From Kyushu University to the world. Introducing research activities that will bring us to the realization of a carbon-neutral society.

Hello! I²CNER

June 2015
vol.13

International Institute for Carbon-Neutral Energy Research

Science Café

Using Next-Generation Hydrogen Energy Safely and Comfortably

Masanobu Kubota
Professor, Hydrogen Materials Compatibility Division, International Institute for Carbon-Neutral Energy Research (I²CNER), Kyushu University
Seinan Gakuin Senior High School

Impacting Society By Solving Problems

wpi World Premier International Research Center Initiative
I²CNER
KYUSHU UNIVERSITY
ILLINOIS UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Meet I²CNER's Newest Researchers

Welcome to I²CNER!

Alexandros Askounis

Post-doctoral Research Associate
Thermal Science and Engineering Division

I am originally from Greece, though I earned my Ph.D. at the University of Edinburgh, U.K. I joined I²CNER in November 2014. My research project is to explore new materials for heat transfer applications, such as electronics and power plant cooling. I am very happy to have joined I²CNER, as it is a very friendly and professional international environment in which to work. Furthermore, I am excited about the unique opportunity to learn more about the Japanese culture and way of life. In my free time, I love visiting the country side, especially onsens.

Benjamin Cunning

JSPS Post-doctoral Fellow
Hydrogen Storage Division

I joined the Hydrogen Storage Division of I²CNER in early January at the suggestion of Prof. Etsuo Akiba and Prof. Stephen Lyth. My goal is to synthesize new, high surface area graphenes and nano-metal decorated graphenes. These materials will be used for hydrogen storage and fuel cell catalysis applications. I am excited about the research opportunities in I²CNER, particularly the world-class laboratories. I have lived in Australia my whole life, and I am excited to experience Japanese food and culture. I am looking forward to viewing the cherry blossoms and listening to live jazz music in Fukuoka.

Hideaki Komiyama

Post-doctoral Research Fellow
Hydrogen Production Division

After finishing my Ph.D. and working as a postdoctoral fellow at the Tokyo Institute of Technology, I joined the Hydrogen Production Division of I²CNER in March 2015. My research focuses on block copolymer templating processes to synthesize nanoscaled* materials and analysis of their functionalities. I enjoy the lively discussions I have with other I²CNER researchers, and I hope they will lead to new research directions. In my leisure time, I enjoy experiencing the culture around Kyushu.

*A nanometer is one billionth of a meter

Prabakaran Saravanan

Post-doctoral Research Associate
Hydrogen Materials Compatibility Division

Konnichiwa!!! I am originally from India. I earned my Ph.D. from the National University of Singapore in the area of Materials and Tribology (friction, wear, and lubrication). I am very pleased and honored to be a part of I²CNER. I will be working on the development of polymer composites for hydrogen environmental applications. My primary research focus will be on the tribological side. I aspire to one day be an entrepreneur. I like to play badminton and go to the gym. I also enjoy reading, especially history and politics.

Evolution of a Career

Following her Ph.D. research, which focused on ceramics for fuel cells (ionic conductors), and her postdoctoral work on developing new transparent ceramics for solar cells (electronic conductors), Perry joined I²CNER in 2012. Prof. Perry's I²CNER project on mixed ionic and electronic conductors for clean energy conversion and storage combines these two areas. While she is based at Kyushu University, her position is unique, in that it allows her to spend up to half of her time at MIT in the U.S.

Nicola H. Perry

Assistant Professor
Fuel Cells Division, I²CNER

Nationality : U.S. and U.K.
Hobbies : Cycling, Hiking, Arts & Crafts

Career Path

- **9/2014-present** Research Affiliate, Department of Materials Science and Engineering, MIT, U.S.A.
- **8/2014-present** Assistant Professor, I²CNER, Kyushu University, Japan
- **11/2012-8/2014** Visiting Scholar, Department of Materials Science and Engineering, MIT, U.S.A.
- **9/2012-8/2014** Post-doctoral Research Associate, I²CNER, Kyushu University, Japan
- **11/2009-8/2012** Postdoctoral Fellow, Energy Frontier Research Center for Inverse Design, Northwestern University, U.S.A.
- **12/2009** Ph.D. in Materials Science & Engineering, Northwestern University, U.S.A.
- **5/2005** BS in Materials Science & Engineering & BA in French Studies, magna cum laude, Rice University, U.S.A.

