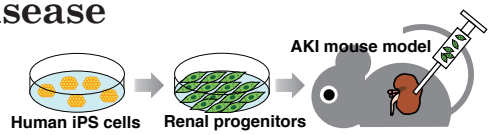
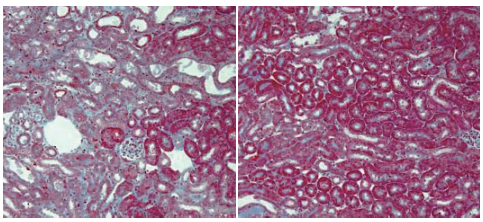
Cutting-Edge Research Aiming to Contribute to the Society

MED-BIOL

iPS Show Promise for Kidney Disease

Acute kidney injury can be ameliorated by cell therapy.





Kidney without treatment (left) shows high levels of damage (blue). Cell transplantation therapy using iPS cell-derived renal progenitors significantly ameliorates the kidney damage (right).

Acute kidney injury (AKI) is defined as a rapid loss of renal function due to various etiologies and has a high mortality rate, especially in intensive care patients. In addition, AKI has also been reported as a cause of chronic kidney disease (CKD) and a risk factor for cardiovascular diseases. Despite urgent needs, a treatment for AKI remains to be developed. In a new study in collaboration with Astellas Pharma Inc., our group recently succeeded in attenuating the symptoms of AKI mouse models induced by ischemic injury by cell transplantation therapy using renal progenitors differentiated from human iPS cells. The result suggests promise that the iPS cell-derived renal cells could be used for cell therapy and drug discovery to remedy AKI. The research group is also aiming to develop cell therapy for CKD and generating metabolically or physiologically functional renal tissues from human iPS cells to develop regenerative treatments for kidney diseases.

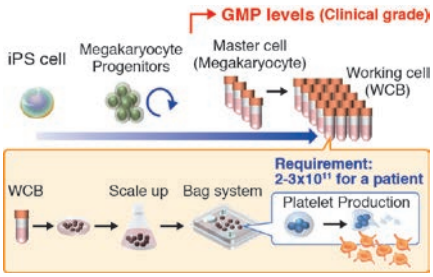
From the Editor Prof. Osafune received the Oshima Award 2014 from the Japanese Society of Nephrology for his research achievements, including this study.

Kenji Osafune, MD, PhD *Professor, Center for iPS Cell Research and Application (CiRA)*
www.cira.kyoto-u.ac.jp/j/research/osafume_summary.html

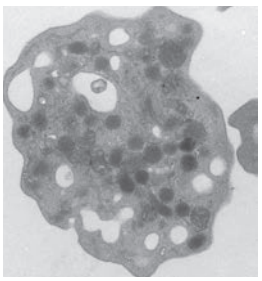
MED-SCI

Manufacturing Marketable Blood

Platelet packaging supply using human iPS cell-based technology.



Blood transfusion has a long history as the most successful form of cell therapy, but it is totally dependent on donors. In addition, platelets have a short shelf-life, which means that donors are constantly needed. In Japan, it is anticipated that its blood banks will fail to meet the demand for blood by up to twenty percent in ten to fifteen years. For this reason, my colleagues and I, with the involvement of industrial partners, are developing a system to produce marketable platelets. One challenge in cell therapies is providing a sufficient number of cells, and so we are currently seeking ways, using iPS cell technology, to achieve the required numbers by designing unipotent progenitors (immortalized megakaryocytes) that can generate platelets. These can be cryopreserved and expanded when required. In this way, they can be preserved for many months, instead of the few days for which blood cells can be normally stored.



Koji Eto, MD, PhD
Professor, Center for iPS Cell Research and Application (CiRA)
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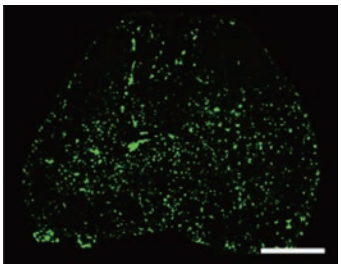
STEM CELL

Regenerative medicine for ALS using human iPS cells

Transplanted glial cells improve the disease environment in spinal cords of ALS mice.

There is currently no effective cure for amyotrophic lateral sclerosis (ALS), which is characterized by a loss of motor neurons. Diseased glial cells are thought to accelerate motor neuron degeneration. My colleagues and I have found that transplanted healthy glial cells derived from human induced pluripotent stem cells (iPSCs) can protect motor neurons in spinal cords and prolong the lifespan of ALS mice. Despite the hurdles ahead for human trials, all possible avenues provided by iPSC technology should be considered and tested to combat this pervasive disease.

Schema of spinal cord transplantation



Transplanted cells expressing green fluorescent protein in spinal cords of ALS mice (Kondo *et al.*, *Stem Cell Reports*, **3**, 242-249 (2014).

