KYOTO UNIVERSITY

Research Activities 2011

Vol.1 No.1 July

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Message from the President

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

President
Hiroshi Matsumoto

Our campuses have been home to many historically respected scholars, such as Japan's first Nobel laureate, Professor Hideki Yukawa, whose pioneering interdisciplinary research led to profound breakthroughs in the field of theoretical physics. Yukawa's award was followed by six further Nobel Laureates and two Field Medalists from Kyoto University. Not only these, many other internationally respected accolades and awards in diverse fields have been garnered by the university's researchers throughout its 114-year history.

In recent years, the university system in Japan has undergone a period of radical reform, which entailed Kyoto University's re-establishment as an incorporated national university. Amid such changes, we must continue contributing to higher education and academic research as a university in tune with the local community of Kyoto. This must be accomplished while preserving and further developing our 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 presents some prominent examples of recent research activities at Kyoto University. I hope the information herein will be helpful in establishing new international relationships and networks among researchers in both the academic world and in the industrial sector.

July 2011

H. Matsumoto

Hiroshi Matsumoto

Kyoto, the Heartland of Japan

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.

The main campus of Kyoto University itself is surrounded by a classic landscape featuring many sites of historical and cultural interest, such as a traditional *sukiya*-style buildings dating from the Edo period and the Seifu-so, a university owned traditional villa. The Seifu-so is registered by the government of Japan as an Important Cultural Property, and features a traditional tea ceremony room and a Japanese-style garden. Other notable features near the university include the famous Yoshida Shrine, with its distinctive red torii gate and Daimonji Mountain, which is decorated with a huge rendition of the Chinese character meaning "large" (大). The mountain is the site of a lively summer festival held annually in August. There are many other places of interest around the university and in Kyoto as a whole.
For more information please refer to the website below.

www.kyoto-u.ac.jp/en/profile/intro/photo/list

Seifu-so villa

Daimonji Mountain as seen from Yoshida Campus

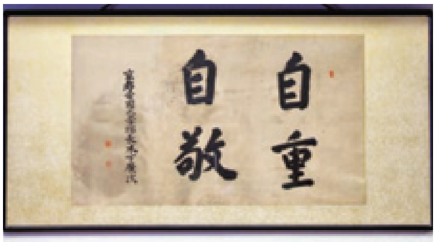
Yoshida Shrine

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.

Kyoto University in a Nutshell

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

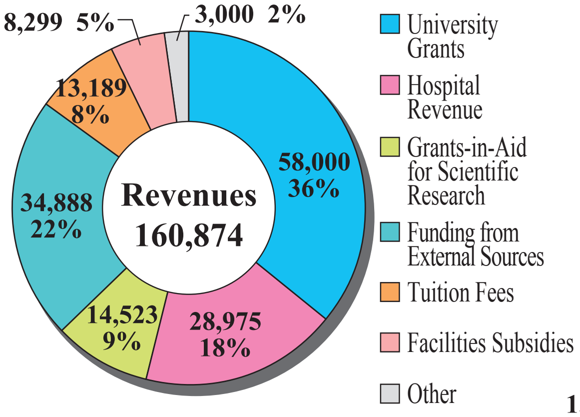
as of May 2011

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

Budget

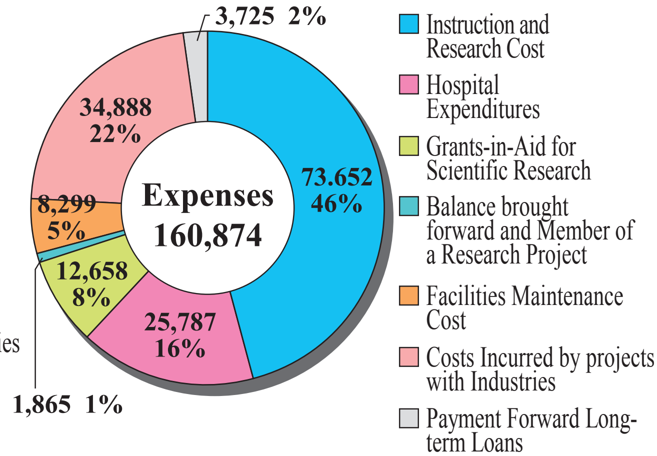
Revenues in Fiscal Year 2010

Unit: million JPY



Expenses in Fiscal Year 2010

Unit: million JPY



Awards

7 Nobel Prizes


Hideki Yukawa
1949


Sin-itiro Tomonaga
1965


Kenichi Fukui
1981


Susumu Tonegawa
1987


Ryoji Noyori
2001


Makoto Kobayashi
2008


Toshihide Maskawa
2008

2 Fields Medals | 1 Gauss Prize | 4 Lasker Awards


Heisuke Hironaka
1970


Shigefumi Mori
1990


Kiyosi Itō
2006


Susumu Tonegawa
1987


Yasutomi Nishizuka
1989


Yoshio Masui
1998

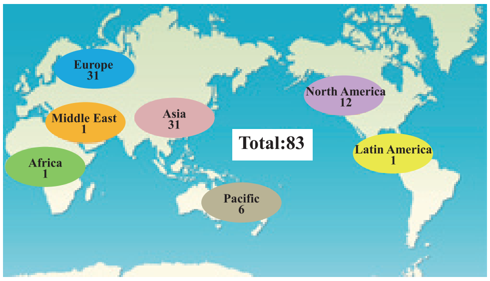

Shinya Yamanaka
2009

Global Connections

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.

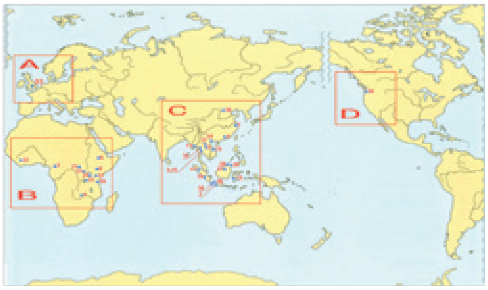
www.kyoto-u.ac.jp/en/research/international/agreement