Research Experience

My research topic is the development of design principles for more efficient and durable solid oxide fuel/electrolysis cell electrodes that exchange oxygen rapidly with the atmosphere but retain long-term stability. More broadly, I conduct fundamental studies into relationships between oxide structure (across multiple length scales) and key opto-electro-chemo-mechanical properties for various energy and electronics applications, by using and developing advanced *in situ* characterization techniques. I also conduct research regularly at MIT, strengthening KU-MIT ties.

Experience of Japan

I enjoy exploring Japan's geography and culture, with recent highlights including a visit to Mt. Aso and a hike to a mountain onsen during sakura season. I'm grateful for new Japanese and international friends here, through I²CNER or church, and I love visiting restaurants and sites with them.

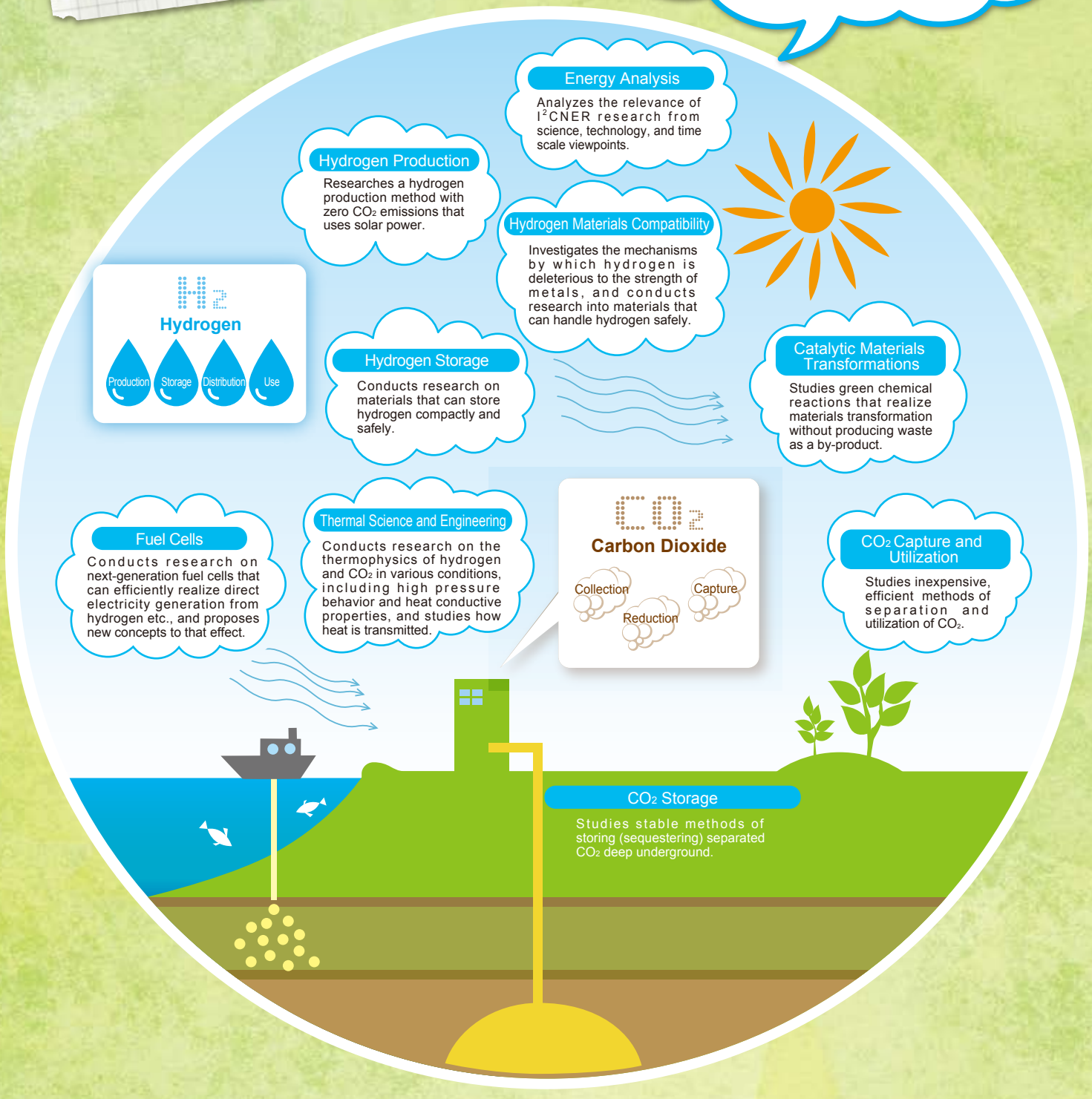
A day in the Lab

- **8:00** Teleconference with collaborators at MIT
- **9:15** Check ongoing dilatometry, optical, impedance, and/or thermogravimetry experiments in lab and update their settings (continue throughout the day)
- **10:00** Grow thin film model SOFC electrode by pulsed laser deposition (PLD)
- **10:30** Fabricate current collectors for asymmetric fuel cell; electrode performance will be tested in the evening
- **11:00** Research discussion with collaborators at Kyushu University
- **12:30** Lunch (preferably omerice!)
- **13:30** Write portions of grant proposals
- **15:30** Remove new film from PLD
- **16:00** Write/edit in-preparation manuscript
- **18:00** Data analysis
- **19:00** Continue to build new setups for *in situ* opto-electrical measurements
- **20:00** Dinner & Japanese lesson
- **21:00** Free time/ exercise/ literature reading/ proposal writing

Research Division Introductions

What is a carbon-neutral society?

This is a society where CO_2 emissions generated by energy use are reduced to a minimum, and where a balance is achieved between emissions and the amount absorbed and stored in the natural world.



Introducing the nine research divisions of I²CNER, which are engaged in cutting edge research to create a green and clean carbon-neutral society free of CO_2 emissions.

HELLO! I²CNER 2015

Science Café

Using Next-Generation Hydrogen Energy Safely and Comfortably

