KYOTO UNIVERSITY

Research Activities 2011

Vol.1 No.2 November

Contents

Front cover: Tower Clock, Kyoto University in Autumn

Message from the President

Ever since its foundation in 1897, Kyoto University has valued open-minded dialogue under a liberal academic culture, fostering the spirit of independence and self-reliance while promoting higher education and advanced academic research.

Our campuses have been home to many historically respected scholars, including seven Nobel Laureates and many other winners of world authoritative prizes and awards for academics and researchers.

President
Hiroshi Matsumoto

Currently Kyoto University and other Japanese universities together, are sincerely exploring the ways in which the efforts of research universities can best contribute to the recovery process in the wake of the Great East Japan Earthquake and tsunami disaster of March 11, 2011. We must continue contributing to higher education and academic research as a university existing in harmony with the local community of Kyoto and Japan, further more with the world's human and ecological community. This must be accomplished while preserving and further developing its liberal academic culture and global standing as one of Japan's most diverse research-oriented universities. The university currently comprises 10 faculties, 17 graduate schools, 14 research institutes and 27 centers and other facilities, each of which is dedicated to making its own unique contributions to the international community.

This brochure is the second issue of the first volume to present some prominent examples of recent research activities at the university. I hope this information will be helpful as the initial publication which successfully have been estimated of its value in establishing new international relationships and networks with researchers in academics as well as in the industries, throughout the world.

November 2011

H. Matsumoto

Hiroshi Matsumoto

History and Culture

Kyoto University was established over 100 years ago, and its history has been colored by the unique cultural heritage and philosophy of Kyoto City.

Renowned as a culturally rich city, Kyoto was Japan's imperial capital for approximately 1,000 years following its founding as the city of Heian-kyo in 794. Throughout its 1200-year history, Kyoto has been the center of Japanese culture – both traditional and new. Even after the transfer of the capital to Tokyo with the Meiji Restoration in 1868, Kyoto continues to be regarded by many Japanese as the country's cultural capital and spiritual heartland.

Kinkaku-ji Temple in autumn, the first completion 1397

Consisting of three campuses spread over the urban and suburban districts of Yoshida, Uji and Katsura, Kyoto University is surrounded by beautiful scenery and historic sites where the old architectural style and designed picturesque gardens are hailed throughout the world.

Kinkaku-ji Temple, known as the Golden Pavilion, is located west from the Yoshida Campus, and is one of the most famous among the 17 UNESCO World Heritage Sites in Kyoto. Standing over a large pond, the building is literally decorated with gold leaf. Its presence is highlighted by picturesque view as it changes from season to season.

Byodo-in Temple completed 1052(above) Japanese 10 yen coins(below)

Byodo-in Temple situated in Uji City – a suburb of Kyoto City – is also a popular world heritage site. The main building, Phoenix Hall, has a pair of mythical Chinese Phoenixes embellishing the roof, while the building itself is also said to resemble to the shape of the mythical bird just before flight. This image is inscribed on the Japanese ten-yen coin.

Katsura Imperial Villa in the Katsura district, southwest of Kyoto city, has long been favored by garden and architecture lovers. The tea rooms designed for moon viewing provides an excellent view of the moon that is pleasing to the eyes.

Katsura Imperial Villa completed early 17th century (view of Shokin-tei from Geppa-ro)

These are only a few examples of the rich cultural history in the area, the basis upon which stands Kyoto University.

Academic

Although it is famous for its rich traditional culture, Kyoto is also well known as a modern city with a progressive outlook. This side of Kyoto is reflected in the rare examples of early 20th century architecture that can be found on some of its high streets, or the ultra-modern glass and steel structure of Kyoto Station. One of the newest cultural spots in Kyoto is the Kyoto International Manga museum, which is dedicated to the phenomenon of manga comics, which have become an internationally recognized symbol of modern Japanese culture.

Such elements of Kyoto reflect the fact that it has long been a city of academics, and a university town with a large student population. Of the approximately 1,460,000 people living in Kyoto, approximately 10% are college or university students attending one of the city's thirty-seven universities and colleges.

The city's unique academic atmosphere has influenced and inspired the distinctive academic style pursued by Kyoto University since its founding. Characterized by academic freedom and frank dialogue, Kyoto University's academic approach is founded on the concepts of self-reliance and self-respect (written in Japanese as 自重自敬 *jichō jikei*). Guided by those concepts, the university encourages its scholars to be independent and creative, and to make the most of their own originality and individuality.

"Self-reliance and self-respect"
Calligraphy by Professor **Hiroji Kinoshita**, founding president of Kyoto University.

Innovative

In Kyoto, the headquarters of world famous information technology and electronics companies are located a stone's throw from the headquarters of centuries-old traditional craft industries such as pottery and porcelain companies. Many innovative companies have been developed by fusing advanced technology developed at Kyoto University with the tried and tested techniques of traditional industry.

While advancing its education and research, Kyoto University also places a great emphasis on making a significant contribution to society. The contribution is manifested in many forms, such as collaborative undertakings with industry and government, assisting with the development of governmental policy, or providing state-of-the-art medical treatment at the university's affiliated hospitals.

President **Hiroshi Matsumoto** with the prefectural governor, the city mayor, the president of the Consortium of Universities in Kyoto, and the president of the Kyoto Chamber of Commerce and Industry. Photo taken in 2009.

Mission Statement

Our mission is to sustain and develop our historical commitment to academic freedom and to pursue harmonious coexistence within human and ecological community on this planet.

Foundation

- 1897
- Japan's second oldest national university

[left] The Clock Tower, as seen in 1925
[right] The original university library (built in 1899) and the Sonjodo building seen to the left.
*Both photos are preserved in the Kyoto University Archives

Katsura Campus

Uji Campus

Yoshida Campus

Facilities

- 3 Campuses located in Kyoto
- 10 Faculties
- 17 Graduate Schools
- 14 Research Institutes
- 27 Research and Educational Centers

Faculty, Staff & Students

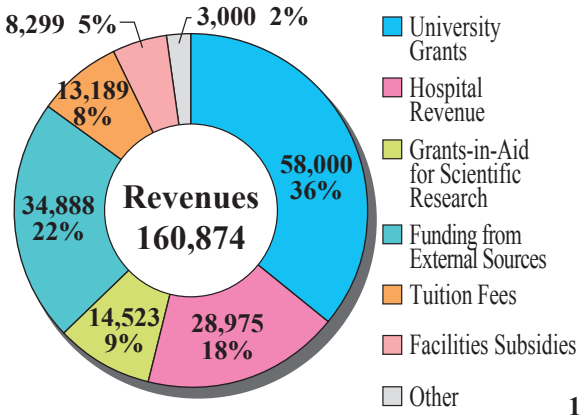
as of May 2011

- 2,868 Tenured Faculty
- 2,556 Non-teaching Staff
- 13,473 Undergraduates
- 9,314 Graduate Students
- 1,563 International Students
- 820 International Researchers

Budget

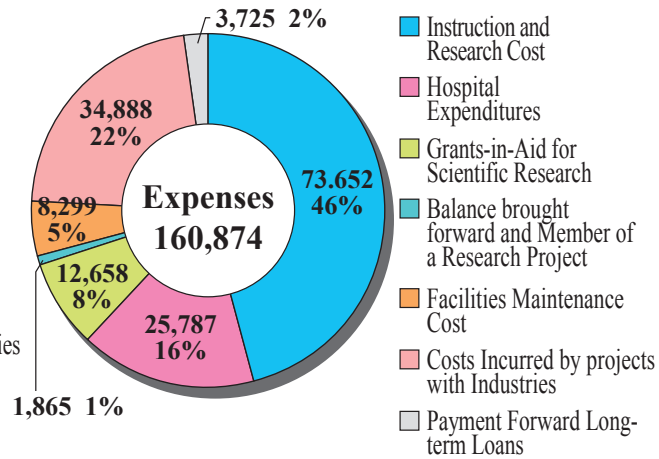
Revenues in Fiscal Year 2010

Unit: million JPY



Expenses in Fiscal Year 2010

Unit: million JPY



Awards

7 Nobel Prizes

Hideki Yukawa	Sin-itiro Tomonaga	Kenichi Fukui	Susumu Tonegawa	Ryoji Noyori	Makoto Kobayashi	Toshihide Maskawa
1949	1965	1981	1987	2001	2008	2008

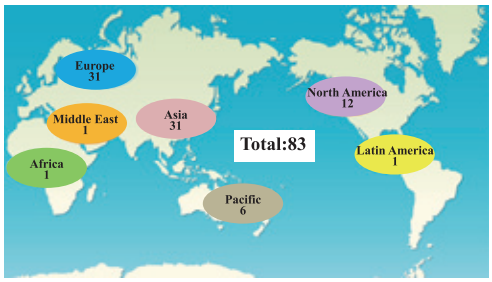
2 Fields Medals | 1 Gauss Prize | 4 Lasker Awards

Heisuke Hironaka	Shigefumi Mori	Kiyosi Itō	Susumu Tonegawa	Yasutomi Nishizuka	Yoshio Masui	Shinya Yamanaka
1970	1990	2006	1987	1989	1998	2009

Partner Universities and Consortia

Kyoto University's international exchange activities are intended to be mutually beneficial for all participants. We seek to develop multilateral exchanges and provide focused support for exchange activities in specially designated fields.

www.kyoto-u.ac.jp/en/research/international/agreement



Overseas Facilities

As a testimony to our global perspective, we have a well established history of building and maintaining a significant number of overseas research stations and branch offices, largely in Asia and Africa.