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

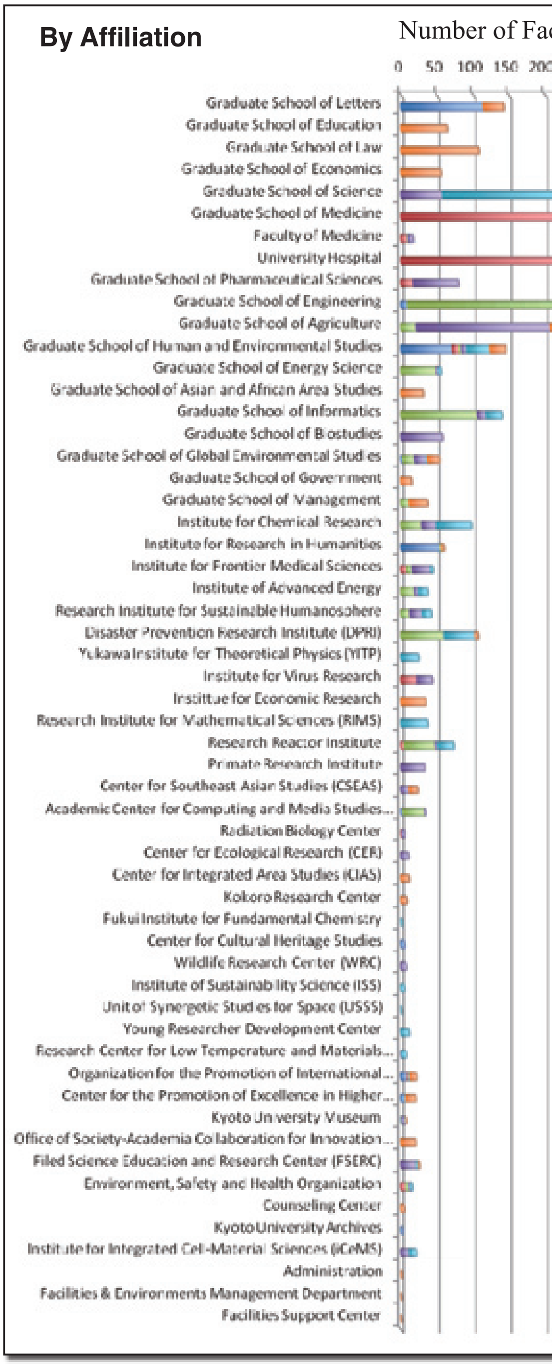


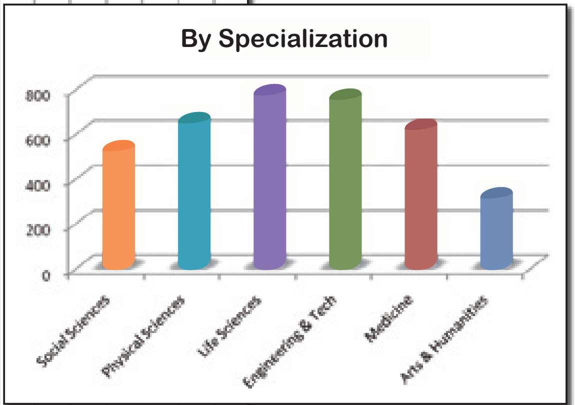
Support Organization

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.

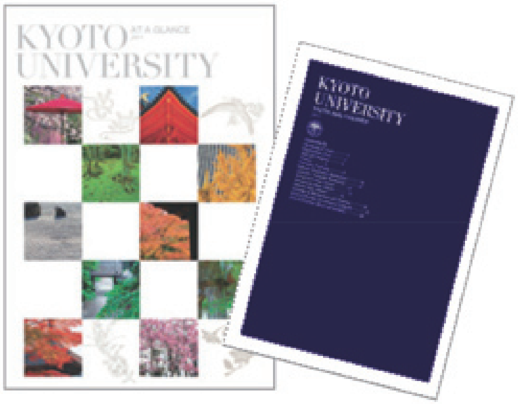
For further information: www.opir.kyoto-u.ac.jp/e

Diversity of Research at Kyoto University





Refer to our Facts & Figures booklet for more information

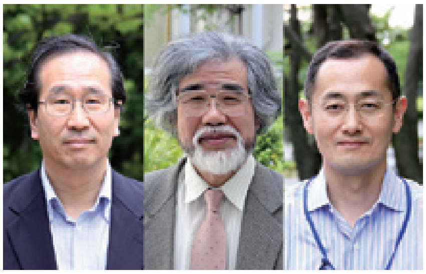


www.kyoto-u.ac.jp/en/issue/ku_eprofile

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

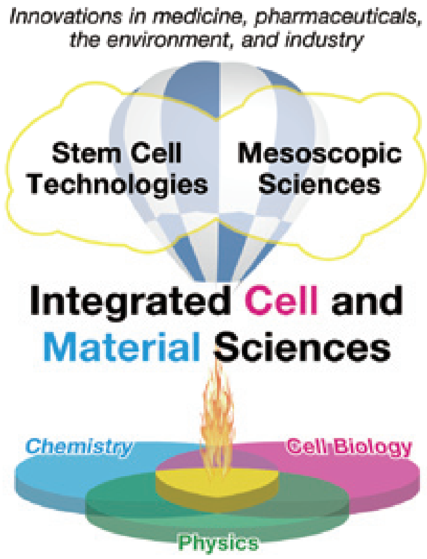
WPI: Institute for Integrated Cell-Material Sciences (iCeMS)

The **World Premier International Research Center (WPI) Initiative**, a MEXT* program, 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 was selected as one of five WPI centers and established at Kyoto University in 2007. 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.



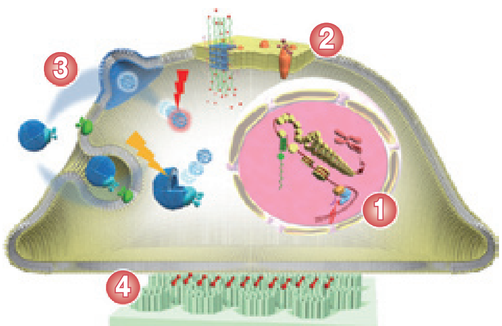
From left: Deputy Director **Susumu Kitagawa**, Director **Norio Nakatsuji**, CiRA Director and iCeMS Professor **Shinya Yamanaka**

The iCeMS aims to create new cross-disciplinary fields through the integration of cell and material sciences, pioneering the development of *stem cell technologies* and *mesoscopic sciences*. These are anticipated to lead to innovations in medicine, pharmaceuticals, the environment, and industry.



