Integrated Research Center for Sustainable Energy and Materials

Institute of Industrial Science,
The University of Tokyo

2018–2019

Integrated Research Center for Sustainable Energy and Materials, Institute for Industrial Science 2018–2019

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Introduction

International research center for realizing a sustainable society by integrating of materials engineering and energy engineering

The Integrated Research Center for Sustainable Energy and Materials (IRCSEM) was established on April 1, 2016 as a brand-new research center. This center consists of four units, with ten principal investigators belonging to the center as core members. From April 2018, the members of the Collaborative Research Center for Energy Engineering have newly joined and the range of activities has expanded.

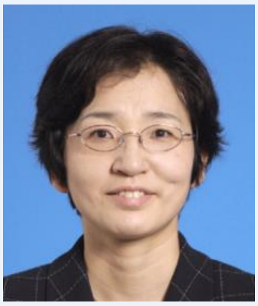
To realize a sustainable society, the recycling of resources and materials and the highly efficient use of energy are essential. IRCSEM is the first platform in Japan to scope the fusion of the research fields of energy engineering and materials. It promotes cutting-edge research and development on the advanced use of energy and resources, circulation of resources and materials, and innovation of material and system with low environmental load, by collaborating with other research institutions around the world.

IRCSEM fosters human resources of the next generation in conjunction with the Endowed Research Unit for Non-ferrous Metal Resource Recovery Engineering (JX Metals Endowed Unit) established in the Institute of Industrial Science, and related industrial sectors.

Director
Toru H. Okabe

Core Members


Director
Toru H. Okabe,
Professor


Deputy Director
Naoko Yoshie,
Professor


Hiroyuki Inoue,
Professor


Keiichi Edagawa,
Professor


Naoki Shikazono,
Professor


Takeshi Yoshikawa,
Associate Professor


Shunsuke Yagi,
Associate Professor


Shuji Owada,
Visiting Professor


Katsunori Yamaguchi,
Visiting Professor

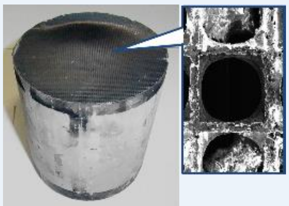

Atsushi Shibayama,
Visiting Professor

Research Units

Resources/Materials Recycling Unit:
Design of Resources/Substances/Materials Flow and Process Control

- ➢Process development based on international material flow
- ➢Analysis of generation, immobilization and recycling of hazardous substances
- ➢Development of recycling processes for exhaustible resources
- ➢Improvement of production technologies for base materials
- ➢Development of highly-efficient electrolytic smelting processes

Members: Prof. T. H. Okabe, Assoc. Prof. S. Yagi,
Visit. Prof. K. Yamaguchi, Visit. Prof. A. Shibayama



Recovering of PGMs from automobile scraps

Energy/Resources Efficient Utilization Unit:
Base Engineering for a Low Energy Consumption Society

- ➢Solution growth of eco-semiconductor SiC and AlN using alloy solvent
- ➢Determination of economic indicators for energy and materials market
- ➢Improvement of power density and reliability of solid oxide fuel cell
- ➢Development of novel heat technologies for heat engines and heat pumps

Members: Prof. N. Shikazono, Assoc. Prof. T. Yoshikawa

Direct observation of high-temp. interface during crystal growth

Advanced Substances/Materials Design Unit:
Materials Engineering for Maximized Utilization of Resources/Substances

- ➢Design and fabrication of polymers and glasses with a reduced environmental load
- ➢Development of chemical technologies for biomass utilization
- ➢Mechanical properties of environmentally sound materials
- ➢Development of novel high-efficiency thermoelectric materials

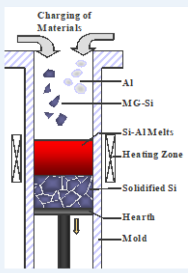
Members: Prof. N. Yoshie, Prof. H. Inoue, Prof. K. Edagawa

Melting of simulated waste borosilicate glass

Establishment of Social Implementation Promotion Unit:
Strong Cooperation with Industry

- ➢Development of ultra-long-life materials
- ➢Atomic-scale optimization for prolonging materials lifetime
- ➢Optimization of waste treatment of huge amounts of structural materials
- ➢Establishment of recycling technology for socially valuable materials

Members: Professor (under consideration), Visit. Prof. S. Owada



Solidification refining process for solar grade Si

(As of April 1, 2018)

Missions

Social Backgrounds

It is crucial to realize a low-energy consumption / highly recycling-based society, and to reduce resource-consumption and environmental loads on a global scale.

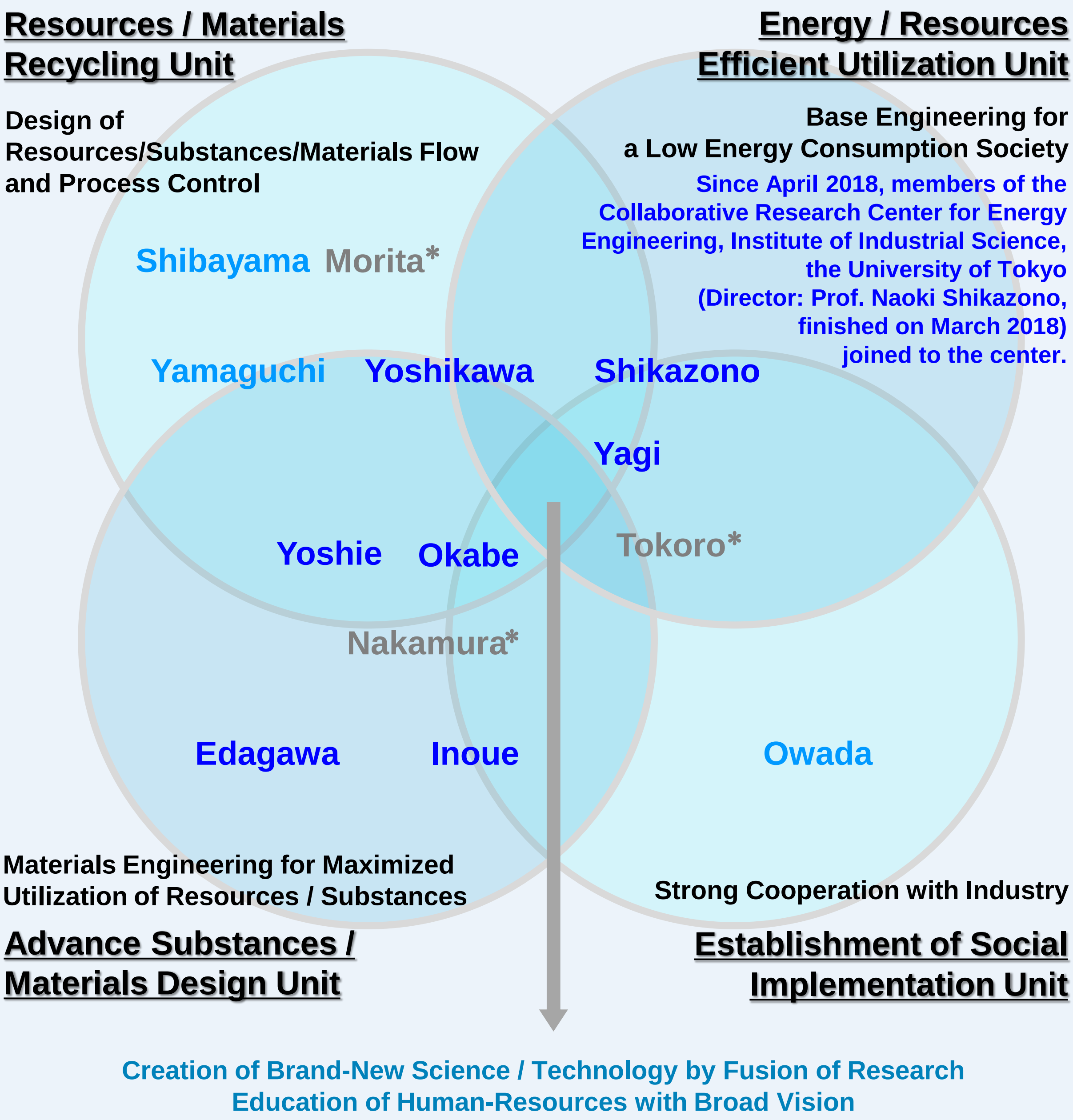
Visions

IRCSEM serves its roles as a world-leading international research center using its accumulated worldwide research network with a new focus on solving energy problems.

Research and Development / Education and Social Collaborative Activities

- ✓ Design of resources / substances / materials flow and control process
- ✓ Base engineering for a low-energy consumption society
- ✓ Materials engineering for the maximized utilization of resources / substances
- ✓ Establishment of strong-cooperation with industry
- ✓ Promotion of internationally cooperative research / suggestions and education of global human resources for the establishment of a highly sustainable society
- ✓ Industrial collaboration, promotion of the implementations of research achievements, and adult's education of personnel in industrial sectors
- ✓ Out-leach of importance of energy, resources, and materials to public domain

Research Structure / Fields



* Cooperative Researcher

Laboratories

Okabe Laboratory

Resource Recovery and Materials Process Engineering

Future Materials : Titanium, Rare Metals

Changing Rare Metals to “Common” Metals !