Hydrogen is drawing attention as an important next-generation energy carrier. Fuel cell vehicles (FCVs) that run on hydrogen were put on the market at the end of 2014. Hydrogen is an especially attractive energy carrier, as it can be produced from a variety of sources, it emits only water when electricity is generated, and it can be used for storing electricity. One of the most crucial points in the safe adaptation of hydrogen energy is the strength of the storage tank. Led by Professor Masanobu Kubota, who is conducting research on material deterioration caused by hydrogen, students from Seinan Gakuin Senior High School conducted tensile tests on metal and participated in a discussion on the safe use of hydrogen energy.

Discussion Participants

Masanobu Kubota
Professor, Hydrogen Materials Compatibility Division, International Institute for Carbon-Neutral Energy Research (I²CNER), Kyushu University

&

Sayaka Kawaguchi
Hiromi Shizunaga
Mayu Shimbara
Kaoru Terazaki
Second-year students
Seinan Gakuin Senior High School

(As of March, 2015)

Material Engineering's Role in Everyday Life

Kubota Today, I would like to talk about an important "background" technology that supports our daily life. This technology is a vital element in the process of using hydrogen as a fuel. Now, when you woke up this morning and switched on the light, it probably came on right away. Today, this is a common occurrence, but how do you think the electric light was turned on?

Kawaguchi Electricity was brought to it.

Kubota That's right. So then, how was the electricity generated?

Shizunaga It was generated at a power plant. I learned that water is boiled using thermal power or nuclear power and the pressure of the steam rotates a turbine to generate electricity.

Kubota You are correct. Turbines for power generation keep turning 24 hours a day, 365 days a year. Don't you wonder why they don't break down, even though they continuously spin like that?

Shimbara I have never thought about that. Are there any problems?

Terazaki I wonder why they don't break down even with such continuous rotation.

Kubota Here is another question. You often ride in a car, right? I believe you are comfortable riding in a car because you believe that the car will always stop if you apply the brakes. But why aren't the brakes damaged in the process?

Shizunaga They don't wear down so easily, do they?

Kubota Of course not. Bridges don't fall down suddenly, nor do buildings usually collapse all at once. The reason is that when we design something, we

carefully select what materials to use and we know how to use them in a way that makes them durable.

Kawaguchi The academic field in which we study these ideas is called Mechanical and Materials Engineering. You are in this field, right?

Kubota Yes, that's right. We study the properties of materials, looking at things such as how much strength must be applied to break a material and the mechanism of how materials break down. The comfort of our daily lives is dependent upon Mechanical and Materials Engineering.