Stem cell technologies 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 sciences include:
- Imaging and probing mesoscopic complexes in living cells
- Production of functional mesoscopic materials
- Integration of mesoscopic materials and living cells
- Modeling, simulation, and physics theories of mesoscopic events in materials and living cells



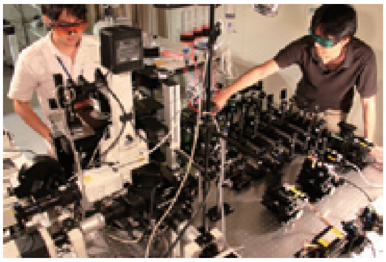
Integration of cell and material sciences

1. Chromatin architecture/function and meso-control
   - Gene expression control with bio-functional chemicals/materials
2. Cell membrane architecture/function and meso-control
   - Ion channel transporter/receptor with bio-functional chemicals/materials
3. Intracellular delivery of bio-functional materials
   - Control by external signals
4. Cellular environment architecture/function and meso-control
   - Nano/meso/micro-engineered materials with bio-functional molecules

* Japanese Government Ministry of Education, Culture, Sports, Science and Technology. Also known as Monkashō.

iCeMS Center for Meso-Bio Single-Molecule Imaging (CeMI)

The CeMI was established in 2009 as the iCeMS' imaging innovation center for cellular meso-science. Its key missions are: 1) develop new, powerful technologies for imaging the *restless* nano- to meso-scale universe of biomolecular complexes in living cells, at the spatiotemporal resolutions of functioning single molecules, and 2) make these technologies available quickly to the scientific community worldwide for the further advancement of cellular meso-science.



The center places special emphasis on **single-molecule imaging** and **tracking**, and on **terahertz spectroscopy and microscopy**. The CeMI's aim is to become a world hub, where scientists from across the globe can gather to engage in meso-bio, single-molecule imaging, and to develop the meso-science of cells. The founding director of the center is Prof **Akihiro Kusumi**.

www.cemi.icems.kyoto-u.ac.jp/e_index.php

Kyoto University Center for iPS Cell Research and Application (CiRA)

Following Prof **Shinya Yamanaka**'s successful generation of induced pluripotent stem (iPS) cells from human fibroblasts in 2007, the Center for iPS Cell Research and Application (CiRA) was established in 2008 under the auspices of Kyoto University Institute for Integrated Cell-Material Sciences (iCeMS) in order to further advance iPS cell research. Institute Director **Norio Nakatsuji** appointed iCeMS Prof Yamanaka as director of the CiRA.

In 2010 Kyoto University reestablished the CiRA as an independent institute under its jurisdiction. Prof Yamanaka serves both as director of the new center while continuing in his iCeMS professorship. The two sister institutes continue to be closely tied in their cooperative investigations involving basic research related to iPS cells.

www.cira.kyoto-u.ac.jp/e

For further information:
www.icems.kyoto-u.ac.jp
info@icems.kyoto-u.ac.jp

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

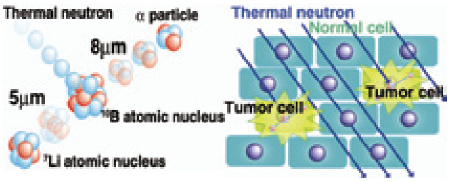
Category : Interdisciplinary, combined fields (Since 2008)
Title : **Energy Science in the Age of Global Warming -Toward CO_2 Zero-emission Energy System**
Leader : Professor Takeshi Yao,
Graduate School of Energy Science
URL : www.energy.kyoto-u.ac.jp/gcoe/en

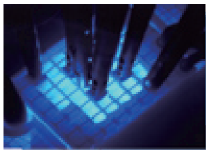
Category : Interdisciplinary, combined fields (Since 2009)
Title : **Sustainability/Survivability Science for a Resilient Society Adaptable to Extreme Weather Conditions**
Leader : Professor Kaoru Takara,
Disaster Prevention Research Institute
URL : ars.gcoe.kyoto-u.ac.jp/index.php?id=3

The most advanced institute for BNCT

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.

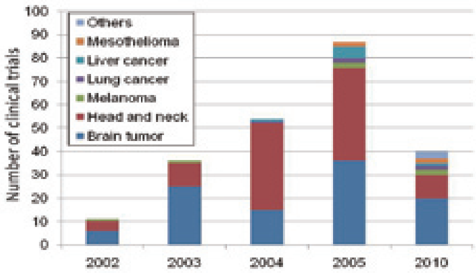
Professor **Koji Ono**





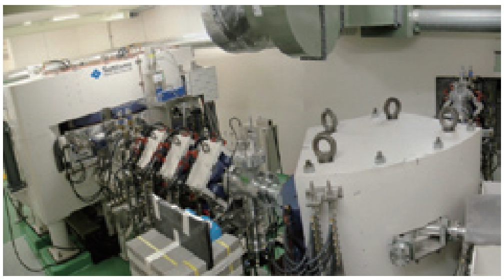
Kyoto University
Research Reactor Institute
www.rri.kyoto-u.ac.jp/en

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.



Trend of clinical trials using KUR

In order for BNCT to be recognized as an approved medical treatment, Prof Koji Ono, who is the leading figure of BNCT research in Japan, began a new project in August 2004, to develop an accelerator based neutron source. In the past twenty years, many researchers tried, but failed to succeed due to weaknesses in current and neutron production targets. Ono's group successfully developed the cyclotron neutron system with sufficient current and beryllium targets with an optimized neutron production method, on March 2009. Today, preparations are being made to begin clinical testing.



Accelerator based neutron source

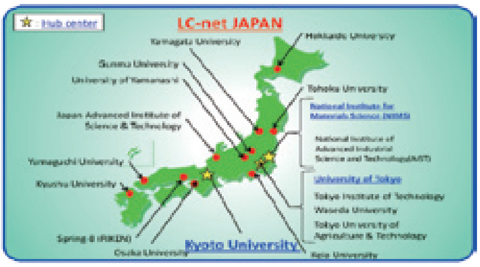
www.rri.kyoto-u.ac.jp/en/RD/LSMS/lsms04_pro.html

Low-Carbon Research Network JAPAN (LC-net)

Nano/Micro device fabrication Infrastructural Platform for a Low Carbon Society

The **Low-Carbon research network** that was proposed in 2010 is under development by the MEXT as the new research infrastructure network in Japan, according to the scope of the "Challenge toward Environment and Energy Technology" initiative, which is a part of the greater "Groundwork for Growth" strategy. Its total budget is 13 billion JPY. The research accomplishments and Nanotechnology discoveries will be integrated into the environmental technologies and systems in practical use to accelerate new developments and applications.

Achieving innovative research thorough the fusion of related 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 work toward the development of new materials, the fabrication of micro and nano devices and carry out their testing.