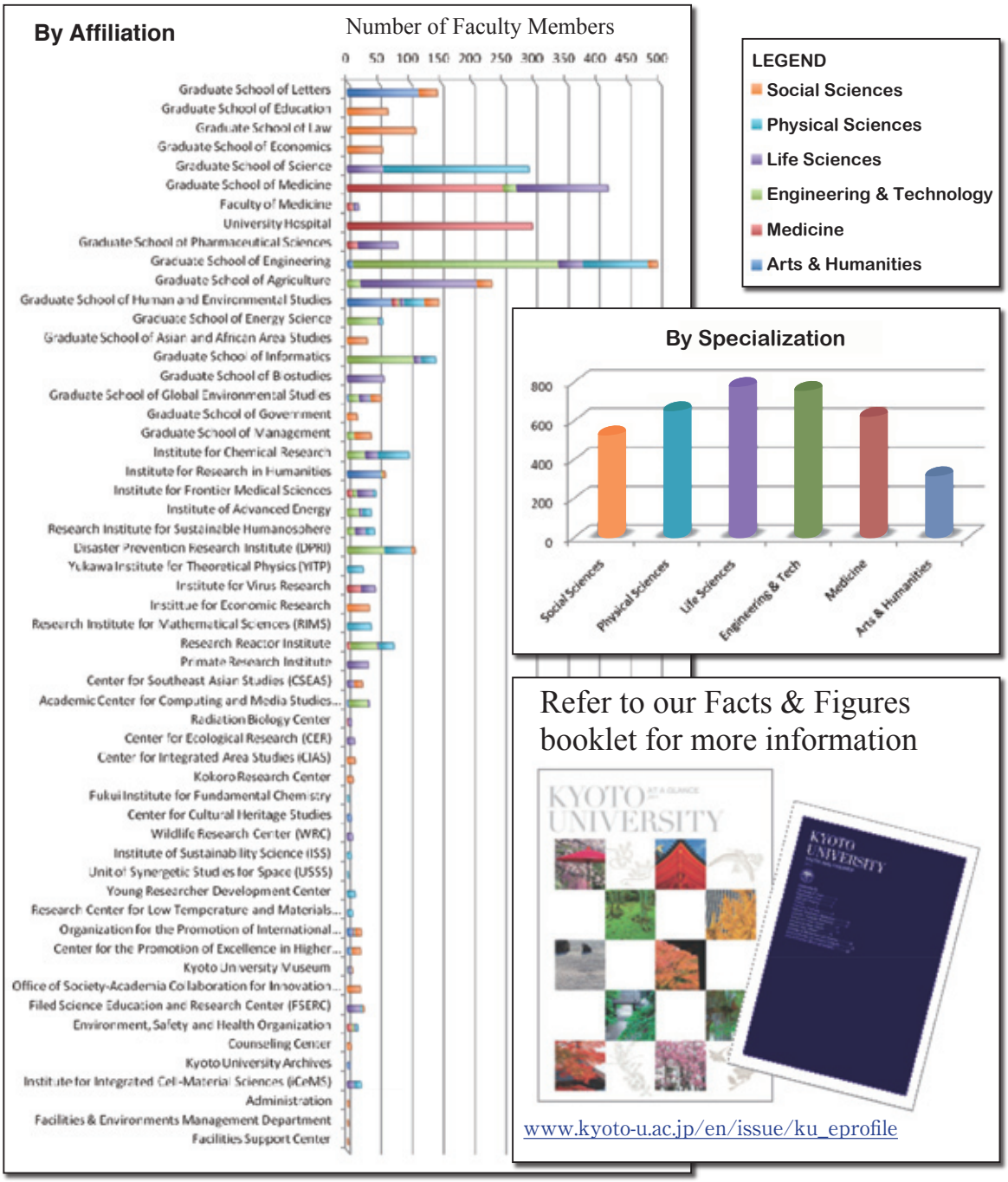
www.kyoto-u.ac.jp/en/profile/intro/facilities/foreign.htm

Support Organization

The Organization for the Promotion of International Relations (OPIR) coordinates and seeks to maximize the mutual benefits that may be attained between Kyoto University and its partner institutions. The OPIR is the international strategy headquarters which makes decisions regarding international exchange matters for Kyoto University. It also oversees several long existing international exchange committees.

For further information: www.opir.kyoto-u.ac.jp/e

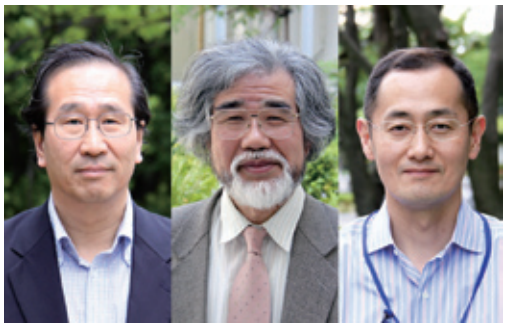
Diversity of Research at Kyoto University



・Based on the data used in the 2011 world university rankings.
・Non-permanent positions multiplied by 0.3.

WPI: Institute for Integrated Cell-Material Sciences (iCeMS)

Launched in 2007 by the MEXT* to create globally visible research centers, the **World Premier International Research Center (WPI) Initiative** seeks to 1) advance leading edge research, 2) create new inter-disciplinary domains, 3) establish truly international research environments, and 4) reform existing research organizations. The iCeMS is one of six WPI centers. Its founding director is Prof. **Norio Nakatsuji,** Japan's pioneer in the establishment and distribution of human ES cell lines, and a leader in ES/iPS cell-based drug discovery.



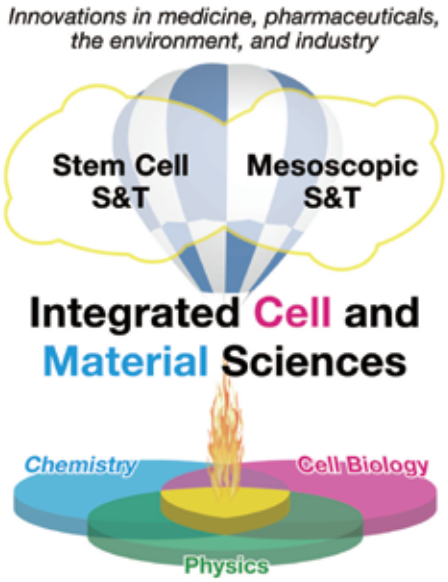
From left: Deputy Director **Susumu Kitagawa,** Director **Norio Nakatsuji,** CiRA Director and iCeMS Professor **Shinya Yamanaka**

Creating new cross-disciplinary fields through integration of the cell and material sciences

Investigating the control mechanisms of multimolecular structures within cells and artificial materials, the iCeMS pioneers the development of *stem cell science and technology*, and *mesoscopic science and technology*. These are anticipated to lead to innovations in medicine, pharmaceuticals, the environment, and industry.

Stem cell science and technology include:
- reprogramming with chemical compounds for iPS cell derivation
- chemical probes for stem cell research
- control of ES/iPS cell growth and differentiation with chemicals and materials
- creation and applications of stem cell-derived model cells in medicine and drug discovery

Mesoscopic science and technology include:
- imaging and probing mesoscopic complexes in living cells
- production of functional mesoscopic materials (e.g., porous coordination polymers)
- integration of mesoscopic materials and living cells
- modeling, simulation, and physics theories of mesoscopic events in materials and living cells



wpi iCeMS KYOTO UNIVERSITY WPI Research Center

www.icems.kyoto-u.ac.jp

*Japanese Ministry of Education, Culture, Sports, Science and Technology

Center for iPS Cell Research and Application (CiRA)

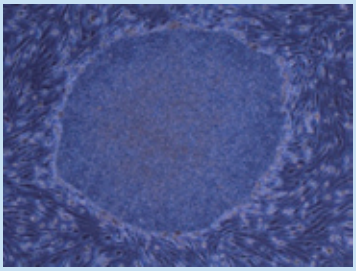
The Center for iPS Cell Research and Application (CiRA) was established in April 2010 as the world's first institute focusing on induced pluripotent stem cells or iPS cells. Professor Shinya Yamanaka, who pioneered the research field of iPS cell technology, leads the institute as director. Equipped with a cell processing facility and laboratory animal research facilities, CiRA is comprised of four research departments - Reprogrannig Sceience, Cell Growth and Differentiation, Clinical Application and Regulatory Science and 26 principal investigators work here to realize medical and pharmaceutical applications using iPS cells.

Director
Shinya Yamanaka

iPS cells can be generated by the introduction of a few genes into human somatic cells, such as those taken from skins and blood, and culturing them for a few weeks. Similar to embryonic stem cells, iPS cells have the ability to differentiate into any type of cell in the body, including neurons, cardiac muscle cells and liver cells. iPS cell-derived functional cells are expected to be used for toxicological studies, in vitro drug screening and regenerative medicine. For more information about CiRA, please visit our website.
www.cira.kyoto-u.ac.jp/e/

CiRA's goals over the decade

- Establishing basic technologies and securing intellectual properties.
- Developing new drugs by using patient-derived iPS cells.
- Establishing an iPS cell bank for use in regenerative medicine.
- Conducting preclinical and clinical studies on a few diseases.



Human iPS cells

CiRA's intellectual property

CiRA's Legal Affairs and IP Office plays a central role in the management of patents associated with iPS cell technologies at Kyoto University and works closely with iPS Academia Japan Inc., which is authorized to license the use of the iPS cell patents. Kyoto University has obtained 3 patents in Japan, 1 patent in Europe and 1 patent in the U.S.

Global COE Programs: 13 Centers of Excellence

The Global COE (Centers of Excellence) is a program with an aim to support quality research and education centers of the world's highest order. 13 projects have been selected from the wide range of scientific fields at Kyoto University, and are supported by the MEXT. These are the projects that have been chosen from among hundreds that were established by the previous 21st Century COE program, and continue to contribute to the world's knowledge bank.

www.kyoto-u.ac.jp/en/research/capital/global_coe/global.htm

Category : Life sciences (Since 2007)
Title : **Formation of a strategic base for biodiversity and evolutionary research: from genome to ecosystem**
Leader : Professor Kiyokazu Agata, Graduate School of Science
URL : gcoe.biol.sci.kyoto-u.ac.jp/gcoe

Category : Chemistry, material sciences (Since 2007)
Title : **International Center for Integrated Research and Advanced Education in Materials Science**
Leader : Professor Mitsuo Sawamoto, Graduate School of Engineering
URL : www.mtl.kyoto-u.ac.jp/gcoe/E

Category : Information sciences, electrical and electronic sciences (Since 2007)
Title : **Informatics Education and Research Center for Knowledge-Circulating Society**
Leader : Professor Katsumi Tanaka, Graduate School of Informatics
URL : www.i.kyoto-u.ac.jp/gcoe

Category : Information sciences, electrical and electronic sciences (Since 2007)
Title : **Center of Excellence for Education and Research on Photonics and Electronics Science and Engineering**
Leader : Professor Susumu Noda, Graduate School of Engineering
URL : www.kuee.kyoto-u.ac.jp/gcoe/eng

Category : Humanities (Since 2007)
Title : **Revitalizing Education for Dynamic Hearts and Minds**
Leader : Professor Masuo Koyasu, Graduate School of Education
URL : www.educ.kyoto-u.ac.jp/gcoe/en

Category : Interdisciplinary and combined fields (Since 2007)
Title : **In Search of Sustainable Humanosphere in Asia and Africa**
Leader : Professor Kaoru Sugihara, Center for Southeast Asian Studies
URL : www.humanosphere.cseas.kyoto-u.ac.jp/en

Category: Medical sciences (Since 2008)
Title : **Center for Frontier Medicine**
Leader : Professor Syu Narumiya,
Graduate School of Medicine
URL : www.med.kyoto-u.ac.jp/GCOE/E

Category: Mathematics, physics, earth sciences (Since 2008)
Title : **Fostering top leaders in mathematics - broadening the core and exploring new ground**
Leader : Professor Kenji Fukaya,
Graduate School of Science
URL : gcoe.math.kyoto-u.ac.jp/english

Category : Mathematics, physics, earth sciences (Since 2008)
Title : **The Next Generation of Physics, Spun from Universality and Emergence**
Leader : Professor Hikaru Kawai,
Graduate School of Science
URL : www.scphys.kyoto-u.ac.jp/gcoe/index_e.html

Category : Mechanical, civil engineering, architectural and other fields of engineering (Since 2008)
Title : **Global Center for Education and Research on Human Security Engineering for Asia Megacities**
Leader : Professor Yusuru Matsuoka,
Graduate School of Engineering
URL : hse.gcoe.kyoto-u.ac.jp

Category : Social sciences (Since 2008)
Title : **Global Center of Excellence for Reconstruction of the Intimate and Public Spheres in 21st Century Asia**
Leader : Professor Emiko Ochiai,
Graduate School of Letters
URL : www.gcoe-intimacy.jp

