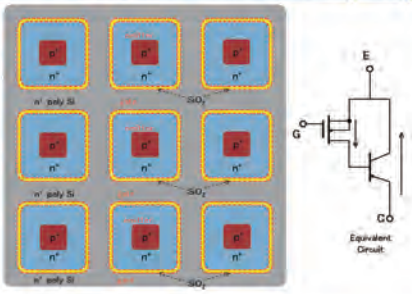


IGBT Products of Fuji Electric Co., Ltd.

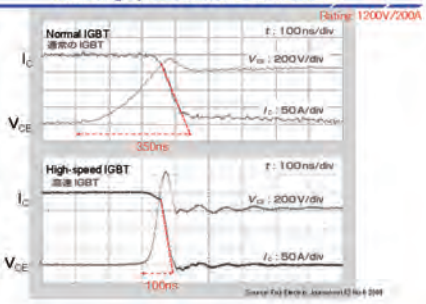
Cross-Section View of IGBT



Plane View of IGBT Emitter and Gate Electrodes



Switching Speed and Turn-off Waveform



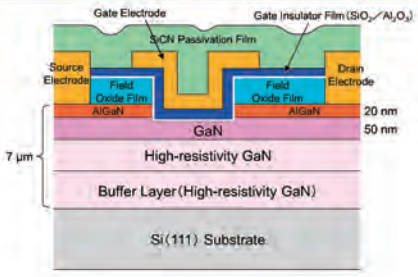
Physical Property of Si and Wide Band Gap Semiconductors

	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[cm²/V·s]	1350	900	370	1000	1200
Breakdown field[10^6V/cm]	0.3	1.2	2.4	3.0	3.3
Electron saturation velocity[10^7cm/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

Progress Since the Great East Japan Earthquake and Future Prospects

Measures for the Great East Japan Earthquake

New Industry Creation Hatchery Center, Tohoku University
FFF : Fluctuation Free Facility

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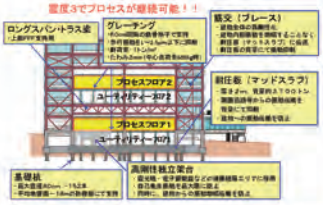
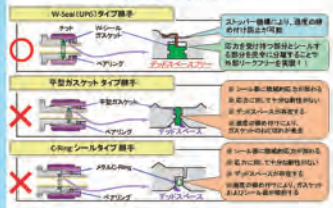
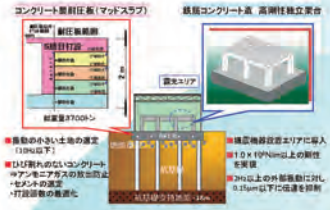
Measures for Earthquake

NICHe, Tohoku University
Fluctuation Free Facility

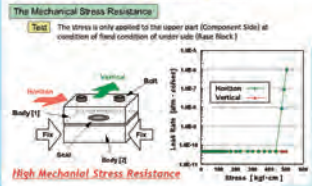


Structure of Joints

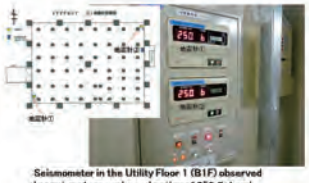




Leakage Rate and External Stress



Just After the Earthquake

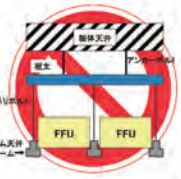


Seismometer in the Utility Floor 1 (B1F) observed largest peak ground acceleration of 250 Gal and seismic intensity of 6.
(The largest peak ground acceleration was saturated at 250 Gal.)

Falling of FFU(Fan Filter Unit)

FFU(Fan Filter Unit) were fallen down.
FFU must be fixed firmly to the ceiling frame and neighboring FFU.

Conventional FFU is just putting on the ceiling frame and not fixed firmly.



Removal of Galvalume Steel Sheets

The Galvalume steel sheet are used at the wall surface. They are screwed on the clean cross boards. The boards were cracked by the earthquake vibration and the Galvalume steel sheet were removed from the wall.

Break of Table Levelness Adjust Leg

Table levelness adjust leg is vulnerable to the earthquake vibration. There were many legs broken. It is necessary to use metal fittings to measure the vibration.

FFF

(Fluctuation Free Facility)

Optimal Cleanroom for Semiconductor Manufacturing

Completely controlled are parameters influence device characteristics.

Innovative infrastructure and utility are combined for comprehensive semiconductor researches.

Recovery

Damages in the Office

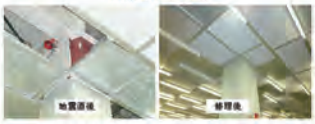
Damages were Minimized by the Measures against Earthquake

Providing is preventing.

Exhaust Duct

Exhaust duct was broken by the seismic vibration

FFU(Fan Filter Unit)



Summary of the Damages of the Fluctuation Free Facility

- No Cracks in the Building and Mat Slab
- No Collapses of the Semiconductor Manufacturing Equipment
  ← Since they are bolted to steel frame
- No Leakage at the Gas Supply System
  ← By completely introducing the W-seal joint

Recovery Records of the Fluctuation Free Facility

Earthquake	3/11
Stopped Electricity, Water, and Gas Services	
Recover Electricity	3/18
Recover Positive Pressure (+18Pa)	3/19
Recover Water Service	3/21
Recover Primary Pure Water Equipment	4/5
Recover Gas Service, Start Boiler Operation	4/13
Recover Secondary Pure Water Equipment	5/12
Recover Normal Operation	5/19

Prospects

Vibration | Power and Electric Magnetic Noise | Low Power, Low Energy | Organic Matter | Recycle and Reuse

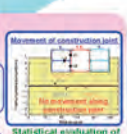
Ambience in which remaining factors for fluctuation in clean room are controlled more effectively.

The institution which concentrated the innovative infrastructure utility technology of doing synthetic research of a design, a device process, equipment, material, and measurement technology.

Crack Prevention for Mat Slab Concrete

Application of Expansive Concrete
Combination of low-heat Portland cement and high-grade expansion admixture reduces shrinkage by effective expansion at early stage of concrete hardening.

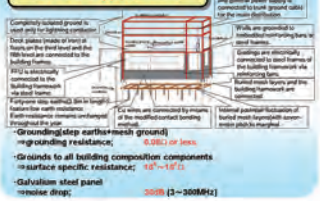
Casting mat slab with shrinkage-type concrete and expansion-type concrete alternatively enlarged effective surface area at construction joints.
Realizes Mat Slab Concrete without Crack



Statistical evaluation of cracking by actual measurement

Future risk of cracking is within allowable range.

Ground to Reduce Fluctuation of Power Supply Potential



-Grounding(Deep earths+mesh ground)
⇒grounding resistance; 0.08Ω or less
-Grounds to all building composition components
⇒surface specific resistance; 10⁷~10⁸Ω
-Galvalum steel panel
⇒noise drop; 30dB (3~300MHz)

Counter Measure for Fire

Detect fire and refuge in early stages by providing super high sensitivity smoke detector.

Concept

Current fire fighting law and restrictions may need to be modified.

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

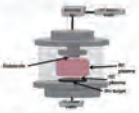
Institute of Fluid Science, Tohoku University
Takagi・Kosukegawa Laboratory / Uchimoto Laboratory / Miki Laboratory
Email: web-asel@wert.ifs.tohoku.ac.jp URL: http://www.ifs.tohoku.ac.jp/asel/

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

Development of functional thin film containing nanoclaster metals

Development of technique of mixing nanoclaster metals

To develop the apparatus for fabricating materials utilizing plasma process



Conceptual diagram of fabricating film

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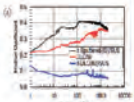
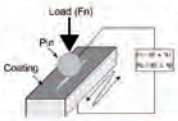
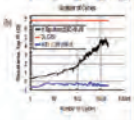
The technique, which makes contact to the object which moves without preventing a motion, is one of the required technique for a motor, a switch, etc.







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Development of thin film fatigue sensor

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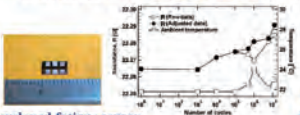

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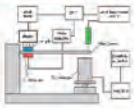
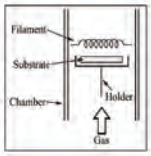


Conceptual diagram of fatigue testing

Development of low friction / low wear diamond coating

Fabrication of "polishable" diamond film

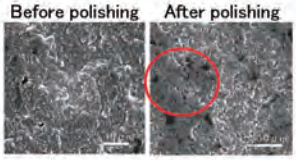
Fabrication of diamond film by utilizing hot filament chemical vapor deposition method



Rubbing both films

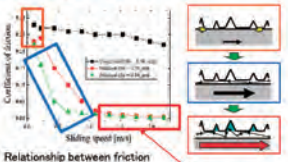
Materials: hydrocarbon gas, hydrogen gas

Before polishing After polishing



Polished diamond film has partially flat surface.

Friction velocity dependence



Relationship between friction coefficient and velocity

Super low friction !

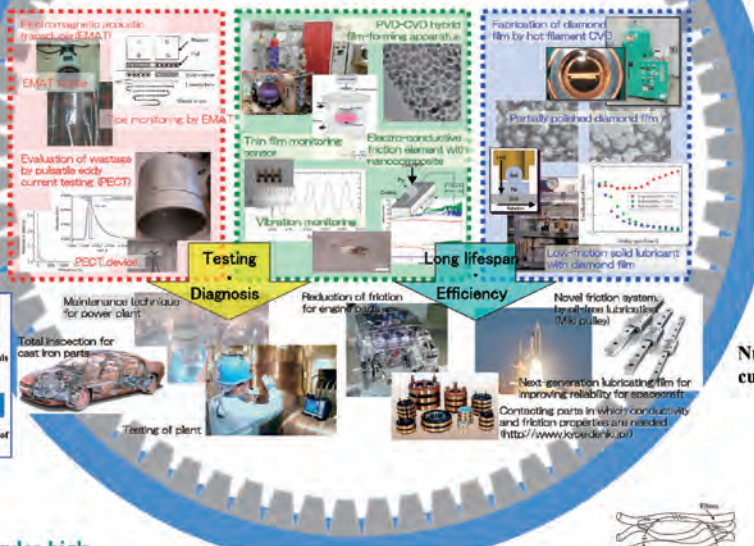
Perspectives

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.

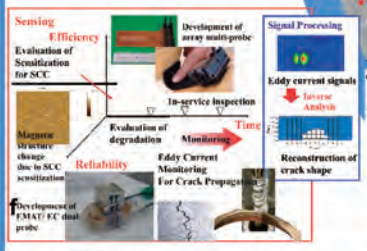
Linear motion bearing prototype

Laboratory Challenges

Safety and relief by diagnosis
Energy saving by low frictional lubrication

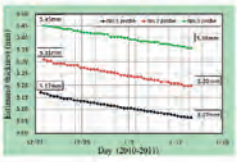


Research activities of non-destructive evaluation



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

Probe installed on pipes

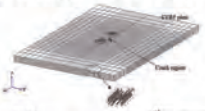


- Possible to evaluate thickness under high temperature condition at 165°C
- Error of measurement of thickness is the order of 10 μm

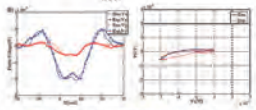
Non-destructive inspection of CFRP by utilizing electromagnetic phenomena

CFRP: Carbon fiber reinforced plastic

Numerical simulation of eddy current signal in CFRP by FEM



Eddy current path in CFRP



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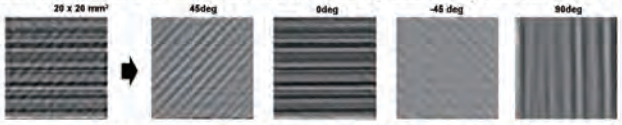

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3rd Consortium of CFRP lecture(H27.7.9)

Contact address for consortium of CFRP: cfrp-ken@mit.pref.miyagi.jp

Equipment of lab

Analysis & Evaluation

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

Material process

- Fabrication apparatus for diamond
- Fabrication apparatus for diamond-like-carbon
- Electrical furnace
- Fiber reinforced plastic apparatus (PCM, VaRTM)
- Single-axis kneading extruder

Non-destructive evaluation

- Ultrasonic inspection
- Eddy current inspection
- Pulse eddy current inspection
- Electromagnetic acoustic resonance

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

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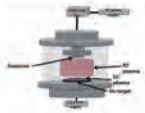

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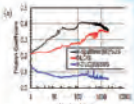

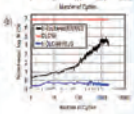

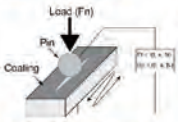

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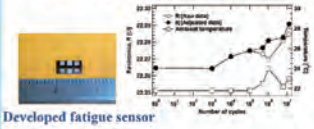

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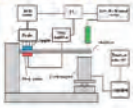

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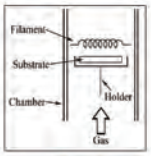
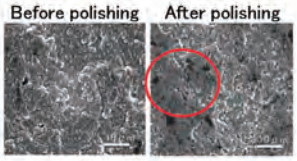


Materials: hydrocarbon gas, hydrogen gas

Rubbing both films

Before polishing After polishing



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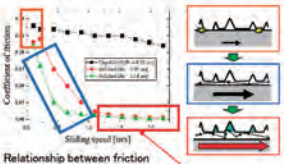

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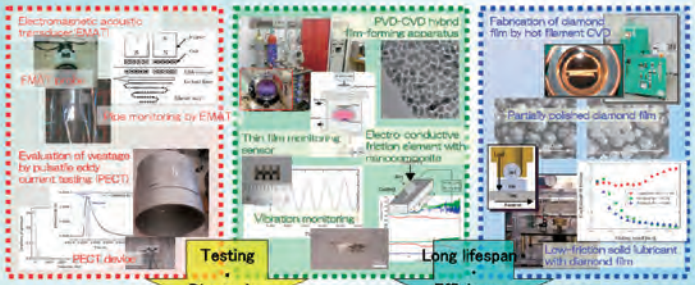


Maintenance technique for power plant

Total inspection for cast iron carbs

Testing of plant

Reduction of friction for engine

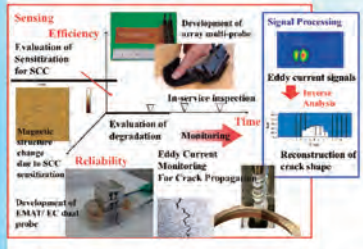
Novel friction system by oil-free lubrication (Mid pulley)

Next-generation lubricating film for improving reliability for spacecraft

Contacting parts in which conductivity and friction properties are needed (=http://www.kyoeidenki.jp/)

New Industries in Tohoku Region for Reconstruction from the Earthquake

Research activities of non-destructive evaluation



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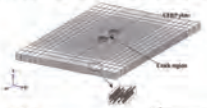

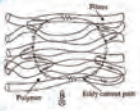

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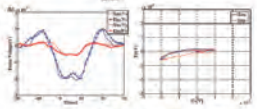

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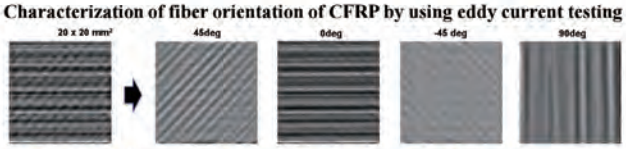

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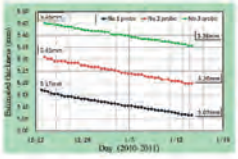

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Manufacturing industry based on science and technology to establish a safe and secure society

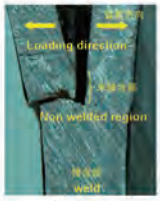
Shoji Project
New Industry Creation Hatchery Center, Tohoku University

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)

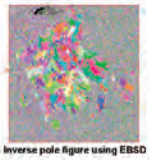
Crack path
(surface after removable of copper plate)

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

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

Crack path after fatigue test and strain measurement using copper plate


Analysis region on copperplate


Inverse pole figure using EBSD

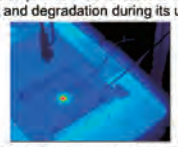
Estimation of strain amplitude and its distribution

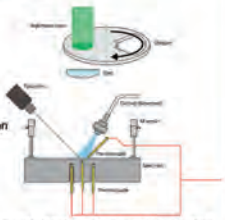
Estimation of stress amplitude in nugget is possible during cumulative fatigue damage

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

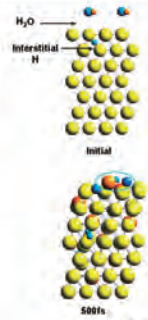
Illusidation of surface・interface phenomena
Aging degradation and damage during manufacturing process
Casting・molding technology, ultra high precision machining technology

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

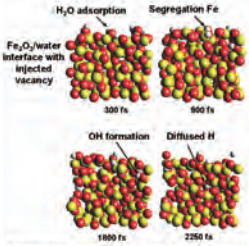


Dissociation of water and subsequent penetration of negative charged hydrogen atom into Fe-Cr binary alloy

・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

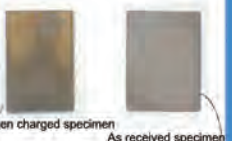
Degradation of structural material exposed to severe environments, especially for high temperature water is investigated through
- international cooperative researches
- development of instrumentation and measurement system for operating plant
- development of advanced analysis technique

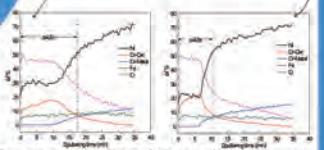


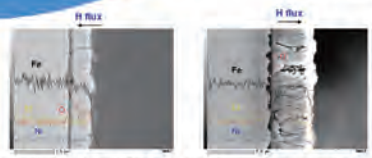
Accelerated dissolution of iron by water dissociation and hydrogen atom penetration at iron oxide and water interface


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.

Supports for industry by human resource development programs and research equipments

Shoji Laboratory, New Industry Creation Hatchery Center (NICHe), Tohoku University

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Human resource development programs

Human resource development programs by academic lectures, research & technical supports are performed for industrial research and development.

Case1.「Materials reliability evaluation in various environments」

For material manufacturer, automotive company, electronic part manufacturer, etc.

Academic lectures, research & technical supports concerning following subjects were provided for materials reliability evaluation in various environments such as high temperatures, corrosion environment, etc.

- Material & Fracture mechanics
- Material Science
- Fractography
- Fatigue, Creep Failure
- Hydrogen Embrittlement
- Stress Corrosion Cracking
- High-temperature Oxidation & Corrosion

Case2.「Surface observation & analysis」

For materials manufacturer, electronic parts manufacturer

We provided technical supports on surface observation and analysis techniques which are essential for material evaluation in terms of principles, practical techniques and data analysis.

- Scanning Electron Microscopy
- Electron Back-scattered Diffraction (EBSD)
- Energy Dispersive X-ray Spectroscopy
- Auger Electron Spectroscopy
- X-ray Photoelectron Spectroscopy
- Time of Flight Secondary Ion Mass Spectroscopy
- Raman Spectroscopy
- Glow Discharge Optical Emission Spectroscopy

Glow discharge optical emission spectroscope

Time of flight secondary ion mass spectroscope

Case3.「Thermal spray techniques & surface modification」

For energy equipments manufacturer

Technical supports on thermal spray techniques (plasma spray, cold spray, etc.) were performed in terms of principles, technical features and surface modification.

Cold spray system

Future Prospects

"Contribution to industrial R&D"

We continuously contribute to industrial R&D especially in Tohoku region by human resource development and sharing of research equipments.

"Long-term reliability assessments of structural components"

We aim to establish a safety and reliable society by development of prediction technologies for latent risks of failure and fracture of infrastructures or energy conversion systems.

"New materials development for extreme environment"

Development of extreme environments resistant new materials is conducted to enhance safety and reliability in environment of high temperature, corrosion, hydrogen etc.

Research equipments

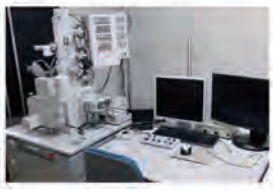
Research equipments in our laboratory are shared with industry, and used for industrial research and development.

Shared equipments

1. Optical microscope
2. Polishing machines for metallographic observation.
3. Auger Electron Spectroscope (AES) with slow strain rate test (SSRT) system (Ulvac-Phi: SAM680)
4. Scanning X-ray Photoelectron Spectroscope (XPS) (Ulvac-Phi: Quantum 2000)
5. Scanning Electron Microscope (SEM) with electron back-scattered diffraction (EBSD) system (Hitachi High-Tech: SU-70, S-3400, IM-4000)

Auger Electron Spectroscope with SSRT system

Scanning X-ray Photoelectron Spectroscope



Scanning Electron Microscope with EBSD system

Cases

- Surface analysis of oxide film on heat-treated parts (Optical microscope, XPS)
- Trial preparation of specimens of electronic parts for EBSD analysis (Polishing machines, SEM)
- Observation and surface analysis for fatigue fracture surface of machine elements (SEM, XPS)
- SSRT and surface analysis of fracture surface for welded components (AES)

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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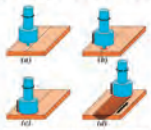
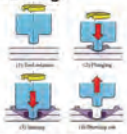
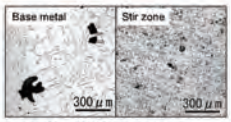
Fundamental study on FSW and FSSW

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

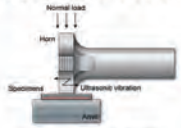


Application of FSW into cast alloys
Elimination of cast defects
Homogenization of microstructure
Enhancement of toughness and fatigue strength

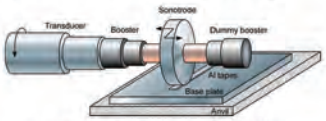
Al/Fe dissimilar FSSW
Multi-material structure

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

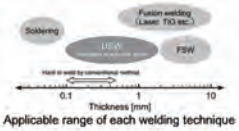


Ultrasonic Welding (USW)

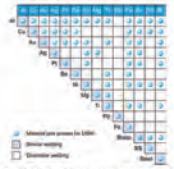


Ultrasonic Additive Manufacturing (UAM)

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



Applicable range of each welding technique

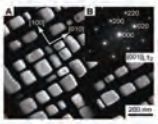

Dissimilar ultrasonic weldabilities

Novel joining technology and joining mechanism

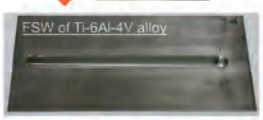
Development of sound joint by novel joining technologies in poorly weldable materials and understanding of joining mechanism and phenomena

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

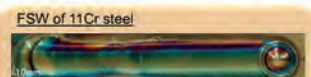

High stiffness FSW machine in Tohoku Univ.



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



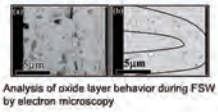

No damage after FSW
✓ Al alloy like surface quality
✓ Excellent joint properties

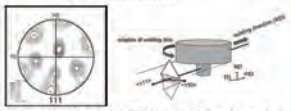


FSW in dual phase range
✓ 1.8 times as strong as base metal
✓ Higher ductility than base metal

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

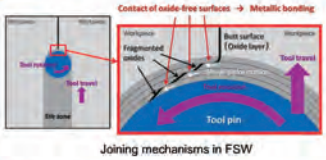
High grade joining of steels and Ti alloys


Analysis of oxide layer behavior during FSW by electron microscopy

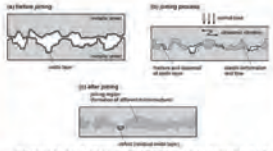

Understanding of materials flow during FSW by crystallographic analysis

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!!

Development of innovative joining technology

Kokawa laboratory

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Situation after the earthquake

Our main building including Kokawa laboratory was destroyed by the great east Japan earthquake and new building was established in 2014.

Strewn books and office furniture

Fallen tensile strength test machine

Cracked wall at experimental room

Cracked wall of building

Broken post

Collapse of ceiling

Vision for the future

Our research group attempts to enhance the performance and reliability of the joints through understanding of the mechanism and fundamental phenomena during welding and joining processes based on the materials science.

1. Improvement of FSW joint and prediction

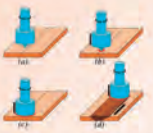
- Microstructural evolution during FSW
- Relationship between microstructure and joint properties
- Quantitative measurement of heat input

2. Practical application of FSW in steels and Ti alloys

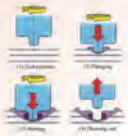
- Development of low price and high performance tools
- Application to FSW and clarification of related phenomena

3. Expansion to dissimilar welding

- Application to FSW and USW
- Clarification of metallurgical phenomena at the joint interface



Friction Stir Welding (FSW)



Friction Stir Spot Welding (FSSW)

Friction stir welding (FSW)
Seam joining by solid state stirring of inconsumable rotating tool

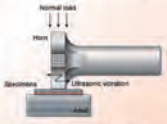
Friction stir spot welding (FSSW)
Spot joining that utilizes friction stir welding

Novel joining technology and joining mechanism

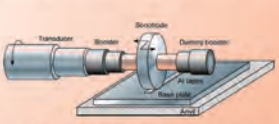
Ultrasonic welding (USW)
Solid state joining technique using ultrasonic energy

Ultrasonic additive manufacturing (UAM)
Additive manufacturing that utilizes ultrasonic seam welding

FSW and USW machines of Kokawa laboratory

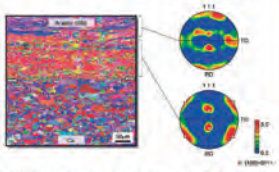


Ultrasonic Welding (USW)



Ultrasonic Additive Manufacturing (UAM)

Microstructural evolution in USW of Al alloy to Cu

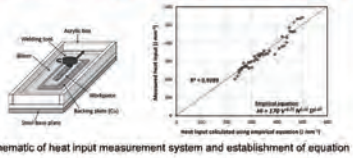


Microstructure around the joint interface between Al alloy Cu in USW

Establishment of heat input equation for FSW

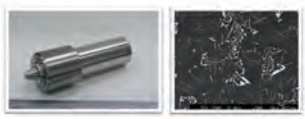
Heat input equation

$$HI = 170V^{-0.75}N^{0.10}D^{0.47}$$

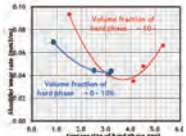


Schematic of heat input measurement system and establishment of equation

Development Co based alloy tool for FSW of steels and Ti alloys

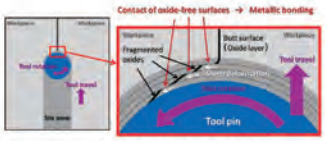


Co based alloy tool in the market and its microstructure

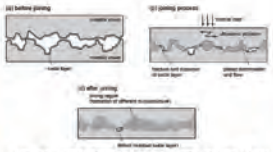


Evaluation of tool performance

Our research group focuses on friction stir welding and ultrasonic welding as solid-state welding processes for the structural materials with poor fusion-weldability and dissimilar combination of the materials.



Joining mechanisms in FSW



Physical and chemical phenomena during USW

Woks after the earthquake

Development after the earthquake

Prof.
H. Kokawa

Assoc. Prof.
Y.S. Sato

Assist. Prof.
H.T. Fujii

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Tel: +81-795-7353
URL: http://www.material.tohoku.ac.jp/~setsugo/lab.html

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

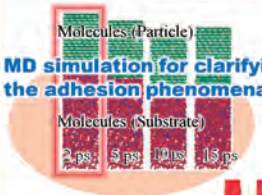
Vacuum-free/Room-temperature process — High deposition rate

Advantages of Powder Jet Deposition (PJD)

Widely applicable technique to various materials

Double Nozzle PJD Device

SPH Simulation for clarifying the phenomena during collision



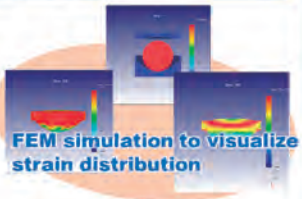
MD simulation for clarifying the adhesion phenomena

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

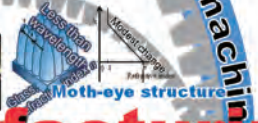
Development of Aspherical Glass Mold Press Equipment



FEM simulation to visualize strain distribution

Profile analysis for nonisothermal molding press

Aspherical Molding Die Fabricated by Precision Grinding



Powder jet machining — Glass mold press — Laser machining — Nano precision cutting — Ultrasonic machining

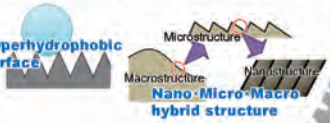
"Safety, Security, Comfort and Energy-saving" Elements for Next Generation Automobiles

Devices Installed in Next Generation Automobiles

High Value Manufacturing

Form + Function

Functional surface



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

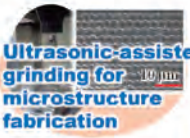
To realize
- ✓To shorten machining time
- ✓To stabilize machining precision
- ✓To deburr and mirror-finish
- ✓To improve form accuracy

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

Laser Microstructure Fabrication

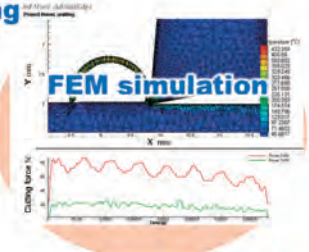
Ultrasonic Electrolytic grinding

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

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

Design, Creation and Manufacturing for Sustainable and Sucure Future

Tohoku University Nano-Precision Mechanical Fabrication/ Bio-Medical Interface Fabrication Lab
Kuriyagawa, Shimada & Xu Lab./ Mizutani Lab.

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Advanced Technologies

Ultra-precision mechanical machining

Ultra-fine structure

As the quick development of functionalization and minimization of industrial components, machining accuracy becomes more important. Research in our laboratory focuses on improving the machining accuracy for both metal and other advanced materials.

Expect for improving machining accuracy, fabrication of micro/nanostructured surfaces on different materials are also being carried out in our lab. As you know, creating functional interfaces (e.g., antireflective or superhydrophobic surface) by modulating surface structures has attracted much attention worldwide.

Human-Friendly Concept

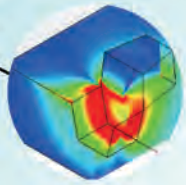
Engineering and Bioengineering

As the advances of technology, various industrial products have been created and used for improving qualities of our lives. The total security is highly required with the best performances.

We also focus on creating a more secure life for humans by applying machining technologies for medical treatment. Especially, we have developed a new powder deposition method for dental treatment, which is now not far from practical application.

Multiple and diverse human resource

Theoretical research with simulation



Human-friendly development

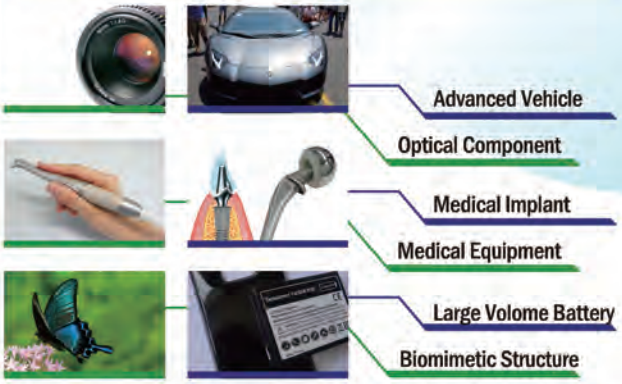
Realization of next generation vehicles

Advanced hybrid machining method

Development of sustainable technology

The Next Generation High Value Manufacturing

Open New Possibilities



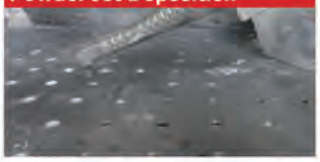
In recent years, fabrication of functional micro/nanostructured surfaces has attracted a lot of attention. The machining methods and the achievement of functional performances by modulating structural features are being intensively researched. Some functional surfaces have been practically applied like the retroreflective structured surface.

In our laboratory, we develop various new technologies to fabricate functional structured surfaces by considering the relation between functions and requirements of humans. We are progressing our research for creating a more sustainable and conformable society.

Leading Edge Facilities

Ultra-Precision Cutting

Powder Jet Deposition



Laser Micromachining

High-Precision Mesurement

High-resolution measuring equipment and ultraprecision machine tools have been well equipped in our lab, including 3D surface profiler, high-temperature nanoindentater, friction and wear tester, 5-axis cutting machine, laser machine and ultrasonic machine. More importantly, we have accumulated rich knowledge and experience due to our long-term research of mechanical machining.

As a leading research team in the world, we are always challenging the cutting-edge technologies in mechanical engineering to solve problems and create value for society.

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

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

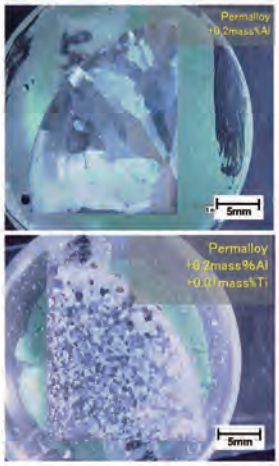
Center segregation in columnar structure

⇨ 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

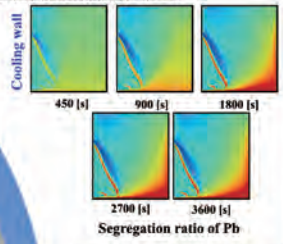
- With Computer Aided Optimization (CAO)
- Reproduction of segregation in ingot of Lab.

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 : Miwa Ohtomo
- DC Students : 2
- MC Students : 7
- BC Students : 6

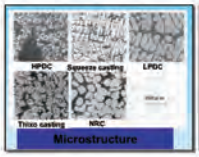
Semi-Solid Casting

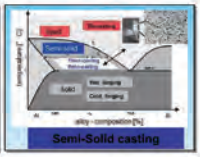
Target QI : 430
TS 280MPa
Elongation 10.0%

⇨

Performance QI:484
TS 305MPa
Elongation 15.6%

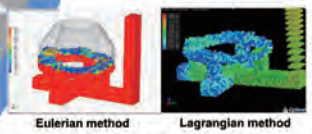
QI (Quality index) = TS (MPa) + 150 log(Elongation %)



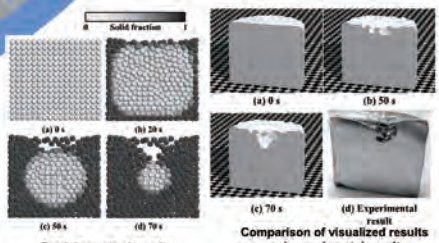


Advantage of Semi-Solid Die Casting
- Less gas entrapment
- Less residual gas
  - heat treatable & good weldability
- Higher mechanical property
- Higher shape precision and surface quality
- Low process temperature : longer die life

Innovative Casting CAE Technology



Ex.) Flow simulation



Particle method results

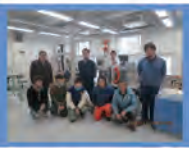
Comparison of visualized results and experimental result.

Numerical simulation of shrinkage behavior in a casting using particle method

Particle method (Lagrangian method)
- Movable computational element
- Coupling simulation : easier

⇔

Conventional method (Eulerian method)
- High calculation speed
- Fixed computational grid
  → Low flexibility of shape
- Interaction analysis: difficult



Progress Since the Great East Japan Earthquake and Future Prospects

Innovative Casting Technology

Graduate School of Engineering
Department of Metallurgy, ANZAI Lab.

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ADSTEFAN CASTING SOLUTION CENTER

We perform a integrated solution for various problems related to the casting process from a viewpoint of both "Software" and "Hardware". "ADSTEFAN Casting Solution Center" was established in the Graduate School of Engineering, Tohoku University, to enhance the collaboration with industries and universities.

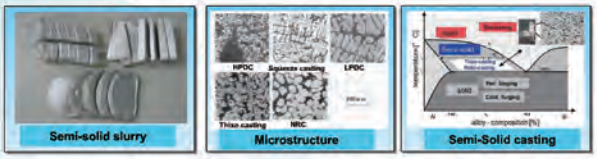
Opening ceremony of the center


Collaboration map

Casting Technology for Automobile Parts Manufacturing

Replacement of underbody parts

Light-weighted underbody parts will significantly improve the fuel efficiency. We are trying to replace from heavy iron-based products to light metals by low-cost & high-quality casting technology.



Development of Innovative Casting Technology for Making High Quality Automobile Parts

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

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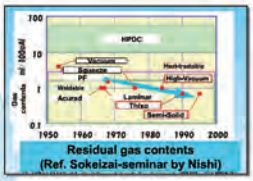
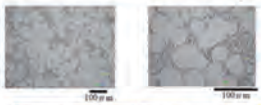


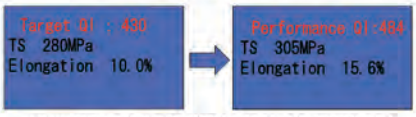
Residual gas contents (Ref. Sokeizai-seminar by Nishi)

Semi-Solid Casting



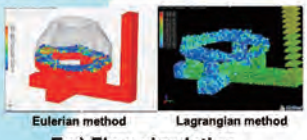
Parameters	Performance
Grain size of α-Al	50±10 μm
Eutectic Si size	2~3 μm
Tensile strength	280~290 MPa
Proof strength	190~200 MPa
Elongation	14~19 %
Impact value	63±5 J/cm²
Hardness Hv	82±2

Advantage of Semi-Solid Die Casting
- Less gas entrapment
- Less residual gas
  - heat treatable & good weldability
- Higher mechanical property
- Higher shape precision and surface quality
- Low process temperature : longer die life

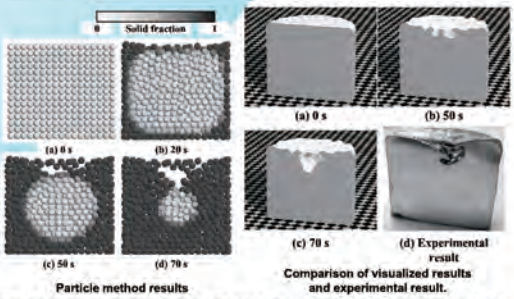


QI (Quality index) = TS (MPa) + 150 log(Elongation %)

Innovative Casting CAE Technology



Ex.) Flow simulation



Particle method results
Comparison of visualized results and experimental result.

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⟷

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

To foundries...

We, Anzai-Lab. members, have been trying with collaborators who assent the activity of Next Generation Automobiles to establish useful, effective and innovative casting technology with the mission of Tohoku University; 1: Education and development of human resources, 2: Progress of research and learning, 3: Contribution to society.

TOHOKU UNIVERSITY

Anzai Lab.

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

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

Introduction

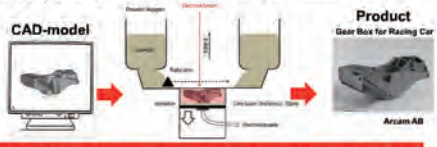
- **Inconel 718 Ni-based Superalloy**

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.

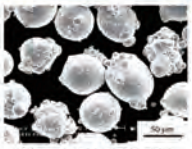
Experimental

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.

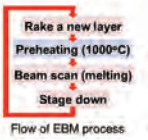
Particle size : 45~150 μm (74 μm ave.)



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

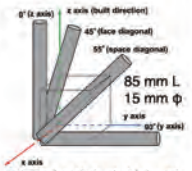
Solution treatment at 980°C for 1 h → Water quench (WQ) → 1st aging at 720°C for 8h → 2nd Aging at 620°C for 8h → WQ

Tensile test

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

Microstructure analysis

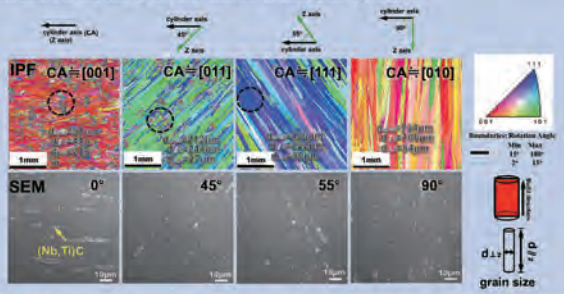
SEM-EBSD, EPMA



Schematics of of rods fabricated.

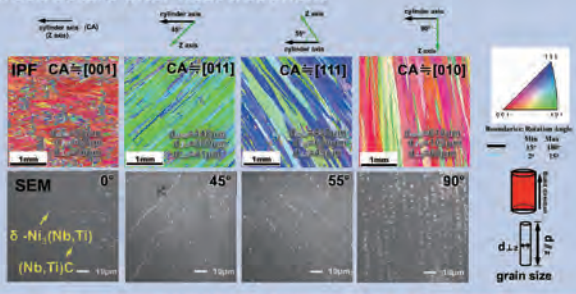
Results & Discussion

Microstructure of as-EBM-built samples



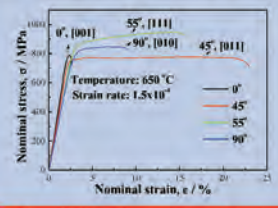
As-EBM-built rods are strongly cube-oriented in both the beam scanning direction and build-diretiaon.

Microstructure after heat treatment



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

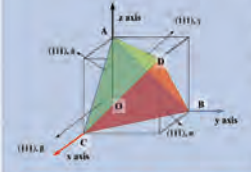
Effect of build-direction on tensile property



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[6]	1018	1140	3
Wrought[7]	860-1000	1000-1200	12-19

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

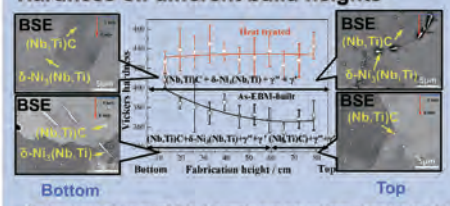


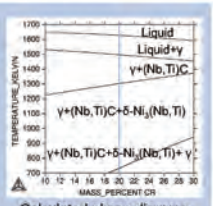
Schmid factor μ of perfect dislocation in {111}<110> slip system.

	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



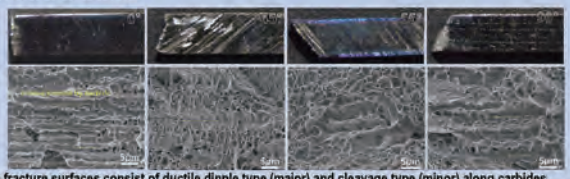


Calculated phase diagram.

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 55ºsample 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 0ºsample was not appropriate, and the unmelt particle lead to the low ductility.