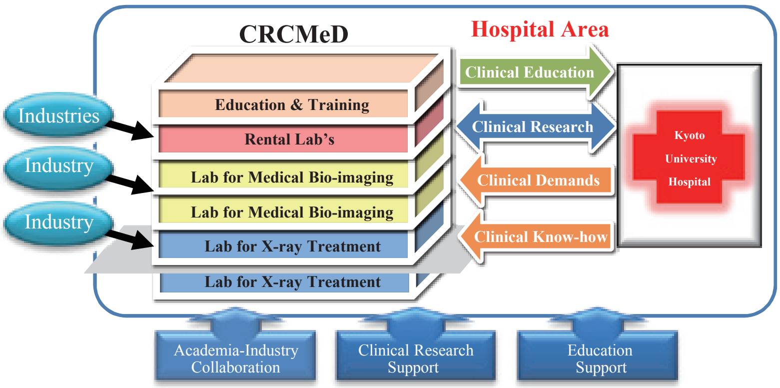
Kyoto university is equipped with more than 70 fabrication and testing facilities supported by the senior professional engineers responding to not only support and advise its users, but to develop new technologies to build mico/nano devices, and also educate the students. The coordinators lead the users to collaborate with each other in open innovation and also provide a seamlessly interconnected environment between each user's labs and the HUBs.

Clinical Research Center for Medical Equipment Development (CRCMeD)

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.

CRCMeD Director
Michiaki Mishima

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



The RISING Project

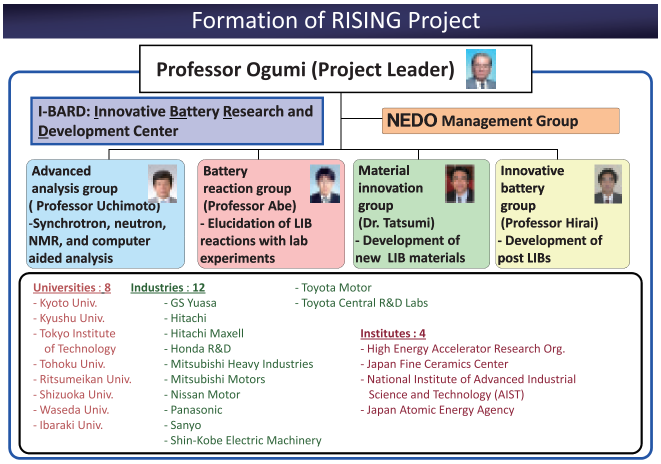
Professor
Zempachi Ogumi

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.

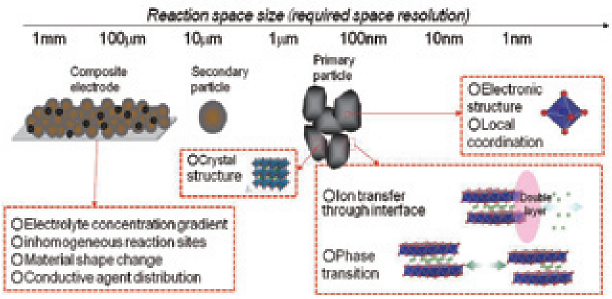
Objectives:
1. To strengthen the battery industry within Japan at this time of tough global competition.
2. To develop a new generation of batteries with high performances of greater than 500Wh/kg.
3. To act as a central hub for the battery community.

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
(Japanese only)

The **Hakubi Project :** Fostering Young Researchers

In this age of globalization, it is increasingly important for researchers to possess creativity, broad perspectives and a flexible mindset, all of which are essential for pioneering new academic frontiers. With this in mind, Kyoto University launched what is called the Hakubi Project. Under this project, Kyoto University annually selects and employs up to twenty researchers as associate and assistant professors for terms of up to five years. The Young Researcher Development Center (also known as the Hakubi Center) is responsible for the logistics of this program, acting as liaison between the selected individuals and Kyoto University's research institutions.

The Hakubi Project is open to applicants of all nationalities, from anywhere in the world, and welcomes young researchers holding doctoral degrees (or equivalent research skills) in any range of basic and applied studies, in all academic fields.

■ What does *Hakubi* mean?

The term *hakubi* literally means "white eyebrows" in Japanese. The project is named after a legend from *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.

■ Number of Applicants

	Total No. of Applicants	Successful Applicants	Competition Rate
FY 2009	588	18	32.7 times
FY 2010	517	19	27.2 times

Ratio of Total Applicant	FY 2009	FY 2010
Male : Female (%)	77.9 : 22.1	81.4 : 18.6
Humanity & Social Sciences : Natural Sciences (%)	33.3 : 66.7	27.3 : 72.7
Kyoto U. Affiliate : Others (%)	38.4 : 61.6	35.4 : 64.6
Address in Japan : Other Countries (%)	81.0 : 19.0	79.5 : 20.5

Hakubi Researchers visit Professor **Shinya Yamanaka**, director of the Center for iPS Cell Research and Application. (May 20, 2010)

■ How do I apply?

Applications are complete with the receipt of both the registration form and e-mailed proposal. The first group of Hakubi researchers took up their positions as program-specific associate and assistant professors in April of 2010, and the second group in April 2011. The third call for applications was closed on May 26, 2011.

Stay tuned for the call next spring!

■For further information:

www.hakubi.kyoto-u.ac.jp/eng

Development of Small-Molecule Tools for Cell Therapy

Cell Biology empowered by small molecules

Professor Motonari Uesugi – Institute for Chemical Research *and* iCeMS

Taking advantage of technology available in fields ranging from organic chemistry to clinical medicine, Prof Motonari Uesugi and his research team seek to discover and use synthetic small molecules that modulate fundamental processes in human cells, specifically small-molecule adhesion factors and small-molecule growth factors. Their goals extend beyond the discovery of clinically useful molecules, to include design innovations and chemical synthesis that will lead to new, broad, and cost-effective general applications of synthetic organic molecules.

Prof Uesugi's discoveries have made possible the investigation of complex cellular events and the improvement of cell therapies. The team has already discovered a synthetic small molecule, "adhesamine," which boosts adhesion and growth of cultured human cells. Using this molecule as a seed, Prof Uesugi and colleagues designed a synthetic molecule that behaves just like fibronectin, a naturally-occurring protein commonly used in a range of fields from basic biology to cosmetics. The team has additionally shown that it is possible to replace fibronectin, a large protein, with a synthetic compound appropriate in size for mass chemical production. The development of this "small molecule fibronectin" is a groundbreaking contribution to chemistry, biology, and medicine.

www.icems.kyoto-u.ac.jp/e/pr/2011/05/12-tp.html

Receptor Behaviors Observed in Living Cell Membranes

Expanding drug development horizons

Professor Akihiro Kusumi [left] – iCeMS
Rinshi Kasai PhD [right]

Unprecedented single molecule imaging movies of living cell membranes, taken by a research team based at Kyoto University and the University of New Mexico, have clarified a decades-old enigma surrounding receptor molecule behaviors. The work focuses on G protein-coupled receptors (GPCRs), a class of molecules in cell membranes that comprise the largest superfamily in the human genome. According to iCeMS Prof Akihiro Kusumi, "We obtained a parameter called the dissociation constant, which will allow us to predict numbers of monomers and dimers if the total number of GPCRs in a cell is known. The ability of scientists to obtain such key numbers will be essential for understanding GPCR signaling, as well as defects leading to diseases from the neuronal to the immune systems. The blocking of signal amplifications by monomer-dimer interconversions and its implications for drug design are profoundly important."

