

GREEN

Global Research Center for Environment and
Energy based on Nanomaterials Science





Director-General of GREEN
Kohei Uosaki

Making Breakthroughs in Materials Technology toward Solving Global Environmental and Energy Issues

Research and development of efficient energy conversion, storage, and transport are carried out intensively worldwide. To realize these systems, it is essential to develop new materials and devise that effectively utilize the newly developed materials but it is impossible to win the global competition if R&D is carried out via empirical approach.

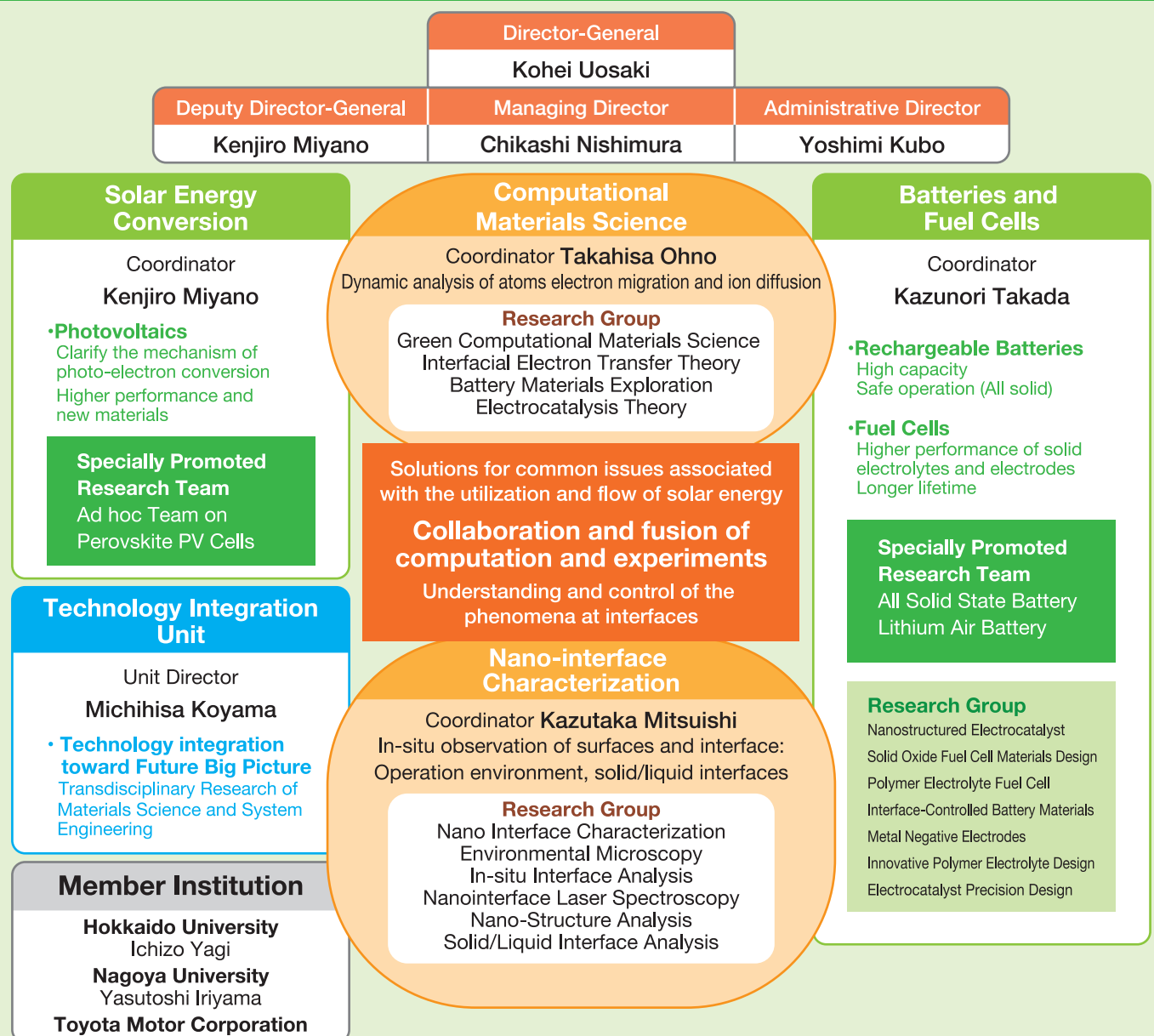
In Global Research Center for Environment and Energy based on Nanomaterials Science (GREEN), leading scientists in fundamental science such as theory, simulation, and measurement, and in applied fields such as solar energy conversion, secondary batteries, and fuel cells, gather together from not only NIMS but also from universities and industries are carry out cutting edge research with close collaboration. GREEN also provides external scientists with most advanced equipments as well as knowledge and know-how of GREEN scientists through open-lab system so that GREEN will contribute to accelerate R&D in universities and industries.