Okabe Lab. is focusing on research into new production processes for reactive metals and environmentally sound recycling technologies for rare metals, based on “Future Materials : Titanium, Rare Metals” as the keywords.

Environmentally Sound Recycling Process for Rare Metals

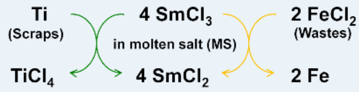
Recycling technologies for low-grade Ti metal scraps utilizing molten-salt-based reactions

Fabrication of aviation parts using Ti alloys usually involves a material loss of up to 80-90%.

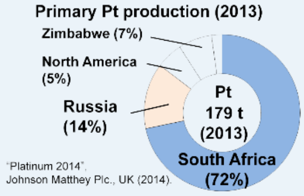
O and Fe removal from Ti is very difficult.

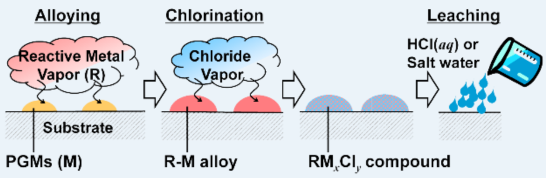
“Electrochemical deoxidation”
Oxygen dissolved in scrap was removed by electrolysis in $MgCl_2$.

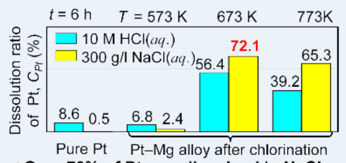
“Reaction-mediator-based chlorination”
$TiCl_4$ was effectively recovered by combining Ti scrap and chloride waste.



Dissolution process for PGMs using alloying and chlorination







⇒**Over 70% of Pt was dissolved in NaCl aq.**

New recycling technology of Ni-based superalloy scraps utilizing molten metals

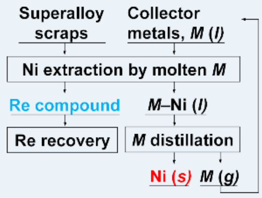
Main Re application : Turbine blade
Re-added Ni-based superalloy is used

[ref] Honda Motor Co., Ltd. webpage

Re is one of the rarest elements in the world

Environmentally sound recycling without toxic waste generation has been investigated.

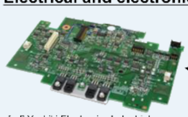
- Metal extraction using low-melting metal as a collector
- Separation and refining of rare metals based on chloride volatilization



No toxic waste generation

Novel Cu refining technique using chlorination

Main Cu application : Electrical and electronic products



Printed board : Cu film is used as electronic circuit

[ref] Yoshiki Electronics Industrial Co., Ltd. webpage

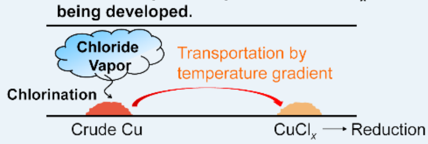
Electrorefining

[Ref]http://www2.edu-ctr.pref.okayama.jp/

Electrochemical reaction occurs only on the surface of electrolytic cells

Many electrolytic cells are needed to compensate the low productivity of this method

Novel Cu refining technique based on chemical vapor transportation of $CuCl_x$ is being developed.



Cu separation from impurities by distilling Cu chloride

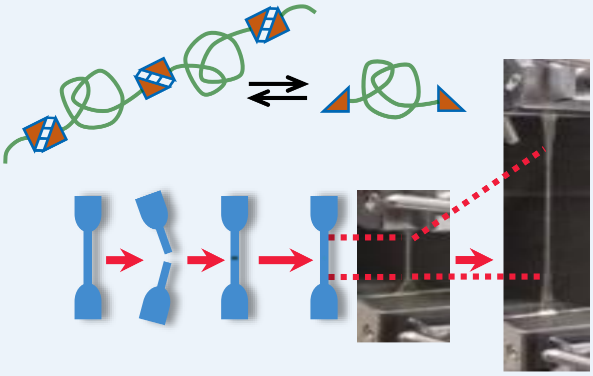
Yoshie Laboratory

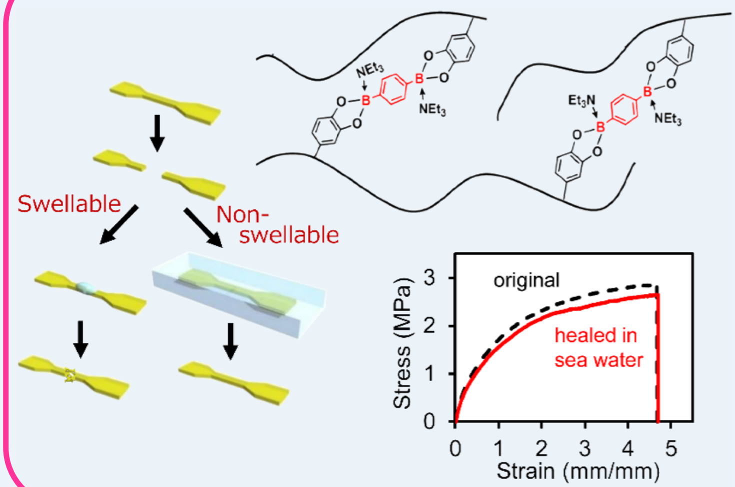
Polymeric and Environmentally Conscious Materials

Materials Developed using Polymer Dynamics

Polymers with Dynamic Bonds

Polymers with novel environmental functions are developed by using dynamic bonds such as reversible covalent bonds and hydrogen bonds. Through dynamic controls of the polymer multi-level structures, various polymers with novel functionalities such as hard/soft conversion, self-healing, tough elastomers and shape memory.

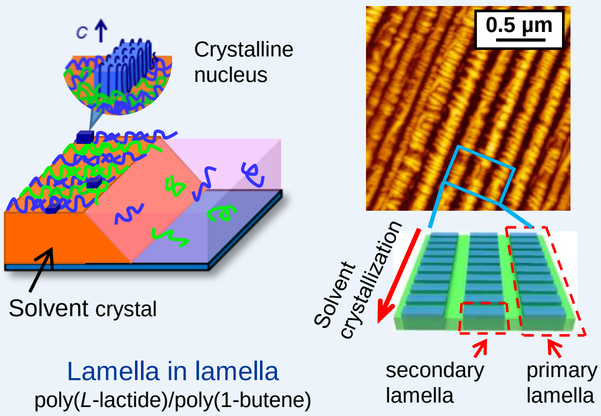




Much focus has been taken into polymers healed by ubiquitous stimuli. They include polymers healed with the assistance of water swelling of the damaged area. However, such polymers often suffer from swelling-induced mechanical instability. Recently, we have developed a non-swellable polymer that can heal under seawater. Dynamic crosslinking of catechol functionalized polymers with *p*-phenyldiboronic acid through non-ionic boronate ester bonds is the key to realizing these two properties simultaneously.

Nano-ordered Patterns by Polymer Blends

We successfully obtained a long-range ordered nanoscopic lamellar morphology in polymer blends. Solidification, directional phase separation and structural freezing in the blends are induced instantaneously by solvent crystallization. This method using polymer blends instead of block copolymers may serve as a low-cost facile way to produce nanoscale lamellar orientation in thin films.



Lamella in lamella
poly(*L*-lactide)/poly(1-butene)

Inoue Laboratory

Amorphous Materials Design

Gas Levitation Furnace and Glass

Materials Design of Amorphous and Liquid States

We study the materials from an amorphous state to a liquid state. Atomic and electronic structures of the amorphous and liquid states have not been well understood. We study the method in order to understand these materials, and apply it to a variety of materials. Moreover we will produce novel materials and their applications.

◆ Computer Simulations of Amorphous and liquid States

Novel Titanium/Manganese Redox flow battery

Ti(III)/Ti(V) Mn(II)/Mn(III)

Charge: ←, Discharge: →

Anorde

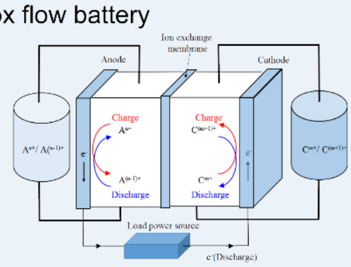
$Ti^{3+} + H_2O \rightleftarrows TiO^{2+} + 2H^+ + e^-$

Cathode

$Mn^{3+} + e^- \rightleftarrows Mn^{2+}$

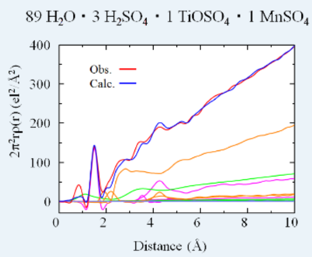
Unstable Mn^{3+}

$\boxed{2Mn^{3+} + 2H_2O \rightleftharpoons Mn^{2+} + MnO_2 \downarrow + 4H^+}$



A schematic diagram of a redox flow battery

・Total correlation functions
・Molecular dynamics simulations



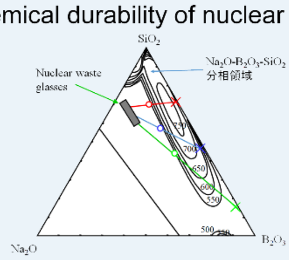
The experimental and calculated total correlation functions