www.icems.kyoto-u.ac.jp/e/pr/2011/02/08-nr.html

DNA Engine Observed in Real-Time,Traveling Along Base Pair Track

Applicable to the development of advanced drug delivery methods and molecular manufacturing systems

Professor Hiroshi Sugiyama [left] – Graduate School of Science *and* iCeMS
Masayuki Endo [right] – iCeMS

In a complex feat of nanoengineering, a team of scientists at Kyoto University and the University of Oxford have succeeded in creating a programmable molecular transport system, the workings of which can be observed in real time. Resembling a monorail train, the system relies on the self-assembly properties of DNA origami and consists of a 100 nm track together with a motor and fuel. Using atomic force microscopy (AFM), the research team was able to observe in real time as this motor traveled the full length of the track at a constant average speed of around 0.1 nm/s. “DNA origami techniques allow us to build nano- and meso-sized structures with great precision,” elaborated iCeMS Prof Hiroshi Sugiyama. “We already envision more complex track geometries of greater length and even including junctions. Autonomous, molecular manufacturing robots are a possible outcome.”
www.icems.kyoto-u.ac.jp/e/pr/2011/02/07-nr.html

Shining New Light on Air Pollutants Using Entangled Porous Frameworks

Applicable to the development of a new range of portable, solid-state pollution detectors, and possibly even new types of light sources

Professor Susumu Kitagawa [right] – iCeMS *and* Graduate School of Engineering
Associate Professor Shuhei Furukawa [left] – iCeMS

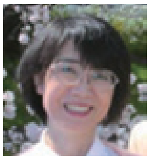
Associate Prof Shuhei Furukawa and Prof Susumu Kitagawa at iCeMS, and Dr. Yohei Takashima (currently at the University of Glasgow, Scotland, UK) have synthesized a newly-formulated entangled framework of porous crystals (porous coordination polymers, or PCPs) that can not only capture a variety of common air pollutants, but are distinguishable with a corresponding easily-detected color. The research team has created what amounts to interlocking jungle-gyms that move relative to each other and are therefore able to capture molecules of varying sizes. This PCP based on naphthalenediimide, known as NDI, expands and contracts to confine air-born aromatic volatile organic compounds (VOCs) such as benzene, toluene, xylene, anisole, and iodobenzene, which are common pollutants in the lower atmosphere. When exposed to ultraviolet light, the enhanced NDI-VOC interaction luminesces in an unusually wide range of colors, sufficiently intense enough to be observed even with the naked eye. The cooperative structural transition in mesoscopic crystal domains result in a nonlinear response to the guest concentration. Thanks to its high emission intensity in the full range of visible light, this new material may demonstrate new types of light emitters – even including white-light.
www.icems.kyoto-u.ac.jp/e/pr/2011/01/26-nr.html

Flow-microreactor Approach to Protecting-group-free Synthesis Using Organolithium Compounds

Potential applications in the mass production process for drugs and specialty chemicals.

Professor Jun-ichi Yoshida – Graduate School of Engineering

Protecting-group-free synthesis has received significant recent research interest in the context of ideal synthesis and green sustainable chemistry. In general, organolithium species react readily with ketones, and therefore ketone carbonyl groups should be protected before an organolithium reaction, if they are not involved in the desired transformation. If organolithium chemistry could be freed from such a limitation, its power would be greatly enhanced. Prof Yoshida and his research group have shown that a flow microreactor enables such protecting-group-free organolithium reactions by greatly reducing the residence time (0.003 s or less). Aryllithium species bearing ketone carbonyl groups are generated by iodine–lithium exchange reactions of the corresponding aryl iodides with mesityllithium and are reacted with various electrophiles using a flow-microreactor system. The present method has been successfully applied to the formal synthesis of Pauciflorol F.
dx.doi.org/10.1038/ncomms1264



Peptides and Genes that Enhance the Formation of Stoma in Plants

Improvement of growth and biomass productivity

Professor Ikuko Hara-Nishimura – Graduate School of Science

Stomata, in the epidermal tissues of leaves, are valves through which CO_2 passes, influencing the global carbon cycle. The two-dimensional pattern and density of stomata in the leaf epidermis are genetically and environmentally regulated to optimize gas exchange.
Prof Ikuko Hara-Nishimura at the Graduate School of Science and her research team have found that a novel secretory peptide, known as STOMAGEN, is a positive intercellular signaling factor that is conserved among vascular plants. STOMAGEN is a 45-amino-acid peptide and is able to enhance the formation of stoma in plants. If the technology is further developed, it will be possible to modify plants to absorb CO_2 much faster, without genetically modifying the genome of the target plants. Such plants should grow faster and be able to remove CO_2 more effectively from the atmosphere.
The advantages include: (1) STOMAGEN positively regulates stomatal density without modifying the genome (2) It may be possible to enable plants to absorb CO_2 much faster (3) Plants should be able to grow faster.
www.nature.com/nature/journal/v463/n7278/abs/nature08682.html

Highly Efficient and Precise Processing Inside Transparent Materials Using Femtosecond Laser

Potential applications in optical waveguides, 3D optical data storage, space selective light emission, coloration, ion migration inside glasses and transparent and flexible solar cells

Professor Kazuyuki Hirao – Graduate School of Engineering

Graduate School of Engineering Prof Kazuyuki Hirao and his research team have developed a series of techniques to create refractive index distribution inside various transparent materials with a spatial resolution of less than a micrometer, by focusing femtosecond laser pulses.

The techniques include: (1) Highly efficient laser processing with an LCOS-SLM (Liquid Crystal on Silicon - Spatial Light Modulator), e.g. multiple light spots can be generated by modulating the phase distribution of a laser pulse. (2) Ultrafast microscopic photography of laser processing inside various transparent materials, e.g. the material deformation process after irradiation with a focused laser pulse can be observed with a time resolution of 10^{-13} second. With this technique, the research team was able to elucidate the origin of damage after loading external forces on to various solid materials, and (3) Nanostructuring inside a glass – Nanograting – which leads to rewritable 5D optical storage with a capacity of 37GB/cm^3, which corresponds to about 10 times the size of Blue-ray discs.