Haruhisa Inoue, MD, PhD *Professor, Center for iPS Cell Research and Application (CiRA)*
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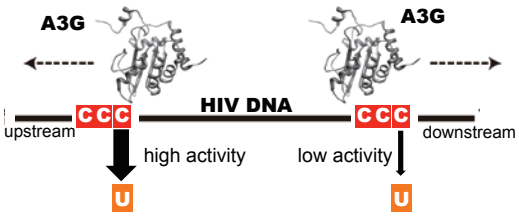
STRUCT•BIOL

Behavior of a Guard Against HIV (AIDS)

Real-time monitoring of anti-HIV enzymatic activity by NMR.

Human APOBEC3G (A3G) protein deaminates and mutates cytosine bases of HIV genes and thus destroys the genetic information of HIV. This is how A3G, a guard against HIV, exhibits anti-HIV activity. I developed a method to monitor the enzymatic activity of A3G in real-time by nuclear magnetic resonance (NMR) in collaboration with the Suntory Foundation for Life Sciences. The method enabled us to elucidate the dynamic behavior of A3G in action for the first time. A3G slides along HIV DNA to find a target cytosine. When A3G finds the target, A3G deaminates it. The catalytic rate of deamination is dependent on the sliding direction: the rate is higher when A3G slides upstream than it when sliding downstream. These properties of A3G are beneficial for effective destruction of the genetic information of HIV. Comprehensive understanding of the behavior of A3G may lead to the development of an anti-HIV drug.



Mutation by A3G coupled with sliding along HIV DNA

Masato Katahira, PhD *Professor, Institute of Advanced Energy*
www.iae.kyoto-u.ac.jp/bio/english.html

MED SCI

KEGG MEDICUS Drug Information Service

Making drug interactions easier to understand.

The aging population in Japan has led to a growing demand for medicines. In order to raise awareness of the drugs taken by each individual, my laboratory has developed the KEGG MEDICUS drug information service as part of our KEGG (Kyoto Encyclopedia of Genes and Genomes) project. It contains package insert (drug label) information for all prescription and over-the-counter drugs marketed in Japan, and is integrated with scientific data and information about diseases and drugs, as well as a database of adverse drug interactions. Its users can create personal medication lists in a web browser tool or an iPhone app, and the lists are automatically checked for any adverse interactions. This is a new form of the medication notebook (called *okusuri-techo* in Japanese) that is commonly used in Japan, which encourages more active involvement by each individual in managing their own medication plan.

Minoru Kanehisa, PhD
Project Professor, Institute for Chemical Research
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HEALTH SCI

Device for Mild Hyperbaric Oxygen and its Effect

New product for the maintenance and improvement of health and prevention of aging and metabolic disease.

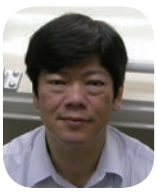
In cooperation with Medical O_2 Co., Ltd. (Kumamoto, Japan), my laboratory has developed a device (Japanese patent number: 5076067; Inventor: Akihiko Ishihara; Registration date: September 7, 2012) that can maintain conditions at 1.25 atmospheres absolute with 36% oxygen (mild hyperbaric oxygen). Mild hyperbaric oxygen raises the level of dissolved oxygen in plasma and increases blood flow due to vasodilation, thereby enhancing metabolism effectively and safely. In addition, mild hyperbaric oxygen stabilizes the activity of the autonomic nervous system.


Mild hyperbaric oxygen chamber

The chamber consisted of two instruments: an oxygen tank in which a single participant could lie down and a control box containing an oxygen concentrator and an air pump.

Space travel induces degenerative changes such as muscle atrophy in the neuromuscular system. We observed that preconditioning with mild hyperbaric oxygen inhibits disuse-induced muscle atrophy (2008, 2010). We also observed that mild hyperbaric oxygen in experimental animals effectively treats type 2 diabetes (2006, 2007, 2010), diabetes-induced cataracts (2011), hypertension (2010), and type II collagen-induced arthritis (collaborative project with NH Foods Ltd., Tsukuba, Japan, 2010).

In human clinical studies, we observed that mild hyperbaric oxygen inhibits ultraviolet B irradiation-induced melanin pigmentation and diminishes senile spot size (collaborative project with Kao Corporation, Tokyo, Japan, 2011). Recently, we determined that mild hyperbaric oxygen is beneficial in the treatment of infertility (collaborative project with Suwa Maternity Clinic, Hospital for Obstetrics, Gynecology, and Pediatrics, Suwa, Japan, 2013, 2014). The rates of clinical pregnancy in thirty-seven women with intractable infertility were 4.9% and 13.8% before and after mild hyperbaric oxygen treatment, respectively. Finally, women treated with mild hyperbaric oxygen gave birth after *in vitro* (five subjects) and natural (two subjects) fertilization. Currently, we are examining the effects of mild hyperbaric oxygen on mental conditions such as depression, autism, and autonomic ataxia.