◆ Chemical Durability and Phase Separation of Nuclear Waste Glasses

Control of the chemical durability of nuclear waste glasses

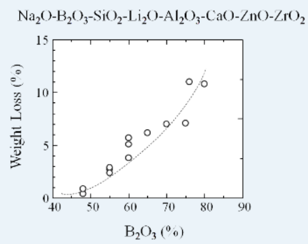
Nuclear waste glass

Composition	wt (%)	mol (%)
SiO_2	49	54
B_2O_3	15	14
Na_2O	10	11
Li_2O	3	7
CaO	3	4
Al_2O_3	5	3
ZnO	3	3
FP	12	4



$10Na_2O \cdot 50B_2O_3 \cdot 40SiO_2$

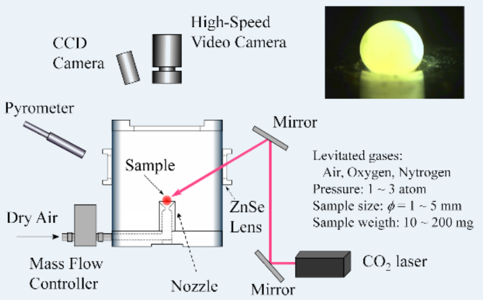

SEM photograph after phase separation and elution

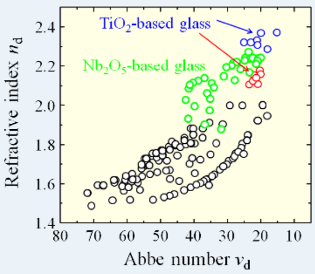


Weight loss after phase separation and elution

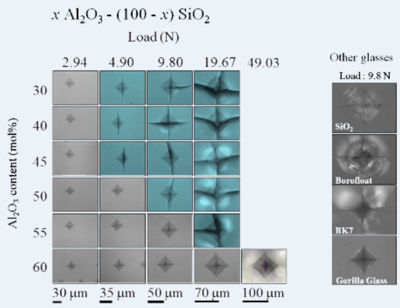
◆ Glasses prepared using a gas levitation furnace and their physical properties

Gas levitation furnace





Refractive indexes of the glass prepared



Mechanical properties of the glass prepared

Edagawa Laboratory

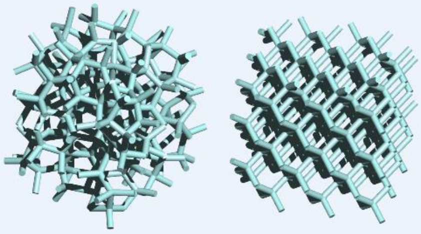
Mechanical Properties of Solids

Order in Atomic Arrangement and Physical Properties of Solids

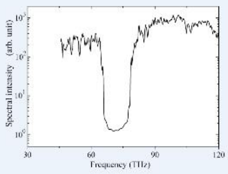
Order in Atomic Arrangement and Physical Properties of Solids

If we look into solids microscopically, we find that atoms are arranged in some ordered manner. Microscopic structures in solids can be classified in view of the atomic order into three groups: periodic structures (crystals), quasiperiodic structures (quasicrystals) and amorphous structures. Such atomic orders often determine the macroscopic properties of solids. We aim at elucidating the relation between the microscopic structure and macroscopic physical properties of solids, and also at developing new materials with desirable properties using the information obtained through such studies.

◆ Development of random network photonic devices
Discovery of an amorphous structure exhibiting a 3D photonic band-gap



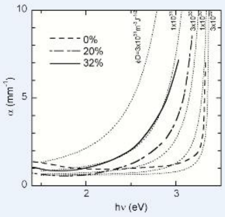
Photonic amorphous diamond structure and photonic crystalline diamond structure



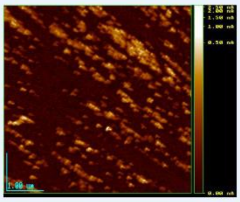
Photonic density of states calculated by an FDTD method

Fabrication of photonic amorphous diamond structure in a microwave regime

◆ Physical properties of dislocations in semiconductors

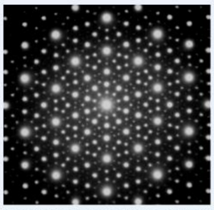


Change in optical absorption spectra by plastic deformation



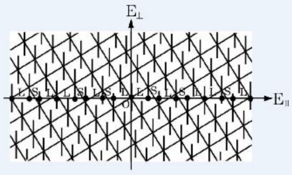
Conductive spots on surface of GaN introduced by plastic deformation

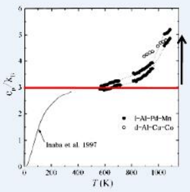
◆ Phason dynamics in quasicrystals: Elucidation of origin of physical properties inherent to quasicrystals



Electron diffraction pattern of Al-Cu-Fe icosahedral quasicrystal with the incident beam parallel to a fivefold axis

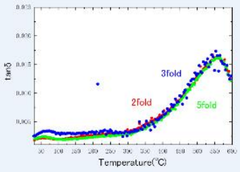
An example of a 1D quasicrystalline structure described as a section of a 2D periodic structure





Braking of Dulong-Petit's law in high-temperature specific heat

Measurement of high-temperature internal friction



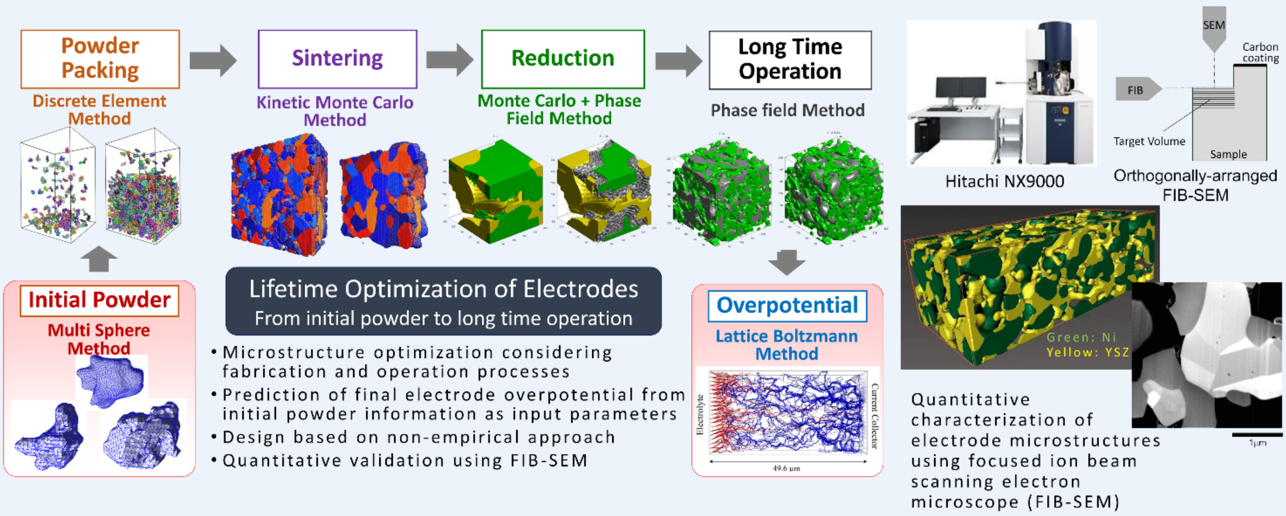
Shikazono Laboratory

Thermal Energy Engineering

Solid Oxide Fuel Cell and Next Generation Heat Engines

Prediction of Polarization Characteristics and Microstructures of Solid Oxide Fuel Cell Electrodes

In solid oxide fuel cell (SOFC) electrodes, it is widely known that their microstructures strongly affect polarization characteristics. Numerical simulation tools such as lattice Boltzmann, phase field, kinetic Monte Carlo and discrete element methods are developed to optimize whole lifetime characteristics of the electrodes from initial powder to long time operation. Three dimensional microstructures reconstructed by FIB-SEM plays inevitable role for model validation.

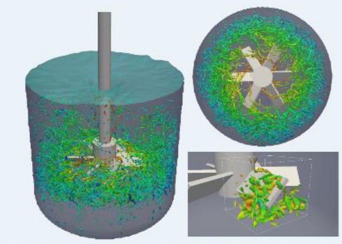


R&D for Next Generation Heat Engines

Efficient utilization of thermal energy will become even more important in the future. In order to reduce exergy loss from the heat processes, heat engines which operate at low temperatures and component technologies such as compact gas-liquid separators and compact heat exchangers are developed under collaboration with industry partners.

・Development of trilateral and oscillating steam cycles
・Large scale numerical simulation of two phase flows using super computers
・Development of component technologies: laminar heat transfer enhancement, compact gas-liquid separators, compact finless heat exchanger, etc.

Two phase expander & demonstration unit for trilateral cycle



Two phase flow structure and gas-liquid interface shape in a mixing tank

Compact gas-liquid separator

Compact finless heat exchangers

Yoshikawa Laboratory

High Temperature Sustainable Materials Processing

Solution Growth of Next-Generation Semiconductor SiC and AlN

Production of Semiconductors from Molten Alloy

Our laboratory tries to develop the innovative materials process — by combining high temperature physical chemistry (including thermodynamics and crystal growth) with an original technique to visualize high temperature reacting interfaces.