The above mentioned laser techniques are now being applied to the fabrication of high efficiency transparent and flexible solar cells.

int.icc.kyoto-u.ac.jp/video.htm

Softening Crystals without Heat Using Terahertz Pulses to Manipulate Molecular Networks

Possibilities in manipulating large molecules, thereby increasing understanding of the properties of molecular complexes such as proteins

Professor Koichiro Tanaka [right] – iCeMS
Assistant Professor Masaya Nagai [left] – Graduate School of Science

Prof Koichiro Tanaka at iCeMS and his research team have successfully developed a kind of tractor beam that can be used to manipulate networks of molecules. The research team has succeeded in generating intense terahertz (far-infrared) pulses with the electric field exceeding 1 MV/cm [*1] and demonstrated that it is possible to use the intense terahertz pulses to climb 20 ladder steps on the anharmonic intermolecular potential in the microcrystals [*2]. In this case, intense terahertz pulses were used to successfully increase the amplitude of movement between amino-acid molecules in crystalline form, essentially softening the crystals. Previous softening methods have always correspondingly raised the temperature, resulting in unwanted changes to the crystals' structure and properties. This novel technique using terahertz pulses may have broad applications in the chemical and pharmaceutical industries.

www.icems.kyoto-u.ac.jp/e/pr/2010/11/01-nr.html

[*1] http://apl.aip.org/resource/1/applab/v98/i9/p091106_s1

[*2] http://prl.aps.org/abstract/PRL/v105/i20/e203003

Selective Dye Loading at the Polymer/Fullerene Interface

Improving efficiency of plastic solar cells by using dye surfactants similar to soap

Associate Professor Hideo Ohkita – Graduate School of Engineering

Graduate School of Engineering Associate Prof Hideo Ohkita and his research group have succeeded in improving the efficiency of plastic solar cells based on a blend of poly(3-hexylthiophene) (P3HT) and a fullerene derivative (PCBM) by incorporating a light-harvesting dye, silicon phthalocyanine derivative (SiPc), and revealing the underlying mechanism of selective dye loading. Focusing on a similarity between the dye they used and surfactants in soap, both of which spontaneously segregate to form an interface, they found that SiPc was located at the P3HT/PCBM interface from the absorption and surface energy measurements. Such interfacial segregation of dye molecules can be rationally explained in terms of the surface energy of each component similar to the effects of surfactant compounds in soap. Crystallization of P3HT by annealing also induces additional enhancement of segregation. As a result, the photocurrent density and power conversion efficiency of the ternary blend solar cells were most improved by loading SiPc with a content of 4.8 wt%.

dx.doi.org/10.1002/aenm.201100094

High Power Silicon Carbide Bipolar Junction Transistors

Fabrication of silicon carbide power device for high energy efficiency

Associate Professor Jun Suda [left] – Graduate School of Engineering
Dr. Hiroki Miyake [center] – Graduate School of Engineering
Professor Tsunenobu Kimoto [right] – Graduate School of Engineering

Prof Tsunenobu Kimoto and Associate Prof Jun Suda of the Graduate School of Engineering have reported achieving world-record current gains in silicon carbide (SiC) bipolar junction transistors (BJTs) by using original fabrication technologies. SiC BJTs are promising power semiconductor devices for high-efficiency energy conversion, when employed in a variety of motor control (including EV/HEV) and power supplies (including solar cells). However, SiC BJTs have suffered from low current gains, typically 50-70. The research team was able to significantly reduce carrier recombination in bulk SiC as well as at the SiC surface, based on their recent inventions on defect elimination. This defect elimination includes the annihilation of point defects by thermal oxidation and the reduction of surface states by passivation with deposited oxides annealed in nitric oxide. The research team successfully demonstrated high-voltage SiC BJTs with record current gains (β) of 257-335, which is a two- or three-fold improvement on the previous best BJT.

ispsd2011.e-papers.org/ESR/paper_details.php?PHPSESSID=66kfvn7o4arvt9o3u344249j64&paper_id=1161
www.ispsd2011.com/index.htm

BIOTECHNOLOGY

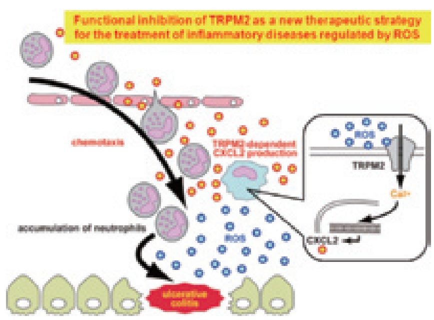
Knockout Mice for Inflammatory Disease Research

Valuable for drug discovery, especially for validation of the target mechanisms of various inflammatory diseases

Professor Yasuo Mori – School of Global Environmental Studies
Dr. Shinichirou Yamamoto – Graduate School of Pharmaceutical Sciences

Prof Yasuo Mori and Dr. Shinichiro Yamamoto have developed the TRPM2 knockout mice. TRPM2 is a member of the transient receptor potential protein (TRP) family and its gene encodes a plasma-membrane calcium ion channel. Recent research have suggested that TRPM2 plays important roles in inflammatory responses, and that it is/may be related to rheumatoid arthritis, asthma, Alzheimer's, or other diseases caused by inflammation. TRPM2 knockout mice serve as a valuable animal model for drug discovery, in screening, developing and clarifying mechanisms of various inflammatory diseases. TRPM2 knockout mice are available as research materials.

int.icc.kyoto-u.ac.jp/?p=1251



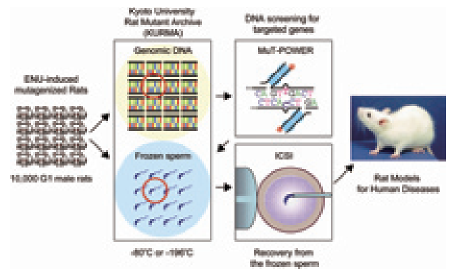
An ENU-induced Mutant Archive for Gene Targeting in Rats

A method for generating rat models of human diseases

Professor Tadao Serikawa – Institute of Laboratory Animals
Dr. Tomoji Mashimo – Institute of Laboratory Animals

Chemical mutagenesis is a powerful tool to produce genetically modified mutations in many species, especially where no functional embryonic stem cell lines exist. The ENU (N-ethyl N-nitrosourea) mutagenesis, followed by a screening method to detect single nucleotide substitutions within the targeted gene, is one of the most promising technologies in rats. Prof Tadao Serikawa and Dr. Tomoji Mashimo have developed a novel, efficient approach that combines two methods: a high-throughput, low-cost screening assay which makes use of the Mu-transposition reaction (MuT-POWER); and intracytoplasmic sperm injection (ICSI) for the recovery of the rare heterozygous genotypes from their newly generated frozen sperm repository, the Kyoto University Rat Mutant Archive (KURMA). So far several rat models of gene-targeted human diseases, such as cancer, obesity, hyperlipidemia, and neurological diseases, have been developed from the KURMA and used for drug development and translational research.