Future Society Supported by Hydrogen Energy

Kubota By the way, I'm sure you know that the influence of CO_2 is considered to be one reason for climate change.

Shizunaga CO_2 is a greenhouse gas, and it increases the temperature of the atmosphere. I think that's why renewable energy that has no CO_2 emissions is attracting a lot of attention.

Terazaki We were taught that one of the most anticipated energies is hydrogen.

Kubota You have studied well. It is true that hydrogen is one of the suitable energy sources for a sustainable and environmentally-friendly society. In the near future, many automobiles will run on hydrogen, rather than on gasoline.

Shimbara I read in a newspaper that FCVs(Fuel Cell Vehicles) were launched last year, and that they are selling like crazy.

Kubota What are the advantages of a FCV?

Kawaguchi When it generates electricity, it produces only water, because it makes oxygen from the air react with hydrogen, which is stored in a tank. In addition, it is highly energy efficient.

Kubota Compared to burning gasoline, it is much more energy efficient. Also, hydrogen can be produced from various materials, and it can be stored.

Terazaki It seems that hydrogen may be the energy source that will support our lives when we start working.

Shizunaga But if hydrogen is such a wonderful thing, why didn't it become popular much earlier?

The Ultra-High Pressures of Hydrogen

Kubota That's a very good question. As a new energy source, hydrogen has been attracting attention for quite some time now. For example, it was predicted around 2003 that 50,000 FCVs would be running and 180 hydrogen refueling stations would be established throughout Japan by 2010.

Shimbara But FCVs were actually put on the market only at the end of last year, and there are only dozens of hydrogen refueling stations nationwide, with more coordination and construction underway.

Kubota Well, do you know how much one FCV costs?

Kawaguchi I heard it is very expensive. I think it costs several million yen.

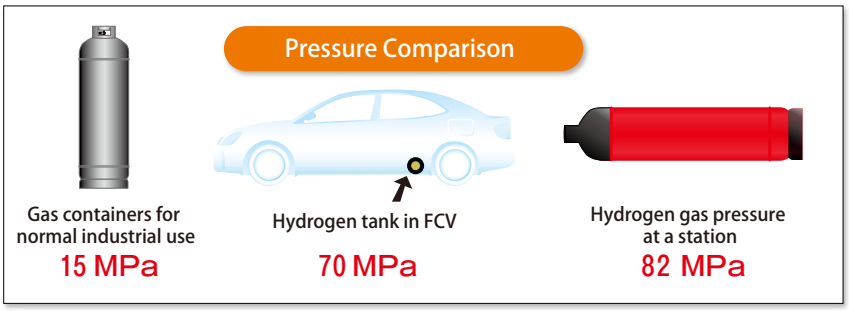
Kubota The FCVs on the market now cost more than 7 million yen each. And it costs about 500 million yen to construct a hydrogen refueling station.

Terazaki Why is it so expensive?

Kubota At a hydrogen refueling station, the hydrogen is stored at around 82 MPa (megapascals) , and in a FCV, it is stored at about 70 MPa. Hydrogen must be stored at this high pressure in order to ensure that FCVs can travel long distances so that they can compete in the market with traditional vehicles.

Shizunaga That sort of high pressure is beyond my imagination. FCVs and stations are expensive because they need strong materials and advanced technologies to withstand those conditions.

Kubota For safety reasons, FCVs and stations are costly. Reducing these costs as much as possible while still maintaining safety standards is an important challenge.



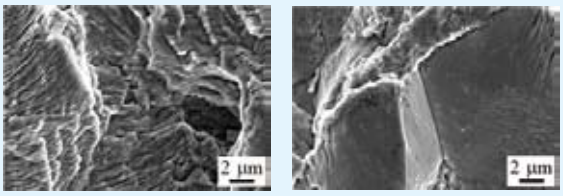
Laboratory Visit

Let's Try a Tensile Test!

In the laboratory, using a tensile testing machine, we tested what level of force will cause steel to fracture. We prepared a specimen that had absorbed hydrogen and one with no hydrogen absorption in order to study hydrogen's influence. The specimens set in the machine were subjected to the application of intense force. Looking at a graph, we noticed they had reached a limit. Suddenly, we heard a big bang, and the steel specimens broke apart. When we looked at the cross-section of the break using an electronic microscope, we found there were slight differences in the surfaces between the one that had absorbed hydrogen and the one that had not.