Category : Interdisciplinary, combined fields (Since 2008)
Title : **Energy Science in the Age of Global Warming -Toward CO_2 Zero-emission Energy System**
Leader : Professor Takeshi Yao,
Graduate School of Energy Science
URL : www.energy.kyoto-u.ac.jp/gcoe/en

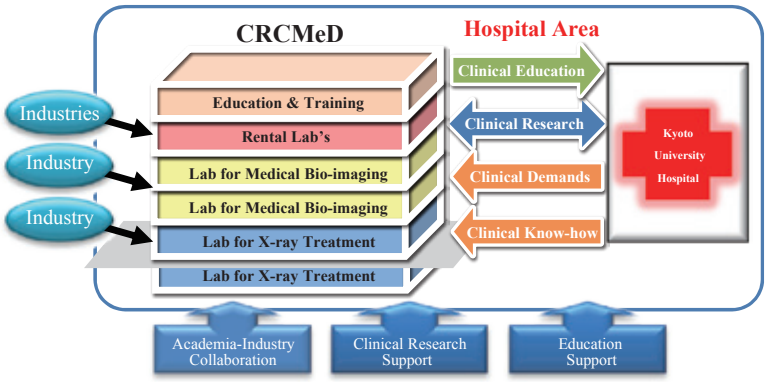
Category : Interdisciplinary, combined fields (Since 2009)
Title : **Sustainability/Survivability Science for a Resilient Society Adaptable to Extreme Weather Conditions**
Leader : Professor Kaoru Takara,
Disaster Prevention Research Institute
URL : ars.gcoe.kyoto-u.ac.jp/index.php?id=3

Clinical Research Center for Medical Equipment Development (CRCMeD)

CRCMed Director
Michiaki Mishima

The **Clinical Research Center for Medical Equipment Development (CRCMeD)** was established in 2011 in order to accelerate product development in innovative medical equipment and devices to support all stages throughout early diagnosis and treatment. Clinical research is a critical part of the medical product development process. The key function of the CRCMed is to promote academia-industry collaboration in this clinical research field.

Established on July 1, 2011
Building Area 4,635m²

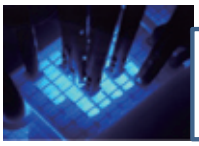


The most advanced institute for BNCT

Professor **Koji Ono**

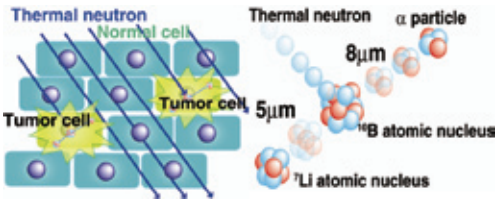
Boron Neutron Capture Therapy (BNCT) is a binary treatment for cancers. The ^{10}B nucleus absorbs thermal neutrons at much higher probabilities than other elements in the body, and instantly splits into two high linear energy transfer particles, an α-particle and a Li atomic nucleus, with a total range of 13 μm, which corresponds to general cell diameter. Therefore, with the combination of pre-injecting ^{10}B-compound to selectively accumulate in cancer lesions, and thermal neutron irradiation, we are able to selectively destroy cancers. A huge amount of neutrons are necessary for BNCT and the research reactor is used as a neutron source.

At the Kyoto University Research Reactor Institute (KURRI), more than 330 patients with no other viable treatment options, have received BNCT to the present. This is the largest number of BNCT treatments in the world. The kind of cancers that has been treated by BNCT include malignant brain tumors, malignant melanoma, recurrent H & N cancers, multiple liver cancers and lung cancers, especially malignant pleural mesothelioma. The effectiveness of BNCT has been clearly demonstrated on the first 3 cancers. KURRI was the first in the world to begin BNCT for malignant melanoma, H & N cancer and mesothelioma.



Kyoto University
Research Reactor Institute
www.rri.kyoto-u.ac.jp/en/

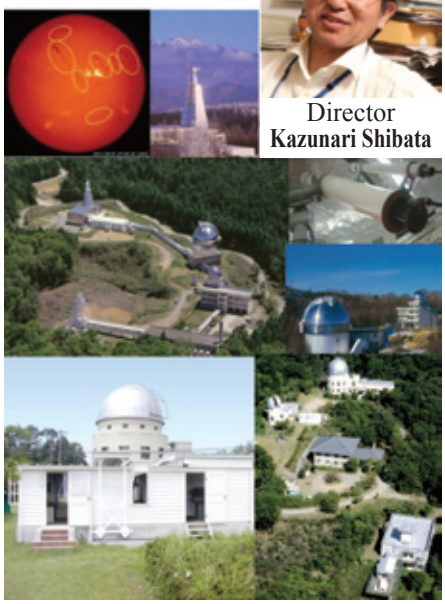
www.rri.kyoto-u.ac.jp/en/RD/LSMS/lsms04_pro.html



Kyoto University's Observatories:

The Kwasan Observatory in Kyoto City & Hida Observatory in Gifu prefecture

Director
Kazunari Shibata



The Hida observatory was built in 1968. It is located in the Japanese Northern Alps, where the clean air provides us with one of the best observational sites in Japan. We have several noteworthy instruments at Hida observatory, including the Domeless Solar Telescope (DST), and 65cm refractor telescope. We use these large, powerful telescopes to conduct pioneering research.

The Kwasan observatory, built in 1929, was historically Kyoto University's most important observation station before the construction of Hida. Today, the main activities at Kwasan are data analysis, conducting of numerical simulations using computer workstations, and academic instruction. However, high quality solar observations are still carried out on a smaller scale.

The observatory's instruments and workstations are made available for educational use at the high school level, as well as for students from other universities. We also continue to keep the observatory open to the general public.

www.kwasan.kyoto-u.ac.jp/general/index_en.html

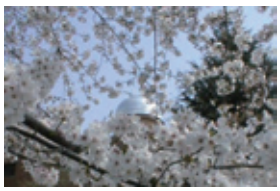
The current rise in solar activity is being monitored and reported.
www.kyoto-u.ac.jp/en/news_data/h/h1/news6/2011/110916_1.htm

Research Projects

Solar Physics: High resolution observations are carried out intensively utilizing the 60cm DST and Solar Magnetic Activity Research Telescope (SMART), to investigate the processes related to the storage, release, and transport of energy in the solar atmosphere. The main areas of interest are the evolution of small-scale magnetic fields and associated dynamical phenomena, sunspots, coronal heating, flares, prominence eruptions, and related space weather research. These studies also provide us with various hints to aid in our understanding of the origin of stellar and galactic activity as well as the role of such things as magnetized plasma in the universe. Coordinated observations and data analysis are carried out with domestic and overseas institutions, such as NASA and the National Astronomical Observatory of Japan (NAOJ).

Solar and Astrophysical Plasma Physics: Using theoretical, numerical, and observational methods, we work to solve the puzzles relating to highly explosive phenomena in the universe, especially magnetohydrodynamic (MHD) explosions and jets. Observational work deals with solar flares, stellar flares, and variable stars. There are a variety of different objectives in our theoretical and numerical studies, including understanding active galactic nuclei (AGN), jets ejected from protostars, MHD processes in accretion disks, and gamma-ray bursts, all of which are often referred to as the deepest mysteries of the universe.

Stellar Physics: Our research topics include stellar atmospheric structure and chemical composition, stellar active phenomena, stellar winds, cataclysmic variable stars, black holes, accretion disks and gamma-ray bursts. We investigate these topics using spectroscopic imaging and polarization observations using telescopes in Okayama and the NAOJ Hawaii observatories. In collaboration with the Department of Astronomy, Nagoya University, NAOJ and Nano-Optonics Energy, Inc., a 3.8m optical and infrared telescope is constructed with new technologies in Okayama prefecture.



www.kusastro.kyoto-u.ac.jp/

Micro/Nano Fabrication Hub in Kyoto Univ.

Part of the Low-Carbon Research Network (LC-net)

The Low-Carbon research network that was proposed in 2010 is under development by the MEXT as a new research infrastructure network in Japan with a focus on environmentally friendly energy technologies. Its total budget is 13 billion JPY. The research accomplishments and nanotechnology discoveries will be integrated into practical environmental technologies and systems to accelerate new developments and applications.

Achieving innovative research thorough the fusion of research fields, the LC-net is composed of three HUB centers – one of which is Kyoto University – and 15 other satellite research centers. All of the centers will be equipped with advanced systems and apparatus. The three HUB centers are placed to work for the development of new materials, the fabrication of new micro and nano devices and for carrying out their testing.

Professor
Hidetoshi Kotera

The role of Kyoto University as the micro/nano fabrication hub is to accelerate the research and the development of various innovative materials and micro/nano devices, and to contribute to technology transfer in the industrial field for the realization of a low-carbon future. The research fields are divided into the four domains of “Creation”, “Store”, “Use” and “Return”. More than 70 pieces of equipment are accessible by researchers and students at the Hub and are used for fabricating and evaluating micro/nano devices of various materials. Users are able to handle 4 and 6 inch wafers at the Hub.

Specialized technical engineers provide every user with training and support for the use of various fabrication processing and testing machines to carry out thin film deposition, photo and EB lithography, photoresist processing, patterning, dry and wet etching, bonding, dicing and evaluation. Teleconferencing systems serve to provide seamless communication between the Hub and each user’s laboratories.

www.mnhub.cpier.kyoto-u.ac.jp/index.html
(Japanese Only)

The **RISING Project**

Professor
Zempachi Ogumi

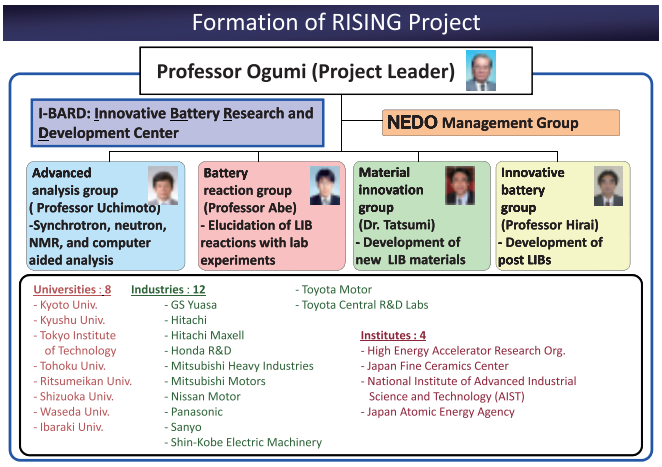
The **R&D Initiative for Scientific Innovation of New Generation Batteries (RISING)** project is an endeavor to develop innovative rechargeable batteries for a green revolution within Japan at this time of tough competition.

Cooperation between Kyoto University and NEDO (New Energy and Industrial Development Organization) has been ongoing to support this framework since 2009, and currently 12 industries and 12 academic institutions participate from across the nation.