MEXT Program for Integrated Materials Development

GREEN was established in October 2009 with NIMS as the core host institution to carry out MEXT Program for Development of Environmental Technology using Nanotechnology and its aim is to promote nanotechnology in materials science research with the collaboration between industries and academia for achieving Green Innovation in Japan so that environmental and energy problems can be solved and a sustainable society can be realized.

In 2016, a new program "Integrated Materials Development" was started and in the new program, GREEN's research is significantly enhanced by the cooperation between "technology integration overlooking the entire social systems" and "material research integrated with theory, measurement and material creation", for properly matching the needs of future society and materials seeds in environmental technology.

Collaboration of Computation, Characterization and Material in GREEN



Establishing a Research Center Involving Collaborations between Industries, Government and Academia

Promoting Overriding Themes with an ALL JAPAN Formation

Open Laboratory

Aiming to accelerate materials research for the solution of environmental and energy issues, GREEN invites researchers from universities and research institutes in Japan to work on the topics well linked to GREEN's mission through a public recruiting process. GREEN open-lab guest researchers have an opportunity to communicate with NIMS researchers from various fields, and jointly analyze the experimental results obtained by using the cutting-edge facilities at NIMS. This leads them to yield significant research results.

Proposal Submission

Review of Proposal

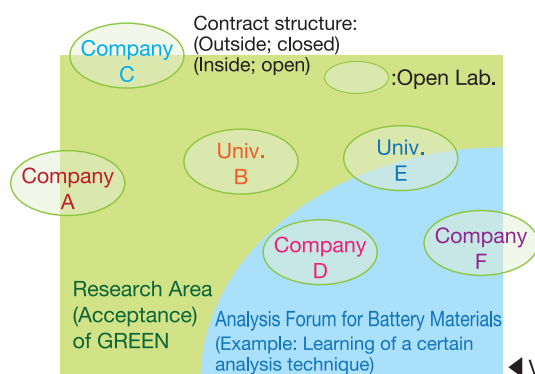
Invitation Procedure

Research

Report

Year Round Applications

Contact: **GREEN Administrative Office** E-Mail: GREEN@nims.go.jp



Short-term Research Assistant

GREEN short-term research assistants, who are the students of the universities and the colleges of technology where GREEN open-lab guest researchers belong to, are expected to participate actively in the Open Laboratory while learning leading-edge study in NIMS. This program can be also applied flexibly to a certain technical training for young researchers and engineers in companies under the agreement between guest and host researchers.

◀ Various models of Open Laboratory and networking

GREEN Symposium

GREEN symposium is regularly held as a forum for sending up-to-date information and exchanging views concerning GREEN's results and challenges. More than 200 people mainly belonging to companies have participated in this symposium held at Tokyo once a year.

NBCI-NIMS Joint Seminar

NBCI and NIMS have held joint seminar since October, 2012 and GREEN plays a central role.

Battery Research Platform

Battery Research Platform was established by a supplementary budget in fiscal year 2012 to accelerate the R&D of the next-generation batteries in our country, and started service in 2014 with state-of-the-art equipment installed. It preferentially supports the JST-ALCA project "Specially Promoted Research for Innovative Next Generation Batteries". It also supports other projects for next-generation batteries being carried out by universities, research institutes and companies in Japan.

Analysis Forum for Battery Materials

For the purposes of dissemination of GREEN's results on the next generation batteries to companies and offering opportunities for various collaborations, workshops as well as technical courses including practical training have been organized on a continuing basis.



Super Dry Room



Nurturing Young Leaders for the Future Generation

We foster the promising young researchers actively for the next generation. At GREEN, young leaders themselves were assigned the responsibility of group leaders. Each floor of NanoGREEN building completed in 2012, has an open space for stimulating interactions between researchers of a variety of backgrounds under one roof. Corporate researchers can obtain a doctoral degree at GREEN from partner universities of NIMS. Postdoctoral researchers and doctoral graduate students can acquire necessary skills of working in the industry through their experience at NIMS.

