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

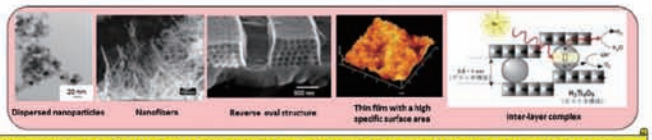
The Development of Innovative Three-way Catalysts via Solvothermal Reactions

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

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

Property improvement of ceramic materials by controlling composition and morphology

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



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

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

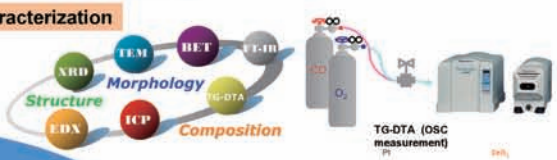
To solve problems ...

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

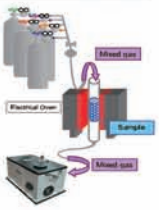
Development of innovative automobile exhaust gas purification catalyst by precisely controlling the morphology and composition

Synthesis

Characterization



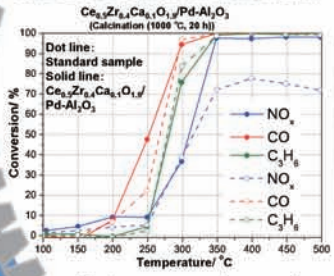
Three-way catalysts (TWCs) performance evaluation



FT-IR (Automobile exhaust gas purification measurement)

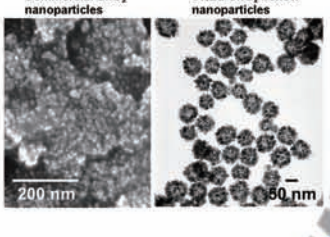
Innovative automobile exhaust gas purification catalysts

Ceria-based catalyst performance evaluation



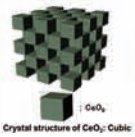
Performance was improved by the composition control !

Non-ceria catalyst performance evaluation



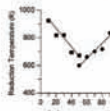
Performance was improved by the morphology control !

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



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

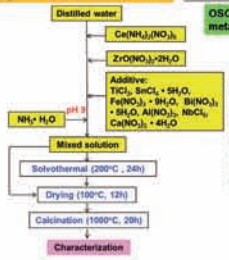
MO_8 oxide ideal $r(M^{n+})/r(O^{2-})=0.732$
CeO_2 $r(M^{n+})/r(O^{2-})=0.703$



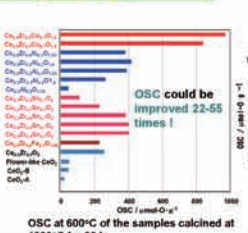
R.D.Monte, J. Alloy Comp., 275-277, 877 (1998).

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

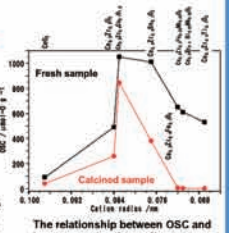
Synthesis of ceria-based solid solution



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

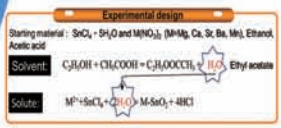


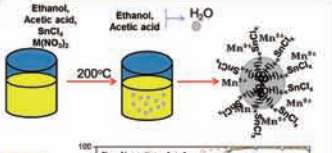
The relationship between OSC and incorporated cation radius

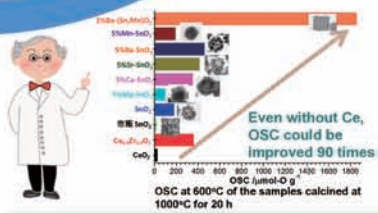
Oxygen storage capacity (OSC) of CeO_2, could be improve 22 times by co-doping Zr and Sn into CeO_2, which is a well know automotive co-catalytic material. It was possible to reduce the consumption of Ce more than 30%.

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

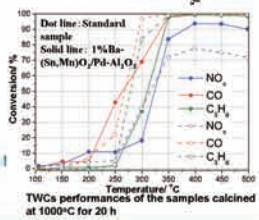
Non-ceria automobile exhaust gas purification catalyst— M-SnO_2







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: tsusato@tagen.tohoku.ac.jp

Professor
Tsugio SATO

Associate professor
Shu YIN

Assistant professor
Qiang DONG

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

Supercritical Fluid Technology

—Cleaning, Functional material preparation—

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

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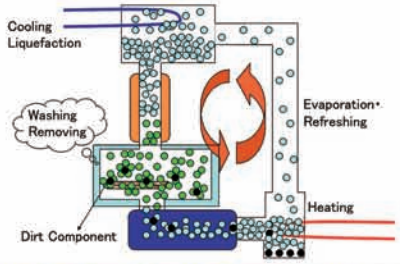
Cleaning& Drying using SC-CO_2



Utilization of large density change with temperature gradient

Pump-less, Thermal Circulation & Solvent refreshing

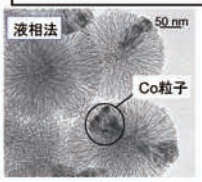
No drying process
No solvent remaining
Applicable to
- water-prohibit materials
- Very fine structured materials
- Hybrid materials

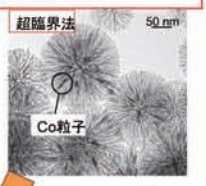
Ex; *Cloth Dry cleaning,*
Fine metal devices
HEPA Filters, etc

Catalyst Preparation by Supercritical Fluid

Previous Works : Metal Doping on Porous Silica

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





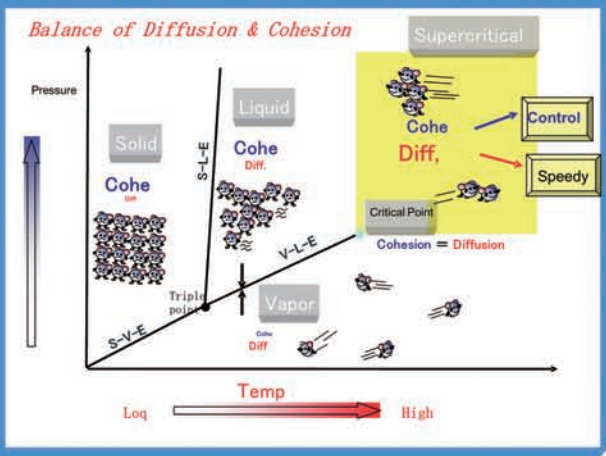
Efficient Utilization of micro pores
High dispersion of metal particles

High Penetration Ability

Particles Aggregation Control during Drying Process

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

Dissolve Metal Complex, Penetrate into porous media



Prediction of Adsorption in Porous Materials

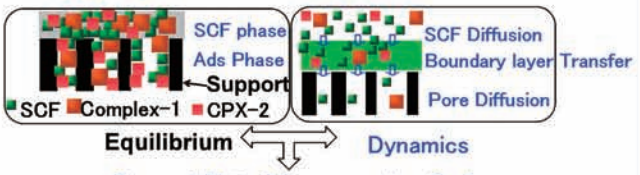
Catalyst Preparation by SCF

Precursor Dissolution
→ Adsorption on Support →Calcine

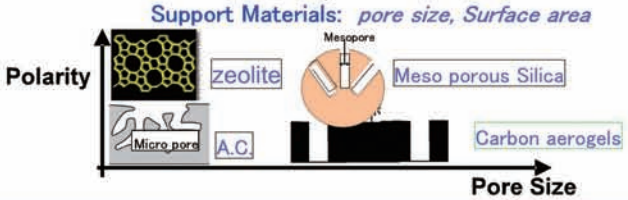
For Designing・

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

Development of Prediction Methodology for equilibrium, dynamics and support materials



Support Materials: *pore size, Surface area*

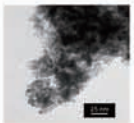


Applying to Automobile Exhaust -Rh/CeO_2-

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

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

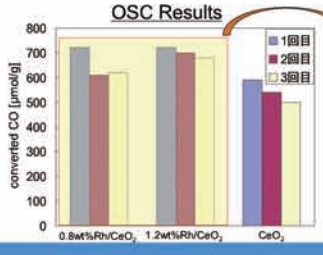
TEM Observation



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

Highly dispersion of very small Rh particles ??

OSC Results



Rh Doping increases OSC

Rh-Support Interaction plays am importance role

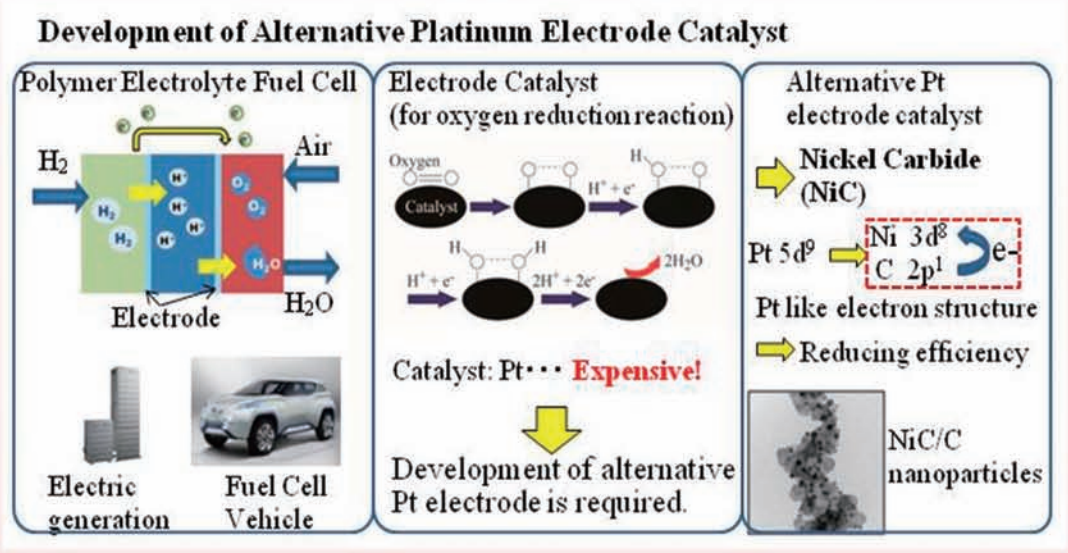
Extending this method to Other metals on CeO_2-Al_2O_3

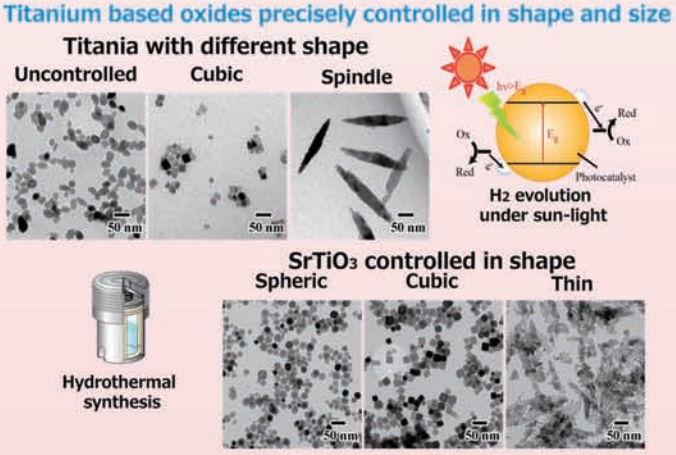
Synthesis of Hybrid Nano-Particles and Application to Functional Materials

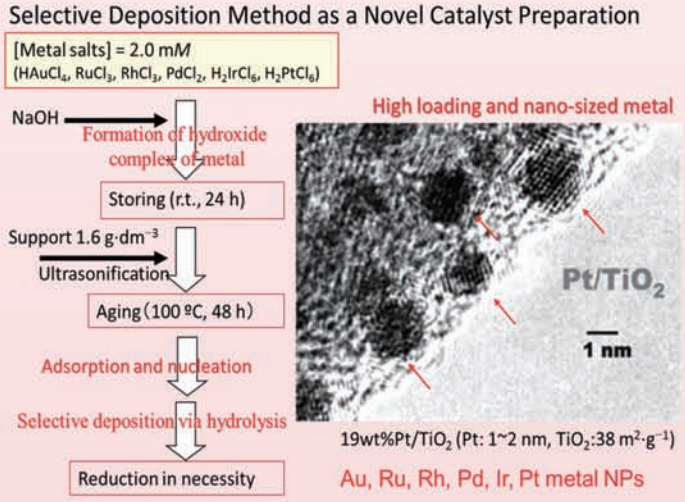
Institute of Multidisciplinary Research for Advanced Materials, Tohoku Univ.

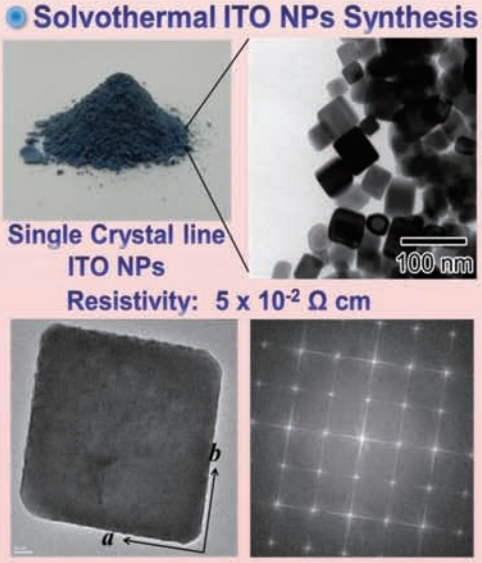
Muramatsu Laboratory

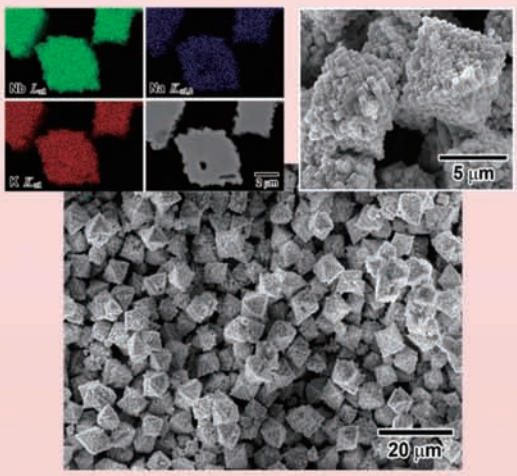
mura@tagen.tohoku.ac.jp











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

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

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

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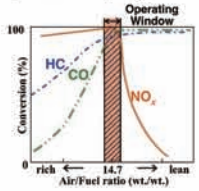
1. Research Background

TWC : Three-Way Catalyst and Promoter

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

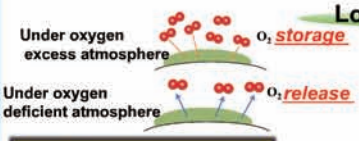


It is absolutely imperative to *suppress the air to fuel ratio* in order to remove the pollutants efficiently.

problem

Expensive precious

Low OSC property under 500˚C



Requirements

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

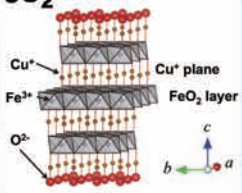
2. Research Target and Method

Delafossite-type $CuFeO_2$

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

Space group : *R3c* layered structure

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



Crystal structure of delafossite-type $CuFeO_2$

Experimental condition

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

Starting materials Cu_2O, γ-Fe_2O_3

Grinding・Pelletization

2.45 GHz Microwave Irradiation

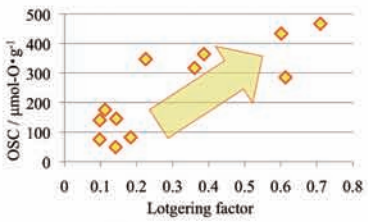
Characterization

Expectative effect...

Promotion of *anisotropic grain growth*

Influence OSC property

OSC measurement at 500˚C



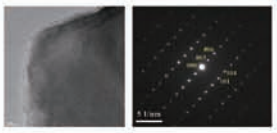
Maximum OSC value : 466 μmol-O/g

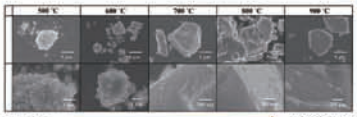
Phase stability and OSC rate during oxygen uptake-release behavior was promoted

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

3. Results

TEM and SEM observation

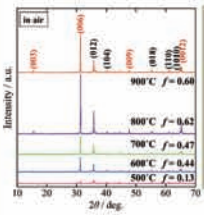




isotropic → *anisotropic*

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

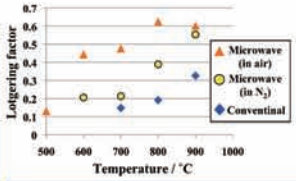
XRD analysis



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

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

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



Microwave heating promoted *anisotropic grain growth*.

4. Discussion

Anisotropic grain growth

The cause of anisotropic grain growth by microwave processing

difference of *microwave penetration depth*

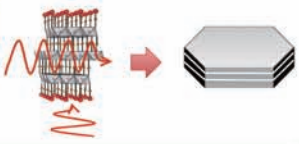
The depth of microwave penetration

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

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

Mechanism of anisotropic grain growth

	Penetration depth
c-axis	Shallow
ab-plane	Deep



5. Conclusion

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

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

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

New catalyst for automobile using organic-inorganic Hybrid nanoparticles

New Industry Creation Hatchery Center, Tohoku University
Adschiri laboratory

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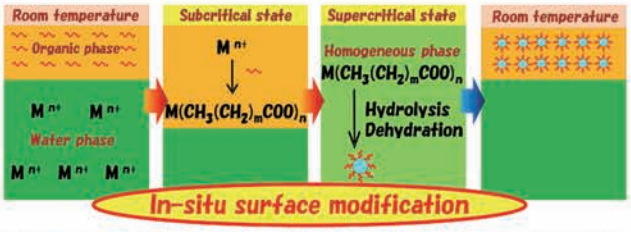
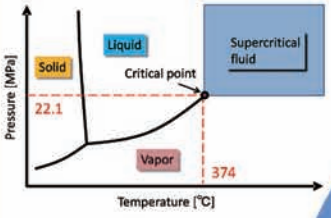
What is supercritical fluid?



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



Supercritical fluid has gas like diffusibility and liquid like solubility

How to create nanoparticle?

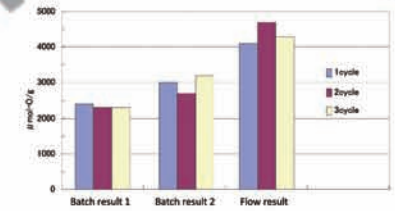
Determination of reaction temperature, pressure, pH condition etc. by batch type reactor

Create nanoparticle continuously by flow type

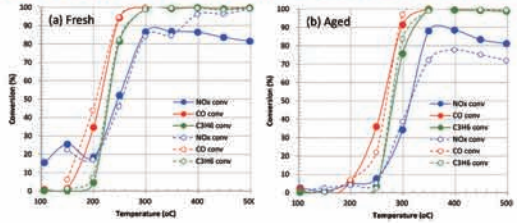
10t/year
Substantiation instrument (Momi-cho GIGA)

Middle type instrument (Momi-cho)

Table type compact instrument (Momi-cho mini)

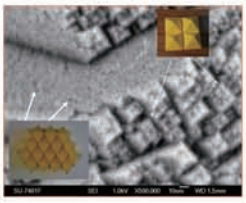


OSC results by Zirconium – Iron nanoparticles

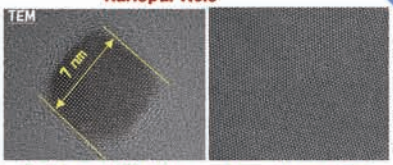


Results of the conversion of exhaust gases

Filled circle: new nanoparticle
Open circle: CeO_2 conventional catalyst

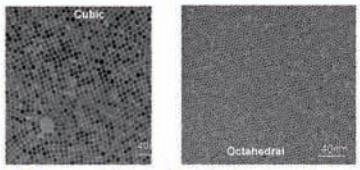


We can control the structure of nanoparticle



Surface modification nanoparticle | mono-dispose CeO_2 nanoparticle

Increase modifier concentration

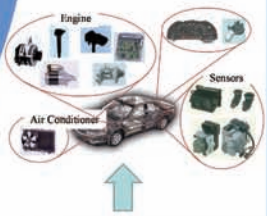


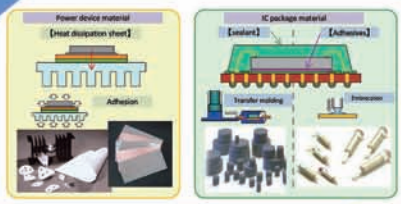
No surface modification CeO_2 nanoparticle (in water)

Surface modification CeO_2 nanoparticle hexane)

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

Example of creation nanoparticles





How to use nanoparticle for Automobiles

Message

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

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

Please contact us, if you are interest.

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

Synthesis of Ceria Nanoparticle-Assembled Hollow Mesoporous Silica Composite Particles

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Introduction

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

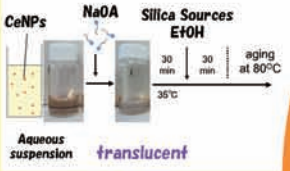
Assembling of Nanoparticles
- Novel properties different from nanoparticle itself
- Higher catalytic activity

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

Methods

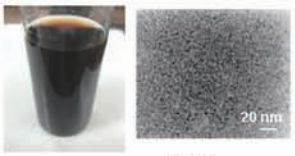
Ceria nanoparticles (CeNPs)
- Aqueous precipitation of a cerium salt in the presence of trisodium citrate

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



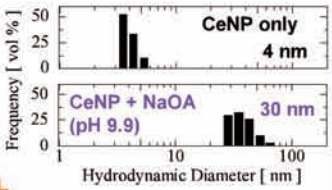
Self-assembly formation in CeNP-NaOA suspensions

Characterizations of CeNP



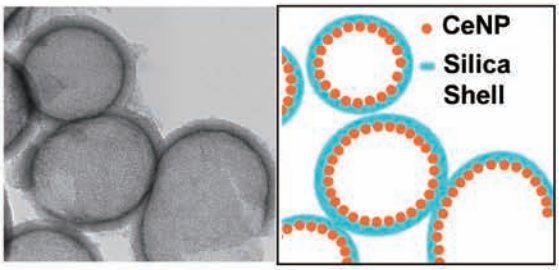
-Well-dispersed suspension
-Particle size: 3 ± 0.3 nm
-Fluorite structure (determined by X-ray diffraction)

DLS measurements of CeNP-NaOA suspensions



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

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

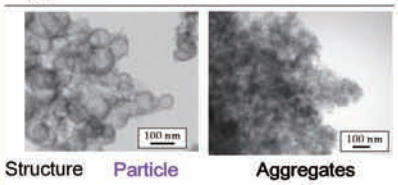


H. Ishii *et al.*, *Colloids and Surfaces A, in press.*

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

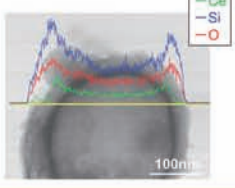
Particle Syntheses & Characterizations

TEM images of obtained samples



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

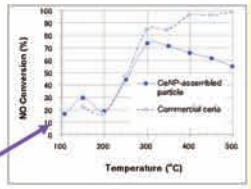
EDX analyses



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

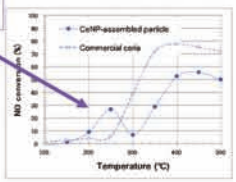
Catalytic activities

Fresh Sample



Effect of nano-size? or nanoparticle assembly?

Aging at 1000 ℃ for 20 h



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

Reaction Gas
Mixed gas with similar composition to exhaust gas.

Conclusion

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

Prof. Mikio Konno

Associate Prof. Daisuke Nagao

Assistant Prof. Haruyuki Ishii

Konno Laboratory Members

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

Catalysis for conversion of next-generation resources

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

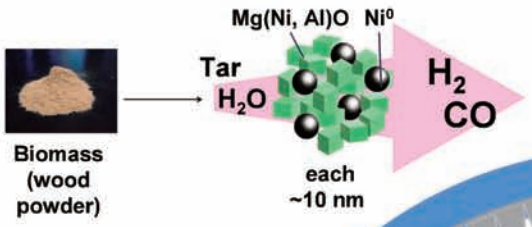
MEXT TOHOKU ECONOMIC FEDERATION Tohoku University 宮城県 七十七銀行 ICR

Production of syngas from biomass

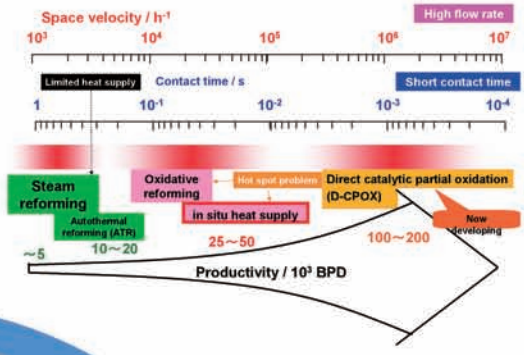
Biomass + O_2 or H_2O → H_2 + CO

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

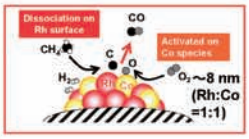
Ni-oxide nanocomposite catalysts



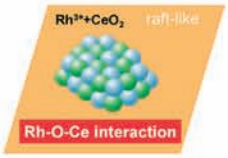
Production of syngas from natural gas



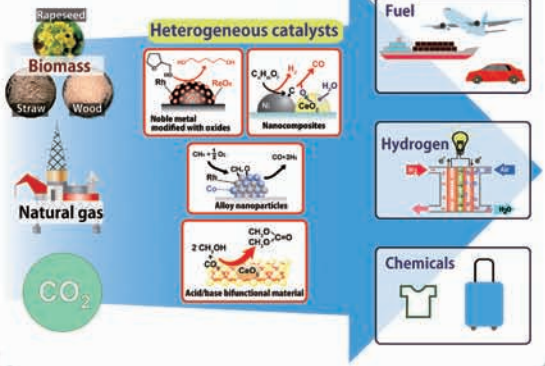
Rh-Co alloy particles for D-CPOX



Rh-CeO_2 interface

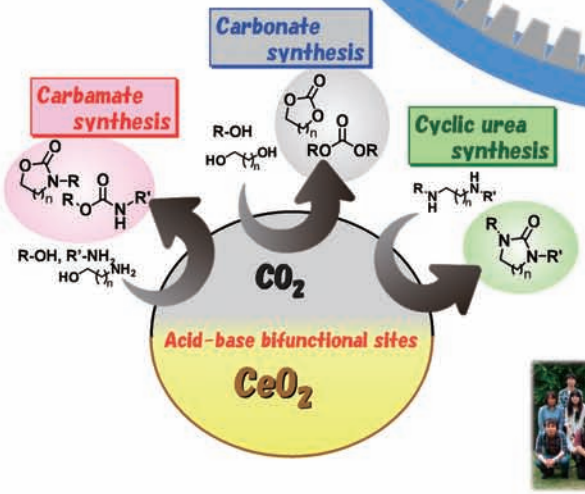


We are developing new catalysts for upgrading next-generation resources.

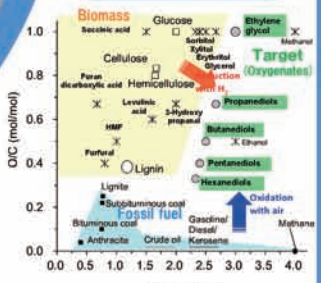


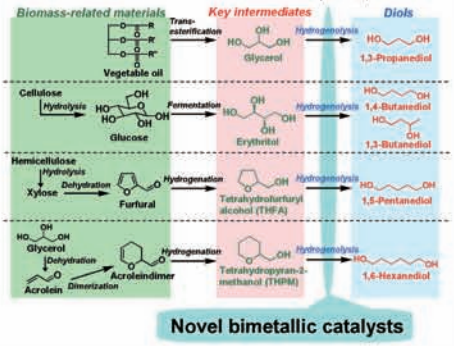
Production of chemicals from CO_2

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



Production of chemicals from Biomass





Novel bimetallic catalysts

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

Next-Generation Advanced Mobility System

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

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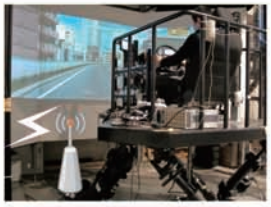
The automotive technology studies and development base

The demonstration place is a new campus in Tohoku University.



Driving simulators

Energy information

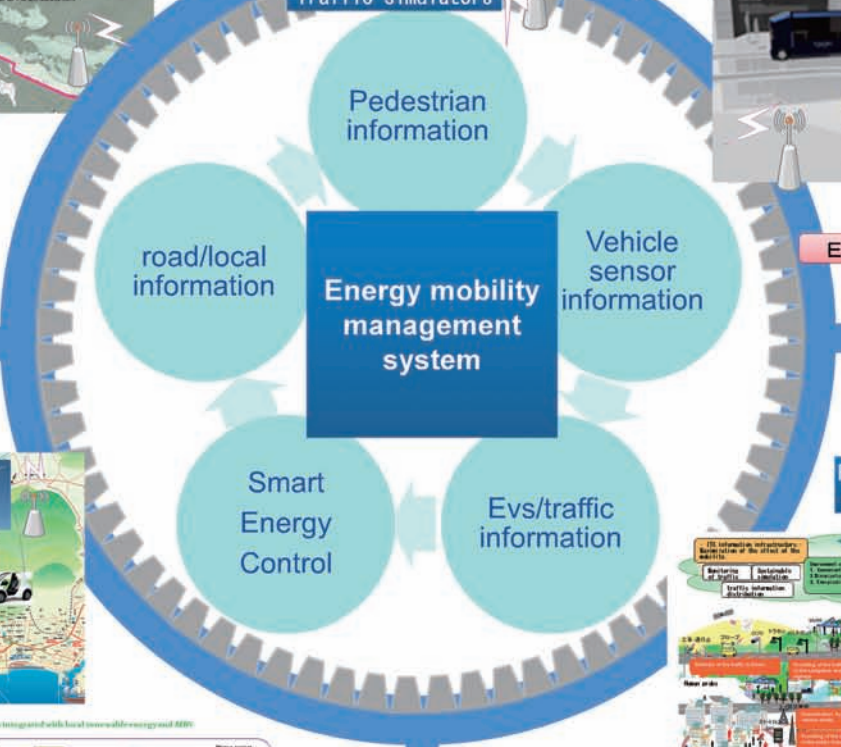
Information Displays

Small EV

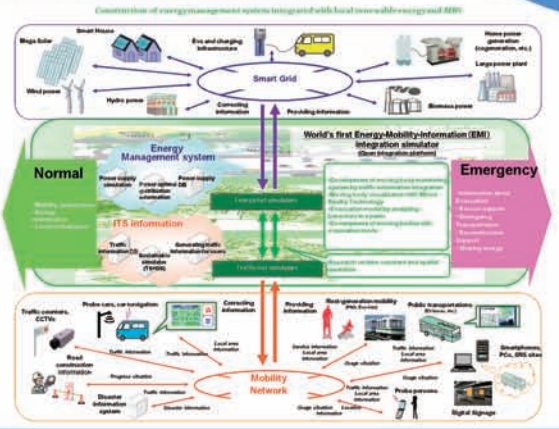
ITS information infrastructures

Traffic simulators

EV buses



Experimental implementation



Function of integrated system

Social mode change for emergency state

Ordinary state

Emergency state

New Industry Creation Hatchery Center, Tohoku University
Aramaki Aoba, Aoba-ku, Sendai, Miyagi 980-8579

http://mobility.niche.tohoku.ac.jp/
mobility-office@niche.tohoku.ac.jp
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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

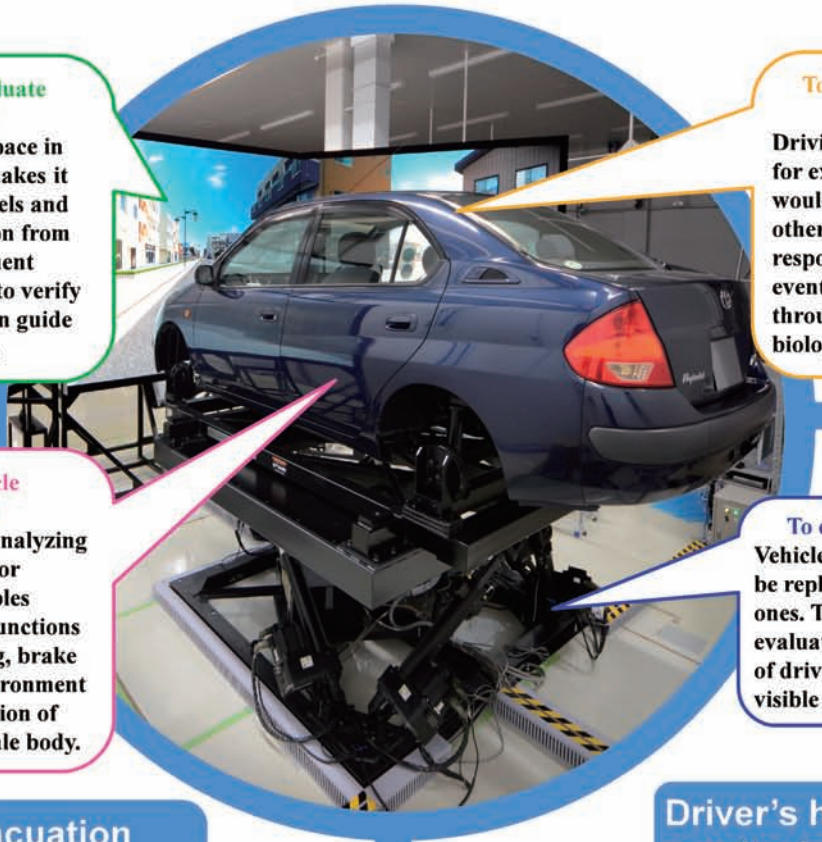
To reproduce real vehicle motions with real car cabin on motion device of 6 axes (X: front/back, Y: right/left, Z: up/down; roll, pitch, yaw)

<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

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

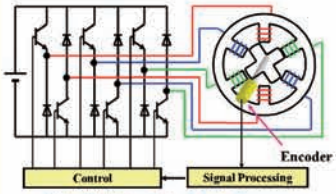
Motor Technology for Next Generation Automotive

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

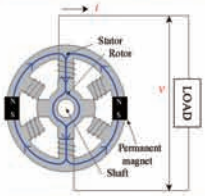


High Reliable & Rare Earth Free

Planetary type Magnetic Gear

Contactless High Power Transmission

PM Reluctance Generator

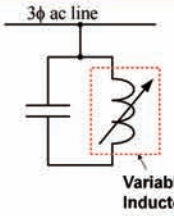


High Power without Rare Earth Magnet

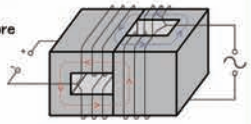
We are studying about High Performance Rare-Earth Free Motor/Generator and Planetary type Magnetic Gear for Contactless High Power Transmission.

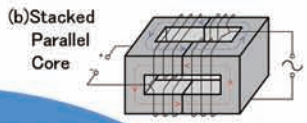
Motor Bench for In-Wheel Motor

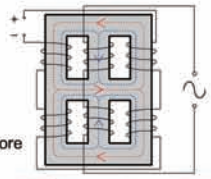
HIGH QUALITY POWER CONVERSION & CONTROL



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



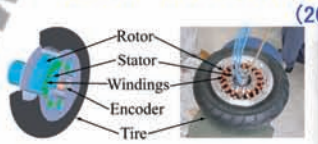


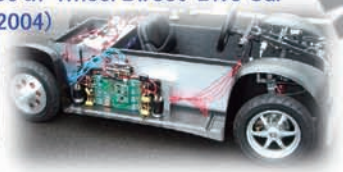


Field Test of Variable Inductor

NEXT GENERATION ELECTRIC VEHICLE

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

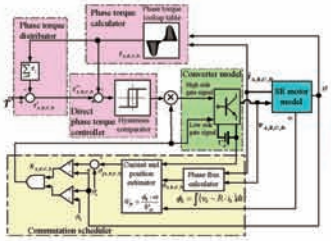




World 1st Success of Driving with 3D Structure Rare-Earth Free In-Wheel Direct-Drive Motor (2012)

Fully Digital Controlled Inverter

Computing Room



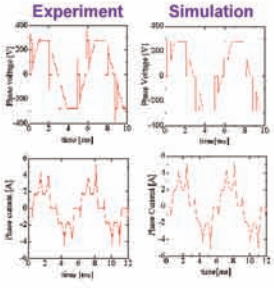
Novel Torque Control for SR motor

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

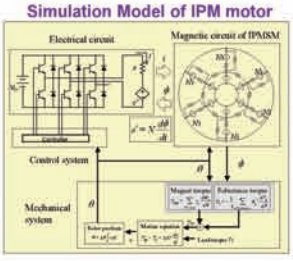
Motor Simulation by Magnetic Circuit Method

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

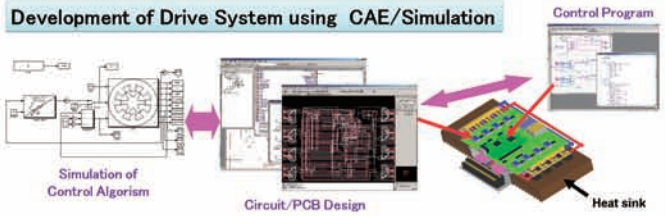
Experiment Simulation



Simulation Model of IPM motor



Development of Drive System using CAE/Simulation



POWER ELECTRONICS & CONTROL

ANALYSIS & SMULATION

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

Recycling Technologies for End of Life Vehicles

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

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

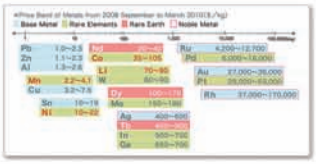
Many materials are used in various components for automobiles, which bring the advanced performance to advanced cars like EHV. miner rare metals are essential substances for high performance automobiles, while their supply chains have been recently unstable and their price change is strongly intense.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

Miner Rare Metals Used in Vehicles

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

Fig.1 Miner Rare Metals Application for Automobiles

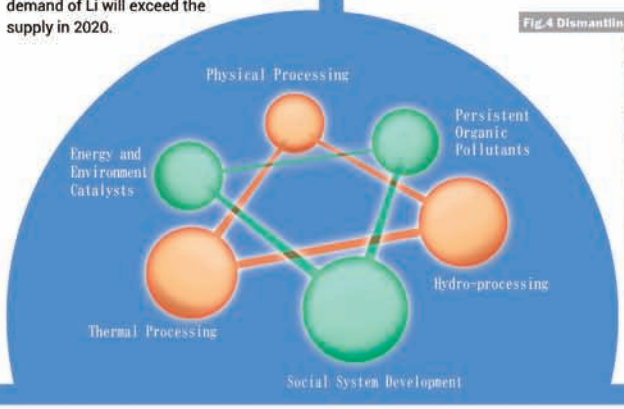
Fig.2 Price of Metals



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

Table1. Supply and Demand Forecast of Li

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



Recycling on Automobile Components

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

Fig.3 Utilization of Disassembled Components from Scrapped Vehicles

Fig.4 Dismantling of Electric Motor in Electric Vehicle

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

Research Works on Recycling Technology

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

1 High Efficiency Rare Elements Extraction Technology Area Project

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

2 Research on High-Temperature Processing Technology

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

3 Research on Hydrometallurgical Processing Technology

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

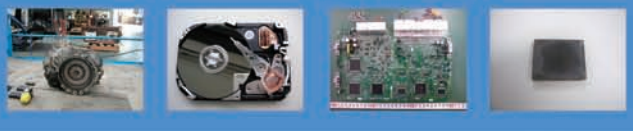
About the Concept "Urban Mine"

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

Contact Information

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

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



Automation of physical distribution and traffic using robot technology

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

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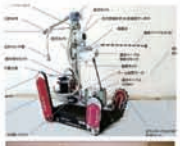
Heightened needs for the robot technology



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

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

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

Core technologies for autonomous robots

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

Sensing
- 3-D measurement
- Environmental recognition

Probabilistic logic
- Recognition & planning
- Localization

Control
- Actuator control
- Motion generation

Robotic Technologies for Safety, Security and Welfare of the Life

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

Pedal-driven wheel chair

Autonomous unmanned carrier

Autonomous driving electric vehicle

Autonomous quad rotor






Problems for autonomous driving in outdoor environment

1. Weather and bad road surface condition

2. Obstacles: Peoples & cars

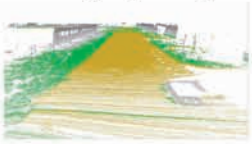
3. Laws

Collaborative project:

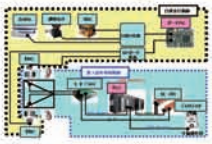
Development of autonomous unmanned carrier in snowy region

Hardware development

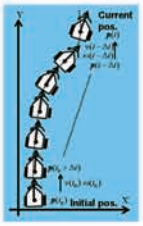

3-D mapping using LIDAR



System integration



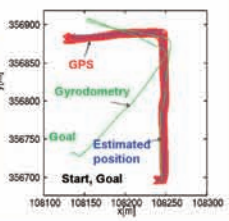
Precise & robust localization using Bayes filter



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

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
URL: http://www.rm.is.tohoku.ac.jp
Email: staff@rm.is.tohoku.ac.jp

Tad Lab

System Robotics Laboratory

Department of Bioengineering and Robotics
Graduate School of Engineering
Tohoku University

Coordinated Motion Control of Multiple Robots

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

iCART(Intelligent Car Autonomous Robot Transporters)

Mobile Dual Manipulators Coordination

Multiple Robots Coordination

Manipulation of a rigid object (1989)

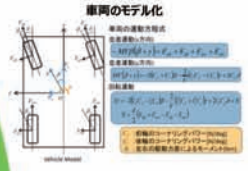
Manipulation of a flexible object (1995)

Parts Assembly By Dual Manipulators (1994)

Next Generation of Advanced Vehicle Control System

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

Design of New Control Systems



System Robotics

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

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

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

Human Power Augmentation System (1993)

Mobile Robot Helper (1997)

Human-Robot Interaction

PaDY (Parts/tools Delivery to You Robot)

Concept of PaDY

Partner Ballroom Dance Robot (2005)

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

Partner Robot

Passive Intelligent Walker

Assistive Technology

Wearable Walking Helper

Advanced Power assisted cycle chair

Wearable Walking Assist System & Intelligent Passive Cane

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

Motion Support System

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

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

Applying Robot Technologies to Design of Next-Generation Car

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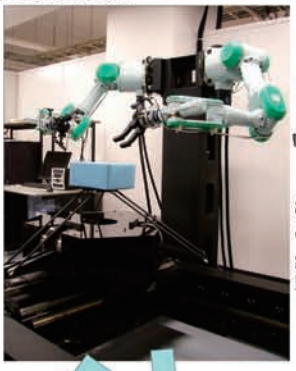
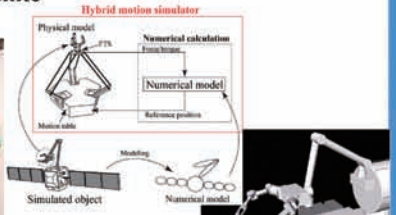
Space robot teleoperation & Microgravity simulator

Teleoperation between a satellite and the earth

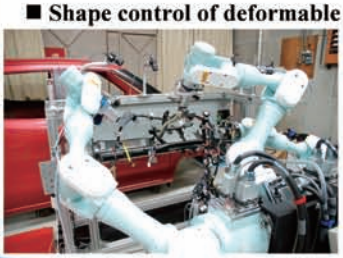




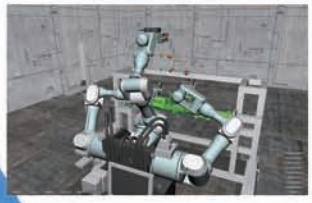
Simulation of robot operation in micro gravity environment with hardware-in-the-loop simulation

Automatic assembly of wire-harness with robot

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

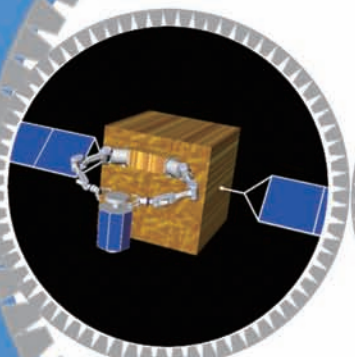


Robot system designed for automatic assembly of wire harness in automobile plant

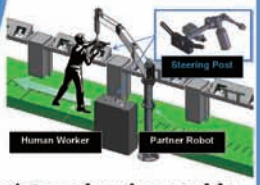


CG based simulator used for task planning

Make a Robotic car!