Electron Beam Melting (EBM)

Deformation Processing Division (Chiba Laboratory)
Institute for Materials Research, Tohoku University

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Additive Manufacturing (AM) for Metals and Alloys

Machine

	Electron Beam	Laser
Powder Bed ・High Precession ・Small Size	Arcam EBM®	EOS DMLS® / MTT SLM® / Concept Laser DCM®
Deposition ・Low Precession ・Large Size	Sciaky EBF³®	Optomec LENS® / POM DMD®

[1] S. Aarnio, "RAPID PROTOTYPING," 2010. http://www3.hamk.fi/instnet/Documents/RAPID PROTOTYPING_COTTBUS_2010.pdf.
[2] K. M. B. Taminger and R. A. Hafley, "ELECTRON BEAM FREEFORM FABRICATION : A RAPID METAL DEPOSITION PROCESS," 2003.
[3] http://www.rpmandassociates.com/RPMILaserDepositionTechnologyAdvancesAdditiveManufacturingAndRepair.aspx

Application

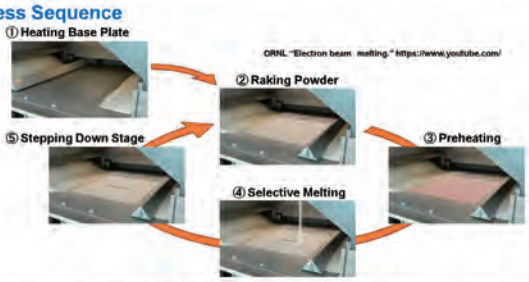
Biomedical, Aerospace, Automotive, etc.

http://www.arcam.com/

Objects Fabricated in Chiba Lab.
(Using ARCAM A2X)

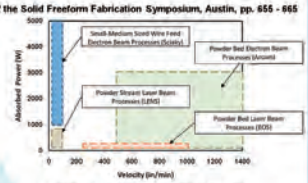
EBM Process Sequence and Its Process Window

Process Sequence



Process Window

J. Beuth *et al.*, 2014 Proceedings of the Solid Freeform Fabrication Symposium, Austin, pp. 655 - 665



Powder Bed Electron Beam Process
:Much wider range compared to laser types
Advantageous for controlling microstructure

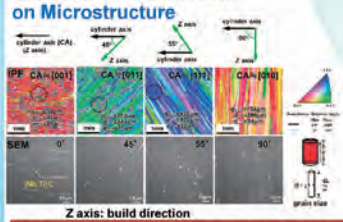
Parameters for controlling microstructure
- Beam Power
- Scan Speed
- Focus Offset (Beam Diameter)
- Line Offset
- Scan Sequence
- Preheating Temperature

etc.

IN718 Alloy Fabricated by EBM

Shihai Sun, PhD thesis, Tohoku University, 2015

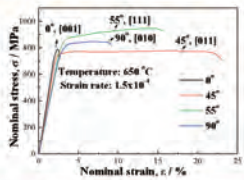
Effect of Build-Direction on Microstructure



Z axis: build direction

As-bulit rods are strongly cube-oriented in the build-direction.

Effect of Build-Direction on Mechanical Properties



Comparison of strength and elongation.

Sample	0.2% YS (MPa)	UTS (MPa)	Elongation %
0°	790	799	0.53
45°	756	783	20.8
55°	840	917	15.8
90°	787	852	6.4
HIP[4]	1018	1143	3
Wrought[5]	860-1000	1000-1200	12-19

[4] "SAE International, Aerospace Material Specification,AMS5662G," 1993.
[5] G. A. Rao, M. Kumar, M. Srinivas, and D. S. Sarma, *Materials Science and Engineering: A*, Vol. 355, pp. 114–125, Aug. 2003.

The strength of the rod built in diagonal direction (55° sample) is comparable to those of the wrought

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.

TRAFAM

Technology Research Association for Future Additive Manufacturing

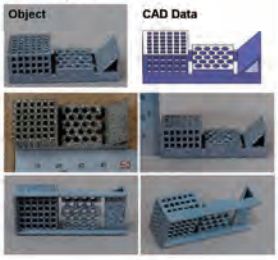
TRAFAM https://trafam.or.jp

Objective:
Development of Domestically-Produced 3D Printer for Metals and Alloys

Electron Beam Type (Powder Bed)

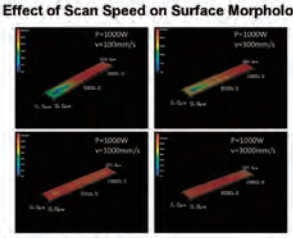
Maximum Building Size : □250 × H350 (mm)
Minimum Beam Diameter : 0.280 mm
Maximum Power : 9 kW

As-Built Objects

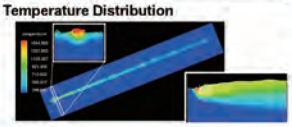


Simulation of Melt Pool

Effect of Scan Speed on Surface Morphology



Temperature Distribution



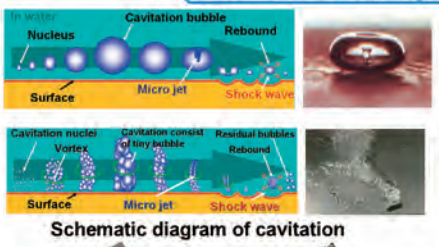
Strategic Regional Innovation Support Program by MEXT, Next Generation Automobiles / Miyagi Area

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

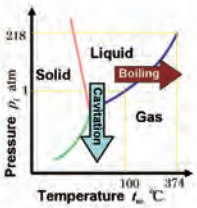
Hitoshi Soyama and Osamu Takakuwa, Tohoku University

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

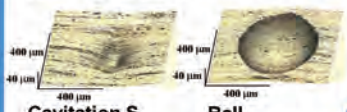
Cavitation S Peening®



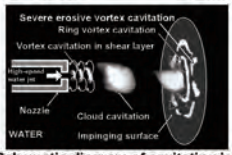
Schematic diagram of cavitation



Cavitation S Peening® | Shot peening

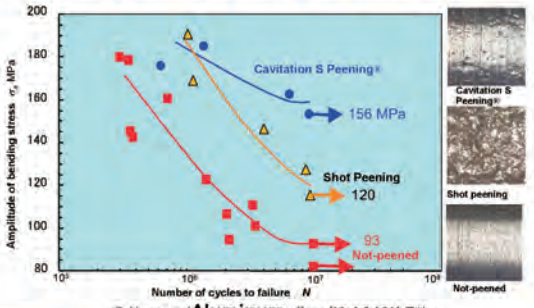


Cavitation S Peening® | Ball indentation

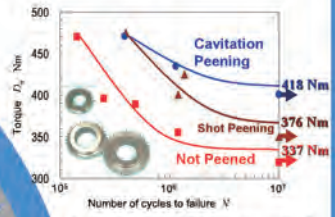


Schematic diagram of cavitating jet

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

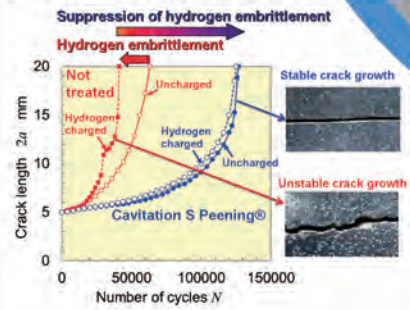
Cavitating jet in air

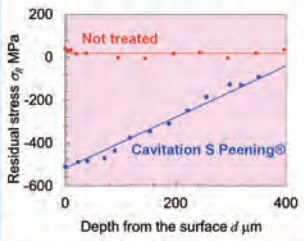
Suppression of Hydrogen Embrittlement

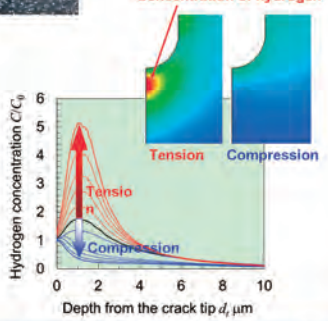
Introduction of compressive residual stress

⇒Suppression of hydrogen adoption

⇒Suppression of hydrogen embrittlement

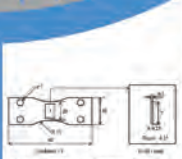




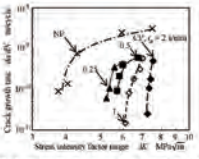


Evaluation of Materials Properties

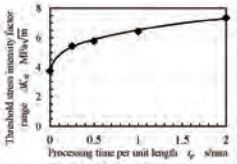
Load controlled plate bending fatigue test machine developed by Soyama Lab.



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.
H.Soyama et al., Peening by the Use of Cavitation Impacts for the Improvement of Fatigue Strength, *Journal of Materials Science Letters*, Vol.20, 2001, pp.1263-1265.
H.Soyama et al., Improvement of Fatigue Strength of Aluminum Alloy by Cavitation Shotless Peening, *Journal of Engineering Materials & Technology, Trans.ASME*, Vol.124, 2002, pp.135-139.
H.Soyama, High-speed Observation of Cavitating Jet in Air, *Journal of Fluids Engineering, Trans. ASME*, Vol. 127, 2005, pp.1095-1101.
H.Soyama et al., Improving the Fatigue Strength of the Elements of a Steel Belt for CVT by Cavitation Shotless Peening, *Journal of Materials Science*, Vol. 43, 2008, pp. 5028-5030.
H.Soyama and N.Yamada, Relieving Micro-Strain by Introducing Macro-Strain in a Polycrystalline Metal Surface by CSP, *Materials Letters*, Vol.62 , 2008, pp.3564-3566.
H.Soyama and Y.Sekine, *International Journal of Sustainable Engineering*, Vol. 3, No. 1, 2010, pp. 25-32.
H.Soyama et al., Introduction of Compressive Residual Stress into Stainless Steel by Employing a Cavitating Jet in Air, *Surface & Coatings Technology*, Vol. 205, 2011, pp. 3167-3174.
H.Soyama, Enhancing the Aggressive Intensity of a Cavitating Jet by Means of the Nozzle Outlet Geometry, *Journal of Fluids Engineering, Trans. ASME*, Vol. 133, 2011, pp.101301-1-11.
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.

Novel Developments of Cavitation Technology

Hitoshi Soyama, Tohoku University

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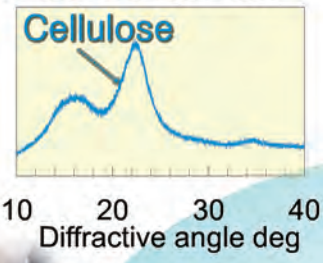
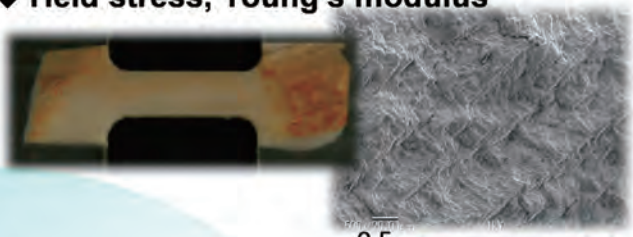
Manufacturing Cellulose Nano-Fiber

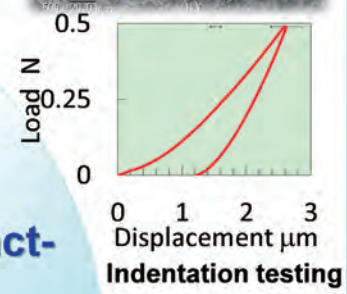
- ◆Nanofiber from inedible biomass
- ◆Dismantling Lignin by cavitation
- ◆Production of cellulose bioethanol



Manufacturing innovative material based on Biomineralization

- ◆Verification of Biomineralization
- ◆Mechanical properties of Biomineral
- ◆Yield stress, Young's modulus





Indentation testing

Cavitation Technology for Sustainable Scociety

-Reduction of environmental impact-

Hydrodynamic Cavitation

Next Generation × Cavitation Technology

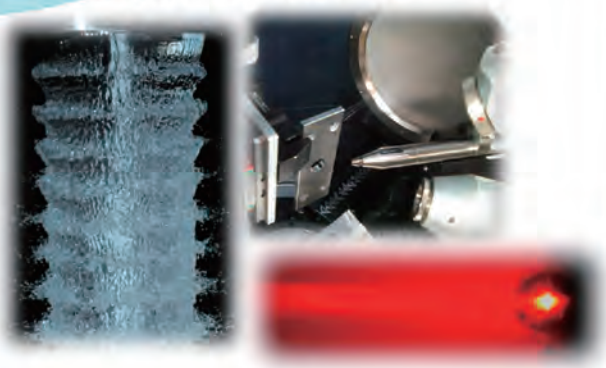
= Solution of Environmental Issues

3D-manufacturing of Magnetite by CW Laser

- ◆Structural manufacturing at MARS
- ◆Hematite to Magnetite and OXYGEN
- ◆Cooperative research with NASA Johnson Space Center

Sustainable Surface Modification

- ◆Forming high functional surface layer
- ◆Intelligent Sensing of the surface
- ◆Utilizing Laser Cavitation

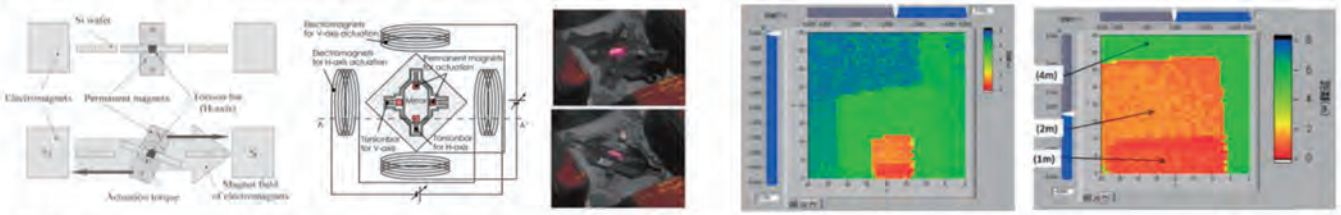


MEMS Based Safety Systems for Automotive

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

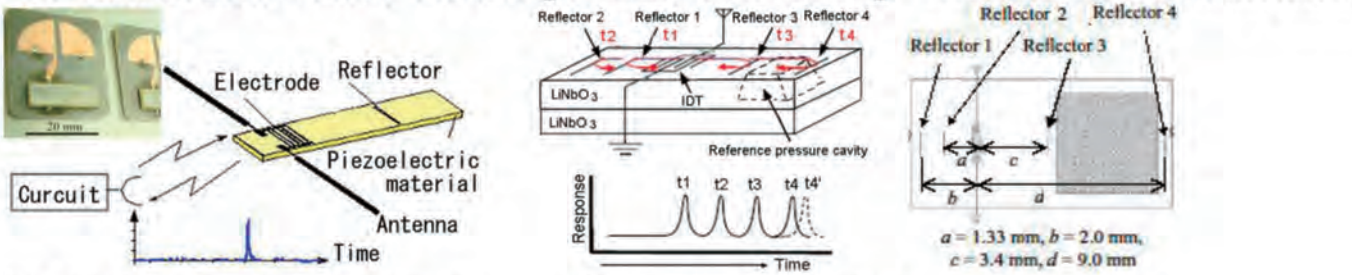
2. Range finder using LED pulse and image intensifier camera with shutter

(a) Principle (b) Experimental setup (c) Experimental result

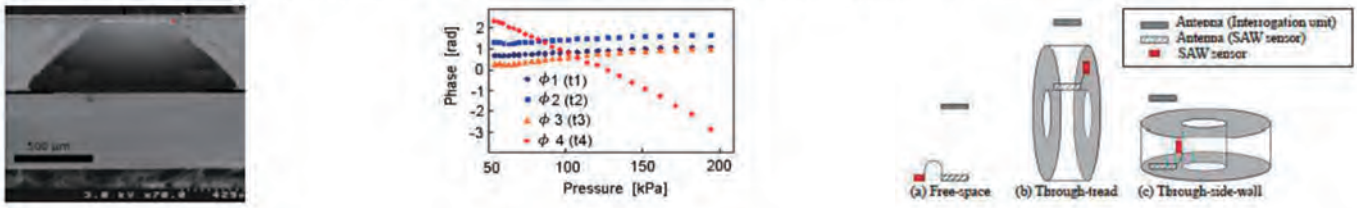
Y.Nakano, Y.Kawai, N.Ikegami and M.Esashi, Time-of-flight Range Finder Using LED Light Source, 2010 IEEJ Convention, Tokyo, (March 17-19, 2010) 1-116 p.132 (in Japanese)

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

MEMS (Micro Electro Mechanical Systems)

Micro System Integration Center μSIC, Tohoku Univ., Esashi Lab.

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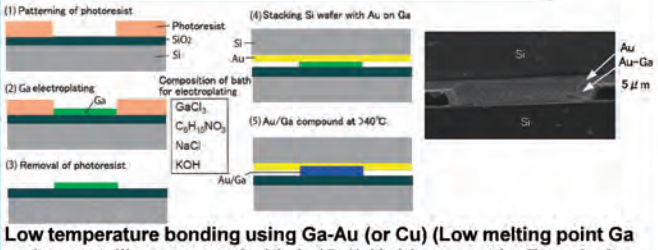
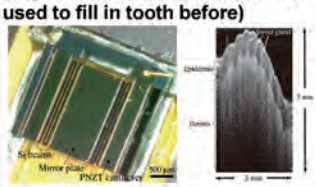
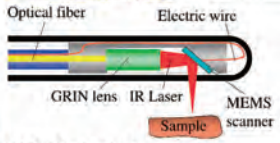
MEMS using new process and materials



Low temperature bonding using Ga-Au (or Cu) (Low melting point Ga makes metallic compound with Au(Cu)) (Achievement by Fraunhofer project center) (similar method to amalgam method (Hg + Cu powder) used to fill in tooth before)

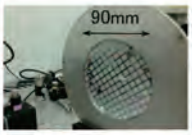


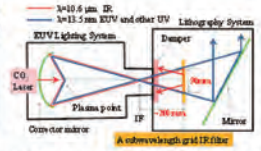
Optical scanner (left), Cross sectional image of finger tip (right)



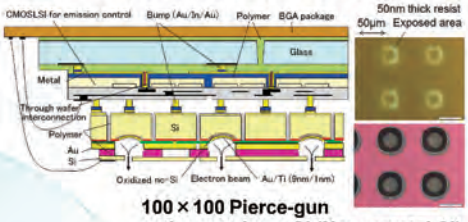
OCT (Optical Coherent Tomography) using PZT optical scanner (Collaboration with Fuji film Corp.)

MEMS for micro lithography





EUV pass ·IR cut filter for EUVL (Extreme Ultra Violet Lithography)

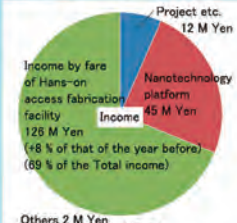


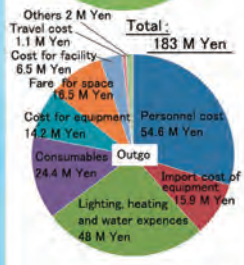
100×100 Pierce-gun active matrix nc-Si (Nanocrystal Si) electron source

Massive parallel electron beam exposure system for maskless lithography

Basics of MEMS
by M.Esashi
(Morikita shuppan, 2009)

Future MEMS - Fusion with LSI -
by M.Esashi and T.Ono
(Morikita shuppan, May, 2016)





Hands-on access fabrication facility to which companies dispatch employees to operate equipment for prototyping (more than 180 user companies)

Contribution for industrialization

Point contact transistor

Historical museum of technology
http://www.mu-sic.tohoku.ac.jp/museumE/index.html

Prime-minister award , Home security robot (Fukushima prefecture Koriyama-kita engineering high school), (winner of iCAN 2014)

"Anywhere Sadoh" (Tohoku Univ., Osaka Univ., Natural Science), (winner of iCAN 2015)

iCAN (International Contest of Application in Nano-Micro Technology)
http://www.rdceim.tohoku.ac.jp/iCAN15/

Training for well-motivated person

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

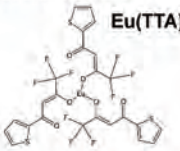
MEXT TOHOKU ECONOMIC FEDERATION Tohoku University 宮城県 七十七銀行 ICR

Temperature Sensitive Paint (TSP)

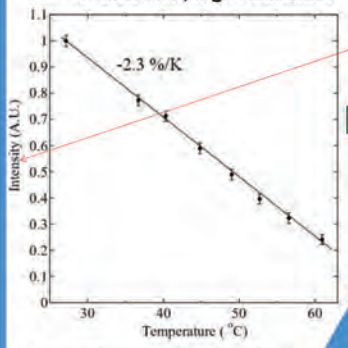
The Intensity of luminescence from the TSP is modulated by the temperature of TSP.

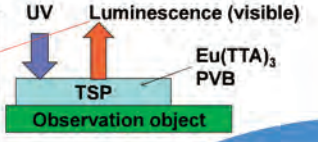
The TSP consists of $Eu(TTA)_3$ as a luminescent material and PVB as a matrix.

$Eu(TTA)_3$



A normal CCD/CMOS camera with microscope (without high-cost Ge optics)
→ Low cost, high resolution





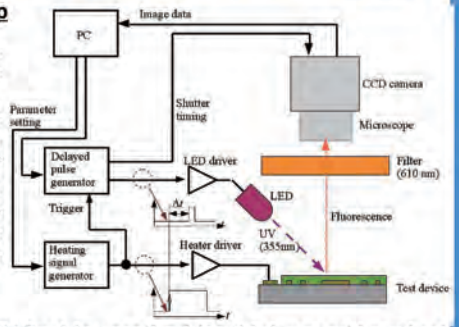
Temperature coefficient of intensity (TCI) from the TSP.

Temperature distribution → Optical image

High speed, and high resolution thermal imaging

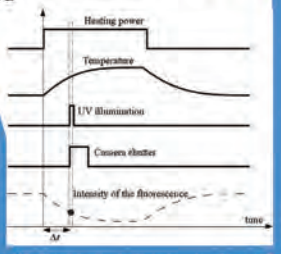
Experimental setup

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.



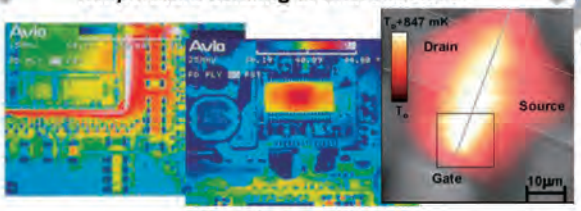
UV flashing method (for high speed imaging)

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

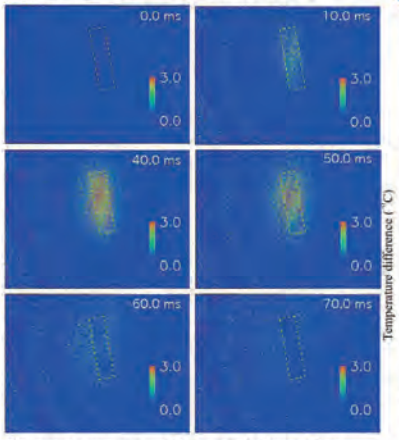
TSP is one of the candidates for the micro thermal imaging with high spatial, temporal and temperature resolutions

Obtained thermal images

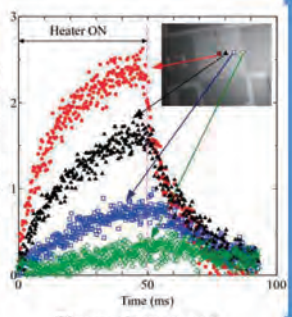
$$\Delta T(x,y) = S^{-1}\left(\frac{I(x,y)}{I_0(x,y)} - 1\right)$$

S : TCI
I : Luminescence
x, y : Address of the picture

Spatial resolution : 39 μm
Temporal resolution : 0.2 ms
Temperature flucsutaion : ±0.2°C



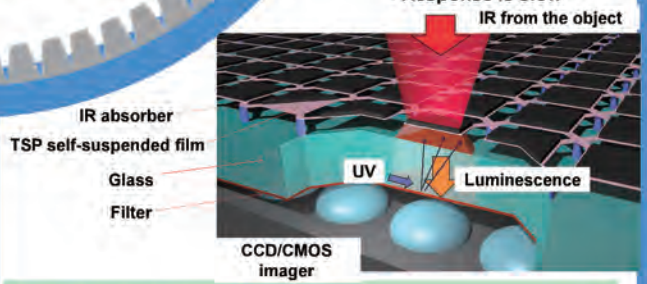
Thermal images at the each time step.



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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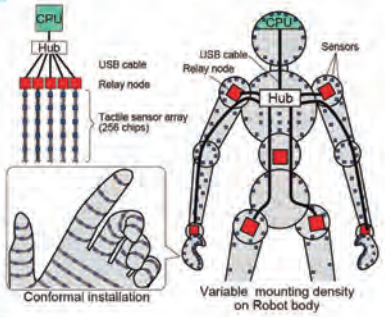
Progress Since the Great East Japan Earthquake and Future Prospects

MEMS devices for future life

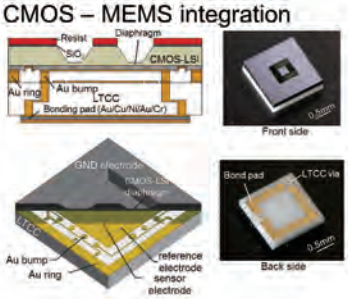
Takashiro Tsukamoto and Shuji Tanaka
Tohoku University

Tactile sensor network system for robot

Give a tactile sensation for robots using a lot of sensors.
→ Human – robot coexistence



CMOS – MEMS integration



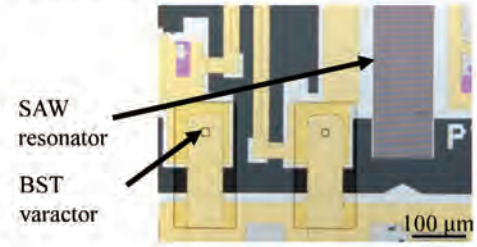
Each MEMS device has a signal processor (CMOS) for sensing and digital communication via shared bus.

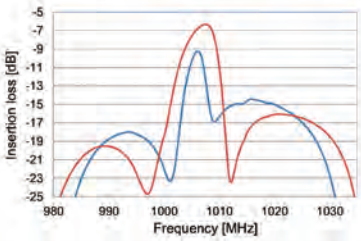
Shared bus system can reduces wirings
- Event driven data transmission
- Adaptive data transmission

→ Efficient data transfer using single bus line

Tunable filter for cognitive radio

Use white space of TV band
→Increase wireless data traffic
Tunable filter is essential for such a system.

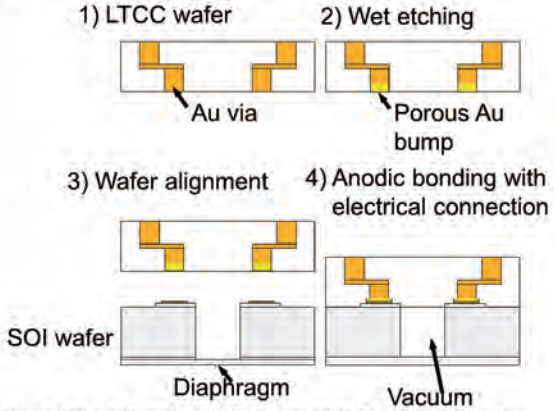




Band-width control using Laser assist transferred BST thin film.

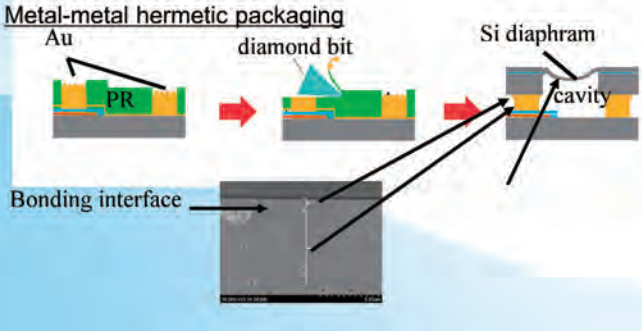
Hermetic packaging technology

Hermetic packaging using LTCC wafer



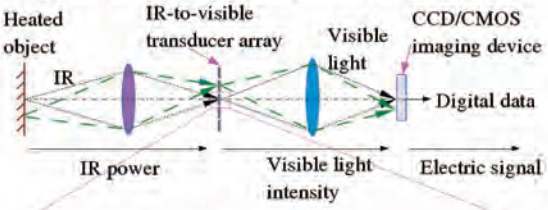
Harmetic packaging with electrical feedthrough is possible.

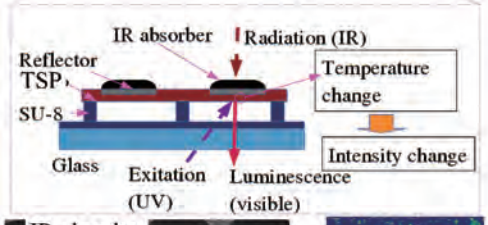
Metal-metal hermetic packaging

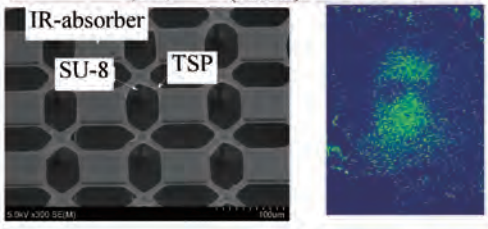


Far infrared detector

Infrared detector based on wavelength conversion
Using temperature sensitive paint (TSP)







Investigation of combustion phenomena, development of diagnostics and analysis method

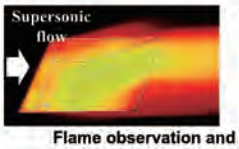
Institute of Fluid Science, Tohoku University
Kobayashi Hideaki & Hayakawa Laboratory

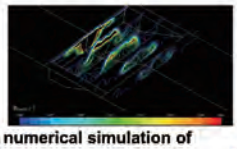
Supersonic Combustion

Researches on mixing, combustion and interaction of shock wave in supersonic flow are essential for the development of next-generation supersonic combustion engine. In our laboratory, planer laser induced fluorescence for OH (OH-PLIF) and numerical simulation are performed in order to investigate the effects of the incident shock wave on the mixing and combustion for cavity flame-holder and cavity flame-holder with a pylon.

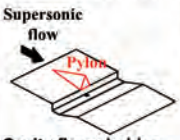
Hypersonic airplane (concept)

Schematic of scramjet engine

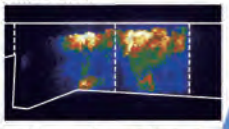




Flame observation and numerical simulation of supersonic combustion



Cavity flame holder with a pylon

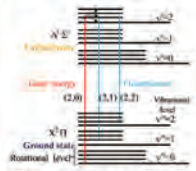


Flame observation by OH-PLIF

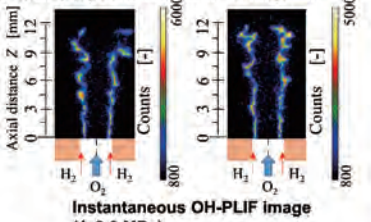
Laser diagnostics for rocket combustion

In a rocket engine, liquid hydrogen and liquid oxygen are used for fuel and oxidizer, respectively. The pressure and temperature inside of the rocket engine achieve higher than 10 MPa and 3000K. Although understanding of combustion phenomena in a rocket engine is required, measurement method for a rocket motor has not been developed because of extremely high pressure and high temperature.

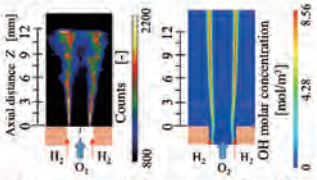
The purpose of this study is to develop of a laser diagnostics for rocket motor. At high pressure conditions, the influence of chemiluminescence from a flame on OH-PLIF images are significant. In order eliminate the influence of chemiluminescence, OH(2,0) band excitation is adopted.



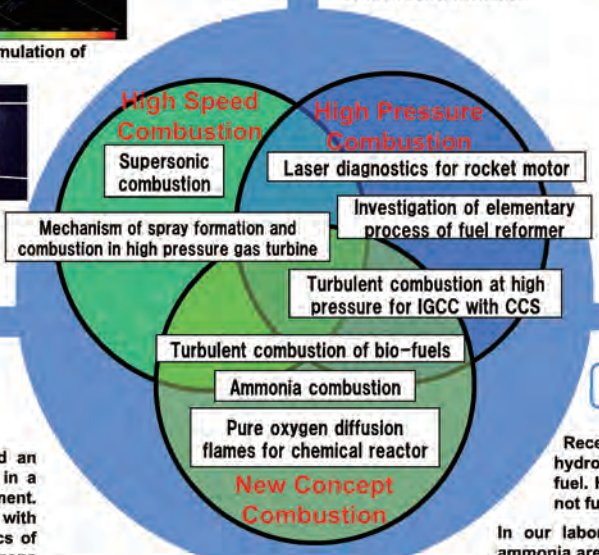
OH(2,0) band excitation



Instantaneous OH-PLIF image (≒2.0 MPa)



Comparison between experimental and numerical simulation (≒2.0 MPa)



Spray formation and spray combustion

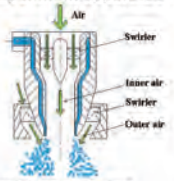
Gas turbine is used for a power plant and an aircraft engines and combustion is operated in a high temperature and high pressure environment. In order to realize a gas turbine combustor with stable and effective combustion, characteristics of spray formation and spray combustion phenomena must be clarified.

In our laboratory, the spray formation and combustion phenomena are investigated using a laser diagnostics (PDPA, PIV) and high speed flame observation to realize a fuel lean gas turbine combustor for an aircraft.

High pressure spray experiment apparatus

P_c = 0.1 MPa, U_A = 70 m/s, AFR ≃ 10

P_c = 0.1 MPa, U_A = 30 m/s, ϕ = 1.1



Pre-filimng air-blast atmizer

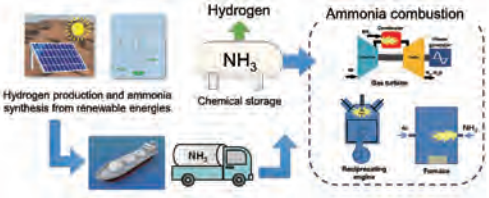
P_c = 0.5 MPa, U_A = 70 m/s, AFR ≃ 10

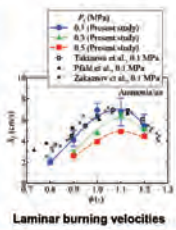
P_c = 0.3 MPa, U_A = 30 m/s, ϕ = 0.8

Ammonia combustion

Recently, ammonia is expected not only as hydrogen energy carrier but as also carbon-free fuel. However, its combustion characteristics are not fully understood.

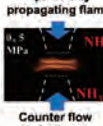
In our laboratory, the combustion characteristics of ammonia are investigated based on experiments as well as numerical simulations with detailed chemistry. In addition, flame stabilization mechanism and turbulent combustion are also studied in order to apply the ammonia combustion for gas turbines and reciprocating engines.





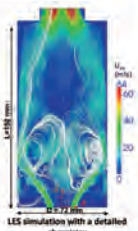
Laminar burning velocities

Spherically propagating flame



Counter flow twin flame

Ammonia flame stabilized in a swirl burner



LES simulation with a detailed chemistry

Contact
Prof. Hideaki Kobayashi
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JapanTel:022-217-5273 / Fax:022-217-5323
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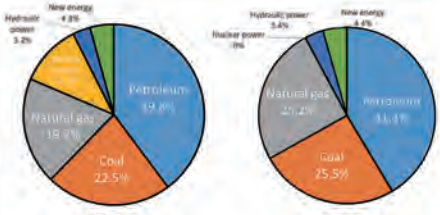
Progress Since the Great East Japan Earthquake and Future Prospects

The roles of combustion in energy and decomposition of wastes

Institute of Fluid Science, Tohoku University
Kobayashi Hideaki & Hayakawa Laboratory

Importance of combustion as an energy source



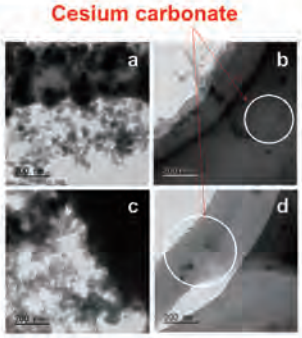
Percentage of primary energy source in Japan before and after the Great East Japan Earthquake

Combustion is a complex phenomenon composed of multi-dimensional dynamics of temperature, concentration, velocity, and chemical reactions. And also advanced combustion technologies are essential for solving the environmental and energy problems. Our laboratory focuses on investigation of combustion phenomena, development of diagnostics and analysis method. Projects on turbulent combustion at high pressure and high temperature, heterogeneous combustion such as fuel spray and wastes, and controlling of supersonic combustion are in progress.

* http://www.enecho.meti.go.jp/about/whitepaper/2016html/2-1-1.html

Cesium decontamination by a honeycomb-type ceramic filter

Temporal storage area of the radioactive wastes



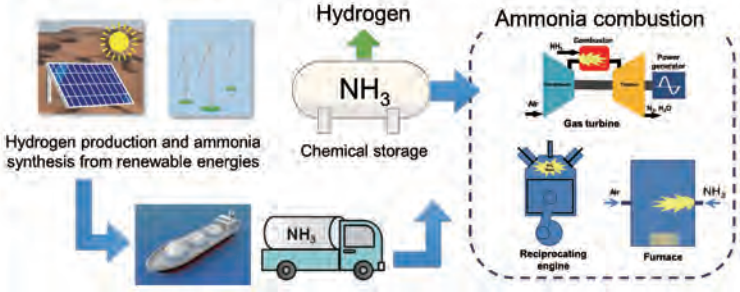
A large quantity of radioactive waste was caused by the nuclear plant accident and the shortage of a temporal storage area of the radioactive wastes has been problem. Thus, it is essential to reduce the volume of the radioactive waste by incineration.

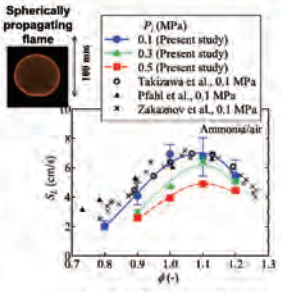
The purpose of this study is to clarify the decontamination characteristics of the honeycomb-type cordierite ceramic filter for the radioactive wastes, and to examine the potentiality of the ceramic filter to be used for the disposal of the radioactive wastes.

Investigation of ammonia flame characteristics and its application to an actual combustor

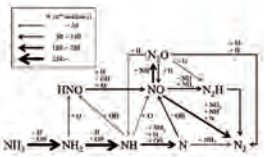
Ammonia (NH_3) is anticipated as a hydrogen energy carrier because of its higher hydrogen capability and infrastructure of ammonia production, storage and transportation have been established. In addition, ammonia is also anticipated as a carbon-free fuel. However, because of low flame intensity of ammonia flame, it is not considered as a fuel and fundamental flame characteristics of ammonia/air flame have not been clarified.

In our laboratory, fundamental flame characteristics of ammonia, such as laminar burning velocity and extinction stretch rate, are experimentally and numerically investigated. For an application of ammonia to an actual industrial combustor, stability and emission characteristics of ammonia flame is also investigated. In addition, a collaborative research with Fukushima Renewable Energy Institute (FREA), Advanced Industrial Science and Technology (AIST) is conducted for verification tests of the power generation by ammonia firing gas turbine.

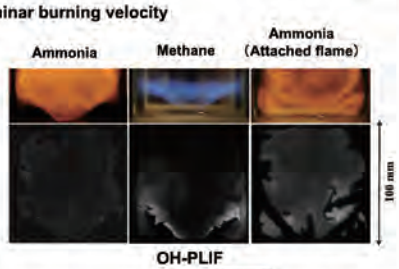




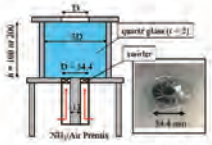
Laminar burning velocity



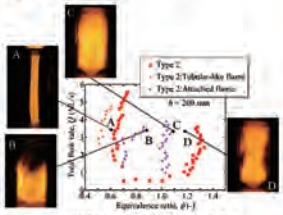
NO reduction flow for rich ammonia/air mixture



OH-PLIF



Schematic of a model gas turbine combustor



Flame stability limit

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

Toward new concept combustion technology

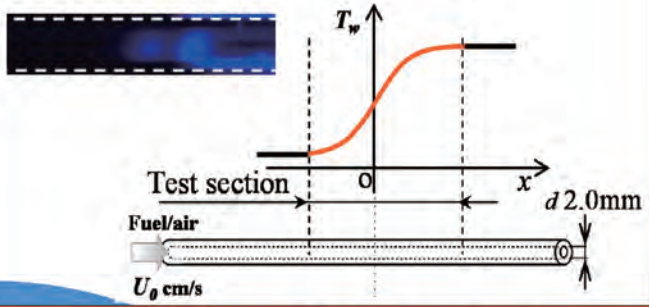
Energy Dynamics Lab. (Maruta & Nakamura Lab.),
Innovative Energy Research Center,
Institute of Fluid Science, Tohoku University.
2-1-1 Katahira, Aoba, Sendai 980-8577, Japan

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

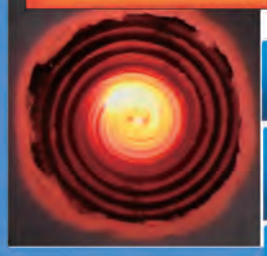
Combustion-based heater without bare flame
(Co-developed with IHI)
Fuel consumption reduced by 80% !

Swiss Roll Micro Combustor as Heat Source

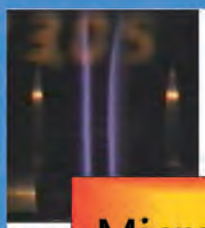
Clarification of combustion characteristics by original Method !