The GREEN Prize

The GREEN Prize was established in the FY2011 to encourage and recognize the contribution of young researchers who have made excellent achievements in terms of promoting green innovation and addressing the associated challenges.

Advanced Computational Science Field



Computational Materials
Science Field Coordinator

Takahisa Ohno

Based on advanced computational science techniques we are aiming to analyze the structures, physical properties, and functions at nanoscale surfaces and interfaces and to elucidate physical and chemical phenomena occurring in energy conversion systems.

Green Computational
Materials Science

Takahisa Ohno

Interfacial Electron
Transfer Theory

Ikutaro Hamada
(Associate Professor,
Osaka University)
Yang Sun

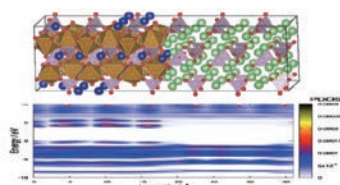
Battery Materials
Exploration

Masanobu Nakayama
(Professor, Nagoya
Inst. Tech.)

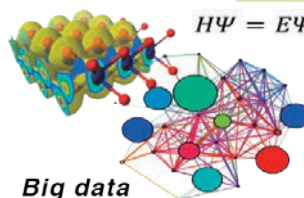
Electrocatalysis
Theory

Tetsuya Taketsugu
(Professor, Hokkaido
University)

Andrey Lyalin

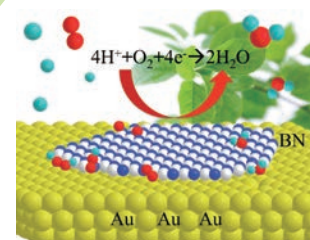


Structure and density of states at
electrode/electrolyte interface of
solid state secondary battery



Big data

New material research based
on materials informatics



Proposal of electrocatalytic
reaction by theory

Advanced Nano-interface Characterization Technology Field



Nano-interface
Characterization Field
Coordinator

Kazutaka Mitsuishi

We are developing in-situ nanocharacterization technologies for the surface and interface while controlling various environmental fields. We aim at clarifying the basic mechanism of the interfacial phenomenon which is the key of the functional manifestation of the environment and energy materials.

Nano Interface
Characterization Group

Nobuyuki Ishida
Chikako Sakai

Environmental
Microscopy

Ayako Hashimoto

Nanointerface Laser
Spectroscopy

Hiddenori Noguchi
Shuo Yang
Suresh Kukunuri

In-situ Interface
Analysis

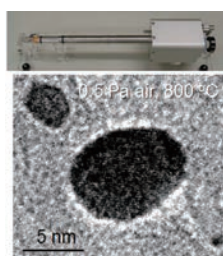
Kazutaka Mitsuishi
Raman Bekarevich

Nano-Structure
Analysis

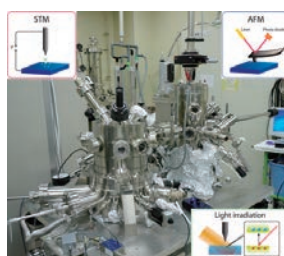
Naoyuki Sugiyama

Solid/Liquid Interface
Analysis

Takuya Masuda
Ruttala Devivaraprasad



Gas environment heating specimen
holder and obtained TEM image
of Pt nanoparticles



Low temperature STM/AFM chamber
for in situ observation of solar cell



Femtosecond laser system

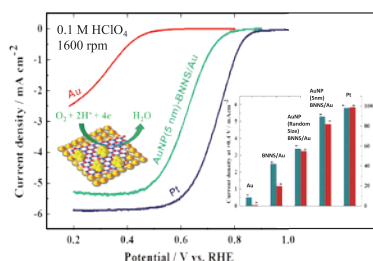
Nanostructured Electrocatalyst Group



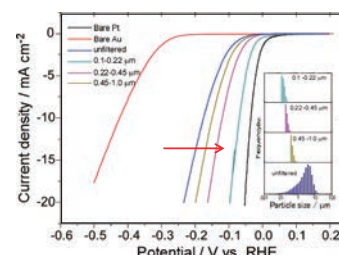
Kohei Uosaki

Kohei Uosaki
Akihiro Okamoto
Kentaro Tomita
Yang Liu

Bottom-up fabrication of unique
electrocatalysts and clarification of
the mechanism of electrocatalytic
reactions



Au nanoparticles decorated BN nano
sheet on Au substrates and their
oxygen reduction properties.