The kit car under development



Assist workers' assembly

Drifting experiment

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

Research on driving assistance

Tested in a practical assembly line

Developed robot

Partner robot in automobile assembly line

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

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

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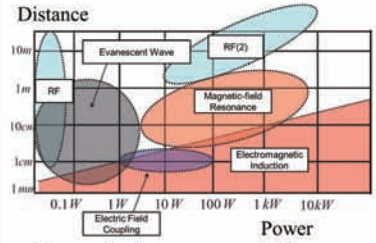
Wireless power transmission (WPT)

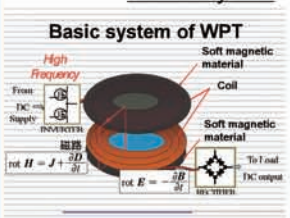
Wide range power (about 1 mW～ 150 kW)
Adapt to every needs for contactless power supply



Transmission power and distance of WPT system

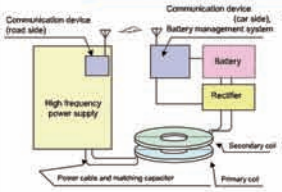
High Efficiency, High Power based on LC-booster method

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



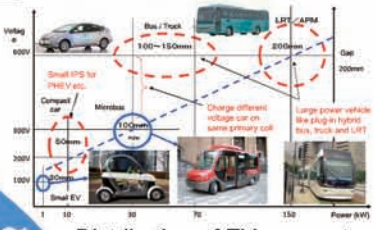
Example of basically WPT system

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



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

WPT system for EV charging



Distribution of EV parameter

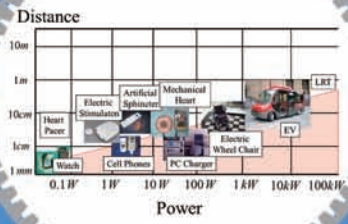
WPT coil for Electric Bus (30kW)

Integration of Medical and Engineering

～Future of Wireless Power Transmission～

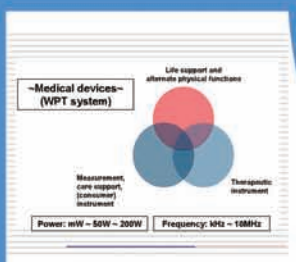
Optimized WPT system for each load

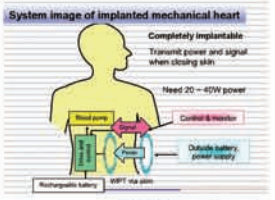
LC-booster, Wireless power rooter, Flexible charging



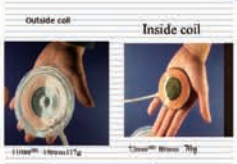
Highway IPS system

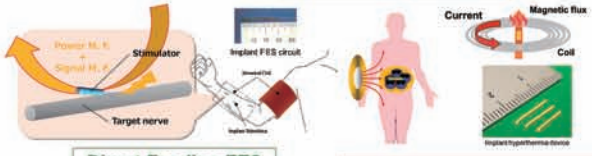
Future of Energy Transfer





WPT system for mechanical heart

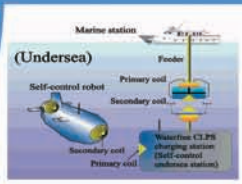




Direct Feeding FES
Treatment for spinal cord injury, Reconstructing exercise function

Soft-heating Hyperthermia
Advanced cancer therapy

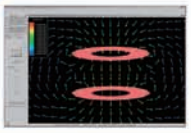
WPT system for implantable medical devices



WPT system for Underwater
Underwater robot, Underwater energy network

Advanced Assistive Vehicle
Intelligent power conditioning

3D magnetic field simulation about WPT coil



WPT system for consumer and industrial equipment

For companies

～Call for joint research and technical development～

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


Prof. H. Matsuki


Assoc. Prof. F. Sato


Assist. Prof. T. Takura


Research fellow T. Sato

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

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

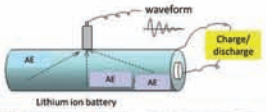
Development of In Situ Measurement Techniques for Lithium-ion Batteries

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

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

Doctor of a battery: degradation diagnosis

Acoustic emission (AE) from lithium battery




Li-ion battery for mobile phone


Li-ion battery for laptop (18650-type)

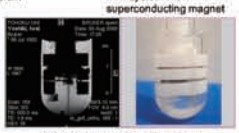

AE measurement system


AE signals from lithium battery (fracture of SnO anode)

MRI of lithium battery (Magnetic resonance imaging)

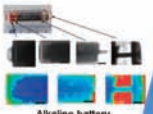

MRI of human brain


MRI system with superconducting magnet


MRI of a model lithium ion battery

X-ray picture

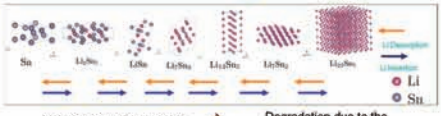

Li-ion battery


Alkaline battery

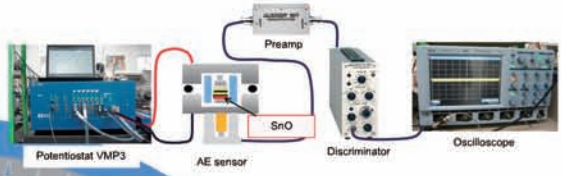
Degradation detection of the lithium battery by acoustic emission (AE)

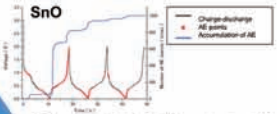
Large reversible capacity; 800 mAh/g → Anode material for next-generation

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

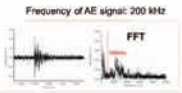


Volume expansion > 400% → Degradation due to the fracture of electrode



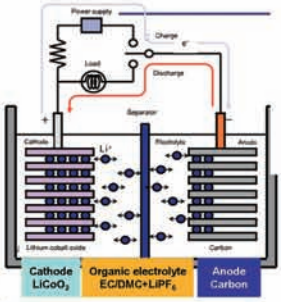


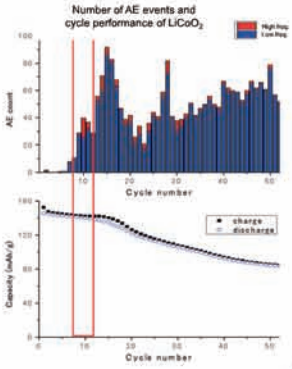
- AE signals are detected for lithium extraction at 1st cycle.
- Different waveforms were observed several regions.



Fractures of SnO cause 200 kHz AE signals

Application of AE measurement: $LiCoO_2$ cathode

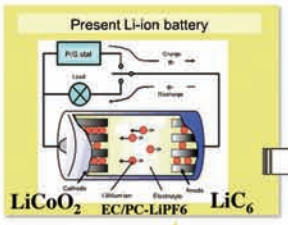




Relationship between AE signal and capacity fading is found.

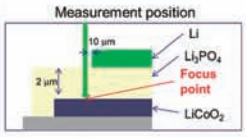
Solid-state thin-film battery

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

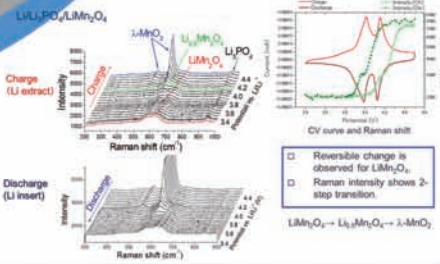



Fire accident of Li-ion battery (Organic liquid electrolyte)

In situ Raman spectroscopy




Li/Li3PO4/LiCoO2 thin-film battery

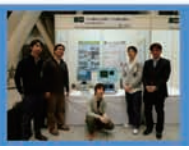


In situ techniques for monitoring Li-ion batteries

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

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








Professor Junichi Kawamura

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

Development of Thermal Barrier Coating for Black Automobiles

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

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

Background

Car paint

http://image4.kurumaerabi.com/

Dark color is popular for car.

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

Too much energy usage

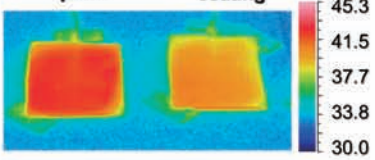
Environmental problem

Greenhouse effect

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

Cool black-color coating

Typical black paint | CuO coating



Visual and infrared images

Experimental evaluation

Reflectance measurement

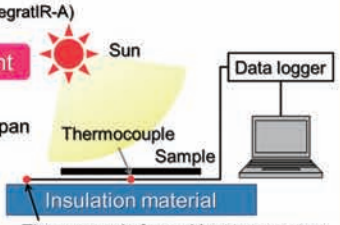
- M. Baneshi, et al., *JQSRT*, 113, (2012), 594.
- H. Gonome, et al., *ASME/JSME 2011 8th Thermal Engineering Joint Conference*, (2011), AJTEC2011-44622.

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

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

Temperature measurement

Place
IFS, Tohoku University, Japan



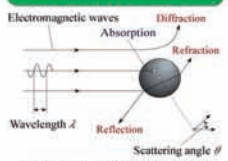
Schematic of the temperature measurement

Exposure experiment

Design

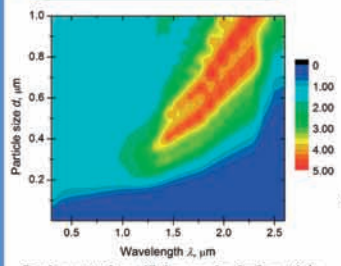
- M. Baneshi, et al., *JQSRT*, 110, (2009), 192.
- M. Baneshi, et al., *J Therm Sci Tech-JPN*, 4, (2009), 131.
- M. Baneshi, et al., *JQSRT*, 112, (2011), 1197.

Nano scale radiation effect



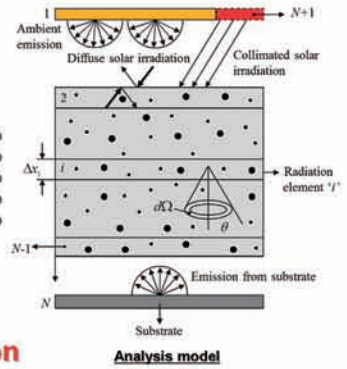
The interaction of a small particle and radiation

- Shape
- Size
- Material
- Clearance



Back-scattering efficiency of a CuO particle

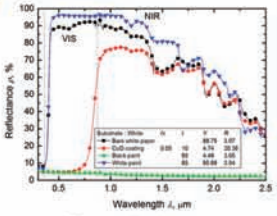
Theoretical optimization



Analysis model

Result

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



Measured reflectances

Measured temperatures of the coating

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

Cool & Dark was achieved.

For company

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

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

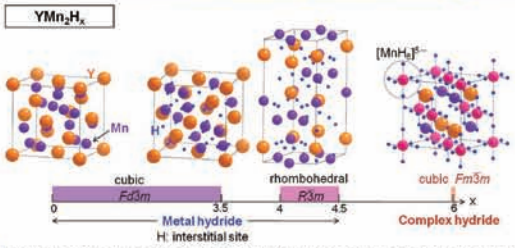
Development of Novel Hydrogen Storage Materials

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

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

The special property of YMn_2 hydrides...

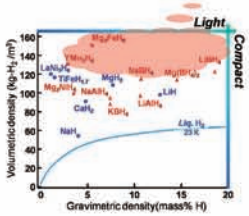
Transition from Metal hydride to Complex hydride



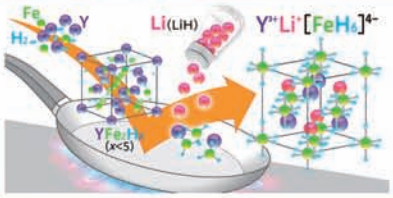
Extend to general transition metal hydrides

Charge neutrality in complex hydrides should be considered

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



Adding lithium to synthesize novel hydrides of general transition metal



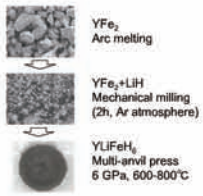
Although YFe_2 has the same crystal structure with YMn_2...

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

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

Research on the fundamental property and transition of hydrogen bonding state

For developing hydrogen storage materials and fuel cell



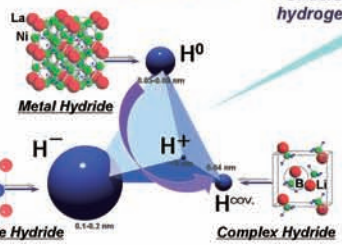
Subject:
Low pressure synthesis is necessary

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

Subject:
Characterize the novel hydride.

Hydrogen diagram

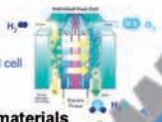
"Understanding the transition of hydrogen bonding states in hydrides."



Unique synthesis methods

Efficient analysis instruments

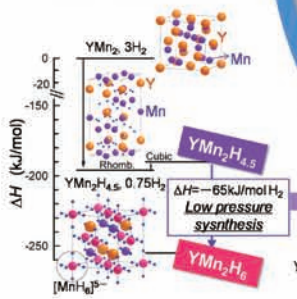
"Exploring the undiscovered properties in hydrides."



Advanced energy devices

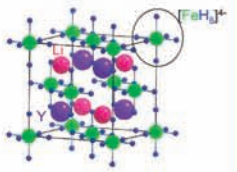
- ✓ High density hydrogen storage materials
- ✓ High energy density electric power storage materials
- ✓ Superconductivity

First-principles calculation [2]



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

First-principles calculation



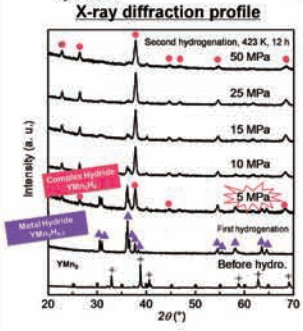
Structural properties
F-43m (No. 216), a=6.851 Å

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

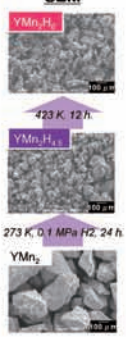
Experimental results [4]

Synthesis:

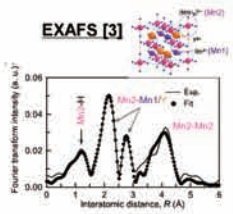
X-ray diffraction profile



SEM



EXAFS [3]



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

Mn-H bonding in the complex ion

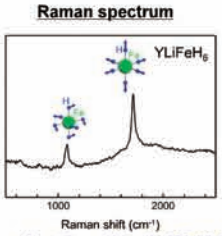
Optical Γ-point phonon frequencies

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

R: Raman active IR: IR active

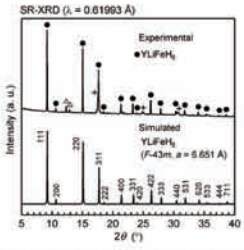
Vibrational mode *Structural characterization*

Raman spectrum



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

SR-XRD



$YLiFeH_6$ structure is confirmed

[1] V. Paul-Boncour, S.M. Filipek, M. Dorogova, F. Bourée, G. André, I. Marchuk, A. Percheron-Guégan, R.-S. Liu, *J. Solid State Chem.* 178 (2005) 356.
[2] M. Matsuo, K. Miwa, S. Semboshi, H.-W. Li, M. Kano, S. Orimo, *Appl. Phys. Lett.* 98 (2011) 221908.
[3] M. Matsuo, D. Matsumura, Y. Nishihata, G. Li, N. Hiyama, S. Semboshi S. Orimo, *Appl. Phys. Lett.* 100 (2012) 044101.
[4] M. Matsuo, H. Saitoh, A. Machida, R. Sato, S. Takagi, K. Miwa, T. Watanuki, Y. Katayama, K. Aoki, S. Orimo, *RSC. Adv.* 3 (2013) 1013.

Exploring and understanding the transition of hydrogen bonding states in hydrides

To synthesize novel hydrides for advanced hydrogen storage materials

Nanoscale Imaging of Living Cells using Nano-Scanning Electrochemical Microscopy

Advanced Institute for Materials Research,Tohoku University
Matsue Lab

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

Cell function evaluation using scanning electrochemical microscope

Signal transduction Membrane protein Differentiation process

(a) EGFR(+)

295 265 [pA]

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.

15 pA 50ms 10 s 5 pA

Localized Electrochemical measurement

JACS, 2010, 132, 10118.

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

Battery material Topography measurement

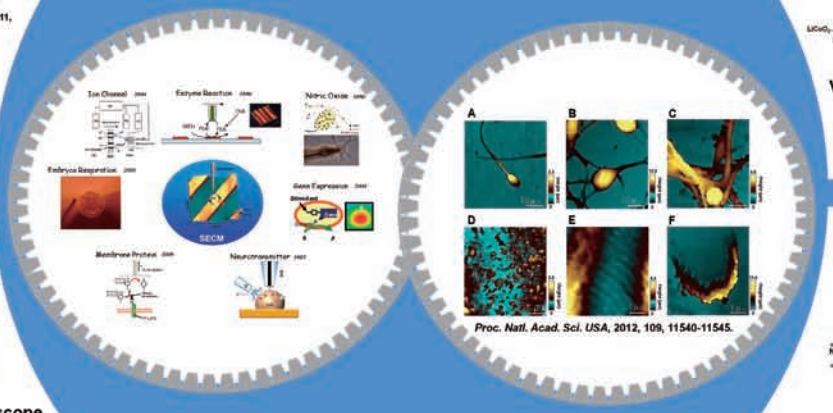
Faradaic current Optical microscope image

SECCM

Topography Faradaic current

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

Before adding EGF | After adding EGF (20 min) | After adding EGF (50 min)

10 μm 11 μm 11 μm 5 μm

High resolution topography image

Setpoint = 0.8 % | Setpoint = 8.0 % | High magnification image

1 μm 5 μm 1 μm 700 nm

Applied negative voltage during scanning

Applied positive voltage for measurement

Topography Electrochemical image

20 μm

Living cell imaging using scanning ion-conductance microscope

Nano electrochemical imaging using carbon nanoelectrode




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

Energy Conversion Devices Based on Solid State Ionics

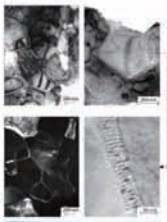
H. Takamura
Graduate School of Engineering, Tohoku University

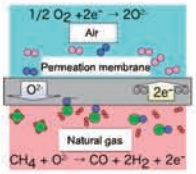
MEXT TOHOKU ECONOMIC FEDERATION Tohoku University 宮城県 七十七銀行 ICR

Hydrogen Production using Oxygen Permeation Membranes

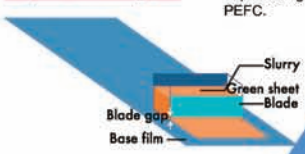
Oxygen permeation membranes for hydrogen production.

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



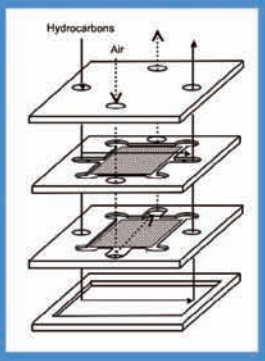


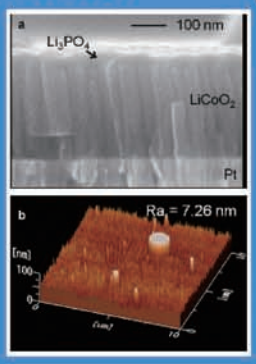
- Sm-doped CeO_2 –$MnFe_2O_4$ Nano composite
- 10 μmol·cm⁻²·s⁻¹ (=13.4[STP]cc·cm⁻²·min⁻¹)
- 10 sheets with dimensions of 5 cm x 5 cm are capable of producing H_2 for 1 kW PEFC.



Mass Production of Functional Materials by Tape Casting

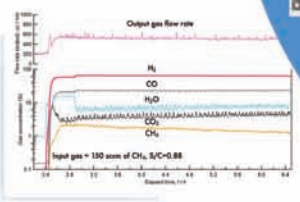
Applications of Solid State Ionics Materials to Energy Conversion





Actual performance

CH₄ reforming properties



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

Membrane reformer

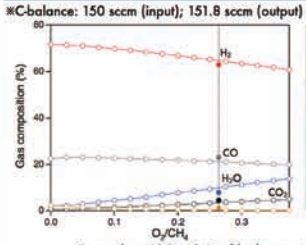
- Interface between cathode and electrolyte is key issue
- 30 cycles of charge-discharge are confirmed.

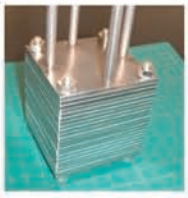
All-solid-state LIB

CH₄ reforming properties

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

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





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

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.

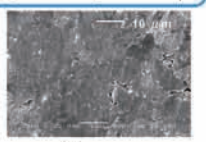
Conventional LIB

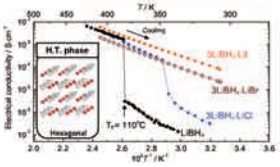
- Organic solvents are volatile and flammable.

All-solid-state LIB

- Solid electrolyte
- Higher safety
- Wide temperature range

High σ_{Li} and plasticity: $LiBH_4$

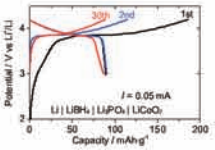




Intermediate layer between $LiBH_4$|$LiCoO_2$

Intermediate lyaer
Li_3PO_4
Thickness ≈10 nm
Prepared by PLD

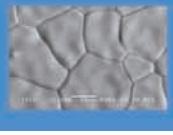
working!

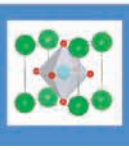


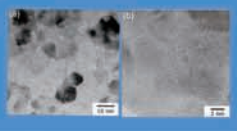
For those who are interested

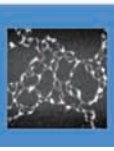
Our focus: Material design of solids in which ion is highly mobile, and its application to energy conversion & storage

Application : Fuel cells, Secondary batteries, Sensors









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

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) : Introduced in this poster.

Photocatalysts with specific morphology: Stratified Photocatalysts

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

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

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

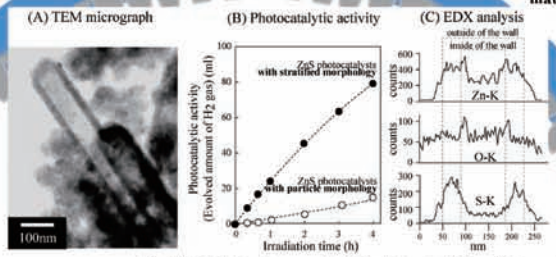

Fig.1 (A) TEM micrograph, (B) photocatalytic activity and (C) EDX analysis of stratified ZnS photocatalysts

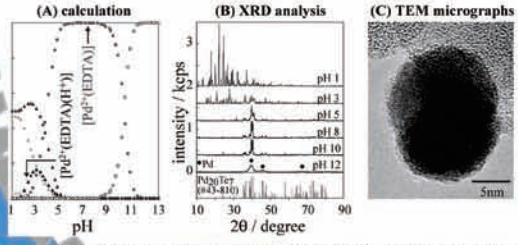

Fig.2 (A) Results of calculation for Na_2PdCl_4 - H_4EDTA system, (B) XRD analysis of synthesized materials and (C) HR-TEM micrographs of uniform and well crystallized $Pd_{20}Te_7$ alloy nanoparticles synthesized by obeying to this method

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

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

Uniform and well crystallized alloy nano materials

Staffs

Professor: Kazuyuki Tohji

Assistant Professor: Shun Yokoyama

Associate Professor: Hideyuki Takahashi

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

Our address

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

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

Energy Materials

Goal: High Energy Density Nanostructure Cathode Materials

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

Li_2MSiO_4 very interesting cathode materials

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

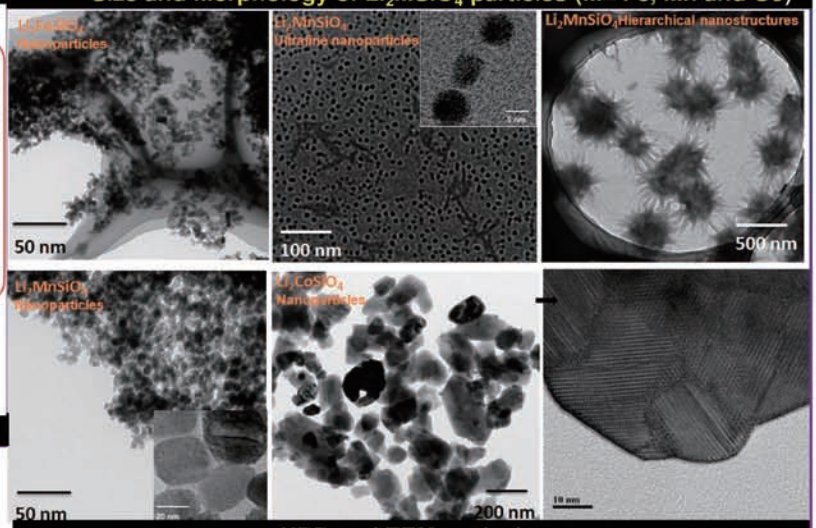
$Li_2Mn^{2+}SiO_4 \longrightarrow Mn^{4+}SiO_4 + 2Li^+ + 2\bar{e}$

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

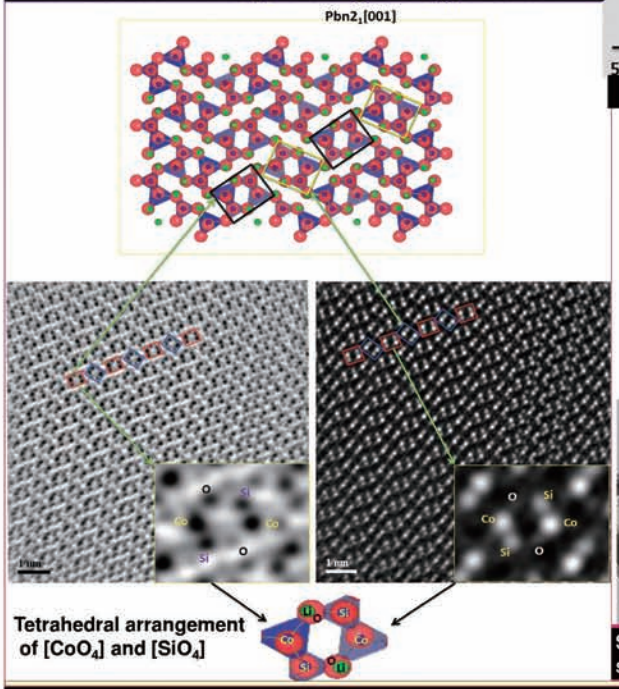
Li_2MPO_4F

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

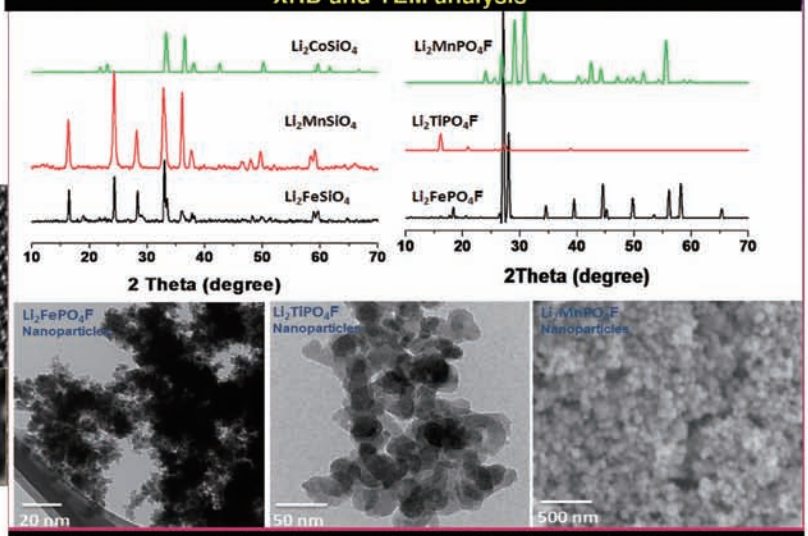
Size and Morphology of Li_2MSiO_4 particles (M= Fe, Mn and Co)



ABF and ADF analysis of Li_2CoSiO_4 particles

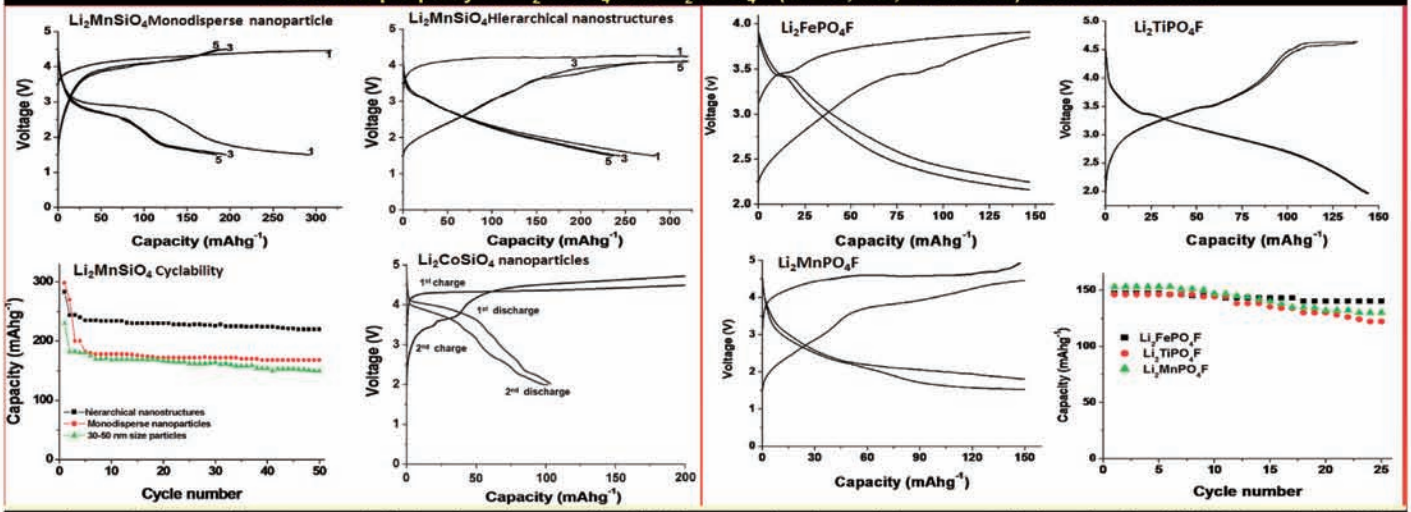


XRD and TEM analysis



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

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



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

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

Green Nanodevice by Super Low Damage Process

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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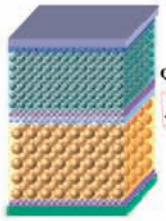
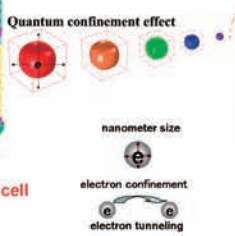
Quantum Dot Solar Cell

Theoretical conversion efficiency >60%

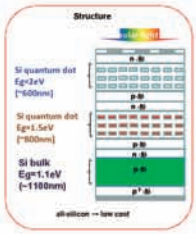


Quantum confinement effect



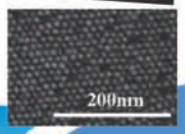
Quantum dot solar cell

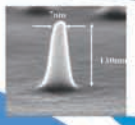
Low recombination probability of electron and hole
Multiple bandgaps
Electron and hole can move by tunnel effect



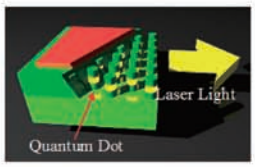
Solar spectrum can be efficiently utilized by only one material

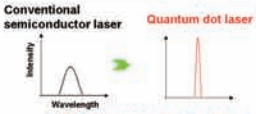
Bio-template ultimate top-down process



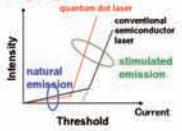


Quantum Dot Laser





Narrow peak width, high gain



Low threshold

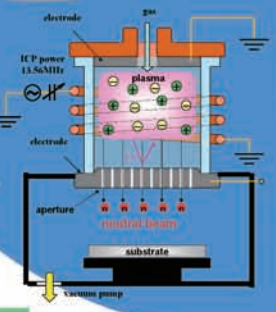
Ultralow-damage neutral beam process

Biomolecules
Bottom-up Process
Bio-template technology

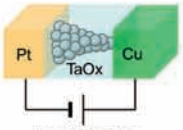
Low-damage
Top-down Process
Neutral beam technology

Low-power-consumption semiconductor devices

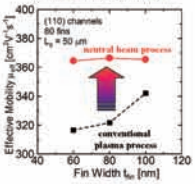
- 3-dimensional MOS transistor
- Ion conducting devices
- Graphene transistor
- Germanium transistor
- Single electron transistor

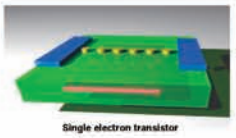


3-dimensional MOS transistor

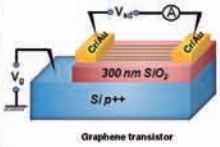


Ion conducting device





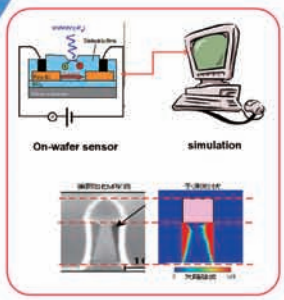
Single electron transistor



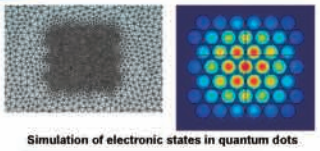
Graphene transistor

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

Simulation for processes and devices



Prediction of plasma process damage



Simulation of electronic states in quantum dots

Message for industry

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

Prof. Seiji Samukawa

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

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

Core Technology Consortium for Advanced Energy Devices

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

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Outline

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

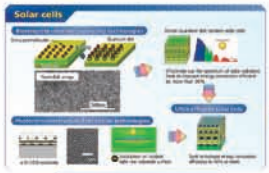
Therefore, we intend to support the reconstruction of the Tohoku area and the renewal of Japan, and to contribute to the establishment of an energy-technology nation, through the realization of state-of-the-art core battery technologies (solar cells, secondary batteries, fuel cells) and their energy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

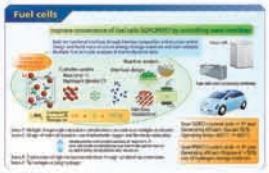
Our efforts will be realized through open innovations in an industry-academia collaboration setting with a vertically-integrated group of companies. The innovations are based on nano-structure interface control technologies, which Tohoku University has been accumulating for many years.

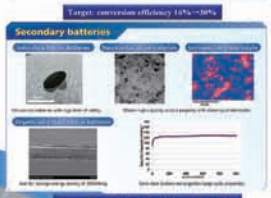
Features

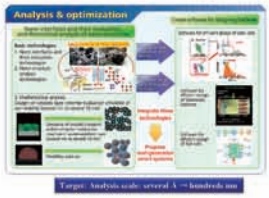
1. Unique consortium aiming at establishment of *optimized nano-energy system* created as a fusion of solar cells, secondary batteries, and fuel batteries.
2. Strategic research and development by gathering technologies from *vertical integration type firms* based on nano-interface material structure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

Research and Development

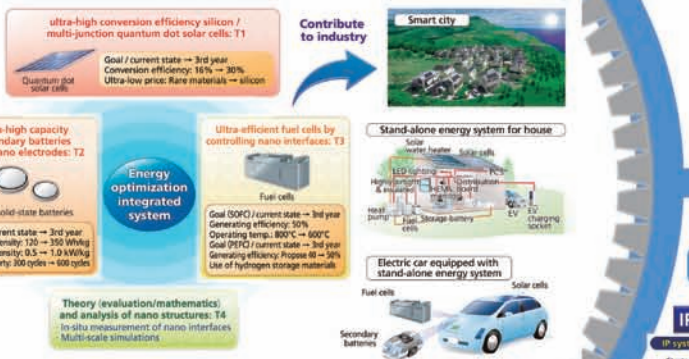








Our Target



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

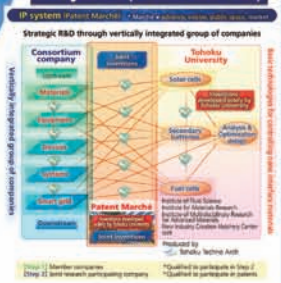
Organization

Members

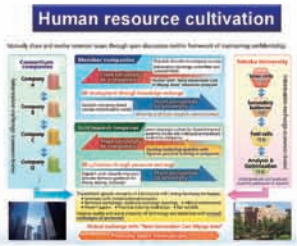
Director	Institute of Fluid Science (IFS) and Advanced Institute for Materials Research (AIMR), Professor	S. Samukawa
Solar cells	Institute of Fluid Science (IFS) and Advanced Institute for Materials Research (AIMR), Professor	S. Samukawa (Leader)
	Nagoya University Professor and Tohoku University Visiting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

Open Innovation

IP System (Patent Marché)



Human resource cultivation



Equipment sharing program

Membership application

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

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

Contact information

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

Contract-related Reception Desk
Accounting Section, Institute of Fluid Science, Tohoku University
TEL: +81-22-217-5305 / FAX: +8122-217-5311
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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: $Si + O_2 \xrightarrow[\text{Thermal energy}]{1000^\circ C} SiO_2$ {(O_2 Molecular reaction) (Only on (100) silicon surface)}

Kr : Krypton
O : Oxygen
Si : Silicon

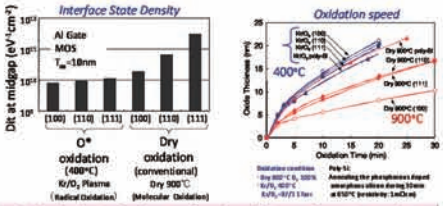
Nitridation : Nitride film formation on Silicon

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

Xe : Xenon
NH_3 : Ammonia
Si : Silicon

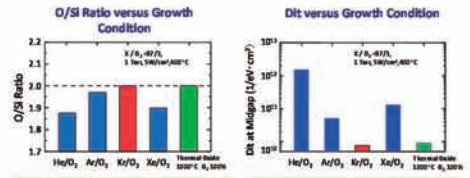
★The technology that the students study at the university becomes available on the practical production site.
★Very high integrity SiO_2 and Si_3N_4 can be formed on any crystal orientation silicon surface with the same formation speed.
★Very expensive gases (Kr, Xe) ⇒ Complete reuse and recycling system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

Film Properties Fabricated by the Plasma Oxidation



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

Film Properties fabricated by the radical oxidation method

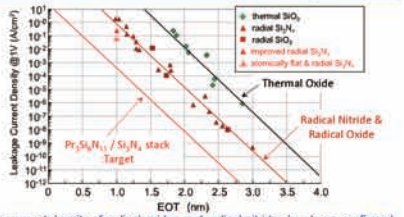


Complete Stoichiometric Structure SiO_2 for Kr/O_2

Very Low Interface Trap Density for Kr/O_2

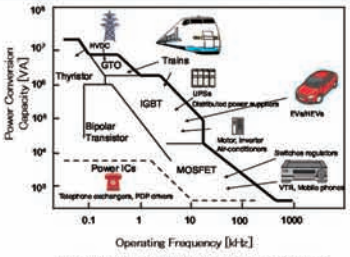
In Kr / O_2 gas combination, there generate O* radicals only while O_2^+ and O_3 are generated in other gas combinations. O* radicals can move freely in oxide films even at low temperature such as 400°C, resulting in complete oxidation of Si.

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



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

Application of Power Semiconductors

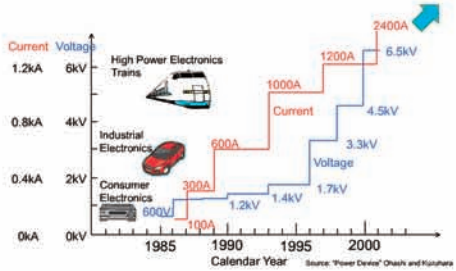


Used Area of Si Power Semiconductors

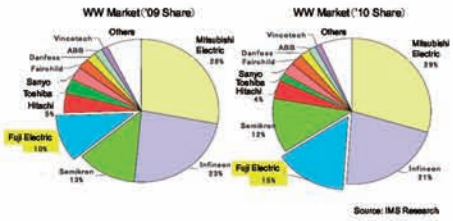
Structure and Electrical Properties of Major Power Semiconductors

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

Progress of IGBT toward High Voltage and Large Current



IGBT Market Share



IGBT Products of Fuji Electric Co., Ltd.