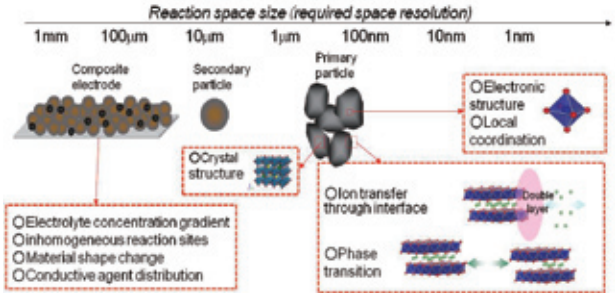
Objectives:
1. To strengthen the battery industry within Japan at this time of tough global competition.
2. To develop a new generation of batteries with high performances of greater than 500Wh/kg.
3. To act as a central hub for the battery community.

Project Duration:
Planned for 7 years:
2009 through 2016

Budget:
3 billion JPY per year



Three important targets for the RISING Project are; 1) establish advanced analytical methods based on close collaboration between industrial society and academia, to understand the phenomena in LIBs and to improve the performance 2) develop novel technology to realize innovative batteries with its performance as high as 500Wh/kg 3) form an interdisciplinary community for developing new generation batteries.



Towards this goal, what is most important is to realize that the battery reaction proceeds in a variety of space and time scales; from the sub-nanometer range where the charge transfer reaction takes place, to the centimeter range which corresponds to the size of the whole battery. This structural size hierarchy gives non-uniform distribution in the battery reaction sites so that we often fail to understand the details of the phenomena, kinetics and stability. Accordingly it is necessary to elucidate these phenomena in broad space and time ranges. We believe that to understand the limitations of LIBs with advanced analytical methods is the most effective way to lead to new concepts for innovative batteries.

www.rising.saci.kyoto-u.ac.jp/pdf/RISING_Battery_Project_en.pdf

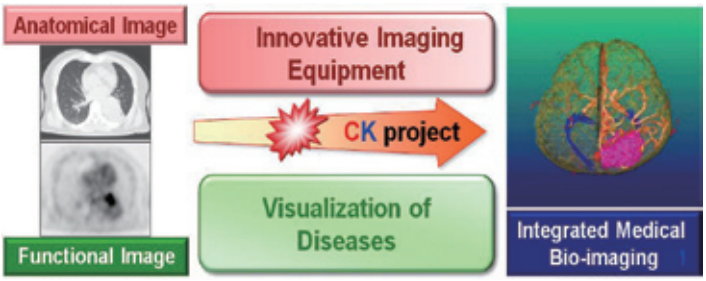
CK Joint Project with Canon

The **Innovative Techno-hub for Integrated Medical Bioimaging** project, also known as the **CK project**, combines the university's background in integrated science and technology and its excellent record in clinical research, with Canon's technical strengths in product development. Initiated in 2006, it is expected to continue on a 10-year MEXT supported budget.

The goals of innovating treatments in medicine has become the drive behind this work. Our long-term aims are to propose and realize new imaging-diagnosis techniques.

C: Canon
K: Kyoto University

Project Members:
47 Researchers and Postdocs
(School of Engineering, KU)
56 Researchers and Medical doctors
(School of Medicine, KU)
50 Researchers
(Canon)
Budget Total:
10 billion JPY over 10 years
(2006-2015)



For further information: ckpj.t.kyoto-u.ac.jp/?lang=en

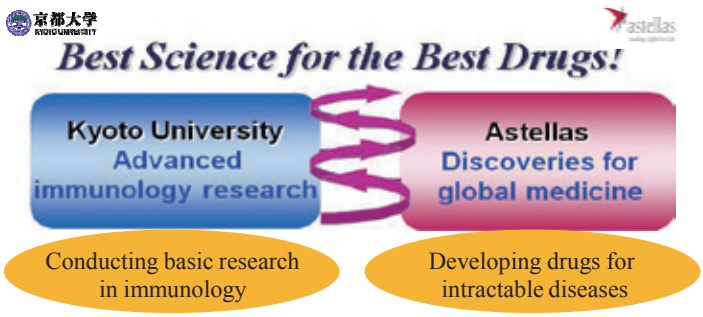
AK Joint Project with Astellas

The **Center for Innovation in Immunoregulative Technology and Therapeutics (AK Project)** collaborating with Astellas at the Fusion Laboratory within the School of Medicine.

- Innovating drug development systems.
- Identifying and validating new drug targets.
- Developing new drugs for allergies, autoimmune diseases, cancer, and immuno-suppression.
- Nurturing young talents comprehensive for drug discovery and intellectual properties.
- Funded by the MEXT for the promotion of science and technology.

Project Members:
45 Researchers and Postdocs
(KU and worldwide)
MD: 19
PhD (Non-MD): 26
52 Researchers (Astellas)
3 Intellectual property managers
14 Technical assistants

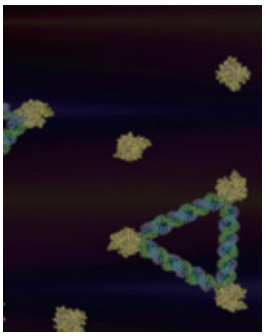
Budget Total:
11.6 billion JPY
over 10 years (2007-2016)



For further information: www.ak.med.kyoto-u.ac.jp/index.html
(Japanese only)

Hakubi Project : Fostering Young Researchers

The *Hakubi* Project welcomes applications from researchers all over the world regardless of the applicant's nationality. It is a project to support young researchers in any range of basic and applied studies in all academic fields. The following are introductions to recent research activities produced by two Hakubi researchers.



Synthetic RNA-protein nanostructure shaped like an equilateral triangle

RNA and RNA-Protein (RNP) Architectures

Associate Professor Hirohide Saito

The field of synthetic biology and bioengineering has promising outlooks for improving human health, and particularly for understanding the self-organizing principle of biological molecules and systems in life. Dr. Hirohide Saito, Associate Professor of the Hakubi Project, focuses on RNA and RNA-protein (RNP) architectures to build nanoobjects and to regulate cellular functions in a customized manner. This year, he succeeded in developing new RNP design technologies (two papers published this year; Nature Communications 2:160 and Nature Nanotechnology 6:116). Continuously, he aims to gain an understanding of the design principles of biological molecules and systems by employing "bottom-up" synthetic approaches.

Bhutanese Buddhism Research Project (BBRP)

Assistant Professor Seiji Kumagai

Interview with the principal Religious Minister Dorji Lopon (August 25, 2011)

Bhutan attracts attention throughout the world because of its promotion of the concept of Gross National Happiness (GNH). Recently, the Japanese media too has noted this as a significant guiding principle for social and political prosperity. In order to understand the concept of GNH in its proper context, we must examine the Bhutanese Buddhist doctrines in which it is rooted. Although studies of Bhutanese society and our understanding of its cultural strata have taken off in recent years, Bhutanese Buddhist doctrine has remained largely unexplored. It is to meet this need for academic focus on the religious roots of contemporary Bhutanese cultural trends that Dr. Kumagai started the BBRP in collaboration with the Center for Bhutan Studies, establishing its head office at Kyoto University. Dr. Kumagai, along with four post-doctoral researchers, runs the BBRP, which has adopted as its mission the publication of classic Bhutanese Buddhist texts, as well as the development of philological, historical, and anthropological studies in the area. This is the first ever full-scale research project on Bhutanese Buddhism.

■ What is the *Hakubi* ? How do I apply?

The term Hakubi literally means "white eyebrows" in Japanese. This project is named after a legend in Shu (蜀), one of the states of the Three Kingdoms era in ancient China. According to the legend, in the Kingdom lived five brothers with extraordinary talents. Since the fourth brother, who was particularly outstanding, had white hairs in his eyebrows, the term *Hakubi* has come to refer to the most prominent individuals. The call for applications will open for the fourth time in March, 2012.

■ **For further information:** www.hakubi.kyoto-u.ac.jp/eng

Elucidating of the Mechanisms behind Common Complications from Chronic Kidney Diseases

Applicable to chronic kidney diseases drug development

Professor Motoko Yanagita - Graduate School of Medicine
(Hakubi Associate Professor: April 2010 - October 2011)

Chronic kidney disease is a worldwide public health problem. Professor Motoko Yanagita and her research team have elucidated the mechanisms of common complications in the progressive stages of chronic kidney disease; renal fibrosis and renal anemia.

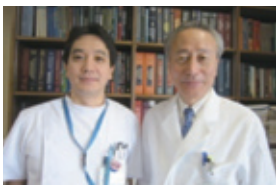
Renal fibrosis is the consequence of an excessive production of extracellular matrix produced by scar-producing cells, whereas renal anemia is mediated by the reduced production of erythropoietin (EPO), an erythrocyte production–stimulating hormone in the injured kidney.

Prof. Yanagita and her team demonstrated that EPO-producing cells in healthy kidneys and scar-producing cells during fibrosis both originate from a single cell lineage with neural characteristics. These cells enter the developing kidney during embryogenesis, and transform from one to the other depending on the status of the kidney. They further demonstrated that renal anemia is caused by the loss of EPO production in this cell lineage during fibrosis, and more importantly, that this loss can be restored in vivo. Discovering of the reversibility of reduced EPO production and fibrosis leads to the possibility of better therapeutic approaches for treating chronic kidney disease in the near future.

www.kyoto-u.ac.jp/en/news_data/h/h1/news6/2011/110913_1.htm

Epigenetic Regulation of the TGF-beta Pathway in Ovarian Cancer

The cancer advances when genes are silenced



Professor Ikuo Konishi - Graduate School of Medicine
Assistant Professor Noriomi Matsumura - Graduate School of Medicine

Researchers at Kyoto University and Duke Cancer Institute have found evidence of epigenetics at work on a genome-wide scale in cases of ovarian cancer. The researchers performed a series of studies on cancer cell lines and primary tumor specimens from ovarian cancer patients by comparing the genome-wide gene expression profiles of cells that were treated or mock-treated with drugs that inhibit DNA methylation. From these studies they identified 378 candidate methylated genes. From this group, all 43 of the predicted genes the researchers analyzed showed methylation in ovarian cancers. The researchers found that many of these genes were part of one pathway, the TGF-beta signaling pathway. When the researchers treated tumor cells with methylation inhibitors, the TGF-beta pathway showed increased activity. In addition, the genes they studied included a cluster of genes that strongly correlated with TGF-beta pathway activity in specimens from older women, which suggested that age-related epigenetic changes can accumulate and may contribute to cancer. Two different groups of patients the team identified might need different approaches. Some women with ovarian cancer have a lower expression of these tumor-suppressing genes and may be amenable to epigenetic therapies that lead to gene reactivation. Another group of women with ovarian cancer have a higher expression of these genes, suggesting it may be possible to specifically inhibit particular components in this pathway to stop tumor development or progression.

www.kyoto-u.ac.jp/en/news_data/h/h1/news6/2011/101214_1.htm
www.med.kyoto-u.ac.jp/E/grad_school/introduction/1404/

Artificial Hearing without Artificial Power

Piezoelectric materials mimic the function of the cochlear sensory epithelium

Associate Professor Takayuki Nakagawa - Kyoto University Hospital, Graduate School of Medicine
Dr. Takatoshi Inaoka - Kyoto University Hospital, Graduate School of Medicine