Arnaud Macadre

Post-doctoral Research Associate
International Institute for Carbon-Neutral Energy Research (I²CNER)
Kyushu University



Fracture surface of fatigue specimen: The steel that had absorbed hydrogen (right) was more fragile than the steel that had not (left).

Ryosuke Komoda

D1, Hydrogen Compatible Materials and Fracture lab, Department of Mechanical Engineering, Graduate School of Engineering,
Kyushu University

Using Hydrogen Safely

Kawaguchi Are there any other challenges to achieving the widespread use of hydrogen as an energy source?

Kubota Well, yes. One of the problems is that hydrogen causes storage containers to deteriorate. The technical term is "hydrogen embrittlement." Hydrogen must be stored at a high pressure, which puts strain on the storage materials, but in addition, the hydrogen itself makes storage materials fragile.

Shimbara If a high pressure storage container becomes degraded, there is the risk of a rupture.

Kubota That's why our research is important. First, we have to understand how and why hydrogen causes materials to deteriorate, then we may be able to predict the speed of the deterioration.

Shizunaga If we can find materials that are resistant to the effects of hydrogen in the first place, we can feel more secure about it.

Kubota We are studying this issue, as well. One of our research themes is the creation of new materials.

Terazaki Are extremely strict regulations one reason for the high cost of FCVs and hydrogen refueling stations?

Kubota Yes, that's a good point. For example, it costs roughly 200 million yen to construct a hydrogen refueling station overseas. But if we are not careful about deregulating, we might create some problems. We need to verify what level of regulations is appropriatefrom a scientific perspective.

Shimbara There are many more things we need to study before we can live a comfortable life in a green and clean society in the future.

Kubota Yes. Many things need to be studied in order to see widespread, safe usage of hydrogen energy in our society. I²CNER is trying to bridge science and society. Don't you feel excited to know that research in this institute can improve our daily lives? To realize an eco-friendly hydrogen society and develop science, we need the power of the younger generation, people like you. I am truly looking forward to the day when you join us in this research effort as a scientist or engineer.

Message to Students from Professor Kubota

Though Japan has few natural resources, it became one of the biggest economies in the world because of its strength in manufacturing. However, the manufacturing industry is now facing problems because the number of engineers is decreasing as the overall population decreases. One solution may be to invite engineers from abroad. Another would be to recruit more women into the field of Engineering! If you dive into the depths of the field of Engineering, you will find a very interesting world spreading out in front of you. Kyushu University's Graduate School is the only one in the world that has a department which offers a major in hydrogen energy systems. We are developing engineers and scientists who will support a future hydrogen society. I do hope you will enter Kyushu University, pursue a doctoral course, and join us in our research and development of technology that will support our future. I am truly looking forward to the energy you will bring.

Post-discussion

Seinan Gakuin Senior High School

This discussion was made possible by the cooperation of senior high school students from Seinan Gakuin, a private institution that will mark its 100-year anniversary next year. The school's mission is to nurture creative people who will serve the local community and the world, in accordance with the teachings of Christ. The school offers a high-quality education and is characterized by a culture of respect of liberty and the spirit of independence. It focuses on allowing the students to lead a balanced life, without placing too much emphasis on knowledge acquisition, and offers unique programs, including international exchange and camp school. Under the principle of fostering each student's character, Seinan offers diverse educational programs and is regarded as a top high school. Its graduates enter Kyushu University, and many other competitive national and public universities.

Sayaka Kawaguchi

I learned that there are still plenty of challenges to overcome before hydrogen can be used universally, and that hydrogen research has been developed from various perspectives. I noticed that Professor Kubota's research and the flight dispatcher job I am aiming for have a common first priority of safety.

Mayu Shimbara

I study biology and physics in school, but I became more interested in engineering after today's discussion and experiment. Professor Kubota was different from my image of a "typical" university professor, and very friendly. He answered each of our questions with care, which was very impressive.

Hiromi Shizunaga

I was surprised to see how the electronic microscope at the laboratory was different in shape and function from the one we use at our school. I could see the tiny differences between the steel cross-sections very vividly. I didn't know that steel containing hydrogen becomes more fragile. I have become more interested in this field, and I wonder what it would be like if we changed the duration of the application of force to the metal.