For Consumer Electronics (eg. Room Air-Conditioner)

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

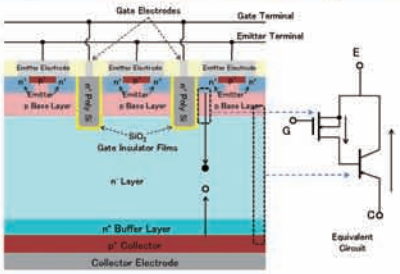
600V / 15A,20A,30A

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

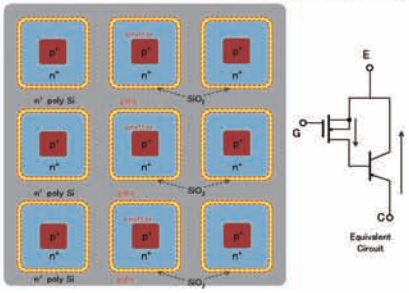
1200V / 600 – 3600A
1700V / 600 – 3600A
3300V / 650 – 1500A

Source: Fuji Electric website

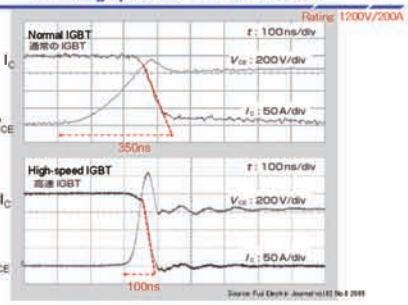
Cross-Section View of IGBT



Plane View of IGBT Emitter and Gate Electrodes



Switching Speed and Turn-off Waveform



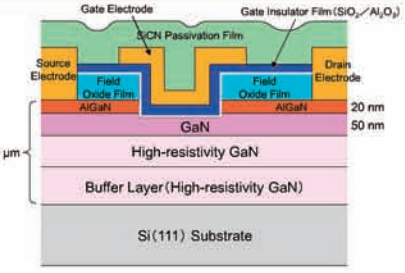
Physical Property of Si and Wide Band Gap Semiconductors

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

AlGaN/GaN/(111)Si Power Semiconductors

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

AlGaN/GaN/(111)Si Power MOSFET



Features of the Proposed GaN Power Semiconductors

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

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

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

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

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

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

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1.Institute for Materials Research, Tohoku University 2. New Industry Creation Hatchery Center, Tohoku University
3. TDK corporation E-mail : t_kudo@imr.tohoku.ac.jp

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

Introduction

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

⇨ Combustion pressure sensor

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

Advantage of Combustion sensor

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

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

Problems

High cost of manufacturing the langasite-type crystal

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

⇩ La free

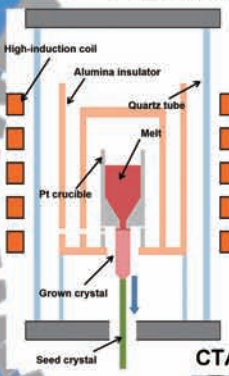
After 1998, $Ca_3TaGa_3Si_2O_{14}$ (CTGS), $Ca_3NbGa_3Si_2O_{14}$ (CNGS) has been developed.

Motivation

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

Key Technology

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



CTAS crystal

Experimental

Crystal Growth by μ-PD method

Liquid-solid interface during crystal growth

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

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

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

Sintered powder was set in Pt crucible.

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

⇩

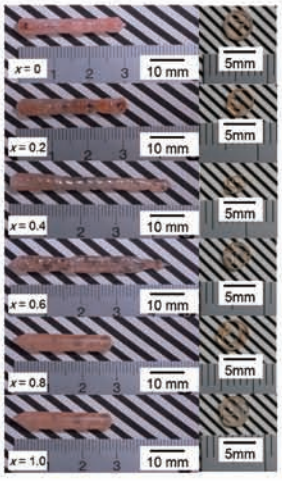
Crystal growth was performed by pulling down the melt
Seed crystal: LTG crystal with *a*-axis
Growth rate is 0.5 mm/min.

Evaluations

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

Results & Discussions

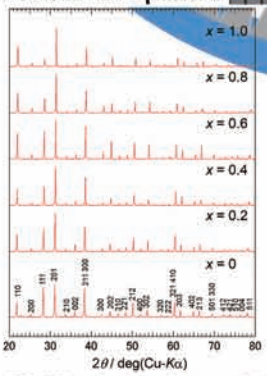
$Ca_3Ta(Ga_{1-x}Al_x)_3Si_2O_{14}$ crystals grown by μ-PD method



Insides of the crystals had high transparency.

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

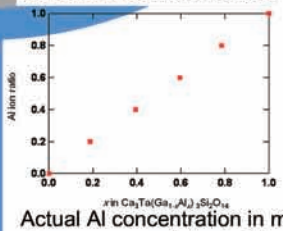
Powder XRD pattern



All diffraction peaks were identified by langasite-type structure.

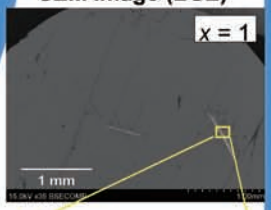
Lattice parameters were systematically decreased with Al concentration

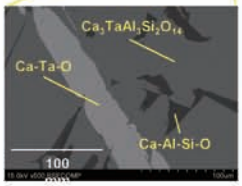
Actual Al concentration



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

SEM image (BSE)





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

Future plans

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

Nanotechnology Platform : Structural Analysis

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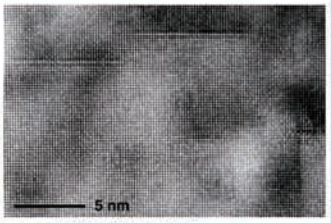
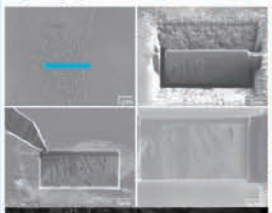
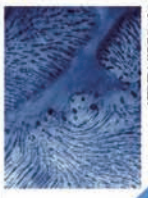
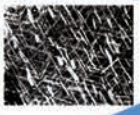
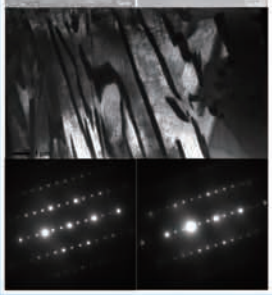
IMR

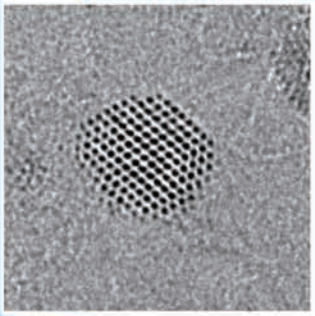
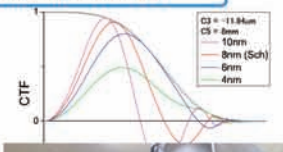
Institute for Materials Research

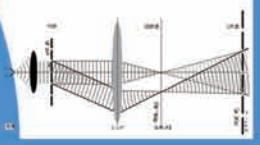




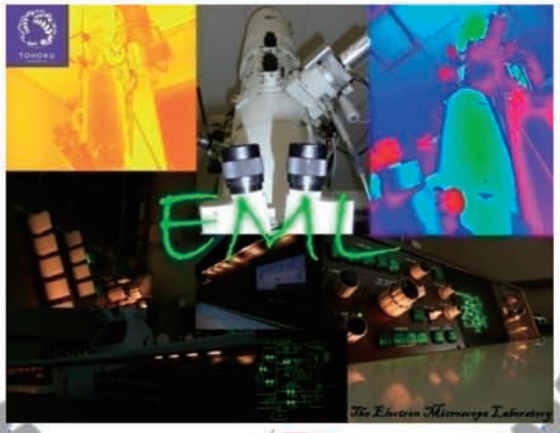
Art of Advanced Electron Microscopy

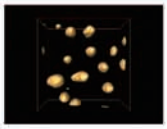



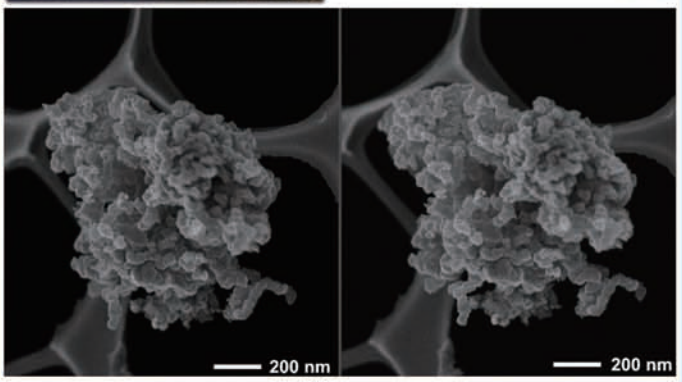
CENTER FOR INTEGRATED NANOTECHNOLOGY SUPPORT

CINTS

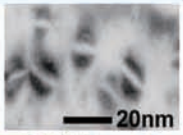


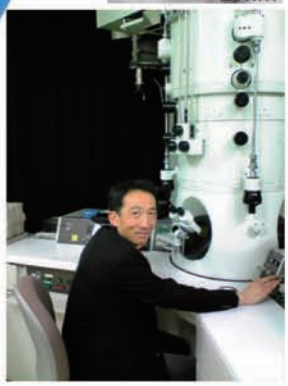
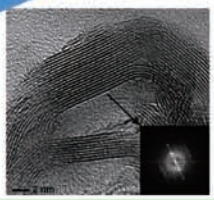
Materials for Environment





Materials for Safety



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

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

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

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

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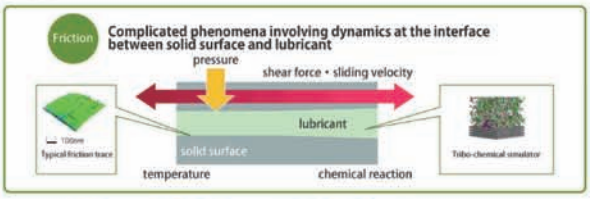
Friction Technology

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

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

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



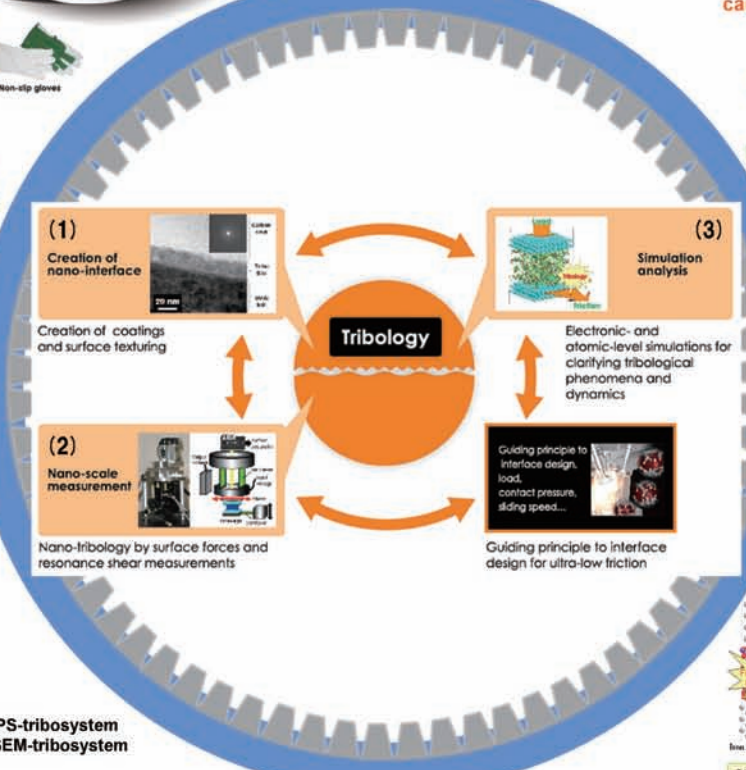
- **Economic influences of tribology (study of friction) is about 2 % of GDP**
- **Friction problems at contact interfaces of machines cause mechanical deterioration, damage and short life.**

control of friction/wear

Improvement of energy efficiency on mechanical systems

Guarantee of stable quality, high reliability and long life.

Innovation in Tribology



Research Topics

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

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

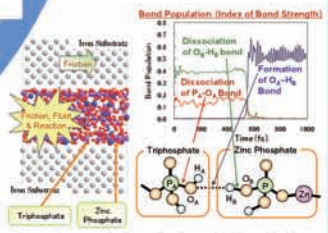
Construction of
-creation technology and argument of optimized design for nano-interafce realizing ultra-low friction
-platform for in-situ analysis of friction/wear

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

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

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

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



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

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

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

Collaborating Companies:

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

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

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

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

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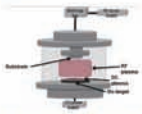
Development of functional thin film containing nanoclaster metals

Development of technique of mixing nanoclaster metals

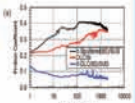
To develop the apparatus for fabricating materials utilizing plasma process

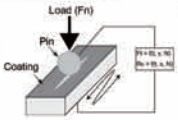


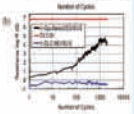
Conceptual diagram of fabricating film

Development of electro-conductive friction element

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



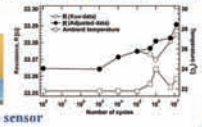




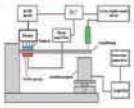
Conceptual diagram of contact monitoring

Development of thin film fatigue sensor

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



Developed fatigue sensor

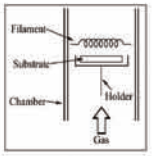


Conceptual diagram of fatigue testing

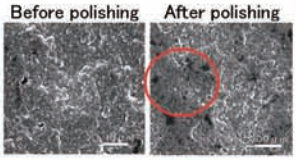
Development of low friction / low wear diamond coating

Fabrication of "polishable" diamond film

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



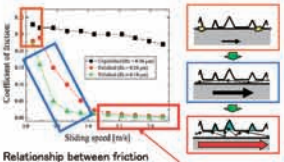
Rubbing both films



Polished diamond film has partially flat surface.

Materials: hydrocarbon gas, hydrogen gas

Friction velocity dependence



Relationship between friction coefficient and velocity

Super low friction !

Perspectives

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

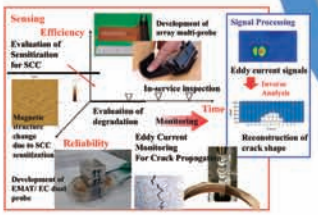
Linear motion bearing prototype

Laboratory Challenges

Safety and relief by diagnosis

Energy saving by low frictional lubrication

Research activities of non-destructive evaluation



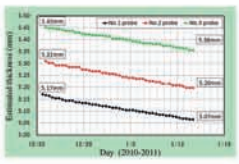
Non-destructive evaluation of casting iron

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

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

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

Probe installed on pipes



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

Equipment of our lab

Analysis & Evaluation

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

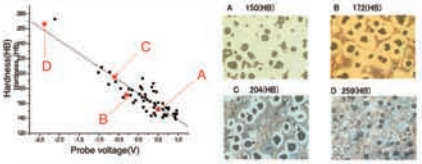
Material process

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

Non-destructive evaluation

- Ultrasound flaw detection
- Electromagnetic non-destructive evaluation apparatus

Evaluation of hardness of ductile cast irons by eddy current testing



Possible to evaluate hardness in nondestructive way

Eddy current hardness tester

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

IFG Institute of Field Generation

To corporations

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

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

Contact address:

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

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

Shoji Project
New Industry Creation Hatchery Center, Tohoku University

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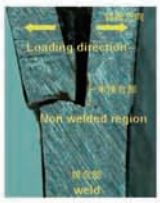
Local strain measurement and fatigue strength evaluation by means of copper plating and EBSD method

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

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



Crack path
(surface after removable of copper plate)

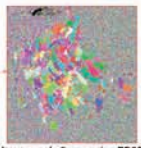
Crack path
(surface after removable of copper plate)

Crack path after fatigue test and strain measurement using copper plate

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

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

Analysis region on copperplate



Inverse pole figure using EBSD

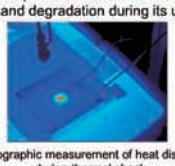
Estimation of strain amplitude and its distribution

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

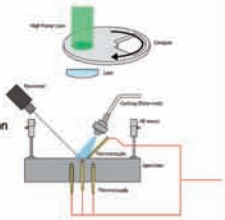
Development and evaluation of reproducing test for thermal fatigue cracking of metallic mold

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

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



Thermographic measurement of heat distribution during thermal shock



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

Laboratory reproduction of thermal fatigue cracks on metal mold

Promotion of manufacturing industry supported by most advanced science and technologies

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

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

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

cooperation

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

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

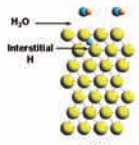
Casting・molding technology, ultra high precision machining technology

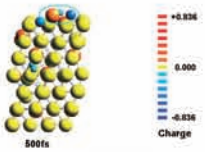
Human resource development
Small-group professional education for Mid-level member of society

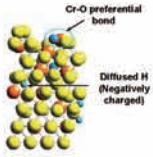
Innovations for Next Generation Automobiles

International center of excellence in aging degradation research

Expert group







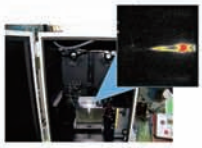
Dissociation of water and subsequent penetration of negative charged hydrogen atom into Fe-Cr binary alloy

・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

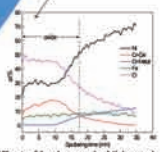


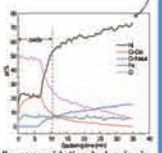
Evaluation of radical distribution by emitting light measurement with radical former using ultrasonic vibration

Build up behavior of hydrogen on metal surface

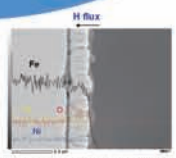
Hydrogen charged specimen

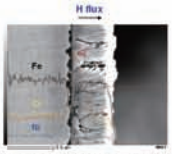
As received specimen





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.

文部科学省地域イノベーション戦略支援プログラム　次世代自動車宮城県エリア

Creation of Advanced Mechanical Systems by Control of Nanointerface

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

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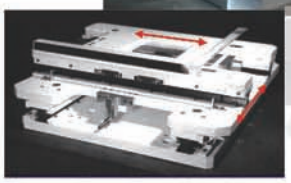
Creation of surface and interface for high friction and anti-wear ~ R&D of highly functionalized friction-driving actuators ~

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.

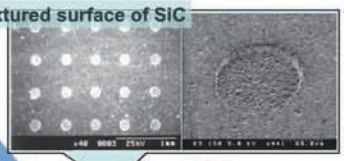
Water is lubricant in next generation

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

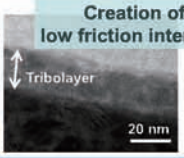
Inert gas is lubricant in next generation

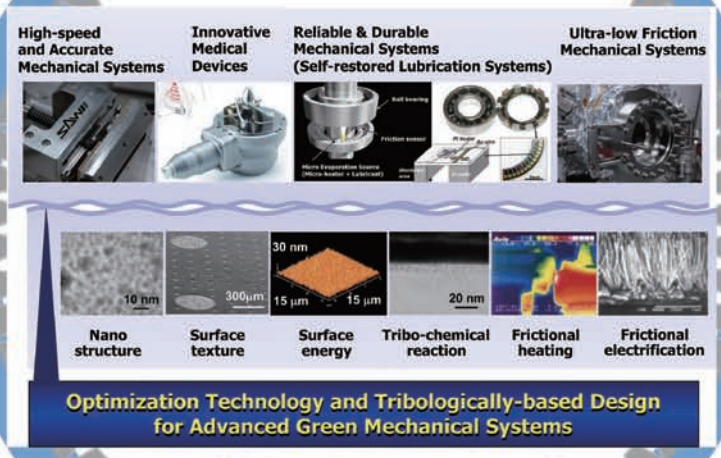
Hard thin coating can achieve friction of μ=0.004 under dry friction condition by the control of ambient.

Textured surface of SiC



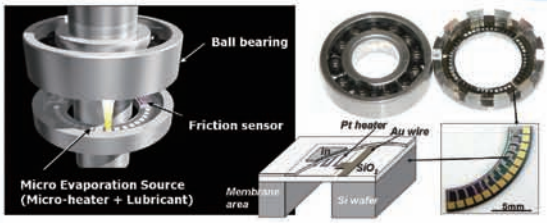
Creation of low friction interface





X-ray CT scan system

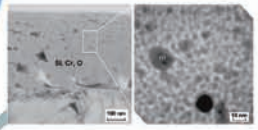
In-situ restoration system of solid lubricant can allow us to achieve semi-parmanent life-time of mechanical systems.



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

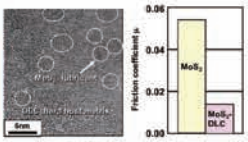
Creation of surface & interface for guarantee of low friction vibration for long time ~ R&D of silent medical mechanical systems ~

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

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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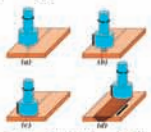
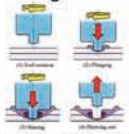
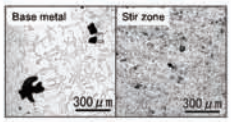
Fundamental study on FSW and FSSW

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

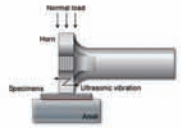


Application of FSW into cast alloys
Elimination of cast defects
Homogenization of microstructure
Enhancement of toughness and fatigue strength

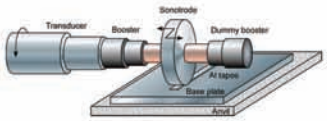
Al/Fe dissimilar FSSW
Multi-material structure

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

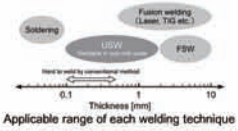


Ultrasonic Welding (USW)

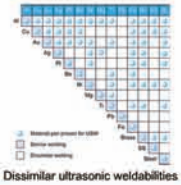


Ultrasonic Additive Manufacturing (UAM)

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



Applicable range of each welding technique

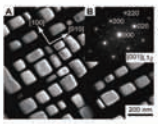

Dissimilar ultrasonic weldabilities

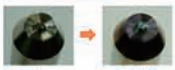
Novel joining technology and joining mechanism

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

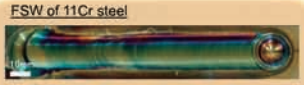
- Multi-material design of industrial components
- Energy saving and environmental load reduction


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 of 11Cr steel

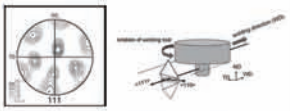

FSW in dual phase range
✓ 1.8 times as strong as base metal
✓ Higher ductility than base metal

Dissimilar FSW of 11Cr steel to 316 SS

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

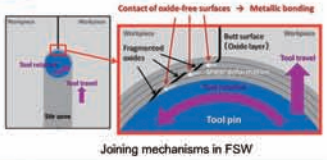
High grade joining of steels and Ti alloys


Analysis of oxide layer behavior during FSW by electron microscopy

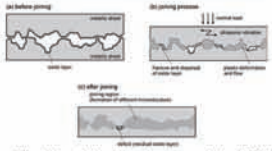

Understanding of materials flow during FSW by crystallographic analysis

Forefront microstructural analysis

Joining mechanism and phenomena



Joining mechanisms in FSW



Physical and chemical phenomena during USW

Challenges in solid state joining

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

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

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

Advanced Manufacturing Technology Utilized Nano-Precision Machining

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

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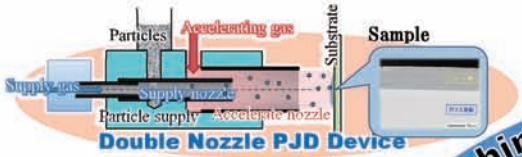
Energy storage!!
Powder Jet Deposition (PJD) for Creation of Secondary Batteries for Automobiles

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

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

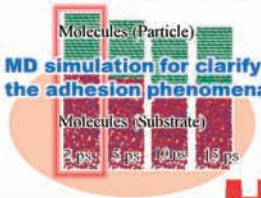
Advantages of Powder Jet Deposition (PJD)

Widely applicable technique to various materials



Double Nozzle PJD Device

SPH Simulation for clarifying the phenomena during collision



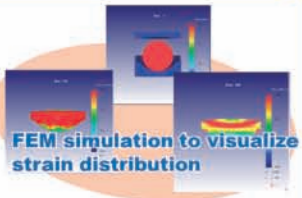
MD simulation for clarifying the adhesion phenomena

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

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

To realize Safe and Secure Next generation automobiles

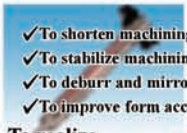
Development of Aspherical Glass Mold Press Equipment



FEM simulation to visualize strain distribution

Profile analysis for nonisothermal molding press

Aspherical Molding Die Fabricated by Precision Grinding

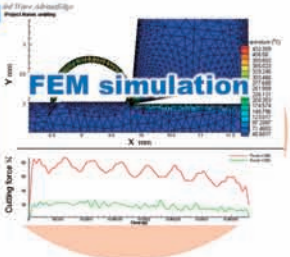


- ✓To shorten machining time
- ✓To stabilize machining precision
- ✓To deburr and mirror-finish
- ✓To improve form accuracy

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

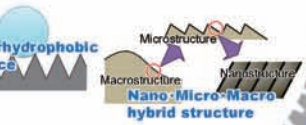
Ultrasonic Electrolytic grinding

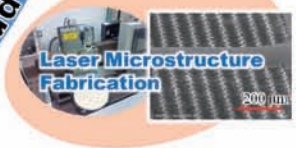
World first
3-dimensional ultrasonic-assisted machining



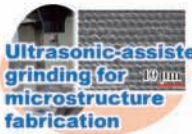
Energy saving!!
Ultrasonic Hybrid Machining for Manufacturing of Ultrahigh Pressure Fuel Jet Injector

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





Ultrahigh Precision Cutting for Fabrication of microgrooves



Ultrasonic-assisted grinding for microstructure fabrication

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

Development of Innovative Casting Technology

Graduate School of Engineering
Department of Metallurgy, ANZAI Lab.

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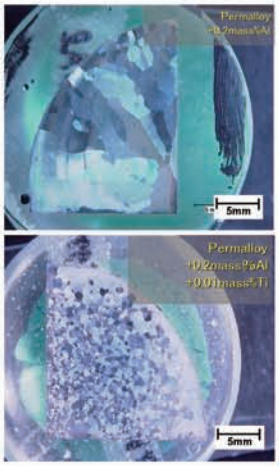
Microstructural Control of Ni Alloys

Ni alloys: excellent high-temperature strength, corrosion resistance
Center segregation in columnar structure

⇩ Decreasing of properties

Fine equiaxed structure is needed
⇩
Realization by elemental addition



Numerical Analysis of Macro Segregation

Background

◆Production method of special alloy
Ingot making: difficult to control quality
Macro-Segregation ⇒ Channel segregation

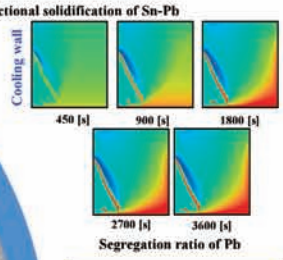
For optimization of operating condition
- With Computer Aided Optimization (CAO)
- Reproduction of segregation in ingot of Lab.

Purpose

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

Numerical result

Directional solidification of Sn-Pb



Reproduction of channel segregation

Anzai Laboratory

Development of Innovative Casting Technology
for Making High Quality Automobile Parts

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

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

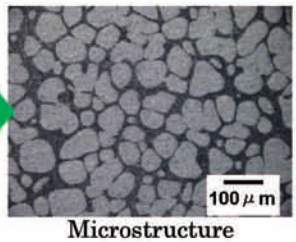
Semi-Solid Slurry Making Method

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

Cup method
- Able to make slurry easily

Metallic vessel

AC4CH slurry



Microstructure

Casting Simulation using Particle Method

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

Particle method
- Movable computational element
- Interaction analysis: easy

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

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

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

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

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Introduction

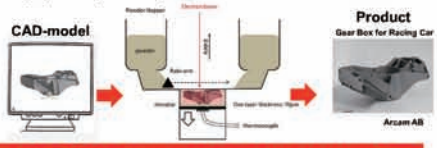
- **Inconel 718 Ni-based Superalloy**

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

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

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

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



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

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

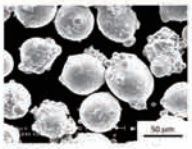
Experimental

Raw material (Gas atomized powder)

Chemical composition of Inconel 718 powder (mass %)

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

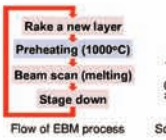
Particle size : 45~150 μm (74 μm ave.)



SEM image of powder particles.

EBM process

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



Flow of EBM process

Scanning direction

Preheating

Heat treatment

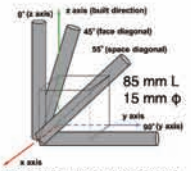
Solution treatment at 980˚C for 1 h → Water quench (WQ)
→ 1st aging at 720˚C for 8h → 2nd Aging at 620˚C for 8h → WQ

Tensile test

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

Microstructure analysis

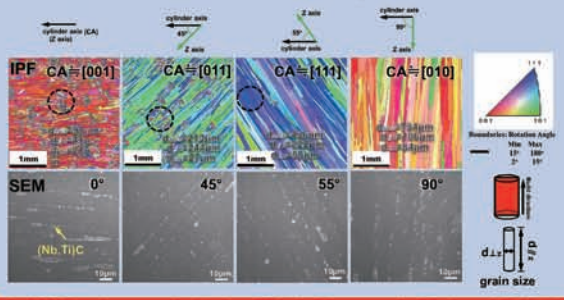
SEM-EBSD, EPMA



Schematics of of rods fabricated.

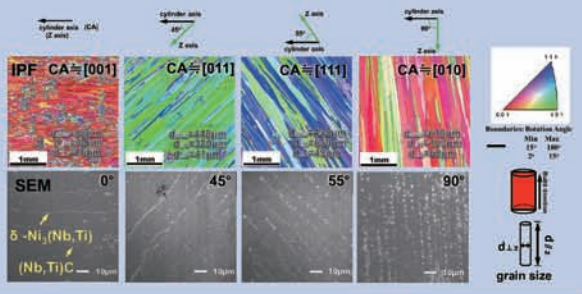
Results & Discussion

Microstructure of as-EBM-built samples



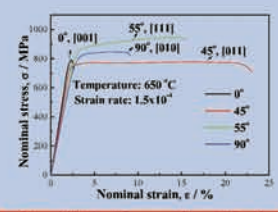
As-EBM-built rods are strongly cube-oriented in both the beam scanning direction and build-diretiaon.

Microstructure after heat treatment



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

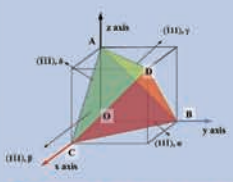
Effect of build-direction on tensile property



Comparison of strenghth and eleongation.

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

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

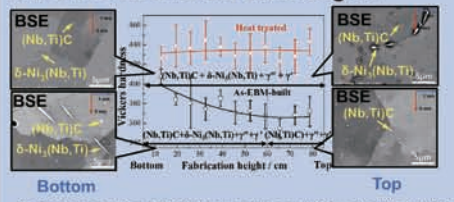


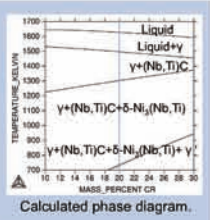
Schmid factor μ of perfect dislocation in {111}<110> slip system.

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

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

Hardness on different build heights



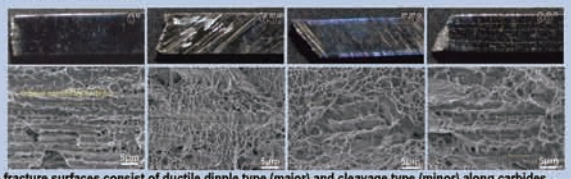


Calculated phase diagram.

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

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

Fracture surface



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

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

Conclusions

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

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

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

Hitoshi Soyama and Osamu Takakuwa, Tohoku University

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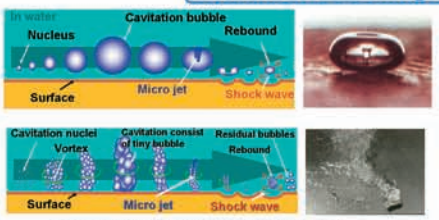
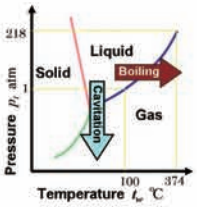
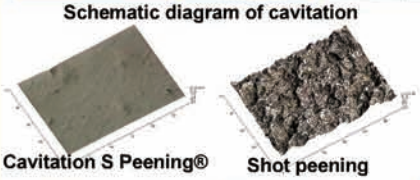
Cavitation S Peening®

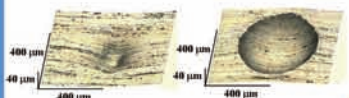


Schematic diagram of cavitation

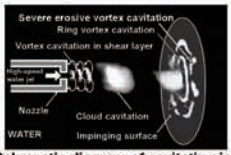




Cavitation S Peening® | Shot peening

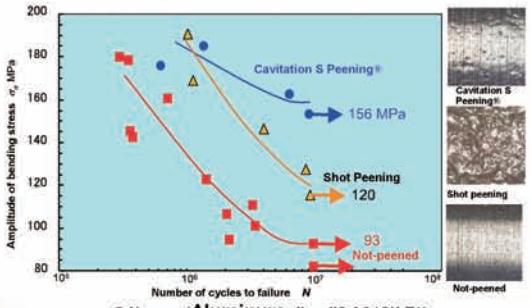


Cavitation S Peening® | Ball indentation



Schematic diagram of cavitating jet

Improvement of Fatigue Strength of Metallic Materials

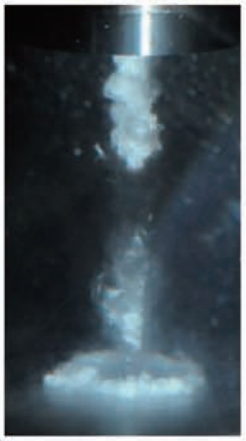


S-N curve (Aluminum alloy JIS AC4CH-T6)

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

Surface modification by using cavitation impact

Cavitation S Peening®



Cavitating jet in water

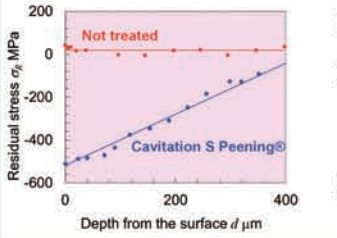
Cavitating jet in air

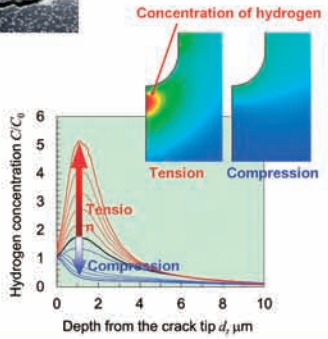
Suppression of Hydrogen Embrittlement

Introduction of compressive residual stress

⇒Suppression of hydrogen adoption

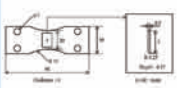
⇒Suppression of hydrogen embrittlement



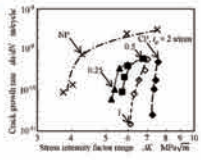


Evaluation of Materials Properties

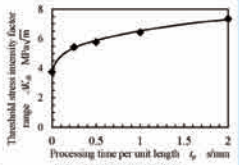
Load controlled plate bending fatigue test machine developed by Soyama Lab.



Geometry of specimen with notch



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



Increase of ΔK_{th} by Cavitation S Peening®

Conclusions

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

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O.Takakuwa and H.Soyama, Suppression of Hydrogen-Assisted Fatigue Crack Growth in Austenitic Stainless Steel by Cavitation Peening, *International Journal of Hydrogen Energy*, Vol. 37, No. 6, 2012, pp. 5268-5276.
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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.)

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

1, Introduction

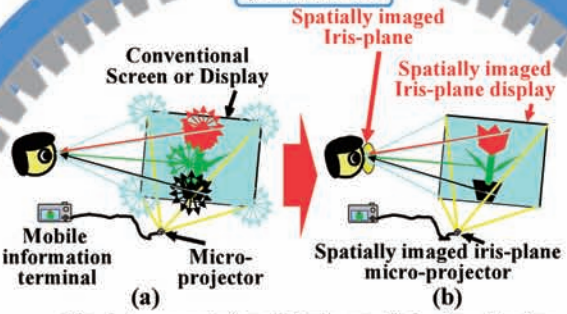

Fig. 1 A concept of spatially imaged iris-plane display
(a) a conventional display (b) a spatially imaged iris-plane display

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

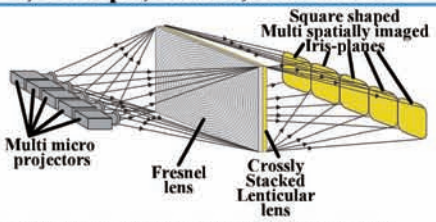

Fig. 2 Multi-view display using multi spatially imaged iris-plane technology

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.

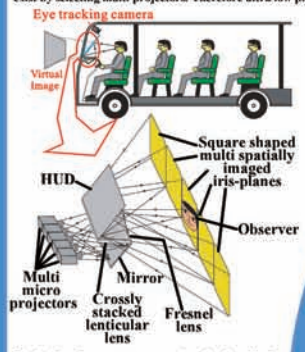

Fig. 3 Ultra low power consumption head up display by multi spatially imaged iris-planes and eye-tracking system

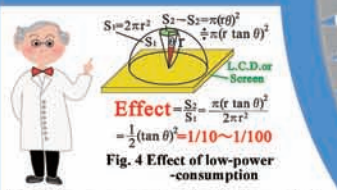

Fig. 4 Effect of low-power -consumption

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)×(1/25)=1/250. On this condition we set diffusion angle 5.1 degrees because of $(\tan^2\theta)/2$=1/250.

3, Experiment

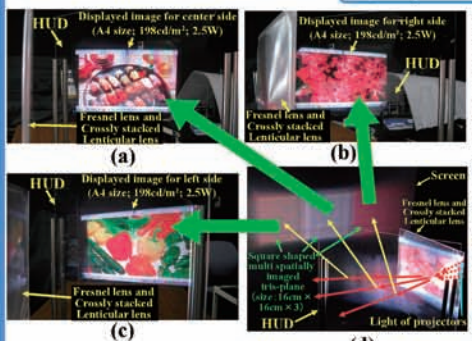

Fig. 5 An experiment and results of ultra low power consumption multi-view HUD
(a) Center side, (b) Right side, (c) Left side, (d) Multi-view HUD

Fig. 5(d) shows an experimental set-up of three-view HUD as shown in Fig. 3. In spatially imaged iris-plane an observation screen is set as shown in the upper side of Fig. 5(d). On this screen three square shaped spatially imaged iris-planes are successfully imaged side by side with no cross-talk and no gap. This is the ideal condition of eye-tracking system. Fig. 5(a), (b) and (c) show observation results of displayed images from within corresponding three spatially imaged iris-planes. It is confirmed that no cross-talk and instantaneous switching of displayed image at boundary between iris-planes. Displayed image size is A4 and luminance is 198cd/m2. Power consumption of a normal A4 size liquid crystal display is 40W. Compared with this the power consumption of our display is 2.5W. Namely ultra low power consumption of 1/16 is successfully achieved. In case of direct view shown in Fig. 2 ultra low power consumption of 1/400 is successfully achieved.

4, Ultra Low Power consumption HUD on EV bus

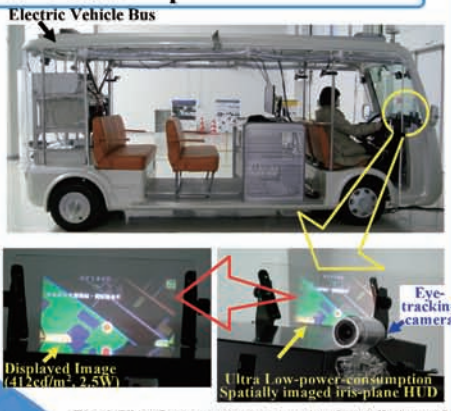

Fig. 6 Ultra Low-power-consumption Spatially imaged iris-plane HUD mounted on Electric Vehicle Bus and Displayed image

Fig. 6 and 7 show our HUD and an eye-tracking system mounted on EV-Bus. This HUD is 5-view HUD shown in Fig. 3 and range of each view is ±5 degrees. Namely total range is ±25 degrees. For practical use this range is enough. Luminance is 412cd/m2 and power consumption is 2.5W. Ultra low power consumption of 1/16 compared with a normal liquid crystal display is successfully achieved. An eye-tracking system detects the position of observer's eyes at processing speed of 50 frames per second and selects projectors to move spatially imaged iris-plane. Therefore smoothly eye-tracking by spatially imaged iris-plane is successfully achieved as shown in Fig. 7.

5, Eye-tracking system

Fig. 7 Ultra Low-power-consumption Spatially imaged iris-plane HUD and Eye-tracking system mounted on Electric Vehicle Bus

6, Conclusions

Low power consumption is more and more important for next generation motives. For this purpose we proposed and developed a spatially imaged iris-plane HUD. By this novel HUD ultra low power consumption of 1/16 compared with a normal liquid crystal display is successfully achieved. Moreover by direct view type ultra low power consumption of 1/400 is successfully achieved. We believe that this display will strongly contribute to realization of ultra low power consumption HUD for next generation automotives.

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References
[1] T. Kawakami, B. Katagiri, T. Ishinabe, T. Uchida "High-Resolution Multi-View Projection Display With a Quantized-Diffusion-Angle Screen" Journal of Display Technology , Vol.8, No.9, p.496-504, September 2012
[2] T. Kawakami, B. Katagiri, T. Ishinabe, T. Uchida, "Multiple Directional Viewing Projection Display Based on the Incident-Angle-Independent, Diffusion-Angle-Quantizing Technology" IEEE IAS annual meeting 2011, 2011-ILDC-382 (2011)
[3] Takahiro Ishinabe, Tohru Kawakami, Noriyuki Takahashi, Tatsuo Uchida "High-resolution autostereoscopic 3-D projection display with a space-dividing iris-plane shutter" Journal of the Society for Information Display 18/8, 2010 ,pp583-588.