Akihiko Ishihara, PhD *Professor, Graduate School of Human and Environmental Studies*
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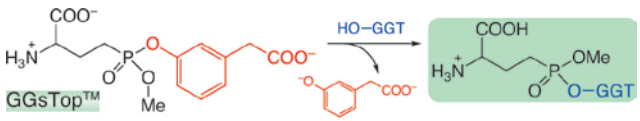
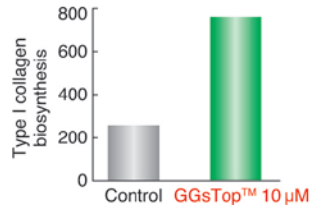
BIO-ORG CHEM

γ-Glutamyl Transpeptidase Inhibitor Marketed

γ-Glutamyl transpeptidase inhibitor as an innovative ingredient in anti-aging cosmetics.

Glutathione (γ-Glu-Cys-Gly, GSH) is a natural anti-oxidative and detoxifying agent against reactive oxygen species (ROS) and toxic xenobiotics. In its metabolism, γ-glutamyl transpeptidase (GGT) plays a critical role as the sole enzyme that degrades glutathione. We developed phosphorus-containing mechanism-based inhibitors of GGT for controlling cellular redox status. The most potent inhibitor GGsTop™ was found to increase the biosynthesis of collagen, elastin and HSP47 in fibroblasts in human skin.





After careful examination of efficacy *in vivo* (human) and toxicity tests, we founded a venture company called Nahls Corporation in 2012, and marketed the GGT inhibitor as an innovative anti-aging cosmetic ingredient under the registered trade name of Nahlsgen®. Nahlsgen® increases skin elasticity and keratin water content. Nahlsgen® has gained a reputation as a unique anti-aging cosmetic agent based on a novel concept, and has penetrated the cosmetic market not only in Japan, but also in other Asian countries.

From the Editor For the production and sales of Nahlsgen®, the Nahls Corporation received the NBK Grand Prize and the Director of Kinki Economic Industries Prize from the New Business Conference Kansai (NBK) in 2012.

Jun Hiratake, PhD (left) **and Bunta Watanabe, PhD**
Professor (left), and Assistant Professor, Institute for Chemical Research
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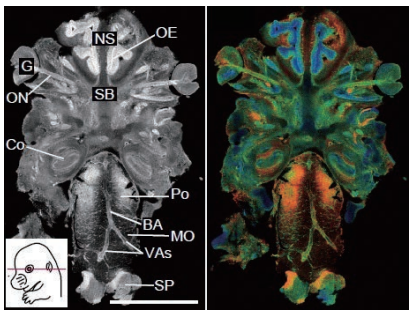
MED-SCI

Seeing "in a Living Mouse" is Believing

Live imaging of molecular activities by cutting-edge microscopy.



With the advent of microscopy and the discovery of green fluorescent protein (GFP), even molecular activities can be visualized in tissue culture cells. However, does what we see in the tissue culture cells occur also in living tissues? To seek answers to this question, I have generated transgenic mice expressing GFP-based biosensors for the molecular activities. Furthermore, in collaboration with Olympus Co., I developed imaging instruments designed specifically for the observation of living mouse tissues. Now, we can see how protein activities are regulated in inflamed tissues or cancer cells in living mice. More recently I have even been able to visualize molecular activities in the brains of awake-behaving mice.

From the Editor Prof. Matsuda and his colleagues observe and document *in vivo* behaviors of bacterial materials which express fluorescent proteins. Videos of their work can be viewed on their laboratory website (www.fret.lif.kyoto-u.ac.jp/movie.htm).

Michiyuki Matsuda, MD, PhD *Professor, Graduate School of Biostudies*

www.fret.lif.kyoto-u.ac.jp/e-phogemon/index.htm

BLDG ENG

Seismic Retrofit of Wooden Houses

What's the best way to reinforce houses to withstand nearby earthquakes?

Prof. Kawase explaining the structure and functions of the seismic retrofitting for an NHK broadcast. This research has been receiving increasing attention from the media.

After the Hyogo-ken Nanbu (Kobe) earthquake disaster in 1995, we found that the heavy damage in Kobe was caused by relatively long-period (approx. 1 second) ground motions typical for earthquakes occurring nearby, in which both peak accelerations and velocities are quite high. The current building codes and retrofit methods for old buildings consider only how to cope with high acceleration input, for which any rigid structure can survive. We performed two different kinds of shaking table experiments, one to examine tolerance to high acceleration input and the other to examine high acceleration and velocity input. It turned out that the conventional method for reinforcing wooden houses seemed effective to the former, but not to the latter. On the other hand, our newly developed "Wall-of-Columns" technique can make houses survive both inputs. We are promoting this technique to retrofit as many wooden houses as possible in preparation for subsequent earthquakes.