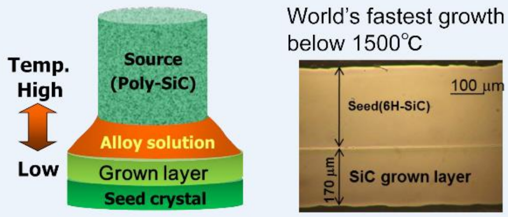
Solution Growth of Single Crystals of Wide-gap Semiconductors

Wide-gap semiconductors such as silicon carbide (SiC) and aluminum nitride (AlN) are key materials to achieve the innovation in power conversion and optical devices. We are developing the rapid growth technique to produce their high quality single crystals

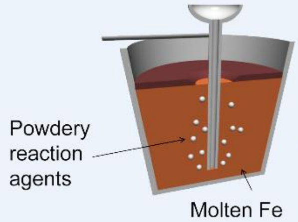
Control of Reacting Interface During Steelmaking Process

Tens or hundreds tons of molten steel react during steelmaking process, but the reaction proceeds thorough micron-scale phenomena. We try to contribute to the design of sustainable process for 21st century.

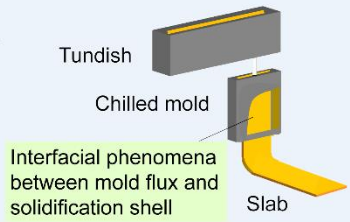
Low temperature rapid growth of SiC by the float zone method



Reaction control between molten Fe and reaction agents



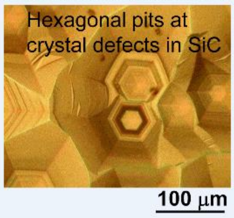
Microstructure control during the solidification in mold



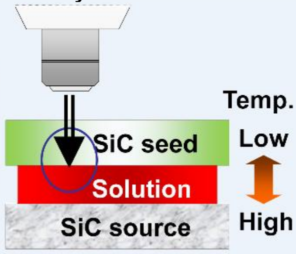
Real-time Observation of Reacting Interface at High Temperature Using Visible Light Transmission

We carry out the in-situ observation of the high temperature interface of reacting couples using the transparency for visible light of the one phase such as SiC.
For example, we observed the growth interface during the solution growth of SiC for the first time in the world. We aim at establishing the optimal condition for the growth of high quality crystal of SiC based on the nano-scale observation of interfacial morphology and defects in grown crystals.

Dissolution interface at 1300°C



Growth interface during solution growth of SiC at 1400°C



Yagi Laboratory

Energy Storage Materials Engineering

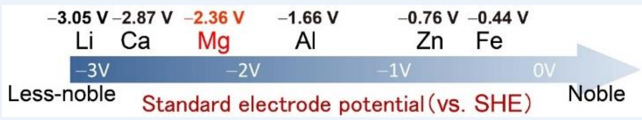
Electrochemical Materials and Processes

Innovative Rechargeable Batteries and Highly-efficient electrochemical processes

Yagi laboratory develops rechargeable batteries based on novel ideas and highly-active electrochemical catalysts composed of abundant elements for the growth of the sustainable society.

Magnesium Battery

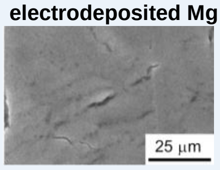
Magnesium possesses two valence electrons and has the lowest standard electrode potential among the metals usable in air. The electrochemically deposited magnesium surface tends to be flat. We investigate magnesium battery technologies to achieve rechargeable batteries with high energy density and ease of handling.



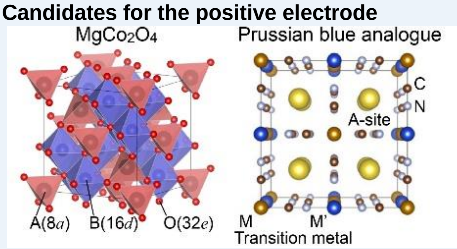
High capacity of Mg metal

	Potential (V vs. SHE)	Capacity (mAh/g)	Capacity (mAh/cc)
Mg	−2.36	2200	3830
LiC_6	−2.8	372	841
Li	−3.05	3860	2070

Flat surface of electrodeposited Mg



Candidates for the positive electrode



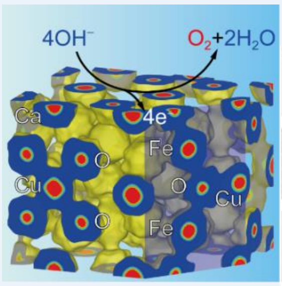
Prototype of Mg battery

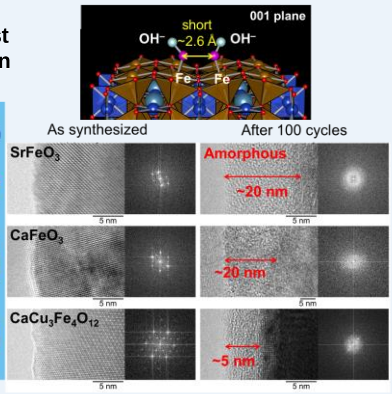
Analysis of the insertion/extraction behavior of Mg ions by electrochemical QCM

Catalysts for Oxygen Electrochemical Reactions

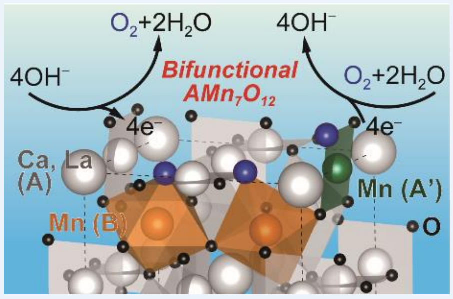
Oxygen electrochemical reactions are significantly important and utilized in fuel cells, rechargeable metal–air batteries, electrochemical water splitting by renewable energy, and electrolytic smelting. We investigate highly-active catalysts to promote the oxygen electrochemical reactions using abundant elements.

Highly-active oxide catalyst $CaCu_3Fe_4O_{12}$ for the oxygen evolution reaction

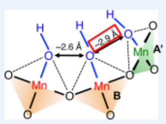




Bifunctional catalyst $CaMn_7O_{12}$ active for both the oxygen evolution and reduction reactions



Prototype of metal–air battery



Owada Laboratory

Materials Separation and Recycling Process

Visiting Professor from Faculty of Science and Engineering
(School of Creative Science and Engineering), Waseda University

Smart Recycling

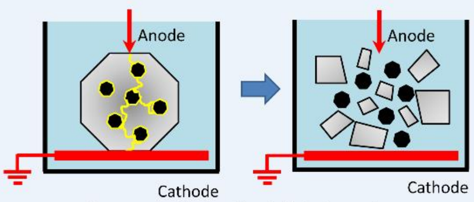
Smart Comminution and Separation

Since valuable and useless components are mixed in natural and artificial (waste) resources, it is necessary to recover the former elements and to reject or appropriately treat the latter ones. Key technology of solid–solid separation, in other words **“SOFT SEPARATION”**, should be applied with high efficiency and high reliability. In order to achieve the above separation, the following two kinds of technological development is essential.

1. **Intelligent Comminution** to make good liberation of componential elements
2. **Intelligent Separation** of compositional elements with high energy efficiency

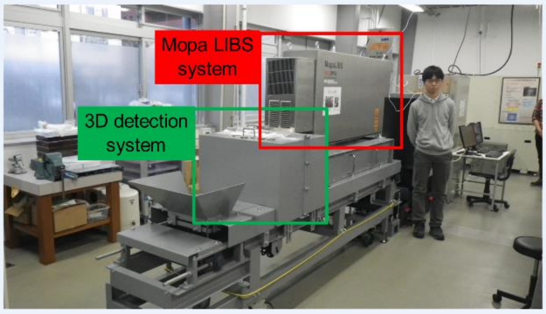
The Followings are examples of research topics.

- ◆ **Mechanical comminution** to achieve high liberation
- ◆ Clarification of mechanism of the **electrical disintegration**
- ◆ Development of high performance **sensor based sorting** (**LIBS**・XRF・XRT etc.) and process optimization
- ◆ Stochastic and rheological study on **flotation**
- ◆ Concentration of **precious metals** from scrap **catalyst** by **flotation**
- ◆ Recovery of **precious metals** from **incineration bottom ash**

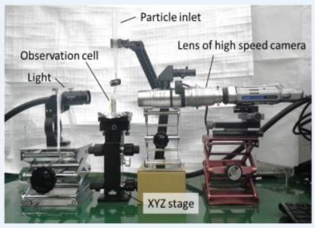


Concept of electrical disintegration

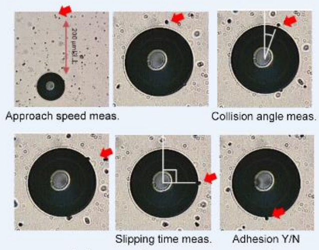
Various Materials of IC chip liberated by Electrical Disintegration



The first developed LIBS sorter in the world, Feb, 2015



Equipment for measuring bubble-particle adhesion



Measuring process of bubble-particle adhesion

Shibayama Laboratory

Mineral Processing

Visiting Professor from Graduate School of International Resource Science, Akita University

Development of Advanced Mineral Processing Technology and Recycling Process

Our laboratory is investigating development of treatment process of unutilized resources which are impurity containing and/or low grade and valuable metals contain electronic waste. The typical research work introduce as follows.