Tatsuo Uchida
Guest Professor


Yoshito Suzuki
Specially missioned Professor


Tohru Kawakami
Guest Associate Professor


Mutsumi Sasai
Industrially, Academically and Governmentally Associated Researcher

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

Image Sensing Technology Breaking the Limit of Pixel Resolution

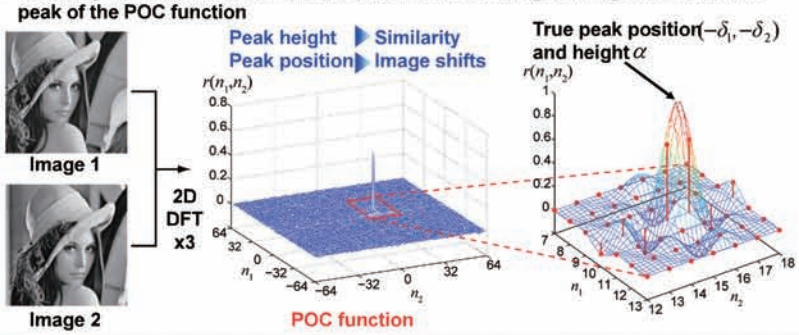
Graduate School of Information Sciences, Tohoku University, Japan
Prof. Takafumi Aoki, Assoc. Prof. Naofumi Homma and Assis. Prof. Koichi Ito

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

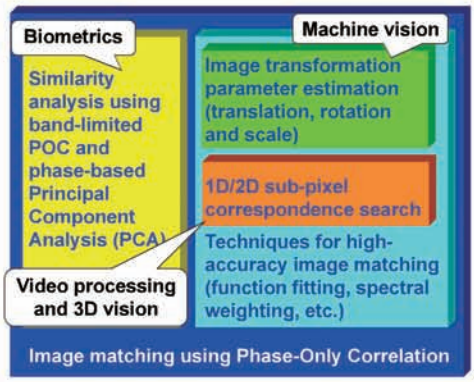
We present fundamentals of Phase-Only Correlation (POC) --- a technique for high-accuracy registration of 1D, 2D and 3D signals using phase information of discrete Fourier transform. Since 1990s, our research group has developed a novel technique of phase-based image matching for fingerprint verification and industrial machine vision. We have recently proposed an efficient image correspondence algorithm using POC, which can find pairs of corresponding points between the given two images with sub-pixel accuracy. This allows us to apply the POC technique to a wide range of applications, including smart image sensors, microscope image analysis, passive 3D vision, automotive image processing, image-based human interface, biometrics authentication, and medical image analysis.

Phase-Only Correlation (POC)

- A high-accuracy image matching technique using the phase components in 2D Discrete Fourier Transforms (DFTs) of given images
- Similarity and displacement estimation between two images using the correlation peak of the POC function



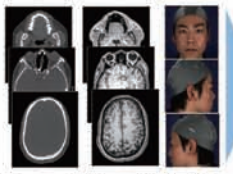
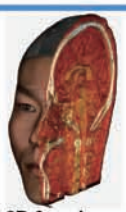
High-Accuracy Image Matching Technology




3D reconstruction from multi-view images


Projector-camera system


Automotive 3D vision for driver assistance

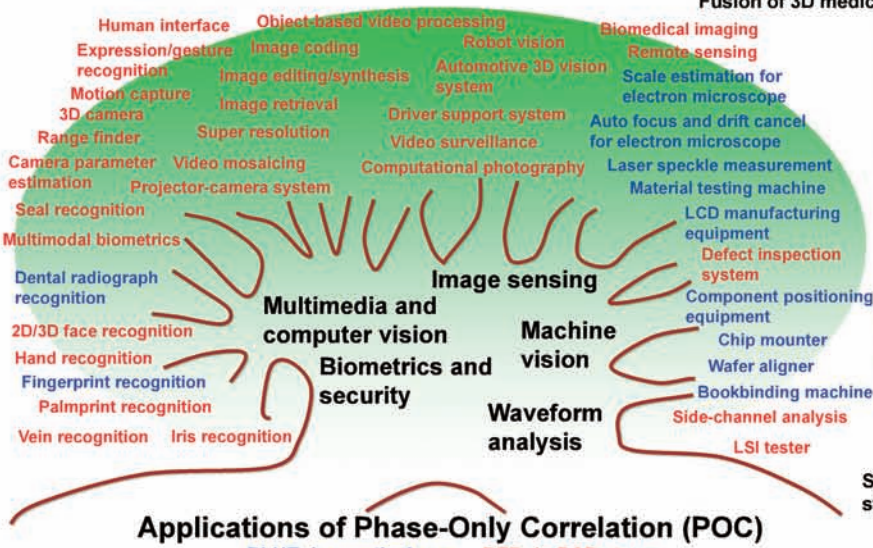


Fusion of 3D medical data and 2D face image


3D human capture


Real-time 3D measurement system


Universal image recognition sensor


Side-channel attack standard evaluation boards



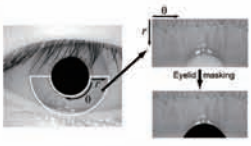
Applications of Phase-Only Correlation (POC)

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

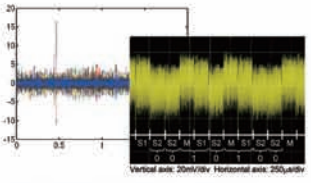

2D/3D face verification system

Dental radiograph recognition


Palmprint verification for mobile phones



Iris recognition


Waveform analysis against cryptographic circuits

Aoki Laboratory,
Graduate School of Information Sciences, Tohoku University, Japan
Web: http://www.aoki.ecei.tohoku.ac.jp/

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

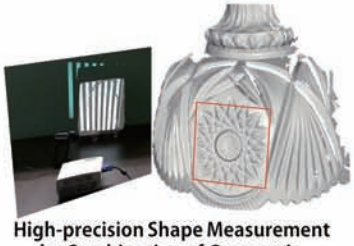
Future Created by Computer Vision

Okatani Lab.
Graduate School of Information Sciences, Tohoku University

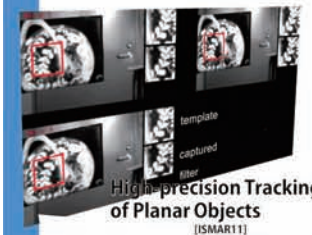
MEXT TOHOKU ECONOMIC FEDERATION Tohoku University 宮城県 七十七銀行 ICR

Basic Research

Optimization of Markov Random Fields [CVPR12, CVPR13]



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



High-precision Tracking of Planar Objects [ISMAR11]

Mechanism of "Miniature Scene Photographs" [CVPR07]

Applications

Projector-based Virtual Reproduction of Surface Reflectance [CVA10]

Projector Super-resolution [IEEE-TIP09]

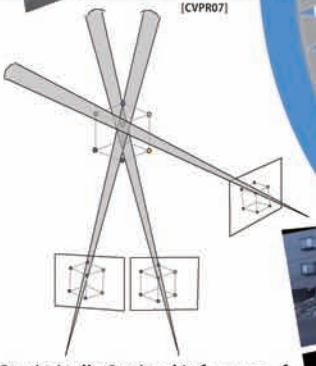
Easy Calibration of Multi-projector Displays [IJCV09]

Image Compensation of Hand-held Projectors [ACCV10]

"Gaze-reactive" Displays

Future World Shaped By Computer Vision

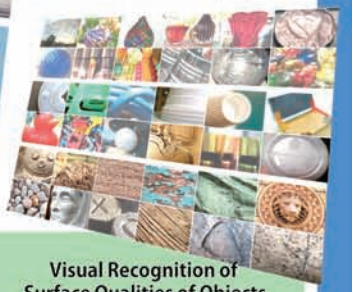
Statistical Mathematics and Numerical Computation + Physics-based Vision



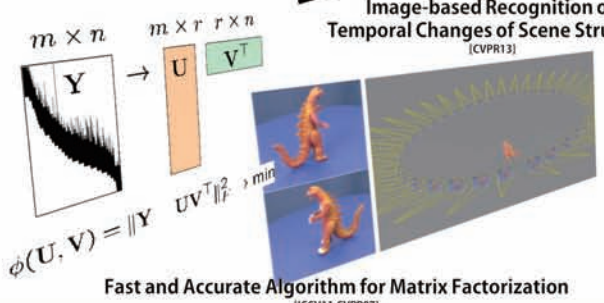
Statistically Optimal Inference of Multi-view Geometry and Numerical Computation [CVPR09,ICCV09]

Image-based Recognition of Temporal Changes of Scene Structure [CVPR13]

Image Archiving of Great East Japan Earthquake and Its Appications



Visual Recognition of Surface Qualities of Objects



Fast and Accurate Algorithm for Matrix Factorization [ICCV11,CVPR07]

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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.

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

Our Seeds: Neuroimaging Facilities

Our laboratory have been managing all kinds of neuroimaging equipment. <= unique and rare


3T-MRI for Human


200-channel MEG


192-channel EEG


Multi-channel NIRs


7T-MRI for Rat


EEG for Rat


Handy EEG


Wearable NIRs


2-channel NIRs

A Message to Industrial Circles

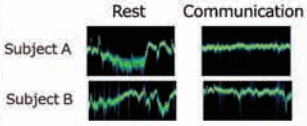
~Visualization of brain function is now ready for your R&D. Let's join us.~

We believe our new original system, which can estimate quality of communication and/or sympathy etc., will bring forth a new perspective for your developments.

A New Ultra-small NIRs System

- Total weight: 90g
- Radio transmission (currently using Zigbee)
- Enable simultaneous recording from 20 subjects

Neural activities of the dorsolateral prefrontal cortex show synchronization when participants make a well established communication.



Reformation of Convivial Society by Visualization of Communicative Activities and Sympathy

Seeds of Our University

Ultra-small NIRs system

- Real time and simultaneous measurements from multiple subjects under daily circumstances

- Synchronization of brain activities among different individuals when established good communication

Qualitative Measurements of Human Communicative Activities

Industries making products that correlate human communication

E.g. Automobile, Construction, IT, Electrical, Education, Welfare, etc.

Current social problems;

Declining birth rate and super ageing populations

↓

Social Isolation

Conception of collaborations; Reformation of convivial society which enables mutual aid.

R&D for social systems enable better communicative activities among different generation.

Examples of industrial enterprises

①Mobility which can produce good communication with driver and passengers

②Ultra-productive meeting system which can engage intense brainstorming.

③Social network services which can mediate better communication and understanding among different generation and people with different cultural backgrounds.

Establishment of Minimally Invasive Cell Therapy for Diabetes by Introducing Interdisciplinary Approach

Kimiko Watanabe and Masafumi Goto
Graduate School of Medicine & New Industry Creation Hatchery Center, Tohoku University,
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E-mail goto@niche.tohoku.ac.jp

ABSTRACT

Arteriovenous malformation (AVM) is appropriately treated with total pancreatectomy (TP) with islet autotransplantation (IAT). We performed this treatment for three AVM patients and had good outcomes in two of the patients. Further optimizations based on a systematic evaluation of clinical experiences are needed to improve the outcome and safety of this promising approach. The roles of Collagenase G (ColG) and Collagenase H (ColH) during pancreatic islet isolation remain controversial, possibly due to the enzyme blends used in the previous studies. We revealed that ColH is crucial, while ColG plays only a supporting role, in rat islet isolation.

1. Introduction

The pancreatic islet transplantation has strong social impact in many of the advanced cell transplant therapies, and is the ideal "minimum invasive" treatment for the severe diabetic patients who are suffering with controlling the blood glucose levels (Fig. 1). However, multiple organ donors are still needed in order to cure a diabetic patient. Therefore, establishment of minimally invasive cell therapy for diabetes by introducing interdisciplinary approach could be necessary to make islet transplantation a standard treatment. Our chief objective is to construct the center of medical cell-engineering therapy as successful examples in Tohoku University.

2. Method

(1) Clinical Experiences in the treatment of pancreatic arteriovenous malformation (AVM) by total pancreatectomy (TP)

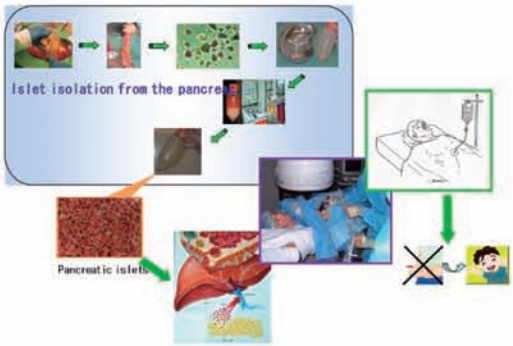


Fig. 1 Islet isolation and transplantation

with islet autotransplantation (IAT) Most AVM cases have pancreatic bleeding due to portal hypertension and the rupture of abnormal vessels and AVM is thought to correlate with pancreatitis. To prevent diabetes induced by TP, three male AVM patients underwent TP with IAT.

(2) Collagenase H is crucial for isolation of rat pancreatic isles Rat pancreases were digested using thermolysin, together with collagenase G (ColG), collagenase H (ColH), or ColG/ColH (n=9, respectively). An immunohistochemical analysis, *in-vitro*-collagen digestion assay, and mass spectrometry were also performed to examine the target matrix components of the crucial collagenase subtype.

3. Results and Discussion

(1) Clinical Experiences in the treatment of AVM by TP with IAT

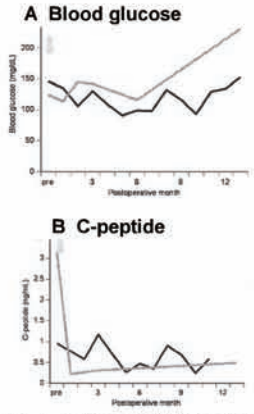
The numbers of isolated islets and total tissue volume were 355,270 islet equivalents (IEQ) and 5.7 mL (patient 1), 244,758 IEQ and 16.0 mL (patient 2), and 310,238 IEQ and 1.0 mL (patient 3). Many larger clusters derived form a cystic lesion were detected in patient 2. Thus, we had to stop patient 2's transplantation when half of the islets were transplanted. Fig.2 shows the postoperative courses of the patients. The blood glucose levels were well controlled using low-dose insulin injection in patients 1 and 3. The blood glucose of the recipients was well maintained without hypoglycemia, and a substantial level of fasting C-peptide was observed under a low dose of daily insulin supplementation (1).

(2) Collagenase H is crucial for isolation of rat pancreatic isles The islet yield in the ColG/ColH group was highest (4,101 ± 460 islet equivalents). A substantial number of functional islets (2,811 ± 581 islet equivalents) were obtained in the ColH group, whereas no islets were retrieved in the ColG group (Fig. 3). To examine the role of the collagenase subtypes, ColG and ColH were sequentially injected into the pancreatic duct of rats. An additional injection of ColG following an initial injection of ColH led to a slight increase in the islet yield (Fig. 3). On the contrary, no beneficial effects were observed following an additional injection of ColH (Fig.3). Mass spectrometry demonstrated

that ColH reacts with collagen-I and III (data not shown). In the immunohistochemical analysis, both collagen-I and III were located in exocrine tissues, although collagen-III was more pronounced (data not shown). The collagen digestion assay showed that collagen-III was more effectively digested by ColH than by ColG (2).

4. Concluding remarks

We are convinced that technical innovation through these projects contributes much more to the activation of medical industry based upon cell therapy.



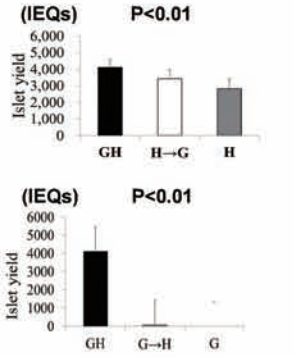


Fig.3 The effects collagenase subtypes on the islet yield.

Fig. 2. A blood glucose, B, serium C-peptide after TP with IAT in patients.
solid line: patient 1, dashed line: patient 3

(These figures were cited from Cell Transplantation, Jun 13, 2013 (Epub ahead of print) .)

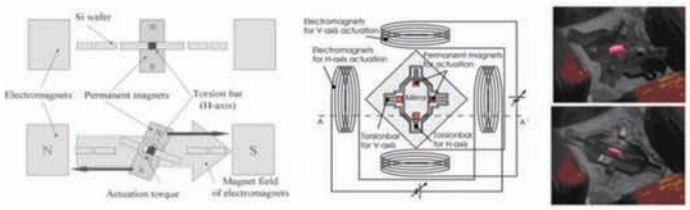
On the other hand, most of us use the motor car and spend amounts of time in a car. In the United State, estimates suggest an additional 42 accidents/year as a result of mild and moderate hypoglycemia in people with insulin-treated diabetes. Therefore, safely driving for people with diabetes requires the development of in-vehicle medical monitoring. **Therefore, in the motor car project, we would like to produce an innovative car in order to reduce the risks of medical mishaps behind the wheel.**

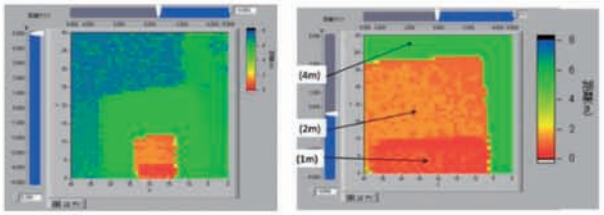
MEMS Based Safety Systems for Automotive

Masayoshi Esashi (WPI-AIMR, Tohoku Univ.)

1. Range finder with zooming function using optical scanner

(collaboration with Toyota motor, Toyota Central Research Lab. and Ricoh)

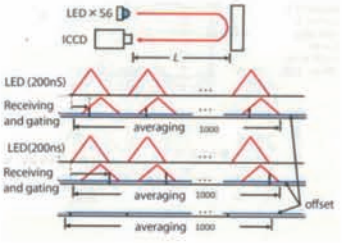


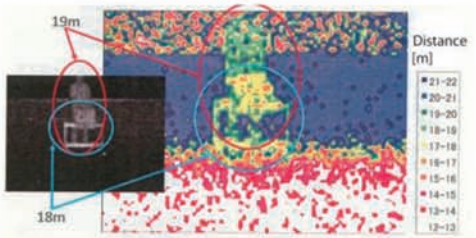


(a) Non-resonant 2D galvanic optical scanner (b) Obtained range image with zooming function

W.Makishi, Y.Kawai and M.Esashi, Magnetic Torque Driving 2D Micro Scanner with a Non-Resonant Large Scan Angle, Trans.IEEJ, 130-E, 4 (2010) 135-136

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



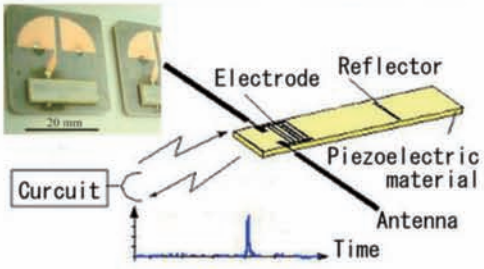


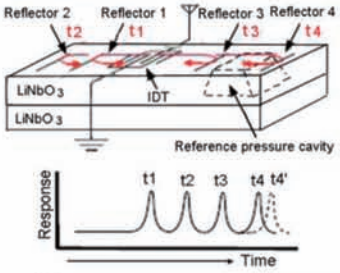
(a) Principle (b) Experimental setup (c) Experimental result

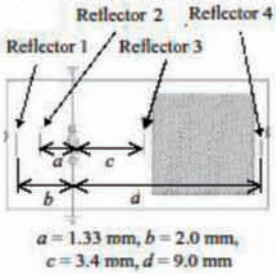
Y.Nakano, Y.Kawai, N.Ikegami and M.Esashi, Time-of-flight Range Finder Using LED Light Source, 2010 IEEJ Convention, Tokyo, (March 17-19, 2010) 1-116 p.132 (in Japanese)

3. Wireless SAW sensor for tire pressure monitoring

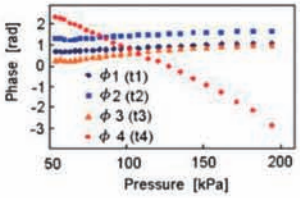
(Collaboration with Nissan motor)

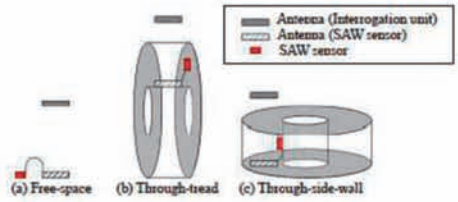






(a) Principle of SAW wireless sensor (b) Structure of SAW wireless pressure sensor





(c) Diaphragm (d) Experimental result of pressure measurement (e) Measurement scheme

S.Hashimoto, J.H.Kuypers, S.Tanaka and M.Esashi, Design and Fabrication of Passive Wireless SAW Sensor for Pressure Measurement, Trans.IEEJ, 128-E, 5 (2008) 231-234

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

Thermal Imaging using Temperature Sensitive Paint

Takashiro Tsukamoto and Shuji Tanaka
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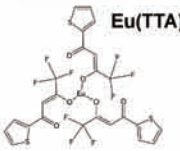
MEXT TOHOKU ECONOMIC FEDERATION Tohoku University 宮城県 七十七銀行 ICR

Temperature Sensitive Paint (TSP)

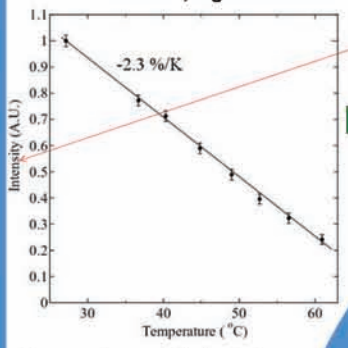
The Intensity of luminescence from the TSP is modulated by the temperature of TSP.

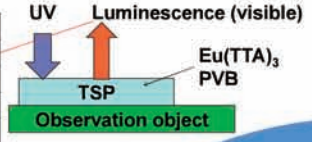
The TSP consists of $Eu(TTA)_3$ as a luminescent material and PVB as a matrix.

$Eu(TTA)_3$



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





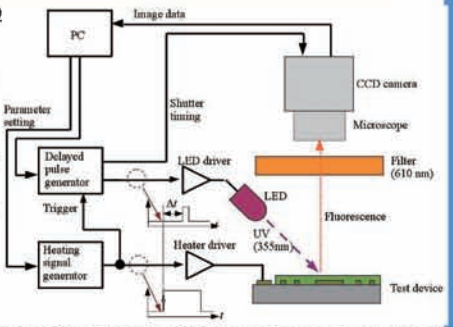
Temperature coefficient of intensity (TCI) from the TSP.

Temperature distribution → Optical image

High speed, and high resolution thermal imaging

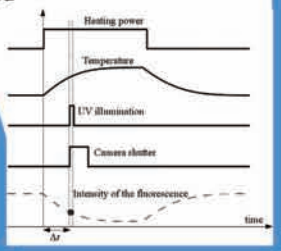
Experimental setup

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.



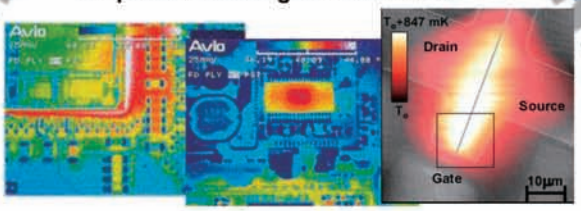
UV flashing method (for high speed imaging)

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

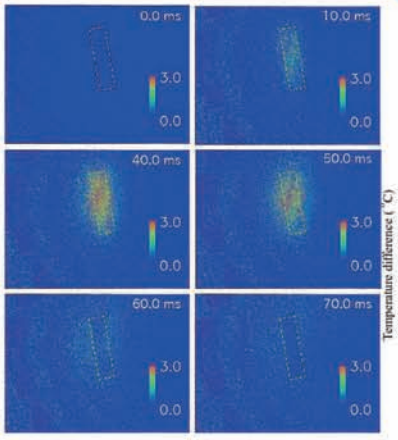
TSP is one of the candidates for the micro thermal imaging with high spatial, temporal and temperature resolutions

Obtained thermal images

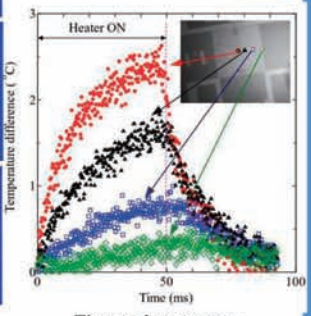
$$\Delta T(x,y) = S^{-1}\left(\frac{I(x,y)}{I_0(x,y)} - 1\right)$$

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

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



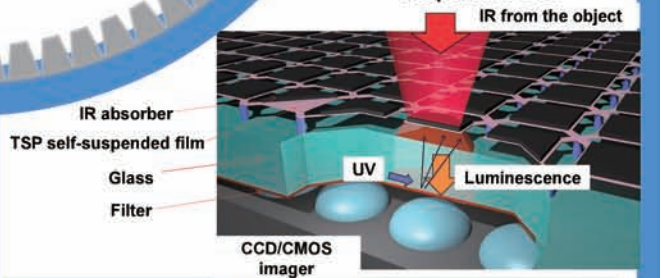
Thermal images at the each time step.



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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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

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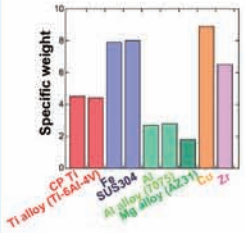
Department of Materials Processing, Graduate School

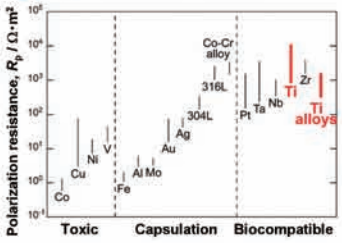
MEXT TOHOKU ECONOMIC FEDERATION Tohoku University 宮城県 七十七銀行 ICR

Titanium: *Wonder metal*

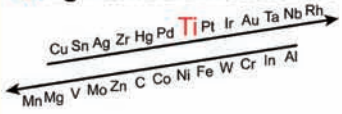
- Low specific weight
- High specific strength



- High biocompatibility



- High corrosion resistance

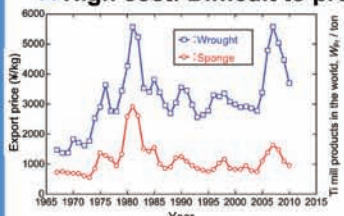


Applications for…

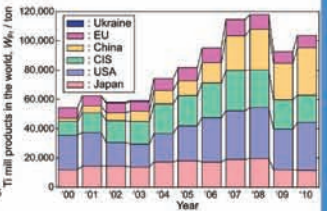
- Space aeronautics
- Medical devices
- Military
- Chemical plants

Disadvantages of Titanium

- ✕ High cost: Difficult to produce



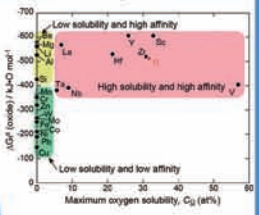
Price: 2-3 times higher than stainless steels
10 times higher than Al alloys



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

- High affinity
- High solubility
- Interstitial
- Abundant

Alloy designing
Strength・elongation・ductility, Anisotropy, Elasticity, Workability, Shape memory・super elasticity

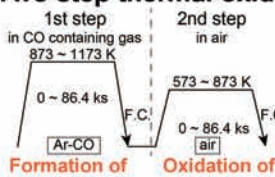
Surface designing
Corrosion resistance, Biocompatibility Photocatalytic activity, Wear resistance

Microstructure controlling
Transformation, Precipitation/dissolution, Grain refinement, Temporary alloying

Refinement process
Process of reduction and melting, Energy saving, Recycle, Purification

Improving photocatalytic activity by anatase formation

Two step thermal oxidation



Formation of Ti(C,N) layer
Oxidation of Ti(C,N) layer

Formation of Anatase layer

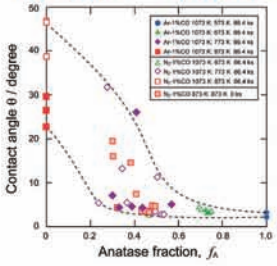


Fig. Effect of anatase fraction in TiO_2 layer on the water contact angle under UV irradiation.

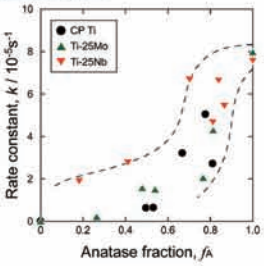


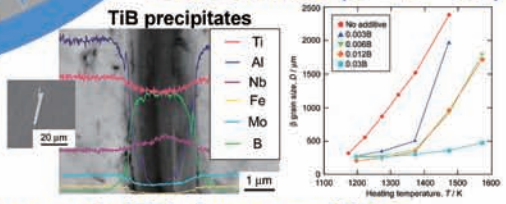
Fig. Effect of anatase fraction in TiO_2 layer on the rate constant of degradation of methylene blue under UV irradiation.

Photocatalytic activity under UV irradiation

Microstructure control of Ti alloys using micro alloying

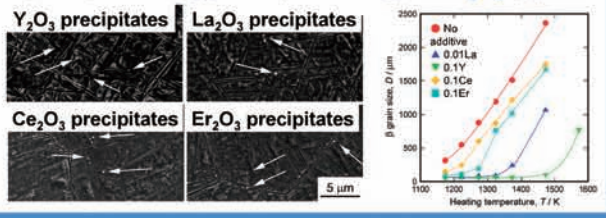
Grain refinement of Ti alloys by pinning using fine precipitates

Boron addition (Ti + B = TiB)



Rare-earth (RE) elements addition

(2RE (in Ti alloy) + 3O (in Ti alloy) = RE_2O_3 (s))



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

Potential of Alternative Fuel Vehicles: Analysis of Disaggregated Cost Benefit

Lab. of Shunsuke. Managi,
Graduate School of Environmental Studies, Tohoku University

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Cost-Benefit Analysis

Costs

1.Alternative vehicle Cost
Differences between the purchase and running costs of alternative vehicles and ICEs vehicles

2.Infrastructure for Alternative vehicles
Construction and operating costs for alternative vehicle diffusion

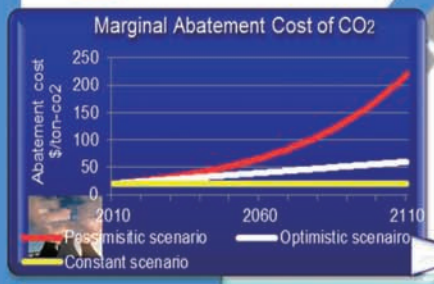
Benefits

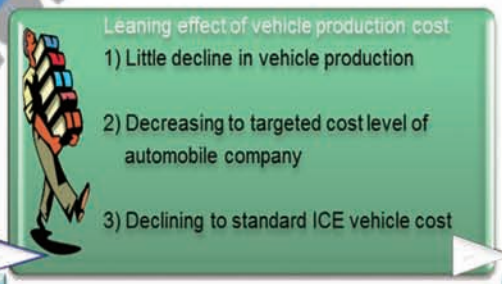
1.Emission reduction effects
The reduction levels of CO2 and NOx emission

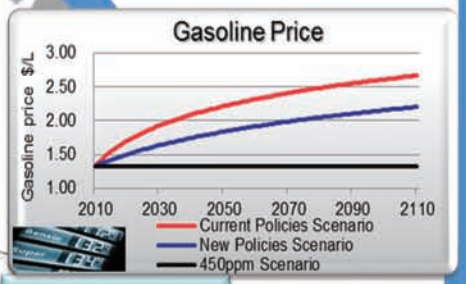
2. Resource-saving effects
The reduction levels of gasoline usage

Scenarios

1. **Scenarios in CO2 reduction costs**
   - Exponentially increasing cost
   - Linear increasing cost
   - BAU-pattern increasing
2. **Scenarios in learning effects in vehicle production**
   - Little decline in vehicle production
   - Decline to the targeted cost level of automobile company's
   - Decline to the standard ICE vehicle cost
3. **Scenarios in gasoline prices**
   - Prices under Current policies
   - Prices under New policies
   - Prices under 450ppm

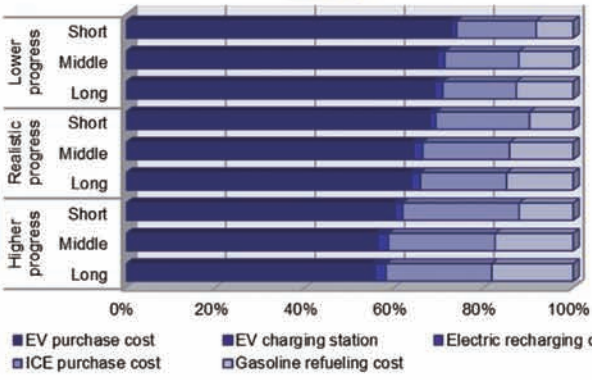






Cost | **Cost-Benefit Analysis** | **Benefit**

Simulations w/ Scenarios based on Questionnaire & Public Data



e.g. The result of EV diffusion scenario cost

Contact
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·Research Interest
Green innovation, Sustainable development
Investment evaluation, Adaptation to disaster

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

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

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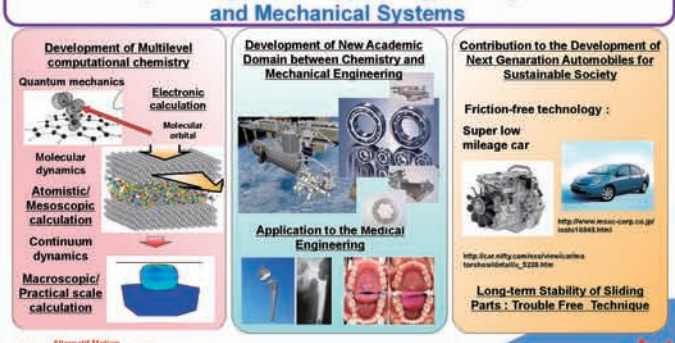
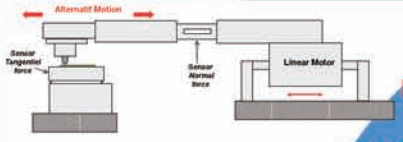
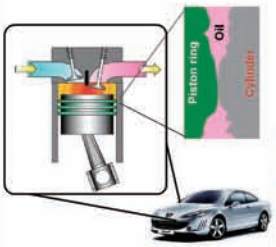
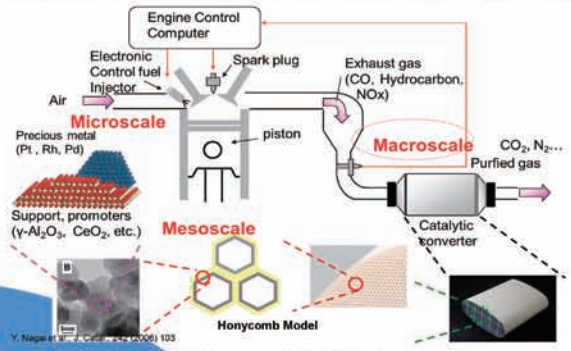
Multi-level Tribology Simulator for Material Development to Realize Long-life, High Reliability, Energy Saving Automobiles and Mechanical Systems

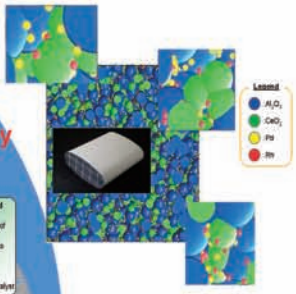






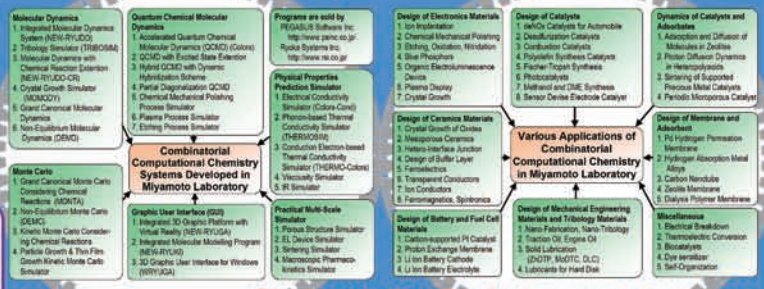
Multiscale, Multiphysics Simulator for the Development of Practical Automotive Catalysts





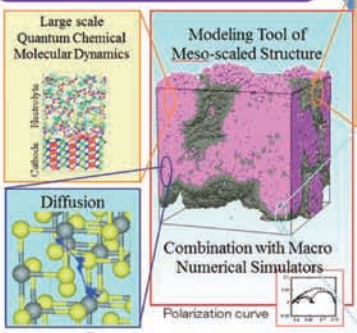
Automotive Parts Company
Automobile Company
Machinery Company
Heavy Industry Company
Chemical Company
Oil Company
Electric Power Company
Gas Company

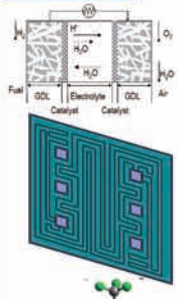
Achievements of Collaborative investigation with Various Domestic / Foreign Companies using our Original Software

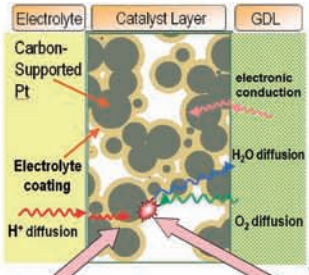


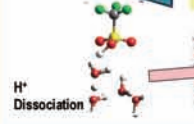
Software Company
Pharmaceutical Products Company
Water Treatment Company

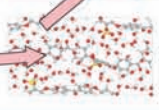
Multi-level Battery Cell Simulator Supporting the Development of Li-ion Battery, Fuel Cell and Solar Cell for Next Generation Automobiles

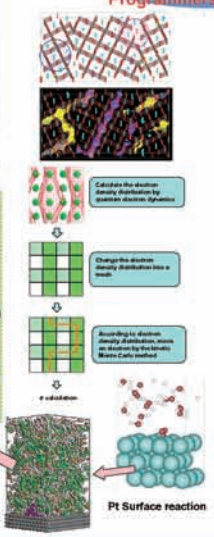






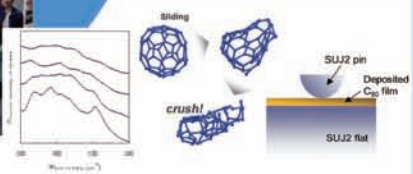




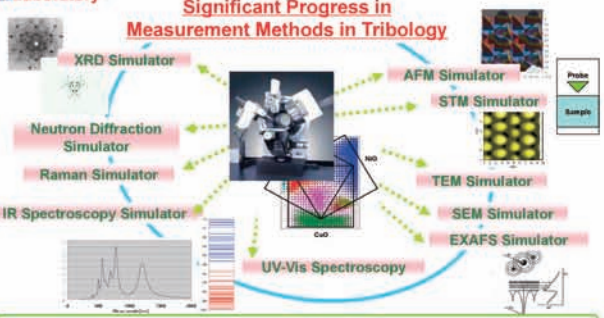


Powerful Support for Industry-University Cooperation by Professors, Research Staffs, Technical Assistants and Programmers in our Laboratory

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



Significant Progress in Measurement Methods in Tribology



"Realistic" Atomic/Molecular Structure Construction from Multi-level Computational Methods

Message to Global/Local Companies

We hope to realize global/local innovations for next generation automobiles by collaborating with our practical multiscale, multiphysics modeling/simulation methods developed through many industrial collaborations.

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

Drag Reduction Mechanism of an Automobile with Inside-Fin Tires

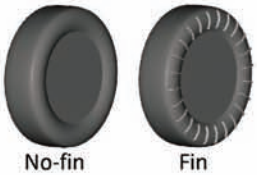
Shigenori Hashida[1], Koji Shimoyama[1], Shigeru Obayashi[1], Masataka Koishi[2] and Yuji Kodama[2]
[1]Institute of Fluid Science, Tohoku University, Japan
[2]Yokohama Rubber Co., Ltd., Japan

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

1. Introduction

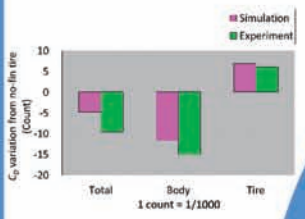
Aerodynamic Drag of an Automobile

- Accounts for 50 % of running resistance at 60 km/h
- Affected by the appearance (owner's preference)



Fin Tires

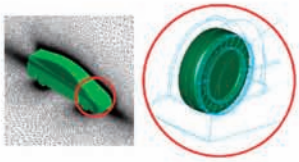
- ✓ Expected to reduce drag without sacrificing appearance
- ✓ Demonstrated to be effective for drag reduction in experiments and numerical simulations
- x Do not clarify its detailed mechanism yet

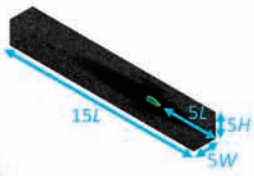


2. Method

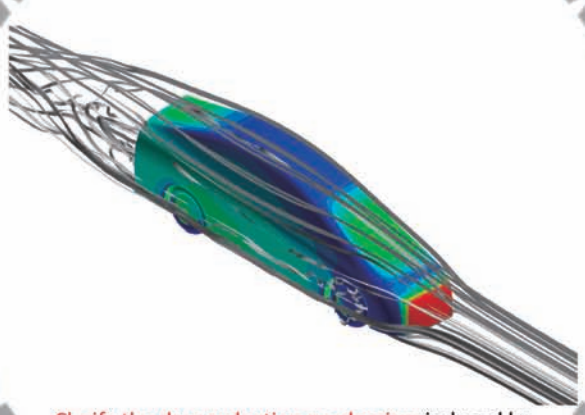
Flow solver	FrontFlow/red
Governing equation	Incompressible Navier-Stokes equations
Sub-grid scale model	Standard Smagorinsky (Constant: 0.15)
Pressure-velocity coupling	SMAC method
Time integration	Implicit Euler method
Spatial discretization	Cell-vertex finite volume method > Second-order central difference (95 %) > First-order upwind difference (5 %)

Model: Wind tunnel model (1/4 the size of a real car)
Velocity: 20 m/s, $Re = 2.1\times10^5$ (based on the tire diameter)





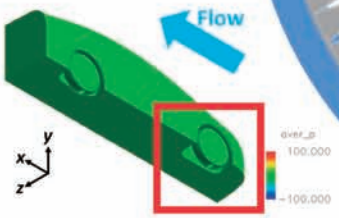
Research Objective

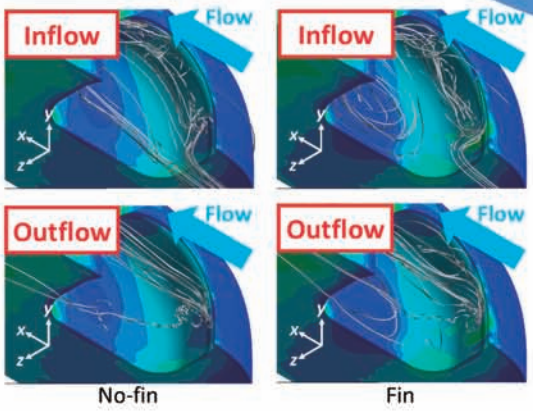


Clarify the drag reduction mechanism induced by fin tires through the numerical simulations for
1.No-fin tire model
2.Fin tire model

3. Result

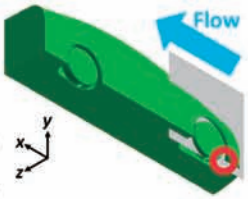
Streamlines

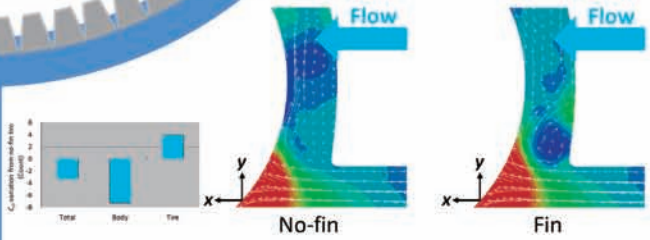




3. Result

Velocity vectors





4. Conclusions

- The fins enhance the interaction between the flow along the tire rotational direction and under-floor flow
- This interaction increases the pressure acting on the front part of the wheelhouse

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

A Concept of Automobiles Aerodynamic Testing using the 1-m MSBS in Tohoku University Low Turbulence Wind Tunnel

Yasufumi Konishi, Hideo Sawada, Shigeru Obayashi
Institute of Fluid Science, Tohoku University, Aobaku, Katahira 2-1-1, Sendai, Miyagi, Japan.
konishi@edge.ifs.tohoku.ac.jp

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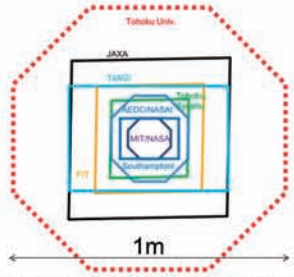
Introduction

MSBS

The Magnetic Suspension and Balance System is the model supporting device without any supporting rod or wire..
It **can also measure the fluid dynamic force.**



the comparison of the size of MSBS

Features:

1. The interference problem between fluid and a mechanical supporting system is eliminated.

2. It can simulate model motion with 6 D.O.F and measure the aerodynamic force on it.

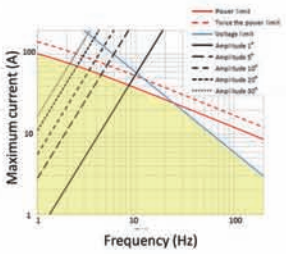
3. New MSBS in Tohoku Univ. Low Turbulence Wind Tunnel (LTWT) become the largest one.