Micro Flow Reactor with Controlled Temperature Profile



Keywords	Combustion, Energy, Alternative & New Fuels, Microgravity
Concept	To avoid energy loss ➡ Heat recirculation To clarify combustion characteristics of fuels ➡ Controlled reactions
Approach	・Experiments, theoretical study, computer simulations ・Cooperative research with academic and industrial partners ・Applications for furnaces, car engines and gas turbines
Themes	Fundamental research to decrease Energy Consumption, Advanced combustion technology



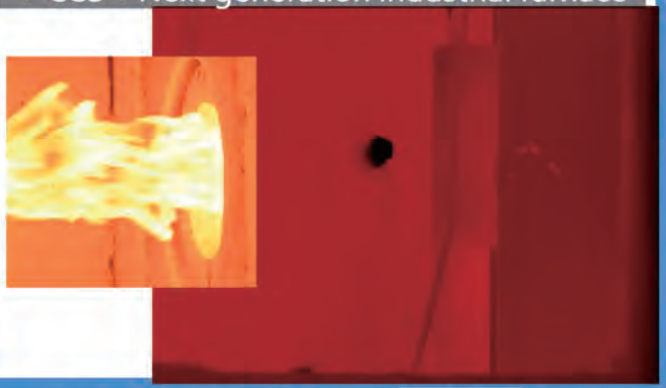
Microgravity Combustion

High Temperature Oxygen Combustion

Invisible flame

Microgravity experiments to investigate combustion limits

High efficiency・Low environmental impact
+ CCS : Next generation industrial furnace



Professor
Kaoru Maruta

Associate Professor
Hisashi Nakamura

Energy dynamics Search

Maruta & Nakamura Lab. Search

Progress Since the Great East Japan Earthquake and Future Prospects

Toward new concept combustion technology

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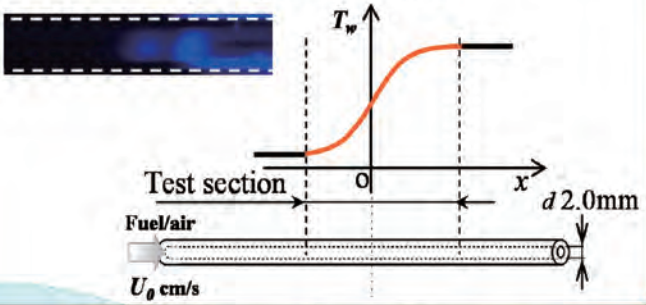

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Energy dynamics Search

Maruta & Nakamura Lab. Search

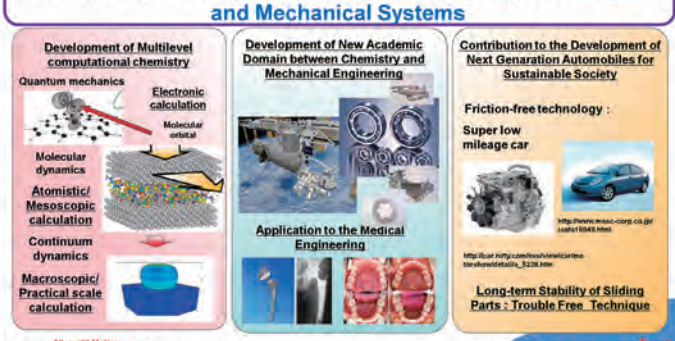
Regional Innovation Strategy Support Program by MEXT "Next-Generation Automobiles" / Miyagi Area

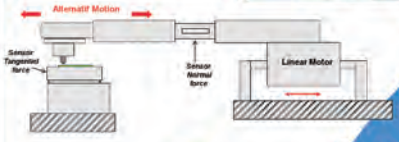
Multiscale, Multiphysics Modeling/Simulation for Next Generation Automobiles: Catalysts, Tribology, and Batteries

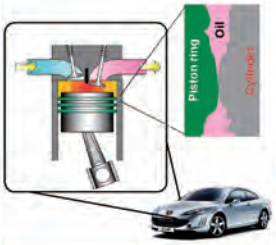
New Industry Creation Hatchery Center, Tohoku University
Akira Miyamoto, Nozomu Hatakeyama, Ai Suzuki, and Ryuji Miura(Miyamoto Lab)

MEXT TOHOKU ECONOMIC FEDERATION Tohoku University 宮城県 77銀行 ICR

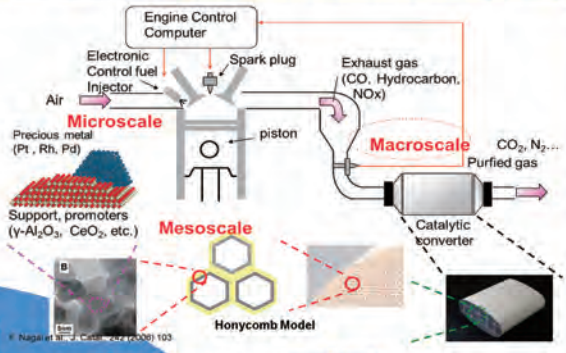
Multi-level Tribology Simulator for Material Development to Realize Long-life, High Reliability, Energy Saving Automobiles and Mechanical Systems

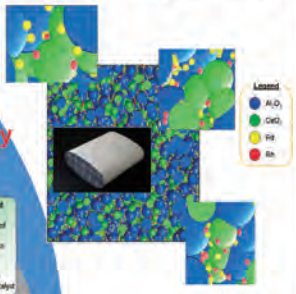






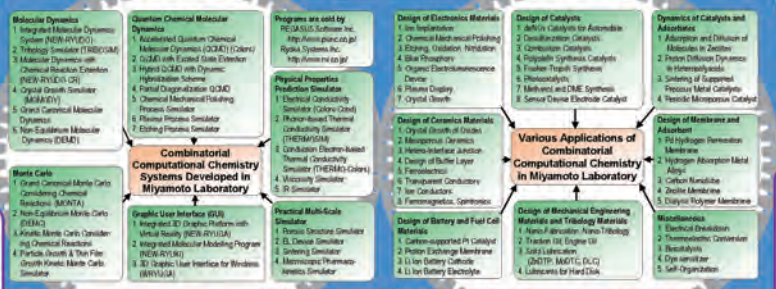
Multiscale, Multiphysics Simulator for the Development of Practical Automotive Catalysts



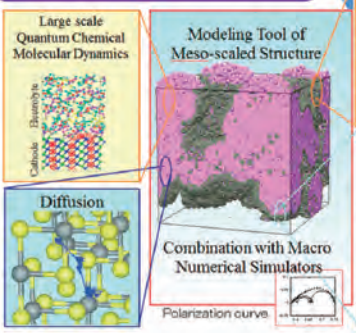


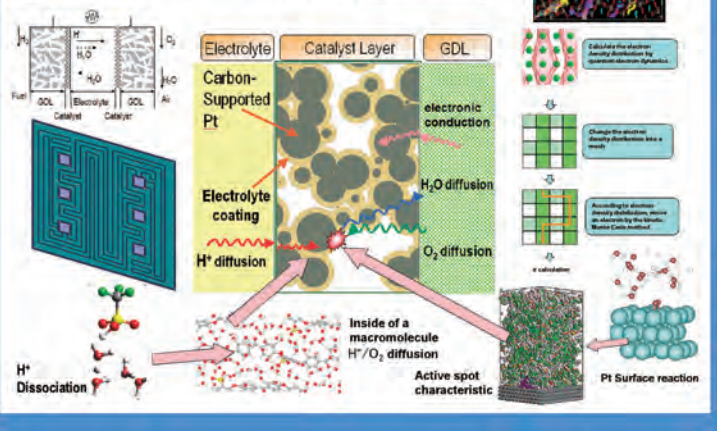
Automotive Parts Company
Automobile Company
Heavy Industry Company
Chemical Company
Machinery Company
Oil Company
Electric Power Company
Gas Company
Software Company
Pharmaceutical Products Company
Water Treatment Company

Achievements of Collaborative investigation with Various Domestic / Foreign Companies using our Original Software



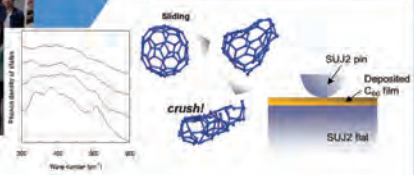
Multi-level Battery Cell Simulator Supporting the Development of Li-ion Battery, Fuel Cell and Solar Cell for Next Generation Automobiles



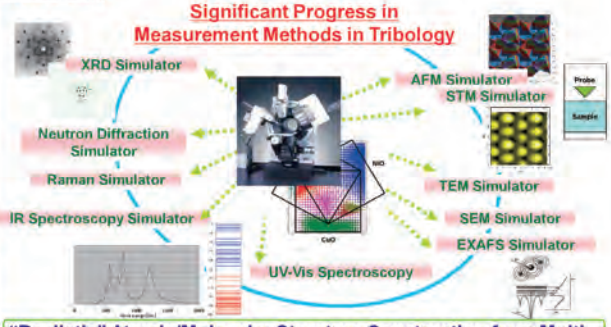


Integrate the Measuring and Modeling Technologies to Improve the Surface and Interface Structural Analysis for Practical Material Development

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.

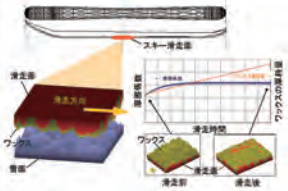
Global and Local Research and Development Progresses in the Environment and Safety Fields

New Industry Creation Hatchery Center, Tohoku University
Miyamoto Laboratory

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

Promoting Collaboration with Local Companies

We perform applied research on the next-generation automobile catalyst in collaboration with the Miyagi Prefecture and local companies. Through various trainings, such as honeycomb court, we also share our university's latest technology and the know-how with Industrial Technology Institute, Miyagi Prefectural Government.
In collaboration research with GALLIUM Co Ltd., we apply "Experimental fusion computational chemistry" to the ski wax. This could promote collaboration between industry, academia, and government.



宮城県
Miyagi Prefectural Government

JAPAN ORIGINAL WAX, GALLIUM

Promoting Collaboration with Worldwide Companies

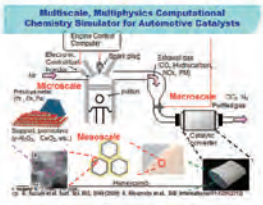
While promoting strong collaboration with domestic companies in various fields, we also do joint researches with overseas enterprises. For example, we collaborate with the French company TOTAL for applied engine oil research. We host their young researchers as trainees to share the knowledge and know-how of in-house developed multi-tribo simulators.

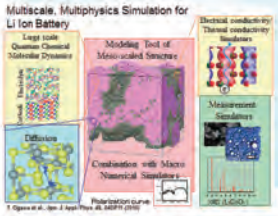
TOTAL Lubrizol

SCG

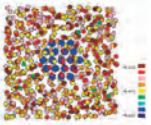
By making powerful support system, We promote collaboration between Industry, Academia, and Government.

Developing the Environment and Safety simulation





In the Wake of the Great East Japan Earthquake and Tsunami, people are concerned about the environment and safety in various fields.
Because of this, we are now promoting "the Environment and Safety simulation" in various fields such as Automotive industry and Energy industry.



The Great East Japan Earthquake caused a serious accident in the Nuclear power plant in Fukushima. Seeking for a way to recover is one of our most important challenge.
At the same time, we employ a huge research effort to improve remarkably the safety of nuclear power system.

JAEA
Other companies

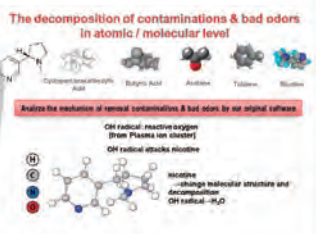
Miyamoto Laboratory

COLLABORATION

Post-Project & Future Prospects

Contributions toward New Tohoku and Japan by artificial intelligence and Multi-scale Multi-physics Computational Chemistry

Our research topics focus not only on global requirement fields like Automobile industry development and energy industries etc., but also on contaminations, bad odors, durability and safety of daily living supplies. Those contributions strengthen the brand name of local products to the world.



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

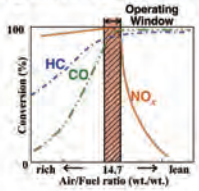
○T. Nakajima, J. Fukushima, Y. Hayashi, H. Takizawa
Graduate School of Engineering, Tohoku University

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

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.

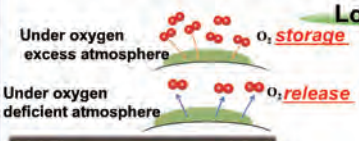


It is absolutely imperative to *suppress the air to fuel ratio* in order to remove the pollutants efficiently.

problem

Expensive precious

Low OSC property under 500˚C



Requirements

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

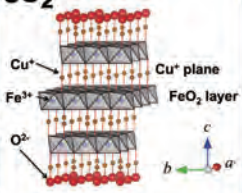
2. Research Target and Method

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

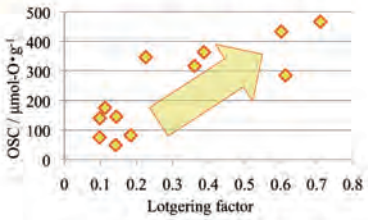
Characterization

Expectative effect...

Promotion of *anisotropic grain growth*

Influence OSC property

OSC measurement at 500˚C



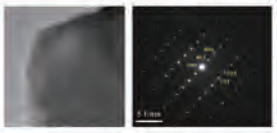
Maximum OSC value : 466 μmol-O/g

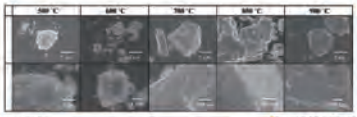
▶ Phase stability and OSC rate during oxygen uptake-release behavior was promoted

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

3. Results

TEM and SEM observation

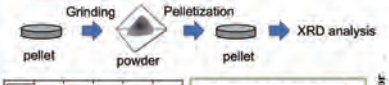


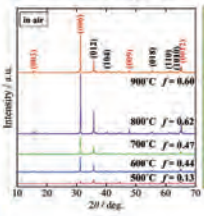


isotropic ⟶ *anisotropic*

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

XRD analysis

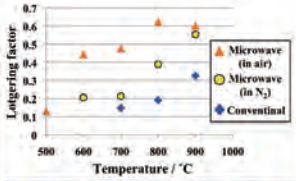




The degree of orientation, *f*, calculated from equation (1)

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

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*

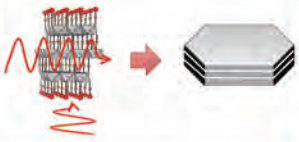
The depth of microwave penetration

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

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

Catalysis for conversion of next-generation resources

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

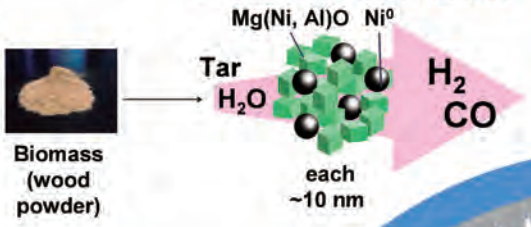
MEXT TOHOKU ECONOMIC FEDERATION Tohoku University 宮城県 七十七銀行 ICR

Production of syngas from biomass

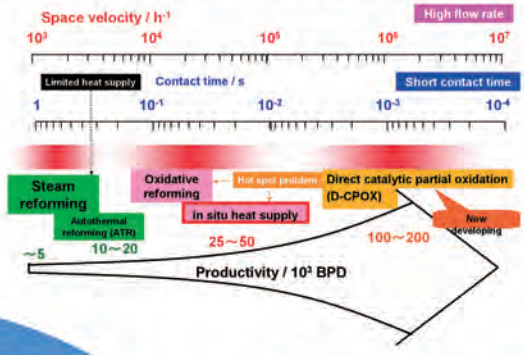
Biomass + O_2 or H_2O → H_2 + CO

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

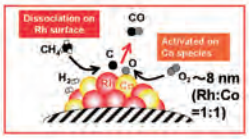
Ni-oxide nanocomposite catalysts



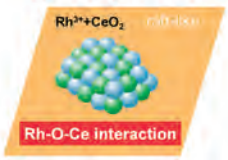
Production of syngas from natural gas



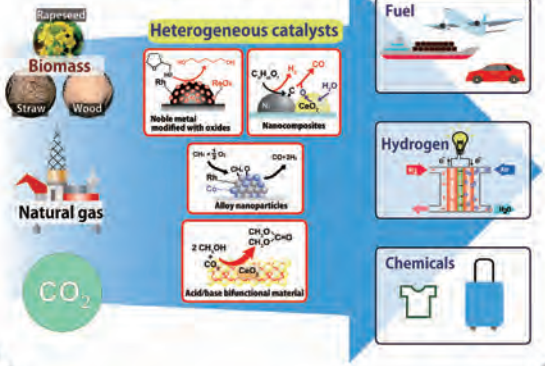
Rh-Co alloy particles for D-CPOX



Rh-CeO_2 interface

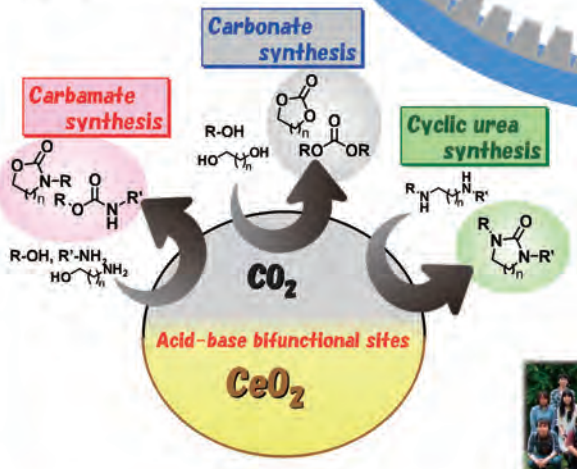


We are developing new catalysts for upgrading next-generation resources.

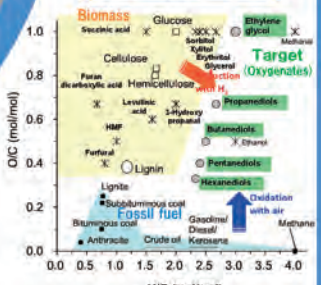


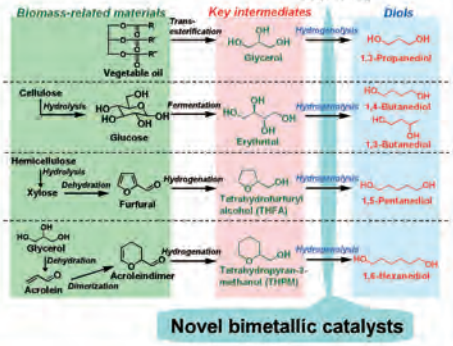
Production of chemicals from CO_2

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



Production of chemicals from Biomass





Novel bimetallic catalysts

For high performance permanent magnets

Graduate school of engineering, Sugimoto Lab.

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Great East Japan Earthquake

For 3.5 years, we were caught up in evacuee life.
However, we have worked with enthusiasm.

Establishment of RaMGI

RaMGI:
Research Center for Rare Metal and Green Innovation

Development of New Material

Development of high coercivity magnetic material

High coercivity ≈ Rare-earth magnet

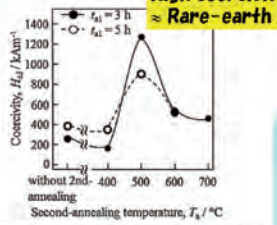


Fig. 3 Dependence of coercivity on the temperature of second-annealing for $Mn_{2.5}Sm_{0.8}Co_{7.5}$ alloy after first-annealing for 3 or 5 h.

K. Shinaji, T. Mase, K. Isogai, M. Matsuura, N. Tezuka, and S. Sugimoto, *Mater.Trans.*,54, (2013) 2007.

Industry-academic-government collaboration

RaMGI is aiming for acceleration of
1. Industry-academic-government collaboration
2. researches for rare-earth elements and compounds

Achievements

インターメタリックス株式会社
INTERMETALLICS CO.,LTD.

Development of Nd-Fe-B ultra-fine powder

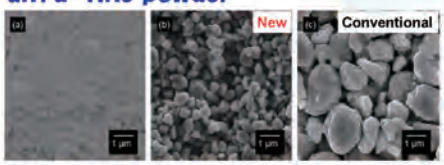


FIG. 6. BSE image of (a) a hydrogen decrepitated HDDR alloy, and SE images of jet-milled powders of (b) HDDR and (c) SC alloys.

M. Nakamura, M. Matsuura, N. Tezuka, S. Sugimoto, Y. Une, H. Kubo and M. Sagawa, *Appl. Phys. Lett.*, 103 (2013) 022404.

TOYOTA

Development of high coercivity Sm-Fe-N Zn-bonded magnets

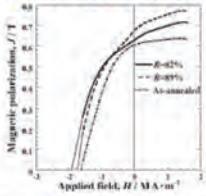


Fig. 2 Demagnetization curves of specimens swaged with R of 82 and 89% and subsequently annealed at 425°C. The demagnetization curve of the annealed specimen without swaging is also shown. The lines extrapolated to evaluate H_{cJ} are shown as dotted lines.

K. Kataoka, M. Matsuura, N. Tezuka, and S. Sugimoto, *Mater. Trans.*, Vol. 56, (2015) 1698.

AICHI STEEL

Investigation of d-HDDR mechanism of anisotropic Nd-Fe-B powder

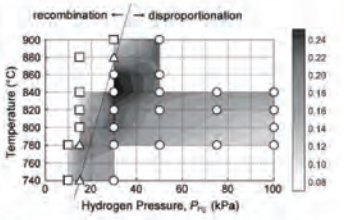


Fig. 5. P_{H_2} and HD temperature dependencies of $L_{d\text{-}Nd_2Fe_{14}B/Fe}$. The dotted line represents the estimated boundary between HD and DR reactions. The symbols denote the state of $Nd_2Fe_{14}B$ phase in XRD patterns of the samples disproportionated respective HD conditions (circles: no peaks, triangles: weak peaks, and squares: obvious peaks).

T. Horikawa, M. Matsuura, S. Sugimoto, M. Yamazaki, and C. Mishima, *IEEE Trans. Magn.*, Vol. 51, No. 11 (2015) 2103904.

Tohoku Univ.

Success of Collaboration

company ⇔ NEDO

For Future

Research frontiers of magnetic materials

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

Automation of physical distribution and traffic using robot technology

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

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

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)

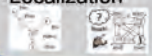
- World market of industrial robots : $6.6 billion
  166.2%up from 2011
- Domestic market of service robots: $ 1.3 billion
  751.6%up from 2011

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

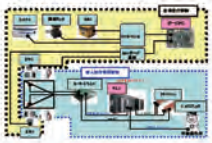
Collaborative project:

Development of autonomous unmanned carrier in snowy region

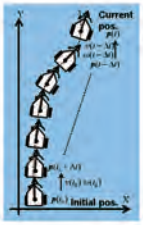
Hardware development


3-D mapping using LIDAR

System integration



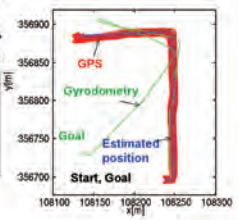
Precise & robust localization using Bayes filter



$$p(\mathbf{x}_t \mid \mathbf{z}_{1:t}, \mathbf{u}_{1:t-1}) = \eta \; p(\mathbf{z}_t \mid \mathbf{x}_t) \int p(\mathbf{x}_t \mid \mathbf{u}_{t-1}, \mathbf{x}_{t-1})$$

Correction Estimation

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



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
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Tad lab

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

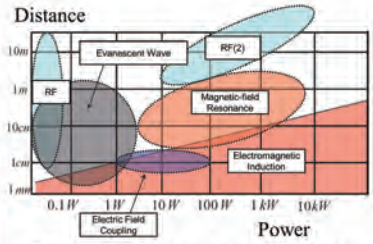
Frontier of Wireless Power Transmission

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)

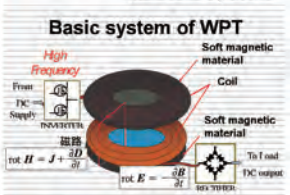
Wide range power (about 1 mW～ 150 kW)
Adapt to every needs for contactless power supply



Transmission power and distance of WPT system

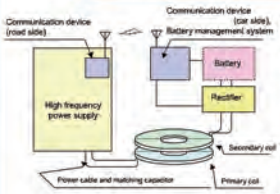
High Efficiency, High Power based on LC-booster method

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.



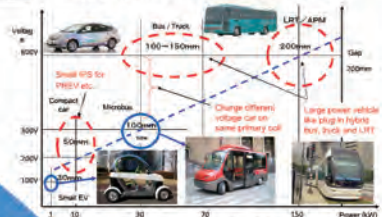
Example of basically WPT system

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

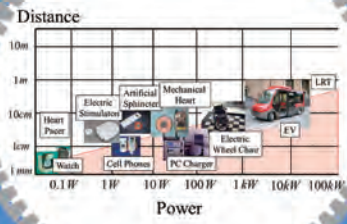
WPT coil for Electric Bus (30kW)

Integration of Medical and Engineering

～Future of Wireless Power Transmission～

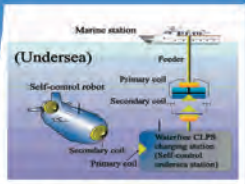
Optimized WPT system for each load

LC-booster, Wireless power rooter, Flexible charging



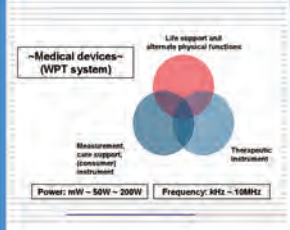
Highway IPS system

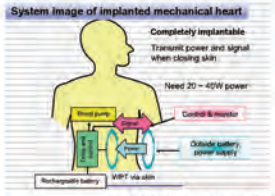
Future of Energy Transfer



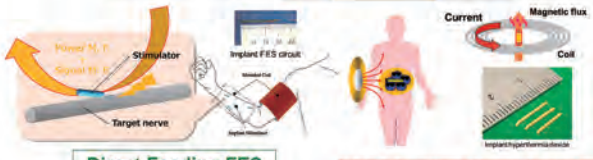
WPT system for Underwater
Underwater robot, Underwater energy network

Advanced Assistive Vehicle
Intelligent power conditioning





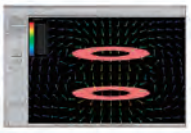
WPT system for mechanical heart



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 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

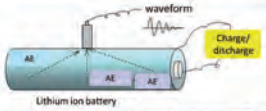
Development of In Situ Measurement Techniques for Lithium-ion Batteries

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

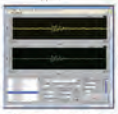


Lithium ion battery


Li-ion battery for mobile phone


Li-ion battery for laptop (18650-type)

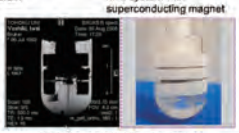

AE measurement system


AE signals from lithium battery (fracture of SnO anode)

MRI of lithium battery (Magnetic resonance imaging)

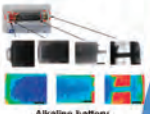

MRI of human brain


MRI system with superconducting magnet


MRI of a model lithium ion battery

X-ray picture

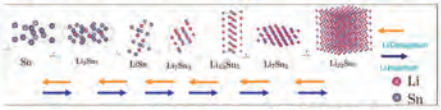

Li-ion battery


Alkaline battery

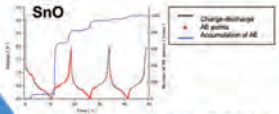
Degradation detection of the lithium battery by acoustic emission (AE)

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

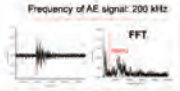
Fracture of SnO anode during charge/ discharge can be detected *in situ* by AE measurement.



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

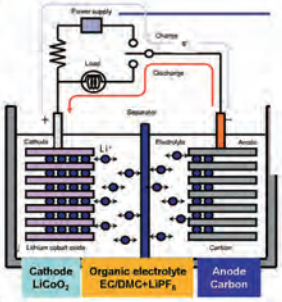


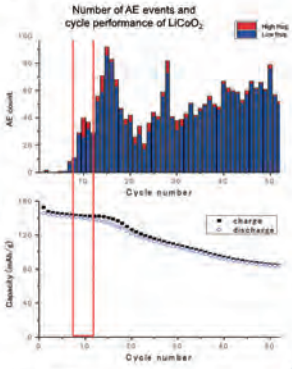
- AE signals are detected for lithium extraction at 1st cycle.
- Different waveforms were observed several regions.



Fractures of SnO cause 200 kHz AE signals

Application of AE measurement: $LiCoO_2$ cathode



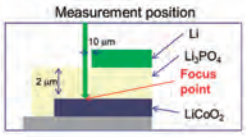


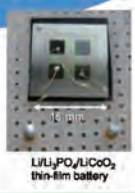
Relationship between AE signal and capacity fading is found.

Solid-state thin-film battery

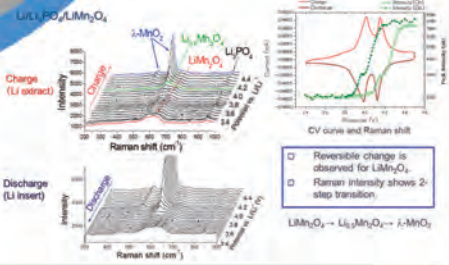
Thin-film battery fabricated by pulsed laser deposition (PLD)

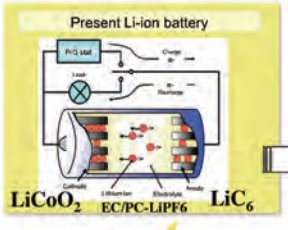
In situ Raman spectroscopy



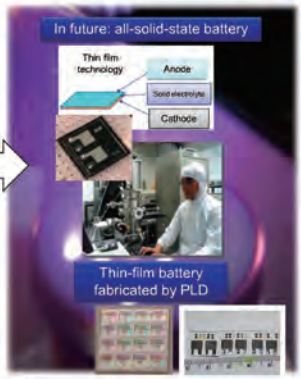


Li/Li3PO4/LiCoO2 thin-film battery






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

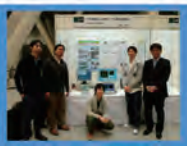


In situ techniques for monitoring Li-ion batteries

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

Energy Conversion Devices Based on Solid State Ionics

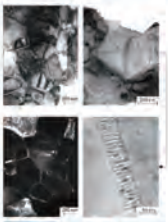
H. Takamura
Graduate School of Engineering, Tohoku University

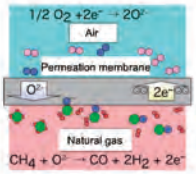
MEXT TOHOKU ECONOMIC FEDERATION Tohoku University 宮城県 七十七銀行 ICR

Hydrogen Production using Oxygen Permeation Membranes

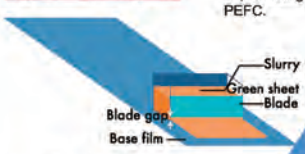
Oxygen permeation membranes for hydrogen production

	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	$Pr_{0.7}Sr_{0.3}Fe_{0.9}Al_{0.1}O_3$	8.2	1000	Takamura *et al.*, 2002
Ceria-MFO	$(Ce, Sm)O_{2-\delta}$-15vol%$MnFe_2O_4$	10.0	1000	Takamura *et al.*, 2002
LBSFI	$(La_{0.3}Ba_{0.3}Sr_{0.3})(Fe_{0.8}Al_{0.2})O_3$	10.6	1000	Aizumi *et al.*, 2004



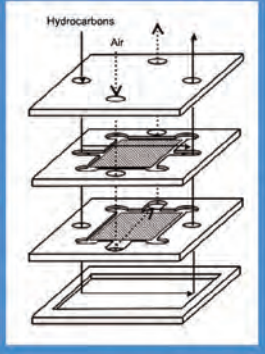


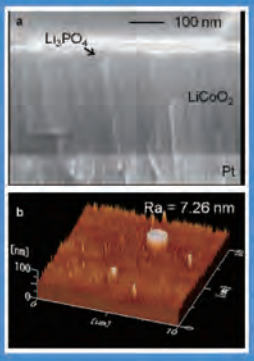
- Sm-doped CeO_2 –$MnFe_2O_4$ Nano composite
- 10 μmol·cm⁻²·s⁻¹ (=13.4[STP]cc·cm⁻²·min⁻¹)
- 10 sheets with dimensions of 5 cm x 5 cm are capable of producing H_2 for 1 kW PEFC.



Mass Production of Functional Materials by Tape Casting

Applications of Solid State Ionics Materials to Energy Conversion





- 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

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.

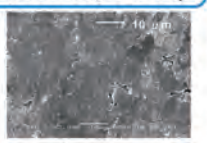
Conventional LIB

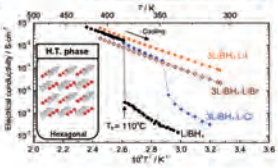
- Organic solvents are volatile and flammable.

All-solid-state LIB

- Solid electrolyte
- Higher safety
- Wide temperature range

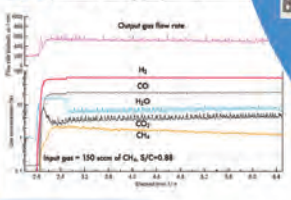
High σ_{Li} and plasticity: $LiBH_4$





Actual performance

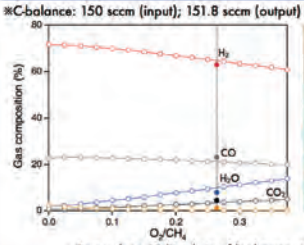
CH₄ reforming properties

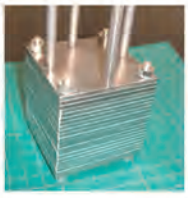


CH_4 reforming properties

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)



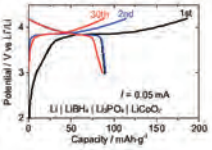


To produce 10 liter/min of hydrogen, stack of 20 modules is required.

Intermediate layer between $LiBH_4$|$LiCoO_2$

Intermediate lyaer
Li_3PO_4
Thickness ≈10 nm
Prepared by PLD

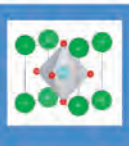
working!

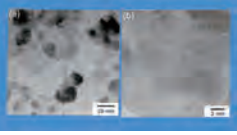


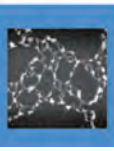
For those who are interested

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







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:

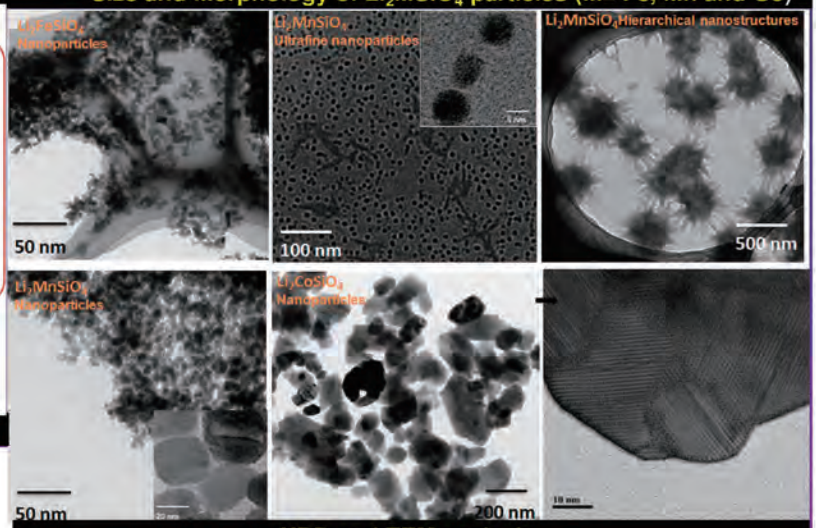
$Li_2Mn^{2+}SiO_4 \longrightarrow Mn^{4+}SiO_4 + 2Li^+ + 2\bar{e}$

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

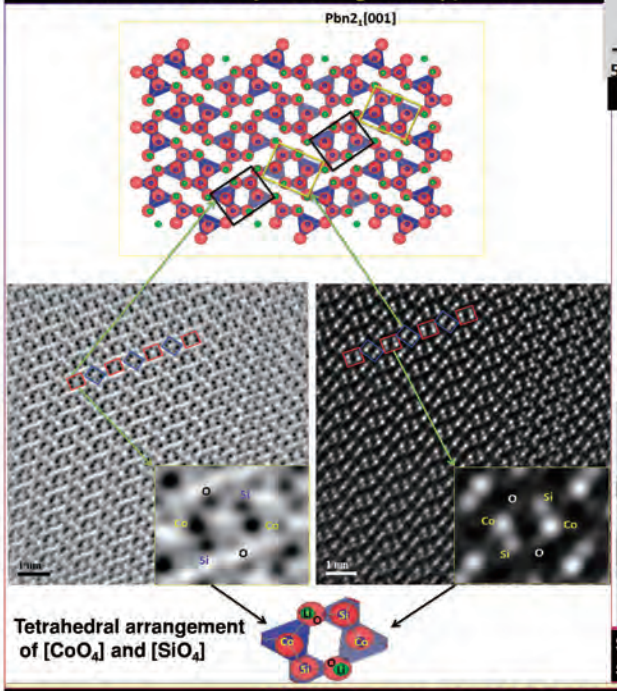
Li_2MPO_4F

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

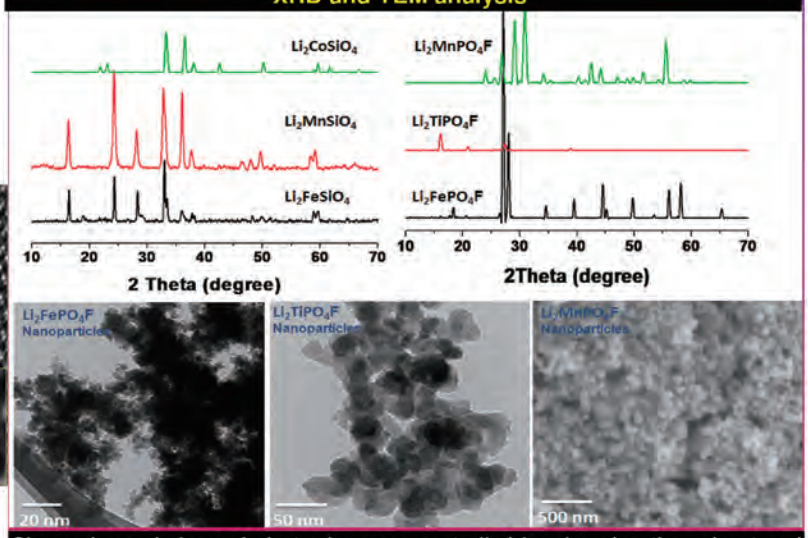
Size and Morphology of Li_2MSiO_4 particles (M= Fe, Mn and Co)



ABF and ADF analysis of Li_2CoSiO_4 particles

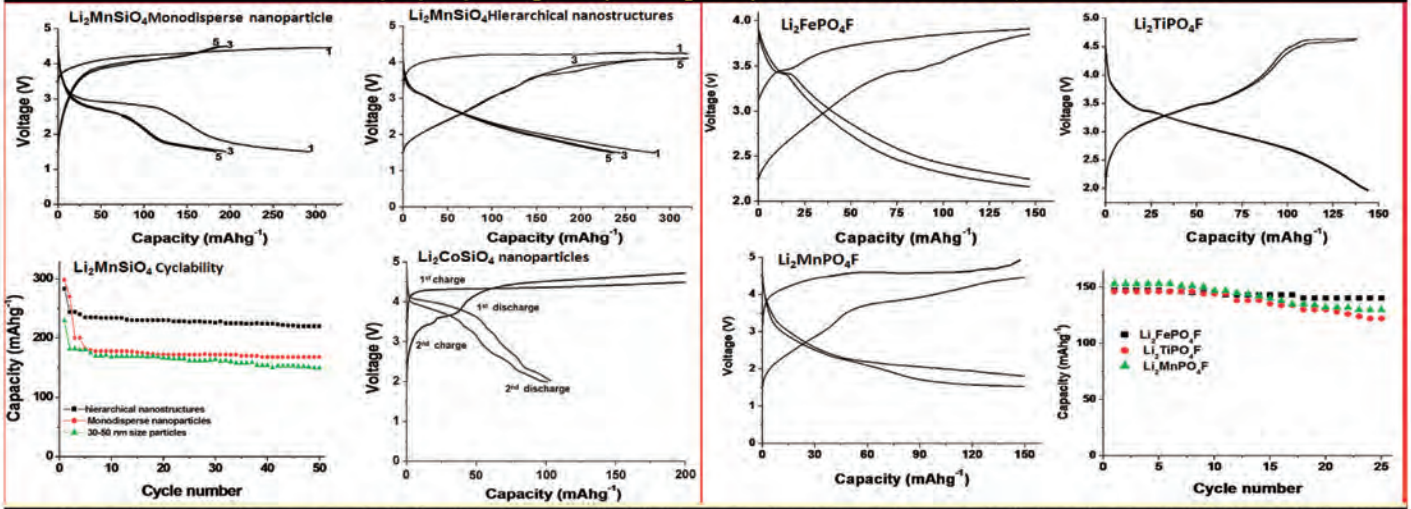


XRD and TEM analysis



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

Seiji Samukawa[1,2,3]
[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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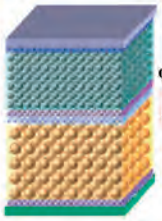
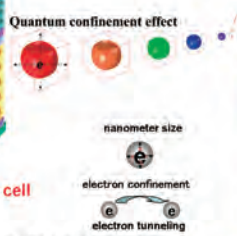
Quantum Dot Solar Cell

Theoretical conversion efficiency >60%



Quantum dot solar cell

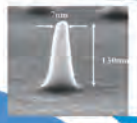


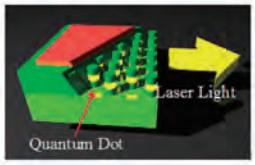
Low recombination probability of electron and hole
Multiple bandgaps
Electron and hole can move by tunnel effect

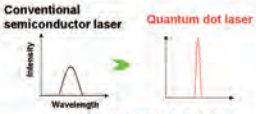
Solar spectrum can be efficiently utilized by only one material

Quantum Dot Laser

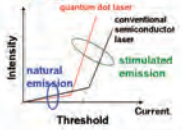
Bio-template ultimate top-down process







Narrow peak width, high gain



Low threshold

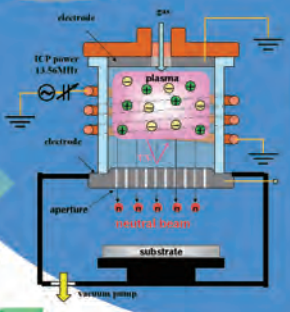
Ultralow-damage neutral beam process

Biomolecules
Bottom-up Process
Bio-template technology

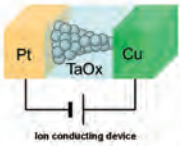
Low-damage
Top-down Process
Neutral beam technology

Low-power-consumption semiconductor devices

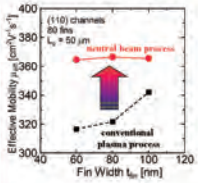
- 3-dimensional MOS transistor
- Ion conducting devices
- Graphene transistor
- Germanium transistor
- Single electron transistor

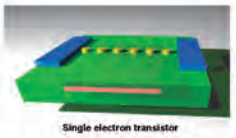


3-dimensional MOS transistor

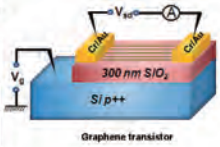


Ion conducting device





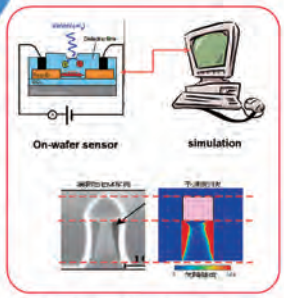
Single electron transistor



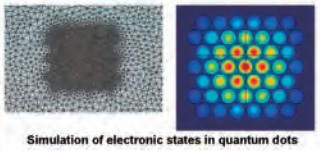
Graphene transistor

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 | IFS 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.

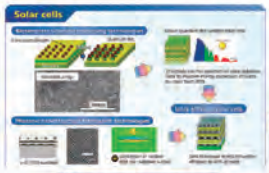
Therefore, we intend to support the reconstruction of the Tohoku area and the renewal of Japan, and to contribute to the establishment of an energy-technology nation, through the realization of state-of-the-art core battery technologies (solar cells, secondary batteries, fuel cells) and their energy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

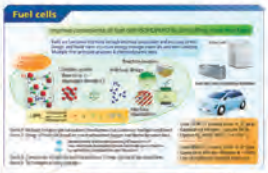
Our efforts will be realized through open innovations in an industry-academia collaboration setting with a vertically-integrated group of companies. The innovations are based on nano-structure interface control technologies, which Tohoku University has been accumulating for many years.