We have found that a battery-free cochlear implant can generate auditory responses in deaf animals. Current cochlear implants partially restore hearing in people who have inner ear hair-cell damage with a series of electronic sensors, actuators, and a battery power source. Takayuki Nakagawa and colleagues built a membrane implant, of which size is less than 1 mm, using a material that generates electricity in response to bending, and inserted the device in the cochlea of deafened guinea pigs. Sound was transmitted through the guinea pigs' ear canals to generate vibrations in the membrane, which created electrical pulses that varied with the sound frequency. The membrane's sound tuning was similarly aligned to the tuning in the cochlear basal membrane. In other tests, the implants were artificially stimulated and auditory brain stem activity was recorded. These results suggest that the device could be described as the "technological regeneration of cochlear hair cells," but caution that the device's electrical output must be increased to stimulate primary auditory neurons in the cochlea in the way current implants do. Together, the results suggest that one day, hearing impaired patients may be able to use small prosthetics that mimic natural cochlear function, without the need for a battery.

www.kyoto-u.ac.jp/en/news_data/h/h1/news6/2011/111025_1.htm
www.pnas.org/cgi/doi/10.1073/pnas.1110036108

Imaging Cell-Cell Communications in Living Animals

To flow, or not to flow,
——that is the question for the first red blood cells

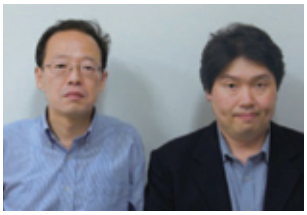
Professor Atsuko Sehara [left] —Institute for Frontier Medical Sciences and Graduate School of Medicine
Assistant Professor Atsuo Iida [right] —Institute for Frontier Medical Sciences

Cells produce different kinds of cell-to-cell signaling and cell adhesion molecules. Such molecules are often generated as transmembrane proteins, and their extracellular domains are cleaved off when cells send messages or detach. This process, called "ectodomain shedding", has come into focus since the discovery of proteases that possess this ability . Questions are in what physiological contexts do these proteases play roles and how do they manage to control shedding spatiotemporally. In order to address these questions, Prof Atsuko Sehara and her colleagues utilize transparent zebrafish embryos, in which dynamic cell behaviors can be visualized as 3D movies. Assistant professor Atsuo Iida succeeded in capturing the onset of blood circulation by monitoring fluorescently labeled erythrocytes and blood vessels. Unexpectedly, the earliest circulation of blood began synchronously. This synchrony was achieved by the retention of erythrocytes in the lumen of blood vessels, and then, by their simultaneous release into the plasma flow. Erythrocytes remained attached when they were devoid of a metalloprotease named ADAM8. ADAM8 shed ectodomains of cell adhesion molecules, which caused synchronous detachment of erythrocytes from blood vessels. Thus, this study demonstrated that the first erythrocytes require both heartbeat passive and proteolysis-dependent active processes to enter the circulation.

www.frontier.kyoto-u.ac.jp/rc03/index-j.html

Heavy Electrons in Flatlands

Unusual superconducting state by the two-dimensional confinement of heavy electrons in artificial superlattices



Professor Yuji Matsuda [Left] - Graduate School of Science
Associate Professor Takasada Shibauchi [Right] - Graduate School of Science

Metals conduct the electron current because they have electrons which are not bounded by atoms, called conduction electrons. At very low temperatures of near absolute zero (-273℃), some metals exhibit superconductivity, a phenomenon of exactly zero electrical resistance. Superconductivity is the most fascinating phenomenon in physics. In metals, electron-electron Coulomb interaction often plays an important role for determining their low temperature physical properties. The ultimately strong electron-electron interaction is attained in the so-called heavy-fermion compounds containing rare earth elements, where the free electron effective mass is enhanced by a few hundred times. Recently we have achieved the first experiment success of putting 'heavy superconducting electrons' in a two-dimensional lattice, which was obtained by fabricating heterostructures unavailable in nature. Superlattices with alternating heavy-fermion CeCoIn5 and nonmagnetic YbCoIn5 layers are grown using the molecular-beam-epitaxy technique. Superconductivity is observed even in superlattices with one-unit-cell thick CeCoIn5 layers, demonstrating heavy-electron superconductivity with purely two-dimensional electron correlations. Most remarkably, the superconductivity in superlattices persists under significantly higher reduced magnetic fields than in the bulk, implying that the "glue" like force holding the superconducting electron pairs together takes on an extremely strong coupled nature as a result of two-dimensionalization -- a situation reminiscent of the high-temperature superconductivity in copper oxides.

www.kyoto-u.ac.jp/en/news_data/h/h1/news6/2011/111011_1.htm

Three Cepheid Variable Stars Discovered in the Center of Our Milky Way Galaxy

The onset of active star formation inferred from infrared observations

Professor Tetsuya Nagata - Graduate School of Science

The region within a few hundred light years of the central black-hole of our Milky Way Galaxy, often called the Nuclear Bulge, presents us with various interesting objects and phenomena. It contains stars with ages ranging from a few million years to over a billion years, yet its star formation history and the triggering process for star formation remain to be resolved.

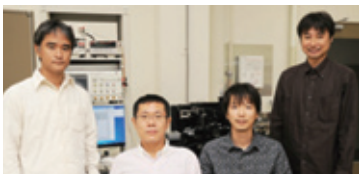
In the Nuclear Bulge, Prof Tetsuya Nagata and his research team discovered three classical Cepheid variable stars. They are pulsating super giants, whose ages can be derived accurately from their pulsation periods. According to the team's infrared observations at the South African Astronomical Observatory, all three Cepheid variable stars have pulsation periods of approximately 20 days and an age of close to 25 million years, suggesting that active star formation occurred at the period around their births. In contrast, the absence of shorter-period Cepheid variable stars shows that the star formation rate was lower between 30 and 70 million years ago. It is suggested that star formation in this region might have occurred on a time scale of a few tens of millions of years.

www.kyoto-u.ac.jp/en/news_data/h/h1/news6/2011/110825_1.htm

Electrical Control of Ferromagnetic Phase Transition in Cobalt at Room Temperature

Development for future low-power magnetic devices

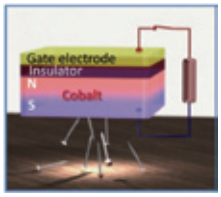
Assistant Professor Daichi Chiba - Institute for Chemical research
Professor Teruo Ono - Institute for Chemical research
Associate Professor Kensuke Kobayashi - Institute for Chemical research
Mr. Kazutoshi Shimamura - D2 student, Institute for Chemical research



From left: Assoc. Prof. Kobayashi, Mr. Shimamura, Assist. Prof. Chiba and Prof. Ono

Electrical control of magnetic properties is crucial for device applications in the field of spintronics. Our research team at the Institute for Chemical research, together with NEC cooperation, have demonstrated the room-temperature electrical control of the ferromagnetic phase transition in cobalt, a representative of the transition-metal ferromagnet family. Solid-state field effect devices, consisting of an ultra-thin cobalt film covered by a dielectric layer and a gate-electrode on top of that, were fabricated (Fig). They found that the ferromagnetic state of the film could be turned on and off isothermally and reversed simply by applying an electric field between the cobalt layer and the gate electrode at room temperature. The shift of the Curie temperature was found to be up to 12 Kelvin by applying an electric field of about ± 2 MV/cm. The result is a significant development for future low-power magnetic devices. For example, it could be used for building a "field-effect magnet"; where the magnet can be easily switched-off to become a non-magnet electrically, and for building a non-dissipative magnetic force generator without an electric current.

In addition, the demonstrated electric field effect of the two dimensional ferromagnet opens up a new way to explore and control magnetism in relation to the dimensionality.



www.nature.com/nmat/journal/v10/n11/abs/nmat3130.html
www.kyoto-u.ac.jp/en/news_data/h/h1/news6/2011/111003_1.htm

Low-Temperature Oxygen Diffusion in Iron Oxide Thin Films

Keys to developing technologies, such as solid-oxide fuel cells, related to energy and the environment

Professor Yuichi Shimakawa - Institute for Chemical Research

Prof. Yuichi Shimakawa and his research team at the Institute for Chemical Research revealed anisotropic oxygen diffusion behaviors in some iron oxides at low temperatures. When the brownmillerite-structure epitaxial $CaFeO_{2.5}$ thin films were reduced to the infinite-layer structure $CaFeO_2$ by low-temperature reductions with CaH_2, some of the oxygen atoms are released from and others are rearranged within the perovskite-structure framework. By evaluating the changes and the reaction time, the research team found two oxygen diffusion pathways and their related kinetics. The team also successfully prepared $[CaFeO_{2.5}]_m/[SrTiO_3]_n$ brownmillerite/perovskite artificial superlattice thin films and reduced them to $[CaFeO_2]_m/[SrTiO_3]_n$ infinite-layer/perovskite artificial superlattices. In the selective topochemical reduction, the oxygen-ion diffusion in the artificial superlattices was confined within the two-dimensional brownmillerite layers. The results obtained by the research team are expected to be keys to developing technologies related to energy and the environment such as solid-oxide fuel cells.

www.nature.com/nchem/journal/v2/n3/full/nchem.547.html
www.nature.com/srep/2011/110630/srep00027/full/srep00027.html

Why Color Vision Has Evolved in Humans and Higher Primates?

The influence of color on visual snake recognition in human children

Professor Nobuo Masataka - Primate Research Institute

Humans are extremely sensitive to biologically threatening stimuli, such as snakes, and it has been suggested that certain basic properties of the human visual system might have evolved precisely because they facilitated the detection of such fear-relevant stimuli. Nobuo Masataka and colleagues investigated the role of color in the detection of fear-relevant stimuli in human children. They showed 111 children, aged between four and six years old, matrices containing either one snake image and eight flower images, or vice-versa. The images were presented either in color or in grey-scale and participants had to detect the target image as quickly as possible.

As in previous studies on adult humans, all of the children detected target snakes more rapidly than target flowers. However, we found children also responded to both target snakes and target flowers faster when the images were presented in color than in grey-scale. Conversely, while the adults had detected target flowers more quickly in color, their response speed to snake targets did not change whether the images were in color or in grey-scale.