Automobiles aerodynamic testing

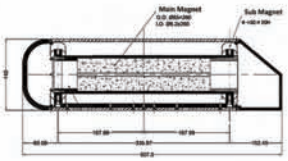
A postural change of the automobile can be simulated by exciting a **unsteady motion** by MSBS.

In excitation motion, the left side of the equation of motion (2) cannot be negligible. At low frequency cases, the second deviation can be estimated by the second-order numerical difference and the low-pass filter.

for example the available yawing motion on the Ahmed model considered becomes as shown in a figure. And because of no support needed, **the MSBS can make more complex motion** to a model, such as a pinching with rolling and so on.



Availablete yawing motion



Designed Ahmed model for MSBS

specification

length:0.5075 m
width:0.1891 m
hight:0.140 m
clearance:0.01344m
mass:10.8kg
Ixx:0.024kgm², Iyy:0.120kgm²
GC: 6.1mm down stream
Re= 1.25 × 10⁶, drag: 9.2N
(coil current drag coil : 30A
lift coil : 81A)
at 40m/s

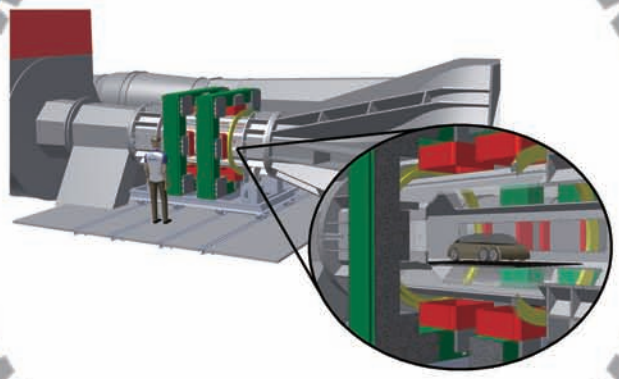


Image of Automobile aerodynamic test using the 1-m MSBS

Basic concept of MSBS

Equation of motion

$$\frac{d(mv)}{dt} = F_{aero} + F_{gravity} + F_{magnet} \quad (1)$$

$$\frac{d(I\cdot\omega)}{dt} = N_{aero} + N_{gravity} + N_{magnet} \quad (2)$$

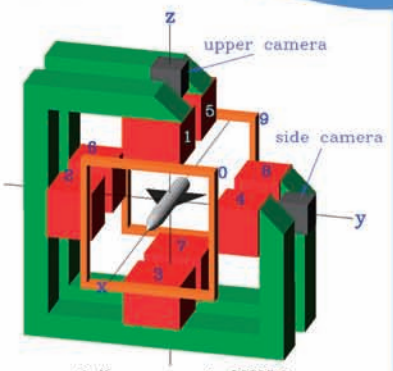
If the position and magnetic force are measured , unknown aerodynamic force can be evaluated.

Position is measured by five line sensor mounted outside of the upper and side walls

Magnetic forces can be evaluated from the following expressions:

$$F_{magnet} = (M\cdot\nabla)H,$$
$$N_{magnet} = M\times H,$$

$$F_x = M_x\frac{\partial H_x}{\partial x} + M_y\frac{\partial H_x}{\partial y} + M_z\frac{\partial H_x}{\partial z},$$
$$F_y = M_x\frac{\partial H_y}{\partial x} + M_y\frac{\partial H_y}{\partial y} + M_z\frac{\partial H_y}{\partial z},$$
$$F_z = M_x\frac{\partial H_z}{\partial x} + M_y\frac{\partial H_z}{\partial y} + M_z\frac{\partial H_z}{\partial z},$$
$$N_x = M_yH_z - M_zH_y,$$
$$N_y = -M_xH_z + M_zH_x,$$
$$N_z = M_xH_y - M_yH_y$$



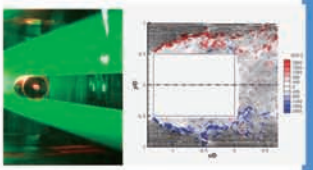
Coil arrangement of MSBS

PSP and PIV

New measurement techniques such as Particle Image Velocimetory (**PIV**) and Pressure Sensitive Paint (**PSP**) will be available as **optical measurements.** It is **not easy to access the interesting area** because measurable area is limited **in the past MSBS system.**

Our Solution

- **3D PIV system will be equipped to test section.**
- **MSBS can move forward and backward** in test section independently.



Example of PIV measurement
Around a circular cylinder

Concluding remarks

A summary of the 1m MSBS in Tohoku Univ. LTWT and advantages in automobile aerodynamic tests are described. We believe that tests at the LTWT test section equipped with the 1-m MSBS play an important role in future at automobile aerodynamics.

Industrial Presentation
Technology and business introduction of local companies

宮城県 Miyagi Prefectural Government

ITIM

Automotive Industry Support using ITIM's Open Equipment

Industrial Technology Institute, Miyagi Prefectural Government (ITIM)

EMC evaluation for car electrical components

Anechoic chamber and shielded room are open for use by automotive businesses. EMC evaluation based on international standards, shown below, are provided.

CISPR25 radiated emissions

Bulk current injection (BCI) test

CISPR25 conducted RF emissions

※We also provide electrostatic discharge immunity test

Shock test machine

Testing more than 1000G of shock with duration of msec is possible. Durability against shock for car electrical and mechanical components is possible to evaluate.

Model	AVEX SM-110-MP
Half-sine Amplitude & duration	30G,18msec～1000G,1msec
Max. shock amplitude	5000G
Max. speed	1.0m/s Peak
Dimensions of test table	W410×D410mm
Max. loading weight	90kg

- Shock direction is changed by altering fixing direction.
- Simultaneous acceleration measurement is possible by use of 3 sensors.

※We can give advise about a structure of test jigs.

Mission of ITIM

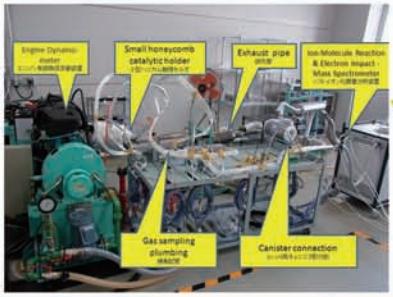
Industrial Technology Institute, Miyagi Prefectural Government

For the purposes of contributing to the promotion of local industry and aim for enhancing the support of businesses opened to local areas, we uphold an operational policy of one stop solutions based on trust, promptness, friendliness, safety, and assurance through utilization of the institute's knowledge and technical resources (facilities and technicians).

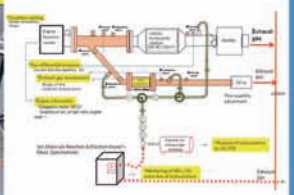
Catalyst property evaluation

This system allows us to evaluate the properties of the small honeycomb catalyst .

	Maker, model	Main specifications
Engine Dynamo-meter	TOKYO METER CO., LTD. GWE-110/150R	Engine : 1NZ-FE, 1.496 L (which is put on Allion made in Toyota Motor CO., LTD.)
Ion-Molecule Reaction & Electron Impact - Mass Spectrometer	V&F Analyse- und Messtechnik GmbH, AirsenseCompact	Gas consumption : 100ml/min Lower detection limit : ppb Response time :20msec
Gas chromatograph and mass spectroscopy /Headspace Preconcentrator	Entech Instruments Inc., 7100A Agilent Technologies Inc., (GC)7890A(MS)5975C	3-Stage preconcentrator Detector : MS and two FID(Flame Ionization detector) Lower detection limit : ppt
Exhaust Gas sampling plumbing	NISHIKAWA KEISOKU CO.,LTD.	The Silonite Coated Tubing made in Entech Instruments Inc.
Diagnostic tester	DENSO CO., LTD. DST-2	Trouble diagnostic software for Toyota cars

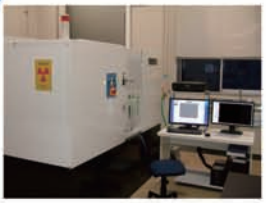


- Small Honeycomb size : D25.4×60mm
- Ion-Molecule Reaction & Electron Impact - Mass Spectrometer enables the simultaneous and synchronous monitoring of NOx, CO, and hydrocarbons(Toluene, Propylene etc.) .
- GC/MS is used to analyze C_2 to C_{11} hydrocarbons (Ethylene, propylene, 1-butene, n-hexane,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



X-ray CT

※Computed Tomography

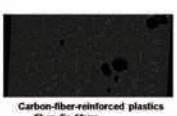


This system allows us to inspect the three-dimensional inner structure of automobile parts non-destructively, for example aluminum die-cast products, electronic parts, molding parts etc..

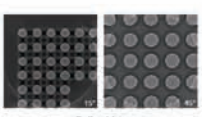
	Microfocus X-ray CT System
Manufacturer, Model	Comscantecno.Co.Ltd ScanXmate-D225RSS270
X-ray generator	Open tube/Transmission head Voltage 20～225kV (variable) Focal spot size Min, 4μm
Detector	Digital flat panel Pixel size(Pitch) 127μm/254μm Active area 235mm(H)×186mm(V)
Sample size	300dia.×300mm H , weight 15kg

	X-ray Inspection System
Manufacturer, Model	Comscantecno.Co.Ltd ScanXmate-RAA110TSS48
X-ray generator	Open tube/Directional head Voltage 20～110kV (variable) Focal spot size 3μm/5μm(selectable)
Detector	Image intensifier, 4 / 2.5 inch selectable
Sample size	Width/depth/height 400/350/50mm Weight 2kg

Aluminum sample size 30×30×10mm



Carbon-fiber-reinforced plastics fiber dia.10μm, sample size 20×20×10mm



Ball grid array





Company Policy

【Progress with creation and service】
The interaction of light with the magnetic and electronic freezes influctuation of space. We aim to develop technologies to measure and control with high accuracy.

Kudo Electronic Corporation

An accelerator・synchrotron・superconductivity・research facility high-precision constant current power supply

Kudo Electronic Co., Ltd.

Main office Nishitaga Taihaku-ku Sendai・・・Natori place Iinozaka Natori-shi

http://www.kudo-denki.co.jp/

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Analog and digital fusion

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

・よりダイナミックで、さらにシビアーに!

Since 1956 to now, our company have been supporting from Tohoku University. Technology very improved from analog generation. From this improved technology, we use this for an elementary particle, accelerator science of radiation, and big science in the field of nuclear fusion. Those technologies use at the research facility in Japan and out of Japan.

Moreover, we use this technologies for heavy particle cancer treatment, medical field of MRI etc... And, the field of semiconductor ion implantation, too.

We established control stability of the DC current and voltage 0.1 ppm, so our next challenge is 0.02 ppm.

POWER ELECTRONICS

Feedback & Computer Technology

10.000.000. =0.1 PPM
High-precision control technology

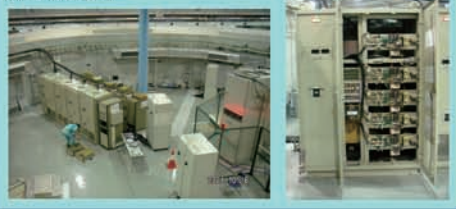
出典 独立行政法人理化学研究所播磨研究所殿
XFEL X Ray free electron laser
○New light to the future・・
National critical technology
X線自由電子レーザー(XFEL)
大型放射光施設 SPring-8
○quest of small world
○super fast! To see the world of chemical reaction
○Realization of super strong Plasma

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

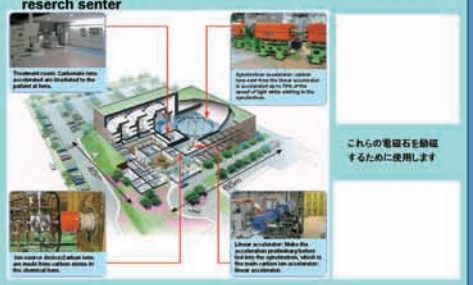
Kyushu synchrotron radiation research facility
Electromagnet, power supply One set（218 units）
March 2004

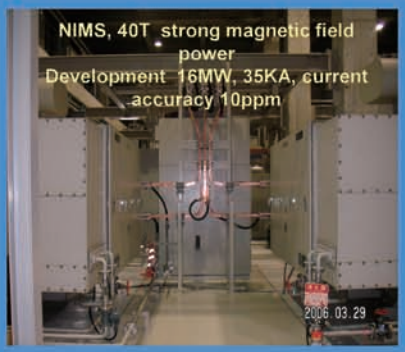
Ring system great capacity electromagnet & constant current power system group
IGPT switching method current stability: 10ppm
300kw*1 100kw*3 20kw*3

300kw/ Deviation electromagnet
IGBT/ Internal power source



2008年
The power supply in the Gunma heavy ion cancer therapy reserch senter





SP-series stabilized power supply

≪small high-precision DC switching power≫

2KW

6.6KW

0.02-0.001% current stability So suitable for the electromagnet excitation
1KW～30kW class unit power

10KW

Kudo corp・EV experiment group

- Joint research with Tohoku University next generation mobile system study group
- The Ministry of Economy, Trade and Industry " IT fusion consortium research and development project"
- Joint research with Tohoku Uni and Ishinomaki sensiyu Uni
- 4 employees organize the project
- Commercialization of next-generation electronic vehicle
- If you're interested in our industrialization, please contact us


Honda "Beat" decomposition


In- Wheel Motor


12V50AH 4 battery


Test Drive


Tagajo Reconstruction Park


EV eco-run race

Industrial labor-saving machinery・Hikichi Seiko automatic machine

～We help customer's "solution annoyances, production reform &improvement, and efficiency～

Hikichi Seiko Co., Ltd.

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

■Company Info

◇name： Hikichi Seiko corporation
◇Place: "main Offices" 2-8-28, Fukiage,Iwanuma- city,Miyagi-pref,989-2436 JAPAN
◇President： Masayoshi Hikichi
◇Fuoudation: May 3,1979
◇Capital: 30 million yen
◇Employee： 65people
◇Certification: ISO9001、ISO14001、&AS9100(challenge)、
◇Approval & license :general construction industry・machinery & equipment installation work

■Overview of Business

◇Business info： ・industrial labor- saving machinery・tooling, design & manufacture of various devices ・prototype, precision parts processing
◇The main delivery equipment ：
◆assembly equipment (line equipment, discrete systems)
◆Inspection equipment ◆cleaning equipment
◆Transport equipment
◆others-Automated equipment,various devices etc...
◇Major clients:
・Toyota Eastern group
・Panasonic
・Toray Engineering
・Seiko- Insutsuru
・electrical , electronics companies
・Food related companies
・Aircraft companies

◇Main Offices

"Engendering & mechanical design department"
・Making concept illustration form customer's offering
・Line equipment, a single machine, fixtures etc. All design

"Technology & control department"
・Use PLC, and make soft & hard design
・response coordination of articulated, Scala, single axis of each robot manufactures

"Manufacturing & machining department"
・We put the data in the automatic machine, and we can finish up all at one place.
・We really good at single item processing, and quick response and delivery. The challenge is cost & technology.

"Manufacturing unit assembly & adjustment department"
・Assembled, measurement data takes a stack accuracy
・The installation adjustment , check the final products
・We support the installation anywhere (domestic & international)

◇Taiwa brunch

・We express support for our ustomers .
・24 hours support for production facilities of our customer.

■Hikichi Seiko' sDNA

■To the employee's book
・The figure what is company's goal
・Knowledge as a society person & company people
・Sprits & motivation
・Self- growth & realization
・Responsibility ・・・

■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"

みやぎ 優れMONO
"SUGURE MONO"

To a company making "only one"

Tohoku Electronics Co., Ltd.

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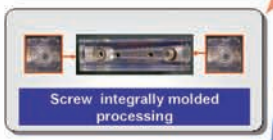
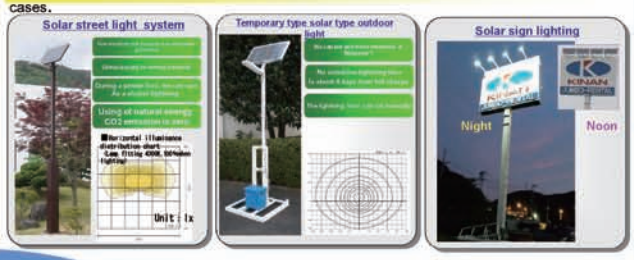
Injection molding

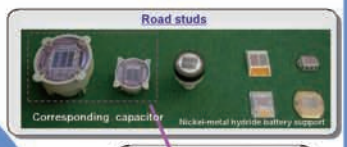
- Set 3D CAD, the optimum conditions using flow analysis.
- Realization of the secondary processing less devised mold structure based on the product shape.



Environmental Products
Union technology of secondary batteries & solar

Even if cut off the power supply, it will start the production of electric power itself by any cases.





Simultaneous engineering
synchronization technology

Quality & reliability evaluation

For reliability and performance ensure that satisfy our customers, we have carried out in the laboratory with a variety of test and analysis equipment, reliability testing on a regular basis, the benchmark test.

Analysis & failure analysis

We observe cross section of the embedded samples.

The main holding facility

Molding machine, processing machine, measuring instrument

1 Small molding machine (7～10t)
2 Injection molding machine (45～180t)
3 Injection molding machine (220～350t)
4 Injection molding machine (450～550t)
5 Vertical injection molding machine (20～40t)
6 NC electrical discharge machine
7 Wire electrical discharge machine
8 Vertical machining center
9 Machining center
10 CNC automatic lathe
11 Three- dimensional measuring device
12 Image measurement system
13 Measuring instrument shape and Contour surface roughness

Test & analysis equipment

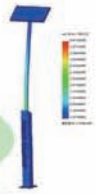
14 Thermostatic bath
15 Tank constant tempter & humidity
16 TCR tank
17 Pressure cooker
18 Thermal shock testing machine
19 strength test equipment (Pull, Compression, Bending, peel test)
20 Soldering test equipment
21 DC regulated power supply
22 Solder bath
23 Electron Microscope
24 Atomic absorption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

Software

26 3D CAD (SolidWorks)
27 3-D CAD/CAM system (CAM-TOOL, CADCEU)
28 2D/3D CAD system (2001PLUS)
29 Resin flow analysis software (3D TIMON)
30 Optical simulation software (Zemax)
31 Analysis simulation software (Femtet)

Proposal of solutions

We propose quickly to our customer about the best solution of customer's use condition.



Problem of stress relationship
- Stress analysis of the pole section
- Simulation of wind load (wind speed, wind direction)

Use of stress simulator

Resin flow analysis technology
- Filling analysis of resin
- Warp shrinkage deformation analysis

Use of injection molding CAE

Optical design & analysis technology
- LED model analysis
- Analysis of the light guide plate

Use of optical analysis CAE

Customer

To everyone in the company

We aim to improve the technical capabilities for the future with local companies.

◆A focus on the manufacture of electronic components & automotive parts production through integrated with community- based.

◆We run in QCD speed from product design to mold equipment.
◆Accumulation of our technology satisfy customers expectation.

Human resources education


The executive staff training


The executive staff training


In- house training


Presentation in a company

In a Development Early Stage the Proposal of the Die-Casting Form which Considered Quality Cost by Original Casting Technology

IWAKI DIECAST Co., Ltd.

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Semi-solid Die-cast Process

Outline of Manufacturing process

How to cast after making melted hot water half-solidification(slurry), comparing with casting from perfect melted hot water, it is little stickiness, it becomes a detailed and uniform organization, the product which called for high resisting pressure, high intensity and high toughness is possible.

Slurry

Casting

Processing

Section

Throw in

Knife cutting of slurry

Comparison of solidification structure

MIM (Metal Injection Molding)

Outline of Manufacturing process

MIM is finished after fabricating a metal particulate powder by injection machine, degreasing and sintering, post-processing accept necessity.

Injection machine

Thermoplasticity binders | Metal particulate powder

↓

Mix and knead

↓

Fabrication

↓

Remove binder

↓

Sintering

↓

Sizing

↓

Post-processing

↓

Product

Continuous sintering furnace

Headquarters・Factory
51-2 Yamazaki, Washiashi, Yamamoto
Watari, Miyagi, Japan 〒989-2204
***TEL* +81-223-37-3322**
FAX +81-223-37-3720
E-MAIL info@iwakidc.co.jp

IWAKI DIECAST

Main Facilities Machinery

The Best our Ability to Construct Factory Line; Pursuing Automation, Energy Saving and User-Friendly

The production line of Iwaki always holds the latest level of a time, the result of original now-how and joint research with an apparatus equipment maker is employed everywhere.
At a casting process, a supervising system and a multifunction robot which foreknows and prevents failure and poor product beforehand are introduced, the production line is automated mostly. And, the utility tunnel which stored the automatic hot water distribution system of an encapsulated type, home generation of electricity facilities for energy saving, compressor or conveyer is prepared.
Furthermore, a factory function is raised even to the highest level, it still continues making an effort to investigation of factory full automation that aims at high quality, high efficiency, low cost, the stable product supply, and realization of comfortable work environment.

Processing Factory

Mold Automated Warehousing

Impregnating Apparatus

Die-Cast Machine

Automation

Main Facilities Machinery

IWAKI DIECAST

Die-cast Model design Proposal System

Outline of Manufacturing Process of Mold and Die-Cast Products

The biggest problem of technology that supports modern high-mix low-volume production system is how to supply confirmed high accuracy molds on a timely manner, and construct a high efficient production system at low cost.
IWAKI designs casting with brand-new technology as a pure-play company focused on die-cast manufacturing. After we hear customer's request, we offer design of casting which can use easily. You'll be satisfied with both quality and cost phases.

Die-cast Model design Proposal System

Color anodized

Kyowa Aluminum Industry Corporation

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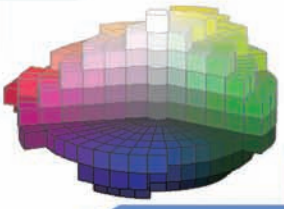
Color anodized

We reproduce wide range of color
Provides the color from your request
Our color reproduction is using proprietary technology



Hard anodized color

We can do hard anodized color
We can balance a vivid decoration and advanced durability

Alumite treatment

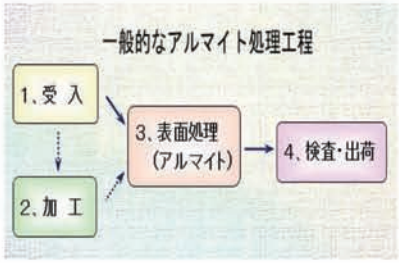
Color ・Hard anodized

Manual line

Normal anodized tank×1 tank
4,000(W)×900(L)×800(H)
Hard anodized tank×1 tank
1,200(W)×900(L)×850(H

Automatic line

Normal anodized tank×4 tank
2,200(W)×900(L)×1,150(H)
Hard anodized tank×1 tank
2,200(W)×900(L)×1,150(H



Greeting from The President

Since 1988, we have been aiming to improve the quality of surface treatment of aluminum products.

Even towards the 22 century, Aluminum is a necessary material to spend a good life for the comfortable environment for us.

We'll continue to challenge to the new generation.

We believed that we provide to our customers as soon as possible, and to serve the community for our future.

The President
Kouzo Inoue

Plating Business

Toho Plating corporation

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Toward Tomorrow

Manufacturing technology in Japan, we have been sweeping all over the world by the management and capacity development prowess. A key foundation technology is industrial surface treatment technology.

Current production in Japan has relocated overseas, " plating industry" in the country in the future must continue on the path of future high-precision and high-quality.

We'll make an effort to improving the technical capabilities, quality of power and environmental power for our future " manufacturing"

Surface treatment processing type list

Plating classification	Plating method	Plating bathtub	
Chemical conversion coating	Fully automatic equipment	chromium chemicol 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	
		sensglous acidity bath: 200 litres	
		dull luster acidity bath: 200 litres	
Decoration chrome plating	Manually operate equipment	copper-nickel-chrome, W nickel-chrome	
Passivation film coating	Fully automatic equipment	nitric acid bath: 250 litres	
	Manually operate equipment	nitric acid bath: 87 litres	
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

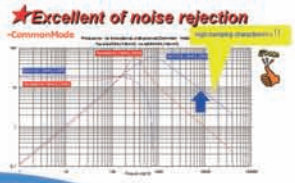
Ueno Coil horizontal type
◆Suitable for thin products◆

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.

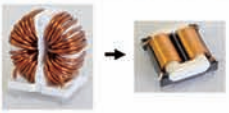
Winding directly to the closed magnetic circuit core

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/

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

Corporation Horio Factory

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3Keystones to make LOWER COST basis in industrial operation

Mold / High-Tech / Casting / Automation

1 Mold Technique - Accuracy Keystone

The Mold has Rich-Functions in a Compact Body! That Helps Usability.

- Compact Mold can be carried by one hand. To make Molds are Low Cost & Quick Turn
- By Discerning Mold, Accomplished Over 1 Million Shots Mold Life.
- By Using a Mold Multiple way, can Produce Various Kind of Products.
- By Coating Mold adv. of friction bush, Making High-Quality Products and Long-Life Mold.
- Creating Standard Mold Die Set which fits to a Die-Cast Machine's Cassette Base.
- Equipped Mold Release Spray Function

Real size

Easy-to-Use ! Multiple Function

- Able to Carry by One Hand
- Low Cost
- Quick Turn
- Mold life : over 1 Million shots

2 Die-Cast Technique - Casting Keystone

The Technique of No Burr in Parting ! That Helps 'Must-be' Quality.

- Accomplished Mass-Produce by 5t Compact Die-Cast Machine, Not large-machinery
- High-Shot Produce by 5t Die-Cast Machine
- Accomplished High-Quality Parts Production by Creating Processing Conditions Standard
- Simplified Mold Description by Cassette System that can be replaced by Whole Set
- By In-House Products, Making Low-Cost / Double the Life of Wearing Parts of Die-Cast Machine
- Nozzle-Touch Mold Injection Prevents Drip-offs
- Equipped In-House Eject Mechanism to Die-Cast Machine (Zinc Materials)
- Purchasing Zinc Materials by Direct Deal, Not from Trading Companies

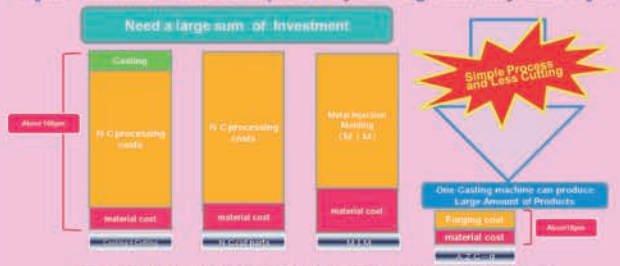
3 Automation - Self-Manufacture Keystone

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

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

Birth of High-Intensity Die-Cast Zinc Alloy !

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

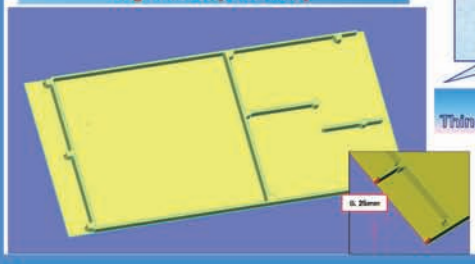


Alternate Current materials to Expensive High-Intensity one ⇒Massive Cost-Cutting

- Cut Costs by 90%
- Cut Costs by 50%
- Trial Manufacture alternative Cast Iron AZC-α
- Cut Costs by 60%

Challenge of Hot Chamber Die-Cast !

Suggesting Thin-Wall Molding by High-Intensity Zinc Alloy



Ultra Thin-Wall test piece (Challenge making chassis of Smartphone)

Completa! Thinness of case; 0.25mm

Aluminum / Magnesium ⇒0.4mm

High-Intensity Zinc Alloy⇒0.25mm

Contributing to Thinner Wall of Mobile devices like Smartphone

High-Intensity Zinc alloy A Z C-α Efficiency

Comparing with ZDC-2, about Double Strength

Composition and performance of AZC-α

1.Chemical composition(%)

Material name	Al	Cu	Mg	Cd	Pb	Fe	Sn	Si	Mn	Mech metal	Zn
AZC-α	7.85-8.15	3.00-3.30	0.03-0.06	≦0.002	≦0.003	≦0.075	≦0.001	–	–	0.03-0.07	Residue

2.Physical properties

Material name	Density kg/m³	Conductivity %IACS	Coefficient of thermal expansion ×10⁻⁶/℃	Solidification temperature range℃	Thermal conductivity W/m·k	Specific heat J/kg·k	Liquidity 430℃ (mm)	Poisson's ratio	Specific gravity	Remarks
AZC-α	6300	28	23	405-390	115	435	280	0.295	6.3	

3.Mechanical properties

Material name	Tensile strength (MPa)	Breath (%)	Longitudinal elastic modulus (Gpa)	Charpy impact (J/cm²)	Fatigue strength (1×10⁴ times MPa)	Hardness (HB)	Pull 0.2% proof stress (Mpa)	Elongation % at break (%)	Potential difference (mV)	Remarks
AZC-α	500	5	93	100-120	180		500	–	–	

Low Cost Manufacturing Comes True by Zinc Die-Cast Parts Casting

Points

- Proposing Engineering to Customers to Derive Better benefit from Manufacturing of New Part at Low Cost
- Supplying Optical Pickup Parts 30% Market Share of Global
- Own-Design Auto Fabrication Technology, Possible to Manufacture
- Own-Design Mold, Possible to Manufacture

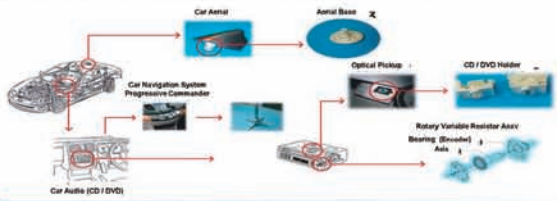
Zinc Die-Cast Parts ((Example of Application)

Technical Content

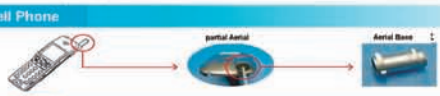
Products which were Created from Encounter with our Customers

Product Line : Optical Pickup Parts (DVD, Blu-ray) , Aerial Parts, Home Appliance Parts, Communication Device Parts, Industrial Device Parts

Vehicle installation



Cell Phone



By Zinc Die-Cast

Making Low-Cost Manufacturing Comes True

- Low-Cost Manufactured Mold Multiple Functioned Compact body Can be Carried by One Hand
- Attain Customer Satisfaction Auto Fabrication Technology
- High-Shot Produce by 5t Die-Cast Machine

〒987-1103 21-2 Takachiyaichi Kitamura Ishinomaki-shi Miyagi prefecture
Corporation Horio Factory
tel0225-73-2488 fax0225-73-3271
e-mail: info@horioss.co.jp

Corporation Horio Factory

Challenge to The State- Of –The Art Image Processing & Next Generation Vehicles

Tohto C-tech Corporation

http://www.tctec.co.jp

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— Obstacle detection on the road —

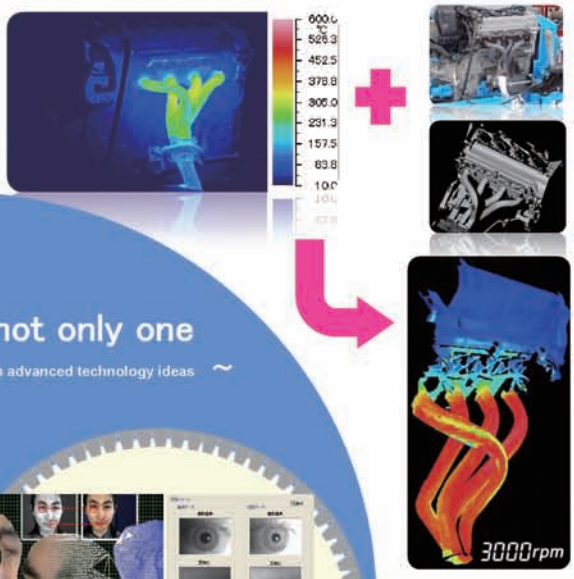
3-D measurement by stereo camera

This system detects obstacles on the road such as vehicle and people. Processing three-dimensional measurement from stereo images, it detects the road surface. If there are some objects higher than road surface, these are detected as obstacles.

— 3dimensional heat measurements —

「3dimensional measurement」×「Temperature distribution measurement」

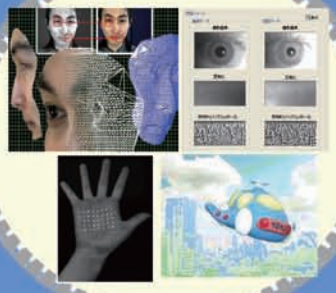
This system can synthesize thermal image and three dimensional data to process three-dimensional temperature distribution data. Using this system, you can detect accurate relationship between spacial position and temperature. For example, You can apply this system to heat test or product evaluation of thermal design.



Point of view is not only one

～ We will help you to solve problems with advanced technology ideas ～

Toto C-tec



System development in the middle of society

AUDIO, smart phone
etc…→Bluetooth／USB／BUS

- Power window／Sliding door
- Auto air conditioner
- keyless entry
- Push engine start

▼Technology component
- Power supply/ Mechanical device control
  System power control, motor control, such as D/D converter control
- Various IC control
  LCD control IC control, Backlight control (FL,LED) etc….
- Model based development
  MATLAB/Simulink, Auto coding／Auto test

—Automotive embedded software development —

Car navigation, body control system ECU

C-tec kun

—Business Area—

Image processing Solution	Embedded system solution	Parallel & speed-up solution
Problem-solving (algorithm Review)	MATLAB/Simulink Model-Based Development	Porting
Prototype development & joint research		Consulting
System development	Software Outsourcing	Software outsourcing

To every customers

～Have you troubled by the image processing system ？～

We're utilizing the state-of- the- art image matching technology with guidance from Tohoku University Professor Takafumi Aoki. Using synthesize of some of image information with different nature such as X-ray, infrared, advanced three-dimensional measurement, we achieve defect inspection system, the abnormal temperature measurement and so on.




Venture Capital for Innovation in Tohoku

Tohoku Innovation Capital Corporation (TICC)

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

■ Company Information

- Company's name Tohoku Innovation Capital Corporation ("TICC")
- Address 1-1-1 Honcho Aoba-ku Sendai-shi Azur SENDAI F16
  <Tohoku Uni. Office> 6-6-40-407 Aoba aza Aramaki Aoba-ku Sendai-shi (inside the T-Biz)
- Business Investment and management support to venture companies, and management of the venture capital funds
- Establishment October 2003
- Paid up Capital 70 million yen
- Number of staff 11 people
- Board members
  President Ko Kumagai (ex President, Nikko Capital)
  Executive Vice President Kazuyuki Igarashi (ex JAFCO)
  Director Shiro Takahashi (ex Representative, Sony Sendai technology center)
  Director Shoichi Noguchi (Professor emeritus, Tohoku Uni.)
  Auditor Akio Nishizawa (Professor, Toyo Uni.)
  Advisor Yasutaka Iguchi (President, Miyagi Organization for Industry Promotion)

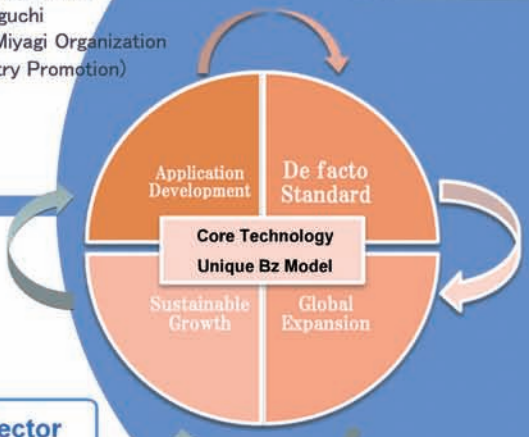
■Funds under management

・Tohoku Incubation Fund
Established March 25, 2004
Fund total 31.8 billion yen

・Tohoku Growth Fund
Established August 31, 2006
Fund total 35.8billion yen

・TICC University Alliance fund
Established June 22, 2007
Fund total 10.11billion yen

Support growing companies seeking global expansion based on the core technology



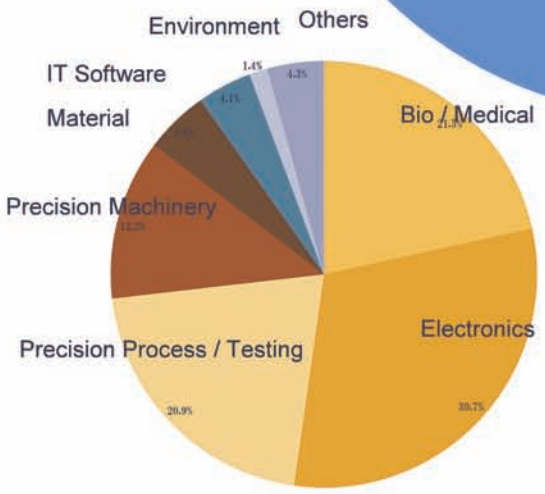
Growing Businesses

- Leading edge technology based on universities/research institutes
- Unique business model
- Application development with high added value to potential demands in various industries
- Adoption by global leading companies aiming to be de facto standard
- International expansion
- Sustainable high growth with profitability

Financial/management support

TICC
- Risk capital
- Business development
- Management support
- International expansion

■Portfolio by Sector



■Building a global network

- It is important for expansion into emerging markets in East Asia.
- In order to support the overseas expansion of investment companies, TICC is conjunction with research and development institution with overseas.
- First of all, signed with MOU with following two institutions

◆(Taiwan) Industrial Technology Research Institute(ITRI)
◆(Korea) Korea Technology Venture Foundation(KTVF)

To potential limited partners

~For "Tohoku Revival Fund" (Our New fund)~

It is our mission that through our investment activities, various technology-potential in Tohoku is commercialized as ventures, develops successfully as sustainable international businesses, and contributes to vitalize regional economy. Now we are launching 4th investment fund until mid of 2014.

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,

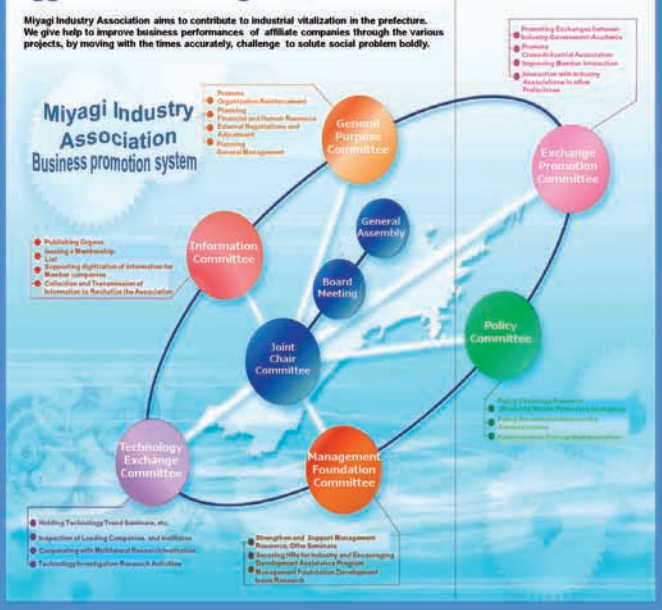
Aiming to;
- Reinforce the Management Base
- Advance their Technology
- Open up a New Market

We contribute to healthy developments of vigorous and creative industries of our prefecture.