Development of advanced mineral processing technology of unutilized mineral resources

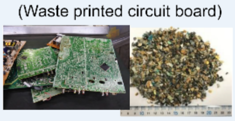
- Treatment process of impurity bearing copper mineral.
- Metal recovery form low grade ore and mine.
- Development of rare earth recovery process.

Development of precious metal extraction process from wasted materials

- Precious metal leaching process from printed circuit board by halogen leaching.
- Development of novel extractant for selective extraction of precious metal.

Recovery of valuable metal from WPCB by physical separation

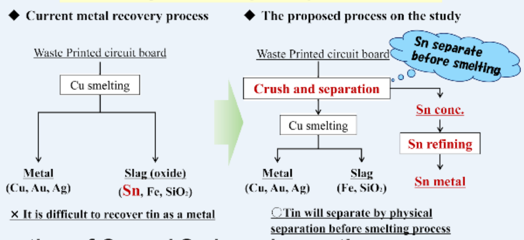
WPCB
(Waste printed circuit board)



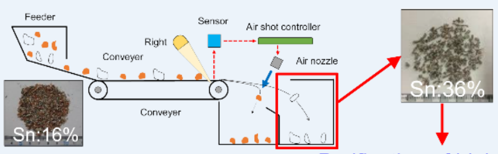
- Copper and other valuable metals were recovered by copper smelting process
- Recycling of a part of valuable metal are difficult because it moved to slag phase

It is necessary to develop pre-separation process of valuable metal from printed circuit board.

This study focus on pre-separation of tin



Separation of Cu and Sn by color sorting



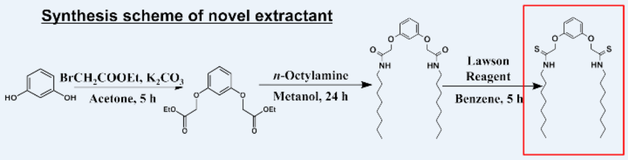
Separation of Cu and Sn using difference of color

Purification of high grade tin by chemical treatment

Development of novel extractant for PGM recycling

Following contents are required for novel extractant.
・Selective extraction of palladium
・Durability for strong acid (possibility of reuse)

Synthesis scheme of novel extractant

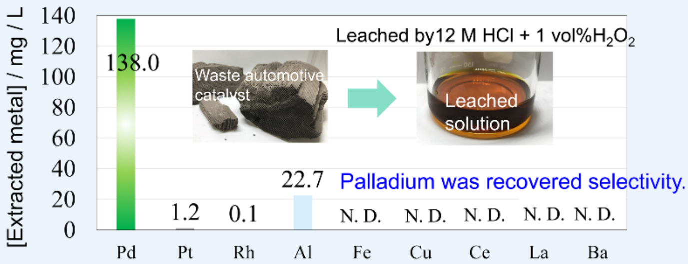


The novel extractant for selective extraction of Pd.

Selective extraction of palladium from automo

Conditions: Extractant concentration = 1 mM, Shaking time = 5 min

	Pd	Pt	Rh	Al	Fe	Cu	Ce	La	Ba
Conc mg / L	395.7	8.0	14.2	1555.6	604.1	29.5	959.8	101.5	51.2



Yamaguchi Laboratory

Recycling of Resources and Materials

Visiting Professor from Department of Resources and Environmental Engineering, Waseda University

Recovery Process of Rare Metals in Non-Ferrous Extractive Metallurgy

In non-ferrous smelting process the base metals of copper, lead and zinc as well as rare metals are produced from secondary materials such as scrap metals, alloys and residues.
The valuable metals that result from the refining process provide the raw materials for a wide range of application possibilities in various fields.

We suggest a new and effective recovery process of rare metals in the non-ferrous extractive metallurgy.

- ◆ Recovery of rare earth elements from magnet scrap by using B_2O_3 flux.
- ◆ Copper enrichment based on liquid phase separations.
- ◆ Recycling of platinum group metals for used auto catalyst.
- ◆ High temperature calorimetry.

The recovery of the rare earth elements from rotors of Hybrid Vehicle and Electric Vehicle using B_2O_3 flux

Fig. HV Rotors Driving Motor 6.8kg, Power Generator 2.1kg

Fig. EV Rotor : 10.4kg

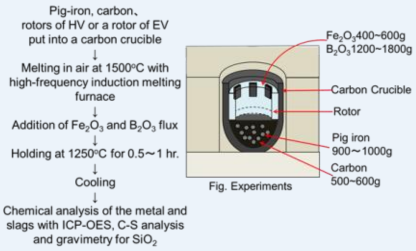
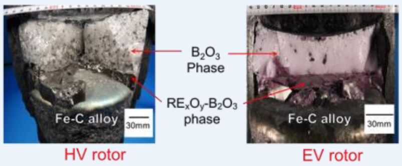
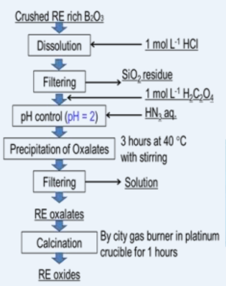


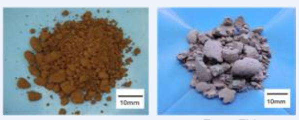
Fig. Experiments



Figs. Samples for after melting process

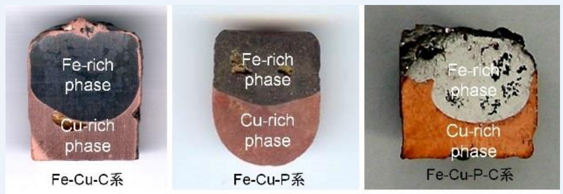


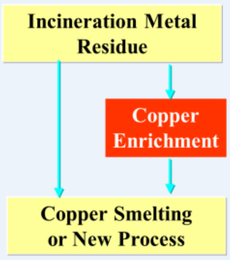
The total of the concentration of rare earth oxides were over 99 mass%.
Recovery rates are more than 99%

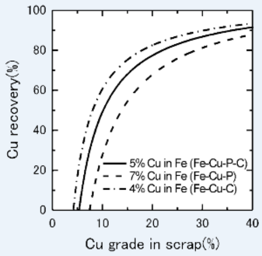


From HV From EV

Copper enrichment process of low grade copper scraps based on liquid phase separation

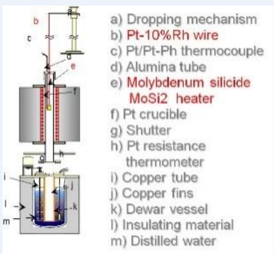




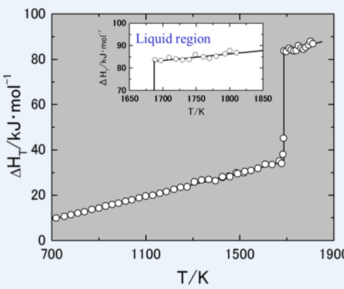


Copper recovery against copper grade in scrap

High temperature heat content measurement of silicon by drop calorimeter



Drop calorimeter



High temp. heat contents of silicon

Representative Activities

Activities on Global Cooperative Research Activities, Collaboration Activities, and Out-leach Activities

E-scrap Symposium 2016
September 27 (Tue), 2016
at the Institute of Industrial Science, the University of Tokyo

Youngsters' Science Festival of Tokyo in Koganei
October 9 (Sun), 2016
at Tokyo Gakugei University

Frontier of Extraction and Recycling Technology of Precious Metals (The 4th KIKINZOKU Symposium)
January 6 (Fri), 2017
at Institute of Industrial Science, the University of Tokyo

The 12th Workshop on Reactive Metal Processing (RMW12)
March 3 (Fri) ― 4 (Sat), 2017
at Massachusetts Institute of Technology

International Exchange with Norwegian University of Science and Technology (NTNU)
April 5 (Wed), 2017
at Institute of Industrial Science, the University of Tokyo

Workshop on Innovative Metallurgical Processes for Advanced Materials 1 Frontier on SiC Solution Growth
June 23 (Fri), 2017
at Institute of Industrial Science, the University of Tokyo

Youngsters' Science Festival of Tokyo in Koganei
September 24 (Sun), 2017
at Tokyo Gakugei University

An Annual Meeting of ICG (International Commission on Glass)
October 22 (Sun) ― 24 (Sat), 2017
at Halic Congress Center (Turkey)

Symposium on Minor Metals in Non-ferrous Metals Smelting
November 10 (Fri), 2017
at Institute of Industrial Science, the University of Tokyo

Frontier of Extraction and Recycling Technology of Precious Metals (The 5th KIKINZOKU Symposium)
January 12 (Fri), 2018
at Institute of Industrial Science, the University of Tokyo

Representative Activities

Symposium for Professor Masafumi Maeda
March 9 (Fri), 2018
at Institute of Industrial Science, the University of Tokyo

The 1st Special Seminar on Resource, Smelting, and Recycling of Non-ferrous Metals
March 14 (Wed), 2018
at The Nippon Club (New York)