When detecting snakes, human children therefore appear to focus mainly on their color, which contributes towards a faster but less precise response. Adults, on the other hand, use the distinctive shape of snakes to help identify them as a target, regardless of color. The findings are published online in *Scientific Reports* on September 1, 2011.

www.kyoto-u.ac.jp/en/news_data/h/h1/news6/2011/110901_1.htm

Changing Families and Social Relationships in Southeast Asia

Effects on supporting care

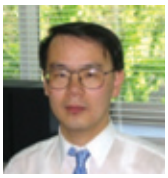
Professor Yoko Hayami - Center for Southeast Asian Studies

Professor Hayami and a team of historians, anthropologists and political scientists from seven Asian countries are working on producing a book on Changing "Families" in Southeast Asia, looking at both the family as an institution through legal, ideological and other national discourse, and at family-based relationships through anthropological fieldwork. In Western Europe, and also to some extent in other industrialized societies, the institutionalization of the modern family took place concomitant with industrialization. In Southeast Asia on the other hand, institutionalization of "the family" took place in varying historical contexts of colonialism, class formation, and emerging nationalist consciousness. Prior to this, rather than enclosed units such as families, networks of intimate relationships constituted the bases of social formation in the region. How then, has this social structure been transformed -if at all- by the institutionalization of the "family"? The family has now long been problematized in the west and other industrialized societies, with demographic changes towards low fertility, aging, and unstable marriages. Some countries in Southeast Asia as well are undergoing the same demographic processes, with further changes involving labor migration and international marriages. How, then, is the "family" and fundamental social relationships changing in Southeast Asia, and how is this affecting social care? These have become crucial questions in present day societies around the globe, and Southeast Asia provides illuminating examples.

www.cseas.kyoto-u.ac.jp/staff/hayami/hayami_en.html

Automatic Speech Recognition Techonolgy

Deployed in the Japanese parliament



Professor Tatsuya Kawahara - Academic Center for Computing and Media Studies

Automatic speech recognition (ASR) technologies have made significant progress in the past decade, leading to services such as voice search and speech translation on smart phones. However, it was still very difficult to accurately transcribe speech in meetings, which are spontaneous and interactive. Prof. Kawahara's group investigated the differences between faithful transcripts of utterances and official meeting records, and formulated a statistical "machine-translation" model of their wording. This has led to an innovative method for semi-automated training of the ASR model using a huge archive of meeting records. In the evaluations conducted with actual Parliamentary meetings, the accuracy of the output defined by the character correctness reached 89%. The system incorporating the technology is now officially used at the House of Representatives in Japan. This is the first system in the world that is officially deployed to automatically transcribe the meeting speech in Parliament. Ongoing developments of the technology include automatic captioning of lectures and assisting hearing-impaired students at universities.

www.ar.media.kyoto-u.ac.jp/diet/index-e.html
www.kyoto-u.ac.jp/en/news_data/h/h1/news6/2011/110512_1.htm

"Cultural Computing"

Art, culture and technology new relationship

Professor Naoko Tosa -Institute for Information Management and Communication

In the present day, one will often be in communication with individuals who have differing cultural backgrounds from their own, so the expectation is higher in understanding the context of other cultures. Because the typical methods in Japan for gaining an understanding of other cultures, are to read books or go to relevant museums, understanding other cultures by finding information is not easy. Can we understand cultures using computers as a medium to supplement thinking and memorization, while it seems to have become more suitable for networking, mobile connections, and two-way communications with its development? This research starts from the topic of art and technology, proceeds to the topic of culture and technology, and finally reaches the topic of a projected world based on the integration of these different concepts where both the creators and viewers of content can reach a deep mutual understanding of each other's culture. This is the field of "cultural computing", that is, the cyber-dealings of the essences of human culture; emotions, national identity and context. It integrates them into verbal and nonverbal information, proposing the prosperity of a field in which computers can better the exchange of cultural information using cultural models. This cultural computing, which is essential for the future development of communication abilities of computers, is a new field that utilizes what humans have accumulated in each culture and its history, in the form of actions or mannerisms when sharing common or peculiar aspects by demonstrating some concrete methodology. Tosa's artworks have been added to the collections of the New York Museum of Modern Art, the National Museum of Art in Osaka, as well as many other museums worldwide.

www.tosa.media.kyoto-u.ac.jp/index.html

BIOTECHNOLOGY

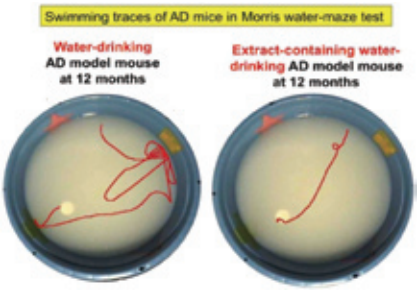
Identification of Plant Extracts Containing Inhibitory Activities on g-Sectetase

Identification of plant extracts that prevent Alzheimer disease

Professor Akira Kakizuka - Graduate School of Biostudies
Graduate Student (Doctor course) Norio Sasaoka - Graduate School of Biostudies

Prof. Kakizuka and his research team identified several plant extracts that contain inhibitory activities on γ-secretase, a key enzyme for Alzheimer disease (AD). They dissolved one showing the strongest inhibitory activity in water, and allowed AD mice to drink it freely. AD mice drinking the extract-containing water were able to quickly find the hidden platform in a Morris water maze test (Figure), showing apparently no impairment of learning and memory abilities.

In Chinese medicine, this plant extract has been used on humans for more than a thousand years. Thus, taking this plant extract itself or extract-containing drinks and/or foods would safely reduce the risk of suffering from AD.



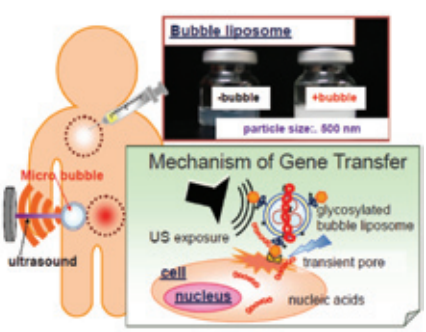
int.saci.kyoto-u.ac.jp/?p=2073

Glycosylated Liposomes for Cell-specific Delivery of siRNA and Plasmid DNA

Gene delivery for treating intractable disease

Professor Mitsuru Hashida - Graduate School of Pharmaceutical Science
Lecturer Shigeru Kawakami - Graduate School of Pharmaceutical Science

Targeted drug delivery via specific cellular receptors is a promising strategy for drug therapy. Prof. Hashida and Lecturer Kawakami have developed glycosylated (galactose, mannose, fucose, and mannose-6-phosphate modified) liposomes for cell-selective targeting of gene drugs and demonstrated their therapeutic activities. Recently, the researchers have developed a new gene delivery system in which glycosylated bubble lipoplexes are combined with ultrasound (US) exposure. Intravenous injection of mannosylated bubble lipoplexes followed by US exposure resulted in specific delivery of plasmid DNA (pDNA) and siRNA to splenic dendritic cells or hepatic endothelial cells (HECs) expressing a mannose receptor in mice. DNA vaccine with pDNA expressing melanoma-related antigen (gp100) exhibited high inhibition activities against tumors. The siRNA against intracellular adhesion molecule-1 (ICAM-1) administered with this system exhibited strong reduction of inflammatory responses by knocking out of ICAM-1 production in HECs and suppressed migration of neutrophil. Thus, glycosylated bubble lipoplexes combined with US exposure demonstrated efficient nucleic acids delivery and therapeutic efficacy.



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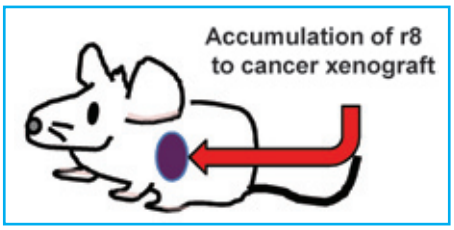
Delivery of Anti-cancer Drugs Using Oligoarginine Peptides

Oligoarginine peptides may provide novel methods of cancer targeting!

Professor Shiroh Futaki - Graduate School of Pharmaceutical Science

Prof. Futaki and his research team have developed a new approach of cancer targeting using oligoarginine peptides. Intravenous injection of D-form of octaarginine (r8) effectively led to the accumulation of r8 to tumor-xenograft in mouse. The sustained retention over 24 h in tumor was observed. The r8-doxorubcin conjugate (4 mg doxorubcin/kg) effectively suppressed the tumor proliferation without the decrease of mouse weight after intravenous injection of the conjugate. Unconjugated doxorubicin required higher dose (6 mg/kg) to obtain the same extent of tumor growth suppression, accompanied by a significant weight loss of the mice.



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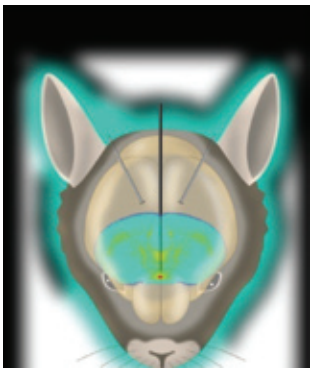
Molecular Dissection of Circadian Timing System for the Treatment of Life-Style Related Diseases and Sleep Disorders

Identification of clock-related genes involved in the development of metabolic syndrome, cancer and hypertension

Professor Hitoshi Okamura - Graduate School of Pharmaceutical Science

As the living environment changes rapidly, and the numbers of around-the-clock facilities and people staying awake all night increase in efficiency-oriented industries, the biological system that regulates our internal rhythms is being compromised. It is becoming clear that the disruption of the molecular system regulating biological rhythms is linked with the incidence of numerous lifestyle-related diseases and industrial accidents. Under these circumstances, it is now essential to investigate how time is generated by our body and how it can be tuned. Prof. Okamura and his team will approach these questions with a multi-layered perspective at the intracellular, intercellular and system levels. They have identified a number of genes that are strongly expressed in the mammalian circadian center, called the suprachiamatic nucleus (SCN). These genes therefore are likely to be involved in the generation, regulation and integration of time within the multi-neuronal network of the SCN. In parallel, Prof. Okamura and his team will also demonstrate the role of the circadian clock in the healthy function of tissues and organs by studying the pathologies that arise in genetically modified clock-less animals. These two complementary approaches will provide new potential targets for the treatment of diseases and disorders that have a circadian component in their etiology. Specific examples include hypertension, metabolic syndrome, diabetes and cancer, as well as jet-lag and sleep disorders.



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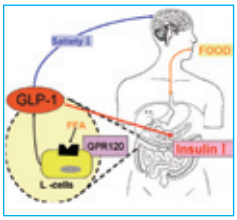
Lipid Sensor GPR120 Regulates Secretion of Gut Peptide Incretin Hormone GLP-1

Lipid sensor GPR120 is a drug target molecule for treating obesity and diabetes

Professor Gozoh Tsujimoto - Graduate School of Pharmaceutical Science
Associate Professor Akira Hirasawa - Graduate School of Pharmaceutical Science

Obesity and its associated disorders are a serious global health problem. Free fatty acids provide an important energy source and also act as signaling molecules in various cellular processes, including the secretion of gut incretin peptides. Prof. Tsujimoto and his research team found that a G-protein-coupled receptor, GPR120, which is abundantly expressed in intestine, functions as a receptor for unsaturated long-chain free fatty acids, especially omega-3 fatty acids. As GLP-1 is the most potent insulinotropic incretin, GPR120- is potentially important drug target for the treatment of obesity-related metabolic disorders.



int.saci.kyoto-u.ac.jp/?p=2020

Activating Effects of Ethanolamines on Bovine Intestine Alkaline Phosphatase Activity

Enzyme for highly-sensitive enzyme immunoassay

Professor Kuniyo Inouye - Graduate School of Agriculture
Graduate student (PH. D. Candidate) Satoshi Sekiguchi - Graduate School of Agriculture

Bovine intestine alkaline phosphatase (BIALP) is widely used as a signaling enzyme in sensitive assays such as enzyme immunoassay (EIA). The sensitivity and rapidity of the assay increase with increasing the activity of the enzyme. Therefore, its activation and stabilization are of great interest. The assay of BIALP has been done conventionally in 0.05-0.5 M borate buffer at pH 9.8, 25 °C with the molecular activity (k_{cat}) value of 120-130 s^{-1} in the hydrolysis of *p*-nitrophenyl phosphate (*p*NPP). Prof. Inouye and his collegues evaluated the effects of various aminoalcohols and amines on BIALP activity. The k_{cat} values in the presence of ethanolamines were much higher than that observed in borate buffer, and the values increased with increasing their concentrations. In the presence of 1 M diethanolamine, triethanolamine, and *N*-methylethanolamine, the values were 1200, 1500, and 2300 s^{-1}, respectively.