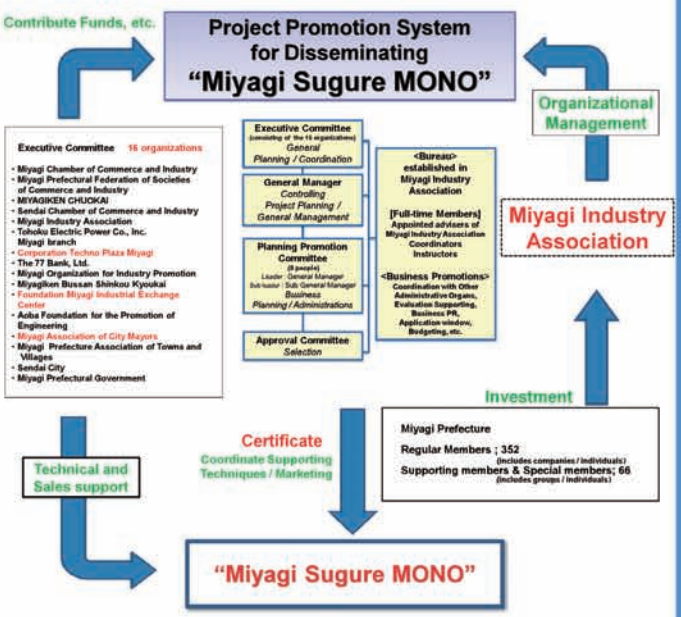
Business Promotion System

We Support Aggressive Challenges — Miyagi Industry Association

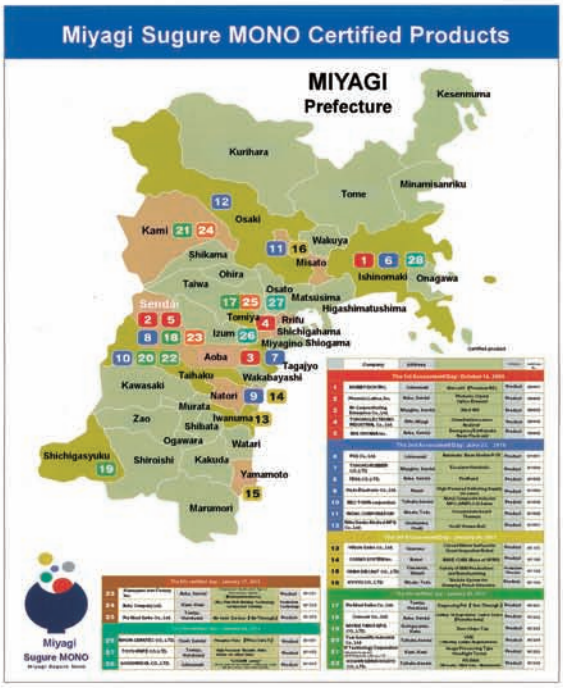
Miyagi Industry Association aims to contribute to industrial vitalization in the prefecture. We give help to improve business performances of affiliate companies through the various projects, by moving with the times accurately, challenge to solute social problem boldly.



[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

Contributing to the filed of Automotive Electronics with Optical Technology

HAMAMATSU PHOTONICS K.K.

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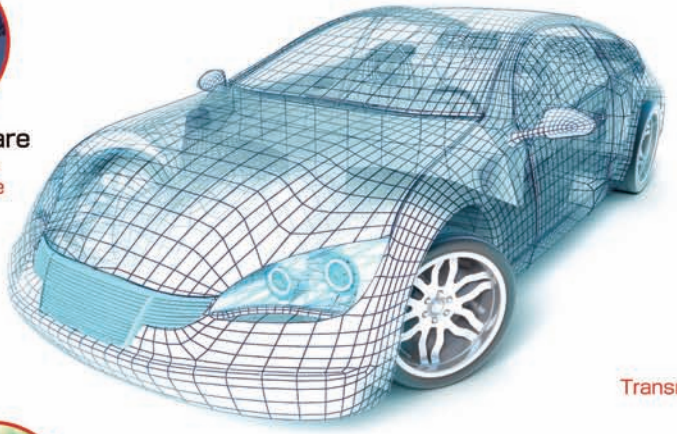
Hamamatsu Photonics' Automotive Solutions

We contribute to safety, comfort, and energy-saving driving for vehicle drivers using our forefront optical technology.



Sense the Glare
Si Photodiode
Photo IC Diode

Sense the Sun
Si Photodiode
Sun Sensor Assembly

Sense the Music
Transmitter Photo IC/ Receiver Photo IC

Sense the Rain
Si Photodiode
Infrared LED

Sense the Distance
APD,
Image Sensor for Distance Measurement
Pulsed Laser Diode

Sense the Corner
APD, Si PIN Photodiode
Image Sensor for Distance Measurement
Infrared LED, Pulsed Laser Diode

Sense the Angle
Photo IC, Encoder Module
MEMS Mirror

Products for Manufacturing Processes

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

- Surface Reforming
- Thickness Measurement
- UV Coating
- UV Gluing
- Laser Welding
- Spectrophotometry
- Electrostatic removal
- Nondestructive Inspection
- Micro/Minute Pin Hole Detection
- Imaging Measurement

HAMAMATSU
PHOTON IS OUR BUSINESS

HAMAMATSU PHOTONICS K.K.

Established	September 29, 1953
Capital	34,928 Million Yen (As of end of Dec., 2012)
Number of Employees	3,045 (as of end of Sep., 2012)
Main Product Lines	Photomultiplier Tubes, Imaging Devices, Light Sources, Opto-Semiconductors, Imaging and Analyzing Systems
Domestic Center	Headquarters, Main Factory, MitsueFactory, Shingai Factory, Toyooka Factory, Tenno Glass Works, Joko Factory, Miyakoda Factory, Central Research Laboratory, Tsukuba Research Laboratory, Industries Development Laboratory, Tokyo Branch Office, Sendai Sales Office Tsukuba Sales Office, Tokyo Sales Office, Chubu Sales Office, Osaka Sales Office, Nishinihon Sales Office
Global subsidiaries	America, Germany, France, UK, Sweden, Italy, China

www.hamamatsu.com

Create our future

～Contribute to people and company with our products by credible technique～

Miyagi-Kasei Co,.LTD

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

Company information

◆Information
- ☐Name　Miyagi-Kasei Co.ltd
- ☐Address　15-4, Kitazawahankinzawa, Ichihasama, Kurihara, Miyagi
- ☐CEO　Akihiko Oyama
- ☐Date of Foundation　April 1987
- ☐Paid in capital　¥20 milions
- ☐Number of Employees　40 employees
- ☐Certification　ISO9001
- ☐Permits and Licences

◆Business Outline
- ☐Manufacture and Marketing for FRP products
  - ・Car Components（Bumper, Body, Air Deflector for Truck, Camper, Covering Panel, Temporary Toilet, Vessel, Playground Equipment, Rest of general FRP products）
  - ・Lent and Marketing for Construction Material（Temporary Toilet, House, Shower House, Supply for an Event）
  - ・Construction Work（Construction of lining and sealing, Insulation, etc.）

◆Main Customer
- ☐ Automobile
  - ・ICL, Mitsuoka Mortor, Lotas, FirstCustom, Fatra Styling, KLC
- ☐ Construction
  - ・Housing Manufacturers , Constructor, Lent Company for constriction machine

◆Group Company
- ☐Haipura-Kasei, Co.LTD

Company Principle

Contributing to our society and people by means of creating newer and valuable products.

Improve our ability and personality to produce and innovative superior products for the benefit of all.

Main Factory Description

Gross Area
6，８００㎡
- Molding factory area　６７１㎡
- assembling factory area　２０５㎡
- finishing factory area　１９７㎡
- resting &warehouse area　１９７㎡
- Office area　１１３㎡

Forming Technique for FRP

①Hand Lay up molding

②Spray-up molding

③Light RTM molding

④Infusion molding

Method of molding

① Hand Lay up molding
Paste glass and resin into mold by hand

② spray-up molding
Spray glass and resin by spray molding machine

③ Light RTM molding
Set glass fiber into rough forming die, and put resin in it.

④ Infusion molding
Set glass fiber and put resin by vacuum drawing

Our effort for new technique

Development of noninflammable transparency

Construction (Bulding material for inside and outside)
Aviation and Space (Aircraft)
透明性
Vehicles (Trains) (Cars)
Energy (Solar light panel)

Cover for light in the Train

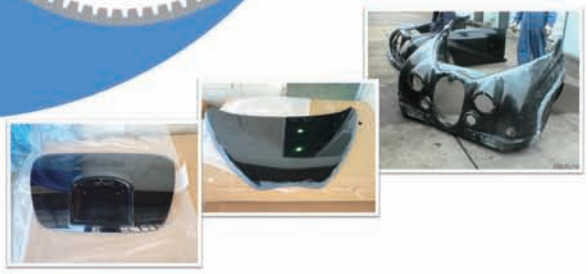
Expected lots of needs in huge field

■ Glass	■ Plastic
・Transparency and noninflammable ・Heavy and easy to brake	・transparency and light ・Hard to brake ・Lack of noninflammable

Transparency, noninflammability and strength are related to the transactions, so it is difficult to cover together in the same time.

Advanced Industrial Science and Technology, and our GFRP try to consist and improve their noninflammability and transparency by our new combination materials

Mitsuoka mortor Viewt FRP　Frontface　Bonnet　Trunk



Message for all

～As your partner company which create our future with new ideas &challenges～

We consider what can be useful for customers and society,
And we develop and create the products to contribute to our society.

TEL +81-(0)228-52-3931　FAX+81-(0)228-52-3933
E-mail : info@miyagi-kasei.co.jp　URL : http://www.miyagi-kasei.co.jp/

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

We provide you the best solution with the highest technology

Daisho Denshi Co.,LTD

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

PROFILE

◇Company Name : Daisho Denshi Co.LTD
◇Address: 2-16-5,Denenchofu, Ota-ward, Tokyo
◇Date of Foundation : 12 September 1968
◇Paid in Capital: ¥730milions
◇CEO: Naotoshi Shinozaki
◇Main Products :Plan and Manufacture of Printed circuit board
・Planning for pattern, various simulation
・BGA board, CSP board, COB board, FC-BGA board
・Build up multilayer board, Cavity board
・BVH/IVH multilayer board
・Magic Resin Career
・Laser Metal Mask
◇Annual Revenue : 20,100milions
◇Number of Employee: 1,000
◇Main Customers : ・FUJITSU Co., LTD
・CANON Co., LTD
・J-Device Co., LTD
・SHARP Co., LTD
・Murata Manufacturing Co., LTD
・Mitsubishi Electronic Co., LTD
・Altech corporation Co., LTD
・Panasonic Co., LTD
etc.

NETWORK

Total Support System

We are flexible to your demands throughout the process for manufacturing.

6Layers Flexible-Rigid Build up

TOYOTA

CAMERA MODULE

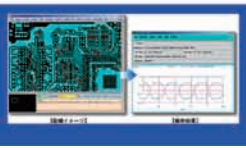
BLUE TOOTH

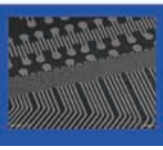
6Layers Build up

4Layers

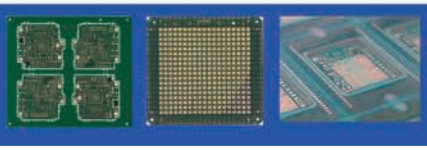
ENGINE CONTROL PARTS

We have cultivated a development and manufacturing technology, expertise and network since our foundation. Utilizing these abilities, we have created total support systems such as manufacturing, pattern planning, simulation, manufacture of tool for production, package support tool, development of inspection tools, parts package, construction for unit, assessment for reliability and so on.





Main Office : ☎ 03-3722-2151
Iwate Plant : ☎ 0191-63-5111
http://www.daisho-denshi.co.jp
DAISHO DENSHI



Using electric vehicle COMS

Car Sharing system

TOYOTA TSUSHO CORPORATION
Green Mobility Business Development Dept.
81-3-4306-3174

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

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Excellent ideas to use eco-friendly Micro EV,"COMS"

EV Sharing
@ Community, Condominium, Workplace, Tourist area etc....

Selling points of COMS sharing system

●Remaining battery level and cruising range estimation

Display battery level & cruising range

Select "Station" ⇒
"Departure time" ⇒choose "Vehicle"

Display battery level and possible travel mileage

＊State-of-charge (SOC) is calculated by information from COMS and accumulated charging data.
＊Cruising range is calculated by remaining battery level.

Driving route search

Plot your "destination"

Route Search ⇒Battery consumption calculation

Possible to reach destination　**Unable**

Display "Estimated time of travel" and "Distance"　**Display "NG"**

＊Calculated by accumulated driving data and slope/grade information on map and driver's past driving characteristic.

State-of-charge projection after drive & estimated battery charging time display

SOC projection after drive

Calculate battery charging time & recharge level

＊Estimated SOC at the .time of car return is calculated by accumulated driving data and actual current battery level.
＊Estimated battery charging time and recharge level are calculated by accumulated charging data and CAN information from COMS.

Inflection line matching algorithm

～Advanced defect detection technique for painting on mirror surface by image processing～

×3PROJECTS By Three projects corporation

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

Company profile

Address：〒981-3212　15-22 4 cho-me, cho-meigaoka Izumiku Sendai, Miyagi
Established ：　March 3, 1987
Capital stock ：　10million yen
Employee ：　31 people（March,2012）
Office ：　Headquarters（Cho-meigaoka Izumi-ku）
　　Furukawa branch（Nakazato Hurukawa Osaki Miyagi）
Business info　：1. Embedded Systems
　　2. Measurement & test system development
　　3. Operational systems development
　　4. Image processing system development
　　5. digital / analog circuit design
　　6. Research & development

東北で初　ナショナルインスツルメンツ社 アライアンスパートナー（東北初）
LabVIEW認定開発者5名（東北最大規模、国内トップクラス）

※April ,2013
・1　NI certified instructor
・5　certified LabVIEW developer
・3 certified　LabVIEW associate developer

NATIONAL INSTRUMENTS Alliance MEMBER

"2010 Strategic Technology Infrastructure Support Sophisticated Business"
Adoption Projects
" Commercialization and development of image processing embedded software for enhancing visual for industrial robot"

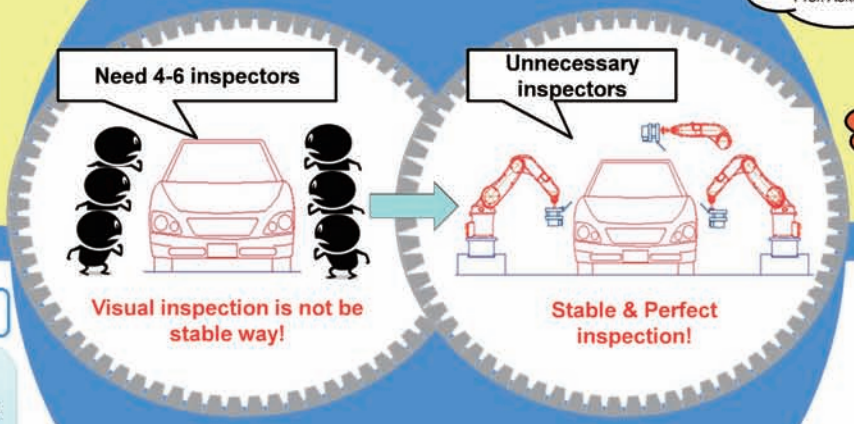
One of the project development result "Inflection line matching method"
※ As "surface inspection method and surface inspection device". The patented in January 2013.
（Patented :Number 5182833 ）

【Joint research group】(Alphabetical order)
Hikichi Seiko Corporation
Miyagi Prefectural Industrial Technology Center

【Adviser】
Tohoku University Grad school of Information Science & Technology.
Prof. Aoki

industry-academia-government – collaboration

Automatic defect inspection



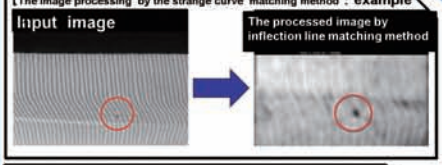
■Prevent defect outflow
■Save inspection cost

Summary of Inflection line matching method

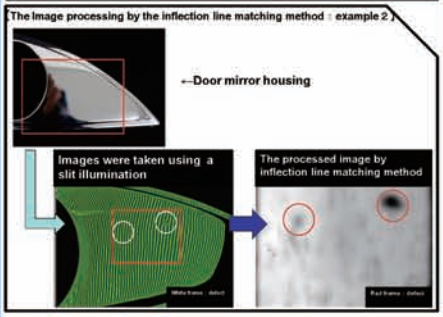
・Algorithm to highlight irregular part of the interval and the direction of the curve in the image.

< Applications >
⇒Using slit of the organic EL lightning to imprint slit on the test object to take in image.

【The image processing by the strange curve matching method：example】



【The Image processing by the inflection line matching method：example 2】



【Applications】

・Surface defect inspection of the exterior and interior automotive products

・Surface defect inspection of plating painted

・Surface defect inspection of metal processed goods

・Surface defect inspection of plastic products

・Surface defect inspection of resin processed products

Etc…Applicable to defect inspection with respect to the surface that has the property of specular reflection to the light.

※１のサンプル画像

① 検査対象物

対象物	表面状態 ゆず※1	微細痕や汚れ※2	鏡面	艶有り	艶なし
塗装（メタリック含）	×	×	○	○	×
メッキ	−	×	○	−	−
金属加工	−	×	○	−	−

② 欠陥、及び検査対象物の形状

表面状態	欠陥 線キズ	汚れ ゴミ	ゆるやかな凹凸	鋭利な凹凸（ブツ含）	検査対象物の形状 平面	ゆるやかな曲面	きつい曲面	カド	複雑な曲面
ゆず※1	×	×	×	×	×	×	×	×	×
微細痕や汚れ※2	×	−	×	×	×	×	×	×	×
鏡面	△	○	○	○	○	○	△	×	△
艶有り	△	○	○	○	○	○	△	×	△
艶なし	×	×	×	×	×	×	×	×	×

※1 欠陥とまでは見なされない程度のゆず肌（塗装表面の粗さ（ラウンド））のうち、比較的きついもの。
※2 表面を研磨した時につく研磨痕のきついもの（光を回折させ虹色に見える線キズなど）や、表面光沢を失わせる汚れが、検査面全面に付いているもの。

By three projects corporation
〒981-3212　15-22　Chomeigaoka Izumi-ku Sendai
TEL:022-342-7077／FAX:022-342-7079
http://www.x3pro.co.jp/
E-Mail:sales@x3pro.co.jp

×3PROJECTS　NATIONAL INSTRUMENTS Alliance MEMBER

We'll provide "New familiar Hybrid"

My Car Plaza Eco Custom Division Corporation

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

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

Hybrid Cars Evolution to " Ultimate Eco-Car"

RHYBRID Prius α(ZVW41)


TMS2011 at Venue

LPG + Electricity + Gasoline

The evolution to the " ultimate eco-car" by the RHYBRID of the motor hybrid car is synonymous with eco- friendly cars.

The exhibitors participating in RHYBRID Priusα in 2011 Tokyo Motor Show. It was a celebration of next- generation vehicles. Many visitors had to experience abroad to see.

Active in the Nationwide "not a dream" as the vehicle realistic

RHYBRID, so called Bi-fuel LPG remodeling is a technique that can be practiced right now.
The economic efficiency and excellent environmental performance, a lot of attention from taxi operators around the country, especially in Tokyo metropolitan area, there are more than 400 taxi vehicle active currently.
As a car running daily basis, there is a running truck record of more than 300,000 km after remodeling.
There is also a truck record of introduction as official vehicles of municipal and commercial vehicles.

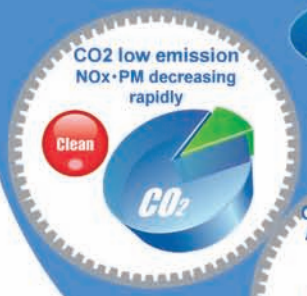
Adoption in local government, is due to the strong focus on LPG in case of emergency in the earthquake earlier.

Use of fuel as the "LPG"

Realistic Ecocustom=" Real HYBRID system "

RHYBRID®

Innovative Custom for Eco



Non-stop Evolution


RHYBRID Hiace(TRH224 renewal)


RHYBRID Camry(AVV50 Renewal)


RHYBRID Professional box(NCP51 renewal)

Prius series is the flagship model in our company, in order to respond to various needs, we'll continue to expand its corresponding model.
We don't think a technology that requires million people, but at present, it is in the process of evolution of automotive technology, we believe that technology that connects to the next generation.
Know-how and retrofit technology that we have is immediately transferable to bi-fuel of the LNG and CNG.
Now, it is a next generation energy issues such as Payload and infrastructure, challenge of widespread use, but when the conditions are in place, it is a technology that can immediately respond.

Our priority

"Operation and without traveling all the same and ordinary cars, and this device many not be in accident"
"We do not put on the market absolutely until convincing technically"
Feelings that we have for RHYBRID specification care is these two points. Car is to break must be somewhere during using it. However, since it is a customize car, development has been put on the maximum important so that it may not say that it broke.
It is modest as those involved in the special car, but it is the feelings that can not be bent in any way.

RHYBRID仕様車 設計・開発・施工・販売
My Car Plaza
http://www.e-rhs.com/
My Car Plaza Eco custom Division Corporation
〒028-3161 4-23-1 Kuronuma Ishidoriyacho Hanamaki Iwate
TEL:0198-45-2700　FAX:0198-45-6579
e-mail:info@e-rhs.com

Ministry of Education, Culture, Sports, Science and Technology
Area innovation strategy support program next generation car Miyagi area

Auto industry support through technology seeds

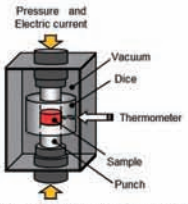
AKITA Industrial Technology Center

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

Super hard tool materials of resources strategic type

We've tackled development of hard tool materials have high hardness and high crack length. As a result, it was found that Tungsten carbide(WC) raw material of the hard metal becomes densification adding SiC. Therefore, we become able to make WC-based cemented without addicting cobalt(Co).

A prototype of burnishing reamer collaborating with companies

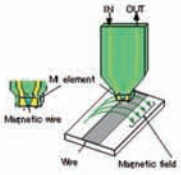


Development method of hard tool materials

A high frequency magnetic detection element

We developed MI probe measurable electric current of the wiring contactlessly from direct current to high frequency with high sensitivity. Covering all frequency band and having flat frequency characteristics, that implements 10 micron spatial resolution. This one can evaluate EMC of the whole vehicle body. Application as high frequency noise sensor, high bandwidth magnetic field sensor, and rotation sensor are capable also. So, the structures are simple and the manufacturing cost can suppress.

The measurement example by developed MI effect type magnetic probe



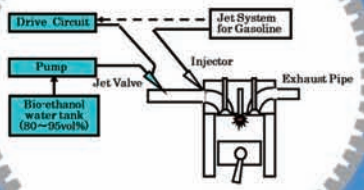
MI probe

Development and proof experiments of Dual-Fuel Vehicle

We took running tests in Solar sports line of Oogata-village.

As a result, we finished proof experiment safely without engine trouble.

It was equipped with a bio-ethanol tank in addition to the gasoline tank.



To a minimum remodeling of around engine!

DFV is the automobile can use two fuel both gasoline and bio-ethanol water coincidently. The vehicle runs by providing the two fuel from the two fuel supply systems to the engine. Accordingly, reducing carbon dioxide could be expected.

A prototype has flexibility.

The example can make simultaneous trials using two color resins.

The Rapid Prototyping technology don't need metal mold, and you can get prototype in a short time. It can raise capability to develop new products. In addition, you are able to shape prototype from three-dimensional data(STL) gained by three-dimensional CAD or 3D scanner, and the feel of shaping model and function can be evaluate.

Prototyping by digital engineering

Autoclave

The carbon fiber reinforced plastic(CFRP) has merits like lightness, high strength, high rigidity, high corrosion resistance. It is the next-generation material which expanding a substitute from conventional metal material rapidly as structure material of automobile parts. Our center aim to expand industrial utilization, by maintenance of facilities and developing technology seeds.

Composite Center

For companies

It becomes high function and low cost of automobile parts and others by the locally laser quenching technique, which is our center's technology seeds. Also, we design an improvement in productivity for automobile factories by the hardness test gripper technique for industrial robots. In this wise, we support automobile industry with seeds of technology of design, processing, and measurement based on materials engineering, mechanical engineering, and electrical and electronic engineering. For more information or any question, please contact the contact address below.

Akita Industrial Technology Center Technological innovation department
TEL +81-(0)18−862−3420 FAX +81-(0)18−865−3949 http://www.rdc.pref.akita.jp/

Highly recommended!

"LNG-DDF", Main figure in the shale gas revolution

LPG・CNG hybrid system of gas

Hana Engineering Japan Co., Ltd.

http://www.hanaeng-japan.com

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Retreat from nuclear power and the shale gas revolution

After the Great East Japan Earthquake, the extreme begun to retreat from nuclear power worldwide. Then, simultaneously the times changed not to rely on petroleum energy. That is the fuel revolution by developing of fuel gas mining technology, representative USA. The new hybrid system of motor and gas not to rely on gasoline protect the global environment, with a thermal power station makes retreat from nuclear possible, and the fuel battery car instead of electric cars.

When Japan is waved by retreat from nuclear, the shale gas revolution is in progress in the world. It advances to retreat from nuclear and protect people's life that Japan make fuel revolution as a member of the shale gas revolution.

Nowadays, if the motor hybrid based on gasoline car increase fuel efficiency 40% compared with gasoline car, development of gas hybrid by the shale gas revolution can increase fuel efficiency 30% furthermore.

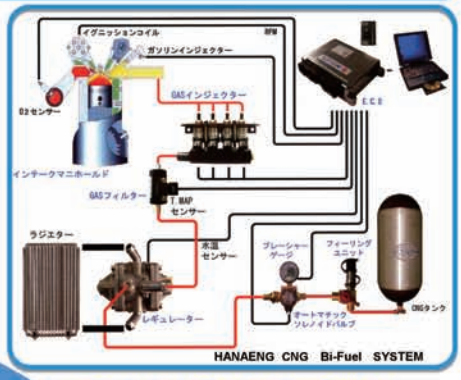
Therefore, almost hazardous wastes will be restrained, and many high environmentally cars exist in the world.

The lowering of price of automobile fuel by the shale gas revolution, automobile fuel efficiency will be able to be halved. So the spread reducing hazardous waste from cars, we can leave the precious legacy beautiful earth to offspring.

The secondary fuel system not rely on gasoline oil when earthquake

Bi-Fuel

Bi-Fuel is hybrid of gasoline and gas, when warming-up operation it uses gasoline, a few minutes later it switches to gas automatically. When the Great East Japan Earthquake gas stations ware filled of crowd, Bi-Fuel car ware able to supply at vacant gas station. Fuel efficiency rise 30 to 35%, and CO2 are cut down above 20%, Nox, PM etc. are able to reduce 50 to 70%. It uses gas: LPG, CNG.



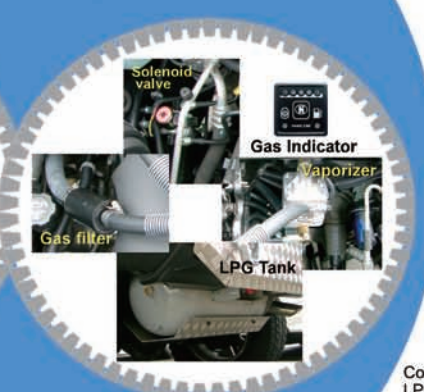
HANAENG CNG Bi-Fuel SYSTEM

LPG・CNG gas hybrid system

We provide next generation car.

Restraining hazardous exhaust materials, CO2 decrease and fuel efficiency increase.

Gas hybrid system, the most practical, becomes the leading role of the shale gas revolution.



We provide the most practical gas hybrid cars that convert petroleum fuel car into high environmentally car as the primacy of post-oil fuel in automobile world, solving retreat from nuclear power in Japan, not being late for the shale gas revolution only once in a century or two centuries in the world.

CNG Bi-Fuel Gas Injection System

It can utilize almost gas, such as LNG, HHO.

Japanese taxies choose Prius Hybrid instead of gas powered vehicles.

For several years, Japanese taxi companies have replaced Toyota Prius with LPG auto gas car. And simultaneously, the number of taxi company convert Prius into gas hybrid boosted. Used Bi-Fuel system are occupied almost 100% by our company made.

Company profile

Company name
Hana Engineering Japan Co., Ltd.
Paid in capital 10,000,000yen
Founded October 2009 established May 2011
President Kazuhiko Kami
Head Office Tsurugaoka2-12-3,Izumi-Ku, Sendai, Miyagi, 981-3109Japan
East Japan Sales Department
HANA JAPAN first building 2F
3-1-43 Haranomachi, Miyagino, Sendai
983-0841,Japan
West Japan Sales Department
Haruhiyaketa67-2Kiyosu-shi, Aichi-ken 452-0962Japan
System hybrid department
HANA JAPAN first building 3F
Haramachi3-1-43,Miyagino-Ku, Sendai
Information center
HANA JAPAN first building3F Haramachi3-1-43,Miyagino-Ku, Sendai

Products and sales items

Gas hybrid system in general
・LPG Bi-Fuel system
・CNG Bi-Fuel system
・LPG-CNG Bi-Fuel system

Correspondence gas:
LPG,CNG,LNG,HHO, oxyhydrogen (OHMASA-GAS) biogas in general
・Plan, Design, Product; Limousine, Adapted vehicles
・The ability test strength and stiffness of cars in general
・Operations authorized by Ministry of Land, Infrastructure and Transport and related ministries

Sales department building, view from National Route 45

The gas hybrid car's the range per one fuel filling is 10 times as long as electric car. It can reduce CO2 20 to 22% compared with gasoline, reducing hazardous wastes 60 to 90% such as Co, HC, Nox, PM, Sox, fuel efficiency can increase 30 to 40%(compared with gasoline car).

※Though "hybrid" means to have plural motor in one car, "Bi-Fuel" means the system combusts dual fuel by switching alternately, we express all of those "hybrid" to understand by general public.

Hana Engineering Japan Co.,Ltd.
East Japan Sales Department 3-1-43 Haranomachi, Miyagino, Sendai 983-0841,Japan
TEL +81-(0)50-1208-5862(representative) FAX +81-(0)22-776-5072
E-mail: hanaeng_japan@ybb.ne.jp
http://www.hanaeng-japan.com

After the Great East Japan Earthquake, the world began breaking with nuclear power generation. One only accident takes life and the health of innumerable people, and it makes towns into the death. Spread of electric car increases electrical energy consumption by 10%, it puts on the brakes retreat from nuclear. It is not enough that wealthy families install solar power system. A nominal that we are supplied from electric cars when a natural disaster, but cars are not able to at the important time. Besides, the batteries retain only several hours. Solar power system responds the case of a power failure due to a disaster, any days or any weeks. Though the problem of thermal power generations is only fire, nuclear reactor convert a hometown into dead town. Almost all regions have the possibility. The tragedy of FUKUSHIMA is not another person's problem. We contribute to retreat from nuclear with making cars using clean energy liquefied natural gas (LNG). Gas cars and electric cars. Electric cars sound smart, but we hope you to find out there are dreadful power supply source behind them. Although the nuke has called safety and reasonable, the Nuke accident of the Great East Japan Earthquake caused a great illlsick, and its amount of damage is as tens or hundreds times as the cost when it was built. Now Japanese government seems to force people to pay that , we are convinced the importance of gas hybrid, because we must choose a choice to protect our offspring .

To provide our customers with the added value different from the other companies based on innovate material

NEC TOKIN corporation

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Company overview

Company's name: NEC TOKIN corporation

Capital stock: 34.2 billion yen

Sales figures: 41.3 billion yen (2012)

Number of employees: Consolidated 6,014 (Domestic 1,298 international 4,716)

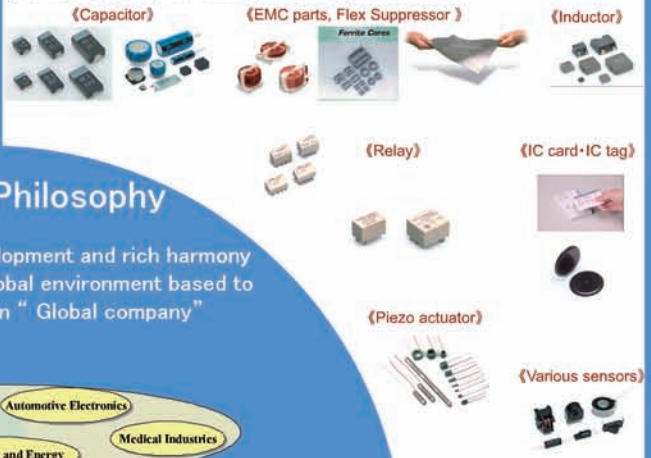
Production plants: 7 (Domestic 3, International 4)

As of March 31,2013

Factories and Products

Main product

Tantalum capacitors, Electric double-layer capacitors, EMI suppressing components, Flex Suppressor (noise suppression sheets), Power inductors, Signal Relays, Power relays, IC cards and IC tags, Piezoelectric devices, Sensors (Temperature, vibration, infrared).



Corporate Philosophy

We contribute to the development and rich harmony between people and the global environment based to the material innovation " Global company"

Main Markets

Digital Consumer Electronics | Automotive Electronics | Industrial Equipment | Environment and Energy | Medical Industries

Main Products

Capacitors
- Tantalum capacitors
- Electric double-layer capacitors
- Proadlizer

EMC Electro-Magnetic Components
- AC line filters, Flex Suppressor
- Power inductors, Transformers
- Magnets, Metals

Electro-Mechanical Devices
- Power relays
- Signal relays

NFS
- Near field communication

Access Devices
- IC cards and tags

Piezoelectric Devices
- Piezoelectric materials
- Piezoelectric actuators
- Piezoelectric transducers

Sensors
- Thermal sensors
- Electric current sensors
- HD haptics ・FFB

Core Technologies

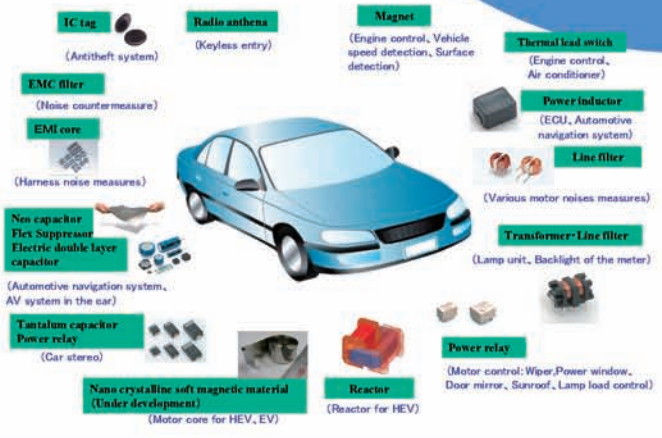
Capacitors' Materials: Tantalum | Conductive polymers | Active carbon

Magnetic Materials: Ferrite | Magnets | Metals

Ceramics: Piezoelectric materials

Expansion into Car electronics market

~To HEV core device the latest from various electrical parts , we'll propose a variety of solution~

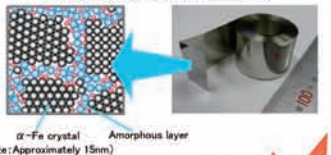


Next generation vehicles for latest items

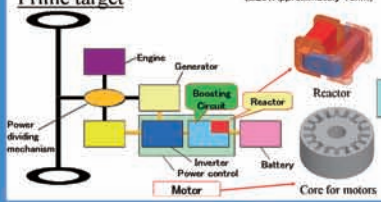
Nano crystalline soft magnetic material

What's Nano crystalline magnetic material ?

High saturation magnetic flux density &
Ultra Low Electric power loss **Nano Cristal**
Found by Prof. Akihiro Makino,
TOHOKU UNIVERSITY
We joint develop to practical use



Prime target



The contribution to the Creation of next-generation vehicles And highly efficient technology development in the Northeast

Towards a leading manufacturer of next generation

Ricoh Industry corporation Tohoku plant

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

About Ricoh Industry

■With the aim of manufacturing to provide new value creation to customers

April 2013, offering integrated part of Ricoh Co., Ltd. Production Division (Tohoku Ricoh, Ricoh Printing Systems, Ricoh Uni-techno) and series production company of three domestic, the company responsible for the domestic production of the Ricoh Group, was established as a production company.

The new company, to mobilize the power of each company so far, and not only with the product, with the aim to advanced manufacturing company that has a technology development capabilities for the next generation of new key parts, such as a new business area, the Ricoh Group to become the company's core to bolster the manufacturing of power, we will continue to strive.

《 Tohoku plant picture 》

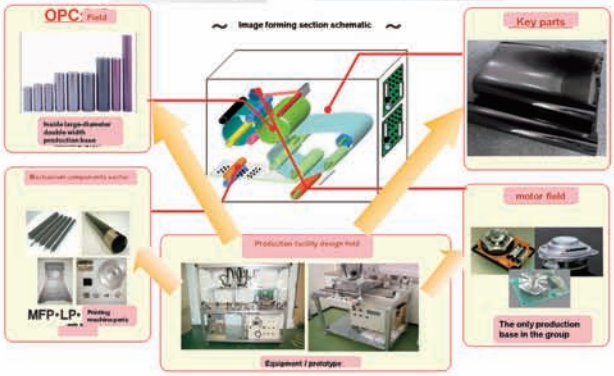
《 Ricoh brand message 》

RICOH
imagine. change.

In bringing together of imagination, we create change. We will continue to provide new value to our customers in the future.

Production items

《 printing machine》 《 copier 》



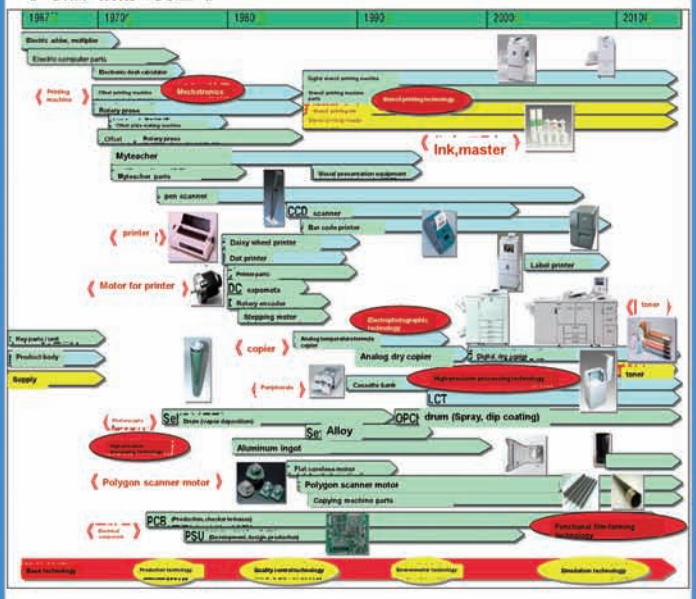
From the main body of product to parts, functions necessary for crafting gather in a northeastern establishment and I perform the action that is the concurrent that did the cooperation with the design thickly routinely, and go ahead through method of construction development, the facilities development concurrently and realize a quick mass production shift, the achievement of QCDSE, production capacity maximization.

Changes in technology (technology that has been polished)

■Production technologies that are the backbone

We always challenge the highest technology development. And, at Tohoku plant, take good care of a forward posture to go one step ahead, a new action through the production of OA apparatus connection product, main parts.

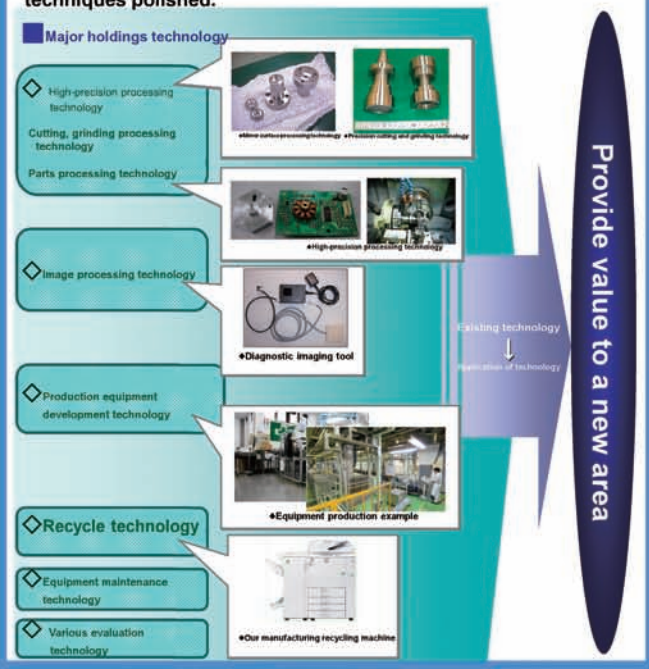
《 製品・技術の変遷 》



Aiming to create new value

■ We will continue to a new value provided to customers.

As a production function companies, not only to contribute to Ricoh group so far, and cultivate it until now from the past, we will make a new value provided to our clients on the base of the techniques polished.



Searches for five senses functional sensing

Miura sensor institute corporation

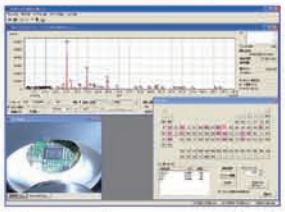
MEXT　TOHOKU ECONOMIC FEDERATION　Tohoku University　宮城県　七十七銀行　ICR

Non-contact type harmful elements detecting device

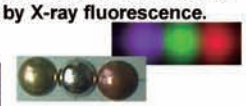
Denbee Series

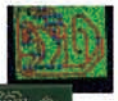
The measured immediately in a non-contact harmful elements

The inspection of RoHS Directive REACH



We can analyze the elements contained in the sample by X-ray fluorescence.





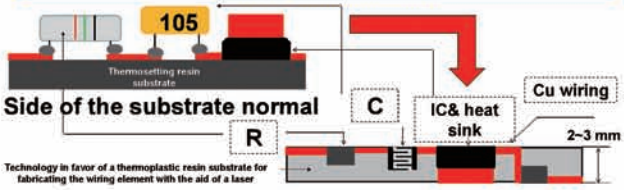
small

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.

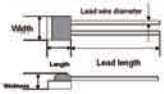
Plastic coating thermocouple line

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

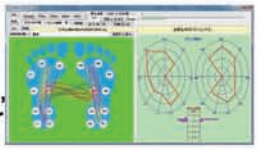
Name	M 222 platinum resistance temperature detector	
Nominal resistance	100Ω (when 0℃)	
Tolerance	German industry standard DIN EN 60751, class A	
Manufacturing standard	German industry standard DIN EN 60751 (IEC 751)	
Temperature range	Class A: − 50 ℃ ～ + 300℃	
Temperature coefficient of resistance	TCR = 3850 ppm/K	
Output wires	Platinum clad nickel wire	
	Connection methods: welding, welding, brazing	
Prolonged stability	Resistance value drift of 500 ℃ 1000 hours after the 0.04 percent maximum(※1)	
Vibration resistance	withstand 40G acceleration in the 10 ~ 2000Hz. (※2)	
Impact resistance	withstand 100G acceleration in half sine wave of 8ms. (※2)	
Use conditions	Available only dry environment.	
Insulation resistance	20℃: 100 MΩ over ; 500℃: 2 MΩ over	
Self-heating	0.4 K/mW at 0℃	
Response time	Underwater measurements (v = 0.4 m/s):	t0.5 = 0.05 s t0.9 = 0.15 s
	Air measurements(v = 2 m/s):	t0.5 = 3.0 s t0.9 = 10.0 s
Measured current	100 W: 0.3 ～ 1.0 mA 500 W: 0.1 ～ 0.7 mA 1000 W: 0.1 bis 0.3 mA (Please consider the self-heating)	

※1 (Guaranteed range of class A is 300 ℃ ~50 ℃. It is the tolerance of the Class B in the case of 500 ℃ ~300 ℃.