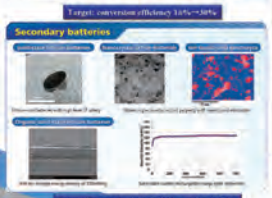
Features

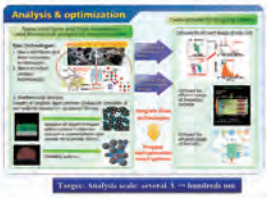
1. Unique consortium aiming at establishment of *optimized nano-energy system* created as a fusion of solar cells, secondary batteries, and fuel batteries.
2. Strategic research and development by gathering technologies from *vertical integration type firms* based on nano-interface material structure 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

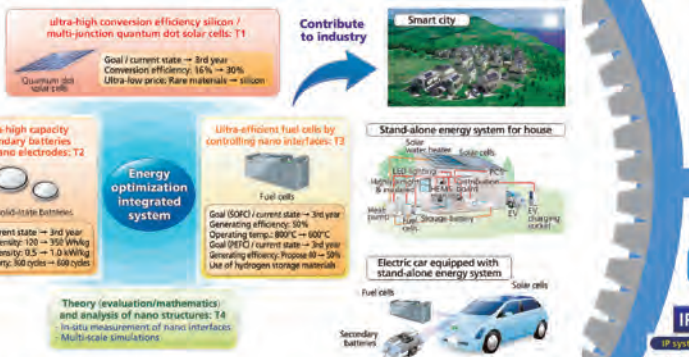








Our Target

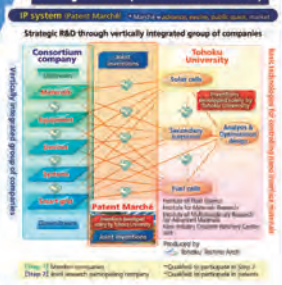


http://www.ifs.tohoku.ac.jp/consortium/eng/index.html
consortium@Sammy.ifs.tohoku.ac.jp

Organization

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 "Outside 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/consortiumeng/application.html
http://www.ifs.tohoku.ac.jp/consortium/jpn/application.html (Japanese)

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

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

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1.Institute for Materials Research, Tohoku University 2. New Industry Creation Hatchery Center, Tohoku University
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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	10^4 - 10^5

Advantage of Combustion sensor

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

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

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.

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.

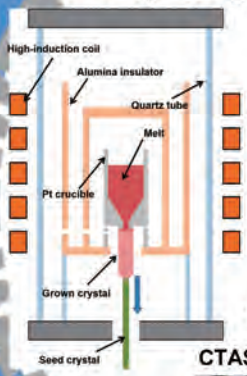
The crucible was heated in air up to melting point by high-frequency induction coil.

⇩

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

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

CTAS crystal

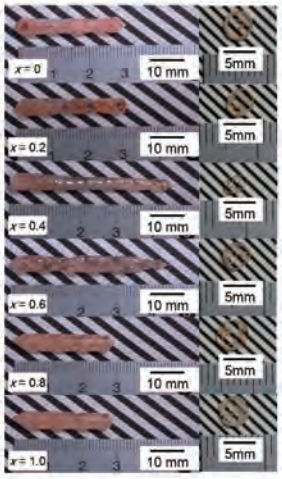
・Reductions of manufacturing cost and amounts of rare metals

Evaluations

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

Results & Discussions

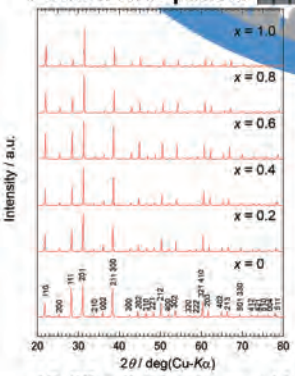
$Ca_3Ta(Ga_{1-x}Al_x)_3Si_2O_{14}$ crystals grown by μ-PD method



Insides of the crystals had high transparency.

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

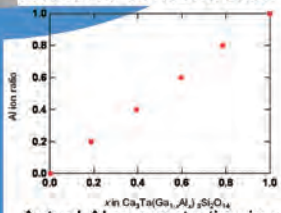
Powder XRD pattern



All diffraction peaks were identified by langasite-type structure.

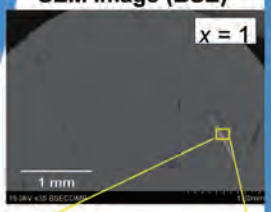
Lattice parameters were systematically decreased with Al concentration

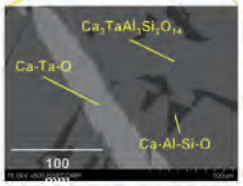
Actual Al concentration



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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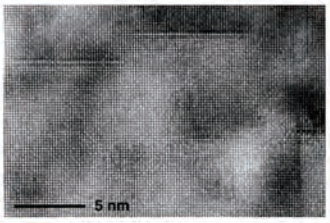
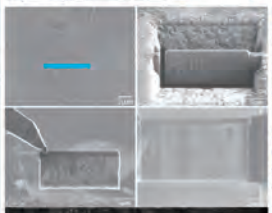
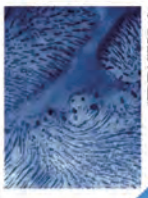
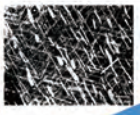
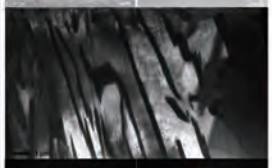
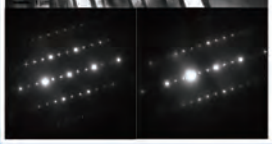
IMR

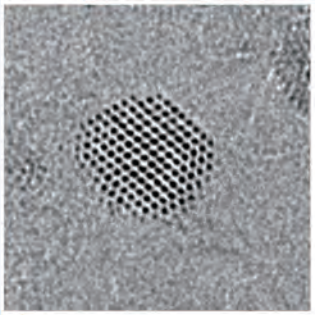
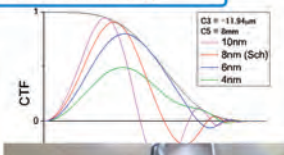
Institute for Materials Research

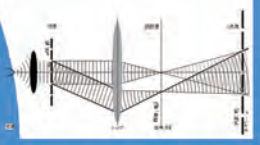




Art of Advanced Electron Microscopy

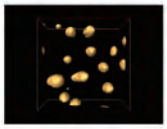



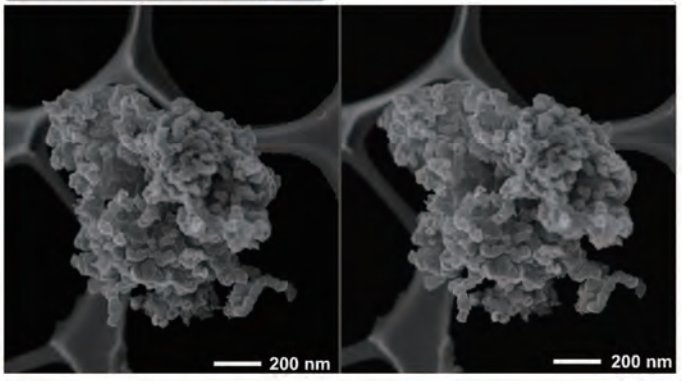



CENTER FOR INTEGRATED NANOTECHNOLOGY SUPPORT

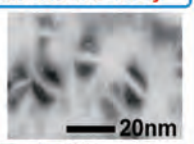
CINTS

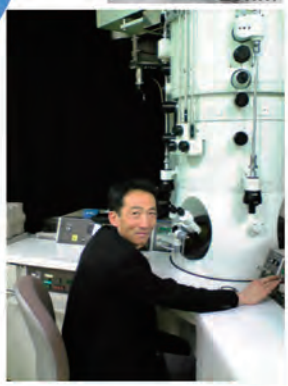
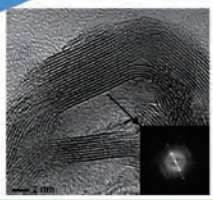
Materials for Environment





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)

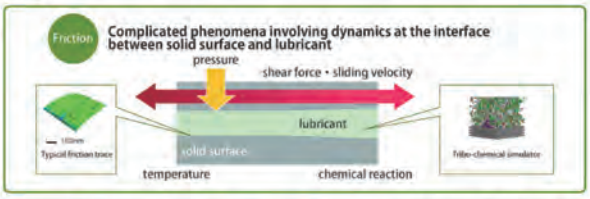
MEXT | TOHOKU ECONOMIC FEDERATION | Tohoku University | 宮城県 | 七十七銀行 | ICR

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.



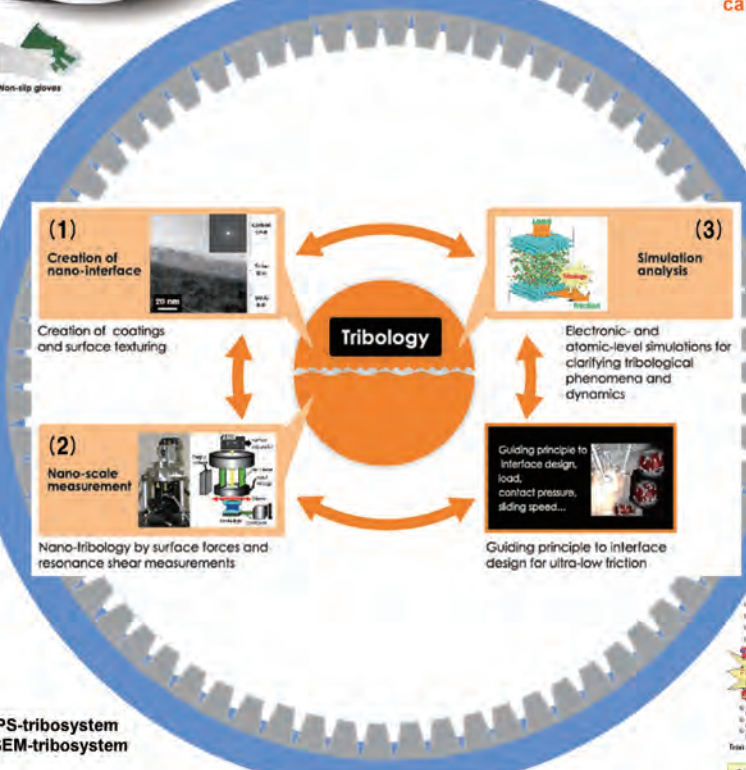
- Economic influences of tribology (study of friction) is about 2 % of GDP
- Friction problems at contact interfaces of machines cause mechanical deterioration, damage and short life.

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

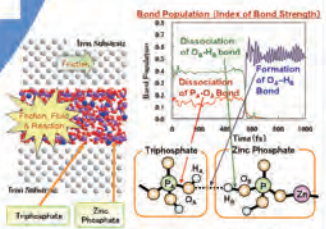
- Construction of
  - -creation technology and argument of optimized design for nano-interafce realizing ultra-low friction
  - -platform for in-situ analysis of friction/wear

(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.

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.

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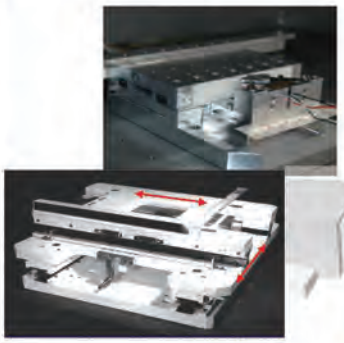
Creation of surface and interface for high friction and anti-wear
~ R&D of highly functionalized friction-driving actuators ~

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.

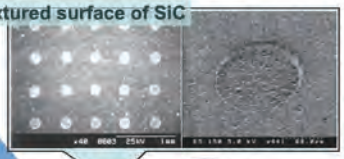
Water is lubricant in next generation

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

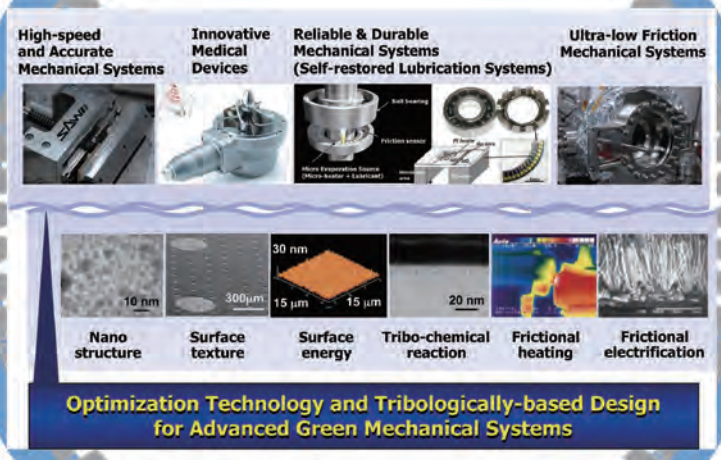
Inert gas is lubricant in next generation

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

Textured surface of SiC

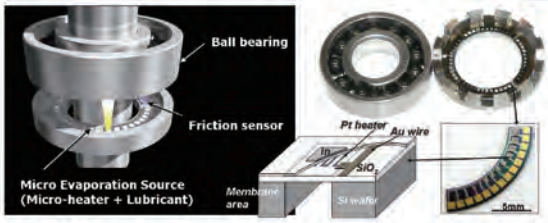


Creation of low friction interface



X-ray CT scan system

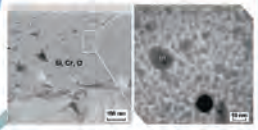
In-situ restoration system of solid lubricant can allow us to achieve semi-parmanent life-time of mechanical systems.



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 ~

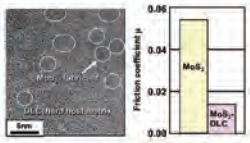
Nanointerface for low friction



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

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

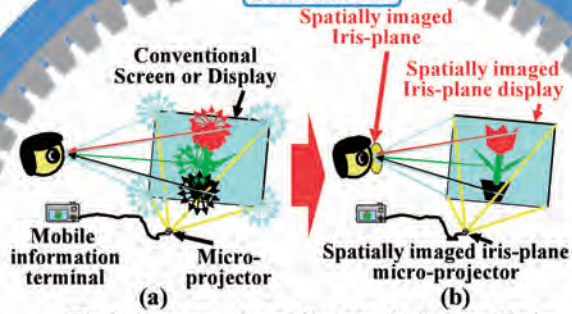

Fig. 1 A concept of spatially imaged iris-plane display
(a) a conventional display (b) a spatially imaged iris-plane display

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

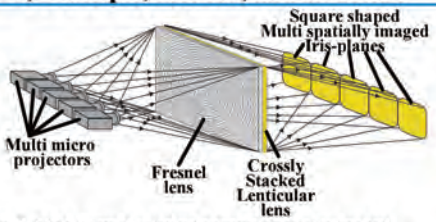

Fig. 2 Multi-view display using multi spatially imaged iris-plane technology

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.

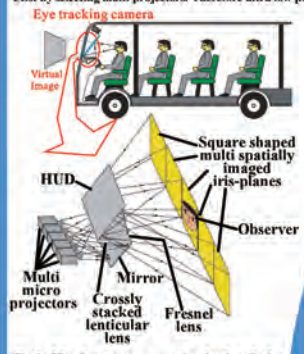

Fig. 3 Ultra low power consumption head up display by multi spatially imaged iris-planes and eye-tracking system

3, Experiment

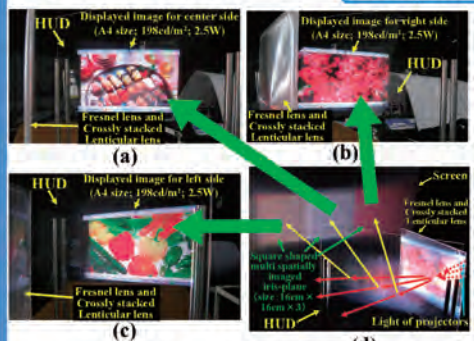

Fig. 5 An experiment and results of ultra low power consumption multi-view HUD
(a) Center side, (b) Right side, (c) Left side, (d) Multi-view HUD

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.

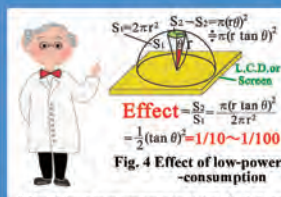

Fig. 4 Effect of low-power -consumption

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 $(\tan^2\theta)/2=1/250$.

4, Ultra Low Power consumption HUD on EV bus

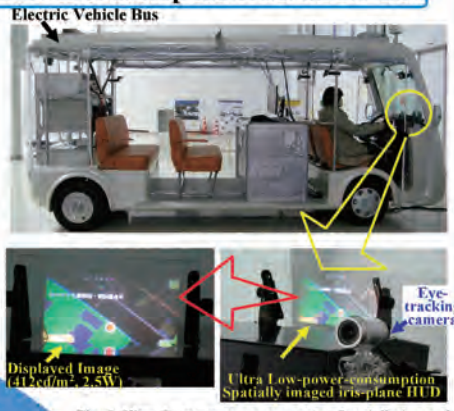

Fig. 6 Ultra Low-power-consumption Spatially imaged iris-plane HUD mounted on Electric Vehicle Bus and Displayed image

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

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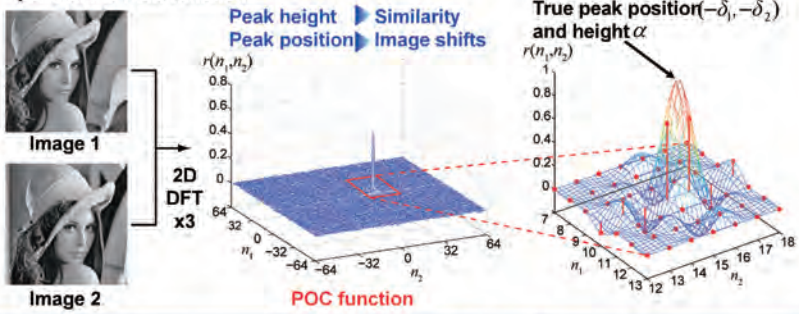
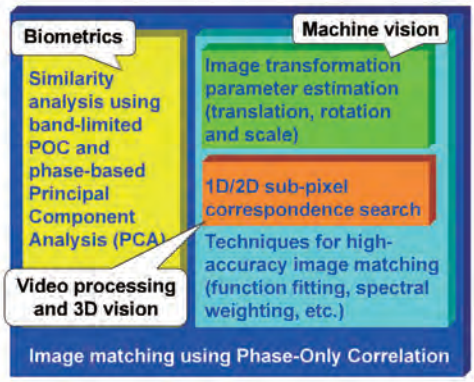
We present fundamentals of Phase-Only Correlation (POC) --- a technique for high-accuracy registration of 1D, 2D and 3D signals using phase information of discrete Fourier transform. Since 1990s, our research group has developed a novel technique of phase-based image matching for fingerprint verification 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

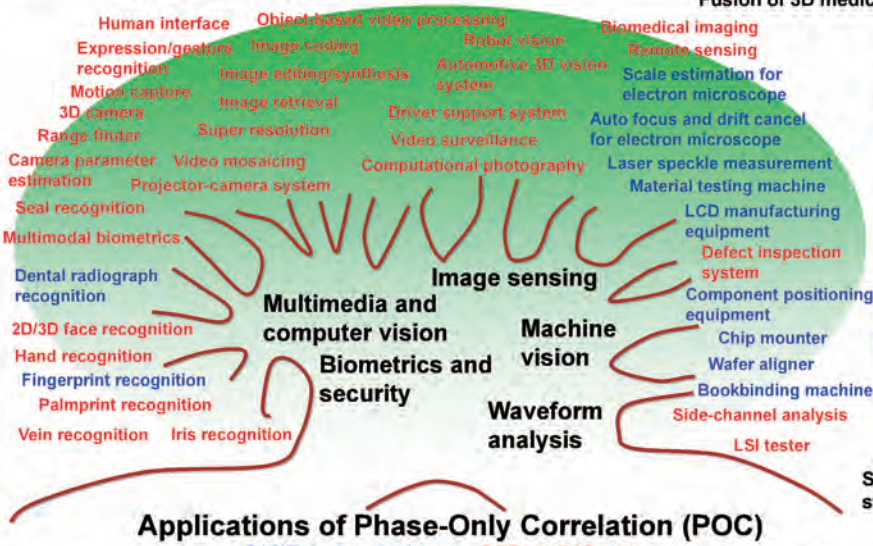

Fusion of 3D medical data and 2D face image


3D human capture


Universal image recognition sensor


Real-time 3D measurement system


Side-channel attack standard evaluation boards



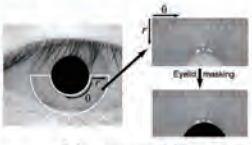
Applications of Phase-Only Correlation (POC)

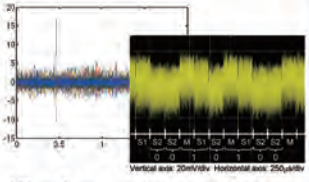
BLUE: in practical use RED: in R&D stage


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

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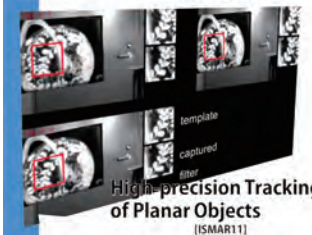
Basic Research

Optimization of Markov Random Fields [CVPR12, CVPR13]

High-precision Shape Measurement by Combination of Geometric and Photometric methods [CVPR12]

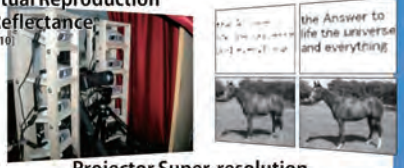


High-precision Tracking of Planar Objects [ISMAR11]

Mechanism of "Miniature Scene Photographs" [CVPR07]

Applications

Projector-based Virtual Reproduction of Surface Reflectance [CVA10]



Projector Super-resolution [IEEE-TIP09]

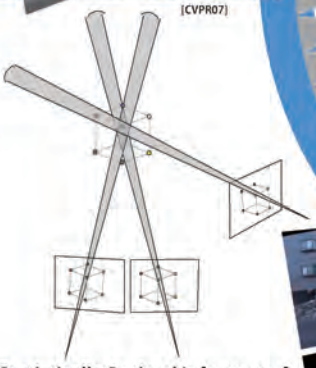
Easy Calibration of Multi-projector Displays [IJCV09]

Image Compensation of Hand-held Projectors [ACCV10]

"Gaze-reactive" Displays

Future World Shaped By Computer Vision

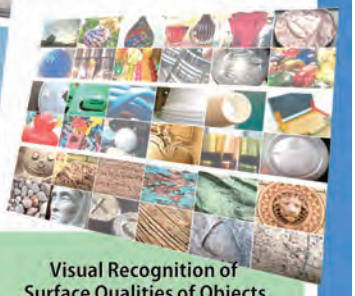
Statistical Mathematics and Numerical Computation + Physics-based Vision



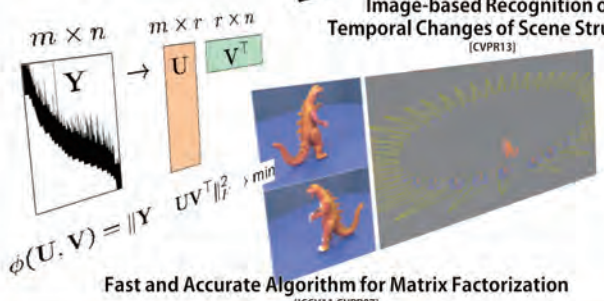
Statistically Optimal Inference of Multi-view Geometry and Numerical Computation [CVPR09,ICCV09]

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]

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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

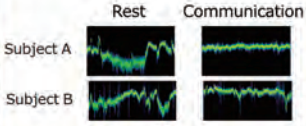
~Visualization of brain function is now ready for your R&D. Let's join us.~

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

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

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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)

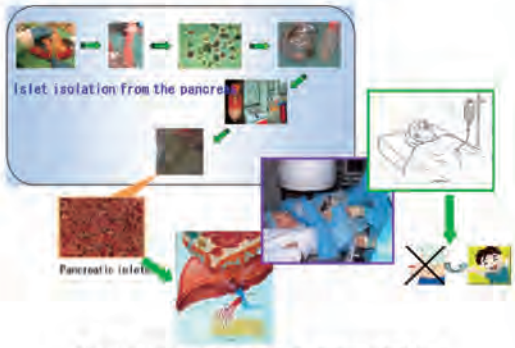


Fig. 1 Islet isolation and transplantation

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.

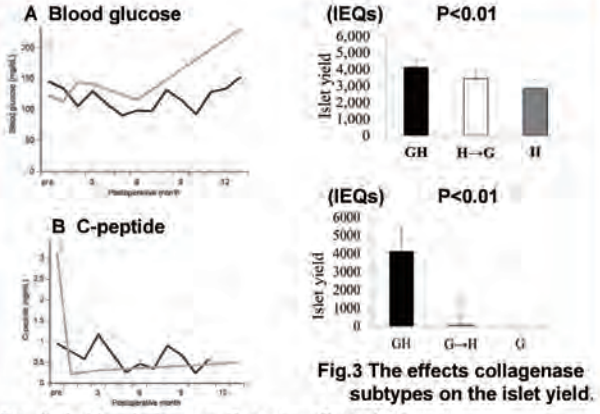


Fig.3 The effects collagenase subtypes on the islet yield.

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.**

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

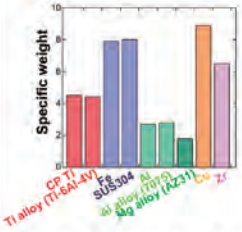
Production of Low-Cost and Highly Functionalized Titanium by Controlling the Light Elements

Takayuki Narushima and Kyosuke Ueda
Department of Materials Processing, Graduate School

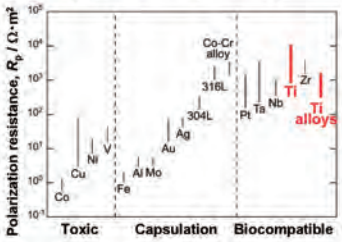
MEXT TOHOKU ECONOMIC FEDERATION Tohoku University 宮城県 七十七銀行 ICR

Titanium: *Wonder metal*

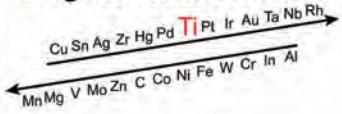
- Low specific weight
- High specific strength



- High biocompatibility



- High corrosion resistance

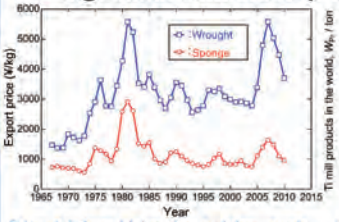


Applications for...

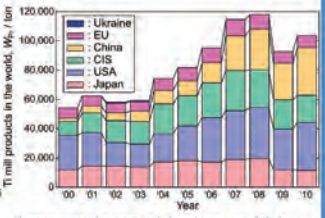
- Space aeronautics
- Medical devices
- Military
- Chemical plants

Disadvantages of Titanium

- ✕ High cost: Difficult to produce



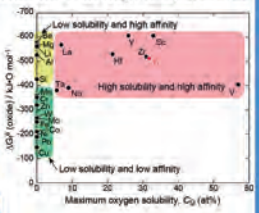
Price: 2-3 times higher than stainless steels
10 times higher than Al alloys



Amount of deposit of titanium ore: High
→Low products: Categorize to Rare Metals

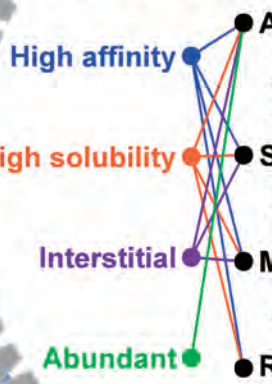
Light elements

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

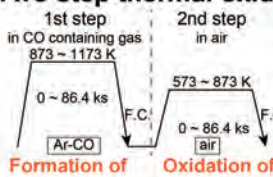
Oxygen, Hydrogen, Nitrogen, Carbon



- **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

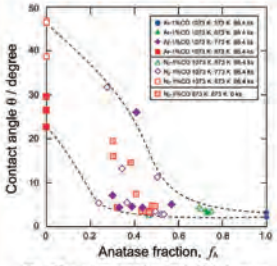


Fig. Effect of anatase fraction in TiO_2 layer on the water contact angle under UV irradiation.

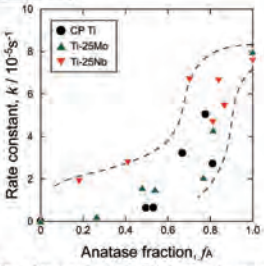


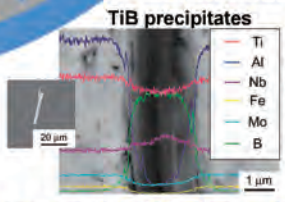
Fig. Effect of anatase fraction in TiO_2 layer on the rate constant of degradation of methylene blue under UV irradiation.

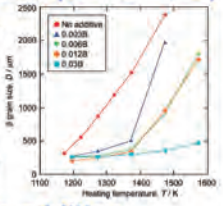
Photocatalytic activity under UV irradiation

Microstructure control of Ti alloys using micro alloying

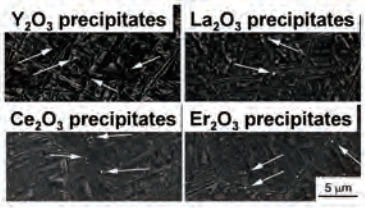
Grain refinement of Ti alloys by pinning using fine precipitates

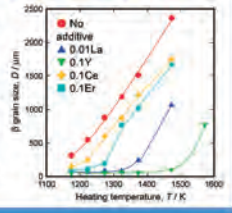
Boron addition (Ti + B = TiB)





Rare-earth (RE) elements addition
(2RE (in Ti alloy) + 3O (in Ti alloy) = RE_2O_3 (s))





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)

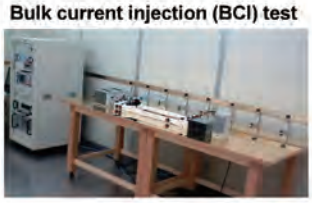
MEXT | TOHOKU ECONOMIC FEDERATION | Tohoku University | 宮城県 | 七十七銀行 | ICR

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 available.

CISPR25 radiated emissions

Bulk current injection (BCI) test



CISPR25 conducted RF emissions

※ Electrostatic discharge immunity test is available.

Shock test

Testing more than 1000G of shock with duration of msec is available. Evaluating durability of car electrical and mechanical components against shock is available.

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.
- 3 axis acceleration measurement is available.

※Consultation of test jigs is available.

Mission of ITIM

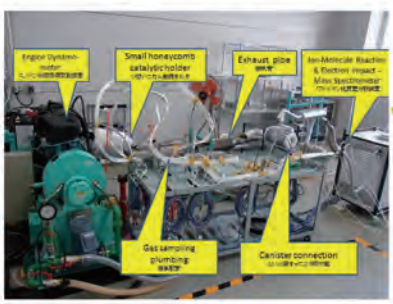
Industrial Technology Institute, Miyagi Prefectural Government

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).

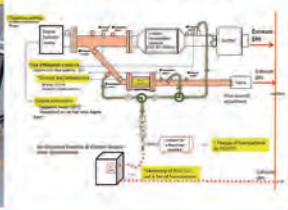
Catalyst property evaluation

Evaluating the properties of the small honeycomb catalyst is available.

	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

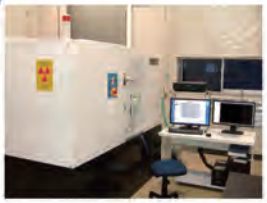


- Small Honeycomb size : D25.4×60mm
- Ion-Molecule Reaction & Electron Impact - Mass Spectrometer enables the simultaneous and synchronous monitoring of NOx, CO, and hydrocarbons(Toluene, Propylene etc.) .
- GC/MS is used to analyze C_2 to C_{11} hydrocarbons (Ethylene, propylene, 1-butene, n-hexane, benzene, toluene, etc.) in automobile exhaust gas.



X-ray CT

※Computed Tomography



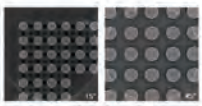
Inspecting the three-dimensional inner structure of automobile parts non-destructively is available, for example aluminum die-cast products, electronic parts, molding parts etc..

	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-RAA110TSS40
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

Address: 2-2,Akedohri,Izumi-ku,Sendai-shi,Miyagi-ken,981-3206,JAPAN.
Phone:+81-22-377-8700 Fax:+81-22-377-8712
http://www.mit.pref.miyagi.jp/index_e.html

Progress Since the Great East Japan Earthquake and Future Prospects

Local Industry Reconstruction Support

Industrial Technology Institute, Miyagi Prefectural Government (ITIM)

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

Activities of the initial 3 months

1. **Damage investigation of equipment and facilities**


2. **Confirmation of employee's safety**
3. **Provision of oxygen cylinder to a hospital** on 14th. Mar.
4. **Radiation dose rate measurement** started from 11th. Apr.

5. **Support to municipalities**
   Tagajo City, Natori City, Ishinomaki City and Watari Town
6. **Provided assistance at temporary morgue after March 11, 2011 disaster** from 13th.Mar. to 10th. May


7. **Restoration support of the affected 5 companies**


Activities of the next 9 months

1. **Free offering research space for the affected 4 companies**
2. **Support of application for subsidies and competitive research funding**
   42 applications
3. **Free measurement of electric power and thermo distribution**


from 11th July to 5th Aug., 11 companies
Collaborated with: TOKYO METROPOLITAN INDUSTRIAL TECHNOLOGY RESEARCH INSTITUTE

4. **Exemption of usage fee and commission**
   63 applications
5. **Radioactivity concentration measurement**
   from Jan., 2012.


MISSION: INDUSTRIAL PROMOTION

Utilization of Intellectual Property
Technical Support
Industry-Academia-Government Collaboration

Technical Assistance
Research & Development
Human Resource Development

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).

The new products by joint R&D

3-dimensional image measurement and analysis, performance evaluation by ITIM

Surface defect image inspection unit (2015) by X3 projects Co., Ltd.

Magnetic simulation by ITIM

Hysteresis brake (2015) by Prospine Co., Ltd.

CAE analysis by ITIM

Quake-Resistant Caster (2014) by Mē Co., Ltd.

Sensor device development by ITIM

Particle Inspection system (2012) by JNS Co., Ltd.

Image processing technology by ITIM

Inspection robot system for automobile body surface (2013) by Hikichiseiko Co., Ltd., X3 projects Co., Ltd. & Tohoku University

Paint design and painted surface evaluation by ITIM

Painting system using supercritical CO2 (2012) by Kanri Electronic Industry CO., Ltd. & AIST Tohoku

Drying Technique by ITIM

"Marugoretto ICHIGO", Dried strawberry (2015) by Hatsuratsu Co., Ltd Yamamoto Strawberry Farm Co., Ltd.

Yeast breeding by ITIM

High quality "Sake" by using miyagi yeast "HONOFUKU"(2011) by Ichinokura Co., Ltd., Urakasumi Sasa Co., Ltd. & Ishikoshi Jozo Co., Ltd.

Design concept work by ITIM

IDEA TRUMP(2011) by Magnet design Co., Ltd.

Acquisition, selection and supply of microorganism by ITIM

Izunuma Craft Hum (2012) by Izunuma-Ninsuan

The future

Miyagi's Vision for The Future
Actualization of wealth Prefecture Miyagi
- Aiming for a "10 trillion yen prefectural GDP" -

ITIM "Business Promotion Plan" (FY2014-18)


2-2,Akedohri,Izumi-ku,Sendai-shi,Miyagi-ken,
981-3206,JAPAN.
Phone:+81-22-377-8700 Fax:+81-22-377-8712
http://www.mit.pref.miyagi.jp/index_e.html


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/

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

Analog and digital fusion

We challenge to find future technique, and we have never ever give up making new stuffs for our future.

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.

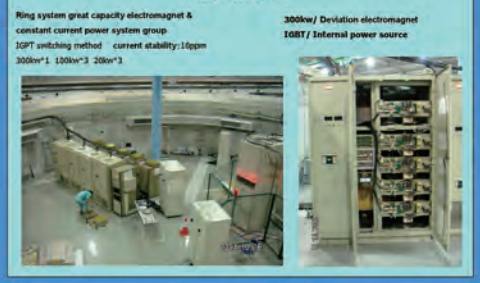
POWER ELECTRONICS

10.000.000. =0.1 PPM
High-precision control technology

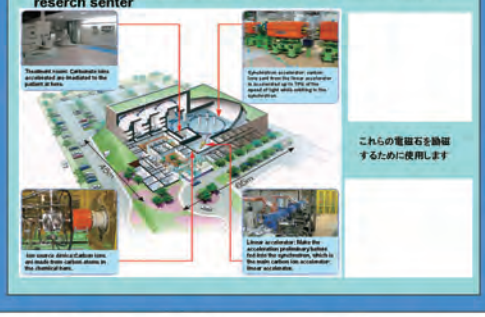
Feedback & Computer Technology

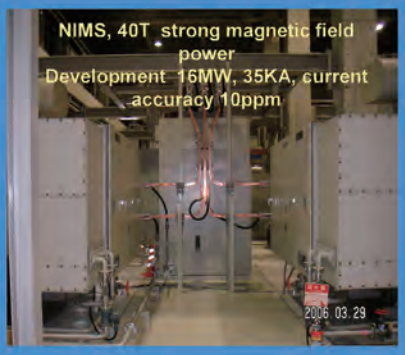
Tohoku Uni science department AVF Cyclotron magnet power supply other 45 units update

Kyushu synchrotron radiation research facility
Electromagnet, power supply One set（218 units）
March 2004



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

Progress Since the Great East Japan Earthquake and Future Prospects

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

Clear the way to the Future with Measurement, Control and Saving Energy Technology

Kudo Electronic Co., Ltd.

Main office: 3-1-5 Nishitaga, Taihaku-ku, Sendai R&D center: 6-3-7 Nagamachi, Taihaku-ku, Sendai Natori place: 3-1-38 Iinozaka, Natori-shi

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Situation after 3.11 earthquake

Some employee's houses were washed away by tsunami. Natori factory had no damage by tsunami, but it was damaged by earthquake. Many our customers helped us recover. Thanks to their help, we could restart operation in 30days.

Lesson from 3.11 earthquake and tsunami

Fuel and electricity are necessary for car or appliance

We contribute to our society suggesting "Ecological and sustainable local community system".

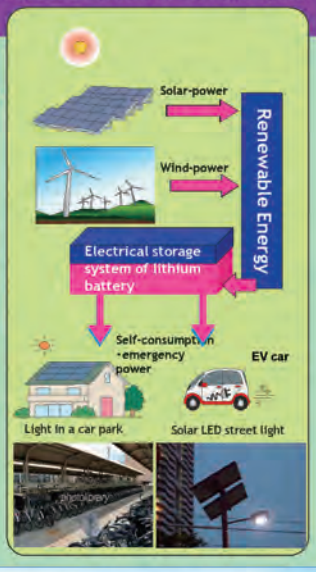
Efforts after 3.11 earthquake

Industry-academia collaboration with Tohoku univ.
「Next generation automobile considering environment and earthquake project」
Development, manufacture and sales of EV car, Lithium battery and electrical storage system

E-7 Japan. Ltd

Investing company

1. Kudo Electronic Co., Ltd
2. Iwaki Diecast Co., Ltd
3. Hikichiseiko Co., Ltd
4. Hondaseiki Co., Ltd
5. Tohoku Electronics Co., Ltd
6. Toei Scientific Industrial Co., Ltd
7. Kojimakousan Inc./Ltd



Achievements after 3.11 earthquake

- 2013 Supplied 8MW buttery for hybrid magnet to IMR, Tohoku univ.
- 2014 Natori office gained ISO9001

human resource development

Introduce our business and products and show prospects for the future.

Visit to local company

2012/4-
「IT fusion R&D projects」
(Joint research with METI)

Cars No.3 Renovated car with EV (SUZUKI Wagon R)

Electric equipment in Bonnet

Status

Weight :830kg	Motor :7.5kwIP servo motor
Speed :60km/h (on the flatland)	Running torque :138Nm (Max: 343Nm)
Grade ability :10%	Buttery charging :AC100V900w・(DC120V7A)
Drive range :50km	Buttery :LI butteryDC103V4.14Kwh

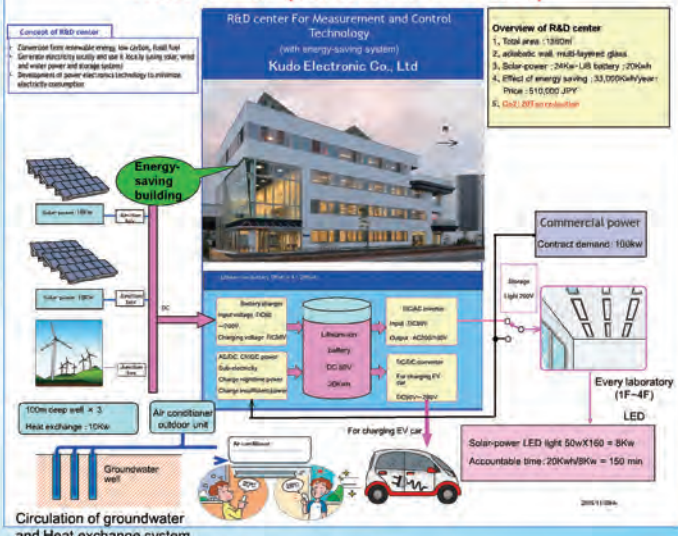
Prospects for the future

Kudo Electronic Co. established R&D center in December 2016 to realize next generation saving energy system which manage disaster risks and conserve environment.

This R&D center is an experimental equipment to save renewable energy to lithium buttery and develop low-carbon ecological energy system.

We contribute to our local community through development and sales of Electrical storage system of lithium battery with Tohoku univ. or local manufacturers.

R&D center (established in 2016)



Circulation of groundwater and Heat exchange system

Eco power generation ・Electrical storage system of lithium buttery

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's DNA

■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 ・・・

■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 ～

◆Management Philosophy
◆Survive the hard time
Employees knowledge:
38 Articles

■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"

"SUGURE MONO"

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: HIKICHISEIKO CO.,LTD
◇Place: Main Offices: 2-8-28, Fukiage, Iwanuma-city, Miyagi-Pref., JAPAN
Utsunomiya Office: 2-16, Sunada-cho, Utsunomiya-city, Tochigi Pref., JAPAN
HIKICHISEIKO THAILAND
◇President: Masayoshi Hikichi
◇Foundation: May 3rd 1979
◇Capital : 30,000,000 yen
◇Employee: 70people
◇Certification:ISO9001, ISO14001, AS9100 (certificated)
ISO27001 (internal systems built)
◇Approval & license: General construction industry, Machinery & equipment installation work

■Overview of Business

◇Business info: Industrial labor- saving machinery and fixture design and manufacture/ Precision parts processing
◇Main delivery equipment:
✦assembly equipment (line equipment, discrete systems)
✦Inspection equipment ✦cleaning equipment
✦Transport equipment
✦others-Automated equipment, various devices etc...
◇Major clients:
- Electronics manufacturers
- Auto motive parts manufacturers
- Aircraft manufacturers
- Food product manufacturers
- Medical product manufacturers
- Other

◇Head Offices

Design Division

・We receive the specifications for a product from a customer, and create a conceptual drawing.
Once we have made the conceptual drawing, we meet with the customer to get his or her approval for the specifics of the design of the product. Then we begin to create detailed drawings of the parts and components of the product.
We make all the designs for all parts of assembly lines, self-standing machines, and jigs.

Production Division

・Our production division has the necessary equipment to be capable of making every component of an automatic machine so as to be able to produce machines all on its own.
We are good at making single products (i. e., high-mix low-volume production). We also have good capability for dealing with orders that allow only short lead-times, and make efforts to reduce costs and improve techniques constantly.
Our company has state-of-the-art cutting machines.