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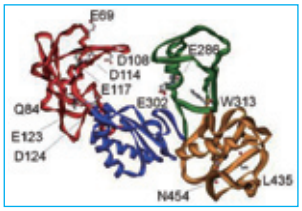
Increase in Thermal Stability of Moloney Murine Leukaemia Virus Reverse Transcriptase by Site-directed Mutagenesis

Thermostable reverse transcriptase suitable for use in research and clinical diagnosis

Associate Professor Kiyoshi Yasukawa - Graduate School of Agriculture
Professor Kuniyo Inouye - Graduate School of Agriculture



Reverse transcriptases act as DNA polymerase using both RNA and DNA as template. The reaction should be performed under increased temperature in order to prevent the formation of a secondary structure of RNA. It is, thus, desirable to develop thermostable and versatile reverse transcriptase. Associate Prof. Yasukawa and Prof. Inouye replaced certain amino acids of DNA interacting region of Moloney murine leukemia virus reverse transcriptase (MMLV RT) with positive or non-polar aminod acids. The multiple variant-type enzymes, MM3 and MM4, produced by this invention, are more thermostable than wild-type enzyme (WT) and a single variant-type enzyme D524A. The MMLV RT produced by this invention can be used as versatile reagents to analyze or detect virus, bacteria, and diseases, and there are no restrictions on types of RNA in samples.

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CHEMISTRY

Production of Novel β-Lactams from α-Amino Acids without Asymmetric Catalysts

Multi-substitued highly strained chiral β-lactams

Professor Takeo Kawabata - Institute for Chemical Research
Dr. Tomoyuki Yoshimura - Institute for Chemical Research

β-lactams constitute an important skeleton of antibacterial agents and are precursors of β-amino acids. Chiral β-lactams are also useful building blocks for the synthesis of biologically active natural and unnatural compounds. Prof. Kawabata and his research team have established a new method for the synthesis of multi-substituted highly strained β-lactams in high optical purity. The synthesis can be performed using abundant L-α-amino acids at room temperature without asymmetric catalysts. Therefore, a large quantity of the novel β-lactams can be synthesized at a low cost. Ring opening of the multi-substituted chiral β-lactams should give rise to novel amino acids that can be used for the construction of a unique peptide library and as novel glutamate analogues for the study of neuroscience.

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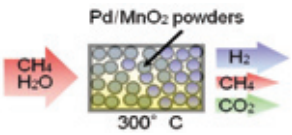
Pd/MnO_2-based Catalyst to Produce Hydrogen from Methane at Low Temperature

Improved hydrogen yield from natural gas in actual industrial plants/Optimization of output energy of fuel cell



Associate Professor Hideki Koyanaka - iCeMS
Mr. Masahiko Tsujimoto - iCeMS

A Pd/MnO_2-based catalyst to produce hydrogen (H_2) from methane (CH_4) has been synthesized successfully. The yield of H_2 from CH_4 (10% of the concentration in argon balance) reached over 200 mL per 1g of the catalyst in an hour under 300℃ without the co-production of toxic carbon monoxide (CO). Conventional catalysts such as Pd/Al_2O_3 and Pd/Carbon, produce CO that significantly decreases the yield of H_2 for the production plant and the efficiency of fuel cells. The Pd/MnO_2-based catalyst contributes to technologies of hydrogen production and utilization.

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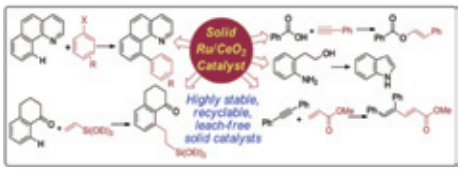
Ceria-supported Ruthenium Catalyst for Green Synthesis of Various Chemicals

Simple solid oxide catalysts for highly efficient, environmentally-benign synthesis of various chemicals,



Associate Professor Kenji Wada - Graduate School of Engineering

Associate Prof Kenji Wada and his research team have developed solid ceria-supported ruthenium (Ru/CeO_2) catalyst, which showed excellent activity towards a wide range of organic transformations, namely:(1) addition of aromatic C-H bonds to vinylsilanes, (2) direct arylation of aromatic C-H bonds to biaryls, (3) addition of carboxylic acids to terminal alkynes, (4) region- and stereoselective cross coupling of alkenes and alkynes, (5) selective synthesis of indole, and so on. The Ru/CeO_2 catalyst is easily prepared, stable towards air and moisture, and recyclable for several times without significant leaching of ruthenium species into the products, indicating its possibility as an attractive, environmentally benign alternative to homogeneous complex catalysts.

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MATERIALS

Utility of a Slightly Modified Collagen Scaffold

Development of a scaffold for use in the reconstruction of various internal organs

Associate Professor Tatsuo Nakamura - Institute for Frontier Medical Sciences
Research Fellow Akira Nakada - Institute for Frontier Medical Sciences

In regenerative medicine, a collagen is an excellent scaffold material. Therefore Associate Professor Tatsuo Nakamura and his research team focused on a characteristic of collagen, which has a molecular structure in the acidic region and forms a fibrous structure with increased strength in the neutral region. The researchers made neutral collagen into a scaffold.

They studied the biocompatibility and durability of this collagen scaffold by embedding it beneath the dorsal skin of rats. Biocompatibility was best when the freezing temperature of the collagen fiber suspension was -10℃, the thermal denaturation temperature was 140℃, and time was six hours. The slightly modified collagen fiber scaffold made in this way appears to be useful not only as a "scaffold" but also as a so-called "cell capsule" to carry cells to a designated location.

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A Single Molecule of Water Encapsulated in Fullerene C_{60}

Endohedral C_{60} encapsulating a water molecule

Professor Yasujiro Murata - Institute for Chemical Research
Dr. Kei Kurotobi - Institute for Chemical Research (present affiliation; iCeMS)

Prof. Yasujiro Murata and his research team synthesized fullerene C_{60} encapsulating a single molecule of water. A single molecule of H_2O without any hydrogen bonds is completely isolated within the confined sub-nano space inside fullerene C_{60}. With the concept of dynamic control of opening size, an open-cage C_{60} derivative was synthesized, whose opening can be enlarged in situ at 120℃ resulting in quantitative encapsulation of a molecule of H_2O under the high-pressure conditions. A simple method to restore the opening was developed to realize the organic synthesis of water-encapsulating C_{60}. The structure of $H_2O@C_{60}$ was determined by the single crystal X-ray analysis, and the properties of the single H_2O molecule as well as the spherical π-system encapsulating the water molecule were studied.

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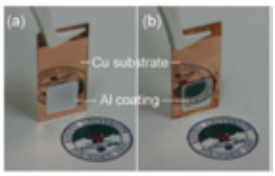
Electrodeposition of Aluminum Layers with Controlled Structures from Dimethylsulfone-based Baths

Fabrication of bright aluminum coatings and porous aluminum layers



Assistant Professor Masao Miyake - Graduate School of Energy Science
Professor Tetsuji Hirato - Graduate School of Energy Science

Assistant Prof. Masao Miyake and Prof. Tetsuji Hirato developed an electrodeposition method for the formation of bright aluminum (Al) coatings. Al coatings can be electrodeposited using dimethylsulfone-based baths; however, the coatings usually lack luster. The researchers have recently found that the addition of a certain additive to the bath resulted in the electrodeposition of bright Al coatings with mirror-like appearances. The coatings can potentially be used as decorative, corrosion-resistant coatings and light reflectors. They have also devised a new method for the fabrication of porous Al layers. In this method, the electrodeposition of Al is performed in a bath containing NaCl powder, yielding an Al layer containing NaCl particles. A porous Al layer can be obtained by washing the composite in water after the electrodeposition.

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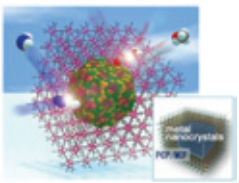
Development of Metal Nano-crystals Covered with Functional Porous Materials

Hybrid nano-catalysts for highly-selective energy-gas capture



Professor Hiroshi Kitagawa - Graduate School of Science
Dr. Hirokazu Kobayashi - Graduate School of Science

Prof. Hiroshi Kitagawa and Dr. Hirokazu Kobayashi are searching for novel methods for introducing functionalities into porous coordination polymers (PCPs) by hybridization with metal nanocrystals. PCPs are organic–inorganic hybrid solids with zeolite-like structures and porous properties. Due to their high surface area and designable pore size with hydrophilic or hydrophobic characteristics, PCPs have attracted much attention as practical adsorbents or membrane materials to separate gases on an industrial scale. Metal nano-crystals, on the other hand, play an important role as effective catalysts for various reactions. The hybridization of the two should deliver enhanced catalytic capabilities. The synergy effect between PCPs and metal nanocrystals is expected to be highly selective and active, and will hopefully provide a clean and green environment.

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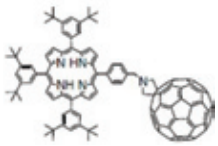
Photovoltaic Cell with Semiconducting Electrodes Modified with Composite

Thin film organic solar cell



Assistant Professor Tomokazu Umeyama - Graduate School of Engineering

Assistant Prof. Tomokazu Umeyama has developed a composite cluster of soluble single-walled carbon nanotube and porphyrin-linked C_{60}, which was prepared in a mixed solvent of o-dichlorobenzene and acetonitrile and then electrophoretically deposited onto a tin-oxide electrode. The photoelectrochemical measurements of the deposited film revealed enhanced photocurrent generation efficiency compared to the reference film without the soluble single-walled carbon nanotube. This technology may be applied to highly efficient photovoltaic devices.

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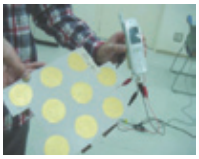
OTHERS

Wireless Power Transmission and Space Solar Power Satellite/Station as Its Application

Wireless Charging, Electric Charging, Wireless Sensor, Electric Vehicle, Mobele Phone, Energy Harvesting, Solar Power



Professor Naoki Shinohara - Research Institute of Sustainable Humanosphere
Assistant Professor Tomohiko Mitani - Research Institute of Sustainable Humanosphere

Wireless Power Transmission (WPT) is useful and convenient technology, which can be used to charge batteries in the equipments without the need for a wire connection. The WPT technologies can also be used to harvest broadcasted radio waves. At Kyoto University, Prof. Shinohara and Assistant Prof. Mitani have a long history of the research of the WPT, especially WPT via microwaves, and have carried out the WPT experiments for various applications. One exciting application of the WPT is wireless charging of an electric vehicle. Prof. Shinohara and Assistant Prof. Mitani can charge the mobile phones without any wires (Figure). They have various technologies and know-how of the WPT via microwaves. Their future dream is wireless power from space, by way of a Space Solar Power Satellite/Station (SPS).