※2 will change by the mounting structure of the sensor

Temperature sensor

Look measured by a variety of sensors, such as the movement of the head, hands and feet, and eyes, listen, and can be feedback to their own feeling.



3 sensory feedback system

To everyone in the company

～ Make the research and prototyping and development of measurement equipment ～

We are a research-based company. We perform the construction of the optical measurement system by the materials tester by the request from a semiconductor, the machine materials maker and a university, the research institute request, device production.

〒981-3203 1－40　2 Cho-me Takamori Izumi-ku Sendai, Miyagi 21st Century Plaza Research Center 207 room
TEL : 022-374-3207　FAX : 022-772-0640
E-mail : office@miura-sensor.jp　HP : http://www.miura-sensor.jp

KTECH
K Technology Corporation

From planning, designing to manufacturing, valuation, servicing of electronic devices

K Technology Corporation

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

Core value &DMS concept

KTECHのコアバリュー

DMSコンセプト

お客様の課題をあらゆる面で解決する
ソリューション企業をめざして

Development & Design
開発・設計

- Design service from a development stage including mass production design,plan design,and the principle examination.

Manufacturing
製造

- Not only mere order production, we offer "manufacturing service" to cover until a process design to guarantee quality and plant development.

Service & Solution
サービス・ソリューション

- We offer technology& know-how that we have.

For example, product repair/analysis,reliability evaluation/inspection.VA/ CDsuggestion,product planning.

Core technique of the in-vehicle business

Development and design of products

・person experienced In-vehicle equipment design 50(an in-vehicle product and display apparatus)
・IMAGE PROCESSING /display technology/digital technology
・cabinet design/ packing design /Printed wiring board design

The quality system

・ISO/TS16949 A quality control system cultivated it with an in-vehicle apparatus product

facilities

・Including evaluation facilities, necessary facilities for securing of quality of the in-vehicle product are enriched.

Designer according to the product area

We provide a solution in accord with the needs of the customers.

We are design and fabrication company to support your manufacturing.

To the needs of the customer, we cope with the form that general and partial of great variety.

企画・構想 → 設計・試作 → 部品購買 → 信頼性評価 → 設備開発 → SMT実装 → Assy組立 → 出 荷 → サービス

Core technology

We have skills and experiences of wide product area and various product categories.

research project

- Application of energy and communication technology
- Bond magnet applied technology
- Supersonic wave skin sectional evaluation
- 3D Image processing & measurement
- Non-contact appearance analyzer
- Film crystal metal formation technology

Company Profile

Company name	K Technology Corporation
Established	April, 2005
Paid in capital	100 million yen
Net sales	¥13.0 billion (FY2011 Results)
No. of employees	634 (As of Jul 1, 2013)
Office	Head Office 325 Ganbara, Kami-machi, Kami-gun, Miyagi,Japan Tokyo Sales Office 6th Floor, Nikko Gotanda Bldg, 29-5 Nishigotanda 2-chome,Shinagawa-ku, Tokyo
Facilities area Site	205, 030 m2
Building	34, 027 m2
Scope of business	Design/development, prototyping, production and services of electronic devices.
The public certification	ISO/TS16949、ISO14001certification

To companies

～Please tell me the company's problem.～

We suggest differentiation and increasing competitiveness with other companies, by adding wide manufactural service from development to service "DMS(Development & Design, Manufacturing, Service & Solution) " has.

KTECH
K Technology Corporation

＜Head Office＞
325 Ganbara, Kami-machi, Kami-gun, Miyagi,Japan
TEL:+81-(0)229-64-1111 FAX:+81-(0)229-63-5652
URL:http://www.k-technology.co.jp/

＜Tokyo Sales Office＞
6th Floor, Nikko Gotanda Bldg,29-5 Nishigotanda 2-chome,Shinagawa-ku, Tokyo
TEL:+81-(0)3-6431-9067 FAX:+81-(0)3-6431-9068
Email:info@k-technology.co.jp

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

We propose an image inspection system of world-class

Inspec Inc.

http://www.inspec21.com/

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】

Famous cherry blossom in Kakunodate

■Image processing technology

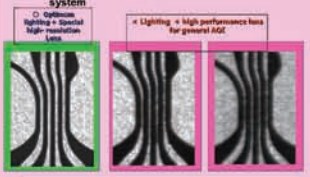
Imaging technology(camera, lens and lighting system)

17000 pixel CCD line camera

Dedicated lens

Lighting configuration example !

☆ The example of optimal imaging optical system

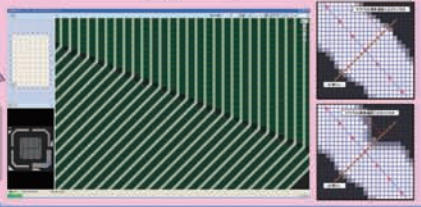


☆ Different of the captured image due to lighting conditions

Inspection algorithm (example)

☆Length measurement algorithm (most stable for the highly precise inspection of the minute pattern)

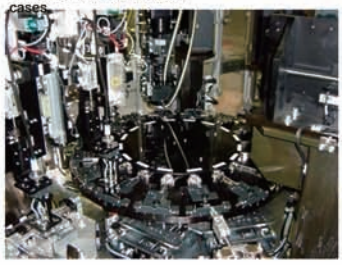
All the pattern and the space make length measurement !



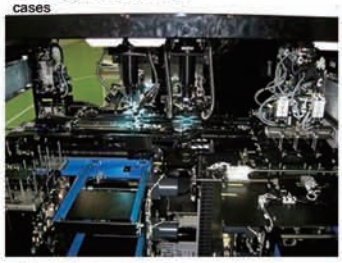
We hold all the elemental technology of the appearance tester

■Mecharonics

☆ Rotation index transport cases



☆ Straight transport index cases



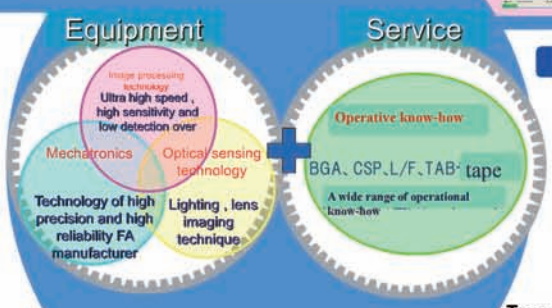
☆Examination for exact dimensions screening equipment

Parts supply from parts feeder
The inspection classification of sub-micron accuracy in digital gauge
High-speed processing by the cam drive
Inspection tact: 2 seconds / 1

☆ Bamp AOI

Jeffrey tray deck to deck Jeffrey tray
Three-dimensional two-dimensional bump + front and back

Composite inspection sorter
Inspection tact: 2 seconds / 1



The image tester development that is most suitable from thorough sample inspection

Product (element crystal technology)

Substrate AOI (SX3300)

Substrate AOI (SX1000)

Tape inspection equipment (TR3000)

BGA・CSP inspection equipment
LED mold frame inspection equipment

To all of companies

How about being considered about possibility such as the collective inspection in the state that stood in line to an examination for all quantity and the tray with the image in the in-line?

If you have a problem with examination for image, please talk to us.

【Contact】 Inspec corporation　sales department　Michiaki Tomioka
TEL : (direct)0187−52−3073　FAX : 0187−54−3195
E−mail : mtomioka@inspec21.com

Supported by high technology business that value

Altech Corporation

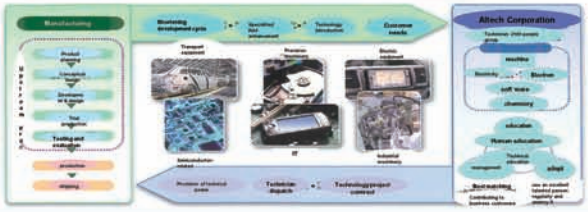
MEXT TOHOKU ECONOMIC FEDERATION Tohoku University 宮城県 七十七銀行 ICR

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

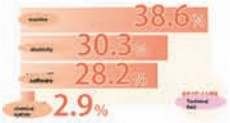
Business model



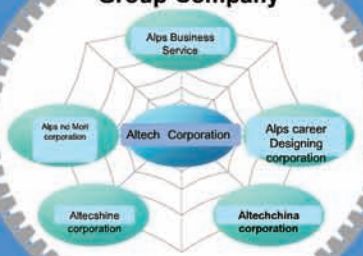
Industry client configuration

A person is the future–Next Technology Frontier

Performance of 45 anniversary

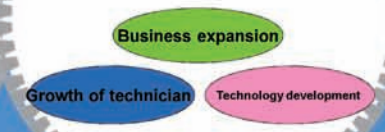


Group Company



Management philosophy

Heart to Heart



One push !

Participation in next-generation vehicles Miyagi area

We offer a ready-to human resources development

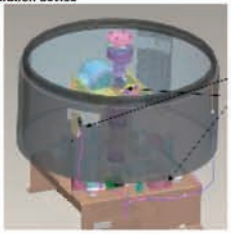
Avoiding development risk

It is most suitable in the short-term and long-term projects

Manufacturing sites that play a role in the manufacturing sector of Altech Corporation.

・Order example of test equipment

1. Cell separation equipment, centrifuge
Design of a centrifugal separation unit equipped with by a cell separation device



Unite dimension
Body : φ500 × Depth 300
Length 500 x side 500x over height 600
Centrifugal force 700G

Realization of new product development and new technology development

To all of companies

～To advance the development, the challenge of securing human resources, to training! Please consult the risk of development.～

■We aim to provide a technique that is community-based.

■Offer of technology and know-how through manufacturing.

The goal of "technology-oriented company," We aim to meet precise and quick to your needs a "manufacturing".

MG corporation

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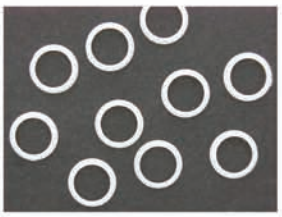
Engineering plastic modeling

Filter device
Multiple insert molding
(Assembly process omission adhesion improvement)



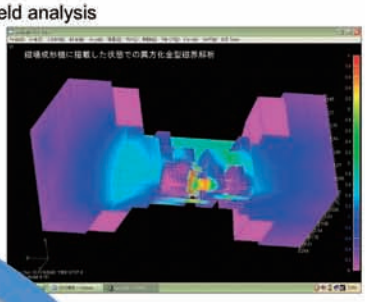
Battery parts
Thin-wall molding and ultra-high cycle molding

Automotive panel unit
- From the mold production, integrated production to molding and assembly
- Decorative processing technology, such as laser processing

Various connector

Forming & plastic magnetized

- Two-color molding and engineering plastics
- Integral molding technologies, including the shaft parts
- The magnet design and design technology magnetized by magnetic field analysis



Plastic magnet various

We aim "technology-driven company"

Technology
All the employees regard a technique as important

Search
Continuing searching for the always most suitable technique

Customer
We offer an appropriate technique Become the company pleased with by a visitor

MG corporation
〒981-0134
6－1－8 Shirakasidai Rifu
Miyagigun Miyagi
Tel: +81-(0)22-356-5571
Fax: +81-22-356-5508

JAB CM035　ASR REGISTERED FIRM ISO9001, ISO14001
We have ISO9001、ISO14001

MG Group Worldwide Network

Product Development

We perform various research and development as well as processing of plastic.

Solar dimming street light signboard

- The power generation by solar, signs will direct the emission of dimming program when it is night.
- It can be chosen dimming pattern that matches the installation scene, and increase the catch of the eye to the sign.
- It turns on even at the time of a blackout, and the charge of the cell-phone is a signboard with the publicity possible, too.

To all of companies

It aims to develop products that make use of advanced injection molding technology, responsible for the rich life of the future.

株式会社エムジー MG Co.,Ltd.

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

"Complete Support" for Miyagi Industry

Miyagi Organization for Industry Promotion

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

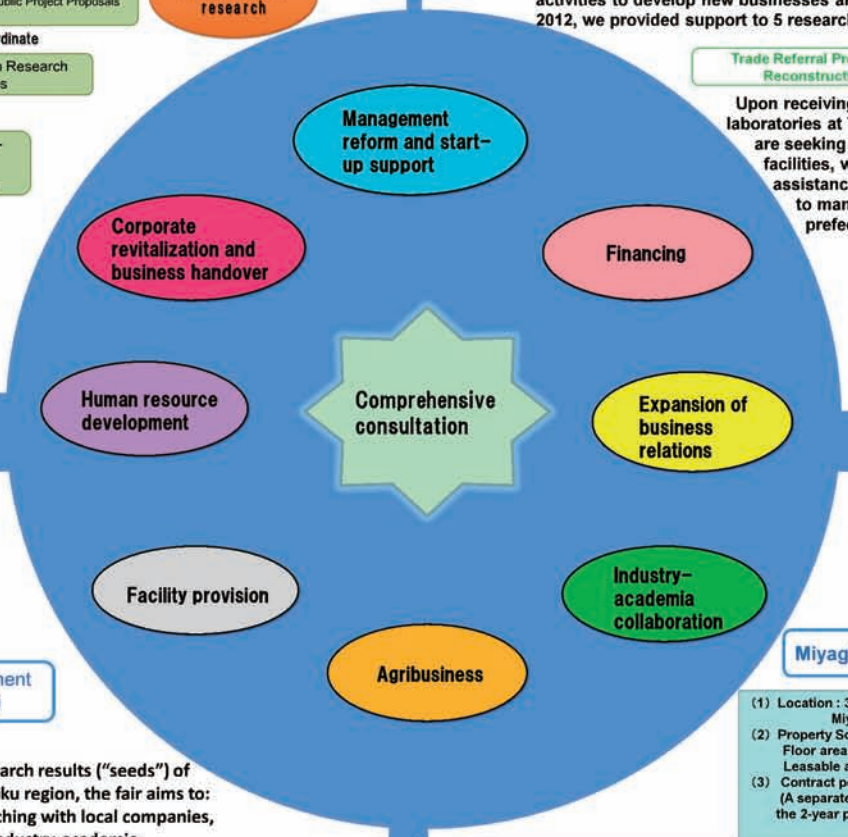
Miyagi Organization for Industry Promotion offers management entity support for competitive funds such as Supporting Industry (Assistance Project for Strategic Advancement of Fundamental Technology). In FY 2012, we offered this service for 6 projects, including ongoing projects.

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.



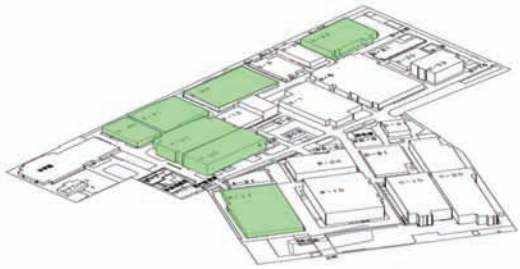
Industry-Academia-Government Collaboration Fair Miyagi

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

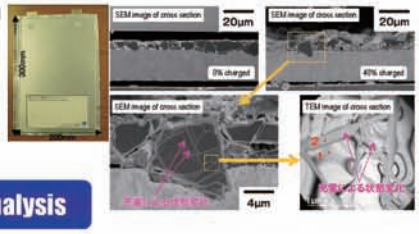
JFE Techno-Research Corporation (Tohoku Branch)

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

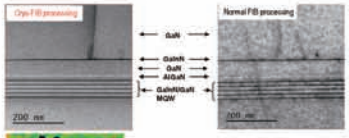

Fracture toughness test

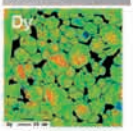

Constant load creep test facility

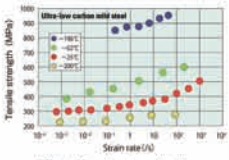
Microstructure analysis

- Evaluation and analysis of power devices and thermoelectric element modules
- Sample processing for microscopy
- Analysis of rare earth magnets
- Failure analysis of electronic components

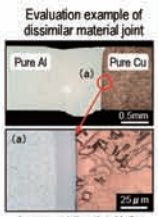

Electron microscope, ARM200F installed in dedicated laboratory



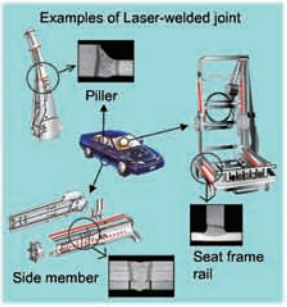

GrainMAP + DyMAP



Effect of strain rate and testing temperature on tensile strength



Laser welding for Al-Cu dissimilar material joints [Joint strength: 80 MPa]

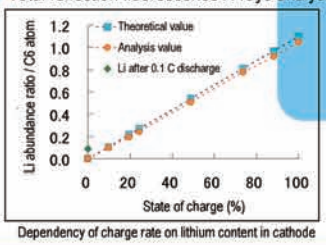


Your Best Partner for "Monodzukuri"

JFE Techno-Research Corporation is .....
A trusted company for analysis, evaluation, investigation, and examination of materials.

Trace analysis, other chemical analyses

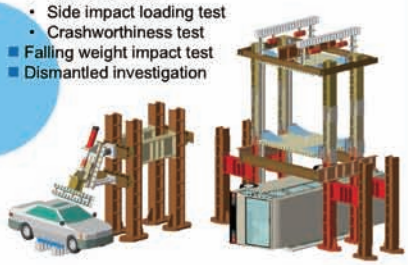
- Trace analysis, analysis of very small amounts of halogen, sulfur
- Mapping analysis by laser ablation
- Total reflection fluorescence X-rays analysis



Dependency of charge rate on lithium content in cathode

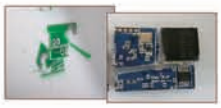
Structural performance evaluation, dismantling investigation

- Collision performance test
  - Roof crush test
  - Side impact loading test
  - Crashworthiness test
- Falling weight impact test
- Dismantled investigation



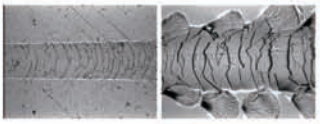
Environmental analysis

- Bad smell analysis (room air pollution) investigation
- Analysis of environmentally hazardous substances (RoHS, REACH, VOC, etc.)



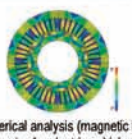
Coating evaluation

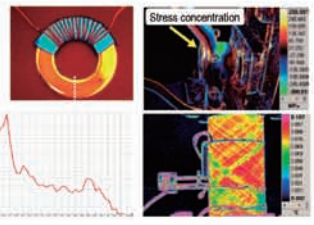
- Evaluation of coating properties of surface-treated materials,
  - Gravel meter testing
  - Coating film investigation
  - Film thickness measurement
  - Surface roughness measurement
  - Hardness measurement
- Corrosion resistance evaluation, accelerated corrosion test
  - Gas corrosion examination
  - 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 will support the manufacturing enterprise

The 77 Bank, Ltd.

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

Action to "industry-university co-operation government funds" cooperation

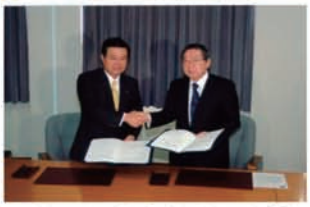
～ Cooperation with national university corporation Tohoku University～

Signed an Agreement on Cooperation with Tohoku University in January, 2007

I support problem solution about a technique and the new product development that a local company works on.

○Manufacturing individual treatment conference (technical consultation by the individual interview)

○Tohoku University laboratory tour (experience-based plan to visit the laboratory directly)



The cooperation agreement conclusion with national university corporation Tohoku University (January, 2007)

"Manufacturing individual consultation"(December,2011)

"Tohoku University lab tour" (Febrary,2013)

Tohoku University laboratory tour (February, 2013)

To everyone in the company

～ We support the "manufacturing company" by the provision of services in the financial and information surface in cooperation with an industry-academia and government agencies ～

Show of consulting and financial intermediation

"We relate to promotion of new operation of the new operation of the medium and small-sized business"

I received the authorization of "the support organization based on the ろ law such as management innovation".

(November 5, 2012 authorization)

○Business content management innovation support organizations

A delicate support in the development and implementation of business plan consultation about the business, such as matching financial and finance, business planning support, establishment support, business succession, and M & A, and analysis of financial condition.

○Management innovation support services

All branches (as long as stores offering business pertaining to the activities of loan)

To everyone in the company

～Please talk about the application support of "a manufacturing subsidy", the inquiry about "establishment of a business subsidies" and various subsidies willingly～

Profile

main building・・・3-20 3 cho-me chuo aoba-ku, Sendai

Established ・・・December 9,1878

Capital stock・・・24.6 billion yen

Employee ・・2，９２５ people

Branches ・・・142

（September 30, 2012）

77 Bank Corporation　Regional development section　Regional Development Division
〒980－8777　3-20 3 cho-me Chuo Aoba-ku Sendai
TEL：022－211－9804　FAX：022－267－5303
E-mail：chisin@77bank.co.jp

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

Efforts to the automotive industry promotion in Akita

Akita Prefecture Department of Industry and Labor
The Akita Center To Implement Vigorous Enterprises

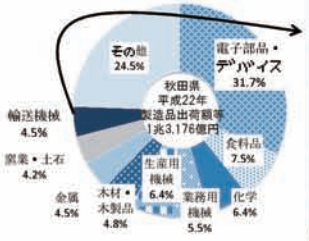
MEXT　TOHOKU ECONOMIC FEDERATION　Tohoku University　宮城県　七十七銀行　ICR

Development of Akita automotive industry promotion plan

Akita is known as an eminent agriculture prefecture, but also the integration of the electronic device industry has progressed in the manufacturing sector, we have set the automotive industry as a pillar of a new industry and establish the directionality of the action.

1. The situation of the Akita manufacturing

Industry Composition of Akita manufacturing (Manufactured goods shipments, etc.)



Attractive car company in Akita

- ○Keep about 50 percent of a share in the semiconductor field of the Toyota group.
- ○Development and production with the power supply unit of the hybrid car
- ○The sulfuric acid parent water factory of the separator nonwoven fabric for nickel hydroids batteries only in Japan
- ○Manufacture O ring for overseas makers diesels over 30 years
- ○Top share in the field of a door switch sensor
- ○Top share in the field of the car navigation embedded software

◆The leading industry of Akita is electronic device industry. Percentage is more than 30%. (The Industry composition of national electronic device industry are 6%)
◆The industry composition of transport machinery industry, Akita in less than 5% to the 19% across the country, we think that the industry has large growth potential.

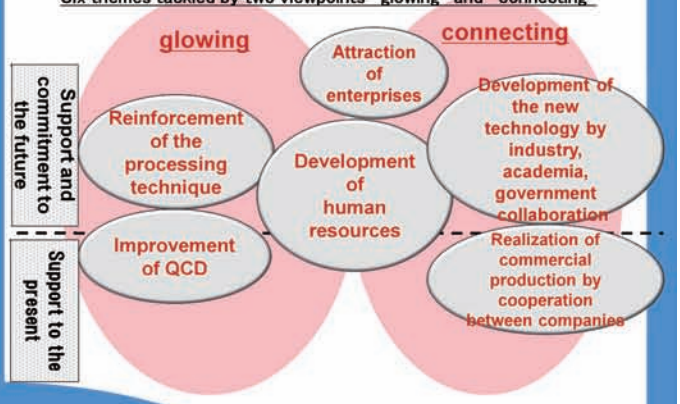
Access to a main factory

2. Figure to aim at of the plan

- ◆Improvement of QCD
- ◆Development of human resources
- ◆Reinforcement of the processing technique
- ◆Realization of commercial production by cooperation between companies
- ◆Development of the new technology by industry, academia, government collaboration
- ◆ Attraction of enterprises

Focusing on six above, All Akita Prefecture aims to become indispensable to car manufacturing in TOHOKU

Six themes tackled by two viewpoints "glowing" and "connecting"



Akita Prefecture aims to become indispensable to car manufacturing in TOHOKU!

3. Main action in the plan

(1) Support efforts to improve productivity improvement and production site(Improvement of QCD)

We carry out the guidance by the process improvement adviser intensively and improve the shop floor corresponding to a price reduction, the mass production required for the auto industry.
◆from October,2012

(2) Offered Akita automotive academy (Development of human resources)

We are training up the core talented person who can lead problem-solving of quality assurance, price reduction and mass production..
◆from August,2012(12-part series)
◆19 people 16 companies participated

(3) Seminars "Akita automobile human resource development training"

Guidance of the 2013 training course

Training Course

1. The cost management
2. QC Circle and small group activities
3. Process improvement
4. Auto parts required performance
5. Management
6. VE・VA
7. Quality management
8. Processing technique

We hold a seminar to train human resources technical capabilities, production capacity and power management required for auto industry.

Permanent exhibition of the AQUA decomposed model

- ○ 1st floor exhibition room exhibition place Akita Industrial Technology Center (4-11 Sanuki,Arayamachi,AkitaCity,Akita)
- ○ Exhibition parts Toyota AQUA (S grade) all parts (about 1,000 points)
- ○ There is no limit to limit visitors.
- ○ Contact the attendance procedures Akita Industrial Technology Center Technology Innovation Unit.

Please visit. (TEL018-862-3420)

Everyone is welcome

This exhibition is a permanent exhibition of AQUA decomposition model for the first time in the whole country.
Since we are also part loan for everyone in the company in Tohoku, Please visit.

Akita Prefecture Department of Industrial and Labor
Industrial Development Promotion Division Transportation industry group
3-1-1 Sanno, Akita City, Akita010-8570, Japan
TEL+81-18-860-2242 FAX +81-18-860-3887 E-mail induprom@pref.akita.lg.jp

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

Next generation hydrogen production process can realize Hydrogen Energy Society

Renaissance Energy Research corporation

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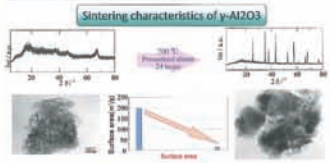
Technology 1: Heat resistant γ- alumina

Development of new carrier with a large surface area in the automotive exhaust gas condition

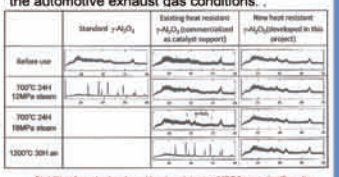
Improved heat resistance of γ-alumina

- γ-Al2O3 has a large surface, but unstable at high temperature
- γ-Al2O3 change to α-Al2O3 easily, and surface area is extremely reduced at high temperatures & humidified atmosphere.

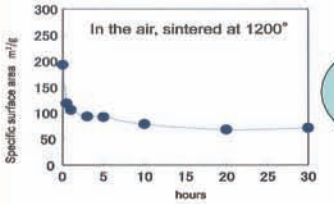
Sintering characteristics of γ-Al2O3



We succeeded in development of new catalyst support which maintain a large surface area in the automotive exhaust gas conditions. .



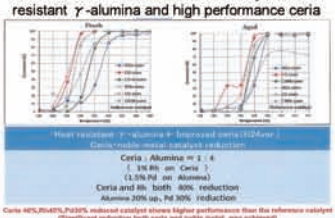
Stability of newly developed heat resistant γ-Al2O3 was significantly improved compared to the existing heat resistant γ-Al2O3.



Time-dependent change of the specific surface area of the heat resistant γ-alumina

Application to reforming catalysts for hydrogen production is promising

The noble metal and ceria reduction by heat-resistant γ-alumina and high performance ceria

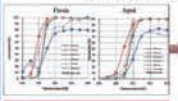


Ceria : Alumina = 1 : 4
(1% Rh on Ceria)
(1.5% Pd on Alumina)
Ceria and Rh both 40% reduction
Alumina 20% up, Pd 30% reduction

Ceria 40%,Rh40%,Pd30% reduced catalyst shows higher performance than the reference catalyst (Significant reduction both ceria and noble metal was achieved)

Technology 2:High performance ceria

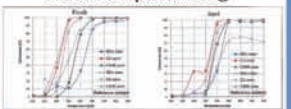
Effect of improved ceria①



Ceria : Alumina = 1 : 2
1% Rh on Ceria
2.5% Pd on Alumina

Aged catalyst shows higher performance than the reference catalyst

Effective of improved ceria②



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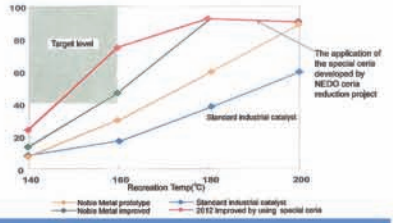
Application to new high- performance CO shift catalyst



The hydrogen production related technique which RER holds

Seeds technologies cultivated by Tohoku University and RER

- Heat resistant γ-Alimina (Technology 1)
- High performance ceria (Technology 2)
- Catalyst performance prediction software

By prevention of sintering
・Precious metal reduction
・Ni catalyst performance improvement

The high performance CO shift catalyst developed by the application of high-performance Ceria

Improve efficiency of the catalyst development and process development

Oil / Natural gas → Desulfurization Removal of sulfur → Steam reforming $C_mH_n + H_2O \rightarrow H_2 + CO, CO_2$ Produce hydrogen by reacting steam and hydrocarbon → CO Shift $CO + H_2O \rightarrow H_2 + CO_2$ Reduction of CO in the reformed gas → Purification process

Purification process
- Chemical absorption method (remove CO2) → Ammonia Methanol
- Selective oxidation (remove CO) → PEFC
- PSA (adsorption) → Hydrogen station

Complete desulfurization → Extra high performance desulfurization Desulfuize to the level of PPb

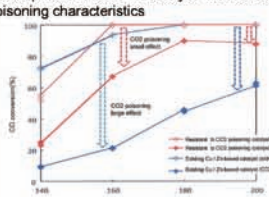
Low S/C possible / High SV possible → High performance Ru catalyst

CO conversion rate improvement → Catalyst without CO2 poisoning (Technology 3)

Energy saving of CO2 removal → CO_2 selective membrane (Technology 4)

Technology 3:CO shift catalyst with reduced CO2 poisoning characteristics

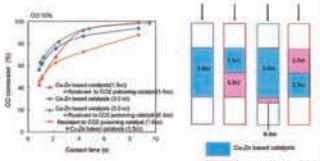
Development of CO shift catalyst with reduced CO2 poisoning characteristics



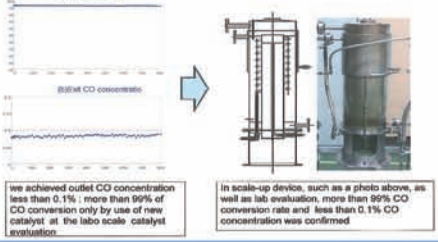
Conventional Cu-Zn based CO shift catalysts were found to be poisoned to large extent by CO2. CO2 formation is inevitable in CO shift reaction. So large amounts of catalyst was used in CO shift process.

Effect of newly developed CO shift catalyst

CO conversion rate is largely improved by using Cu-Zn based catalyst(in up stream) and newly developed catalyst with reduced CO2 poison characteristics together in downstream.



The CO reduction effect of heat exchange isothermal CO shift reactor and newly developed CO shift catalyst

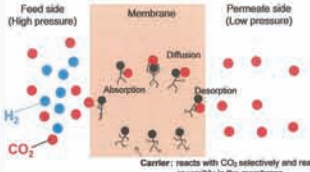


we achieved outlet CO concentration less than 0.1% ; more than 99% of CO conversion only by use of new catalyst at the labo scale catalyst evaluation

In scale-up device, such as a photo above, as well as lab evaluation, more than 99% CO conversion rate and less than 0.1% CO concentration was confirmed

Technology 4:CO2 selective membrane

CO2 Selective Membrane

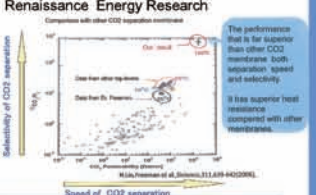


Carrier: reacts with CO_2 selectively and reacts reversibly in the membrane.

Energy of CO2 absorption to carrier covers that of CO2 desorption

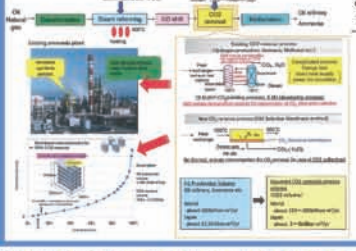
No energy consumption

Superiority of CO2 separation membrane Renaissance Energy Research



・Our CO2 Selective Membrane shows by far the best performance on both Selectivity and Permeability.

Application to Hydrogen Production w/ Reforming System



Joint venture with Sumitomo Corporation, Sumitomo chemical and Renaissance Energy Research was established to promote commercialization of CO2 membrane

2012年10月16日 日経新聞 朝刊

Renaissance Energy research can provide with one-stop service various functions required for the catalyst research, development and commercialization.

(Catalyst prototype, performance evaluation, Catalyst mass production, Pilot testing, Demonstration test, Feasibility study)

Contact : TEL : 06-6228-3111 FAX : 06-6228-3113 Email : information@r-energy.com

株式会社 岩沼精工

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

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Company Profile

NAME: IWANUMA SEIKO Co,.LTD
CEO: KOUJI CHIBA
ADDRESS: 305-3,Omatsubara Shimonogo Iwanuma,Miyagi
TEL: +81-(0)223-29-2121
FAX: +81-(0)223-29-2122
URL: http://www.iwanuma-sk.co.jp/
E-MAIL: info@iwanuma-sk.co.jp

MAIN BUSINESS:
- Mass production press
- Tool product
- Sample product
- Planning and manufacturing for production facilities
- Planning and manufacturing for mold(metal)

Paid in capital: 10,000,000 Yen
Date of foundation: April 1974
Certification: ISO9001、ISO14001
Main Customer:
- SONY Co.,LTD
- FUJITSU Co.,LTD
- SII Micro Parts Co.,LTD
- Keihin Co.,LTD
- IHI Co.,LTD

etc.

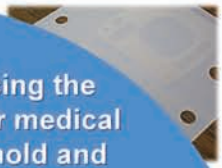
Mass production press and planning and manufacturing the metal mold

They correspond to mass production press using press processing machine(25t–110t).

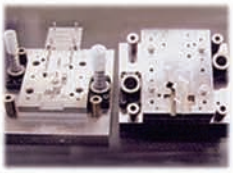
★Secondary battery for the tab

★Primary battery for tanshi

★Speaker grill for the mobile phone



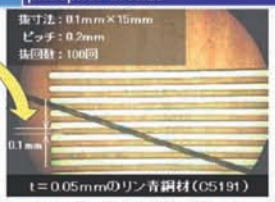
★Planning, processing and cutting-in of metal mold



We contribute to reducing the weight and down size for medical device by Light press mold and equipment technique fusion

★Slit press machine

★Example of slit process to phosphor bronze



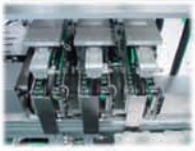
Equipment for labor saving

We contribute to the energy control by our technique

★Unloader
Tact 8sec/1sheet 200sec/
Magazine(25sheet)

★Equipment

★Magazine part



This machine can admit the semiconductor which is from a reflow furnace to the magazine

Sample processing and precision machine

Cost、Down、
Suggestion sample of precision

Technology Fusion

Laser processing, Wire discharge processing
Machining Center, Processing equipment for CNC lathe

★Minute process finishing

★Three dimensions process

★Reflective road sign and metal parts for caulking the ball

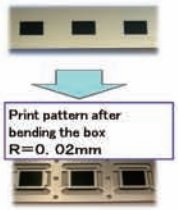
Machine for developing the new product (Support Projects)

★Press process machine development for miniature pattern precoated metal strip

★ Metal mold unit for place revision

Print pattern
R=0. 08 mm

Print pattern after bending the box
R=0. 02mm



★Developing a minute process machine (minute cutting＋minute discharging)

Process for discharging whole

φ20μm×200μm
(Super hardwood)

The precision of locating for whole with steps by front and back discharging process

Less than 1 μm

- Promote 5 themes for innovation with cooperation among industry, government and universities
- Develop and produce for original products by support project

High thermal conductivity silicon nitride substrate, heat sink material

Japan Fine Ceramics Co., Ltd.
URL http://www.japan-fc.co.jp

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Introducing Japan Fine Ceramics (JFC)

We challenge the possibility in an original technique about metal, new material fine ceramics next to the plastic as a 100% investment company of JGC Corporation.

We made use of the electrical characteristics of the various efforts actively to manufacture and sell technology development, and application development, to meet the various needs of various cutting-edge industries.

Introduction of Fine Ceramics Product

In electronic materials Division of JFC, structure materials Division, it produces various ceramics products depending on a use.

Introduction of Electronic Materials Division products :

We produced "The high-grade alumina board" which a dielectric loss is minute small and bends it in the high frequency band, and has high strength, "The microwave dielectric board" which can plan the downsizing of the circuit, "Ceraflextime -A" which is used as turning ceramics, "Ceraflextime -8Y" superior in oxygen ion conductivity"The high heat conduction silicon nitride board" which strength was high, and raised thermal conductivity, "The film integrated circuit substrate" which we attached a film by the PVD method on these boards, and formed a circuit.

Introduction of structural material Division products :

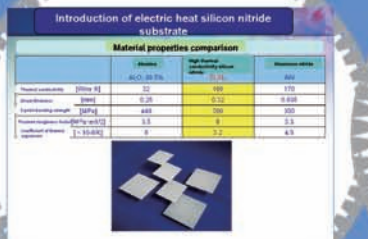
We have been produced by our original (silicon carbide, silicon nitride, alumina, Zirconia) engineering ceramic material with excellent characteristics heat resistance, wear resistance, corrosion resistance. In addition, composite materials "AMC" of metals and ceramics with (lightweight high rigidity, vibration damping) excellent properties not in the ceramic material and metal conventional materials are also produced, and to be able to meet the diverse needs of our customers are.

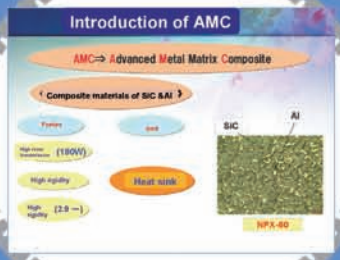
We are daily challenge and aim to material that is always better.

Introduction of high heat dissipation insulating substrate heat sink material

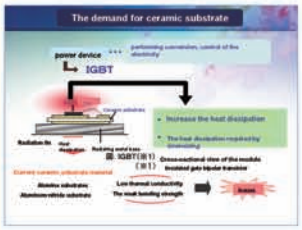
High thermal conductivity silicon nitride substrate

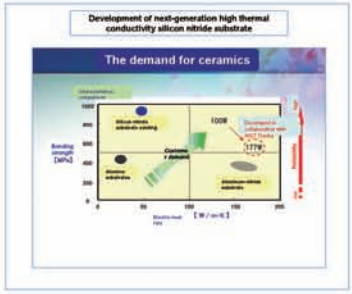
AMC (Advaced Metal Matrix Composites)





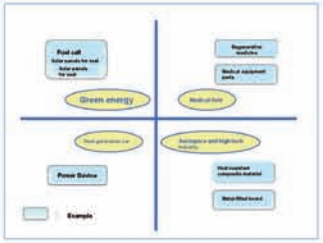
Needs of high heat radiation insulation board, heat sink materials





Technical Skill And Creation !

JFC's challenge field



To all of universities and companies

~why don't you begin an action for the next generation with us?~

Our company focus on material development.

We believe that we would like to supply the products with high originality that can be to the world from Tohoku to join forces with you.

日本ファインセラミックス株式会社
JAPAN FINE CERAMICS CO., LTD.

Engineering Department Product Development Department
Chief Shin Sato
TEL:022-378-7825 FAX:022-377-4161
Email:satousin@japan-fc.co.jp

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

" Iwate Center of Development for the Novel Human- and Eco-friendly Vehicles "

Regional Innovation Strategy Promotion Project

General Coordination Agency: Public Service Corporation Iwate Industry Promotion Center
2-4-26, Kita-Iioka, Morioka Iwate 0200857 Japan Tel:+81-19-631-3825 Email:mobility@joho-iwate.or.jp
http://www.joho-iwate.or.jp/mobility/index.html

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【Iwate Innovation Promotion Council for Next-generation Vehicles】
Iwate automotive industry Promotion Council, Iwate University, Iwate Prefectural University, Ichinoseki National Collage of Technology, Iwate Prefecture, Iwate Industrial Research Institute, The Bank of Iwate, Ltd., Kita-Nippon Bank, Ltd., Iwate Industry Promotion Center

Strategy formulation

Selected as Regional Innovation Strategy Promotion Area (international competitiveness regions)

【Iwate Center of Development for the Novel Human- and Eco-friendly Vehicles】
Along with further advancing technologies for auto industry ever accumulated in Iwate such as materials/metal working, electronic devices, information and communication, etc., we will promote cultivation of professional engineers and commercialization of projects through cooperation with industry, academia, local authorities and banks, to realize the persistent innovative region with prospective activities for vehicle innovation.

《Activity plan for the strategy realization》

①Establish & promote partnerships among industry, academia and local authorities
- assess potential of research institutes including universities (such as researcher, technical seeds, personnel training program, research equipment)
- assess potential of major suppliers (such as researcher, engineer, technical seeds, facilities) and their technical needs
- mediate ('Matching') company needs and technical seeds of research institutes relating to next-generation vehicle
- support networking among researchers and technical engineers
- enhance relationship between academia and local industry that are active in next generation vehicle development

②Promote research & development through cooperation with industry, academia and local authorities
- promote seeds-creating research and development relating to next-generation vehicle
- promote market needs-oriented joint research relating to next-generation vehicle among industry, academia and local authorities
- introduce and promote common utility of research equipments for the creation of next-generation vehicle innovation

③Cultivate human resources and disseminate the result
- cultivate R&D engineers with high skills who take key roles in enhancement of technological capability and competitiveness of local industry
- develop and offer new personal training programs for the creation of next-generation vehicle innovation

④Promote practical use and commercialization
- grasp market trends of next-generation vehicle and conduct survey global technological trends
- organize meeting opportunities, such as presentation meeting, briefing sessions of study seeds and technical needs, debriefing session, seminars, and networking events
- support IP management and the commercialization
- disseminate and conduct public relations of the result

support | Utilization

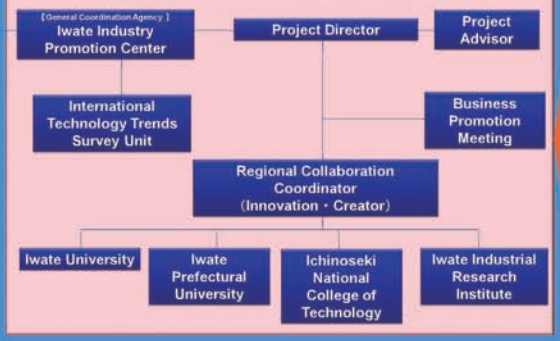
Realizing strategy through effective and comprehensive utilization of various measures of ministry (ex. Ministry of Economy, Trade and Industry) and funds from local authorities (ex. Prefectures)

《Implementing projects for strategy realization》

The Regional Innovation Strategy Support Program
(recovery assistance to The Great East Japan Earthquake disaster-stricken area),
National Government Support (Ministry of Education, Culture, Sports, Science and Technology)

① establish knowledge networks to cooperate in the region (arrange regional collaboration coordinators and support their activities)
② find researchers (invite and support their activities)
→ for the priority research area (materials/advanced processing technique, electronic device, information and communication) and promote joint researches among industry, academia and local authorities
③ develop and offer new personal training programs
→ program for individuals focused to creation of innovation (research and technology coordinator, technical expert of manufacturing and software merging EV design engineer)
④ promote sharing research facilities (arrange technical support staff and support for the public use of research equipments)

《Project Promotion System》



Committee | Assessment | External

Cultivating of human resources for the continuous next-generation vehicle innovation.