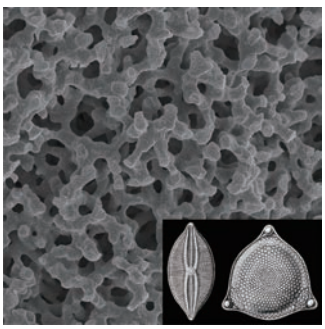
Hiroshi Kawase, PhD *Professor, Disaster Prevention Research Institute*

zeisei5.dpri.kyoto-u.ac.jp/en/index.html

INORG-CHEM

An Artificial Diatom?

Porous Silica Monolith by Sol-Gel. purifies chemical substances.



Microstructure of monolithic silica with uniform-sized pores (inset: Diatom [taken from Ernst Häckel, *Kunstformen der Natur*, 1904])

A microorganism called a "diatom" utilizes silica to support its body, and a variety of sponge, network or slit morphologies are found in nature. My study started with synthesizing silica gels from a solution, through a sol-gel process, to obtain spongy solids in a bulk form, "monoliths." Diatom-like porous structures are obtained with the aid of water-soluble polymers. Similar materials consisting of various metal oxides, such as titania and alumina, are also available now. Monolithic silica with uniform-sized pores allows solutions to quickly flow through and can purify chemical substances by a method called "liquid-chromatography (LC)." The "monolithic silica LC column" was commercialized in 2000, and I have since explored many extended applications with my venture companies.

From the Editor This achievement earned Dr. Nakanishi the 2010 Commendation for Science and Technology, awarded by MEXT.

Kazuki Nakanishi, PhD *Associate Professor, Graduate School of Science*

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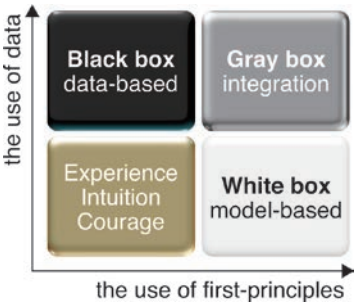
PROCESS SYS ENG

Virtual Sensing Technology

How to predict and control product quality in real time.



We must control product quality, but is it always measured in real time? Unfortunately, the answer is no. Thus, virtual sensing technology, which predicts difficult-to-measure product quality from easy-to-measure process variables, plays a key role in industrial processes. We have developed a "just-in-time" modeling technique, which can predict product quality with high accuracy even when process characteristics change abruptly due to equipment maintenance. The idea is that we build a local approximation model every time prediction is required. In addition, we have developed a unified framework of gray-box modeling, in which first-principle (white-box) models and statistical (black-box) models are integrated in three ways. The developed modeling method has been applied to various industrial processes such as petrochemical processes at Showa Denko, semiconductor processes at Sony Semiconductor and Toshiba, steel processes at Nippon Steel & Sumitomo Metal, and pharmaceutical processes at Daiichi-Sankyo. Through this technique, product quality, productivity, and process stability have been improved in real industrial processes.

From the Editor For this work, Prof. Kano and his colleagues received the Technology Award from the Society of Instrument and Control Engineers (SICE), the Outstanding Paper Award from the Journal of Chemical Engineering of Japan (JCEJ), and the Instrumentation, Control and System Engineering Research Award from the Iron and Steel Institute of Japan (ISIJ).

Manabu Kano, PhD *Professor, Graduate School of Informatics*
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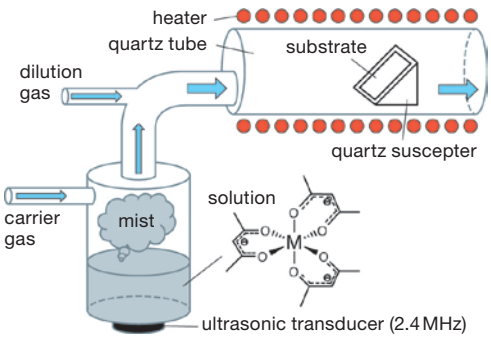
ELEC-ENG

Using Green Technology to Manufacture Green Devices

Reducing the energy use of electronic devices to help save the environment.



Electronic devices have a key role to play in saving environment, as highlighted by the Nobel Prize awarded for the development of blue LED technology in 2014. It should be noted that huge amounts of energy (electricity, waste disposal, etc.) are used in fabricating electronic devices, and that efforts to lower the energy used is now an important issue. We have developed a mist chemical vapor deposition as an environmentally-friendly and non-vacuum-based growth technology for nanoscale-controlled thin films and devices (see schematic illustration). A variety of metal-oxides, metal-sulfides, and organic films have been grown under nanometer-scale control without using vacuum systems and dangerous sources.

Through collaborative research and development with a lot of companies, as well as patent management by Kyoto University's Office of Society-Academia Collaboration for Innovation (SACI), this technology is becoming more widely used for fabricating solar cells, high-voltage devices, functional coating, and applications. With the support of the New Energy Development Organization (NEDO), the further development and application of this technology is rapidly progressing.