Hydrogen evolution from BN nano
sheet on Au substrates. Inset:
Size distribution of BN nano sheet

All Solid State Battery Specially Promoted Research Team



Team Leader
Kazunori Takada

Lithium-ion batteries are already used very widely for various applications. Much higher performance and reliability are, however, required for their future applications. This special team in GREEN is studying all solid state battery to achieve the high performance by dissolving the limitations originating from liquid electrolytes in the collaborative research among materials, computational, and characterization scientists.

Materials

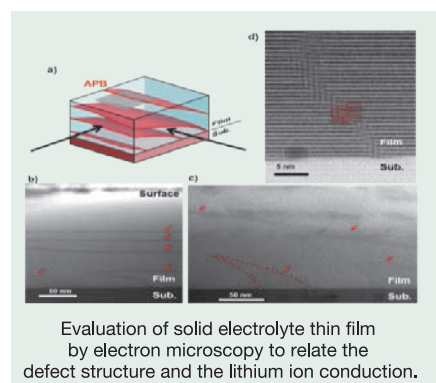
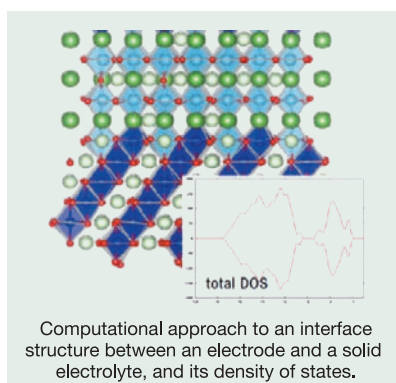
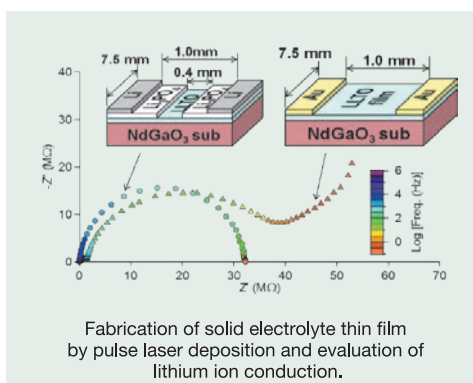
Kazunori Takada, Tsuyoshi Ohnishi
Narumi Ohta, Shogo Miyoshi
Kazuhiro Kawashima, Yusuke Matsuki

Computation

Takahisa Ohno
Yoshinori Tanaka

Characterization

Kazutaka Mitsuishi



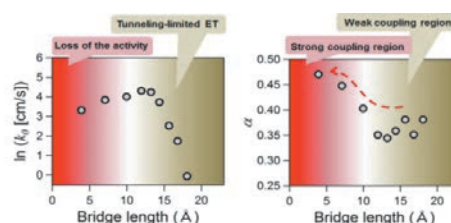
Electrocatalyst Precision Design Group



Katsuyoshi Ikeda

Katsuyoshi Ikeda
(Professor, Nagoya Institute of Technology)

Study on electrocatalyst models based on atomic and molecular scale control of electrode interfaces



Solid Oxide Fuel Cell Materials Design Group

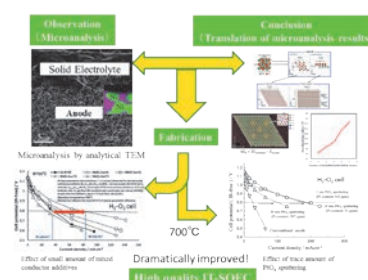


Toshiyuki Mori

Toshiyuki Mori

To design of the active solid electrolyte/ electrode interfaces and the high speed ion diffusion pathway in the area of grain boundary and grain interior, the combination approach among micro-analysis, defect structure simulation and processing route design is used in our group. We believe that our approach will guide us to radical innovation in development of fuel cell and its practical use.