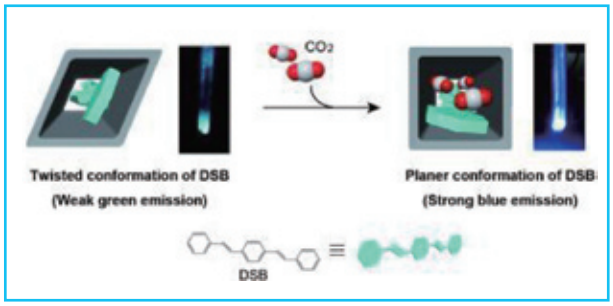
int.saci.kyoto-u.ac.jp/?p=2047

Gas Detection by Structural Variations of Fluorescent Guest Molecules in a Flexible Porous Coordination Polymer

Fast, cheap, and accurate: detecting CO_2 with a fluorescent twist

Associate Professor Takashi Uemura - Graduate School of Engineering
Professor Susumu Kitagawa - iCeMS and Graduate School of Engineering

Prof. Kitagawa and his research team reported a novel strategy in which gas molecules are detected by signals from a reporter guest molecule that can read out the structural transformation of a porous coordination polymer (PCP). A fluorescent reporter molecule, distyrylbenzene (DSB), was incorporated into a flexible PCP. The PCP-DSB composite selectively adsorbed CO_2 over other atmospheric gases, such as N_2, O_2, and Ar. This gas adsorption induced a transformation of the PCP framework, which was accompanied by conformational variations of the included DSB. This read-out process resulted in a critical change in DSB fluorescence at a specific threshold pressure. Their PCP-DSB system showed, for the first time, that fluorescent molecules can detect gas molecules without any chemical interaction or energy transfer.



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Automatic Generation of 3D Building Models Using Airborne LiDAR and Aerial Photograph

Automatic generation of 3D urban map

Associate Professor Junichi Susaki - Graduate School of Engineering and Graduate School of Global Environmental Studies

Associate Prof. Junichi Susaki has developed an algorithm that automatically generates 3D building models even in dense urban areas. The proposed algorithm uses the results of building segmentation from aerial photographs. Segmentation of buildings in urban areas, especially dense urban areas, by using remotely sensed images is also challenging because of unclear boundaries between buildings and shadows cast by neighboring buildings. He has developed another algorithm that segments buildings, including shadowed buildings, in dense urban areas from an aerial photograph. By considering the segmented regions and airborne light detection and ranging (LiDAR) data, models of actual building types—gable-roof, hip-roof, flat-roof and slant-roof buildings—are generated.

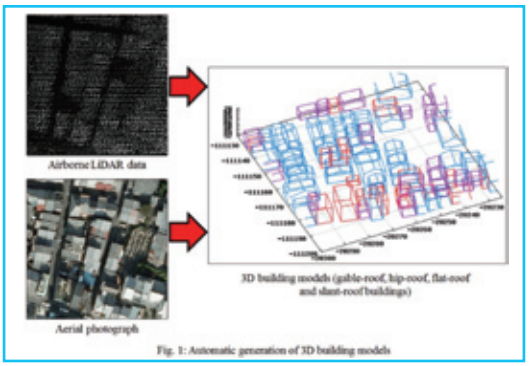

Fig. 1: Automatic generation of 3D building models

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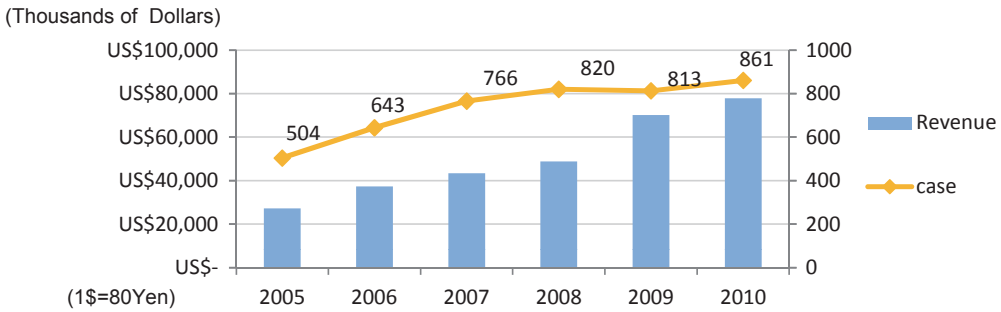
SACI :
Office of Society-Academia Collaboration for Innovation

Missions :
1) to promote collaborative research between academia, industries and the government
2) to support business startups by researchers and students
3) to manage and utilize the university's intellectual properties.

Director
Keisuke Makino

Collaborative Research Courses and Laboratories

Specializes in researches based on collaborative research contracts and are established to improve the efficiency of such research with private companies and a variety of other organizations. These courses are supervised by the deans and directors of the university and are supported by the faculty to help ensure successful progress.



SACI is instrumental in supporting research by developing many different forms of collaborative networks.

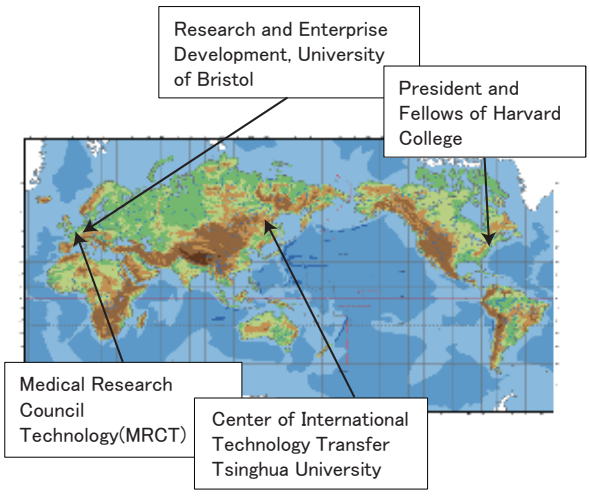
General Memoranda for Cooperation and Exchange

One example of a large multilateral agreement is with four similar organizations in various areas of the world (see map) – with missions of their own to develop industry-government-academia connections. We exchange information and build links to expand access to Kyoto University's research results for the benefit of society.

Comprehensive Collaboration Agreements

Another equally important type of partnership we have is with global corporations. We tie general agreements with these multi-national entities to work together in identifying academic research seeds* at KU, so that they may be developed further for practical utilization.

*Research seeds are budding technologies with great future potential



University-Launched Ventures

The SACI offers an educational platform to encourage entrepreneurship and future business leaders to explore the integration of academic research and its business applications. It also maintains close relations with the Kyoto University Venture Fund (NVCC), allowing for the promotion of spin-out venture companies that are based on the university's research.

Business Planning Seminar:

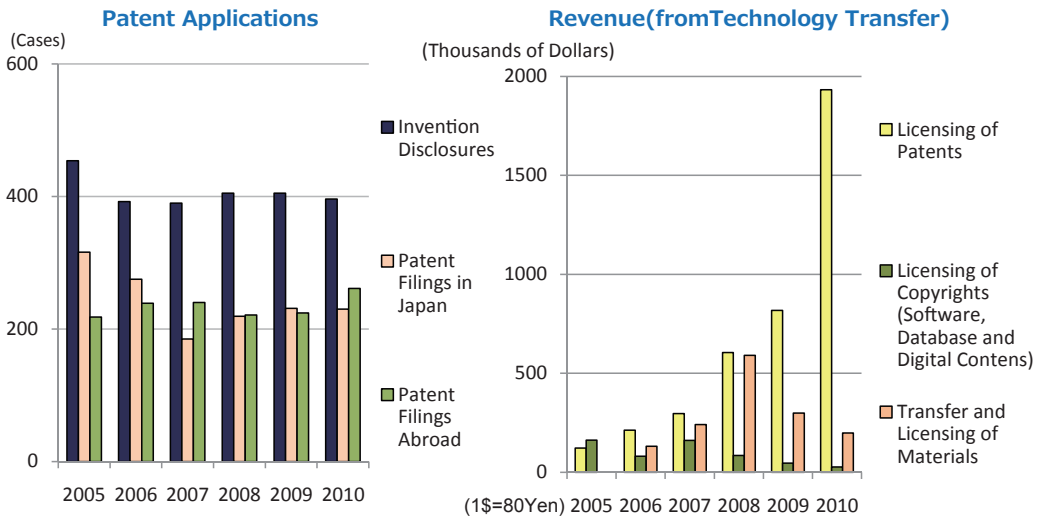
This is an intensive program designed to encourage undergraduate and graduate students to build their own businesses by learning the skills necessary to succeed. A select number of students participate in the annual program over the course of several months.

Under the guidance of professors, venture capitalists and consultants, students act as the CEO, technical specialist and sales manager of their own company and are required to build a solid business model/framework incorporating their ideas to market the technologies of Murata Manufacturing Co.

The final objectives of the program are for participants to present their ideas at a number of global business planning competitions in order to attain experience and the necessary recognition to attract serious investment by venture capitalists.

A recent student achievement was made at the World Business Planning competition that took place at UC Berkeley- a team of 6 Kyoto University students and 2 Doshisha University students and their virtual high-tech venture company ROCAK.K. have become the first Japanese university group to move to the finals at the competition.

Results of Utilizing University's Intellectual Properties



European Representative Office in London

Contact:
Tel: +44-(0)20-3217-1380
Fax: +44-(0)20-3217-1381
Mail: saci@kyoto-u.eu

Website for Notable R&D available for Technology Transfer

We provide access to up-to-date technologies developed by Kyoto University in their various stages: not only completed intellectual properties such as patents, but also technologies which are still undergoing research.

int.saci.kyoto-u.ac.jp/

General Contact Information

Kyoto University
Yoshida-Honmachi, Sakyo-ku
Kyoto, JAPAN 606-8501
www.kyoto-u.ac.jp

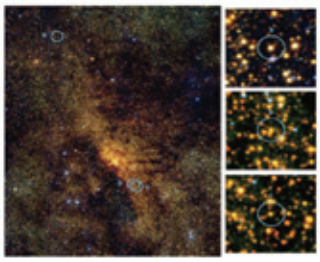
Access Map: www.kyoto-u.ac.jp/en/issue/ku_eprofile/documents/Profile_2011/47-access.pdf

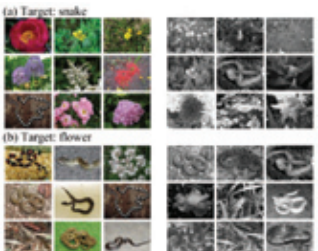
Students:
Foreign Student Division
Tel: +81-75-753-2543 Fax: +81-75-753-2562
E-mail: ryugak78@mail.adm.kyoto-u.ac.jp

Researchers:
International Affairs Division
Tel: +81-75-753-2047 Fax: +81-75-753-2042
E-mail: koryu52@mail.adm.kyoto-u.ac.jp (visitation support)
research_promotion@mail2.adm.kyoto-u.ac.jp (research collaboration support)

Businesses:
Office of Society-Academia Collaboration for Innovation
Tel: +81-75-753-5534 Fax: +81-75-753-5538
E-mail: info@saci.kyoto-u.ac.jp

For inquiries regarding this publication:
Research and International Affairs Department
E-mail: research_activities@mail2.adm.kyoto-u.acjp




(a) Target: snake
(b) Target: flower