Developing new projects for next-generation vehicle continuously.

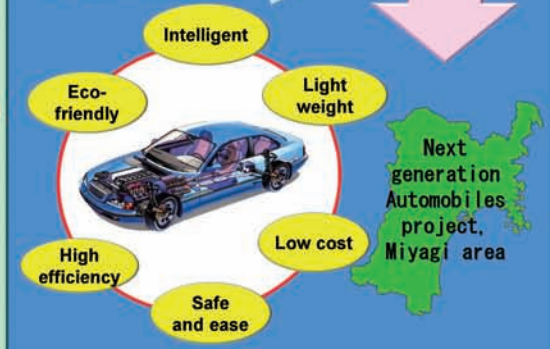
Project Vision

- Create advanced vehicles challenging the future after disaster of the Great East Japan Earthquake
- Realize the Center of Excellence for the development of next-generation vehicles
- Transform to the community reliable and indispensable to automakers

From 'Study seeds-oriented' to 'Social need-oriented and problem solving innovation'

Regional technology innovation guideline (March, 2010 Iwate Prefecture)

Cooperation



continuous innovation | Great East Japan Earthquake, and creating | Realizing the recovery from the disaster of

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

Challenge to the frontier companies in the field of magnetic transmission

Prospine Co.,Ltd.
http://www.prospine.jp

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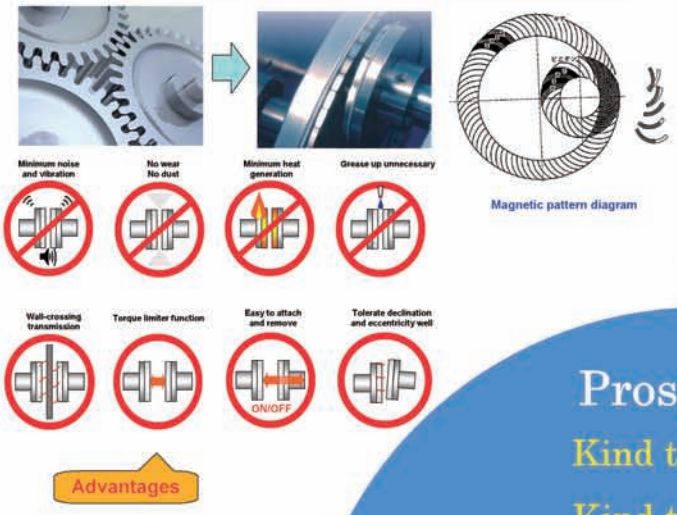
Trend toward "non-contact power transmission"



Magnetic pattern diagram

Advantages

Introduction of Prospine's original magnetic products

Magnetic gear

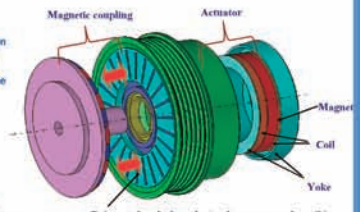
Non contact magnetic gear transmission ratio of 1:4

Orthogonal magnetic coupling

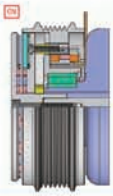
1:1 ratio magnet coupling facing a cylinder magnet and a disc magnet orthogonally (commonly known as magnetic miter)

Magnetic clutch

Position self-maintaining clutch based on non-contact mechanism: Energy saving clutch which changes the on/off actions when only applying current by turning the on/off switch.



Drive tooth yoke board: Apply current to the coil in the actuator, and turn the clutch on and off by sliding from side to side



Prospine is

Kind to people !

Kind to things !

Kind to the globe !

We continue to pursue further unit parts

Contribution to the environment and the energy saving

Non contact type clean roller

Application sample for magnetic miter and coupling

Non contact type belt conveyor

Bottom of a lake exploration robot

Applications

- Semiconductor manufacturing equipment
- Clean roller
- Robot
- Clutch & Brake
- Transmission
- Stirrer

To everyone in universities & companies

~We design and provide custom-made products according to your product specifications.~

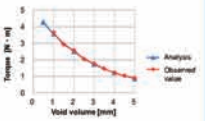
Contact: Prospine Co.,Ltd. Sales department: Ikeda , Sato

Attention !

Technology of magnetic field analysis simulation

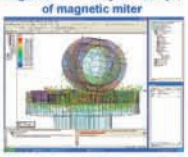
(Cooperation with Industrial Technology Institute, Miyagi Prefectural Government)

Correlate over 90%



Analysis of magnetic torque coupling and its result

Magnetic field analysis example of magnetic miter



Analysis of magnetizing yoke and the york itself

Topics

World first

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

Prospine Co.,Ltd.
117 Azashinsenkarita Tsugihashi Matsuyama Osaki, Miyagi 987-1305
TEL: 0229-55-3375　FAX : 0229-55-4350

Our Key word is Speed! We aim for competitive manufacture.
KYOYU CO.,LTD.

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Company profile

【Company name】KYOYU CO.,LTD. 【Established】May,1980 【Paid in capital】88,880,000 yen 【No. of employees】109 (As of July, 2013)
【President】Tokumi Hatanaka
【Scope of business】Precise mechanical component
The design and assembly for automatic machines
【Certification】ISO9001・ISO14001・AS9100

Tackles by local relationship

～Collaboration between Designer and Artisan and Manufacture company～

The luxurious aluminum material shaped "S" Sendai's initial are coated with Tamamushi lacquerware which has vivid colour and lustre. (Our company take charge of cutting.)

※The photo is a replica.

≪Production Design≫
The Interior Designer lives in Sendai
Mr. Kouichirou Kimura

Aerospace Business

"Combustion test apparatus specimen"

Materials : SUS・Cupper alloy
Electron beam welding(by cooperative company)
(Consent to photograph:JAXA Kakuda Space Center)
Furthermore, we deliver precise cutting products to engine makers and equipment makers.

・3D-CAD
(Installing CATIA V5)

AS 9100 BUREAU VERITAS Certification

・The international standard JIS Q 9100

KYOYU

We challenge high extra value industry, with the core technology we experienced electrical devise business.
We are skillful in hard-to-cut material and precise cutting, so manufacture products which can respond needed by customer, with the production of many kinds in small quantities.
Our slogan is "The key word is speed", we construct 24H/D,7days/W including Saturday and Sunday, standardized from parts on through to finished products. Therefore, we aim to shorten delivery time.

Core Technology

Home Information Appliances

From design to product die and mold and auto machine, based on a precise cutting technique. We are capable of being made consistent from machine processing to evaluation with 3D CAD with original Data-base.

Automobile business

"Divided punch part of stamping die"
Materials and Thickness:SPC440・t=1.0
Die condition:10process progressive die

・The first product cost is 90% or less than conventional die and mold. (For ability to change process method)
・The running cost is 50% or less than conventional die and mold.
・Using holder and blade edges materials are properly usable. (Proper materials can be used each other.)
・Blade edge can be exchanged by only removing stopper.

Controlling whole factory by production management system

In 2006-2007,we succeeded development and practical applications of low cost and excellent durability stamping used die and punch, helped by Strategic generic technology advancement support project (supporting industries).
This product was accredited as third "MONO excellent Miyagi ".

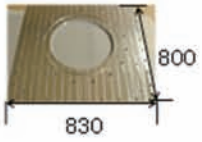
Before After

(Consent to photograph:Toyota Motor East Japan, Inc.)

Semiconductor manufacturing apparatus related business

"Product testing device "

"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 E-Mail info@kyoyu.jp

Embossed carrier tape and electronic component manufacturing

OKURA Industry Co., Ltd.

http://www.okurainc.co.jp

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Embossed Carrier Tape deep drawing

Optimum various molded method, supported by production facilities in depth product variant-diaphragm. In addition, it supports the shape to prevent telescoping product of deep drawing.

•Shape:insertion site (20mm×22mm) deepest part(21.6mm)
•Material: A-PET (W=32mm t=0.5mm)
•Use: On-board electronics parts

• Shape:insertion site (14mm×15mm) deepest part(18.3mm)
• Material: PS (W=24mm t=0.5mm)
•Use: On-board electronics parts

• Shape:insertion site (10mm×19mm) deepest part(17.8mm)
【antiskid eqquiped】
• Material : PS (W=32mm t=0.5mm)
•Use: On-board electronics parts

Achieve a low-cost fast delivery to mass production carrier tape design, mold design and manufacture by house production facilities (line 140 in Japan and China). It also available in taping process, the final step further.

Electronic component manufacturing

Design and development - mold making - prototype - mass production - secondary processing - Packaging - Shipping We are equipped the integrated production system up.

Actual
[Integrated production of narrow-pitch micro connector

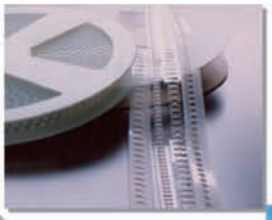
Housing unit
Precision plastic mold
Design and manufacture
processing-Terminal part
Precision press dies
Design and manufacture
processing-Assembly
(housing + terminal)

The embossed packing the finished product

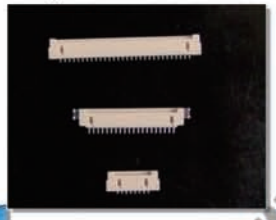
Dispatch

Special shape embossed molding technology Precision molding technology

Embossed Carrier Tape



Narrow pitch micro connector



OKURA INDUSTRY Co., Ltd.

大倉工業(蘇州)電子有限公司

大倉電機(東莞)有限公司

Film sheet slit

Sheet slitter equipment

Including the carrier tape sheet, and cut with high precision a variety of synthetic resin / paper film and sheet. In addition to the sale of the sheet slit goods, to cope with the slitting of bringing material.

The achievement to low cost and short delivery date processing with company design, production facilities

【 Company design facilities 】

Embossed Carrier Tape Manufacturing equipment

Center hole drilling and Inline image inspection apparatus

Traverse (spiral) Winding device

Slit products

(PS、PET Sheets
※Carrier tape
W = 8～72mm
T = 0.3～0.5mm

(Paper sheet)
W = 100mm
T = 0.1mm

(Urethane foam)
W = 60mm
T = 1.5mm

HeadOfiice 〒985-0854
46-3 Niidanishi, Tagajo, Miyagi, Japan 985-0854
TEL:+81-22-368-5836
FAX:+81-22-368-5508

Matsushima Factory
131-107 Uchihibiki, Kawakudari, Higashimatsushima, Miyagi, Japan 981-0304
TEL:+81-225-87-4330
FAX:+81-225-87-4001

Naruse Factory
131-107 Uchihibiki, Kawakudari, Higashimatsushima, Miyagi, Japan 981-0304
TEL:+81-225-86-1681
FAX:+81-225-87-4641

大倉工業(蘇州)電子有限公司
中国江蘇省蘇州市高新区何山路399号
TEL:+86-(0)512-6807-5876
FAX:+86-(0)512-6807-5873

大倉電機(東莞)有限公司
中国廣東省東莞長安烏沙江貝村新南路第三工業區
TEL:+81-(0)769-8509-1910
FAX:+81-(0)769-8509-1920

SME Innovate in Next-Generation Automobiles

ASTER Co., Ltd.

http://www.ast-aster.com

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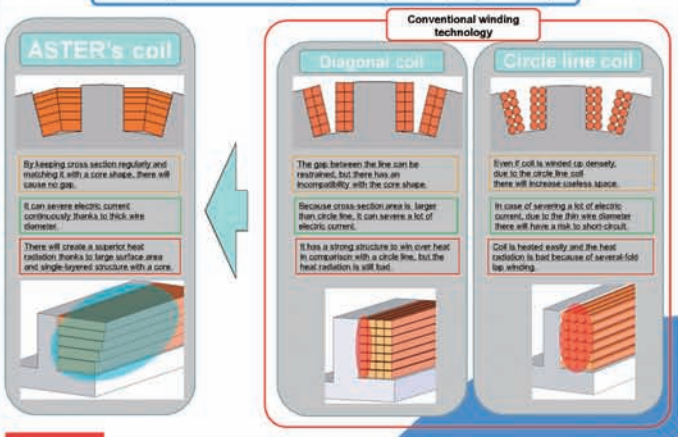
Development of the high efficiency motor (super motor)



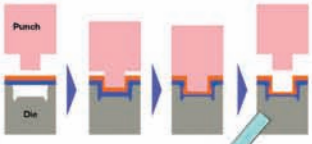
Performance

We can achieve a good balance between the compact and high power by improving space factor, heat radiation and voltage resistance.

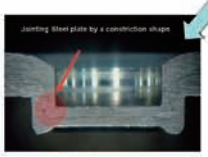
Productivity

We can product high efficiency motor with short process by using slot-in method.

Development of swage joint device for car steel plate

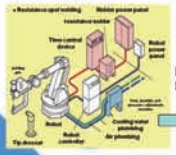


By flowing the steel plate to the die side by a punch, it can be jointed mechanically. So it is easy to joint various different kind of metal such as high-tension steel plate, stainless steel, copper, aluminum with low cost and energy conservation.

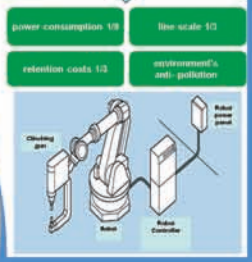


Point

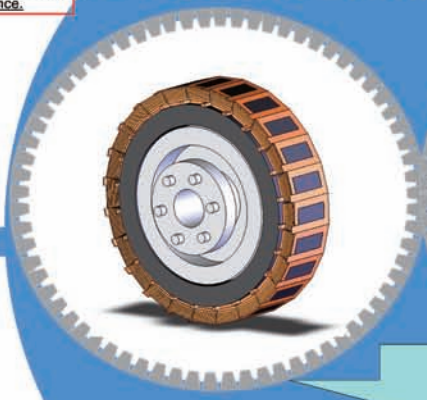
① High endurance strength to dynamic load.
② Jointing more than three pieces is possible.
③ Jointing multiple points simultaneous with 1 shot is possible.
④ Board thickness is available from minimum 0.2mm to maximum 4.0mm.



From an existing spot welding line to swage joint line



Power train section

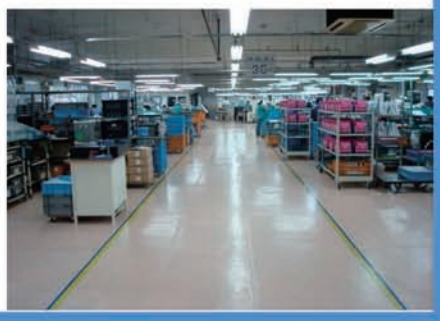


Body section

We propose to next generation automobiles in full scale

Company profile

- Company name ASTER Co., Ltd
- Established January 2010
- Paid in capital 5,000,000 yen
- Employees 70 persons
- President Takenori Hongo
- Business description
  - Car-related parts production
  - Production and sale of the industrial equipment device
  - Production and sale of LED lighting equipment
  - Production of beauty equipment
- Certification ISO 9001
- Ministry of Economy, Trade and Industry
  SME advanced manufacturing certification 2 times (in 2012 and 2013)
- Number of patent applications 5 applications
  (including one application of international patent)
- Number of design registration 1 registration



LED light

Desk lighting Spoon Light series
Fluorescent tube lighting EnaBlight series
High-intensity lighting (25W～1000W) Takumi series

We are developing above 3 series according to application.
Regarding Takumi series, wide range of needs for custom-made from factory lighting to shipboard lighting are available.

Contact
Mail furuyayt@ast-aster.com
Tel 0182-24-1377 (rep.)
Fax 0182-24-0611

Now is made for the future

Automotive Components and Systems

Perfecting the Art of Electronics

ALPS

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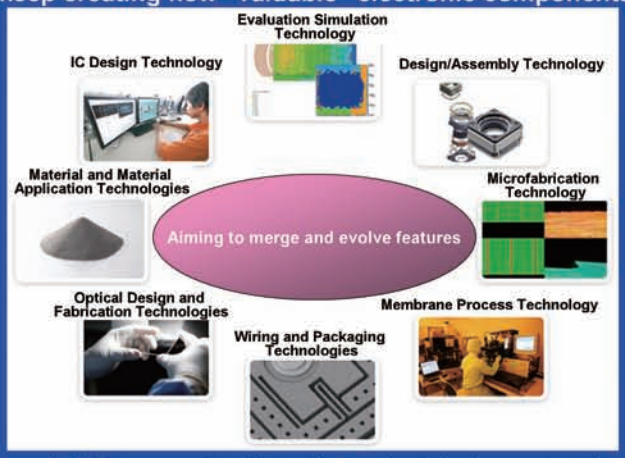
Business Fields

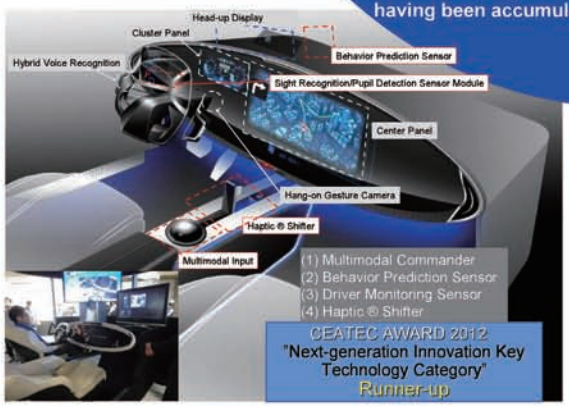
Human Machine Interface (HMI) Products

Evolving and merging unique technologies to keep creating new "valuable" electronic components



ALPS keeps creating "valuable" products that are unrivaled in the industry by merging "process technology" and "material technology" that support functional devices as well as uniquely evolved "mechatronics technologies" having been accumulated for many years.

With newly proposed "value" merging advanced technologies with proven functional devices, ALPS' "Next Generation Premium CockPit" won the Runner-up at CEATEC JAPAN 2012.



Next Generation Premium Cockpit

Vehicle Interior Interface Products

Head Office: 1-7, Yukigaya-otsukamachi, Ota-ku, Tokyo, 145-8501 Japan
Furukawa Plant: 6-3-36, Furukawanakazato, Osaki-city, Miyagi-pref 989-6181 Japan
Phone: +81 229-23-5111 Contact: Masami Terakubo, Business Planning Department
http://www.alps.com

Perfecting the Art of Electronics

ALPS

Efforts for Embedded Industrial Promotion of Miyagi Prefecture

META: Miyagi Embedded Technology Association

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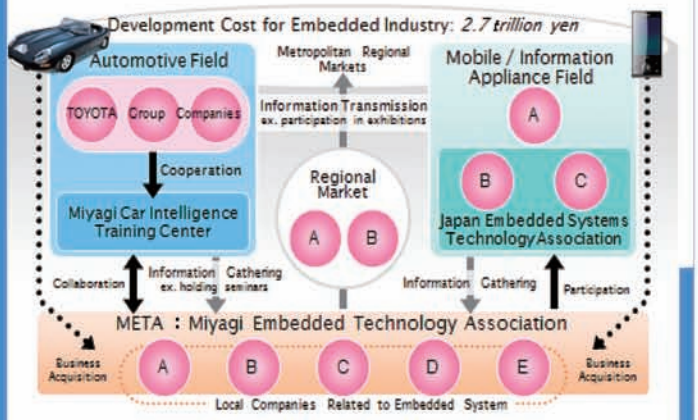
① META: Miyagi Embedded Technology Association



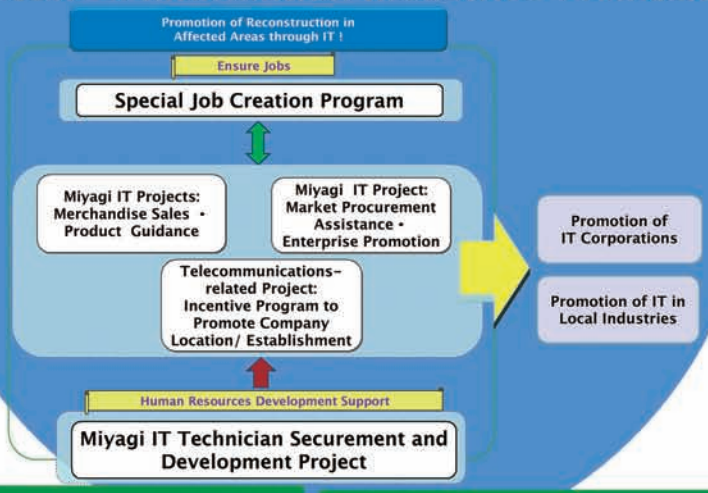
② Technical Show & Exhibition Support

ET2012 TOHOKU Pavilion Display For 7 Consecutive Years

At the Yokohama Embedded Technology Exhibition we have exhibited the "TOHOKU Pavilion" in cooperation with numerous embedded technology-related companies and organizations in the Tohoku (northeast Japan) region.
8 companies participated from the Miyagi Embedded Technology Association and we have made presentations for 7 consecutive years. Approximately 5,851 visitors have come to the pavilion.

One-Stop Service by Miyagi Prefecture's Information Industries Promotion Division

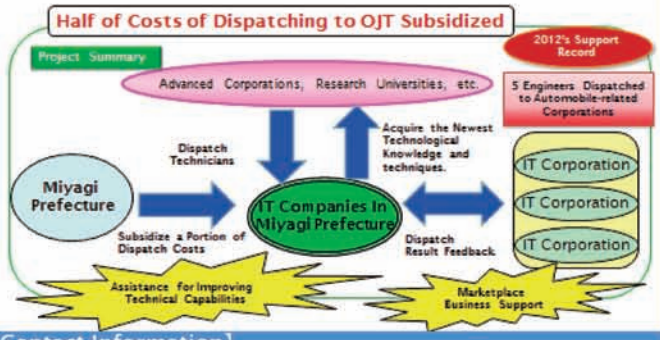
"Towards Recovery! Never Give Up Miyagi!



③ Dispatch OJT Support Project

We support the dispatching of technicians to universities and advanced corporations (Ex Automobile-related corporations, Tohoku University) to have them acquire the newest techniques and technical knowledge .

Can Supply a Maximum of 2 million Yen per Business



④ Human Resource Development Support

Cultivating Miyagi IT technicians for careers in the prospective high-growth industries of advanced electronics and automobiles

1. Enterprise support in developing human resources: Training at the Industrial Technology Institute, Miyagi Prefectural Government

1) Primary Level: Trainees learn basic technical skills necessary for the development of new employees
2) Intermediate Level: Trainees learn technical skills for business solutions
3) Embedded System Technical Seminar: Contents of seminar include the latest information required by companies.

2. Developing practical, advanced human resources: Miyagi Embedded Technology Association (META)

1) Hold human resource development seminars for those entering the auto industry and other fields.
2) Hold "Kumikomi-Tekijuku" practical exercise course via satellite to support Miyagi development of "System Architect" embedded software development
3) Hold "co-design implementation exercises" (Kansai Cooperation) for implementation and design reinforcement of technicians corresponding to the fusion of hardware & software

3. Miyagi Car Intelligent Human Resources Development Center

Develop the next generation automobile industry workforce by fostering comprehension and skills in hardware , automobiles, electronics market dynamics and IT electronics, marketplace dynamics, IT and more

4. Local Human Resources Development (Special Job Creation Program)

Human resource development in diverse fields -software, embedded tech., animation, mobile, etc.

【Contact Information】
META : Miyagi Embedded Technology Association
(Organizer : NEC Software Tohoku, LTD.)
1-10-23, Ichibancho, Aoba-ku, Sendai, Miyagi 980-0811
TEL: 022-215-5653　Fax: 022-215-5665
Email: kumikyo@kumikyo-miyagi.org

Information Industries Promotion Division
Miyagi Prefectural Government
Miyagi Prefectural Government Office (3F government office)
3-8-1, Honcho, Aoba-ku, Sendai, Miyagi 980-8570
TEL: 022-211-2479　Fax: 022-211-2496
http://www.pref.miyagi.jp/soshiki/jyoho-i/

Pursuing the Ultimate Cross-media Advertising

ADOX
Digital Image Creations

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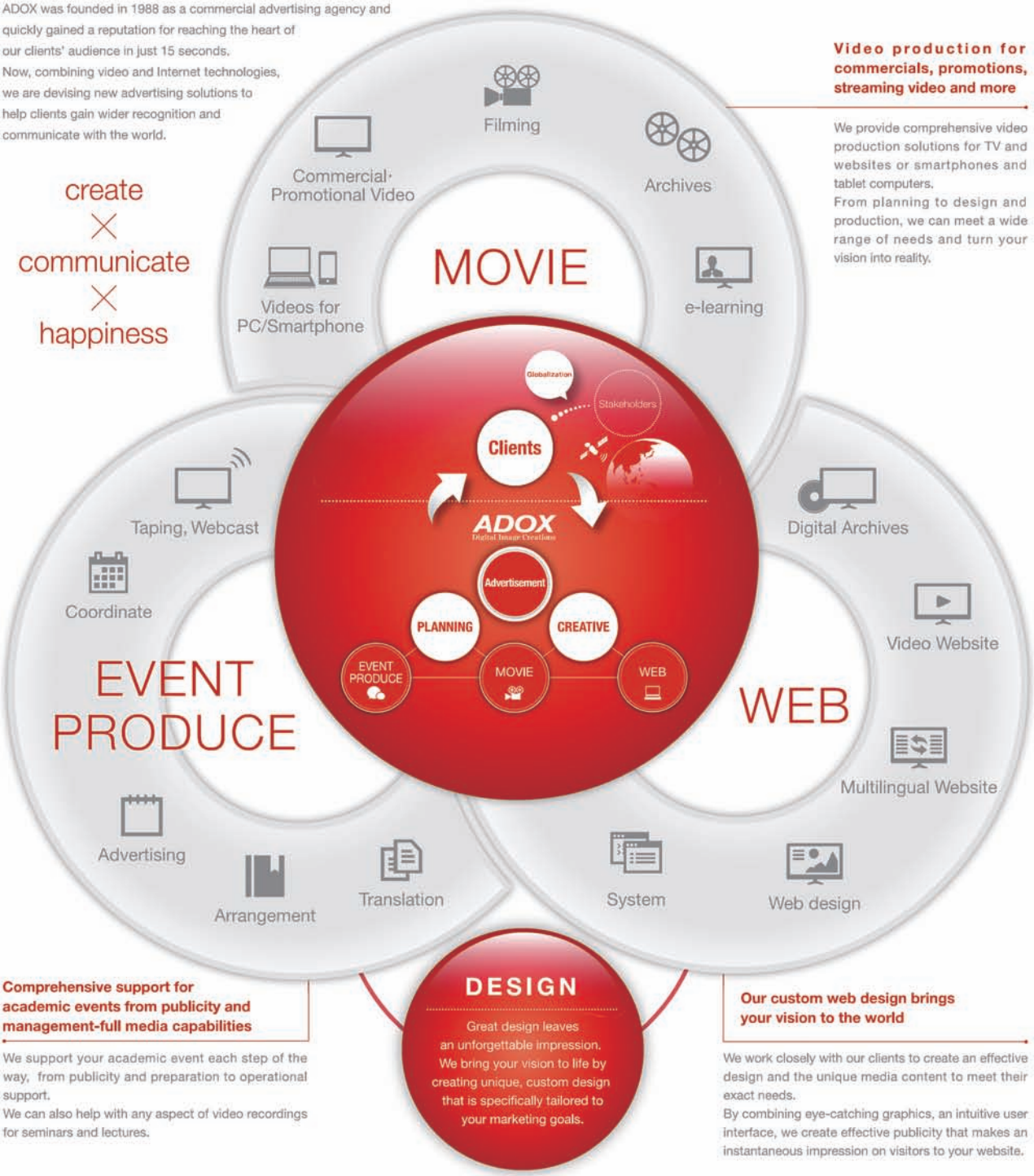
ADOX was founded in 1988 as a commercial advertising agency and quickly gained a reputation for reaching the heart of our clients' audience in just 15 seconds.
Now, combining video and Internet technologies, we are devising new advertising solutions to help clients gain wider recognition and communicate with the world.

create × communicate × happiness



Video production for commercials, promotions, streaming video and more

We provide comprehensive video production solutions for TV and websites or smartphones and tablet computers.
From planning to design and production, we can meet a wide range of needs and turn your vision into reality.

Comprehensive support for academic events from publicity and management-full media capabilities

We support your academic event each step of the way, from publicity and preparation to operational support.
We can also help with any aspect of video recordings for seminars and lectures.

DESIGN

Great design leaves an unforgettable impression. We bring your vision to life by creating unique, custom design that is specifically tailored to your marketing goals.

Our custom web design brings your vision to the world

We work closely with our clients to create an effective design and the unique media content to meet their exact needs.
By combining eye-catching graphics, an intuitive user interface, we create effective publicity that makes an instantaneous impression on visitors to your website.

≪ Contact us ≫
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TOKYO: F&F Royal Bldg, 2-4-6 Kanda-Awajicho, Chiyoda-ku, Tokyo, 101-0063, JAPAN
TEL +81-22-261-9481
WEB SITE http://www.adox.co.jp MOVIE SITE http://cue-tv.net/

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

Recycle spent Organic Solvents & Alcohols by Distilling
Contribution to Resource Circulation Society

MITSUMARU Chemical Corporation
http://3maru.co.jp/mitsumarukagaku.htm

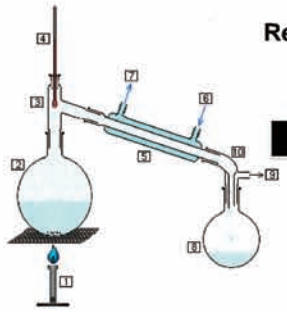
MEXT | TOHOKU ECONOMIC FEDERATION | Tohoku University | 宮城県 | 七十七銀行 | ICR

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

Plant Apparatus & Key Technology

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

"Various Chemical Analyzer "

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

Realization of Resource Circulation Society

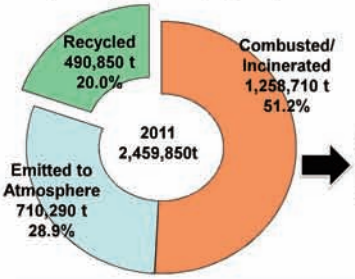
Contribution to Vast Majority of CO_2 Reduction & Resources Circulation

Application Development of Existing Technology

Biomedicine Reagents Production & Commissioned Analyses

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.

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

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

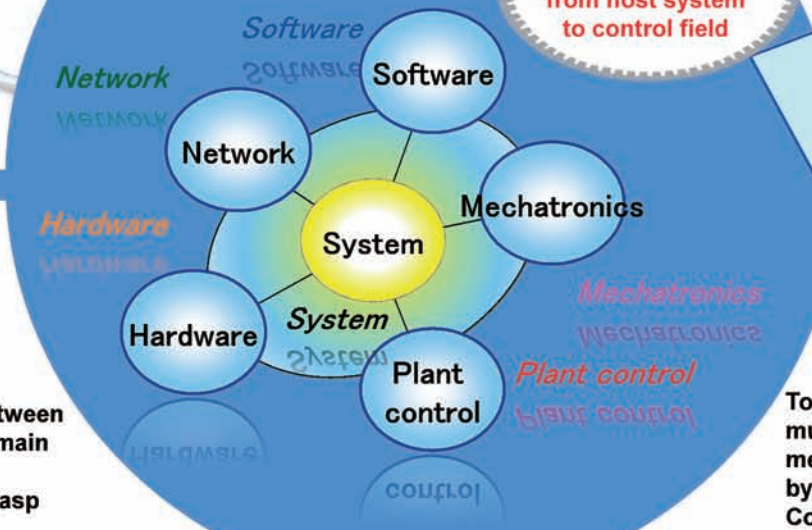
◇Speedy suggestion & specification
- ・Offering variety of solutions & know-hows
- ・Suggesting with being on the customers' stand

◇Machine design / Manufacture

◇PLC / Instrumentation
- ・Technology modifying Equipment old to new
- ・Machine control (Various motor & sensors)
- ・Analog measurement

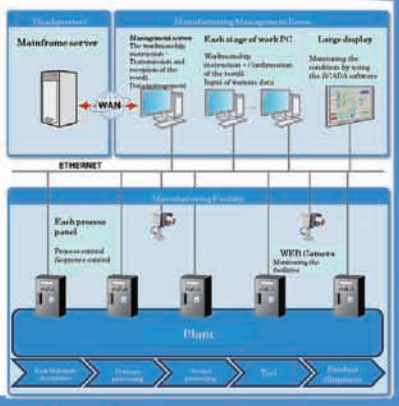
◇PC / Communication technology
- ・SCADA (Graphic, Animation, and Trendy graph)
- ・Making database of manufacture history
- ・Peripheral equipment device cooperation (Two-dimensional cord, RFID)

Core Technology



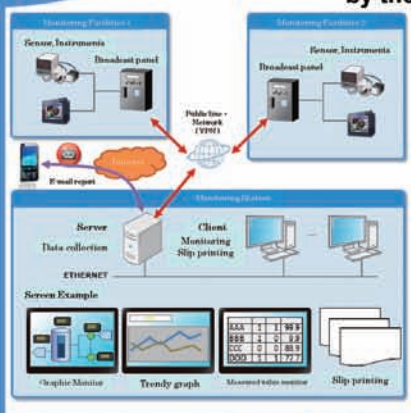
FA System (Factory Automation)

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.




株式会社 エンジニア・サイエンス
5-18-7 Yamatomachi, Wakabayashi, Sendai, Miyagi, Japan 984-0042
TEL +81-22-782-3307／FAX: +81-22-782-3304


International Presentation

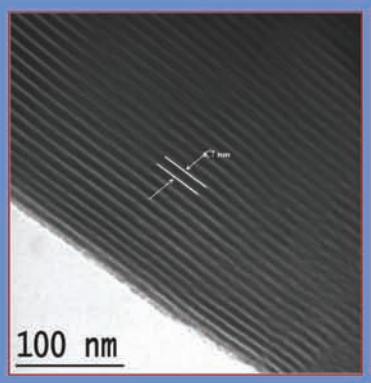
Hydrogen Storage / Solar Hydrogen / Fuel Cell / Exhaust Emission

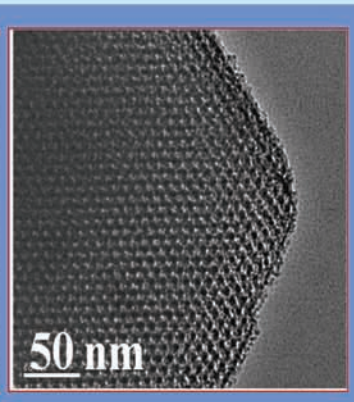
NANOPOROUS AND NANOSTRUCTURED MATERIALS

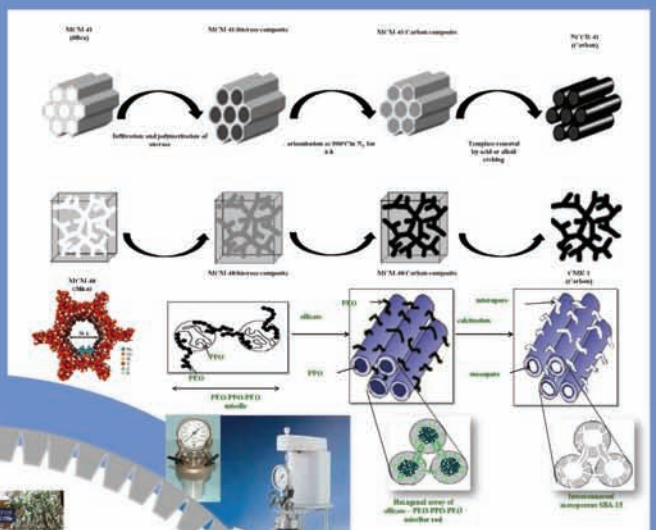
National Centre for Catalysis Research (NCCR)

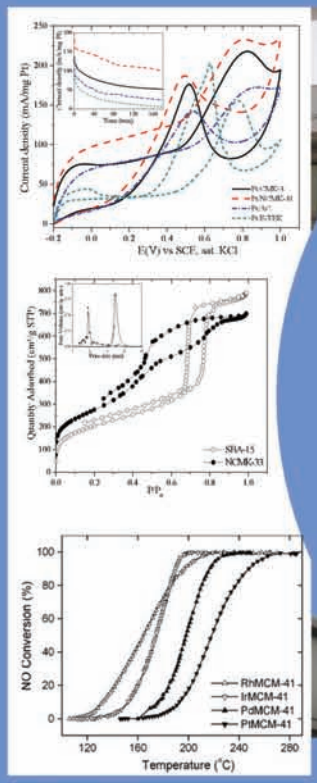
Indian Institute of Technology-Madras, Chennai 600036, India

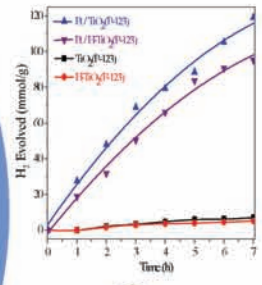
Supported Mesoporous Silica / Carbon / Titania as Photocatalyst / Electrocatalyst / Automotive Exhaust Catalyst

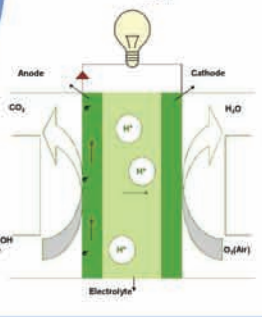


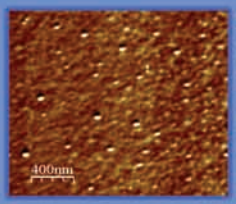


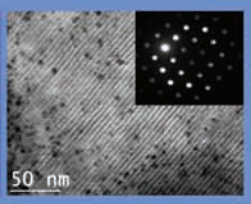


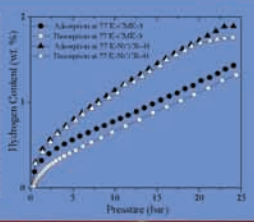


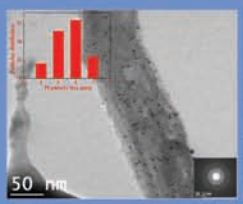










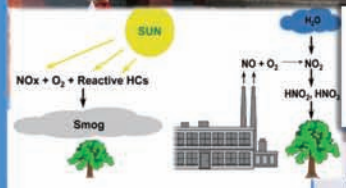


Catalyst (20 wt% Pt/Carbon)	Pt Crystallite size, (nm)		EAS (m^2/g)	Onset potential (V)	Current, i (mA/mg Pt)		Activity loss (%)		i$_f$/i$_i$
	XRD	TEM			0.5 V	0.7 V	1 h	3 h	
Pt/NCCR-41	4.7	5.5	62	0.16	84	156	44	63	1.50
Pt/CMK-3	4.2	3.6	84	0.12	103	199	47	68	1.33
Pt/SBA-15	4.0	3.7	90	0.09	154	251	24	35	1.39
Pt/NCCR-11	4.8	5.0	71	0.14	91	170	44	73	1.56
Pt/CMK-1	5.2	4.8	65	0.15	73	169	38	73	1.44
Pt/E-TEK	5.7	5.0	64	0.12	64	136	73	85	0.72

NH_3-DeNO$_x$ performance of the composite [Fe-Beta + Fe(Mn)-MCM-48] catalyst: Combining SCR activity and NH_3 oxidation activity for NH_3 slip removal

Zelinsky Institute of Organic Chemistry, Moscow, Russia; Indian Institute of Technology-Madras, Chennai, India

Alexandr Y. Stakheev, Dmitry A. Bokarev, Alina I. Mytareva, Rajesh K. Parsapur and Parasuraman Selvam

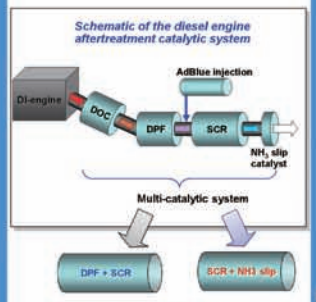


C. Baukal
Metal Finishing
103, 2005, 18
NO$_x$ Effects

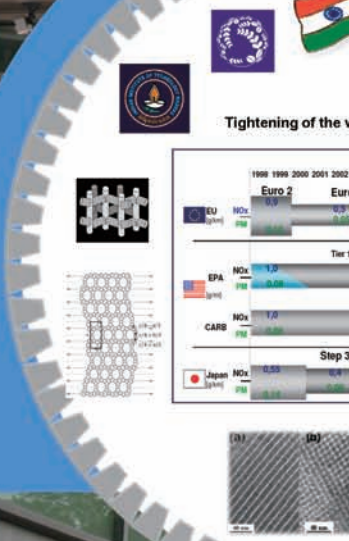
How NO$_x$ is Controlled?

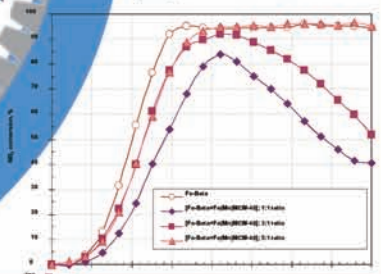
Catalytic Reduction of NO$_x$ to N$_2$

- *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





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.

TARGET

- ✓ Good soot oxidation performance
- ✓ High NH3 DeNOx activity (including T_{react} < 250°C)
- ✓ NH3-slip function is desirable
- ✓ Limited volume