Assembly Division

・Our production division has the necessary equipment to be capable of making every component of an automatic machine so as to be able to produce machines all on its own.
We are good at making single products (i. e., high-mix low-volume production). We also have good capability for dealing with orders that allow only short lead-times, and make efforts to reduce costs and improve techniques constantly.
Our company has state-of-the-art cutting machines.

Control Division

・The control division designs software and hardware products based on PLCs (sequencers).
This division is able to use PLCs from many different controller manufacturers. Therefore, we can install, wire, and debug whatever PLCs our customers designate for their equipment.
We can also incorporate single axis or SCARA robots of many different manufacturers.

■HS-IR100 (Our products)

At 2011, we had received certificate from <Excellent Technology> " Miyagi Sugure MONO"

みやぎ優れMONO

Visual inspection robot for curved surface-mirror.

・Taking advantage of our accumulated design techniques for conveyance, and our vast experience of creating image verification systems for various works, we can propose the best possible vision systems, from design to installation, for inspecting your product.
We have various visual inspection systems, including a visual inspection robot from Denso Wave, so that we are ready to quickly respond to any request. We can also give you advice on what vision system is best for your equipment or facilities, so please do not hesitate to ask us. We have vision system coordinators to take care of your requests.

◇Development after the Earthquake

2014:AS9100 certificated/ Utsunomiya office opened/
Entered the Airs Miyagi
2015:Started selling the image inspection robot standard machine (national & international)
2016:Established HIKICHISEIKO THAILAND on January 27, 2016
(Full operations will launch from March 2017)

◇Future Prospects

Our company has been building the integrated production system as self-contained companies which corresponding the development, design, manufacturing, assembly, installation and maintenance for the industrial labor-saving machinery (dedicated automatic machine).
Our company has been always challenged and solved the numerous challenges with wisdom based on passion and pride for the "Manufacturing and equipment manufacturing", and these experiences currently become our company's cornerstone.
We will proceed with more efforts in order to meet any request of customers while improving the technology, corresponding and proposal ability to provide the best equipment for customers based on our piled up technology.
We would like to sincerely thank you for your patronage in the future.

◇Utsunomiya Offices

"Mechanical design, control design, assembly and adjustment"
We are doing mechanical design, control design, assembly and adjustment same as Head Office.

◇ HIKICHISEIKO THAILAND

Currently, preparatory stage for next year running.
"Full operations will launch from March 2017."

To a company making "only one"

Tohoku Electronics Co., Ltd.

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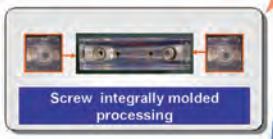
Injection molding

- 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

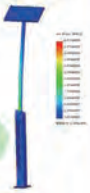
14 Thermostatic bath
15 Tank constant tempter & humidity
16 TCR tank
17 Pressure cooker
18 Thermal shock testing machine
19 strength test equipment (Pull, Compression, Bending, peel test)
20 Soldering test equipment
21 DC regulated power supply
22 Solder bath
23 Electron Microscope
24 Atomic absorption 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)

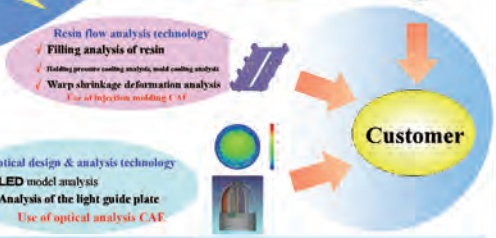
Proposal of solutions

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



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

To the only one manufacturing company

Tohoku Electronics Co., Ltd.

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Great East Japan Earthquake

Our company had gotten enormous damage by the Great East Japan Earthquake. Our headquarters around the plant especially the district Ishinomaki became a flooded area of the tsunami.
As the figure below, our 6 factories got full recovery of the electrical and water service on 28th March after 16 days from the earthquake.
In addition to the damage of the factory, there are some damage to the employees, their families by the tsunami, a house outflow, flood, car submerged in and out, it was also confirmed damage to the house by the shaking of an earthquake.

Damage situation

工場復旧状況　○:被害なし　△:軽微　×:流入

	本社	北村	金型	横生	河南	河北
外装	△	△	△	△	○	○
内装	△	△	△	△	○	○
設備	△	○	△	○	○	○
電気	3/19	3/20	3/20	3/19	3/24	3/18
水道	3/24	3/28	3/28	3/24	3/25	3/19

※全工場 ライフの復旧日前に設備点検調整等を行い、実質復旧日は順次調整次第

Inundation range (Headquarters around)

Before the earthquake	After the earthquake
	

「MAKE THE PEOPLE AND THE NATURE SMILE」

WE AIM TO BE THE ONLY ONE COMPANY WITH OUR REGION, AND CONTRIBUTE TO OUR COMMUNITY

Development After the Earthquake (Industry-academia-government collaboration)

Next-generation vehicles, Miyagi Prefecture area
Speech at the human resource development courses　2012 and beyond

We informed about company introduction, the situation at the time of the earthquake, future prospects, etc. to industry, academia, government and banking parties.

Company tour on November 16, 2012

University researchers and the public sector officials went to participate, and actively exchange information and exchange number.

Development After the Earthquake

March 13, 2013
In collaboration with Japan GE, we supplied about 200 units of Solar LED lighting which has been manufactured and assembled at our company's plant in Ishinomaki city, Miyagi Prefecture to the 32 fishing port (total of 39 locations)of the city.
It contributed to the activities resumption of the fishing port of Ishinomaki city's where lighting facilities became unusable by the Great East Japan Earthquake.

March 3, 2014
Elected for "Excellent SMEs and Micro Enterprises Selection 300"

July 31, 2014
Satellite base of sales and technical departments was installed in Sendai.

April 17, 2015
Our 3 employees got an ingenuity contributor prize.

April 16, 2016
Our 1 employee got an ingenuity contributor prize.

Research andDevelopment

Excellent SMEs and Micro Enterprises

TanigawaHama installation landscape

Ingenuity contributor

Ingenuity contributor

Future Prospects

Development: Solar system LED street light

○Energy-saving lighting fixtures that use storage batteries, solar panels and LED.

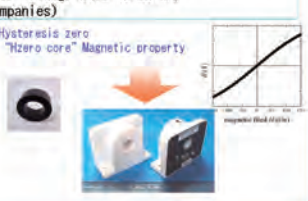
○Features:
・Using of natural energy, zero CO2 emissions.
・There is also a movable type.

Development: High-performance DC current sensor of the storage battery charge and discharge management

○Background of development
We started developing the current sensor for large power storage batteries which is expanding in automotive, HA etc. market, it was applied magnetic material development of hysteresis zero.
(Development is ongoing after adopted Sapoin through 2012 to 2013.)
(Joint development by the private three companies)

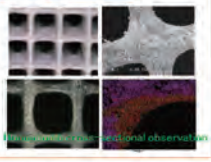
○Features
・Low current range accuracy of high DC current sensor can be achieved by an AC excitation method.
・Current prototype property
Measuring rangeIm：±100A
・Responsiveness：Rising 1.5mS under
(Frequency：DC～200Hz)
・Operation temperature：-20℃～+60℃

Hysteresis zero
"Hzero core" Magnetic property



Development: Small honeycomb catalyst

○Background of development
We planned a prototype evaluation by small honeycomb for experimental cycle increase, cost mitigation as a research for aiming improvement of the honeycomb catalyst performance. We cooperate in research and development through supporting the process of small honeycomb jointing Tohoku University, Miyagi Prefecture General Technology Industry Center. 3



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

Throw in

Knife cutting of slurry

Comparison of solidification structure

Processing

Section

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

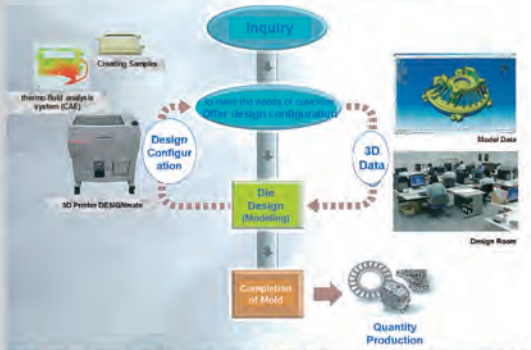
IWAKI DIECAST

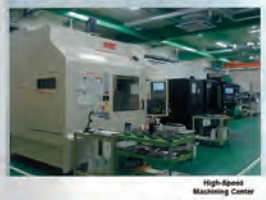
Die-cast Model design Proposal System

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





High-Speed Machining Center

Mold Factory

Progress Since the Great East Japan Earthquake and Future Prospects

We meet the various needs of customers.

IWAKI DIECAST Co., Ltd

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Situation after 3.11 earthquake

In every foundry, small fire occurred.
Due to a power failure, melting furnace, holding furnace hardened.

- Ibarata factory was washed away by tsunami.
- Technical Administration Building had land subsidence.
- Sakamoto second plant wall collapsed.
- Sintering furnace was damaged in Morudaroi factory.

Efforts after 3.11 earthquake

Main factory could not operate because of the power outrage and solidification of aluminum and zinc. They worried about their clients, including the Toyota Motor. Management team, including Saito chairman thought they should not stop supply to clients and determined to ask other companies to produce the same products. They procured generator in 10 days after the earthquakes and after two weeks they started to operate in their own factory. They achieved their duty and role in the supply chain. As a result, relationships with suppliers are more intensified, which led to the order recovery.

(Kahoku Shinpo 2012.10.29)

Iwaki Diecast appealed strength and stability of Japan's manufacturing industry to Neil De Koker, CEO of the Original Equipment Suppliers Association(OECA)

Achievements after 3.11 earthquake

Miyagi prefecture established new factory in Yamamoto-cho, Kodaira district

We invested several tens of billion yen and decided to build new plant of "metal powder injection molding(MIM)" to produce parts of complex shape using a metal powder. They are already used in medical equipment such as endoscopes. It aims to expand the use of them.

Conclusion of an Agreement with Yamamoto-cho

Kodaira factory

Prospects for the future

Our mission :

- Produce new technology in Tohoku and work it in the world.
- Vitalize industry and employment in disaster-hit area.

Sakamoto

Main factory

TPP

Miyanowaki

Saitama

We'll make Zinc alloy, Aluminum, Die-cast prototype, Casting parts machining of 500g or less!

HORIO SEISAKUSYO CO., LTD

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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 Casting Mold oils of friction loss, 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 Base-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

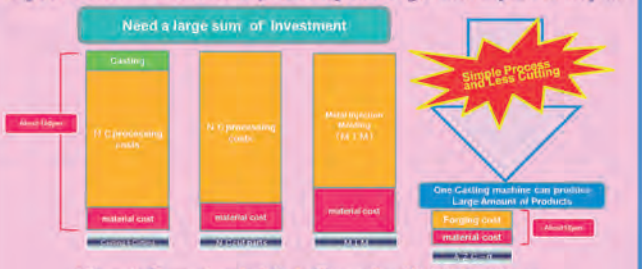
3 Automation - Self-Manufacture Keystone

Responsive Technique; Clued-up Attention to Improve ! That Helps Quick Turn.

- Automatized Hand-Produce Operation Line
- Combined Full & Semi-Automatic Screw-Cutting
- Equipment not for one use, but for versatile
- Automatized Check Device for visual-aspect Check
- Automatized Finishing Base

Birth of High-Intensity Die-Cast Zinc Alloy !

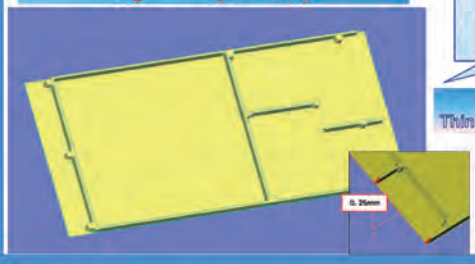
If your materials would be improved by our High-Intensity Zinc Alloy ...



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)

Complete! 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 AZC-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	7.55-8.55	3.00-3.80	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 430℃ (mm)	Poisson's ratio	Specific gravity	Remarks
AZC-α	6500	28	23	495-500	115	435	230	0.296	6.8	

3.Mechanical properties

Material name	Tensile strength (MPa)	Breath (%)	Longitudinal elastic modulus (Gpa)	Charpy impact (J/cm²)	Fatigue strength (5×10⁴ times MPa)	Hardness (HB)	Pull 0.2% proof stress (Mpa)	Elongation at break (%)	Potential (Pa)	Remarks
AZC-α	340	3	83	100-120	100		300	—	—	

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
HORIO SEISAKUSYO CO., LTD
tel0225－73－2488 fax0225－73－3271
e－mail : info@horioss.co.jp

HORIO SEISAKUSYO CO., LTD

The World's Best Processing Technology of Zinc Alloy, Aluminum, Die Casting, and Casting Part

HORIO SEISAKUSYO CO., LTD

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Great East Japan Earthquake

Since our company was located on the hill, we survived the tsunami; but it also caused a huge delay of the delivery. As a result, we received a lot of inquiries from many manufacturers. Ten days after from the disaster, the local infrastructure, such as the electricity supply, was restored.
On March 24, 2011, we reopened some productions. Most unfortunately, however, there were some employees who lost their family members and houses.
Some machine tools still stopped, and what was worse, some engineers couldn't come to the factory due to the traffic disruption and lack of gasoline.

Businesses and Activities for the Restoration

By making the support system between local companies and our clients, We survived the great earthquake disaster.

One of our business partners, Ogatsumusen Ltd., also received a huge damage due to the earthquake and the tsunami. The factory and its equipment for part processing and the inspection were destroyed by tsunami.
Because of this, Ogatsumusen was in the crisis of the business closing.
Therefore, we decided to lend them our plant and space for free to help their business.
On the other hand, due to the stock shortage, we were still dealing with a delay of the delivery.
However, with cooperation of Ogatsumusen, we made work facilities with a rush and solved the problem.
As a result, we were able to keep the contracts with our clients.
During the earthquake disaster, we cooperated with local companies and maintained a supply of parts.

Company Policies

一、固有技術を確立するとともに それをサービスとして
お客様に提供し、オンリーワン企業として発展しよう。

一、オンリーワン企業の構築を通じ、
真に自分たちが満足できる仕事をつくりあげよう。

一、自分たちが発展することで、地域社会と国の発展に寄与しよう。

Development After the Earthquake

After the earthquake, we:
- Produced high performance zinc alloy
- Expanded our business in the new market.
- Utilized development support positively such as Supporting Industry Project and A-STEP.
  (As a result, we were able to develop the high characteristic zinc alloy which wasn't developed in the past.)
- Developed the market in the field of high-strength part
- Expanded the zinc die-casting market

Example: High Strength Zinc Alloy

Mobile Terminal Device

Post-Project & Future Prospects

We aim at improving the reliability of high-strength zinc alloy, and extending the market for automobile parts.

Vision of the 21st Century

Our goal of the 21st century as follows:
・Treating the material of the new field, and evolving it for the field of high value-added products
・Training employees who are in charge of the new field
・Aiming at non-debt management and providing the stable employment

Contribution to the Automotive Electronics Field using Photonics Technology

Hamamatsu Photonics K.K.

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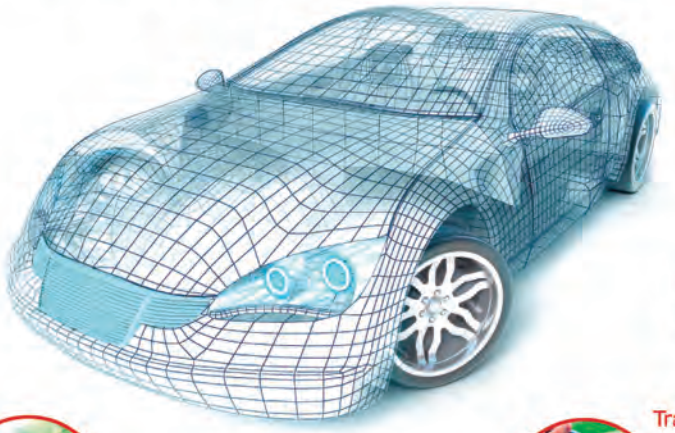
Hamamatsu Photonics' Automotive Solutions

We support safe, comfortable, and energy-saving driving using cutting-edge photonics technology.



Sense the Glare
Si Photodiode,
Photo IC Diode

Sense the Sun
Si Photodiode,
Sun Sensor Assembly

Sense the Rain
Si Photodiode,
Infrared LED

Sense the Music
Transmitter/Receiver Photo IC

Sense the Distance
APD,
Distance Image Sensors,
Pulsed Laser Diode

Sense the Corner
APD, Si PIN Photodiode,
Distance Image Sensors,
Infrared LED, Pulsed Laser Diode

Sense the Angle
Photo IC, Encoder Module,
MEMS Mirror

Manufacturing process support products

Hamamatsu Photonics has a line of products to support manufacturing. Please feel free to contact us.

- **Surface Reforming**
- **Film Thickness Measurement**
- **UV Coating**
- **UV Gluing**
- **Laser Welding**
- **Spectrophotometry**
- **Electrostatic Removal**
- **Nondestructive Inspection**
- **Micro Pinhole Inspection**
- **Image Measurement**

Corporate profile

Company Name
Hamamatsu Photonics K.K.

Established
September 29, 1953

Capital
34,928 Million Yen (as of 18th of Dec., 2015)

Number of Employees
4,482 (as of 30th of Sep., 2015)

Business activity
Manufacture and sales of opto-semiconductors, photomultiplier tubes, light sources, imaging devices, and image processing and measurement systems

Website
www.hamamatsu.com

HAMAMATSU
PHOTON IS OUR BUSINESS

Exploring the Unknown through "Light"

Hamamatsu Photonics K.K.

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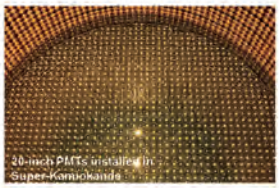
Electron Tube Photodetectors and Light Sources

Electron tube products include light sources which cover a wide range of wavelengths and PMTs which are ultra-high sensitivity optical sensors capable of detecting each photon, the smallest light particle. These products have been developed through basic research and our advanced technology such as vacuum technology. They have a wide range of applications in medical, academic, and various industrial fields and serve as key devices in those fields.


20-inch PMTs installed in Super-Kamiokande


PMTs

Opto-semiconductor Devices

Opto-semiconductor devices which are compact, highly reliable, and suitable for mass production are rapidly increasing their demand in various fields. These products are used in a broad spectrum of applications ranging from medical devices such as X-rays and CT to commodities such as cameras, automobiles, copying and fax machines, and optical disks. They are also used for telecommunications, measurement, and academic researches. With MOEMS technology, applications in yet more new fields are anticipated.


Mini-spectrometer manufactured using MOEMS technology


Opto-semiconductor devices

Exploring the Unknown through "Light"

Ever since Hamamatsu Photonics was founded, we have been pursuing the possibilities of light and developing numerous ingenious products and technologies. These optical applied products have diverse applications in medical, industrial, academic and many other fields.
We will raise awareness of the importance of photonics technology and open up even more needs. By doing so, we aim to generate new industries for the advancement of humankind.

HAMAMATSU
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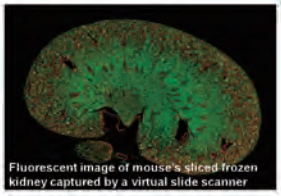
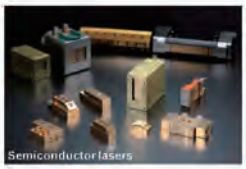
www.hamamatsu.com


Digital CMOS camera for scientific imaging


Fluorescent image of mouse's sliced frozen kidney captured by a virtual slide scanner


Semiconductor lasers


Material processing by a semiconductor laser

We constantly aim for one step ahead of market needs while developing image processing and measurement systems and imaging devices manufactured with television technology. As a result, we have steadily expanded their application range. Our ingenious technology and systems are used in the fields of semiconductor, biotechnology, medical science, FA, optical measurement, and astronomy.

Imaging and Optical Measurement Systems

Semiconductor lasers are suitable for mass production because of their features such as small size, light weight, low power consumption, high-efficiency, and long life. They also achieve high-output power and high functions by being arrayed or stacked. Therefore, semiconductor lasers have various applications such as material processing, welding, soldering, medical applications, distance measurement, laser printing, and excitation light sources for solid-state lasers.

Semiconductor Lasers

Providing the best solutions for customers with “Only One” technology.

Daisho Denshi Co., Ltd.

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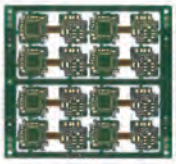
PROFILE

◇Trade Name : Daisho Denshi Co., Ltd.
◇Head Office : 2-16-5, Denenchohu, Ota-ward, Tokyo
◇Established : September 12, 1968
◇Capital : ¥731 millions (March, 2016)
◇CEO : Naotoshi Shinozaki
◇Main products : Design and manufacture of printed circuit board, and other related products
・Designing for pattern, various simulation
・BGA board, CSP board, COB board, FC-BGA board
・Module board, Flex-rigid board
・Build-up multilayer board, Cavity board
・BVH/IVH high multilayer board
・Magic resin carrier
・Laser metal mask
◇Annual Revenue : ¥18700 millions (As of March 2016)
◇Employees : 911 (As of April 2016)
◇Main Customers :
・FUJITSU LIMITED
・CANON inc.
・J-DEVICES CORPORATION
・Sharp Corporation
・Murata Manufacturing Co., Ltd.
・Mitsubishi Electronic Corporation
etc.

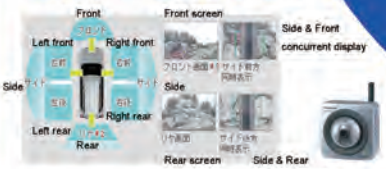
NETWORK

Total Support System

Daisho Denshi flexibly corresponds to all customers needs from R & D, Design through manufacturing, and Assembly, by printed circuit board manufacturing based cutting-edge technology.



4Layers Flexible-Rigid Build up




The white lane marker recognition camera


Automatic high beam camera

CAMERA MODULE

SENSOR, RADAR

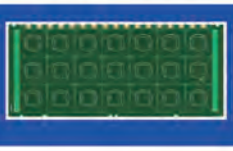
6Layers Build up

COMMUNICATION MODULE

4Layers

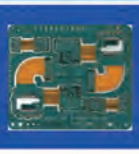
ENGINE CONTROL PARTS

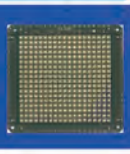
By utilizing production techniques, experience, know-how, and our own networks that have accumulated over the years, we can fulfill our customer's circuit board demand from development through pattern design, simulations, and board production, but also can develop, manufacture and supply production tools to assist in assembly. Our total support policy is complimented with component assembly, Unit fabrication, and high-reliability testers as well. Of course, we offer not only total support, but can bend to meet your needs at each stage of production.



Head Office : TEL03-3722-2151
http://www.daisho-denshi.co.jp

DAISHO DENSHI





Providing The World with Better.

Daisho Denshi Co., Ltd.

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The situation of the Great East Japan Earthquake

■ During the power failure, move forward confirmation and restoration work that can be done during the day

March 11 Set up Disaster measures headquarters
Condition confirmation (Personnel, facilities, unfinished products, materials/chemicals)
We received kind contact of aid and the disaster correspondence from our customers.
Clear scattering things.
March 13 In-house repair of electrical system begin
Repair requests to special traders and correspondence to visitors
March 15 Electrical system was restored, contact with the persons concerned regarding our suffered condition
March 16 Trial run of each facility > Confirmation of detailed damage
Reconsideration of restoration work, make starting up schedule

*The damage amounts to 716 millions yen

■ We would appreciate your kind support for 45 days until production restart!

March 16 Production / shipping begin from light damaged forward processes.
March 22 Special trades arrival begin (Restore groups)
March 24 Restoration work begin in earnest because TOHOKU expressway became passable
March 28 Production restart except a part of process.
We received kind production aid from Tochigi plant and manufacturers concerned
April 4 Whole operation begin except a part of infrastructure
April 7 Maximum aftershock of intensity lower-6.
Temporary power failure
Restart of restoration work > Production restart on 15
April 25 Production start of whole processes

Activities since the earthquake disaster

1. Revival work (Certification of restoration and revival support assistance work)

Iwate south high density cutting-edge PWB manufacturing group (7 companies)

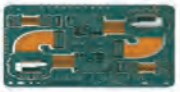
1) New technology products
Component embed board, Heat radiation board
Flex-rigid board

2) Providing of new services
Total support (Development > Design > Substrate manufacturing > Mounting > Shipping)
Quick delivery of prototype

3) Build strong system to disasters
Maintenance of BCP (System making, drill, patrol)

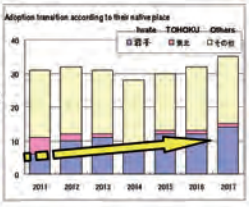
4) Recycling promotion (Group companies)
Correspondence to the small appliance recycling law

5) 6th industry (Group companies)
Special product (Mushroom bed Siitake)
Production/Processing/selling



2. Support

1) Talent
Employment promotion of people from Iwate (New graduates + Mid-career)



2) Local contribution
Parent and child soccer school
Cosponsor KAWASAKI Frontale

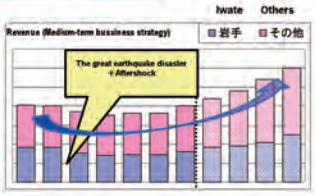
3) Industry-academia-government cooperation
Research project cooperation for Iwate Industrial Research Institute
Local production for local consumption type phosphorus resources circulation system

Phosphorus resources local circulation

Development and activities since the earthquake disaster

☆Expansion of Business
(Overcome depression after the great earthquake disaster)

1. Exploring of New Fields
We started the exploring from IT related fields to receive orders stably.



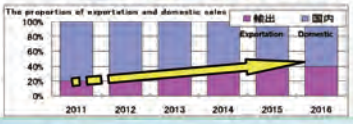
1) Component Module

2) Medical care, health apparatus

3) Wearable

4) Industrial equipment, Robots

2. Expansion of Exportation
Overseas sales reinforcement
Products and services that are accepted in the world



Prospects for the future

1. Utilize lessons of The Great East Japan Earthquake

1) Preparation
Well-known of manual and periodic drill, action plan at the time of emergency, non-border staff arrangement, personnel nurture

2) Initial responses
Information sharing, confirmation system with a diversified point of view, build panoramic indication/order system

3) Transmission
History of our experience for next generation, Disaster measures organization utilizing this time evaluation

2. New Stage

We soon reach the 50th anniversary of the founding of our company. It's time for us to take a great leap forward!

1) Expansion of business
・Expansion sales of new fields
・Strengthening of overseas sales
・Creation of new products and businesses

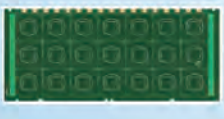
2) Cooperation strengthening
・Industry-academia-government cooperation
Particle accelerator, medical apparatus, automotive component
・Social contribution
Overseas trainee, welfare activities

3) Next generation nurture support

★Total Support

Daisho Denshi "Total Support System" flexibly corresponds to all customers needs from R&D, Design through manufacturing, Surface mount, and Assembly by printed circuit board manufacturing based cutting-edge technology.

We create new businesses with Industry-academia-government cooperation, and try to advance of business expansion.



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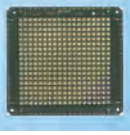
DAISHO DENSHI



We 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 700 taxi vehicle active currently.
As a car running daily basis, there is a running truck record of more than 400,000 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.

Aim for Higher Goals


RHYBRIDCROWN(AWS210 renewal)

The technology and the structure of “Automobiles”, especially “engines” develop firmly and more highly day by day. For example, the latest crown hybrid. It has the new style 2.5L engine “Next generation D-4S” which is concentrated Toyota’s high and advanced technology. We materialized the gasoline × LPG dual fuel reduction by analyzing the vehicle characteristic and the esoteric control system. Immediately, we received construction projects and we are promoting the mass production system.

As “Automobiles” are developing, we are also aiming our technology and system’s progress. This challenge has just begun. We keep on challenging with the aim of future heights.

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

We provide "New familiar Hybrid"

My Car Plaza Eco Custom Division Corporation

http://www.e-rhs.com/

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Great East Japan Earthquake

March 11, 2011 14:46PM That was the moment, ordinary days were completely changed.
Electricity, water and communications, all of the infrastructure functions were stopped, and our corporate activities also stopped completely at the moment.
While watching the small TV screen which was mounted on the vehicle in order to obtain information, we could not help feeling the sense of loss and failure which we could not express.
Our company is located in the inland area of Iwate Prefecture fortunately, so we didn't receive any damage, but we had heard the disaster news that is reported through a small screen and radio with a sense of helplessness and frustration.
Our employees who have a family in Miyagi, was rushed to the family buying the portable gas stove and gas cylinder and grocery.
Also our employees of the local residents rushed the way home due to prepare for spending in the situation that infrastructure does not work.
It is the day, we had attacked by earthquake.
It was after 6 days from the earthquake, our function is restored completely while spending inconvenient days.

Change Predicament to Opportunity

At the time of the disaster, the vehicle ordered by taxi company in Tokyo was stocked in our warehouse.
Our business suspension was a big predicament, but nothing changes if we do nothing.
Therefore, we hurried the making of structure, (such as the kit of the installation part, class manual & contract making), to enable construction in all parts of Japan.
Although there was the framework in the past, we finally shipped a construction kit to the repair shop of the major taxi company in Tokyo, which is our first partner company, and were able to carry out a construction technology class. It was approximately one and a half months later from the disaster.
As a result, 2011 was the year to leave our mark on history to the tie-up with 7 companies & 8 factories. At the same time, it was the year when our participation in "Tokyo Motor Show" was realized. It was an event to be a turning point for both us and the LP gas industry.
I still remember that I looked back on a tumultuous year in Tokyo Big Sight clearly.

Use of fuel as the "LPG"

Practice of realistic eco custom

That is " Real HYBRID system "

RHYBRID®

Innovative Custom for Eco

Learn from the Quake

Post-Project & Future Prospects

The RHYBRID car that we have been developing and selling, has a mechanism called Bifuel (bi-fuel) which equipped with the LPG equipment and the tank to the gasoline car and it use gasoline as sub-fuel and LPG as main fuel.
It is originally said that LPG is a "strong energy to the disaster" because of the lower inexpensive and environmental impact, and it is easy to fill in a cylinder and move, also it is stable demand. Coincidentally we realize that is true through the experience of the earthquake.
At the time of the earthquake, we had a RHYBRID vehicles as company cars and we didn't need to wait in the endless line to seeking gasoline which was undecided when will be replenished.
In addition, there is a fact that people used the taxi which assumes LPG fuel to evacuate. This is a good instance of "strong energy to the disaster"
Fortunately, the number of local governments and the companies which introduce RHYBRID specifications car increased.
It represents the thought that people think the disaster as a lesson.

Human beings have a tendency of "Danger past and God forgotten".
Our disaster prevention awareness fades day by day if we regain a time of peace. It is the fact that we cannot fight against. In a sense it is proportional to an attention degree to our RHYBRID specifications car, too.
However, the first purpose that we worked on RHYBRID specifications car was to switch our custom technique to eco-friendly one. In addition, we noticed the importance of continuing sending our technique to the person needing it while we pushed forward business.
Our target is the niche market, and it is the ideal market size judging on our corporate scale.
Although our company is small, the business profit is important.
We follow the evolution of a car evolving rapidly without being late for it .
Moreover, we offer our technique to the person who needs it, and continue business while valuing that we thank for the connection with people and a relationship.

RHYBRID仕様車 設計・開発・組工・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

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

Highly recommended!

"LNG-DDF"

Main figure in the shale gas revolution

Hana Engineering Japan Co., Ltd.

http://www.hanaeng-japan.com

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

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.

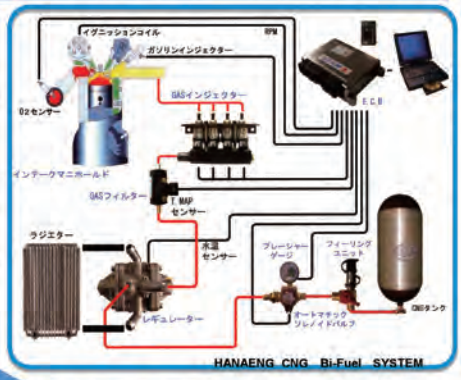
Therefore, almost hazardous wastes will be restrained, and many high environmentally cars exist in the world.

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.



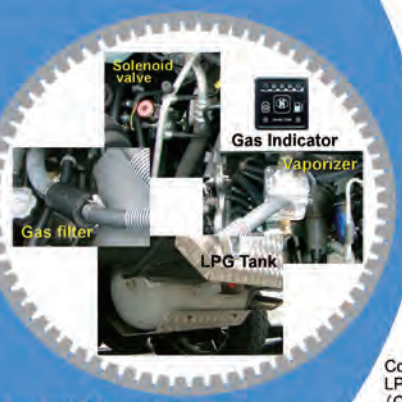
HANAENG CNG Bi-Fuel SYSTEM

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 of 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 .

Next-generation multi-fuel engine

High torque and high environmental performance multi-fuel system

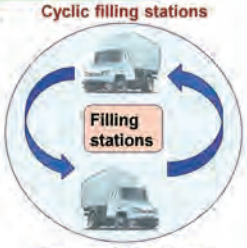
Hana Engineering Japan Co., Ltd.

http://www.hanaeng-japan.com

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

① Current low-pollution technology CNG-burning vehicles and CNG-DDF vehicles

About Fired type CNG vehicles It has been increasing in recent years because of the high environmental, but it is only suit to the busses in urban areas and delivery trucks traveling in the city, not suit to the heavy vehicles for inter-city travel. Because it combustion system with spark plug is same as gasoline vehicles, and it's combustion efficiency decrease from 30 to 35% at a low compression compared with diesel, also torque will be descend. In addition, its own weight requires a large number of gas containers, and the number of filling stations is only about 300 places across the country and they are concentrated in urban areas.



About DDF (Diesel dual-fuel) It is based on the high-torque diesel engine and it makes a high environmental performance engine. When the combustion chamber reaches a predetermined rotational speed (combustion chamber temperature), gasoline and CNG, etc. is injected at the same time in order to increase the combustion chamber temperature to decrease the PM which is generated by the gasoline fuel combustion. In recent years, the technology of engine is advanced and the common rail system has been developed. That system reduce the PM (soot) by the fine mist of gasoline with the injection at a higher pressure. But the PM is still there and PM became micro same as mist of gasoline at the same combustion temperature. It's a Nano PM. Nano-PM is pass through the mask, and enter the blood from the lungs and commit to the reproductive function of genital not only brain and organ. DDF burn completely by raising the temperature with two-way fuel combustion of diesel and CNG, and it has been devised as high environment performance engine which restrain the hazardous waste and Nano PM.

High torque because of the diesel base

It is the best as inter-city movement cars for long-distance with heavy loading, because the base is diesel which combustion efficiency is 30-35% higher than in-fired type CNG vehicles and it is high-torque.

② However, there was a big drawback to the DDF

That is the difference of the ignition temperature of the dual fuel. Ignition temperature of gasoline is 250 ℃, and CNG is 650 ℃ whereas compression heat of the combustion chamber of the diesel engine is 300 ℃. Gasoline will start to ignite immediately, but in case of CNG, injecting cause the incomplete combustion and engine will be knocked. So during startup, only gasoline will be burned, and when the combustion chamber temperature reaches the ignition temperature of the CNG, our vehicle will start fuel injection of CNG gradually in order to keep the best balance of fuel at the peak temperature. It means, it become a low environmental performance engine same as the general diesel engine, because the only gasoline combustion during the low-rpm range and low temperature in the combustion chamber.

LNG-DDF of Sweden Volvo Trucks

③ And, multi-fuel engine has been devised

Drawback of motor vehicles /DDF vehicles On the other hand, fuel cell vehicles which has motor as a prime mover are not suitable systems for large and heavy vehicle because it required ultra high rotation from the start in order to generate a high torque. In modern science, we has been considered DDF is the best of the prime mover for the heavy vehicles. However, as described in ②, DDF has a drawback to mass release of harmful exhaust emissions from the difference of the ignition temperature of the gasoline and gas at a low speed idling.

Development of multi-fuel engine Fired type CNG engine combustion efficiency and torque is low performance at low compression, but environmental performance is high. On the other hand, DDF combustion efficiency is high performance and torque is also high same as diesel, but DDF discharge a large amount of harmful substances at low rotational speed range with only gasoline combustion. So we considered whether we can unite a-fired type CNG engine and DDF engine. Of course, it is absurd to mount the two engines in one car, therefore we considered that placing the cylinder assemblage with two types of features in a single engine. Multi-fuel engine consist of high-compression cylinder assemblage and low-compression cylinder assemblage. Low compression cylinder assemblage has a Otto type sparking plug ignition, and only low-compression cylinder assemblage burns CNG when the engine starts, and when it reaches the 650 ℃, high compression cylinder assemblage as DDF, which deactivated in the cylinder, will start the combustion. At this time, combustion chamber temperature already become over 650 ℃, CNG will be injected to the combustion cylinders which was already injected gasoline, and PM and also nano PM, which are will be difficult to be suppressed by only gasoline combustion suppressed combustion in the combustion chamber by the dual fuel combustion heat.

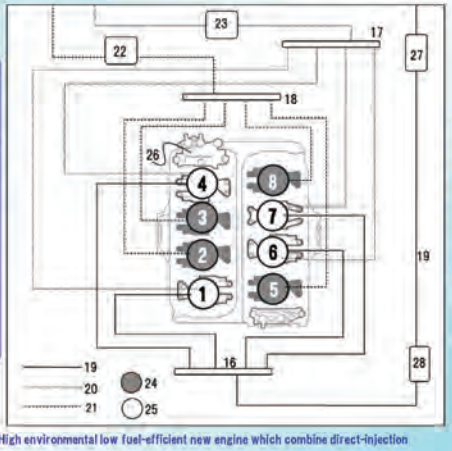
(Liquefied / compressed natural gas)

Providing Next-Generation Large Automobiles

Materialized next generation trucks and buses with high environment and high fuel consumption by new engine development which was completely reconsider about drawback of CNG-DDF of high torque and high environmental performance.

Schematics of MF Engine

- MF engine cruising distance per fuel one filled is 5 times of the electric car.
- Reduction of CO2 13% to 25% and Nox, Sox, such as harmful exhaust emissions 60-90%, compared with gasoline and diesel vehicles.
- Fuel economy is expected to be improved 30 to 40 percent by normalization of the natural gas price by the shale revolution.



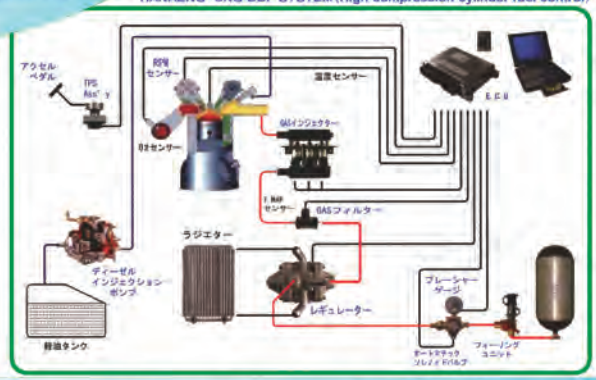
High environmental low fuel-efficient new engine which combine direct-injection two yuan combustion cylinder of liquefied natural gas and gas-fired cylinder of the total rotation range high environmental performance keeping the high torque of long-haul freight transportation and multiple transport large automobiles ! We provide the world's most advanced technology, that's main fuel will be Shale gas which can be the leading role of the earth's resources in the near future.

PM suppression rate by the DDF is measured value 90%, by MF engine has set a target of 100%.

④ MF engine is a multi-clean system which is capable of applying not only car but also ships and power generator.

Multi-fuel engine is a multi-clean engine which is capable of applying not only car but also ships and power generator. In addition, the corresponding gas also wide variety of CNG, LNG, LPG, and hydrogen gas. In the case of vehicles using gas as a fuel, it becomes drawback is the number of the container which needs useless weight and space. Therefore, liquefied natural gas (LNG) infrastructure is expected to be developed in time MF engine with using safe and ideal natural gas will be commercialized. In addition, in case of LNG, it allows saving space and weight of fuel tank 1/6 times in the same range.

HANAENG CNG-DDF SYSTEM (High compression cylinder fuel control)



Next generation passenger car and small cargo vehicles in Japan is becoming determined the direction to the fuel cell vehicles. (However, because the hydrogen filling facility construction cost is high as 10 times that of natural gas filling facility, it is considered the global spread is difficult). On the other hand, development of the new system for next generation large automobile does not proceed even in a car manufacturers. In this situation, that is "multi-fuel engine" for a new next-generation automotive which was invented by the next-generation vehicles, Miyagi Prefecture area.

Hana Engineering Japan Co., Ltd.

East Japan Sales Division: Hana Japan first Bill 2F・3F, Haramachi 3-1-43, Miyagino District, Sendai, Miyagi Prefecture

TEL: 050-1208-5862(Main) FAX: 022-776-5072

E-mail:hanaeng_japan@ybb.ne.jp

Head office: Sendai, Miyagi Prefecture / West Japan Sales Division: Kiyosu, Aichi prefecture

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

Searches for five senses functional sensing

Miura Sensor Laboratory, Inc.

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

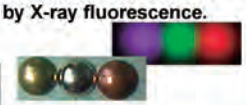
Non-contact type harmful elements detecting device

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.



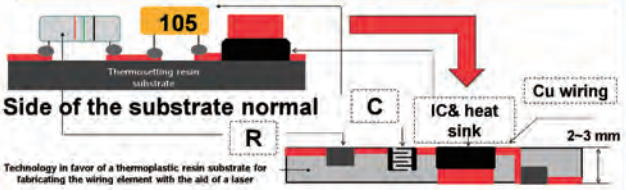
small

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 】

Side of the substrate to be prepared by the action

- 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

ルリフィ

Loulifee

3 感覚 フィードバック システム

株式会社ミウラセンサー研究所

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.

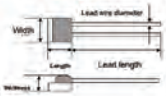
Plastic coating thermocouple line

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

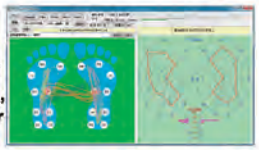
Name	M 222 platinum resistance temperature detector	
Nominal resistance	100Ω (when 0°C)	
Tolerance	German industry standard DIN EN 60751, class A	
Manufacturing standard	German industry standard DIN EN 60751 (IEC 751)	
Temperature range	Class A: − 50 °C ~ + 300°C	
Temperature coefficient of resistance	TCR = 3850 ppm/K	
Output wires	Platinum clad nickel wire	
	Connection methods: welding, welding, brazing	
Prolonged stability	Resistance value drift of 500 °C 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 5ms. (※2)	
Use conditions	Available only dry environment.	
Insulation resistance	20°C: 100 MΩ over : 500°C: 2 MΩ over	
Self-heating	0.4 K/mW at 0°C	
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 °C ~ 55 °C. It is the tolerance of the Class B in the case of 500 °C ~ 300 °C.

※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

Search for the five senses feature of the human being

Miura Sensor Laboratory, Inc.