Shizuo Fujita, PhD *Professor, Graduate School of Engineering*
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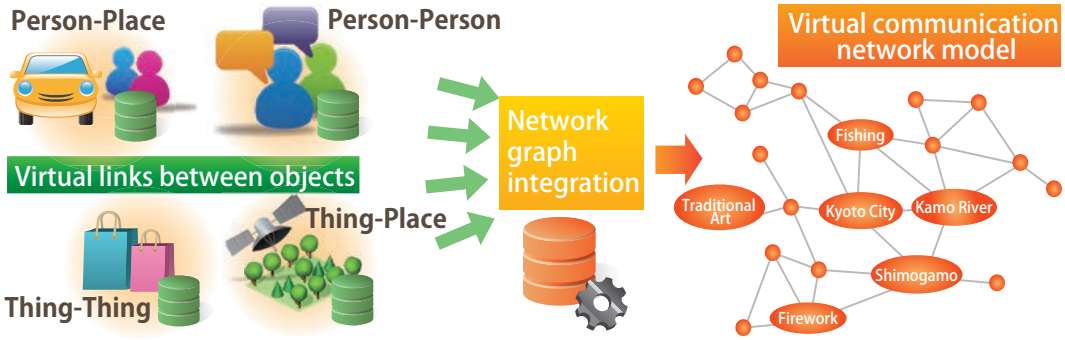
LIFO

A Virtual Link to Behavior Modeling

Communication-network behavior modeling and prediction.

My research has mainly focused on how to model the behaviors of communication-network users and how to predict their future behaviors. My findings suggest that people's behaviors are affected mainly by economic and social factors. First, people are more likely to choose more economically beneficial options: users simply prefer a faster or a more-battery saving connection for their mobile communication. For this reason, a discount-coupon type mechanism might work to provide incentive for users to suppress their data traffic when the network is congested. Second, people use communication network applications like phone calls, e-mail, chat, and SNS, to



establish, maintain, and develop social relationships with their family, friends, colleagues, and business partners. They also use communication networks to obtain information that they are socially interested in. My research results have shown such economic and social models of communication-network users work effectively to solve complex problems in related research fields.

One of the most promising solutions produced from my research results is the "virtual communication network model," in which we can numerically measure relationships between any two objects, i.e., people, things, or places, if we assume everything is virtually equipped with its own communication device, and each pair devices is virtually interconnected via a "virtual" link. In such a virtual communication network model, the strength of each virtual link between each pair of two objects temporally varies according to their interaction, while those virtual links are integrated to a huge network graph. Surprisingly, this model enables us to predict people's behaviors, i.e. who they will meet, what they will want, and where they will go, because the structure of the network graph reflects how it will change in the near future. Behavior prediction attracts many business fields like market analysis, advertising, e-commerce, content delivery, navigation systems, healthcare, etc. In 2011, I co-founded an industrial forum called the Mobile and Socialized Systems Forum (MSSF, http://mssf.jp/en/), in which over sixty private companies in Japan have been actively developing and promoting a commercialized system based on the virtual communication network model.

Ryoichi Shinkuma, PhD *Associate Professor, Graduate School of Informatics*
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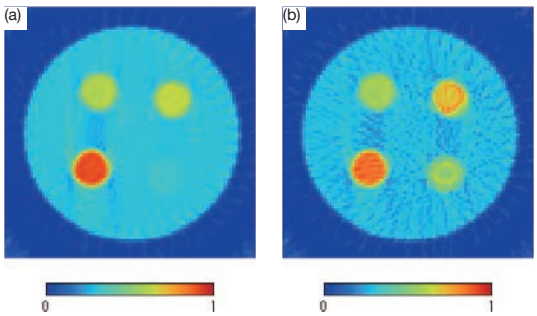
RAD-PHYS

Material Inspection with Fixed X-ray Colors

Energy-resolved computed tomography with a current-mode transXend detector.

X-rays emitted by an X-ray tube have polychromatic energy distribution. The average energy, i.e., color, of X-rays becomes higher as they pass through materials. In the observation of cancer being marked by an iodine contrast agent, the signal of X-ray absorption by the iodine is smaller when the cancer is in a Japanese Sumo wrestler than it is in a boxer: the Sumo wrestler has much more X-ray absorbing stomach, which changes the color of X-rays not very sensitive to iodine. The energy-resolved computed tomography (CT) uses X-rays with specific colors, and CT images obtained are not affected by the thickness of the subject. Our invention the "transXend detector" makes the energy-resolved CT practical. A two-dimensional transXend detector for future human applications is currently under construction through a collaborative study with Mitsubishi Chemical.

From the Editor The Atomic Energy Society of Japan presented a paper associated with this study with their Best Paper Award in March 2015.



CT images observed by (a) the conventional CT measurement method, in which the color of the X-rays changes and (b) the energy-resolved CT, in which materials are inspected by the fixed-color X-rays. The CT subject is 30 mm diameter cylindrical acrylic with four 5 mm diameter holes. In the bottom left and bottom right holes, iodine and tungsten solutions are filled with the thicknesses of 30 μm and 8 μm in 5 mm X-ray pass length (diameter of holes), respectively. The top left and top right holes have mixed solutions with the thicknesses of iodine being 15 μm and tungsten 2 μm, and iodine 15 μm and tungsten 4 μm in 5 mm in length, respectively.