int.icc.kyoto-u.ac.jp/?p=1791



Prognostic Factor in Sarcoma, and Metastasis Inhibitor

Use of AFAP1L1 as a gene involved in the distant metastasis of a tumor or its long-term prognosis

Professor Junya Toguchida – Institute for Frontier Medical Sciences *and* CiRA

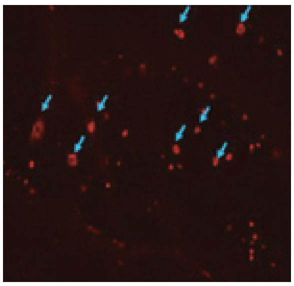
Prof Junya Toguchida and his research team found that the gene encoding a protein of previously unknown function, AFAP1L, specifically expresses in sarcomas and colon cancer cells and that the intracellular accumulation of AFAP1L varies according to the grade of malignancy of tumor cells. The present discovery thus provides a method for determining the risk of distant metastasis in a tumor by (1) measuring the expression level of AFAP1L1 in tumor tissue, and (2) examining the correlation between the expression level and incidences of distant metastasis. Also provided is a metastasis inhibitor comprised of a polynucleotide complementary to mRNA encoding AFAP1L1.
int.icc.kyoto-u.ac.jp/?p=1310

Development of Probe for In Vivo Molecular Imaging of β-amyloid and Tau Proteins in Alzheimer's Brain

Novel modality of molecular imaging for diagnosis and therapy of Alzheimer's disease

Professor Hideo Saji – Graduate School of Pharmaceutical Sciences
Associate Professor Masahiro Ono – Graduate School of Pharmaceutical Sciences

Prof. Hideo Saji and Associate Prof. Masahiro Ono at the Graduate School of Pharmaceutical Sciences have developed several molecular probes for β-amyloid (Aβ) and tau proteins, including positron emission tomography (PET) and single photon emission computed tomography (SPECT) tracers labeled with a radioisotope. In addition to PET/SPECT probes, they have currently focused on the development of near infrared fluorescent (NIRF) probes for optical imaging of Aβ and tau proteins. To develop fluorescent probes for optical imaging of Aβ plaques, they first synthesized several derivatives based on boron dipyrromethane (BODIPY), one of the common fluorophores, and evaluated their utility as Aβ imaging probes. When in vitro plaque labeling was carried out using brain sections from a mouse model of Alzheimer's (Tg2576), some of them clearly stained β-amyloid plaques in the brain sections. In addition, the BODIPY derivative showed in vivo Aβ plaque labeling in Tg2576 mice.



[right] Ex vivo fluorescent image in the brain after injection of a BODIPY derivative.

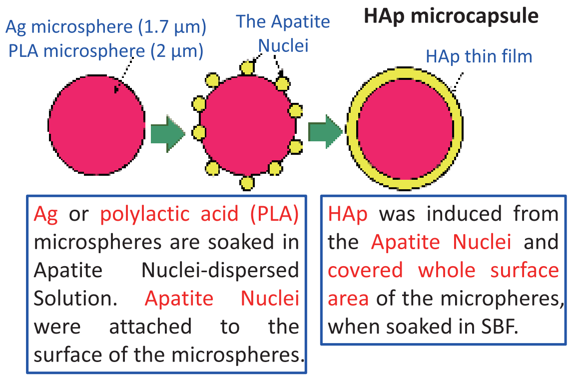
Although optical imaging techniques are not quantitative, especially with significant signal attenuation in tissue, NIRF imaging has the potential to provide a rapid, inexpensive, and nonradioactive drug screening system for Alzheimer's. Currently, the research team is also attempting to develop optical imaging probes targeting tau proteins.
int.icc.kyoto-u.ac.jp/?p=1795

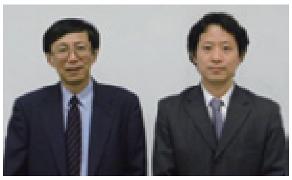
Method of Stabilizing Calcium Phosphate Fine Particles

Hydroxyapatite microcapsule for drug delivery system (DDS)

Professor Takeshi Yao – Graduate School of Energy Science

Prof Takeshi Yao has developed the technology which relates to a method for stabilizing calcium phosphate fine particles formed from Simulated Body Fluid (SBF) whose ionic concentrations are similar to those of human blood plasma. These fine particles have high activity for forming hydroxyapatite (HAp) from body fluid and are named Apatite Nuclei. The Apatite Nuclei are precipitated from SBF by raising pH or temperature and then the growth is halted by lowering the inorganic concentration surrounding them. The Apatite Nuclei can be preserved for long periods, while maintaining its high activity for forming HAp. Microspheres of metals, ceramics and polymers are easily encapsulated with HAp by using the Apatite Nuclei. The resultant microcapsules are biocompatible, show sustained release and are expected to be applied to one of ideal carriers for DDS.
int.icc.kyoto-u.ac.jp/?p=1074





New Method for Producing Alkaloid

Method for mass production of alkaloid

Professor Fumihiko Sato [left] – Graduate School of Biostudies
Dr. Hiromochi Minami [right] – Ishikawa Prefectural University

Prof Fumihiko Sato and Dr. Hiromochi Minami have provided a novel method for producing reticuline and related alkaloids in microbes. Reticuline is the key intermediate for producing the isoquinoline alkaloids. Such isoquinoline alkaloids include morphine, codeine, papaverine, berberine among others. These alkaloids are used in medicine. In this technology, reticuline and the related alkaloids, scoulerine and magnoflorine, are produced with the combination of *Micrococcus luteus* and plant enzymes.
int.icc.kyoto-u.ac.jp/?p=1238

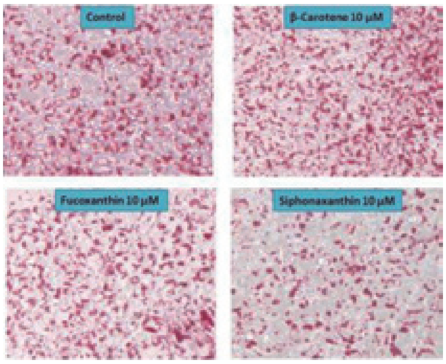
The microbial platform is further developed for the effective synthesis of stereo-specific reticuline and related alkaloids from glucose or glycerol as a culture substrate .
dx.doi.org/10.1038/ncomms1327

Suppressive Effect of Siphonaxanthin on the Differentiation of Preadipocytes to Adipocyte