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The situation of the Great East Japan Earthquake

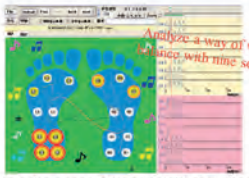
The sludge element measurement in the disaster area

①Mitsumata 1　⑥Nakaze
②Mitsumata 3　⑦Fudocho 1-chome
③Okaidokita 3　⑧Ishinomaki Gyokomae
④Minaminakasato 3　⑨Watanohanagahama
⑤Minamihamacho 1　⑩Shiotomicho 1

Sludge inspection in flooded areas by Denbee Base (May, 2011)

Activities since the earthquake disaster

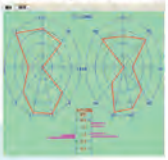
The walking posture measurement for the temporary housing residents



☆ separate the strength by color with five phases

☆ Walking sensation and balance tendency

☆The locus of longitudinal and lateral center of gravity



Using our product "Loulifee", we diagnosed subjects' postures when they walk, and offered the data. (a cumulative total of 400 people)
***Prevent inhabitants' economy-class syndrome !**
***Solve "social withdrawal problem" by making their walks more enjoyable !**

Development and activities since the earthquake disaster

Exhibit the International Industrial Fair 2011 Kobe

Exhibit the business interchange fair in Kyoto(2012)

Join business convention for reconstruction

Donate 11"SOLAR TWINSARUS" to elementary schools & junior high schools in Higashimatsushima (With Mr. Abe, Mayor of Higashimatsushima city)

Join Innovation Japan 2013

Prospects for the future

Conclude "Sanmirai Tagajo・Revival housing complex" agreement (With Mr. Kikuchi, Mayor of Tagajo city, August, 2015)

New office building is going to be opened in March, 2017

From April, 2017, our office is going to move to Tagajo city. In the new factory that we have been waiting for, we'll produce a food processing device which made use of an optics technique and medical welfare apparatus OEM parts. We are also planning to commercialize "Tagajo brand" and interact with local inhabitants positively.

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

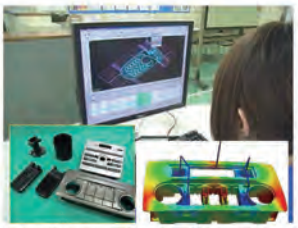
We pursue "Manufacturing" that meets customer needs precisely and promptly

MG Co,. Ltd.

文部科学省　一般社団法人 東北経済連合会　東北大学　宮城県　77 七十七銀行　ICR

Engineering plastics injection molding

Fully automated injection molding multiple inserts



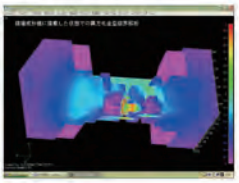
Tool design and production of using abundant experience technology

Control Panel unit for automotive
・Integrated production from molding to assembly
・Decorative processing technology

Connector molding

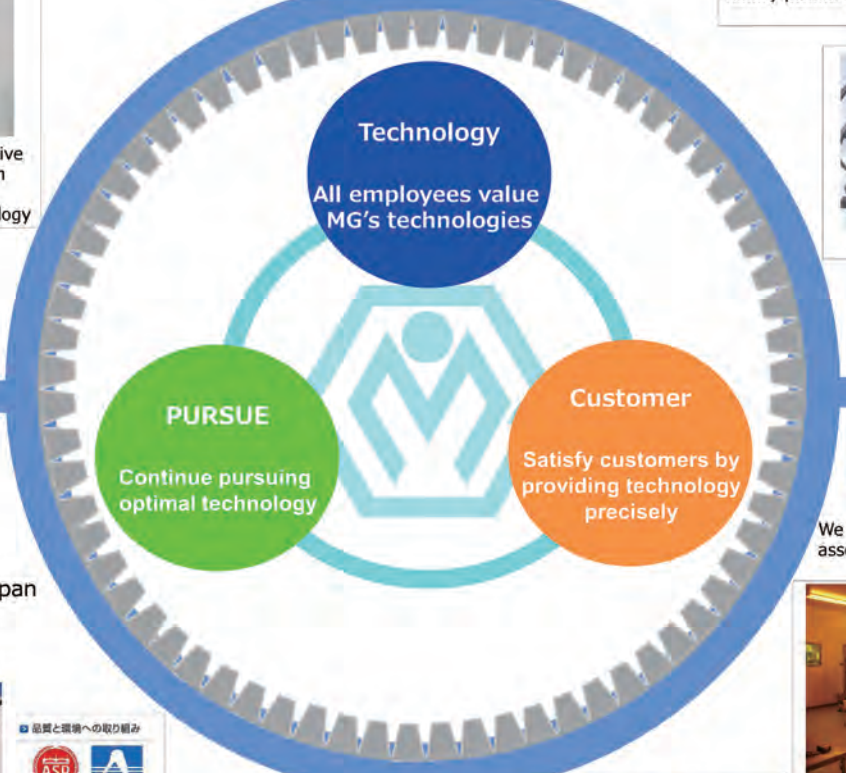
Plastic Magnet Injection Molding and Magnetizing

・Two-color molding with magnet and plastic
・Shaft insert molding
・Magnet and magnetizing design by magnetic field analysis



Rotary positioning sensor using the magnet (Automotive)

Various plastic magnets



MG CO.,LTD

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Fax: +81-22-356-5508

品質と環境への取り組み
ISO9001
ISO14001
JAB CM035

ISO9001、ISO14001の認証を取得しています

MG Group Worldwide Network

Assembly technology

We have manual and automatic assembly, including clean rooms

Automated assembly line in clean room

Automotive parts manual assembly line

Automotive parts robot line

To Corporate Customers

Utilizing the advanced injection molding technology, we pursue manufacturing with customer satisfaction

株式会社エムジー MG Co.,Ltd.

URL : http://www.mg-japan.co.jp/

Contribute regionally and grow ourselves with our technology

MG Co,. Ltd

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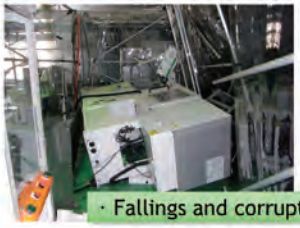
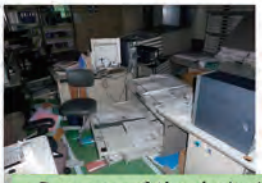
Conditions right after "The Great East Japan Earthquake"in 2011




・Fallings and corruptions of our facility


・Damages of tsunami at Yamoto warehouse (HigashiMatsushima-city)

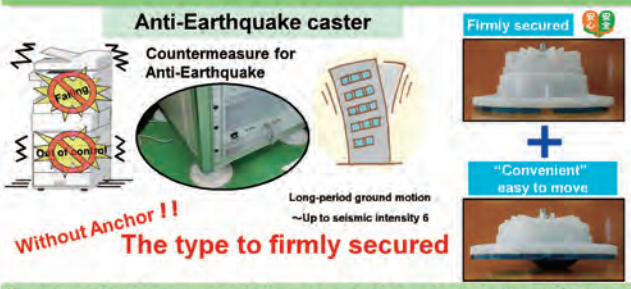



・Damages of the designing room and office area

R & D after "The Great East Japan Earthquake" in 2011

Efforts to develop anti-earthquake products : "Anti-arthquake Caster"

・Prevent heavy equipment/machine sliding at the event of disaster , secure evacuation route , and etc.



Developed solar-powered dimming signboards and street lights

・Easy to install , solar-powered street lights with dimming signboards

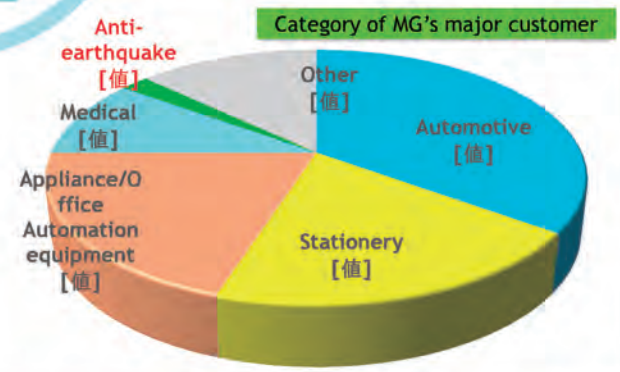

Development and activities after the earthquake

August 7 and 8, 2014
Participate expo at AER(Sendai-city)
"The 5th Earthquake Technology Expo"

January 16 and 17,2014
Participate expo at Forest Sendai "2014 Sento Marugoto Fair"
March 12,2014
Participate expo at Mielparque Sendai
"Practical Solution 2014 by Otsuka-Shokai"


＊Start taking orders for anti-earthquake auto-shutoff breaker as consignment production in 2014

Future outlook



・Expand business specially production for anti-earthquake products as anti-disaster

・Become the anti-disaster company by expanding automotive and medical industries that are the core of regional rehabilitation

・Expand business in application product using plastic magnet, MG's signature technology.(Sensor, encoder, and etc.) Automotive sensors, small motors, and etc.

株式会社エムジー MG Co.,Ltd.

URL : http://www.mg-japan.co.jp/

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.

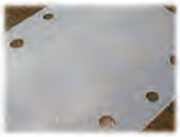
Mass production press and planning and manufacturing the metal mold

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

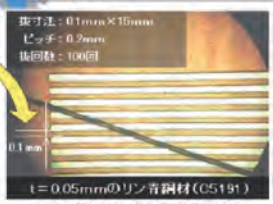


★Planning, processing and cutting-in of metal mold

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 8 sec/1sheet 200sec/
Magazine (25sheet)

★Equipment

★Magazine part

This machine can admit the semi-conductor which is from a reflow furnace to the magazine

Sample processing and precision machine processing

Cost, Down
Suggestion sample of precision

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

After combined

Technology Fusion

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

Progress Since the Great East Japan Earthquake and Future Prospects

Iwanumaseikou Co., Ltd

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Great East Japan Earthquake

The Tsunami following the Great East Japan Quake reached our factory and caused serious damages at almost all our facilities and molds. Molds are strictly necessary to produce customers' parts. With the cooperation of various people, such as local residents and professionals from neighboring prefectures, we could restart the operation partially on April 11, just a month after the Disaster. First we considered how minimizing the adverse effect to the customer. We united and dealt with the problems, removed the sediment and sludge that the Tsunami left, maintained the molds. We completely recovered from the disaster after 3 months.

OUR SLOGAN:
WE DO CREATE NOT ONLY MAKE
WE UNITE AND GO FORWARD !

Development After the Earthquake No.1

Community information magazine published: Nowti

solar panel

Iwanuma mega solar power plant adjacent to the airport

Trestle for supporting the panel

President Chiba:
Searing restoration with confronting the predicament

Development and commercialization of the cable clip which fixes the panel wiring

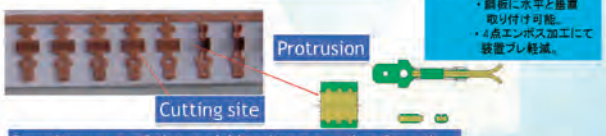
Cable clip skeleton (metal stamping)

We supplied cable clips and trestles developed by our company to the Mega solar power plant (output: 28.3MW), which was built at farmland of Iwanuma Aino west where the Great East Japan Earthquake reached. With that, we contributed to the regional revitalization and industrial promotion.

Development After the Earthquake No.2

Crimp terminal for magnet

Application : Equipment operated at high wire reliability, harsh environments



Development of the mold having a cutting function

Closed forging press working (high voltage connector)

Manufacturing, commercial and service innovation subsidies (Miyagi Industrial Promotion Organization)

In four consecutive years from 2012 to 2014, we worked on research and development actively and we continued challenging the establishment of advanced new technologies and new construction methods, such as the core of the next generation business.

Third factory completed In 2016

Exhibited to the machine element technology Exhibition June 22 to 24 in 2016 :Tokyo Big Sight

Post-Project & Future Prospects

Against the competitors go into abroad and enhancing oversea supply chain, we are standing and pursuing the high quality in Japan. So, we are considering how to lead the younger age passions, ideas, and creativity. And we are also paying attention to carry out women's appointment actively.
we want to pass our humanities, skill, and technologies to the next generation by hiring ambitious people, regardless the gender. And we are also continuously encouraging the community through acceptance of internships from the local high school, or the programming software in collaboration with National College of Technology.

~We aim to further development with actively PR of products and technology continuously.~

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

Frontier company of magnetic power transmission

Prospine Co., Ltd.
117 Azashinsenkarita Tsugihashi Matsuyama Osaki-city, Miyagi-pref. 987-1305
TEL: 0229-55-3375 FAX : 0229-55-4350
http://www.prospine.jp

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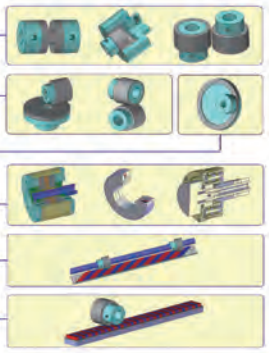
Product variety and advantages

Standard goods
- Coupling
- Miter

Customized goods
- Gear
- Clutch & Brake
- Linear slider
- Rack & Pinion




Power transmission through wall


Torque limiter function


Easy attaching and detaching


Large tolerance for declination and eccentricity

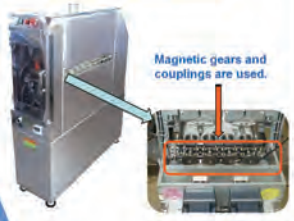
Applications

Belt conveyor for clean room use
Ex. Semiconductor, LCD and food-producing process etc.

Tension control for fiber-producing process

Bread kneader

Clean roller


Magnetic gears and couplings are used.

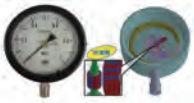
Other applications
-Robot
-Mixer
-Sorter etc.

Prospine offers

non-contact power transmission mechanism.

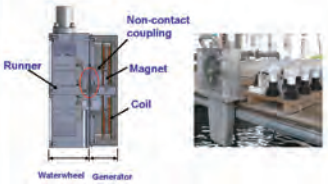
Expansion of applications

Pressure gauge
This mechanism decreases mechanical vibration resulting stable pointing of needle and avoids the wear inherent in mechanical gear.

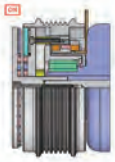


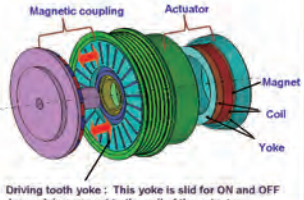
Magnetic gear
Gear ratio is one to five and the power transmission efficiency is more than 96%.

Small hydropower generation
A waterwheel and a generator are separated by magnetic coupler. Field tests have been performed.



Magnetic clutch
A magnetic non-contact clutch is the Prospine coupling with an on/off function. Instant current flows only at the moment of ON-OFF changing to realize an energy saving clutch.





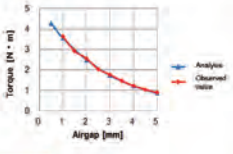
Driving tooth yoke : This yoke is slid for ON and OFF by applying current to the coil of the actuator.

Attention

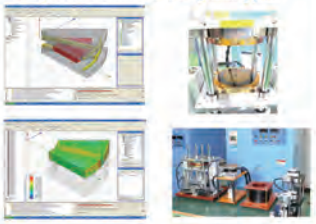
Magnetic field analysis simulation
Cooperation with Industrial Technology Institute, Miyagi Prefectural Government

The example of magnetic field analysis for magnetic miter.

The analysis of magnetic torque coupling shows the correlation over 90%.



Analysis and instruments of magnetizing yoke



Topics

Established the world's first magnetic field analysis simulation technique for the brake unit using hysteresis material !

Co-development with customers
We design and provide custom-made products according to your specifications.
Sales contact: http://www.prospine.jp Kiyotaka Ikeda or Shigehisa Sato

Progress Since the Great East Japan Earthquake and Future Prospect

Frontier company of magnetic power transmission

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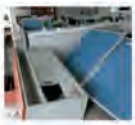
MEXT TOHOKU ECONOMIC FEDERATION Tohoku University 宮城県 七十七銀行 ICR

Damage of The Great East Japan Earthquake

The March 11th earthquake did not bring a fall or fire to our facility, however there were land subsidence, fall-down of some machines, outer wall breakages and so on. Though some employees had their homes collapsed, fortunately all employees and their families were safe. We worked together to prepare the production process by March 22 after the recovery of electricity. Then we tried to restart the mass production by arranging the machines one after the other.



Endeavor after the disaster

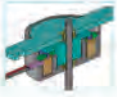
"Restoration and Maintenance Subsidy Project for Facilities of Small and Medium Enterprise Groups"
We are subsidized as "metal die group" through the cooperation of the companies dealing with heat treatment and a variety of metal dies. Some companies introduced new machines and we repaired buildings and floors by this subsidy which was really helpful for our restoration.

"FY2011 Subsidy for Development of Business Environment"
With the help of "Mirai Sangyo Souzou Osaki: Creation of future industry in Osaki", we exhibited our products at 2012 Mechanical Components & Material Technology Expo (Tokyo/Osaka) with other three companies and that was a big help for our business expansion.

Prospine's mission

We will always keep creating the epoch-making products and services with our three strengths;
Highly skilled Craftsmanship,
Future oriented Innovative Mind,
and Strong focus on Customer Relationship

Activities after the disaster



Electromagnetic brake

Pressure gauge

Shoei Engineering Co., Ltd. was renamed Prospine Co., Ltd. and we have been aggressively working on the business growth of non-contact power transmission mechanism.
Our project were adopted by NEDO: New Energy and Industrial Technology Development Organization and JST: Japan Science and Technology Agency in our development activities. Then non-contact type magnetic clutch and electro-magnetic brake were developed and were put into mass production. Besides the above applications, we have been developing a pressure gauge, water power generation, tide power generation and so on. Now the magnetic products have began to prevail in many applications.
We used to produce high precision camera platform as OEM, however we started to sell these products under the name of "Prospine" in 2013. In 2015 the article of our "camera platform" was published on the magazine "Sendai Economic Circles"

Vista for the future

Magnetic gear

Small hydropower generation

Prospine Co., Ltd. will offer good products and services from Miyagi in consideration of the followings;

- commitment to technology capability
We create reliable products to customers through by refining our skill of metal working, heat treatment and magnetic product manufacturing.

- commitment to development capability
We aggressively challenge the development of custom products, the improvement of present products and the creation of new business

- commitment to proposal capability
We satisfy customers' need through the deep focus on their issues with our sales and development team as one.

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】92(As of July, 2015)
【President】Tokumi Hatanaka
【Scope of business】Precise mechanical component
The design and assembly for automatic machines
【Certification】ISO9001・ISO14001・EN9100

Tackles by local relationship

～Collaboration between Designer and Artisan and Manufacture company～

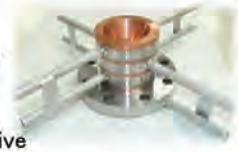
The luxurious aluminum material shaped "S" Sendai s initial are coated with Tamamushi lacquerware which has vivid colour and lustre. (Our company take charge of cutting.)

※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)

EN 9100 BUREAU VERITAS Certification

・The international standard EN9100

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", Therefore, we aim to shorten delivery time.

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.

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.)

Controlling whole factory by production management system

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.

"Product testing device "

Semiconductor manufacturing apparatus related business

"Semiconductor manufacturing apparatus "
Materials : A5052
Thickness : 25mm

"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 http://www.kyoyu.jp/ E-Mail info@kyoyu.jp

Contribute to the product development by our speedy manufacturing

KYOYU Co., Ltd.

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Great East Japan Earthquake

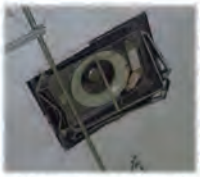
<March 11, 2011>
PM 2:46 Earthquake (M9.0) occurred
PM 3:30 Only managers stayed at the office and instructed other employees to return home.
Instructed the employees who had small home damage to come the office next day.

<March 12, 20011>
About 30 employees carried out clean up work and distributed Noodles.


Septic tank uplifted


Milling machine overturned


Grinder moved


Air conditioning corrupted

March 18: Water, electricity restored at Misato-cho
March 28: 100% restoration of operation before earthquake
April 7 (PM11:32): Largest aftershock(M7.4) occurred.
April 8: Restored the office by all employees.
April 9: Distributed noodles
April 11: Restored the normal operation promptly by the experience at the 3.11 earthquake.


Restoration work

Endeavor after the Earthquake

<August 1, 2013>
Acceptance the local companies tour (industry, academia, the government and banks cooperation)


Factory tours for industry, academia and government officials

<June 4, 2015>
Appearance Tohoku reconstruction calendar (anTV,inc.)


http://www.re-tohoku.jp/movie/31160

"Kirari company selection" producted the benefits Video. "Kirari company selection" selects the small and medium-sized enterprises as "Kirari company" notably college students, and introduce them by SNS.

<May 19, 2016>
Exhibited at the G7 finance ministers and central bank governors conference Welcome Reception

The "cup and Guinomi made of Ogatsu stone" produced by industry, academia and the government, was showed off at the G7 conference, and we received a high evaluation from the G7 finance ministers and other members.

<April 2015>
Miyagi Manufacturing Network "ORIHIME" commenced


Four companies which has manufacturing facilities in Miyagi Prefecture worked on the technical capabilities outgoing and sales channels to overseas with industry, academia and the government.

The original lamp, which is in the image of the Sendai Tanabata Festibal motif "Fukinagashi", was born from the consortium which consists of women managers.

KYOYU

We Take Advance To The Change

Efforts after the Earthquake

Medical Equipment

▸ We conducted research and development about barriles minimization for difficult-to-cut materials jig which insert an optical component using an ultrasonic vibration incorporated and "JST reconstruction Promotion Program collaborated with Tohoku University Kuriyagawa laboratory(2012-2014).

▸Achievement :
We built an ultrasonic vibration cutting technology and improved that parts productivity 140%.

▸Expected effect
We will engage in not only our companies development but also contribution in the world of the aging society and advanced medical technology by involved in human life industry.

Difficult-to-cut materials big-size cutting

We established a prototype demonstration system with focus on the difficult-to-cut materials big-size cutting technology which is required high-precision machining using the "Tip technology demonstration and evaluation equipment maintenance costs subsidiary aid".

▸Achievement :
We have made it possible to develop a less internal strain cutting conditions and mounting method and realized the high quality and high productivity of manufacturing.
We are dealing with the aerospace business, automobile-related business and semiconductor equipment-related business.

Post-Project & Future Prospects

▸Our company is running nationwide.
We aim to be a company that contributes to the "manufacturing" of our country through our "high-precision processing technology".

▸We built a whole process integrated production system which consists of labor-saving machinery, precision machinery, tool design and assembly work, and we promise QDC by the continuous production system. The strength of our company are "quality, speed and proposal ability". We enhance these strong points more, and we enhance these strong points more, and we endeavor to improve the customer satisfaction of existing fields and develop the high value-added industry such as automotive, medical equipment, semiconductor manufacturing equipment and aerospace.

▸We engage in ultra-precision micro-machining to heavyweights cutting of φ2,000mm and we are challenging to the infrastructure business!

KYOYU Co., Ltd.
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TEL:+81-229-34-2329(represent) FAX:+81-229-34-1965
URL http://www.kyoyu.jp/ E-Mail info@kyoyu.jp

SME Innovate in Next-Generation Automobiles

ASTER Co., Ltd.

http://www.ast-aster.com

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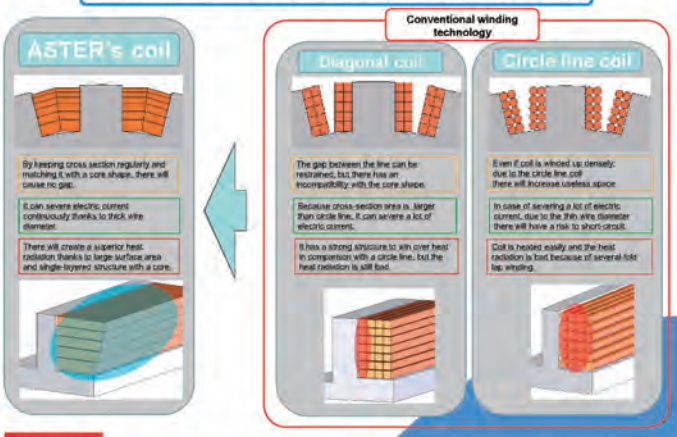
Development of the high efficiency motor (super motor)



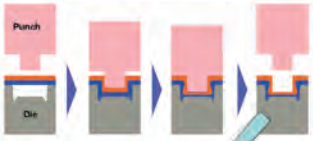
Performance

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.

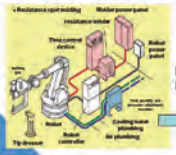
Development of swage joint device for car steel plate



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.

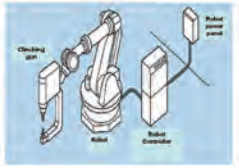
Point

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 consumption 1/3　line scale 1/3
retention costs 1/3　environment's anti- pollution



Power train section

Body section

We propose to next generation automobiles in full scale

LED light

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

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

Progress Since the Great East Japan Earthquake and Future Prospects

Development proposal company born from adverse circumstances

ASTER Co., Ltd.

http://www.ast-aster.com

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

Progress since the earthquake

Just after 10 months from our company establishment, the great east Japan earthquake occurred. It was about time when the work loads had begun to increase. Fortunately, all the employees were safe, and there was not the damage of the collapse and processing machine, but distribution and electricity were interrupted, and the production stopped.
To shine dark stricken area, we developed the desk LED lights and provided 200 of them to the area through Yokote-shi government office.
It was a good chance to start the development of the LED light in earnest.

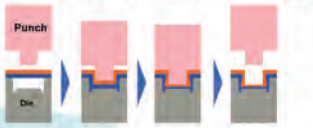
LED light

Efforts after the earthquake

After the earthquake disaster, we are specialized in development of products and the technology development that captured energy saving.
By the active suggestion to the major manufacturer, we develop products with various makers such as a car, aerospace, a railroad, industrial equipment, and house makers.

Development of the Caulking Joining Technology

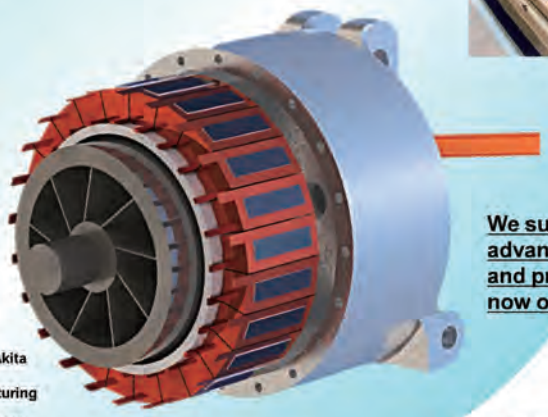
A joining technology and the joining device that make the different kind metal joining and the simultaneous joining at many points cheap and easy.



Energy saving heater technology

By using a special conduction sheet,
we develop, produce, and sale these products below;
・Floor warmth system
・Melting snow sheet
・Heating for stock raising

unconventional product development



Development after the earthquake

Industrial property rights

・Patents have been applied for ：9
(include 4 international patents)
・The patent acquisition ： 4
・Industrial Designs ：1

Certification / Authorization

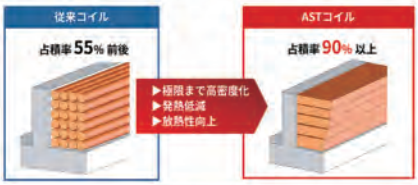
・"Training Support Program of Manufacturing Core Enterprises" (Akita Prefecture)
・Specific research and development plans based on "SME Manufacturing Enhancement Act"
Caulking joining technology:1(July, 2012) /Coil technology:1(July, 2013)

Awards

・Akita Invention Exhibition Tohoku METI award/Akita Metal Machine Manufacturers Association award
・Habataku small and medium sized enterprises 300 in the category of technology (Ministry of Economy, Trade and Industry)

Strategic Energy Saving Technologies Innovation Plan (NEDO)
Research and development of the high density and high output motor with ASTER's coil

We researched and developed the high density coil along the core shape keeping the conductor cross section the largest and constant.
By our innovate manufacturing process, the innovative coil that can output more than 200 % higher by the existing coil was



Post-Project & Future Prospects

We suggest the action of the advanced technology, new technique and products to various fields from now on.

Build a Future

ASTER

We reformed logo mark in July, 2016.
Using "Mirai font" which is imaged for near future,
We made the passionate red logo mark which represents our corporate culture,"Create the future by ourselves"

MEXT Regional Innovation Strategy Support Program Next Generation Automobile Miyagi Area

Automotive Components and Systems

Perfecting the Art of Electronics

ALPS

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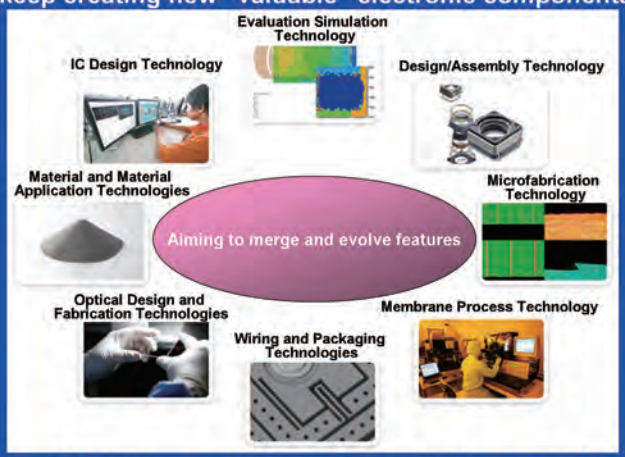
Business Fields

Human Machine Interface (HMI) Products

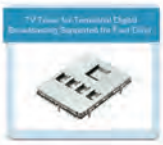
Immersion
TouchSense™ Technology Licensed by Immersion Corporation

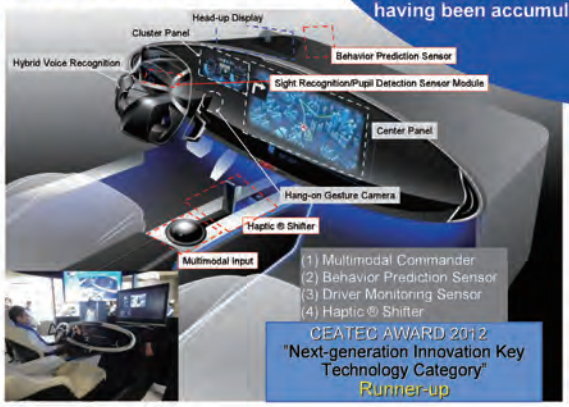
Evolving and merging unique technologies to keep creating new "valuable" electronic components



With newly proposed "value" merging advanced technologies with proven functional devices, ALPS' "Next Generation Premium CockPit" won the Runner-up at CEATEC JAPAN 2012.

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.





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

Aim to be a company for which sustainable growth is possible.

ALPS ELECTRIC CO., LTD.

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

Great East Japan Earthquake

The earthquake struck off the Pacific coast of Tohoku Region in Japan on March 11, 2011 caused damage to seven Alps facilities in Miyagi and Fukushima Prefectures. Within 20 minutes of the quake, a disaster response headquarters was set up at Alps Headquarters, in Tokyo, and a united Alps Group set about confirming the safety of employees and their families, assisting victims in restoration of living conditions and restoring plant operations.

Despite continuous aftershocks and numerous difficulties, restoration work progressed faster than expected thanks to the devotion of all employees, support from suppliers and the efficient delivery of relief supplies. Production had resumed in some plants within a week and in all plants by March 28.

Earthquake Level

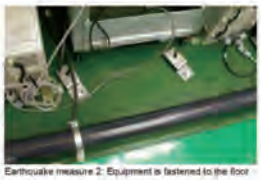
Endeavor after the Earthquake

Worldwide customers had been concerned that the supply of parts from Alps would falter and they had to stop their own production lines. So they offered kind words of appreciation when we were able to carry out deliveries without delay owing to our quick restoration of production activities.

We believed we are able to restore operations quickly despite the unprecedented circumstances because of our readiness for disasters learned through past experiences and exertion of our solid networks with all the parties concerned.

Based on the disaster experience, we aim to further strengthen and enhance risk management and Alps will strive to be trusted by all stakeholders including the customers.

Earthquake measure 1: Items are prevented from falling off shelves



Earthquake measure 2: Equipment is fastened to the floor

We consider these three (Automotive, Mobile market, and EHII) to be the emphasized market. And, we aim for further growth.

Efforts after the Earthquake

We have made effort to revive and contribute to the regions by the industry-university-government cooperation since the great earthquake.
One of the approaches is the participation in "Tohoku Innovative Materials Technology Initiatives for Reconstruction" that has been advanced with Tohoku University.

A special lecture and the technical presentation are executed in Iwaki City aiming to contribute to the material industry development and the revival of the Tohoku region.
We are going to propose the contribution to the revival of Iwaki City.

To commercialize this soft magnetic alloy, Tohoku Magnet Institute Co., Ltd., was established on November 5th, 2015. Alps Electric made an investment in this company together with Tohoku University Venture Partners and four other companies in the private sector. We are committed to supporting the creation, accumulation, and industrialization of the ultralow-loss magnetic core material as the de facto standard for the industry and developing products where the material is applied.

Post-Project & Future Prospects

Our company settled on "The eighth Mid-term Business Plan" from April in 2016 for three years. We aim to be a company for which sustainable growth is possible.
And, we consider these three "Automotive, mobile market, and EHII as a growth market in the future" to the emphasized market.
We work on further earnings improvement in the Business for the Automotive market. For a mobile market , we aim at the continuing creation of the new product and the customer's expansion. As a result, the improvement of earnings in both markets is achieved, and we aim at the expansion of further earnings. EHII is constructed as a business pillar at the early stage.

We work on the development of the new product with the sense of speed and uniting three technologies HMI, sensing and connectivity.

EHII : Energy, Healthcare, Industry, IoT

Perfecting the Art of Electronics
ALPS

Efforts for Embedded Industrial Promotion of Miyagi Prefecture

META: Miyagi Embedded Technology Association

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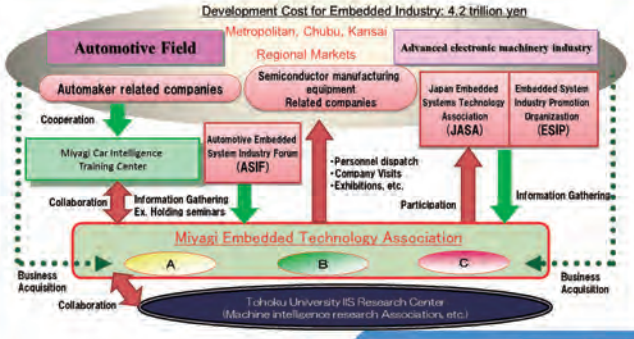
Cooperate with Miyagi Embedded Technology Association: META

Cooperate with companies related in Prefecture to gather the embedded relating industries in Miyagi Prefecture

■Established: February, 2006
■Members: Embedded relating companies in Miyagi Prefecture 36, Supporting members 2 companies in other prefecture (June, 2016)
Special member Miyagi Prefecture, Sendai city, Tohoku University IIS Research Center
Miyagi Embedded Technology Association, Japan External Trading Organization
■Activities: ・Hold seminars for man entering to the automotive field and exhibitions, etc.
・Acquisition of the other area's market, such as Tokyo, Chubu and Kansai through the development of embedded engineers



One-Stop Service by Miyagi Prefecture's Information Industries Promotion Division

Human resources support

Promoting business such as ICT technician UIJ turn

Product sales and introduction support

Market Acquisition Support

Firm location support

Promotion of IT Corporations

Miyagi IT Product sales And introduction promotion business

Miyagi IT Market Acquisition Support And formation promotion business

Information communication-related Firm location promotion Encourage business

Promotion of IT in Local Industries

Human Resources Development Support

Miyagi IT Technician Securement and Development Project

Dispatch OJT Support Project

We support the dispatching of technicians to universities and advanced corporations (Ex. Tohoku university, Auto mobile-related corporations and Advanced electronic machinery industry) to have them acquire the newest techniques and technical knowledge.

Can supply Maximum 2milion Yen per Business

Half of Costs of Dispatching to OJT Subsideized

Project Summary

2007-2015 Support Record

Advanced Corporations, Research Universities, etc.

23 Copmpanies 75 Members

Miyagi Prefecture

Dispatch Technicians

Subsidize a Portion of Dispatch Costs

IT Companies In Miyagi Prefecture

Acquire the Newest Technological Knowledge and techniques.

Dispatch Result Feedback

IT Corporation

IT Corporation

IT Corporation

Assistance for Improving Technical Capabilities

Market place Business Support

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
2015: Microcomputer introductory training, digital oscilloscope training
② Intermediate Level: Trainees learn technical skills for business solutions
2015: Legacy code quality improvement training, ARM core microcomputer training
③ Embedded System Technical Seminar: Contents of seminar include the latest information
2015: ARM core microcomputer seminar

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.
2015"To World IoT from Miyagi"

② Hold "Kumikomi-Tekijuku" practical exercise course via satellite to support Miyagi development of "System Architect" embedded software development
■Based courses
Architect seen from the embedded development field, UX design for embedded systems, requirements engineering for embedded, Built-application basis of the UML, structured analysis and design and object-oriented design, test techniques, embedded software design theory, Reviews method, system development documentation, reverse modeling, the basis of computer architecture
■Elective courses (core technology courses)
Event-driven software design, Concurrency and state transition design, Concurrent systems, time-driven software design, android practice GUI design
■System design courses
System architecting by design thinking

Information Industries Promotion Division
Miyagi Prefectural Government
Miyagi prefectural government Office 3F
3-8-1, Honcho, Aoba-ku, Sendai, Miyagi 980-8570
TEL 022-211-2479
http://www.pref.miyagi.jp/soshiki/jyoho-i/

META : Miyagi Embedded Technology Association
NEC Solution Innovators, Ltd. Tohoku Branch
1-10-23, Ichibancho, Aoba-ku, Sendai, Miyagi 980-0811
TEL 022-215-5912
http://www.pref.miyagi.jp/soshiki/jyoho-i/kumikomikyogikai-index.html

Progress Since the Great East Japan Earthquake and Future Prospects

Recovery from the Great East Japan Earthquake

-Collaboration with Kansai Area-

META: Miyagi Embedded Technology Association, Miyagi Prefecture

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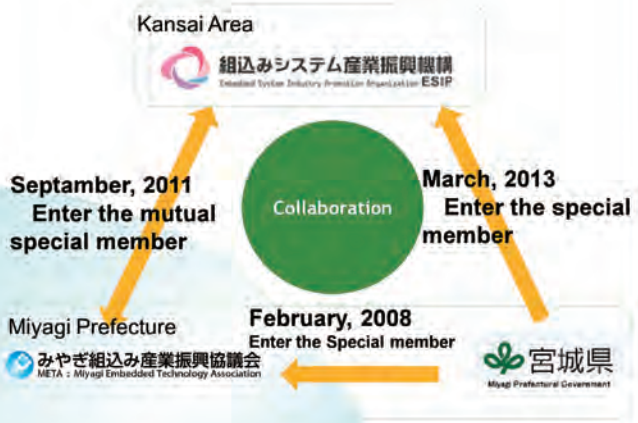
Support from the Kansai Economic Organizations

In the Public Interest Incorporated Orchestra Kansai Economic Federation, they issued the support system of Tohoku area to recover from the great east Japan Earthquake.
In the suggestion, they also announced their continuous support for the employment promotion and the industrial recovery.

The forth proposal for the recovery from the great east Japan earthquake (excerpt)
About the continuous support of Kansai and the reconstruction of Tohoku

4． Promote the industrial recovery, business matching, and employments support
（2）Promote the business matching
・Kansai Economic Federation continuously execute the collaboration with Tohoku regarding embedded technology
【contents】
・We collaborate with Miyagi prefecture and Miyagi Embedded Technology Association as the support for recovery from the earthquake.
*We contribute to industrial recovery in disaster areas by supporting for expanding their market.

Collaboration between Kansai Area and Miyagi Prefecture in Embedded Industry



Support for Market Gain

Some companies in Miyagi have joined the exhibition since the second one.
This exhibition offers the great opportunities to exchange the beneficial information about obtaining an order and the future direction of development.

Year	Venue	Exhibitors
2011	Panasonic Corporation Eco Solutions company	5companies
2012	Daikin Industries, Ltd. (Shiga Factory)	2companies
2012	Mitsubishi Electric Corporation (Itami Factory)	3companies
2013	Kawasaki Heavy Industries, Ltd. (Akashi Works)	2companies
2013	Fujitsu Solution Square, Fujitsu Limited	3companies
2014	Department of infrastructure, Omika office, Hitachi, Ltd.	3companies
2014	Tamagawa office, NEC corporation	3companies
2015	Daikin Industries, Ltd. (Shiga Factory)	3companies
2016	Sonezaki building, Nippon Telegraph and Telephone West Corporation	1companies



Support for Manpower Training

Under the strong supports of National Institute of Advanced Industrial Science and Technology (AIST) and Tohoku University, we train technicians by making use of the video conference system. The goal of this training is to turn out "System Architects" who have both practical knowledge and techniques, and qualities of the technical leader.

Year	The Number of Lectures	Participants
2012	9	5companies, 23people in total
2013	11	8companies, 75people in total
2014	13	13companies, 130people in total
2015	7	2companies, 23people in total
2016	7	3companies, 26people in total


AIST Tohoku


Tohoku University


Superior graders in Miyagi (2014)

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
http://www.pref.miyagi.jp/soshiki/jyoho-i/

META:Miyagi Embedded Technology Association
1-10-23, Ichibancho, Aoba-ku, Sendai, Miyagi 980-0811
(Organizer: NEC Solution Innovators Tohoku, Ltd.)
TEL 022-215-5912
http://www.pref.miyagi.jp/soshiki/jyoho-i/kumikomikyogikai-index.html

Designing & Manufacturing Service of electronic equipment & Desk Robot

COSMOSWEB Co.,Ltd

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

Company Profile

Trade name	:	COSMOSWEB Co.,Ltd
Head office	:	5-4-1 Kuryu , Aoba-ku , Sendai-shi , Miyagi-ken
	:	989-3122 Japan
Establishment	:	Nov. 1989
Capital	:	70 million yen
President	:	Naoyuki Yoshimura
Number of Employees	:	52 (as of Apr. 2016)
Offices	:	

JQA-MD0080 ·Headquarters ·Ayashi Factory

JQA-QMA14006 ·Headquarters ·Ayashi Factory

JAB CM009

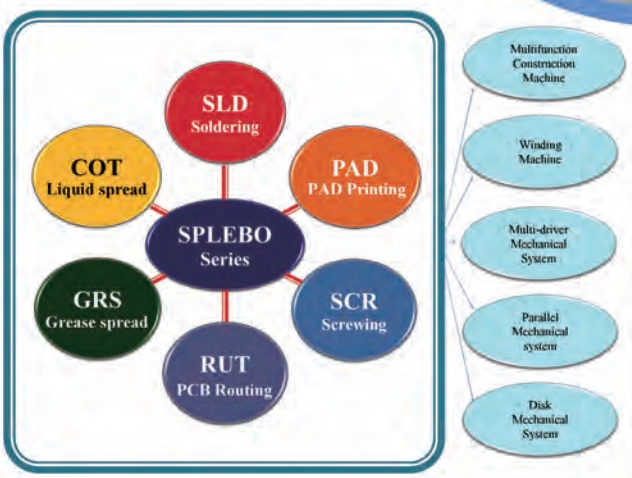
Business Contents

We Help to Make it Possible.