Ikuo Kanno, PhD *Professor, Graduate School of Engineering*
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ROBOTICS

Why Can Snakes Move Without Legs?

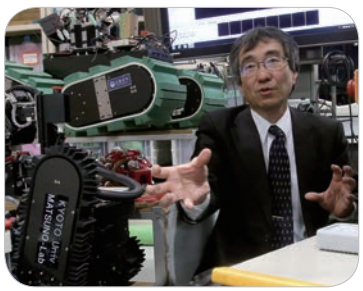
Developing rescue robots based on an understanding of animal behaviors.


KOHGA3


At a harver in Rikuzentakata, Iwate

Our laboratory has been engaged in two broad and connected areas of research that relate to human surroundings: "bio-inspired robotics" and "rescue robotics." Living creatures have survived and been optimized by natural selection. An understanding of the functions of living things is very useful in creating new artificial robots. In our lab, we are interested in analyzing the beautiful skills and behaviors of living things, and we are trying to find solutions to the following questions, among others: Why can living snakes move without legs? Why do quadrupeds change their gait patterns (for example, walk, trot, gallop) depending on their speed of movement? What is the mechanism of the flocking behaviors of birds and fish? How can small ants build a big anthill? Why can human beings walk with two legs? Based on our understanding of these phenomena, we can apply our knowledge to create robots to solve industrial problems. We have also been engaged in collaboration with several companies, through projects such as the swarm control of multiple moving robots, the "Murata Cheerleading Robots," with Murata Manufacturing, and the development of walking-assist carts with RTWorks and Funai Electric.

We believe that rescue robot systems are another important application of robotic technology. During my time as an employee at Kobe University, one of my masters' student, Mr. Motohiro Kisoi, was killed in the Great Hanshin-Awaji Earthquake on 17 January 1995. I have been putting my great efforts into the development of useful rescue robot systems and the establishment of rescue engineering. When the Great East Japan Earthquake occurred in 2011, we dispatched and utilized the rescue robots KOHGA3 (upper photo) to inspect damaged buildings in Hachinohe and Aomori, and we dispatched underwater robots to search for bodies in Minamisanriku, Miyagi, and Rikuzentakata in Iwate (bottom photo). My dream is to establish an international rescue robot team, like the popular TV show *Thunderbirds*, using advanced robotic technologies. If we can dispatch rescue robots from Japan to disaster sites everywhere in the world for disaster response and recovery, it will be a strong contribution to the world. I established the Motohiro Kisoi Fund to encourage and support students, from elementary school through to the university and graduate school-level, who are interested in rescue robotics, and young researchers who are dedicated to research on rescue engineering, emergency medical care, and mental care.



Fumitoshi Matsuno, PhD *Professor, Graduate School of Engineering*
www.mechatronics.me.kyoto-u.ac.jp

John Mung Program*

Opportunities to Explore Global Frontiers

The project to support mid- and long-term research by junior faculty members at leading academic institutions overseas.

*The program is named after the Japanese sailor, Nakahama Manjirō, also known in English as "John Mung," who was the first Japanese to set foot on American soil in 1841.

LAW

What Are Fair Conditions of Employment?

Court checks on the fairness of employment conditions.

Yuko Shimada, JD
Associate Professor,
Graduate School of Law
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MAT-SCI

Ceramics for Nuclear Core Safety

Silicon carbide composites for nuclear reactor core materials.

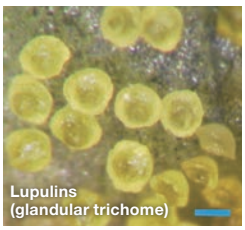
Everything has changed following the Great East Japan Earthquake, resulting tsunami and subsequent damage to the Fukushima Daiichi nuclear power plant complex. Enhancing the accident tolerance of light water reactors (LWR) has become significantly important internationally and in Japan. Silicon carbide (SiC) ceramics are considered as the safest nuclear core material due to their superior stability in high temperature steam. One of issues regarding SiC ceramics is their brittle nature. In collaboration with the Toshiba Corporation, we are developing ductile SiC ceramics by reinforcing SiC fibers (SiC composites) for LWR application. We have successfully developed SiC composites with enhanced corrosion resistance to high temperature water and high temperature steam with precise control of their processing.

Tatsuya Hinoki, PhD *Associate Professor, Institute of Advanced Energy*
www.iae.kyoto-u.ac.jp/conv/hinoki/index.html

BIOCHEM

A Key Gene to Add Bitterness to Beer

Aromatic prenyltransferase for bitter acid biosynthesis in hops.