Kaoru Terazaki

I had thought that universities and research institutions deal with very abstract research themes, but I learned they are pursuing research using familiar materials like steel, things related to our daily life. In the future, I want to be involved in manufacturing things that will help people's daily lives.

AWARDS

The Iron and Steel Institute of Japan 2014 Sawamura Award

Prof. Nobuo Nakada, Prof. Toshihiro Tsuchiyama, Prof. Setsuo Takaki
(Hydrogen Materials Compatibility Division)

Prof. Nobuo Nakada, Setsuo Takaki and their collaborators won the Sawamura Award for their paper, "Effect of Grain Size on Thermal and Mechanical Stability of Austenite in Metastable Austenitic Stainless Steel." The paper was awarded not only for its academic contributions to the understanding of the effect of grain size on the thermal and mechanical stability of austenite, but also for the industrial implications for developing high strength steels, such as TRIP-assisted low-alloy steels. (Oct. 22, 2014)

Inoue Research Award for Young Scientists

Prof. Masaaki Sadakiyo (Catalytic Materials Transformations Division)

Prof. Masaaki Sadakiyo received the Inoue Research Award for Young Scientists for his paper, "Rational Designs of Acidic Metal-Organic Frameworks and Its Proton Conductivity and Selective Sorption Property." The paper was recognized as an excellent doctoral dissertation which is likely to develop a new area in fundamental research in the natural sciences. (Dec. 10, 2014)

The Chemical Society of Japan (CSJ) Award for Young Chemists

Prof. Shintaro Ida (Hydrogen Production Division)

Prof. Shintaro Ida received the "CSJ Award for Young Chemists in Technical Development" for his remarkable research outcome in the field of chemistry application. The title of the awarded paper was "Development of light energy conversion materials using inorganic two-dimensional nanocrystals." (Jan. 7, 2015)

11th Japan Academy Medal

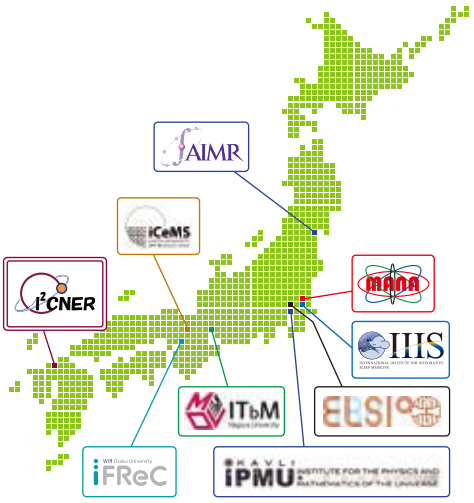
Prof. Keiji Tanaka (Hydrogen Production Division)

Prof. Keiji Tanaka received the 11th Japan Academy Medal for his research, "Study on Structure, Physical Properties and Function of Polymers at Interfaces." This work was recognized not only for its academic significance, but also because it achieved an important outcome for industry by proposing a new concept for material design. (Jan. 13, 2015)

What is WPI?

wpi World Premier International Research Center Initiative

The World Premier International Research Center Initiative (WPI) is a project that was launched by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) in 2007. The WPI seeks to form an ideal research environment within visible research centers that maintain high research standards, where leading researchers will be attracted from all over the world.



Kyushu University
International Institute for Carbon-Neutral Energy Research (I²CNER)

Toward the realization of a low-carbon society, I²CNER aims to resolve the challenges of the use of hydrogen energy and CO_2 capture and sequestration by fusing together sciences from the atomic level to the global scale.

Refer to:
MEXT Website http://www.mext.go.jp/english/research_promotion/1303822.htm
JSPS Website http://www.jsps.go.jp/english/e-toplevel/index.html

Tohoku University
Advanced Institute for Materials Research (AIMR)

Integrating physics, chemistry, materials science, bioengineering, electronics and mechanical engineering, AIMR is striving to create innovative functional materials. A mathematical unit joined the team in 2011 to help establish a unified theory of materials science, aiming at the realization of a global materials research hub.

Osaka University
Immunology Frontier Research Center (IFReC)

An innovative research center, which pursues the goal of comprehensive understanding of immune reactions through the fusion of immunology, various imaging technologies, and Bioinformatics.