The 13th Workshop on Reactive Metal Processing (RMW13)
March 16 (Fri) ー 17 (Sat), 2018
at Massachusetts Institute of Technology

Upcoming Events

E-scrap Symposium 2018
November 30 (Fri), 2018
at Institute of Industrial Science, the University of Tokyo

Frontier of Extraction and Recycling Technology of Precious Metals
(The 6th KIKINZOKU Symposium)
January 11 (Fri), 2019
at Institute of Industrial Science, the University of Tokyo

Workshop on Innovative Metallurgical Processes for Advanced Materials 2
September 10 (Mon), 2018 (planned)
at Science et Ingenierie des Materiaux et Procedes, Grenoble INP

An Annual Meeting of ICG (International Commission on Glass)
September 23 (Sun) - 26 (Wed), 2018
at PACIFICO Yokohama

Symposium for Professor Nobuaki Sato and Professor Toyohisa Fujita
March 8 (Fri), 2019
at Institute of Industrial Science, the University of Tokyo

The 14th Workshop on Reactive Metal Processing (RMW14)
March 15 (Fri) ー 16 (Sat), 2019
at Massachusetts Institute of Technology

E-scrap Symposium 2016

September 27 (Tue), 2016
Institute of Industrial Science, the University of Tokyo

A special symposium titled “E-scrap symposium 2016” was held on September 27, 2016, at the Convention Hall of the Institute of Industrial Science (IIS) with nine invited speakers from government, industry, and academia. The symposium was inaugurated with an opening address by Professor Teruo Fujii, Director of IIS. Approximately 200 people attended this symposium and enjoyed the discussion on the current status and challenges of E-scrap recycling. On September 28, a plant tour of the recycling facilities was arranged for students and young researchers. Participants visited the Strategic Urban Mining Research Base (SURE) of the National Institute of Advanced Industrial Science and Technology (AIST) and the Hitachi Works of the JX Nippon Mining & Metals Corporation.


Prof. Toshikazu Shiratori
Tohoku University


Mr. Makoto Harita
Harita Metal Co. Ltd.

Mr.Takeshi Kuroda
Renet Japan Group Inc.


Prof. Eiji Hosoda
Keio University


Mr. Toru Taniguchi
Mitsubishi Materials Corporation


Mr. Keisuke Tsujimoto
Ministry of Economy,
Trade and Industry


Mr. Hirobumi Ohta
Mitsui Mining & Smelting Co. Ltd.


Mr. Yoshinori Tanaka
Ministry of the Environment


Mr. Toshihiro Kamegai
JX Nippon Mining & Metals
Corporation

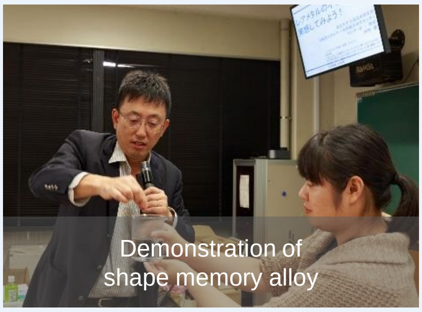
Youngsters’ Science Festival of Tokyo in Koganei

October 9 (Sun), 2016
Tokyo Gakugei University

A public event on “Youngsters’ science festival of Tokyo in Koganei” was held on October 9, 2016, in Tokyo Gakugei University. In this event, lectures and exhibitions on rare metals were delivered by Prof. T. H. Okabe, director of IRCSEM. The demonstrations using the shape memory alloys and the electrochemical plating on metal plates were also delivered by Dr. Akihiro Yoshimura, Associate Research Fellows at Institute of Industrial Science (currently at Chiba University).

Many children and parents were very interested in the lecture on the rare metals that are used in our lives or unusual places. After the lecture, visitors of the event from children to adults enjoyed the demonstration of shape memory alloys and electrochemical plating.


Prof. Toru H. Okabe
IIS
The University of Tokyo


Demonstration of
shape memory alloy


Demonstration of
the plating experiment


Full view of the lecture

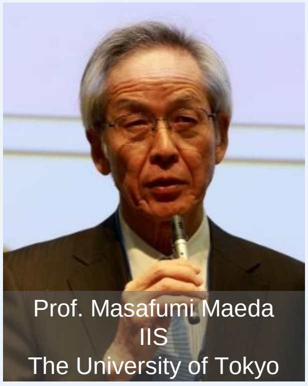

Samples of
rare metals and others


Children were very
interested in rare metals.

Frontier of Extraction and Recycling Technology of Precious Metals (The 4th KIKINZOKU Symposium)

January 6 (Fri), 2017
Institute of Industrial Science, the University of Tokyo

A special joint symposium entitled "Frontier of Extraction and Recycling Technology for Precious Metals (The 4th KIKINZOKU Symposium)" was held at the convention hall at IIS by the JX Metals Endowed Unit, IRCSEM, and Rare Metal Workshop on January 6, 2017. The seminar began with opening remarks by Prof. Masafumi Maeda. About 250 people, primarily from the non-ferrous and recycling industries, attended this symposium and enjoyed a lively discussion. After the lectures, a social gathering was held and further networking among the participants were promoted.

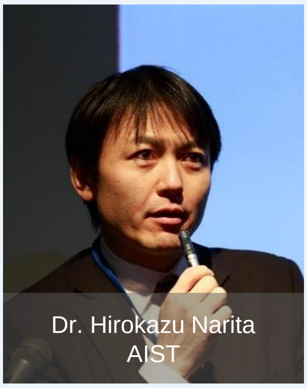

Prof. Masafumi Maeda
IIS
The University of Tokyo


Mr. Tomonari Goda
Pan Pacific Copper Co., LTD.


Mr. Toshiaki Ono
Mitsui Kinzoku


Mr. Satoshi Okada
Mitsubishi Materials


Prof. Takashi Nagai
Chiba Institute of Technology


Dr. Hirokazu Narita
AIST


Mr. Akihito Takedomi
Tanaka Kikinzoku Kogyo


Mr. Hitoshi Tanaka
Asahi Pretec Corp.


Prof. Toru H. Okabe
IIS
The University of Tokyo


Prof. Teruo Fuji
Director General of IIS
The University of Tokyo


Convention hall at IIS, the University of Tokyo

The 12th Workshop on Reactive Metal Processing (RMW12)

March 3 (Fri)－4 (Sat), 2017
Massachusetts Institute of Technology

The 12th Workshop on Reactive Metal Processing (RMW12) was held on March 3–4, 2017, at Massachusetts Institute of Technology (MIT), Cambridge, USA. The RMW, an annual workshop on material processing, is held in collaboration with industry members and universities worldwide, and has been jointly organized by Prof. Toru H. Okabe of IRCSEM and Prof. Donald R. Sadoway of MIT since 2006. Prof. Antoine Allanore of MIT has participated as an organizer since RMW10, and Prof. Shunsuke Yagi of IRCSEM has also participated as an organizer in this workshop. Approximately 45 researchers from a number of countries, such as the USA, Canada, Norway, and Japan, attended this workshop.

During the two-day workshop, eminent professionals delivered presentations on topics of current interest, such as the production/recycle processing of rare metals and advanced battery materials, which are essential for a sustainable society. The participants also actively engaged in discussions. The RMW is a leading workshop facilitating international research activities in the field of reactive metal processing.


Prof. Donald R. Sadoway
MIT


Prof. Toru H. Okabe
IIS
The University of Tokyo


Prof. Antoine Allanore
MIT

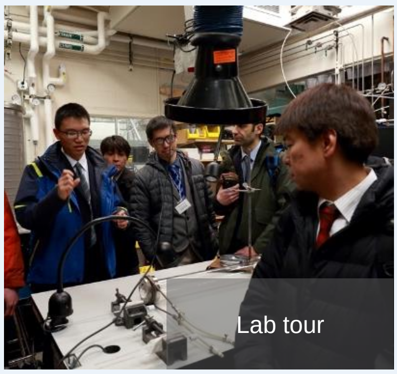

Prof. Shunsuke Yagi
IIS
The University of Tokyo


Presentation


Discussion


Banquet

Group photo


Lab tour

International Exchange with Norwegian University of Science and Technology (NTNU)

April 5 (Wed), 2017
Institute of Industrial Science, the University of Tokyo

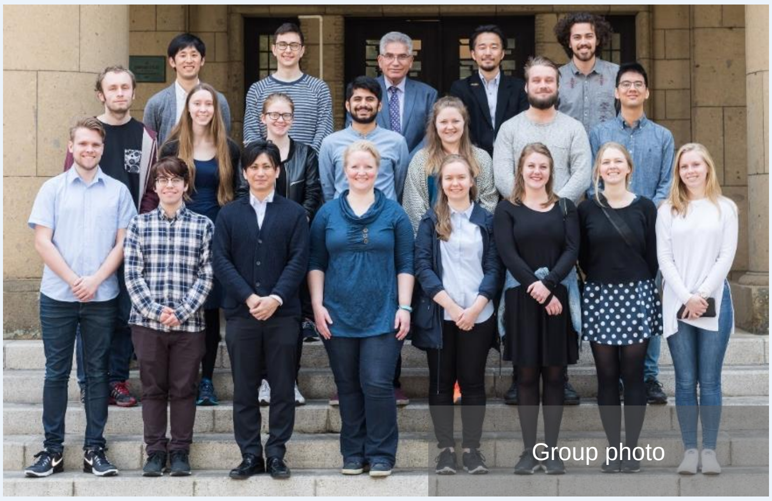
International exchange with Norwegian University of Science and Technology (NTNU) was held on April 5, 2017 at Institute of Industrial Science, the University of Tokyo. Novel research on energy conversion materials and catalysts studied in IRCSEM were introduced to the participants, 15 undergraduate students and 1 associate professor from NTNU. We were engaged in discussions of research and student education. We also conducted a tour of the laboratories and workshop in our IIS. IRCSEM makes a strong effort in transboundary educational activities through the international exchange with NTNU, one of the top institutes in North Europe.