Hops are an indispensable ingredient in beer production. The characteristic flavors and bitter taste of beer are given by hops, which are the female flowers of hop plants widely cultivated for brewery. Prenylated phloroglucinol derivatives of humulone (α-bitter acid) and lupulone (β-bitter acid), contained in lupulin glands in hop cones, are responsible for the bitter taste, and the former compound in particular contributes to the taste of beer. In the biosynthesis of humulone, the prenylation enzyme of phloroglucinol ring has remained a missing piece of the puzzle for many decades. Our group first opened this "black box" of the aromatic substrate prenyltransferase family in 2008 by identifying the first flavonoid-specific prenyltransferase. Then in collaboration with Kirin Holdings, a Japanese brewery company, we found the hop's prenyltransferase HlPT-1 for phloroglucinol substrate in 2012. This membrane intrinsic enzyme is also involved in the biosynthesis of xanthohumol, another hop-specific functional metabolite showing anticancer activities. More than five years are required for the breeding of new hop cultivars. HlPT-1 will be a powerful tool as a new molecular marker of hop breeding.

The book what Prof. Yazaki is a co-author, *Shokubutu-aroma-saiensu-no-saizennsen (Forefront of the Plant aroma-science)* (Tokyo: Fragrance Journal LTD., 2014)

Kazufumi Yazaki, PhD
Professor, Research Institute for Sustainable Humanosphere
www.rish.kyoto-u.ac.jp/lpge/

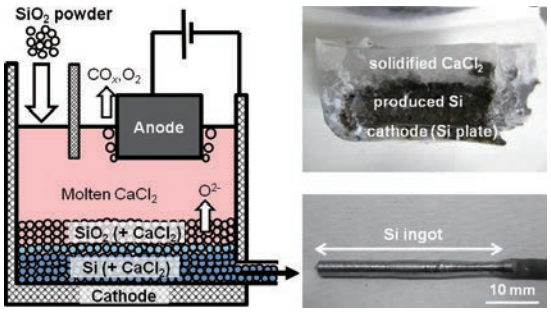
We work mainly for our livelihoods, but also in order to engage with society. The conditions of our employment, e.g., wage benefits and holidays, play an important role. However, most of us are not involved in determining such employment conditions, as they are usually decided by our employers. Most employees must accept the conditions offered by their employers. But, what happens, if the conditions which employers one-sidedly determine are unfair? For example, if an employment condition stipulates that employers can arbitrarily retract benefits? In such a case, the lives of the employees would become unstable. If unfair conditions of employment are prevalent in society, the society itself will become unstable, and it will become difficult to maintain public order. In Germany, I have been engaged in research into a system whereby the court checks the fairness of employment conditions.

From the Editor Dr. Shimada has been engaged in research as a Humboldt Research Fellow since May 2015.

INORG-CHEM

Make Solar Power the Main Energy Source for Mankind

Innovation for solar-silicon production by molten salt electrolysis.



A new method of producing solar-grade silicon through the electrochemical reduction of silica in molten salt.

Solar power generation is one of the most promising renewable energies. However, the percentage of photovoltaic (PV) power in the world's total primary energy production is still less than 1%. Silicon (Si) solar cells are most quickly spreading type of solar cells in the world owing to the advantages of their high efficiency, high durability, and harmlessness to the environment. However, the conventional production method of high purity Si (or solar Si, 99.9999% purity) has the disadvantages of low energy efficiency, low productivity, and high cost. Against this background, my colleagues and I have proposed a new method for the producing solar Si from purified silica (SiO_2) feedstock by using molten salt electrolysis. We have already verified the principle of the method, and are now conducting practical research with the aim helping to make solar power the main energy source for mankind.

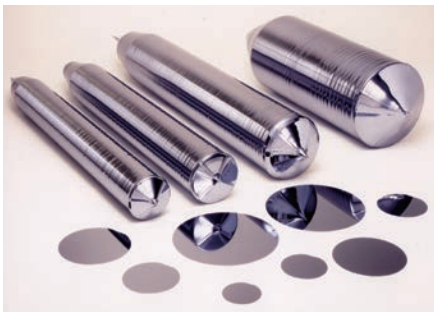
Toshiyuki Nohira, PhD *Professor, Institute of Advance Energy*
www.iae.kyoto-u.ac.jp/chemical/a-10_j.html

PROC SYS ENG

Super-Flat Epitaxial Silicon Wafer

Efficient data-based method for improving wafer flatness

Flatness of thick-film epitaxial silicon wafers is crucial in manufacturing power semiconductor devices. The time-consuming adjustment of flatness is frequently required because parts of the manufacturing equipment are routinely replaced. To standardize the adjustment procedure and improve productivity, we developed a flatness adjustment method based on a statistical model that relates wafer flatness to manipulation of the converted equipment. The statistical model was derived through design of experiments (DoE). The proposed method reduced the adjustment time by 75%. Consequently, we successfully increased productivity and decreased the operational risk.



From the Editor For this achievement, they received the Technology Award from the Division of Systems, Information and Simulation Technologies of the Society of Chemical Engineers, Japan (SCEJ).