Design of high quality fuel cell materials by combination of microanalysis, defect simulation and processing route design



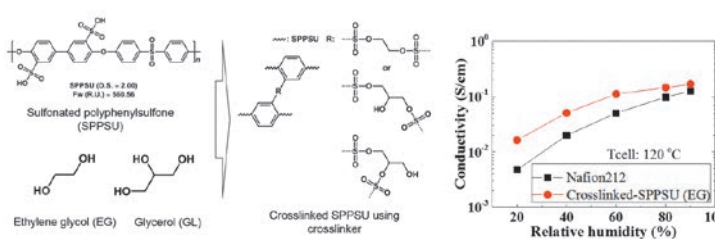
Polymer Electrolyte Fuel Cell Group



Jedeok Kim

Jedeok Kim
Satoshi Matsushita

Development of SPSPU membrane having high durability property



SPSPU polymer development and membrane conductivity (II)

Lithium Air Battery Specially Promoted Research Team



Team Leader
Yoshimi Kubo

In order to promote the widespread use of electric vehicles and renewable energy towards the low-carbon society, dramatic downsizing and price reduction of secondary batteries are required. We are developing basic technologies of Lithium-air battery that has the highest theoretical energy density, by conducting a wide range of R&D from materials science to prototyping of the cell.

Materials

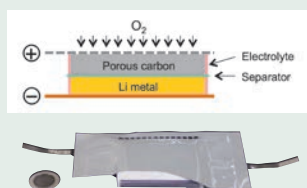
Yoshimi Kubo, Kimihiko Ito
Akihiro Nomura, Ken Sakaushi
Shoichi Matsuda, Xin Xing
Arghya Dutta

Computation

Ikutaro Hamada
(Associate Professor,
Osaka University)

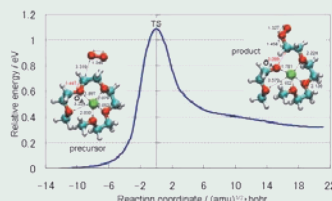
Characterization

Osami Sakata
Ayako Hashimoto
Chulho Song

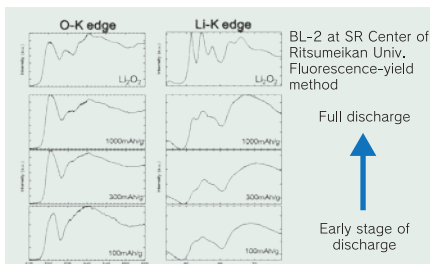


Schematic and 10-cell stack
of lithium-air battery

The highest theoretical energy density is because it uses oxygen in air. Cell stack technology is developed to realize high energy density in practical applications.



Ab initio study of electrolytes
Ether-based electrolytes are stable against the attack of superoxide anion produced by ORR during discharge.



XANES spectra for cathodes
The Li_2O_2 structure is already formed even at the early stage of discharge.

Interface-Controlled Battery Materials Group

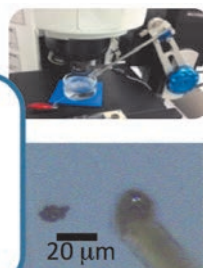
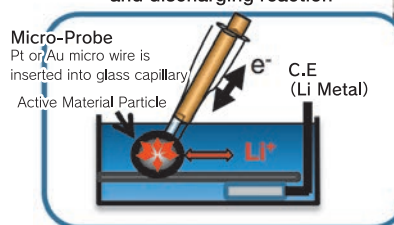


Kiyoshi Kanamura

Kiyoshi Kanamura
(Professor, Tokyo Metropolitan University)
Chunyan Li

The development of single particle measurement technique and the understanding of reaction mechanism of new materials for next-generation batteries

In-situ measurement of one active material particle during the charging and discharging reaction



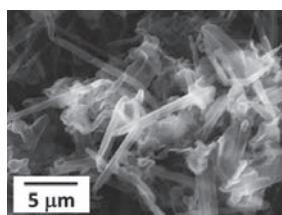
Metal Negative Electrodes Group



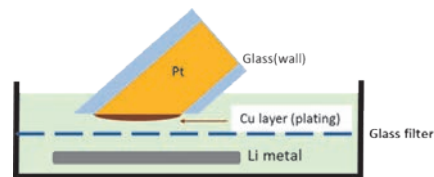
Kei Nishikawa

Kei Nishikawa

Fundamental study of metal negative electrodes for next-generation batteries



SEM image of typical
Li metal dendrites



Schematic diagram of experimental set-up for the morphological variation study of Li metal