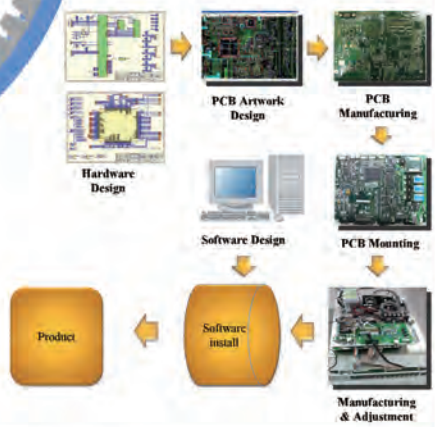
Even if society changes,
Even if the times change,
Our passion and dedication
for production are eternal.

To further evolutions -
Change But not Change.

Desk Robot Technology



Core Technology



Contact us

COSMOSWEB Co.,Ltd
5-4-1 kuryu , Aoba-ku , Sendai-shi , Miyagi-ken Japan
Tel : +81-22-302-8520 Fax : +81-22-392-0270
URL: http://www.cosmosweb.com
Email: cosmosweb.inquiry@cosmosweb.com

Designing & Manufacturing Service of Electronic Equipment & Desktop Robot

COSMOSWEB Co., Ltd

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

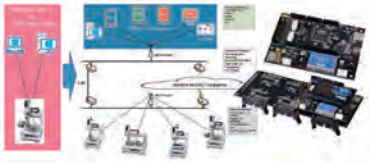
Great East Japan Earthquake

At that time, we were in the accounting period.
Although many employees couldn't come to work, we had to ship our products to the foreign customers by the end of March.
Fortunately, there was not serious damage to the products, but we were forced to change the way to delivery and route.
Therefore, by the cooperation with the shipping company in Yamagata, we delivered products to Tokyo directly not through Sendai airport but through the Sea of Japan route.
We'll never forget their kindest cooperation.

Efforts after the Earthquake

①We developed our manufacturing for the desktop robot, and focused on developing the new small motion control PCB incorporating the network technology, which aims at IoT.

②We competed at the field of medical instrument as the second in-house products' business. For this reason, we collaborated with St. Marianna University School of Medicine.



The small motion control board

Management philosophy

- We seek for employee satisfaction of both materially and morally.
- We always want emotion through work.
- We always have thanks to you.

The CO_2／O_2 Monitoring Devise

Development After the Earthquake

Oct. 2011 Accept Private placement bond (Miyagi organization for industry promotion)
Nov. Exhibit the desk robots at the International Robot Exhibition 2011 in Tokyo Big Sight
Mar. 2012 Increase our capital of 60 million yen
Apr. Formulate the middle period management plan
Jun. Exhibit our products at the Medical Show Japan 2012 in Sapporo
Nov. Exhibit some control equipment at Embedded Technology 2012 in Pacifico Yokohama
Jan. 2013 Develop the disk type robots
Apr. Introduce PCB-CAD"CR-8000" for artwork design
Nov. Apply for a patent for the disk type robots
Nov. Exhibit the desk robots at the International Robot Exhibition 2013 in Tokyo Big Sight

Nov. Launch the new development business

Feb. 2014 Win the incentive award at the session of Industry and Academia Development (Tohoku Polytech Vision)
Feb. Introduce 3D-CAD"i-CAD" for mechanical design
Nov. 2015 Authenticated as ISO13485 (Headquarters / Ayashi Factory)
Mar. 2016 Increase our capital of 70 million yen
Jun. Exhibit the CO_2 / O_2 monitoring devise at the Japan Society for Respiratory Endoscopy in Nagoya Congress Center

Post-Project & Future Prospects

We aim at the small manufacturer whose main business is contracted development. At the same time, we sell our original products. We also plan to expand our business to overseas customers and be the global company which has its base in Miyagi, and supports the world wide manufacture.

SPLEBO

COSMOSWEB Co., Ltd
5-4-1 Kuryu, Aoba-ku, Sendai-city, Miyagi Prf, Japan
TEL:+81-22-302-8520 FAX : +81-22-392-0270
URL http://www.cosmosweb.com
Email cosmosweb.inquiry@cosmosweb.com

ISO 9001 JQA-QMA14006 · Headquarters · Ayashi Factory

ISO 13485 JQA-MD0080 · Headquarters · Ayashi Factory

JAB CM009

Contribution to technology with attention to environment and people

Nippon Chemi-Con Corporation

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

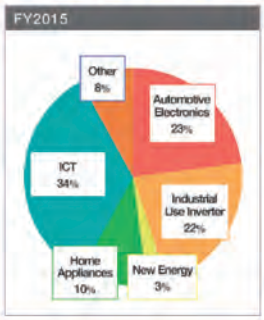
Company Overview

Company Name : Nippon Chemi-Con Corporation
Date Founded : August, 1931
Head Office : 5-6-4 Osaki, Shinagawa-ku, Tokyo, Japan
Capital : 21,526 Million Yen
Sales Revenue : 118,414 Million Yen (FY2015)
Number of Employees : Consolidated 6,743 (March,2016)
Business Content : Manufacturing and Sales of
aluminum electrolytic capacitors,
other various capacitors(Polymer, EDLC, MLCC, Film),
various electro-mechanical devices and parts,
circuit devices, materials for capacitors etc.
International Certification : TS16949 / ISO9001 …

Our Origin is Miyagi Prefecture!

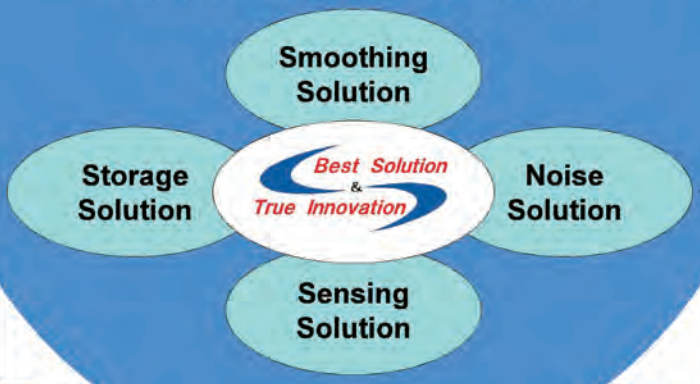
Domestic Value Chain of Aluminum Electrolytic Capacitors

Sales by Market (Aluminum Electrolytic Capacitors)



NIPPON CHEMI-CON

We're
"The Capacitor Company"
Best of the best for Passive Components

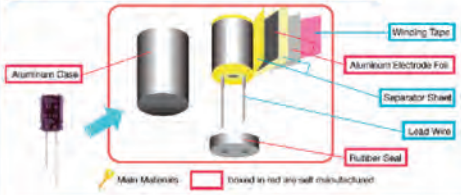


Overseas Assembly Plants
- United Chemi-Con (USA)
- Samyoung Electronics (Korea)
- Taiwan Chemi-Con (R.O.China)
- Chemi-Con (Wuxi) (P.R.China)
- Chemi-Con (Malaysia)
- P.T. Indonesia Chemi-Con

Other Domestic Plants
- Chemi-Con Iwate (Coil Engineering Dept.)
- Chemi-Con Yamagata (MLCC, Film Caps, Varistor)
- Chemi-Con Nagaoka (EDLC Module, Battery Charger , Camera Module)
- Marcon Denso (Automotive Parts)

Aluminum Electrolytic Capacitors

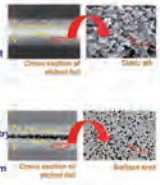
Basic Structure (Radial Lead Type)



Surface Processing Techniques of Electrode Foils (Etching)

AC Etching Process
- For low voltage capacitors (under 100V)
- Pit geometry: Cube geometry
- Features: Continuously produces a cubic pit of about 0.1 to 0.5 μm, which enables increase of effective surface area

DC Etching Process
- For mid to high voltage capacitors (160V and above)
- Pit geometry: circular cylindrical (tunnel-like) geometry
- Features: Produces a circular cylindrical pit with dia of about 1 to 2 μm standing upright against the foil to take advantage in producing thick oxide film

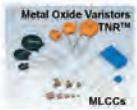


The surface area of the etched foil is about 200 times larger than those of a plain foil

Our Proposal for Automotive Use

Sensing Solution

Noise Solution



Storage Solution

Progress Since the Great East Japan Earthquake and Future Prospects

Becoming №1 for capacitors in the energy field

Nippon Chemi-Con Corporation

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Being an sense E.C.O. solutions company

Our Company suffered staggering operating losses following the Lehman Shock of 2008 and damages due to the Great East Japan Earthquake of 2011. However, after implementing decisive structural reforms in FY2012, we succeeded in returning to a state of profitability in FY2013 and last year in FY2014, we recorded gains in revenues and profits. We also were able to resume issuing dividends for the first time in three years. However, we are not satisfied with these results. We view this success as simply one of the stepping stones toward achieving corporate reforms. We continue to have a strong of urgency as we progress with corporate reforms and move forward towards being an sense E.C.O. solutions company.

*E.C.O. stands for Energy, Capacitor, number One.

GREEN FOR TOMORROW

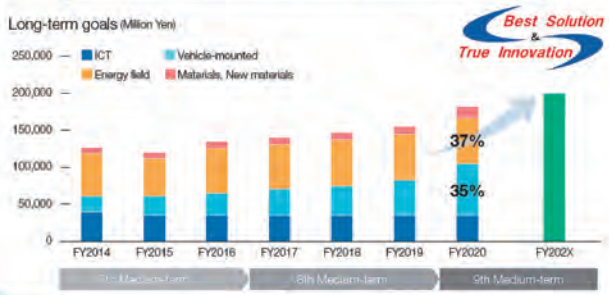
NIPPON CHEMI-CON GROUP

NIPPON CHEMI-CON

Contribution to technology with attention to environment and people

Continually contributing to technology that fulfills the dream of building an enriched future society.

Best Solution & True Innovation



Over the long-term, our goal in FY2022 is to develop into an E.C.O. solutions company.

① Improve the energy field
② Expand ratio of sales from the vehicle-mounted electronics market

We are strengthening our product development as we aim to become a company with net sales of 200 billion yen per year in the early 2020s.

Improve the energy field

Topics ;
What is EDLC?
(Electric Double Layer Capacitors)

DLCAP™

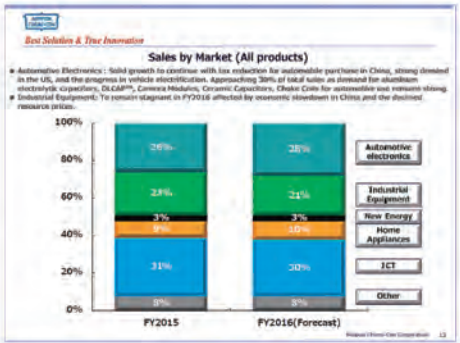
Electric double layer capacitors are electronic components classified as capacitors that are able to store electricity temporarily.

Features

i Long-lasting	Hardly any change in performance even after repeated charge-discharge over 1 million times
ii Low resistance	Low electricity loss even after charge/discharge
iii Environmentally friendly	Structural materials use no toxic heavy metals such as lead
iv High safe	Non-flammable, even if pierced or crushed

Examples of DLCAP™ use in automobiles

Expand ratio of sales from the vehicle-mounted electronics market



Color anodized

Kyowa Aluminum Industry Corporation

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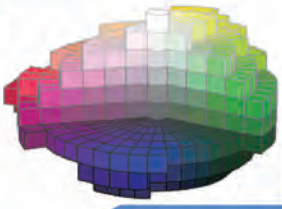
Color anodized

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

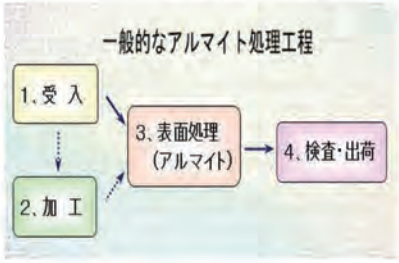
Manual line

Normal anodized tank×1 tank
4,000(W)×900(L)×800(H)
Hard anodized tank×1 tank
1,200(W)×900(L)×850(H

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

Automatic line



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	aluminum 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)
			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	
		semigloss 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	
Alumite 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

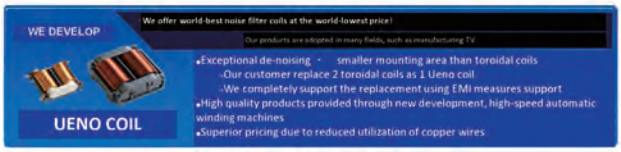
Revolutionize the world of noise filter coil

We developed new coil

Ueno Coil horizontal type
◆Suitable for thin products◆

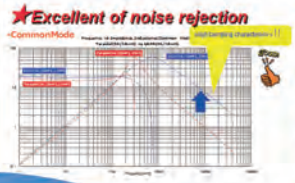
Ueno Coil vertical type
◆Reduce the footprint of a circuit board◆

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.

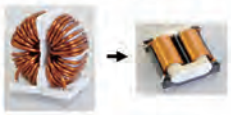
Winding directly to the closed magnetic circuit core

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/

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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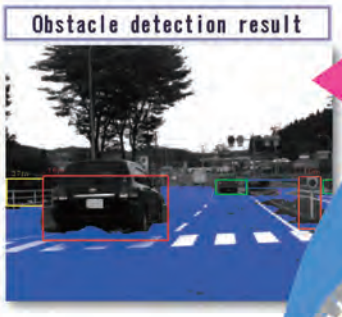
— Obstacle detection on the road —

3-D measurement by stereo camera

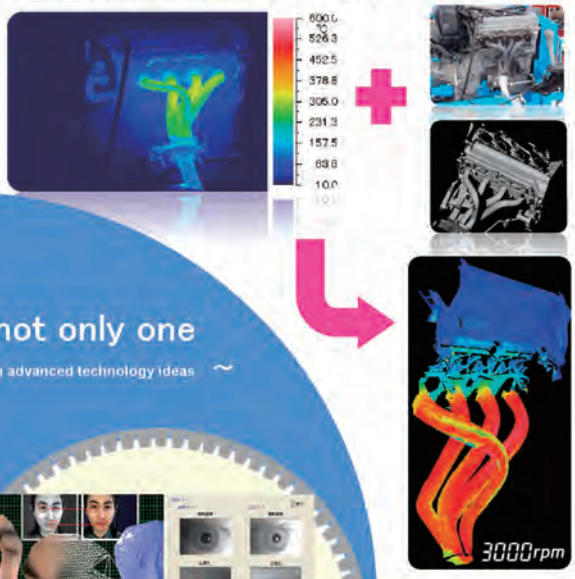
This system detects obstacles on the road such as vehicle and people. Processing three-dimensional measurement from stereo images, it detects the road surface. If there are some objects higher than road surface, these are detected as obstacles.



— 3dimensional heat measurements —

「3dimensional measurement」×「Temperature distribution measurement」

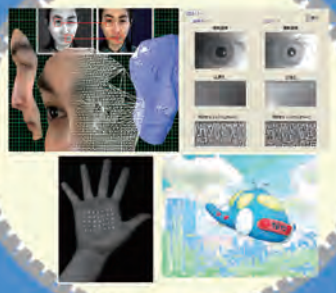
This system can synthesize thermal image and three dimensional data to process three-dimensional temperature distribution data. Using this system, you can detect accurate relationship between spacial position and temperature. For example, You can apply this system to heat test or product evaluation of 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

・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 : 6 people

・Board members
President: Ko Kumagai (ex President, Nikko Capital)

Executive Vice President : Kazuyuki Igarashi (ex JAFCO)

Managing Director: Hideo Hirama (ex SⅡ, ex Sendai Cluster)

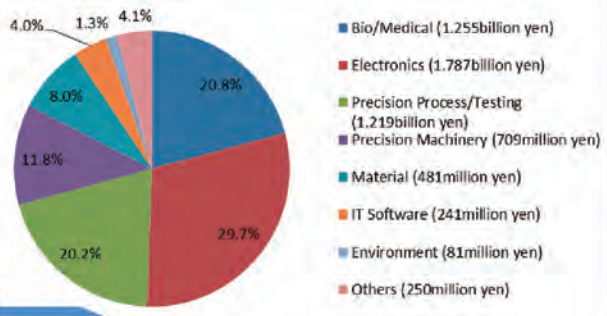
Director: Shiro Takahashi (ex Representative, Sony Sendai technology center)

Auditor : Akio Nishizawa (Professor, Toyo Uni.)

Supreme Advisor : Shoichi Noguchi (Professor emeritus, Tohoku Uni.)

Advisor : Yasutaka Iguchi (President, Miyagi Organization for Industry Promotion)
Tomoya Shiraishi (ex JAFCO, Representative Director of Social Investment Partners)

■Portfolio by Sector



Support growing companies seeking global Expansion based on the core technology

■ Risk money support to growth companies

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

TICC

- Risk capital
- Business development
- Management support
- International expansion

■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)

Vigorous and Creative Industry Development

Miyagi Industry Association

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Association Profile

☆ Name : Miyagi Industry Association

☆ Address : c/o ITIM, 2-2 Akedori, Izumi, Sendai, Miyagi, JAPAN

☆ Establishment : December, 1986

☆ Chairman : Yuki Takebuchi (Corporate Consultant of Tokyo Electron Miyagi Limited)

☆ Membership : 418 - Regular member : 352
- Supporting/Special : 66

Purpose of Establishment

For Miyagi people who engage in industry and its related work

by promoting exchange and improvement beyond their business, size of organizations and arias,

Aiming to;

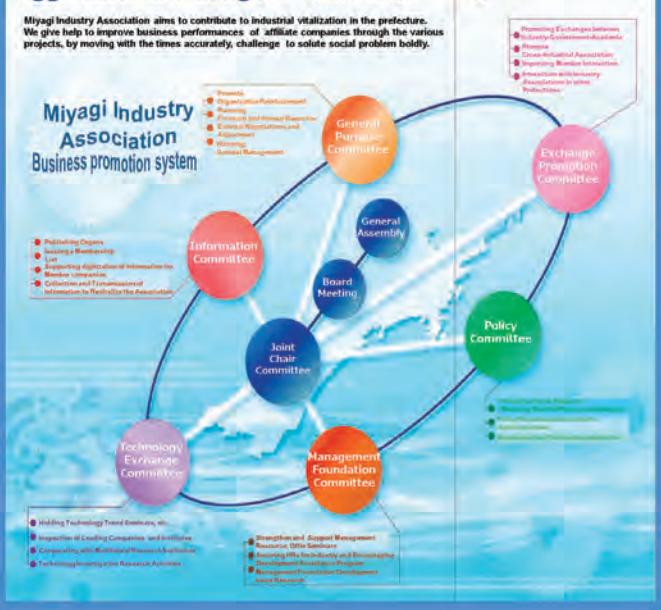
- Reinforce the Management Base
- Advance their Technology
- Open up a New Market

We contribute to healthy developments of vigorous and creative industries of our prefecture.

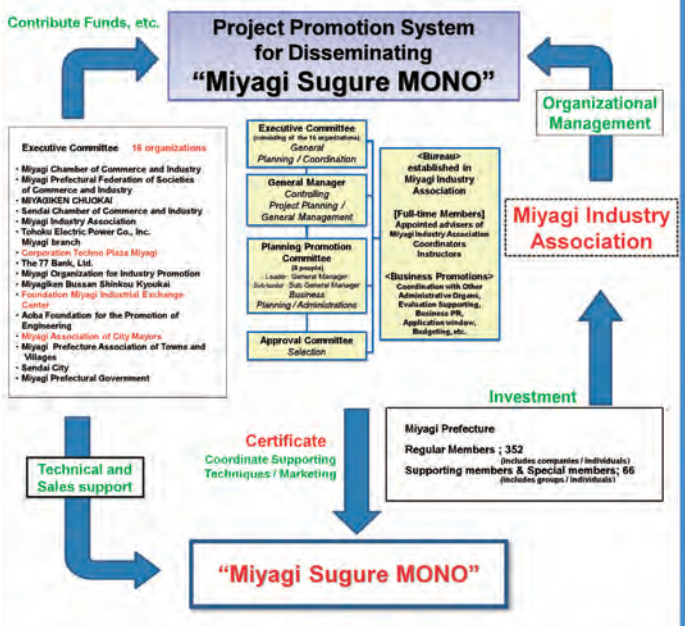
Business Promotion System

We Support Aggressive Challenges — Miyagi Industry Association

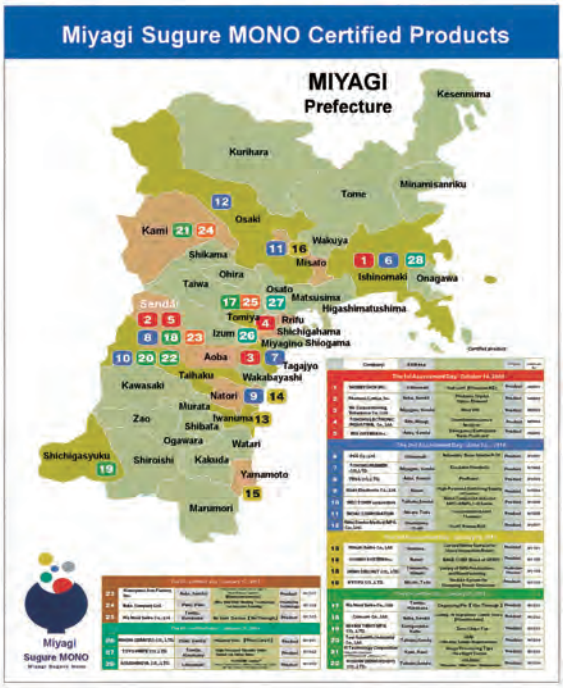
Miyagi Industry Association aims to contribute to industrial vitalization in the prefecture. We give help to improve business performances of affiliate companies through the various projects, by moving with the times accurately, challenge to solute social problem boldly.



[Accepting Consignments of the Industry Association] Business Promotion System



Miyagi Sugure MONO Certified Products



c/o ITIM, 2-2 Akedori, Izumi, Sendai, Miyagi, Japan 〒981-3206
TEL:+81-22-777-9891 FAX:+81-22-772-0528

Create the Future of an Affluent Society

~Contribution for people and companies by solid production techniques~

MIYAGIKASEI Co., Ltd.

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Company Profile

◆Corporate Information

Name MIYAGIKASEI Co., Ltd.
Address 15-4, Kitazawahankinzawa, Ichihasama, Kurihara, Miyagi
CEO Akihiko Oyama
Establishment April, 1987
Capital ¥20 million
Number of Employees 40
Certification ISO9001 & ISO14001
Government Approvals Ordinary Construction Business License chartered by Governor of Miyagi Prefecture (O-19) , The 18067th item

◆Business Summary

Main Business Activities; FRP (fiber-reinforced plastic) production and sales
- Auto components and other FRPs sales and production (bumpers, bodies, truck air deflectors, campers, cover panels, portable toilets, vessels, playground equipment, etc.)
- Construction material rent & sales (portable toilets, shower houses, houses, and event supplies)
- Construction works (lining, sealing, insulation, etc.)

◆Primary Customers

Automobiles
ICL, Mitsuoka Motor Co., Ltd., Lotas, First Custom, FATRASTYLING Inc., KLC
Constructions
House builders and construction machineries

◆Group Company

HAIPURA KASEI Co., Ltd.
8-92-5 Murasakino, Kitakami, Iwate

Corporate Identity

We aim to contribute to society and people through high-value productions and high-quality services.

We always think about better production and service delivery to develop our ability and personality.

Main Factory Profile

Gross Area	6,800㎡
- Molding factory area	671㎡
- Assembling factory area	205㎡
- Finishing factory area	197㎡
- Resting &warehouse area	197㎡
- Office area	113㎡

FRP Molding Technique

①Hand Lay Up Molding

②Spray up Molding

③Light RTM Molding

④Infusion Molding

FRP Molding Method

① Hand lay up molding
Paste fiberglass and resin into mold by hand.

② Spray up molding
Spray fiberglass and resin by spray molding machine.

③ Light RTM molding
Set fiberglass in an uneven mold, and inject resin into.

④ Infusion molding
Set fiberglass in a mold, and inject resin into by vacuum drawing.

Working on New Techniques

The development of EXVIEW

Architecture Field
Interior/exterior building materials

Aerospace Field
Aircrafts

Trans parency

Incombust ibility

Vehicle Field
Trains and Automobiles

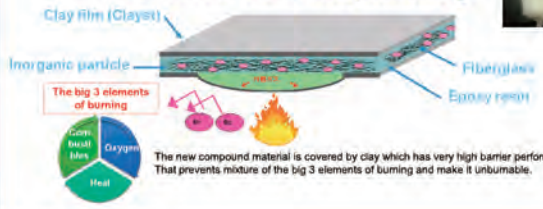
Light weight Properties

Safety

Energy Field
Solar panels

Lighting cover for rail vehicle

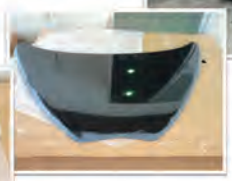
Mechanism of fireproofing



The new compound material is covered by clay which has very high barrier performance on the surface. That prevents mixture of the big 3 elements of burning and make it unburnable.

Mitsuoka Motor Co., Ltd. 'Viewt'

FRP Front face, Bonnet, and Trunk



Message for corporate customers

~As your partner company, we create the future by new ideas &challenges~

We always think what we could do for our customers and society.

By the productions and manufactures, we aim to contribute to society.

Contact

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/

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

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

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 — **Display "Estimated time of travel" and "Distance"**

Unable — **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.

~Defect detection technology on the mirror surface by the image processing ~Surface defect inspection unit SSMM-1

×3PROJECTS 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： 28 people (March,2015)
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 ,2015
- 2 NI certified instructor
- 6 certified LabVIEW developer
- 4 certified LabVIEW associate developer

NATIONAL INSTRUMENTS Silver Alliance Partner

NI certified instructor credential holders enrolled.
NI LabVIEW training have been held regularly in Sendai.

Industry- academia- government collaboration

"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

We developed a defect detection "Slit Shift MinMax method"(SSMM) which has no influence of Yuzu skin-like surface.

簡単！感嘆！どんな小さなキズ・異物も見逃さない！

表面欠陥検査ユニット

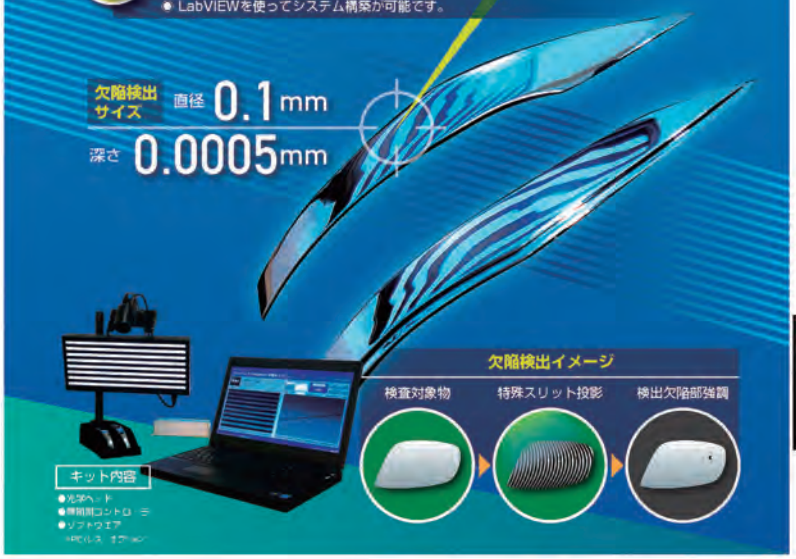
実用新案 2015-001216 号

SSMM-1 スリットシフト MinMax

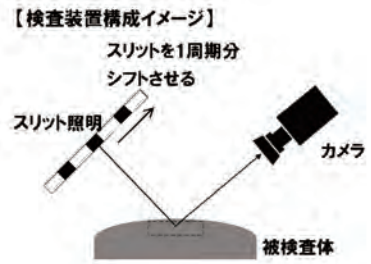
塗装品(ツヤ有り)・メッキ品・フイルム・ガラスのように光を反射
又は透過する製品の表面の傷・異物の検出を行う検査ユニットです。

特徴
- 特殊スリットパターンを使う事で検出能力を高めました（弊社比2倍）。
- その特殊スリットパターンを１周期シフトさせながら輝度差を取る事で、曲面を持つ検査対象物の欠陥を検出できます。
- また、塗装面におけるゆず肌の影響を受けず欠陥を検出できます。
- LabVIEWを使ってシステム構築が可能です。

欠陥検出サイズ 直径 0.1mm
深さ 0.0005mm



SSMM method scheme



While shifting the slit one cycle, it takes a plurality of images and determine the difference between the maximum image and minimum image luminance.
It use the fact that the brightness difference changes only the portion of the defect.

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

×3PROJECTS NATIONAL INSTRUMENTS Silver Alliance Partner

Ministry of Education, Culture, Sports, Science and Technology
Area innovation strategy support program next generation car Mirai area

Auto industry support through technology seeds

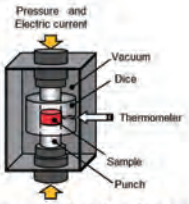
AKITA Industrial Technology Center

MEXT | TOHOKU ECONOMIC FEDERATION | Tohoku University | 宮城県 | 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

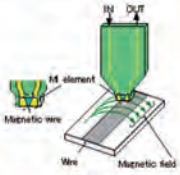


Development method of hard tool materials

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



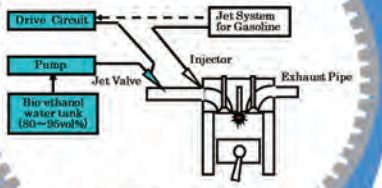
MI probe

Development and proof experiments of Dual-Fuel Vehicle

We took running tests in Solar sports line of Oogata-village.

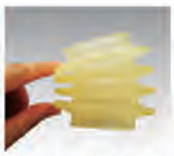
As a result, we finished proof experiment safely without engine trouble.

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 evaluated.

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/

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 | 77 七十七銀行 | ICR

Company overview

Company's name: NEC TOKIN corporation

Capital stock: 34.2 billion yen

Sales figures: 55.3 billion yen (2015)

Number of employees: Consolidated 6,445 (Domestic 1,041 international 5,404)

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).

《Capacitor》

《EMC parts, Flex Suppressor 》

《Inductor》

《Relay》

《IC card・IC tag》

《Piezo actuator》

《Various sensors》

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

N F S
- 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

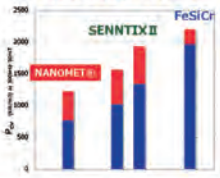
Next generation vehicles for latest items

Expansion into Car electronics market

~To HEV core device the latest from various electrical parts , we'll propose a variety of solution~

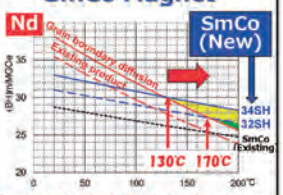
The contribution to the Creation of next-generation vehicles And highly efficient technology development in the Northeast

for High Efficiency Reactor・MPC



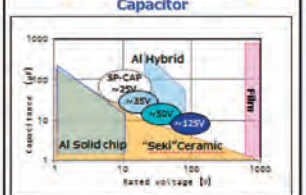
Higher Efficiency(Nanoized Dust core)

for High Heat-resisting SmCo Magnet



Surpass Nd in higher temperature

for High Reliability High pressure-resistant Ta Capacitor



Pressure-resistant~125V

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 》

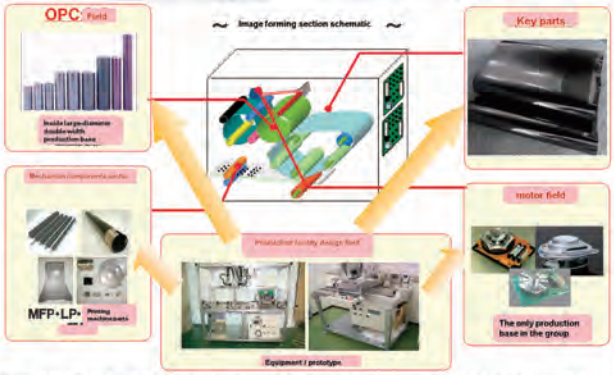
《 Ricoh brand message 》

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 》



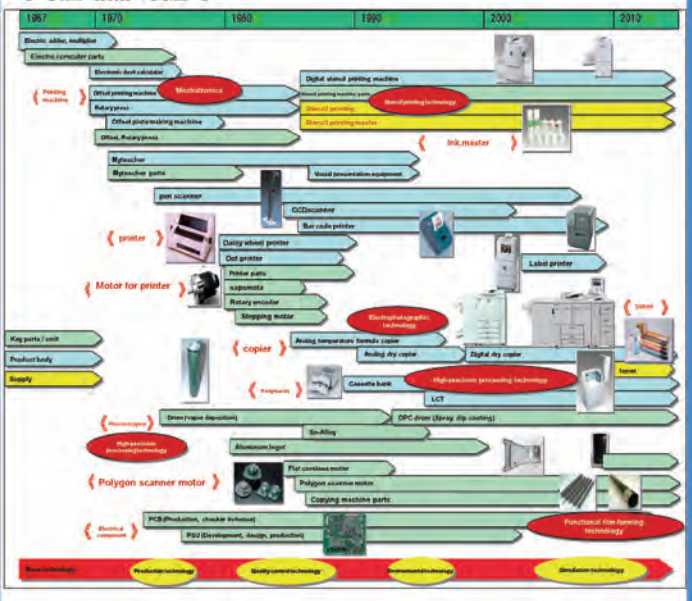
From the main body of product to parts, functions necessary for crafting gather in a northeastern establishment and I perform the action that is the concurrent that did the cooperation with the design thickly routinely, and go ahead through method of construction development, the facilities development 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.

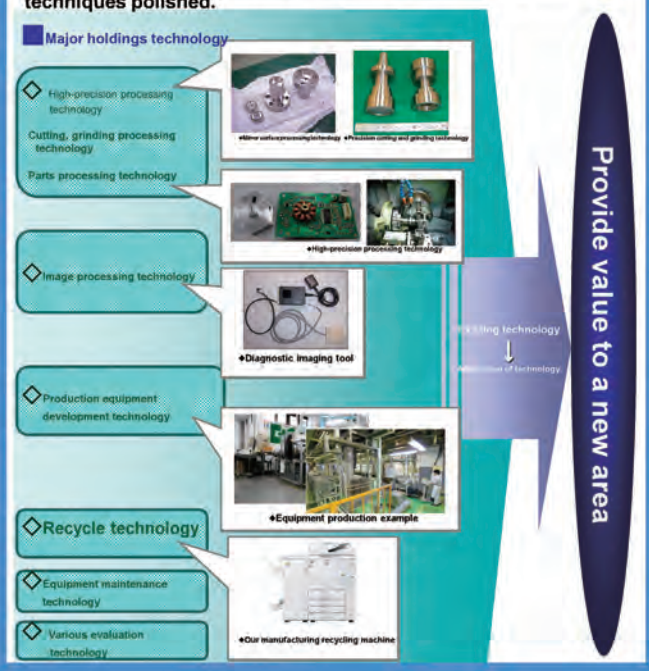
《 製品・技術の変遷 》



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.



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　77 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/CD suggestion, product planning.

Core technique of the in-vehicle business

Development and design of products

- ・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

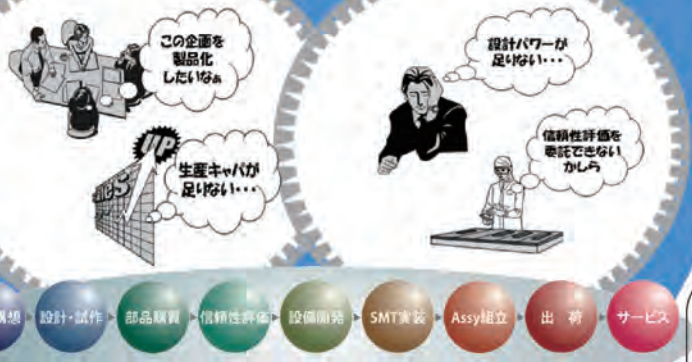
- ・Including evaluation facilities, necessary facilities for securing of quality of the in-vehicle product are enriched.

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.



Core technology

We have skills and experiences of wide product area and various product categories.

research project

- ■Bond magnet applied technology
- ■Supersonic wave skin sectional evaluation
- ■Space imaging applied technology

Company Profile

Company name	K Technology Corporation
Established	April, 2005
Paid in capital	100 million yen
Net sales	9.6 billion yen (FY2015 Results)
No. of employees	433 (As of June 30, 2016)
Office	[Head Office] LIVMO Rising Bldg. 7F, 3-19-1, Shin-Yokohama, Kohoku-ku, Yokohama, Kanagawa 222-0033, JAPAN [Miyagi Tec] 325 Ganbara, Kami-machi, Kami-gun, Miyagi 981-4263, Japan
Facilities area Site	170,785 m²
Building	34,027 m²
Scope of business	Design/development, prototyping, production and services of electronic devices.
The public certification	ISO/TS16949, ISO14001, ISO13485 Manufacturer for Packaging, Labeling and Storage

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＞
LIVMO Rising Bldg. 7F, 3-19-1, Shin-Yokohama, Kohoku-ku, Yokohama, Kanagawa 222-0033, JAPAN
TEL：+81-(0)45-548-9333　FAX：+81-(0)45-548-5982

＜Miyagi Tec＞
325 Ganbara, Kami-machi, Kami-gun, Miyagi 981-4263,Japan
TEL：+81-(0)229-64-1111　FAX：+81-(0)229-63-5652

URL：http://www.k-technology.co.jp/　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/

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

■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】

■Image processing technology

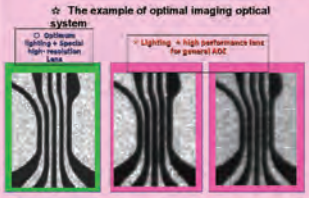
Imaging technology(camera, lens and lighting system)

17000 pixel CCD line camera

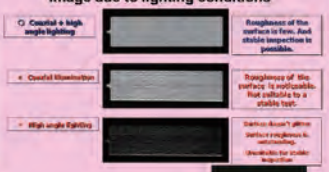
Dedicated lens

Lighting configuration example I

☆ The example of optimal imaging optical system



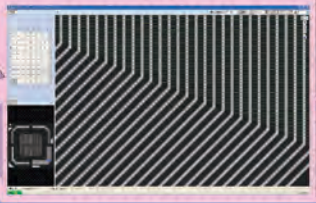
☆ Different of the captured image due to lighting conditions



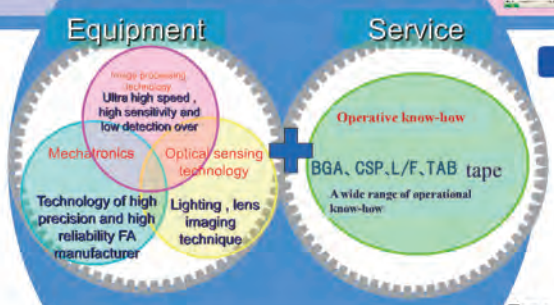
Inspection algorithm (example)

☆Length measurement algorithm (most stable for the highly precise inspection of the minute pattern)

All the pattern and the space make length measurement !

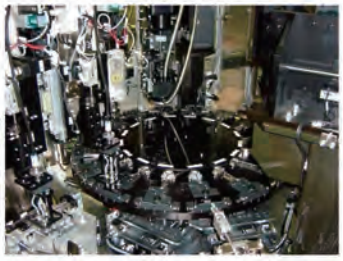


We hold all the elemental technology of the appearance tester



■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

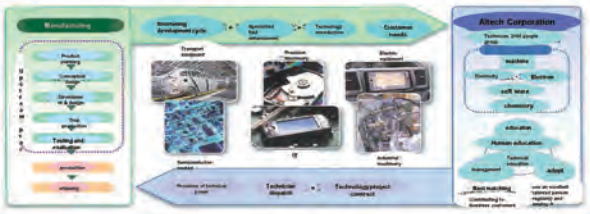
MEXT　TOHOKU ECONOMIC FEDERATION　Tohoku University　宮城県　七十七銀行　ICR

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

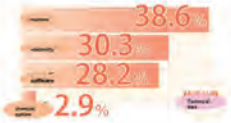
Business model



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

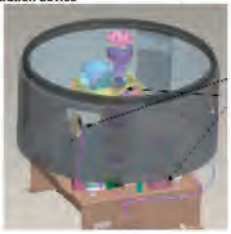
Avoiding development risk

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.

"Complete Support" for Miyagi Industry

Miyagi Organization for Industry Promotion

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

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

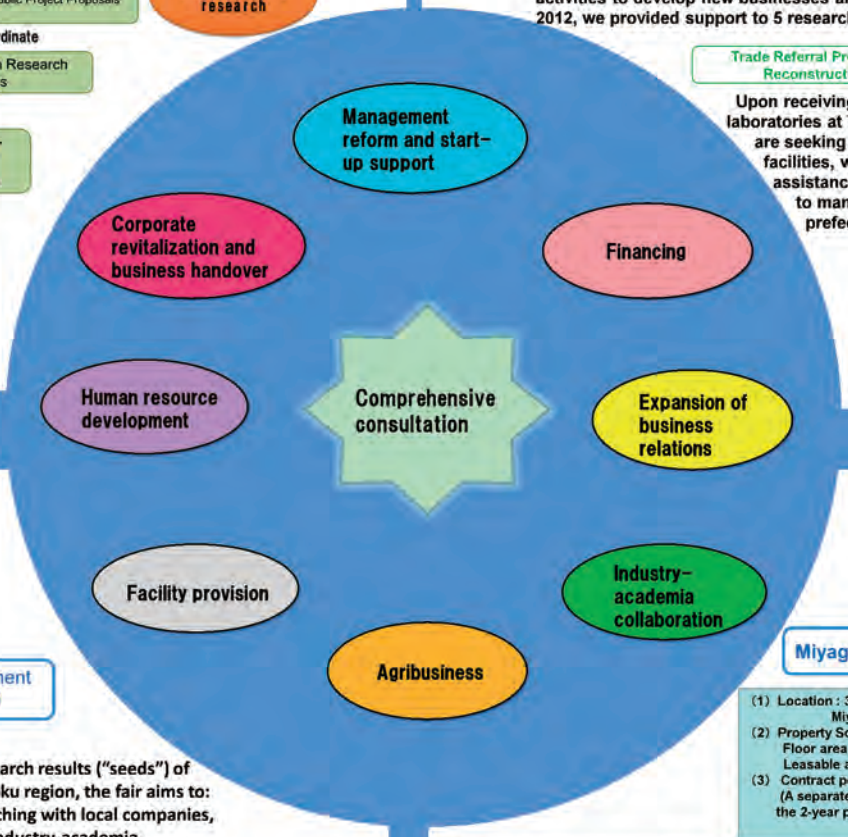
Miyagi Organization for Industry Promotion offers management entity support for competitive funds such as Supporting Industry (Assistance Project for Strategic Advancement of Fundamental Technology). In FY 2012, we offered this service for 6 projects, including ongoing projects.