Active discussion


Glassware workshop


Introduction of NTNU
by a NTNU student


Lab tour


Group photo


Metalware workshop

Workshop on Innovative Metallurgical Processes for Advanced Materials 1
Frontier on SiC Solution Growth

June 23 (Fri), 2017
Institute of Industrial Science, the University of Tokyo

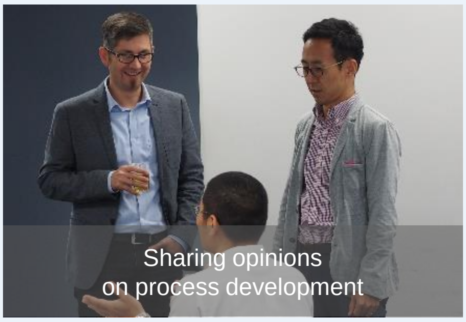
A workshop on the Innovative Metallurgical Processes for Advanced Materials 1 was held on June 23, 2017, in the Dw-604 at the Institute of Industrial Science (IIS). The workshop was initiated by Assoc. Prof. Takeshi Yoshikawa in IRCSEM and Dr. Didier Chaussende in CNRS Grenoble to serve as a platform to facilitate the discussion on the most recent activities in the field of innovative metallurgical processes for advanced materials. It is planned to be held every year alternately in France or in Japan.

The first workshop was dedicated to the hot topics of solution growth of SiC for power device application, supported by the IRCSEM. The program included a special lecture from Dr. Chaussende entitled “Solution growth of silicon carbide: state of the art and perspectives” and four presentations given by the researchers from both university and national research institutions focusing on the control of growth front toward the stable continuous growth of high quality crystals. More than 20 researchers leading the advanced research and development of SiC process in 8 institutions/companies attended the workshop and had deep discussion. Such discussion continued during the lab tour and in the social gathering after the scientific session.


Opening remark by
Prof. Takeshi Yoshikawa


Discussion during the workshop


Dr. Didier Chaussende
CNRS Grenoble


Sharing opinions
on process development


Social gathering

Youngsters’ Science Festival of Tokyo in Koganei

September 24 (Sun), 2017
Tokyo Gakugei University

A public event, “Youngsters’ science festival of Tokyo in Koganei,” was held on September 24, 2017, at the Tokyo Gakugei University. A lecture was delivered by Prof. Okabe, who is a director of IRCSEM, and an exhibition on rare metals was held. Demonstrations using shape memory alloys and electrochemical plating on metal plates were performed by Dr. Akihiro Yoshimura, Associate Research Fellows at Institute of Industrial Science (currently at Chiba University). Several children and parents were very interested in the lecture on rare metals, which are utilized not only in our daily lives but unexpected places as well. After the lecture, participants of different ages ranging from children to adults enjoyed the demonstration of shape memory alloys and electrochemical plating.

Prof. Toru H. Okabe
IIS
The University of Tokyo

Samples of rare metals and others

Demonstration of shape memory alloy

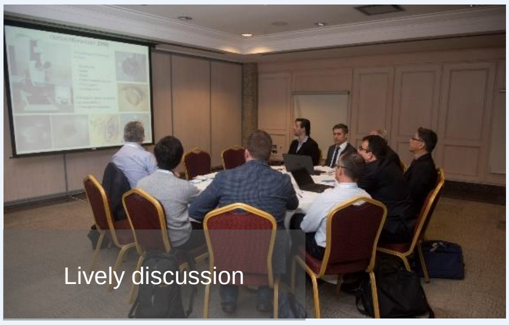
Children were really interested in rare metals

Full view of the lecture

An Annual Meeting of ICG (International Commission on Glass)

October 22 (Sun) ー 25 (Wed), 2017
Halic Congress Center, Turkey

An annual meeting of ICG (International Commission on Glass) was held in Istanbul, Turkey from October 22 to 25, 2017. The meeting is organized annually by international academic societies in the field of glass science and engineering. Professor Hiroyuki Inoue, IRCSEM, IIT, the University of Tokyo is one of the organizers of this event. The event this year was held by Turkish glass company Şişecam. There were 421 participants from 26 countries, with 6 keynotes, 24 invited lectures, 94 oral presentations and 18 poster presentations. In addition to the above presentations, the meetings of Council, Steering Committee and Coordinating Technical Committee were held. ICG meeting will be held in Krakow, Poland in 2020 and in Korea in 2021. Next meeting (ICG2018) will be held in Yokohama by Prof. Inoue.


Lively discussion


Technical committee meeting

Prof. Yano and Prof. Dr. S. Okitik announced ICG 2018 in Yokohama organized by Prof. Hiroyuki Inoue, IIS, The University of Tokyo

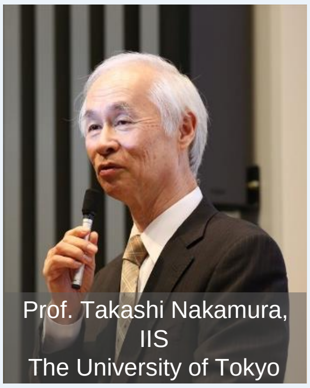
The committee members

Symposium on Minor Metals in Non-ferrous Metals Smelting

November 10 (Fri), 2017
Institute of Industrial Science, the University of Tokyo

A special symposium entitled "Symposium of Minor Metals in Non-ferrous Metal Smelting" was held by the JX Metals Endowed Unit, IRCSEM on November 10, 2017. The seminar began with opening remarks by Prof. Nakamura. More than 160 people from the non-ferrous and recycling industries, academics, and government attended and enjoyed a lively discussion on the future vision and challenges of mining, production, and circulation of minor metals in non-ferrous metal smelting, such as molybdenum, rhenium, and bismuth. After the lecture, a social gathering was held. This encouraged further interaction among the participants.


Dr. Gerardo Alvear-Flores
Aurubis


Prof. Takashi Nakamura,
IIS
The University of Tokyo


Mr. Masaki Kato
Kamioka Mining and Smelting


Mr. Hidenori Okamoto
JX Nippon Mining & Metals

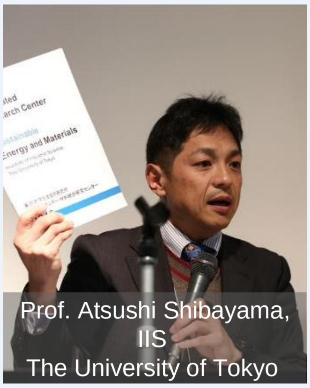

Mr. Suzuki Kazunari
Dowa Metals and Mining


Mr. Yoshitomo Ozaki
Sumitomo Metal Mining Co., Ltd


Mr. Yohei Yagi
IIS
The University of Tokyo


Prof. Chiharu Tokoro,
IIS
The University of Tokyo


Mr. Michiro Daito
Ministry of Economy, Trade and Industry


Prof. Atsushi Shibayama,
IIS
The University of Tokyo


Prof. Shuji Owada,
IIS
The University of Tokyo


Mr. Ichiro Sawamura
Vice President of JX Nippon Mining & Metals

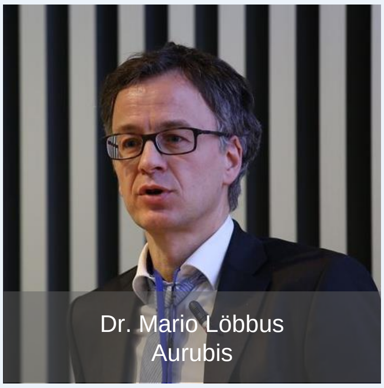
Frontier of Extraction and Recycling Technology of Precious Metals (The 5th KIKINZOKU Symposium)

January 12 (Fri), 2018
Institute of Industrial Science, the University of Tokyo

A special joint symposium entitled “Frontier of Extraction and Recycling Technology for Precious Metals (The 5th KIKINZOKU Symposium)” was held by the JX Metals Endowed Unit, IRCSEM, and Rare Metal Workshop on January 12, 2018. The seminar began with opening remarks by Prof. Masafumi Maeda. Includes 7 presentations given by the lecturers from industries and academia including a foreign company and Prof. Tsuyoshi Minami at IIS. About 250 people, primarily from the non-ferrous and recycling industries, attended this symposium and enjoyed a lively discussion. After the lectures, a social gathering was held and further interaction among the participants were promoted.