National Institute for Materials Science International Center for Materials Nanoarchitectonics (MANA)

A major focus of our activities is the development of innovative materials on the basis of a new paradigm "nanoarchitectonics," ground-breaking innovation in nanotechnology.

Kyoto University
Institute for Integrated Cell-Material Sciences (iCeMS)

Established to integrate the cell and material sciences, the iCeMS combines the potential power of stem cells (e.g., ES/iPS cells) and of mesoscopic sciences to benefit medicine, pharmaceutical studies, the environment, and industry.

Kavli Institute for the Physics and Mathematics of the Universe (Kavli IPMU), Todai Institutes for Advanced Study, The University of Tokyo

With accumulated research on mathematics, physics and astronomy, this research core works to bring light to the mysteries of the universe, such as its origin, and to provide an analysis of evolution.

Tokyo Institute of Technology
EARTH-LIFE SCIENCE INSTITUTE(ELSI)

ELSI focuses the origins of Earth and life. Both studies are inseparable because life should have originated in unique environment on the early Earth. To accomplish our challenge, we establish a world-leading interdisciplinary research hub by gathering excellent researchers in Earth and planetary sciences, life science, and related fields.

University of Tsukuba
International Institute for Integrative Sleep Medicine(IIIS)

IIIS seeks to elucidate the fundamental mechanism of sleep/wakefulness, to develop strategies to regulate sleep, and to contribute to the enhancement of world health by combatting sleep disorders and associated diseases.

Nagoya University
Institute of Transformative Bio-Molecules (ITbM)

The goal of ITbM is to develop innovative functional molecules that make a marked change in the form and nature of biological science and technology (transformative bio-molecules). ITbM will connect molecules, create value, and change the world, one molecule at a time.

Editor's note: "Hello I²CNER" "Energy Outlook"

- I²CNER holds a variety of events.
  For details, please see: ➡ http://i2cner.kyushu-u.ac.jp/en/
  I2CNER Search
- Though it seems as if the I²CNER Kick-off Symposium was held just a short while ago, we find ourselves already embarking upon the second term of the I²CNER project with two dedicated buildings, a portfolio of cutting-edge fundamental science research, a group of close collaborators from around the world, and a highly talented and visionary team of researchers at Kyushu University. In the next five years, we hope to report on many more breakthroughs in I²CNER as the Institute continues to become an internationally-recognized research center. As always, if you have any feedback, please feel free to write to us.

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I²CNER Event Reports

2014.
12.13

The 4th World Premier International Research Center Initiative (WPI) Joint Symposium


Prof. Lyth introduces his research


Prof. Staykov's Lecture


Prof. Staykov answers a question

On December 13th, the 4th WPI Joint Symposium was held at Yurakucho Asahi Hall in Tokyo. The target audience of the symposium was high school students, and the goal was to demonstrate what a privilege it is to perform state-of-art research. Lectures were given by Prof. Aleksandar Staykov from the Hydrogen Production Division of I²CNER, Kyushu University; Prof. Wang Dan Ohtan from iCeMS, Kyoto University; and Prof. Hitoshi Murayama, Kavli IPMU, the University of Tokyo. In addition, each WPI institute and high school ran a booth to introduce their organization and the research they are doing. At the I²CNER booth, Prof. Stephen Lyth (Fuel Cells Division) explained his research on graphene to students and the general public. High school students also presented their research posters and fielded questions from researchers.

2015.
1.24

Kyushu University Soft Engineering Open Lecture 2015 "New age in environment –technologies for our future–"


Prof. Yamauchi explains her carbon-neutral energy cycle


Prof. Taniguchi discusses next-generation CO_2 storage concepts


Dean Yamada gives opening remarks

I²CNER and the Kyushu University Faculty of Engineering co-hosted the Kyushu University Soft Engineering Open Lecture 2015, entitled "New age in environment –technologies for our future–" on January 24th. Prof. Miho Yamauchi (Catalytic Materials Transformations Division) and Prof. Ikuo Taniguchi (CO_2 Capture and Utilization Division) gave lectures called "Thinking about environment-friendly energy cycles" and "CO_2 - Capture & Storage toward for a New Era," respectively. 53 people of all ages attended the lecture. The audience and the researchers engaged in a lively question and answer session. Members of the audience reported that the lectures did a good job of presenting the objectives and significance of engineering research, and that they would definitely participate the next open lecture. When asked what he thought about the lecture, one participant said, "It was a great opportunity for me to learn about the wide range of environmental issues the world is facing." Overall, the event was a great success.