Masahiko Mizuta (left) **and Manabu Kano, PhD**
SUMCO Corporation (left), Professor, Graduate School of Informatics
human.sys.i.kyoto-u.ac.jp/

LAW

A Page of Medieval History

Daily legal life reflected in medieval court records.

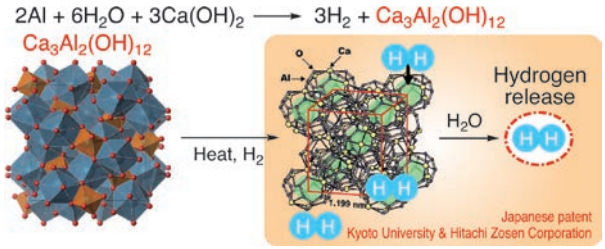
I am currently studying in Göttingen as a visiting fellow. My research deals with the Magdeburgian Law, a representative German medieval town law. It is a well-known fact that medieval towns created many legal institutions. To understand the law, it is essential to work with medieval manuscripts, such as court records. As may be expected, the records contain many civil conflicts. However, those who lived in medieval towns apparently visited courts for rather peaceful purposes—in order to avoid potential problems. Whenever I read the court records, I feel that people have always had similar tendencies, regardless of era or country. My research mainly contributes to the field of legal history, but it could also contribute to contemporary jurisprudence and a reexamination of existing legal systems.

Dan Sato, LLD *Associate Professor, Graduate School of Law* kyouindb.iimc.kyoto-u.ac.jp/e/iS2uO

INORG-CHEM

Save, Recycle, and Reuse Efficiently

Recycling waste using the chemical reactions of aluminum, calcium hydroxide, and water.



In this age in which we are vulnerable to global warming, it is important to make the maximum effective use of natural resources."Save, recycle, and recover" is a slogan for energy-saving and the effective use of resources in the future. We are working to recycle different types of waste using chemical reactions to produce new materials, new properties, or reuse them. One of the waste products is generated by a reaction between aluminum and calcium oxide with water to produce hydrogen. This reaction produces aluminum oxide, calcium aluminate compound, and other materials. With this simple process, we have transformed the waste product into a ceramic which is capable of storing hydrogen in its structure and surface. This ceramic has more advantages than conventional hydride materials used to store hydrogen, such as being lightweight and low cost.

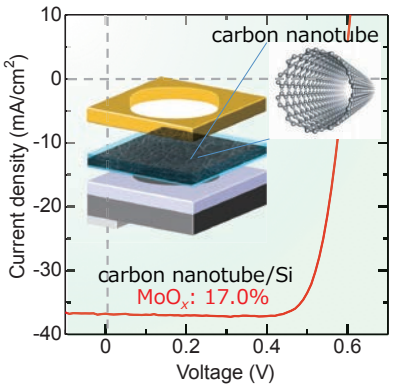
Heidy Visbal, PhD *Researcher, Graduate School of Engineering*
www1.kuic.kyoto-u.ac.jp (The laboratory to which she belongs)

NANO-SCI

Renewable Energy Research for the Next Generation

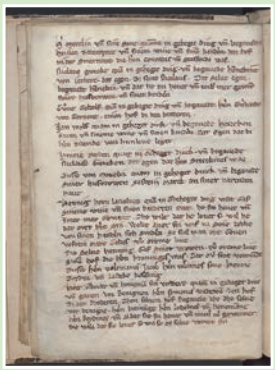
Development of high performance solar cells using carbon nanotubes.

Recently, innovative research and development of renewable energy sources are strongly required to ensure a sustainable society in the future. Solar light is a major clean renewable energy source, and so it is important that we use it efficiently to generate energy. High-performance solar cells with new functionality are key devices for solar light utilization. I have developed a new class of solar cells using carbon nanotubes in collaboration with the Hitachi Zosen Corporation. Right figure shows a schematic picture of my carbon nanotube/Si solar cell, which has a very high level performance (i.e. power conversion efficiency of 17.0%). This value (performance) is currently the highest among solar cells using carbon nanotubes. I am proceeding to develop new solar cells with flexibility and lightweight properties using the insights obtained from this research.



From the Editor Based on this research, Prof. Matsuda co-authored a paper with Mr. Feijiu Wang, for which Mr. Wang received the Young Author's Award at the 28th International Microprocesses and Nanotechnology Conference.

Kazunari Matsuda, PhD *Professor, Institute of Advanced Energy*
www.iae.kyoto-u.ac.jp/conv/en/#



Halle, Universitäts- und Landesbibliothäk, Yd 2° 31 (1), "Hallisches Schöffenbuch Bd. I", fol. 24v.

RESCUED by an American whaler after a terrible shipwreck in 1841, Nakahama Manjirō, also known in English as "John Mung," set foot in America. He enthusiastically learned about new technologies, laws, and customs. After he returned to Japan, he became a pioneering figure in developing the country's international relations. Inspired by his colorful life story, the program seeks to give junior faculty, staff members, and students opportunities to explore new academic and professional frontiers throughout the world.


PHOTO: Wikipedia