Mr. Shinichi Azuma
Hachinohe Smelting


Mr. Hitoshi Hujie
Matsuda Sangyo


Dr. Mario Löbbus
Aurubis


Mr. Yasumasa Sasaki
Hibi Kyodo Smelting Company


Prof. Tsuyoshi Minami
IIS
The University of Tokyo


Mr. Masahiro Shingu
Sumitomo Metal Mining


Mr. Takuya Hosoi
Tanaka Kikinzoku Kogyo


Prof. Teruo Fujii
IIS
The University of Tokyo


Prof. Masafumi Maeda
IIS
The University of Tokyo

Symposium for Professor Masafumi Maeda

March 9 (Fri), 2018
Institute of Industrial Science, the University of Tokyo

A special symposium entitled “Symposium for Professor Masafumi Maeda” was held by the JX Metals Endowed Unit, IRCSEM, and Rare Metal Workshop at the Convention hall in Building An on March 9, 2018. The seminar is held to highlight the research activity and prospect of non-ferrous metallurgy of Prof. Maeda. More than 250 people, from the non-ferrous and recycling industries, academia and government related to Prof. Maeda attended and enjoyed a lively discussion.

Professor Tetsuya Uda, Department of Materials Science and Engineering at Kyoto University, gave a lecture of “New Smelting Process of Titanium”. Mr. Hiroshi Asahi, Executive director of the Sumitomo Metal Mining gave a talk of “Future perspective of Non-ferrrous mining and smelting and their collaboration of academic-industry-government”. Professor Maeda gave an enthusiastic 90-minute lecture on “Outlook of mining and smelting of non-ferrous materials and the collaboration of industry-academia-government – histories of research and people”. After the lecture, a social gathering was held. This promoted further interaction among the participants.


Prof. Masafumi Maeda
IIS
The University of Tokyo


Prof. Tetsuya Uda
Kyoto University

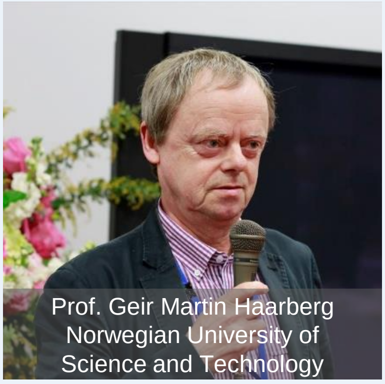

Mr. Hiroshi Asahi
Sumitomo Metal Minging


Convention hall in IIS, The University of Tokyo
The hall was fully occupied and more than 250 people enjoyed live viewing at the foyer.


Greeting by Prof. Maeda and his wife Mrs. Yuko Maeda


Prof. Kazuki Morita
The University of Tokyo


Dr. Adam C. Powell, IV
Infinium


Prof. Geir Martin Haarberg
Norwegian University of Science and Technology


Mr. Michiro Daito
Ministry of Economy, Trade and Industry

The 1st Special Seminar on Resource, Smelting, and Recycling of Non-ferrous Metals

March 14 (Wed), 2018
The Nippon Club (New York)

The 1st Seminar on Resource, Smelting, and Recycling of Non-ferrous Metals was held on March 14, 2018, at The Nippon Club, New York, USA. This seminar was organized by The University of Tokyo New York Office. This seminar is held for Japanese companies in US to enhance a networking of industry-government-academia. One-hour-lectures entitled “Recent topic of Non-ferrous metal recycling” and “Recent topic of Resource, Smelting, Recycling of Rare Metals” were given by Prof. Takashi Nakamura, IIS and Prof. Toru H. Okabe, Director of IRCSEM, respectively. After the lectures, lively discussion was carried out and continued through the social gathering. Most participants enjoyed further networking at the second party afterwards.

This seminar was the first seminar organized by Ms. Yoshimi Nakabayashi at Research Management Office, Institute of Industrial Science, The University of Tokyo to solicit donation for the activities of The University of Tokyo New York Office. It was sincerely appreciated that several companies had already donated to the activities.


Prof. Takashi Nakamura
IIS
The University of Tokyo


Mr. Masaharu Masuyama
The University of Tokyo
New York Office


Prof. Toru H. Okabe
IIS
The University of Tokyo


Presentation and discussion


Networking among participants

The 13th Workshop on Reactive Metal Processing (RMW13)

March 16 (Fri)－17 (Sat), 2018
Massachusetts Institute of Technology

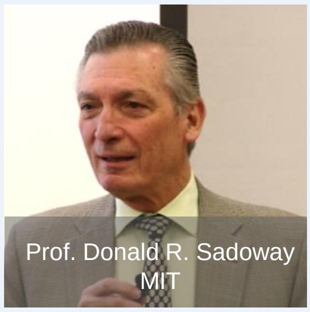
The 13th Workshop on Reactive Metal Processing (RMW13) was held on March 16–17, 2018, at Massachusetts Institute of Technology (MIT), Cambridge, USA. The RMW, an annual workshop on material processing, is held in industry-academia collaboration worldwide, and has been jointly organized by Prof. Toru H. Okabe and Prof. Shunsuke Yagi of IRCSEM, and Prof. Donald R. Sadoway and Prof. Antoine Allanore of MIT. The RMW is a leading workshop facilitating international research activities in the field of reactive metal processing with around 50 attendees from many countries, such as the USA, Canada, Norway, and Japan.

During the two-day workshop, presentations on topics of current production/recycle processing of rare metals and advanced battery materials, which are essential for a sustainable society, were given. The participants also enjoyed lively discussion. Additionally students and support staff from MIT and IIS cooperate to coordinate the workshop and made close networking.


Prof. Shunsuke Yagi
IIS
The University of Tokyo


Prof. Antoine Allanore
MIT


Prof. Toru H. Okabe
IIS
The University of Tokyo


Prof. Donald R. Sadoway
MIT


Prof. Guðrún Sævarsdóttir
Reykjavik University


Lab tour


Banquet


Prof. Gisele Azimi
University of Toronto


Group photo

Access

Transportation Network

東京大学生産技術研究所　IIS-UTokyo KOMABA RESEARCH CAMPUS

小田急線・東京メトロ千代田線/代々木上原駅（駅番号：OH05・C01）から徒歩12分
Odakyu Line / Tokyo Metro-Chiyoda Line 12-min walk from Yoyogi Uehara Station(Station Number:OH05・C01)

小田急線/東北沢駅（駅番号：OH06）から徒歩8分
Odakyu Line 8-min walk from Higashi-Kitazawa Station(Station Number:OH06)

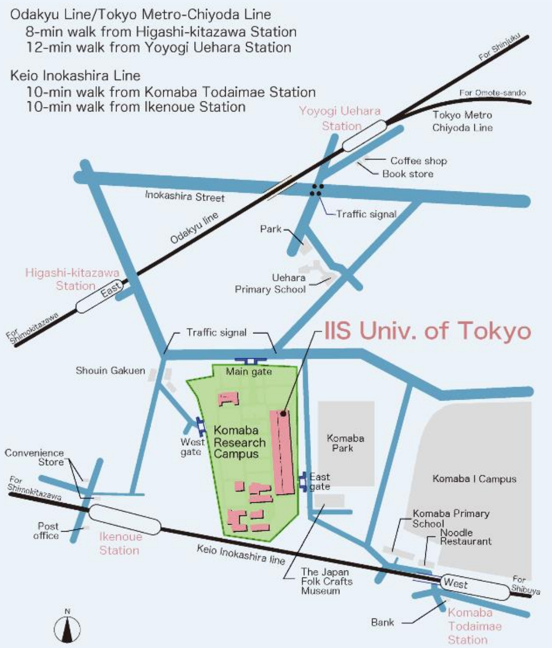
京王井の頭線/駒場東大前駅（駅番号：IN03）西口から徒歩10分
Keio Inokashira Line 10-min walk from Komaba-Todaimae Station(Station Number:IN03)

京王井の頭線/池ノ上駅（駅番号：IN04）から徒歩10分
Keio Inokashira Line 10-min walk from Ikenoue Station(Station Number:IN04)

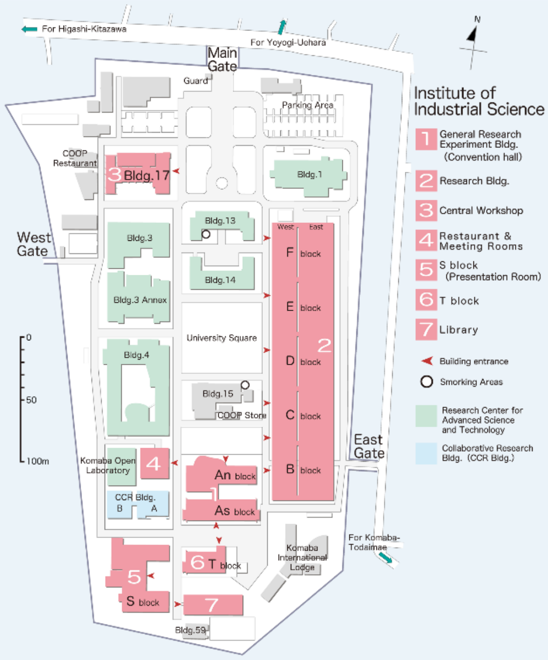
東京大学生産技術研究所　千葉実験所　IIS-UTokyo CHIBA EXPERIMENT STATION

JR総武本線西千葉駅から徒歩５分
5 min. walk from Nishi Chiba station (JR Sobu Line)

Location of Komaba Research Campus



Campus Map



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