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.



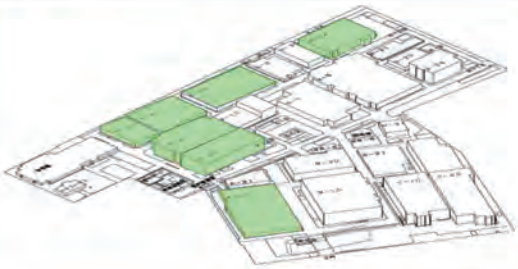
Industry-Academia-Government Collaboration Fair Miyagi

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

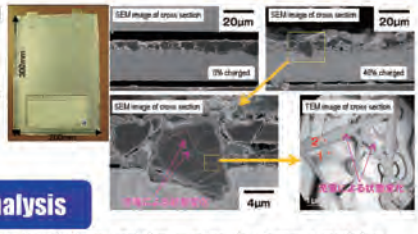
JFE Techno-Research Corporation (Tohoku Branch)

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



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

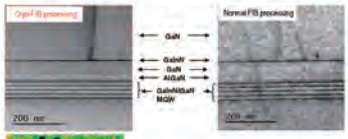
Fracture toughness test

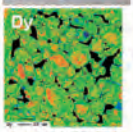
Constant load creep test facility

Microstructure analysis

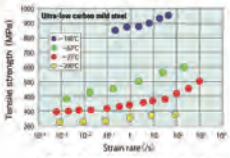
- Evaluation and analysis of power devices and thermoelectric element modules
- Sample processing for microscopy
- Analysis of rare earth magnets
- Failure analysis of electronic components

Electron microscope, ARM200F installed in dedicated laboratory



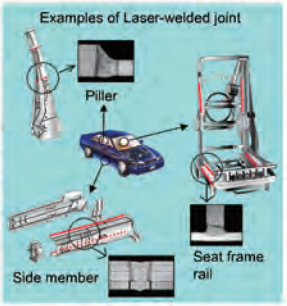


GrainMAP + DyMAP



Effect of strain rate and testing temperature on tensile strength

Laser welding for Al-Cu dissimilar material joints [Joint strength: 80 MPa]

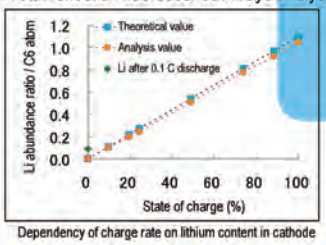


Your Best Partner for "Monodzukuri"

JFE Techno-Research Corporation is ……
A trusted company for analysis, evaluation, investigation, and examination of materials.

Trace analysis, other chemical analyses

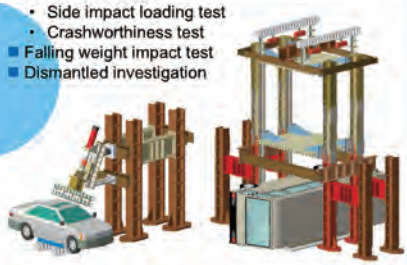
- Trace analysis, analysis of very small amounts of halogen, sulfur
- Mapping analysis by laser ablation
- Total reflection fluorescence X-rays analysis



Dependency of charge rate on lithium content in cathode

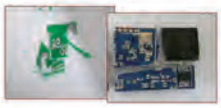
Structural performance evaluation, dismantling investigation

- Collision performance test
  - Roof crush test
  - Side impact loading test
  - Crashworthiness test
- Falling weight impact test
- Dismantled investigation



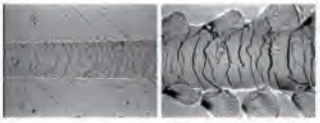
Environmental analysis

- Bad smell analysis (room air pollution) investigation
- Analysis of environmentally hazardous substances (RoHS, REACH, VOC, etc.)



Coating evaluation

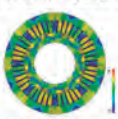
- Evaluation of coating properties of surface-treated materials,
  - Gravel meter testing
  - Coating film investigation
  - Film thickness measurement
  - Surface roughness measurement
  - Hardness measurement
- Corrosion resistance evaluation, accelerated corrosion test
  - Gas corrosion examination
  - Salt spray test



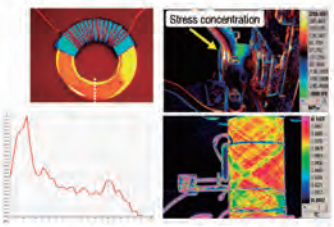
Observation of anodizing film of aluminum (section observation without vapor deposition)

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 Support Regional Manufacturing Companies

The 77 Bank, Ltd.

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

Joint Effort between Industry, Academia, Government and Finance

～ Walking together with Tohoku University, a National University Corporation～

The 77 Bank, Ltd. concluded an agreement on collaborations and linkages with Tohoku University in January, 2007

We support regional manufactures' technology and new product development challenges;

- Conducting individual consultations; Tech-support consultations for each company
- Tohoku University Laboratory Tour; Experience-based project, visit the laboratories directly

Conclusion of Cooperation Agreement with Tohoku University (January, 2007)

"Tohoku University Lab Tour2" (November,2013)

"Tohoku University Lab Tour3" (November,2014)

Tohoku University Laboratory Tour (November, 2014)

Message for Corporate Customers

~ We support "Manufacturing Companies" by offering financial and information providing services through collaboration between industry, educational institutions and government ~

Fulfilling the function of Consulting & Finance Intermediation

We have been certified as one of "Support Institutions for Business Innovation, etc." based on "Act for Facilitating New Business Activities of Small and Medium-sized Enterprises" (Certified on November 5, 2012)

As a Support Institution for SMEs, we do;

Financial affairs, Support developing business plans, Start-up incubation, Support business succession, Providing consultations for M&A, business matching, etc., Analyzing business conditions, and taking finely-tuned supports for each company on the basis of its business plan development

Support for the Business Innovation is available at all 77Banks*

*Only at the offices which offer business loan services

Message for Corporate Customers

~ Please feel free to contact us regarding;
- Inquiries for "Subsidies for Manufacturing" and "Grants to start a business"
- Application supports for various subsidies ~

Cooperate Profile

Head Office; 3-3-20 Chuo, Aoba-ku, Sendai

Date of Establishment; December 9, 1878

Capital Stock; 24.6 billion yen

Number of Employee; 2,791

Number of Establishments; 141
136 of Head Office & Branches and 5 of Local Offices
(As of March 31, 2015)

The 77 Bank, Ltd., Regional development section, Regional development division
3-3-20 Chuo, Aoba-ku, Sendai, Miyagi 980-8777, Japan
TEL : +81-22-211-9804　FAX : +81-22-267-5303
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

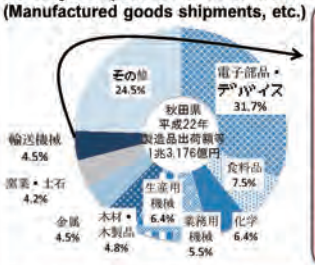
MEXT　TOHOKU ECONOMIC FEDERATION　Tohoku University　宮城県　七十七銀行　ICR

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.

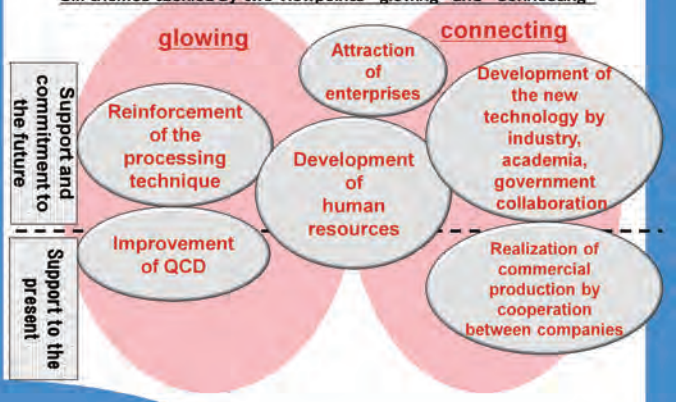
Access to a main factory

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

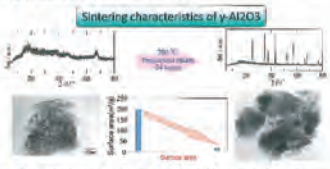
Next generation hydrogen production process can realize Hydrogen Energy Society

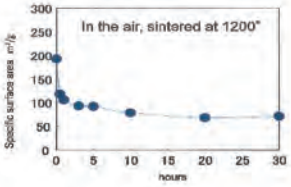
Renaissance Energy Research Corporation

Technology 1: Heat resistant γ- alumina

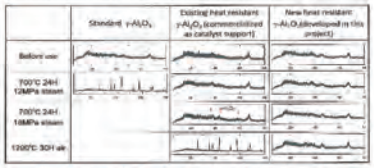
Improved heat resistance of γ-alumina

- 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 timperatures & humidified atmosphere.





We succeeded in development of new catalyst support which maintains a large surface area at the automotive exhaust gas conditions. .

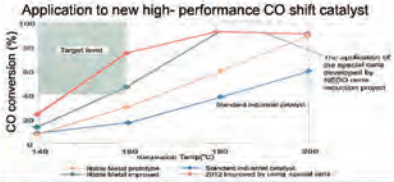


Stability of newly developed heat resistant γ-Al2O3 was significantly improved compared to the existing heat resistant γ-Al2O3.

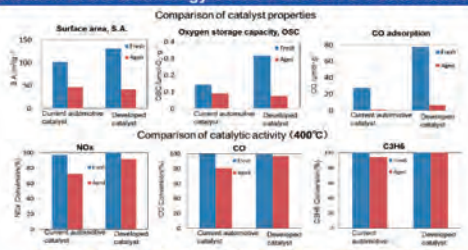
Application to reforming catalysts for hydrogen production is promising

Technology 2: High performance ceria

Application to new high- performance CO shift catalyst



Application of the technology seeds 1 and 2 in the automotive catalyst



Developed catalyst has an excellent exhaust gas purification performance

The hydrogen production related technique which RER holds

Seeds technologies cultivated by Tohoku University and RER

- Heat resistant γ-Alumina (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
CmHn+H₂O→H₂+CO, CO₂
Produce hydrogen by reacting steam and hydrocarbon
→ CO Shift
CO+H₂O → H₂+CO₂
Reduction of CO in the reformed gas
→ Purification process
- Chemical absorption method (remove CO2) → Ammonia Methanol
- Selective oxidation (remove CO) → PEFC
- PSA (adsorption) → Hydrogen station

Complete desulfurization
Extra high performance desulfurization
Desulfurize to the level of ppb

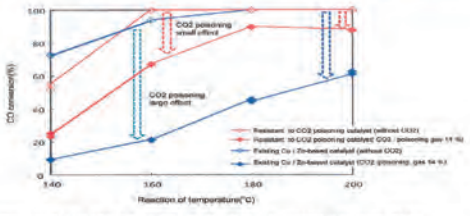
Low S/C possible
High SV possible
High performance Ru catalyst

CO conversion rate improvement
Catalyst without CO2 poisoning (Technology 3)

Energy saving of CO2 removal
CO2 selective membrane (Technology 4)

Technology 3: CO shift catalyst with reduced CO2 poisoning characteristics

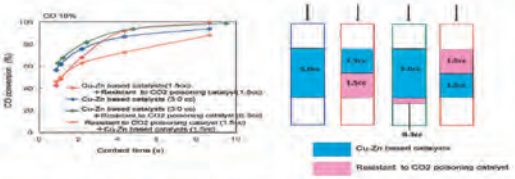
Development of CO shift catalyst with reduced CO2 poisoning characteristics



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.

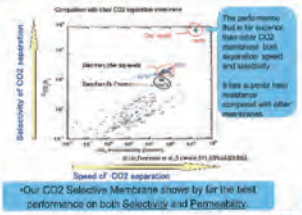
Effect of newly developed CO shift catalyst

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.



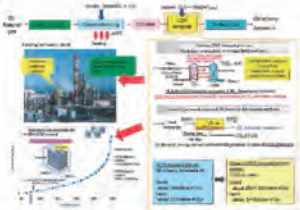
Technology 4: CO2 selective membrane

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



Development of CO2 selective membrane module

Establish a long-term durability

Commercial Department in 2017

Delivered to the domestic chemical manufacturers in 2017

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

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 77 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 :

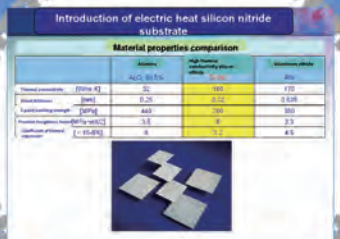
We have been produced by our original (silicon carbide, silicon nitride, alumina, Zirconia) engineering ceramic material with excellent characteristics heat resistance, wear resistance, corrosion resistance. In addition, composite materials "AMC" of metals and ceramics with (lightweight high rigidity, 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.

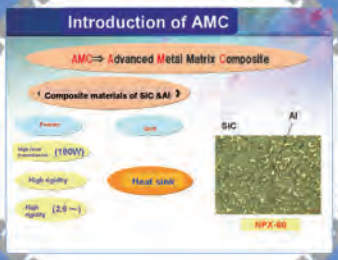
We are daily challenge and aim to material that is always better.

Introduction of high heat dissipation insulating substrate heat sink material

High thermal conductivity silicon nitride substrate

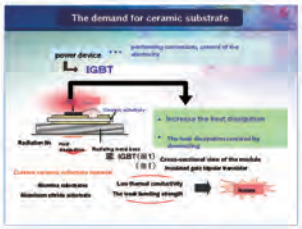
AMC (Advaced Metal Matrix Composites)

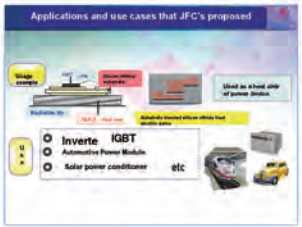


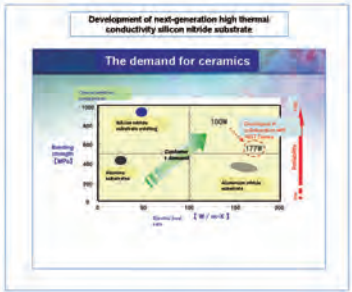


Technical Skill And Creation !

Needs of high heat radiation insulation board, heat sink materials







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

Iwate University, Iwate Prefectural University, Ichinoseki National College of Technology,
Iwate Industrial Research Institute, The Bank of Iwate, Ltd.. Kita-Nippon Bank, Ltd., and Iwate prefecture

Iwate Industry Promotion Center (General Coordination Agency)
2-4-26, Kita-Iioka, Morioka Iwate 0200857 Japan tel: +81-(0)19-631-3825 fax: +81-(0)19-631-3830
email: mobility@joho-iwate.or.jp URL: http://www.joho-iwate.or.jp/mobility/index.html

Metallic casting @Iwate University
High-strength metal casting automotive parts for next-generation vehicles
Applying for ... cylinder liner, brake disc etc.

Insert mold @Iwate University
Simpler process of Insert molding with fine metal parts.
Applying for ... automotive connector etc.

ICT/Software @Iwate Prefectural University
- Development of Plug-and-Play on board sensor system with Radio on Demand technology. Applying for Road to Vehicle / Vehicle to Vehicle info service.

- Development of Wake on Demand communication system.

- Development of Wireless charging system for onboard devices

Promote research & development

"Showcase car" project


Iwate Showcase car visualizes all automotive researches & automotive technologies made in Iwate. Through the Showcase car, fostering the relationships between researchers, engineers, industries and customers, to promote open-innovation for next generation vehicles.

"Matching project" industry needs and academia seeds
Create partnerships of regional industry and academia through matching between industry needs and academia seeds in manufacturing , technology area, and promote finding joint solutions.

Supporting Student Formula EV Team "SIFT"
Supporting "SIFT" (Students of Iwate Formula Japan Team, cooperation of students with two universities and one national collage of technology in Iwate) for participating "Student Formula Japan"

Establishment of knowledge networks

Project Vision
-Realizing the reconstruction from the disaster of Great East Japan Earthquake-

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 commercialization of projects through cooperation with industry, academia, local authorities and banks, and cultivation of professional engineers, to realize the persistent innovative region with prospective activities for vehicle innovation.

Develop human resources

@ Iwate University
Development of engineers with practical skill and engineering knowledge, focusing material/machining and general automobile engineering.

@ Ichinoseki National Collage of Technology
Development of engineers for next-generation automobile industries, focusing material design, vehicle design, and specific EV engineering

@ Iwate Prefectural University
Development of engineers who have specialized knowledge both in manufacturing and software for the creation of next-generation vehicle innovation

Sharing of research facilities and equipments

@ Iwate University
Introduce and promote common utility of cast system and modeling system

@ Iwate Prefectural University
Introduce and promote common utility of equipments at i-MOS, Iwate Monodukuri and Software Integration Technology Center

@ Iwate Industrial Research Institute
Introduce and promote common utility of research equipments for the creation of next-generation of vehicle innovation

岩手大学 IWATE UNIVERSITY　岩手県立大学　一関工業高等専門学校　岩手県工業技術センター　岩手銀行　北日本銀行　岩手県

Reinvention of Our Eco-Friendly Molding Factory

Plamoul Seiko Co., Ltd.
http://www.plamoul-seiko.co.jp/index.html

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

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

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

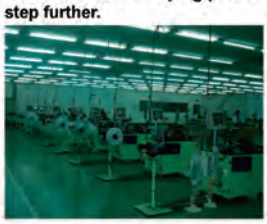
Optimum various molded method, supported by production facilities in depth product variant-diaphragm. In addition, it supports the shape to prevent telescoping product of deep drawing.

•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.

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

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

HeadOffice 〒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鳥沙江貝村新南路第三工業區
TEL:+81-(0)769-8509-1910
FAX:+81-(0)769-8509-1920

Pursuing the Ultimate Cross-media Advertising

AXV

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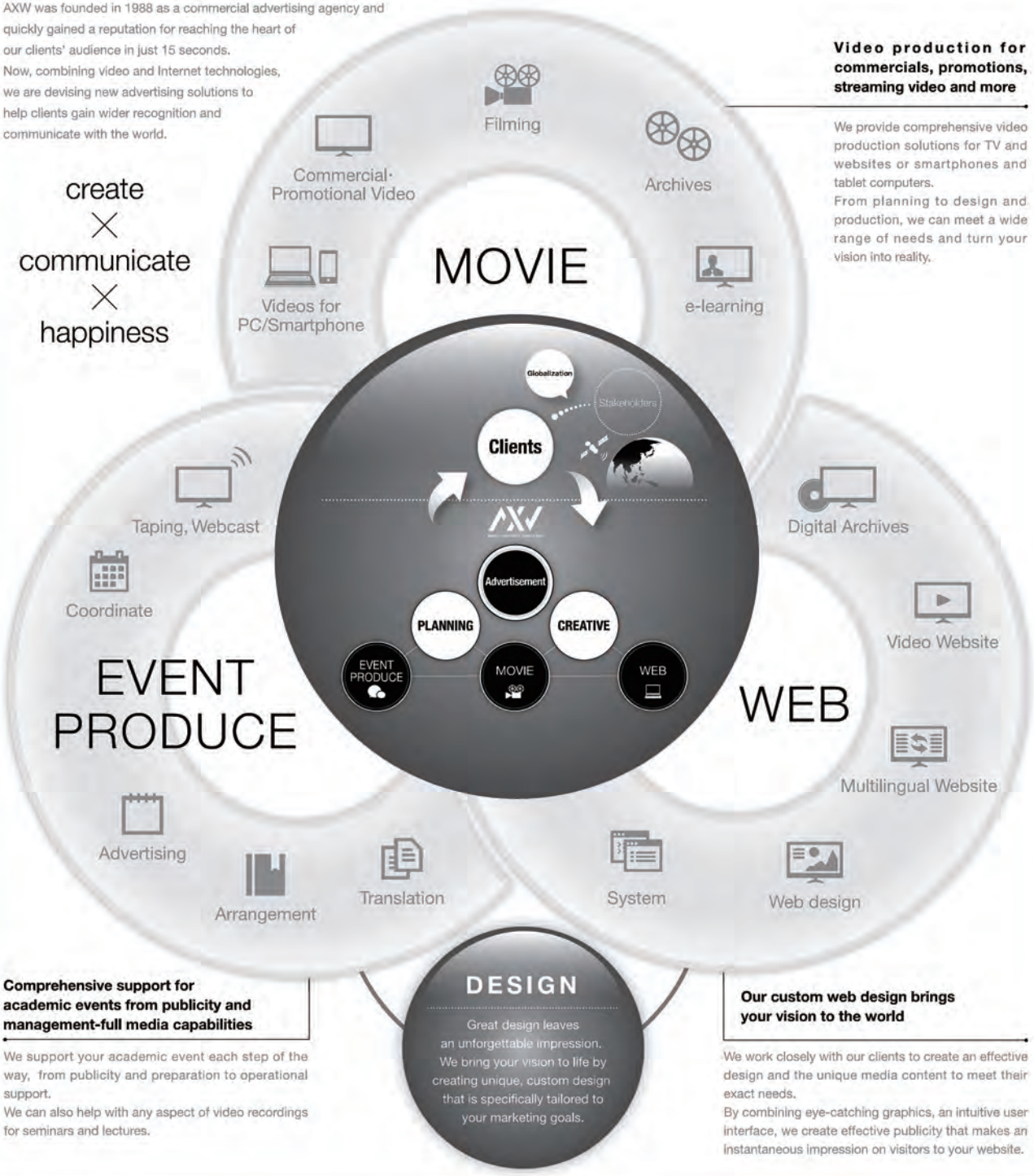
AXW was founded in 1988 as a commercial advertising agency and quickly gained a reputation for reaching the heart of our clients' audience in just 15 seconds.
Now, combining video and Internet technologies, we are devising new advertising solutions to help clients gain wider recognition and communicate 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.

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 ≫

AXW 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

☎ +81-22-261-9481

http://www.axw.co.jp

Recycle spent Organic Solvents & Alcohols by Distilling
Contribution to Resource Circulation Society

MITSUMARU Chemical Corporation
http://3maru.co.jp/mitsumarukagaku.htm

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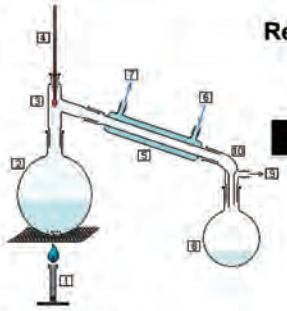
What is Distilling? Here's an Experimental Model ...

What is Distilling ....?

It is a coagulation separation technology of two or more components having mutually different boiling points by fixing after vaporing of mixture organic solvents or alcohols.

Experimental Model



1 : Heat source
2 : Distilling compounds
3 & 4: Heat control
5, 6 & 7: Cooling system
8 : Purified substance receptacle
9 &10 : Vacuum unit

Required Qualities of Distillate

1, Distillation separation purity
2, Moisture content
3, Contamination elements
4, Cost of recycling
5, Comply with Great variety / Small amount
6, Others

Realization of Resource Circulation Society

Contribution to Vast Majority of CO_2 Reduction & Resources Circulation

Application Development of Existing Technology

Biomedicine Reagents Production & Commissioned Analyses

Plant Apparatus & Key Technology

"Various Chemical Analyzer "

Plant Apparatus

1, 5 distillation equipment 21kl/day
2, 6 batch-wise rectification equipment 67kl/day

Key Technology & Features

1, Distillation technology from low to high boiling point solvents; 40 – 250℃
2, Recycle technology to high purity distillation with free-contamination
3, High-tech chemical analyzes & quality assurance system of GC-MAS, ICP, gas chromatograph etc.
4, Handling variety of solvents & alcohols
5, Shipment from small quantity;18l can; to tanker

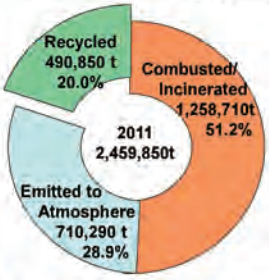
Commodity Recycle Materials & Market

1, Toluene / Hydrocarbon system solvent
2, Methanol / IPA
3, Acetic etheracetic ether
4, Acetone / MEK / cyclohexanone
5, N-methylpyrrolidone / pyridine / DMF
6, GP thinner
7, Others; Having development function

Market1; Li-ion battery solvent
Market2; Pharmaceutical / Chemical reaction solvent
Market3; Miscellaneous paint solvents
Market4; Miscellaneous cleaning solvents
Market5; Magnetic recording tape solvents
Market6; Others

Resource Circulation & CO_2 Reduction comparison chart

Annual usage and Effluent disposal
Adapted from Japan Solvent Recycling Industry Association



Annual usage : 25million tons (approx.)
50% of effluent: Incinerated
30% of effluent: Emitted to Atmosphere
20% of effluent: Recycled

CO_2; Evolution & Reduction

Amount of CO_2 emission per kg of process liquid

Amount of CO_2 emission from combustion system

1, Imported crude oil to Japan from Middle East;
During tanker shipping (0.1Kg CO_2)
2, Crude refining in Japan; During refining (2.0 ~8.0Kg CO_2)
3, Combustion of spent solvents; Thermal recycling (3.0Kg CO_2)
4, Crude oil – Combustion Total amount of CO_2 emission (5.0~ 11.0Kg CO_2)

Total amount of CO_2 emission of oil combustion system; 10 - 22Kg

Amount of CO_2 emission of distillation system

Total amount of CO_2 emission during distillation
0.1 - 1.0Kg CO_2

→ Effective way to Reduce CO_2

Example of Domain-shift Business Evolution Utilizing Solvents-Handling Technology

1; Domain-Shift Utilizing Handling Solvents, Treating Poisonous / Deleterious Substances, Analyses Feature, and Skilled Pharmaceutical Preparations
Production and distribution of non-clinical reagents collaborated with clinical reagent to domestic & overseas markets

2; Commissioned Biologic Analyses utilized ICP spectroscopy
Biological analyses commissioned by research institutes and Universities

3; Others

Products of
Non-clinical in vitro diagnostic

ICP-OES Analyzed Concentration of Trace Metal in biological sample

	Ca	Cu	Fe	Mg	Zn
Sample-1	89.6	1.0	20.7	15.3	2.4
Sample-2	146.0	1.8	59.9	23.6	3.9
Sample-3	234.5	2.8	320.4	25.8	21.7

(unit: mg / l)

Entrusted Analyses (Example)

Multi-Kind and Small-Quantity Automotive Aluminum Forging

ALTEX ALTEX CO., LTD.

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Metal Mold Casting (Gravity)
Sendai Headquarters Factory


9 Crucible Furnaces


Molds for Quantity Production


Metal Mold Maintenance Testing


Setting Core to Metal Mold


Pouring Molten Aluminum


Product Finishing

Sand Mold Casting
Yamagata Obanazawa Factory


2 Crucible Furnaces


Resin Mold Maintenance Testing


Sand Mold Casting


Setting CO_2 core to Sand Mold


Pouring Molten Aluminum


Product Finishing

Production of Shell Core

Production of CO_2 Core

Cast Aluminum

Making Best Effort to inherit
'Craftsmanship' that we value.
Going back to the original once again.

Intake Pipe

Transmission Case

Good Quality, Low Cost, and Quick Delivery

You'll be satisfied with the products we provide.

Materialize

Company Profile

Corporate Name
ALTEX
ALTEX CO., LTD.

Sendai HQ Factory
57-4 Shin Minaminaganuma
Shimonogo Iwanuma
Miyagi JAPAN 989-2421
TEL : 0223-24-5411
FAX : 0223-24-4777

Obanazawa Factory
326-7 Minamiura Harada Obanazawa
Yamagata JAPAN 999-4335
TEL : 0237-28-3121
FAX : 0237-28-2254

Established	Capital	Payroll Number
July, 1983	10 million yen	50

Obtained ISO 9001 : 2008

Main Products

Intake pipes
Intake manifolds
Thermostat cases
Covers / Cases
Truck diesel engine components
Aluminum prototype parts

Major Facility & Apparatus

- Molding Machine: F-1, FD-3
- Mold Casting Machine: 500×500×300h-1000×1000×600h
- Shotblast: IMR-600, table shot (φ1400)
- CNC BARINDER: 400F
- Permeation Apparatus M-100P
- Shell Core Casting Machine: VS-660, SG68, NUS440, SMK430
- CAD System HyperM-DrafVer3.0, CADmeister, MYpac
- Analyses Software: JSCAST
- Brinell Hardness Testing Apparatus: NBH-3

Solutions for Automobiles and Auto Components

Engineer Science Co., Ltd.

URL : http://www.tes-ltd.co.jp

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Automobile-related Solutions

- Automobile carrier
- Plastic molded plane production control system
- ABS machine tool / Interlocking movement control
- Air back assembling, Quality evaluation system
- Small electric car (Battery evaluation)
- Bumper painting system of administration
- The automobile body painting / Electric characteristic
- Latex pushing out line equipment for development
- X-ray tester / Laser marking
- Battery module assembling production line
- Brakes production line / Measurement control
- Semiconductor evaluation equipment
- Engine machine stand number reading
- Infrastructure facilities monitoring system

Core Technology of Engineer Science

◇Speedy suggestion & specification
- ·Offering variety of solutions & know-hows
- ·Suggesting with being on the customers' stand

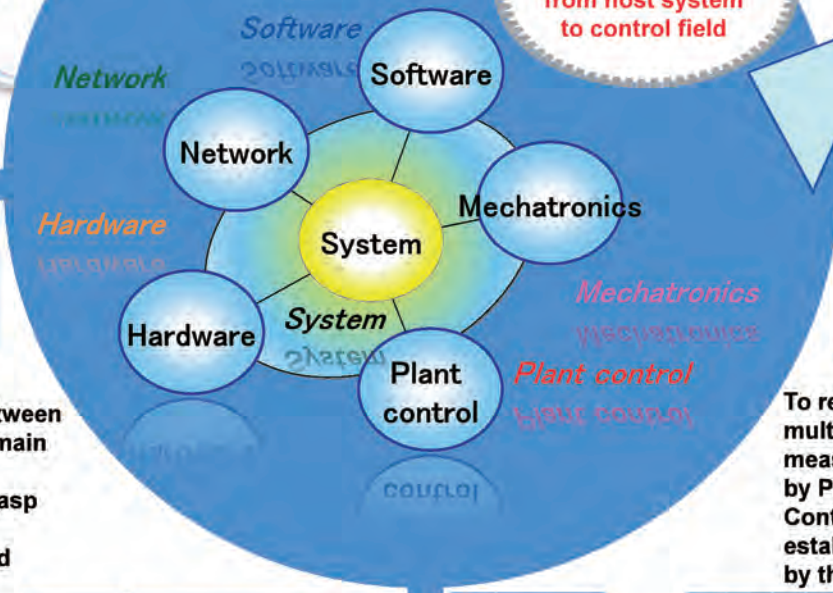
◇Machine design / Manufacture

◇PLC / Instrumentation
- ·Technology modifying Equipment old to new
- ·Machine control (Various motor & sensors)
- ·Analog measurement

◇PC / Communication technology
- ·SCADA (Graphic, Animation, and Trendy graph)
- ·Making database of manufacture history
- ·Peripheral equipment device cooperation (Two-dimensional cord, RFID)

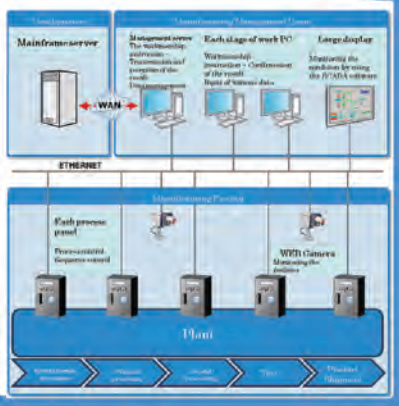
Core Technology

We prove total support from host system to control field



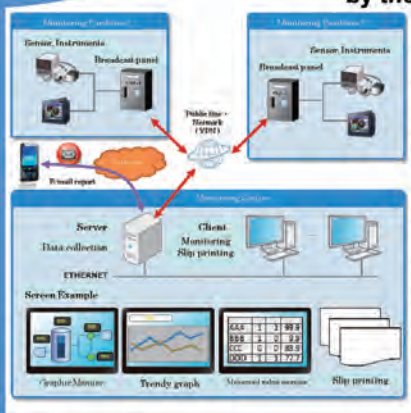
FA System (Factory Automation)

Removing interface between computer system and main production equipment makes it possible to grasp the whole production virtually in real time and to collect the results. And it also can improve production efficiency by developing production schedule automatically, and that achieves reduction of loss rate and cost significantly.



Facility Monitoring System

To realize monitoring multiple facility sites, measure facility signals by Programmable Controllers etc. and establishing the system by the computers which can process and interpret data. The introduction of the system improves immediate response to monitor trouble; notify you mobile text messages / voice call; and stable operation management for the facility.

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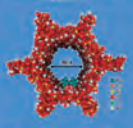
5-18-7 Yamatomachi, Wakabayashi, Sendai, Miyagi, Japan 984-0042
TEL +81-22-782-3307／FAX: +81-22-782-3304

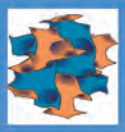

International Presentation

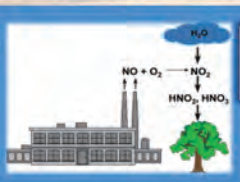
RUTHENIUM-CONTAINING ORDERED MESOPOROUS SILICA: Promising Catalyst for Reduction of NO by CO

Indian Institute of Technology-Madras, Chennai, India; Indian Institute of Technology-Bombay, Mumbai, India

Parasuraman Selvam, Vilas M. Ravat and Preeti Aghalayam







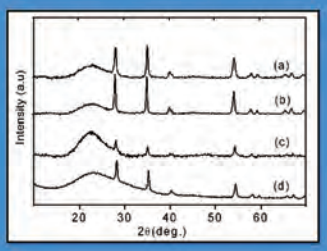
NO_x EFFECTS
Baukal
Metal Finishing
103, 2005, 18

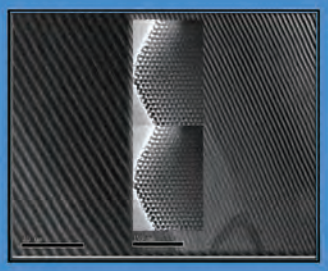
How NO_x is Controlled?

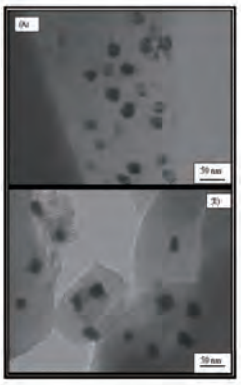
Catalytic Reduction of NO_x to N_2

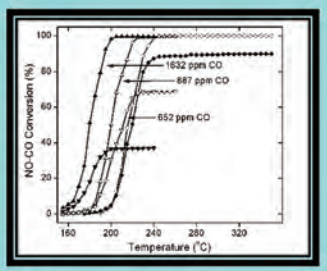
- *Selective Non-Catalytic Reduction (SNCR)*
  Requires high temperature (T >1000°C)
- *Selective Catalytic Reduction (SCR)*
  The most promising technique!
- *Dry Sorption*
  Can't be used for automobile!

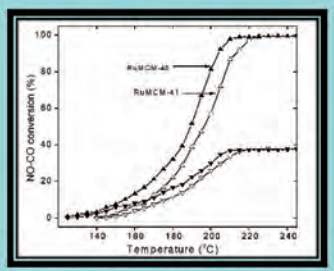
Selective Catalytic Reduction of NO_x

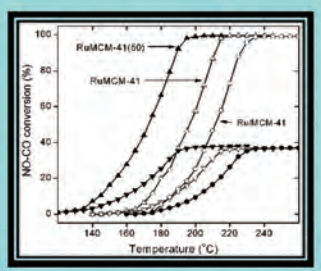


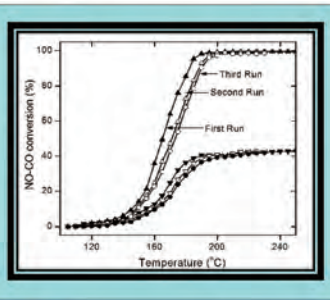












TOHOKU UNIVERSITY

iitmadras

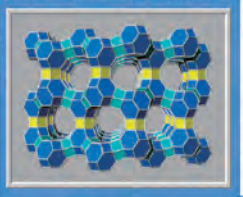
National Centre for Catalysis Research

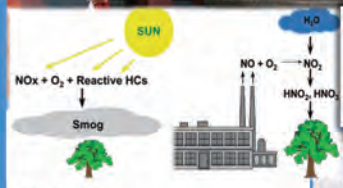
PARASURAMAN SELVAM
NCCR / IITM – NICHe / TU

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



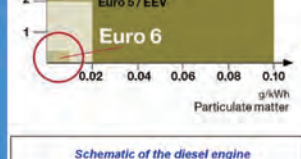


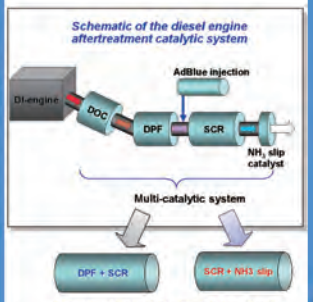
C. Baukal
Metal Finishing
103, 2005, 18
NO_x Effects

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!





Attractive to combine several functions in a single catalyst brick

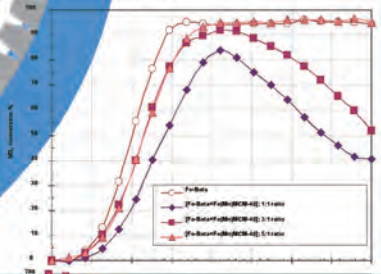
➢TARGET

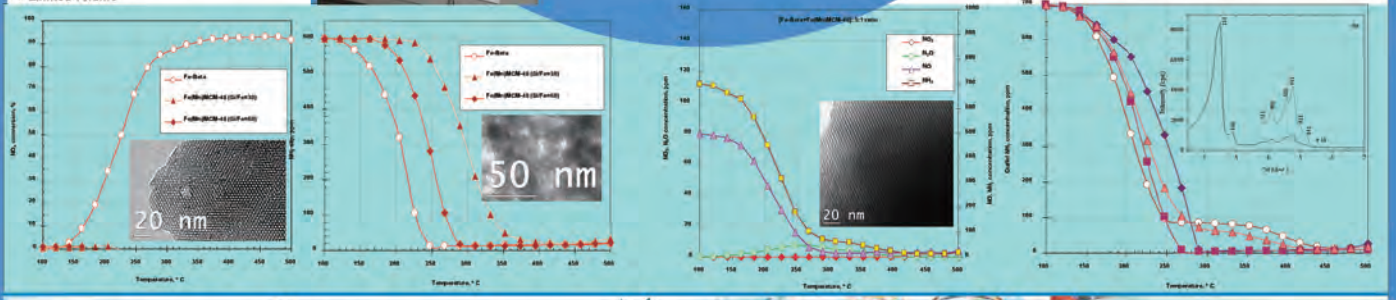
- ✓ Good soot oxidation performance
- ✓ High NH3 DeNOx activity (including T_{react} < 250°C)
- ✓ NH3-slip function is desirable
- ✓ Limited volume

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.



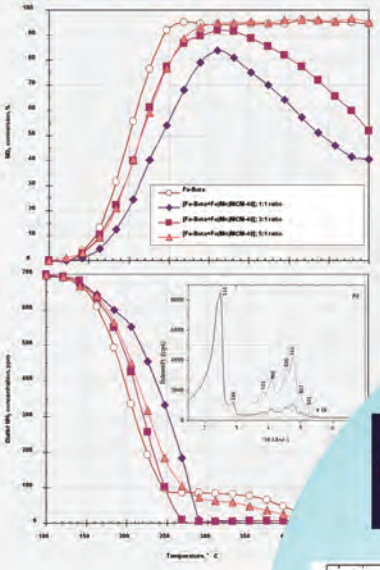


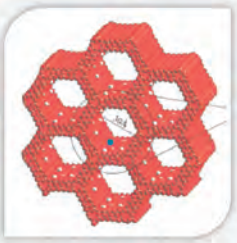
MESOPOROUS MATERIALS AS AUTOMOTIVE EXHAUST CATALYSTS

Indian Institute of Technology-Madras, Chennai, India

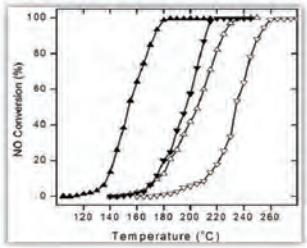
MEXT TOHOKU ECONOMIC FEDERATION Tohoku University 宮城県 七十七銀行 ICR

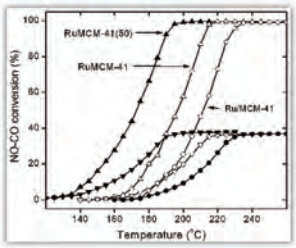
NH_3-DeNO_x Performance Catalyst



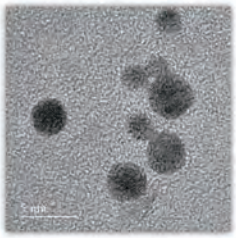


Catalyst for Reduction of NO by CO

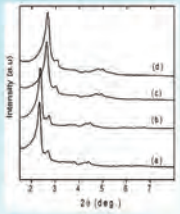


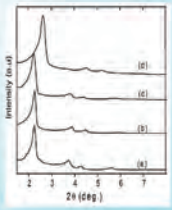


AGRIMOVE SEGMENT
DCU, ZIOC, TU, UQ, UT & UWS

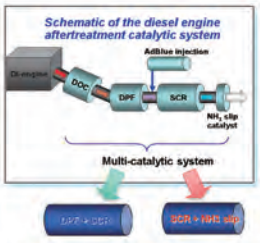


DST / CSIR / BRNS / IOCL / NOCIL
SHELL / P & G / SABIC / GRANULES

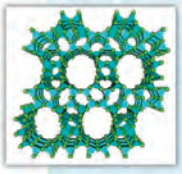




Selective Catalytic Reduction



REGULATION												
	EURO III TO EURO IV				EURO IV TO EURO V				EURO V TO EURO VI			
Reg. pollutants	NOx	PM	HC	CO	NOx	PM	HC	CO	NOx	PM	HC	CO
Emissions target (g/kWh)	3.5	0.02	0.46	1.5	2.0	0.02	0.46	1.5	0.4	0.01	0.13	1.5
Emission reduction[4] (%)	30%	80%	50%	25%	43%	0%	0%	0%	80%	50%	72%	0%
After-treatment system[5]	• NOx control: SCR systems (open loop) • PM control: DOC + PFF				• NOx control: SCR systems (closed loop) • PM control: DOC + PFF				• NOx control: SCR systems (closed loop) • PM control: DOC + DPFs			



Catalyst	Method	NO conversion temperature (°C)		
		25%	50%	100%
Pd/MCM-48	IMP	235	245	280
Pd/MCM-48	DP	210	225	265
Pd/MCM-48	HDP	190	205	235
Rh/MCM-48	HDP	145	155	185
Ru/MCM-48	HDP	188	200	220
Pt/MCM-48	HDP	225	235	260
Pd/MCM-41	HDP	205	220	255
Pd/SBA-3	HDP	235	245	280

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