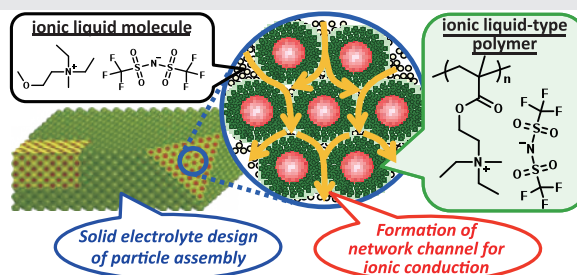
Innovative Polymer Electrolyte Design Group



Takaya Sato

Takaya Sato (Professor, National Inst. Tech., Tsuruoka College)
Yoshinobu Tsujii (Professor, Kyoto University)
Takashi Morinaga (Associate Professor, National Inst. Tech., Tsuruoka College)
Chaofu Zhang

Development of safety multiuse electrolyte using functional ionic liquids



Solid electrolyte using hybrid particle decorated with ionic liquid-type polymer brush

Ad hoc Team on Perovskite PV Cells



Team Leader
Kenjiro Miyano

Photovoltaic cells with lead halide compounds with perovskite structure as the light harvesting layer have been attracting attention due to their relatively high energy conversion efficiency despite their ease of fabrication. We aim at understanding the photo-electronic properties unique to this class of materials in order to reach a guiding principle in application. The ionic chemical nature is emphasized while the physical characterization capacity of GREEN will be fully utilized.

Materials

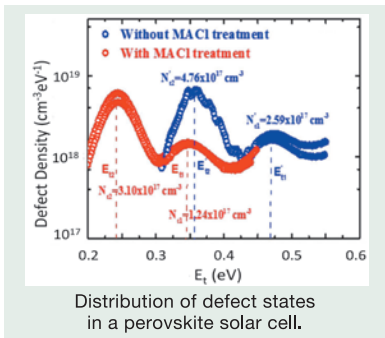
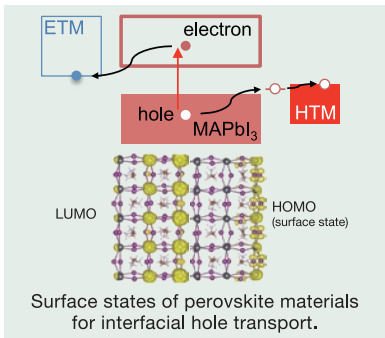
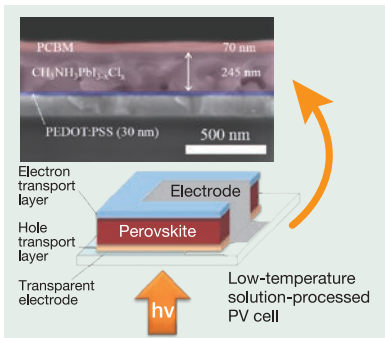
Masatoshi Yanagida
Yasuhiro Shirai
B. Dhruba Khadka
(ICYS)

Computation

Yoshitaka Tateyama

Characterization

Kenjiro Miyano
Hidenori Noguchi
James William Ryan
Xiaoqing Chen



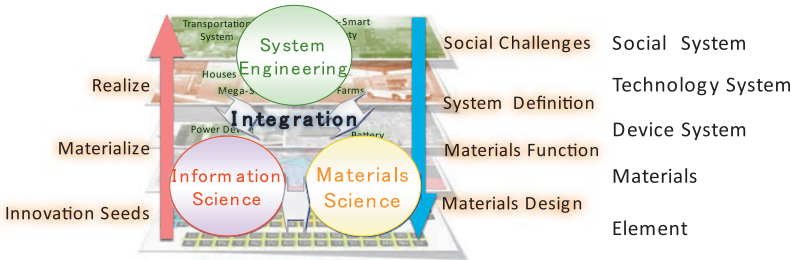
Technology Integration Unit



Michihisa Koyama

Michihisa Koyama (Unit Director)
Yasunori Kikuchi, Gen Inoue
Takahisa Ohno, Tsuyoshi Ohnishi
Karina Vink, Baber Javed
Eriko Ankyu

Integrated Approach Bridging
Materials, Technology, and Society



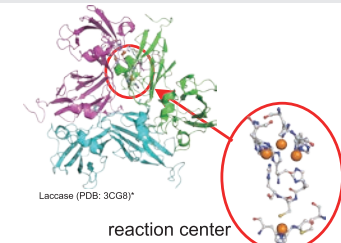
Hokkaido University



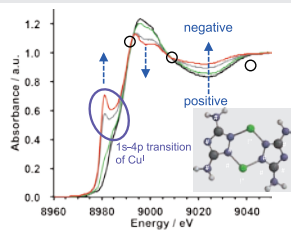
Ichizo Yagi

Ichizo Yagi
(Professor, Faculty of
Environmental Earth Science)
Masaru Kato
(Assistant Professor)

Development of bio-inspired
non-platinum electrocatalysts
for fuel cell



Structure of molecule and its reaction
center of Laccase which is natural catalyst
for oxygen reduction reaction.