I²CNER Event Reports

2015. 2.2 I²CNER Annual Symposium 2015 ~Fuel Generation and Use for the 21st Century~


Prof. Hashimoto explains the difficulties of efficient multiple electron transfer catalyst development

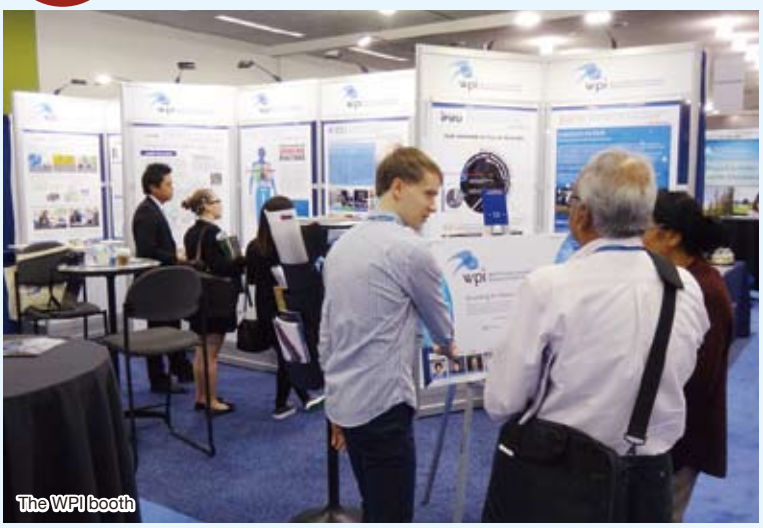

Mr. Kawai discusses the benefits of Fuel Cell Vehicles


Prof. Kunitake describes recent progress in the areas of bi-layer and nano-membranes

"The I²CNER Annual Symposium 2015~Fuel Generation and Use for the 21st Century~" was held on February 2, 2015 on Kyushu University's Ito Campus. Opening remarks were given by Kyushu University President, Prof. Chiharu Kubo, and I²CNER Director, Prof. Petros Sofronis. Plenary lectures were given by Prof. Kazuhito Hashimoto of the University of Tokyo, and Mr. Taiyo Kawai of TOYOTA MOTOR CORPORATION, with a special lecture by Prof. Toyoki Kunitake, WPI Visiting Professor and 2014 Order of Culture award winner. Topics addressed throughout the day included the fundamental science underlying polarization, defect structure, species transport, rate limiting processes, and degradation phenomena in SOFCs and SOECs. Presentations also explored the application of amorphous membranes, even for fuel cells; the effects of proton transfer for non-precious catalysts; and how reverse operation can mitigate degradation. A general conclusion of the discussions was that the future availability of clean energy that is easily dispatched will rely on fuel cells and electrolyzers. As Prof. Joan Ogden of the University of California, Davis mentioned, we are tantalizingly close to the transition to a hydrogen economy, and the long-term benefits of such a transition will outweigh the costs.


I²CNER Annual Symposium 2015 Group Photo

2015. 2.12 ▸ 16 2015 American Association for the Advancement of Science (AAAS) Annual Meeting


The WPI booth


I²CNER staff explaining the objectives of I²CNER


WPI give-away bag


One of the break-out sessions

The Ministry of Education, Culture, Sports, Science and Technology (MEXT) of the government of Japan and the 9 WPI Institutes, including I²CNER, represented WPI at the 2015 AAAS Annual Meeting held in San Jose, California, USA February 12-16, 2015. AAAS is the world's largest general scientific society and is the publisher of the journal "Science." The theme for this year's meeting was "Innovations, Information, and Imaging." World-leading scientists, engineers, educators, policy makers, and journalists participated in scientific discussions and presented their research activities. On February 14 & 15, a family-oriented event called "Family Science Days" was also hosted, during which families could enjoy various science fairs. The WPI Institutes and MEXT hosted the WPI booth. Over the course of the three-day exhibition, more than 350 people visited the WPI booth.