Molecular structure of bi-copper
complex inspired by Laccase and
in situ XANES spectra of the complex
under electrochemical environment.

Nagoya University



Yasutoshi Iriyama

Yasutoshi Iriyama (Graduate school of Engineering, Professor)
Munekazu Motoyama (Graduate school of Engineering, Lecturer)
Takayuki Yamamoto (Graduate school of Engineering, Assistant Professor)
Takayoshi Tanji (Emeritus professor / Green Mobility Research Institute /
Institutes of Innovation for Future Society)
Takashi Ishida (Institute of materials and systems
for sustainability, Assistant Professor)

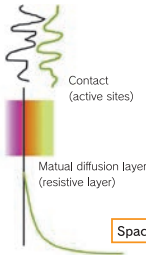


Figure
Probable factors on interfacial
resistance at electrode/solid
electrolyte interface

Fundamental studies on electrode/solid electrolyte interface for advanced all-solid-state LIBs, and
development of in-situ analysis technology of interface structure, potential, and electric field in SOFC

Toyota Motor Corporation

Analysis of Li ion transportation at the interface of a secondary battery



NanoGREEN/WPI-MANA Bldg. (Opened in 2012)

GREEN is registered as a project of TIA.

The new building is equipped with a rich research environment including the shared advanced facilities of NIMS. Further, it is an eco-friendly laboratory featuring solar panels, LED lightings and photocatalyst glass watering systems, etc., and aiming at effective utilization of renewable energy.

History of GREEN

- 866? ".N87/ · Foundation (October)
 - Consists of 6 research areas
- 8676 ".N88/ · The 1st symposium (February)
- 8677 ".N89/ · The 2nd symposium (March)
 - Reorganization into 4 research areas
 - Became a core project of TIA Nano-Green
- 8678 ".N8: / · The 3rd symposium (February)
 - Relocation to new research building (May)
 - The 4th GREEN Symposium (June)
 - The 5th GREEN Symposium (December)
- 8679 ".N8: / · New Director-General and Deputy Director-General
 - were appointed from the researchers (February)
 - Inauguration of two Specially Research Teams (April)
 - The 6th GREEN Symposium (June)
- 867: ".N8</ · The 7th GREEN Symposium (December)
 - ICYS-GREEN (January)
 - The 1st Tohoku Univ. & GREEN Joint Symposium (June) (The 8th GREEN Symposium)
 - The 1st Workshop for Battery Materials Analysis (September)
 - Inauguration of ad hoc team of Perovskite PV Cells (October)
 - GREEN Engineer Training Program (December)
- 867; ".N8= / · The 9th GREEN Symposium (January)
 - The 10th GREEN Symposium (June)
 - The 2nd Tohoku Univ. & GREEN Joint Symposium (October) (The 11th GREEN Symposium)
 - The 2nd Workshop for Battery Materials Analysis (November)
- 867< ".N8> / · The 12th GREEN Symposium (January)
 - Foundation of Center for Green Research on Energy and Environmental Materials (April)
 - The 13th GREEN Symposium (June)
 - The 3rd Workshop for Battery Materials Analysis (November)
- 867=" .N8? / · The 14th GREEN Symposium (February)
 - The 15th GREEN Symposium (June)
 - The 4th Workshop for Battery Materials Analysis (November)
 - The 3rd Tohoku Univ. & GREEN Joint Symposium (December) (The 16th GREEN Symposium)
- 867> ".N96/ · The 17th GREEN Symposium (January)

Logomark▶

The logo mark represents the objective of GREEN; to see, i.e., to observe and to understand, the world of nano-scale and the phenomena of nano-surface and nano-interface by fully exercising computational science and characterization technology.



Global Research Center for Environment and Energy based on Nanomaterials Science (GREEN)

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GREEN URL▶



National Institute for Materials Science (NIMS)