Antiobesity effects of siphoxanthin from green algae

Professor Takashi Hirata – Graduate School of Agriculture
Associate Professor Tatsuya Sugahara – Graduate School of Agriculture

Prof Takashi Hirata and Associate Prof Tatsuya Sugahara evaluated the suppressive effects of naturally occurring carotenoids on the differentiation of 3T3-L1 preadipocytes to adipocytes. Treatment with siphonaxanthin significantly reduced lipid accumulation in 3T3-L1 cells during differenciation to adipocytes. This suppressive effect was stronger than that of fucoxanthin which is also known to show anti-obesity effects. Their findings provide that the green algal carotenoid, siphonaxanthin, is an active component for antiobesity.
int.saci.kyoto-u.ac.jp/?p=1743



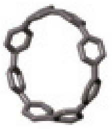
CHEMISTRY

Cross-Coupling Catalyst System for Synthesis of Aromatic Compounds

Novel Iron-based Cross-coupling catalysts

Professor Masaharu Nakamura – Institute for Chemical Research
Assistant Professor Takuji Hatakeyama – Institute for Chemical Research

Recent advances in cross-coupling methodologies have made an enormous contribution to the synthesis of organic electronic materials as well as medicinal/agrochemical compounds. Prof Masaharu Nakamura and Assistant Prof Takuji Hatakeyama have developed several iron-based catalyst systems that are highly effective for the cross-coupling reactions. By using their methods, a variety of alkyl halides are cross-coupled with arylmetal reagents in high to excellent yields, mostly exceeding 90%. The newly developed catalyst systems are easy to handle, ecologically friendly, cost-effective and less toxic compared to the conventional catalysts. Therefore, the methods developed in the Nakamura group can be used as powerful alternatives to the Nobel Prize-winning Suzuki-Miyaura and Negishi coupling reactions, which are regularly applied for the syntheses of functional aromatic compounds by using the rare-metal catalysts, such as palladium and nickel.
int.icc.kyoto-u.ac.jp/?p=967




Synthesis of Cycloparaphenylenes from a Square-Shaped Tetranuclear Platinum Complexes

General synthesis of hoop-shaped π-conjugated molecules

Professor Shigeru Yamago – Institute for Chemical Research

Prof Shigeru Yamago has developed a new synthetic method for cycloparaphenylenes, which are the simplest structural unit of armchair carbon nanotubes. The method allows the synthesis of several cycloparaphenylenes including [8]cycloparaphenylene, which is the smallest cycloparaphenylene derivative synthesized to date, by way of square shaped tetranuclear biaryl-platinum complexes. Cycloparaphenylenes shows different fluorescence depending on the ring size and provides new fundamental skeletons of organic opt-electronic materials. Also, this technology can be applied for the synthesis of various cycloparaphenylene derivatives.
int.icc.kyoto-u.ac.jp/?p=1506

Alcohol as Initiator for Living Radical Polymerization – Based on Reversible Chain Transfer Catalyzed Polymerization (RTCP)

Easily obtain end-functional polymers, block copolymers, star and comb-shaped branched polymers, and graft polymers on surfaces

Associate Professor Atsushi Goto – Institute for Chemical Research
Professor Yoshinobu Tsujii – Institute for Chemical Research

Associate Prof Atsushi Goto and Prof Yoshinobu Tsujii have developed a novel class of living radical polymerization using organic catalysts, termed RTCP. The catalysts are attractive for their low cost, low toxicity, and ease of handling. In this work, Goto and Tsujii develop a novel initiating system for RTCP using alcohols as the initiators (initiating dormant species) (this work concerns the initiator but not the catalyst). In LRP (living radical polymerization), a number of works have used alcohols as the initiating moieties by attaching LRP dormant species to them via esterification or other methods. In most cases, the product was purified and isolated, and then subjected to polymerization. This is a two-step process consisting of the attachment and the polymerization as separate steps. A striking advantage of the invention is that many non-conjugated alcohols can be used. Without prior chemical modification (attachment of LRP dormant species), we may obtain from molecules and substrates with hydroxyl group(s), end-functional polymers, block copolymers, star and comb-shaped branched polymers, and graft polymers on surfaces in a single step.
int.icc.kyoto-u.ac.jp/?p=1462

Triaryl (1-pyrenyl) bismuthonium Salts: Efficient Photoinitiators for Cationic Polymerization of Oxiranes and a Vinyl Ether

Photoinitiators for cationic polymerization with low-toxicity

Professor Hiroshi Imahori – Graduate School of Engineering
Associate Professor Yoshihiro Matano – Graduate School of Engineering

Photoirradiation of triaryl(1-pyrenyl)bismuthonium salts in acetonitrile afforded triarylbismuthanes and pyrene, accompanied by the generation of protic acids. Prof Hiroshi Imahori and Associate Prof Yoshihiro Matano have found that triaryl(1-pyrenyl)bismuthonium hexafluoroantimonates behave as efficient photoinitiators for the cationic polymerization of oxiranes and vinyl ethers, affording the corresponding polymers in good yields within a minute.
int.icc.kyoto-u.ac.jp/?p=976

MATERIALS

Wood-based Materials without Harmful Chemical Substances

Potential applications in construction materials: particleboards, medium-density fiberboards and plywood

Associate Professor Kenji Umemura – Research Institute for Sustainable Humanoshere (RISH)

Associate Prof Kenji Umemura has developed recyclable wood-based materials from bark and waste wood etc. without using petroleum-based chemical adhesives. The product can be used for making house-hold items such as furniture and for other purposes. The procedure to produce thiese products is simple and uses only non-toxic natural materials. First, bark powder or wood chips etc. are mixed with citric acid and sucrose. Second, the mixture is heat-pressured under controlled conditions. The materials become hardened in about 10 minutes. Various wood-based materials such as moldings, particleboards, fiberboards, and plywood can be fabricated. They are suitable for various uses in: construction materials, houses, furniture, etc.
int.saci.kyoto-u.ac.jp/?p=1151

Metal Nanostructures Formed by Electrodeposition within Hydrophobic Microporous Silicon

Metal nanostructures

Professor Yukio Ogata – Institute of Advanced Energy
Assistant Professor Kazuhiro Fukami – Institute of Advanced Energy

Assistant Prof Kazuhiro Fukami and Prof Yukio Ogata have recently developed a method to prepare metal nanostructures, such as nanoparticles and nanofibers, by electrodeposition in chemically-modified porous silicon electrodes. Porous silicon, several nanometers in diameter, have very large surface areas and high porosity. Therefore it has garnered attention for its utilization as a template for metal electrodeposition. However, the oxidation of silicon, which induces the uncontrollable displacement deposition process always takes place in aqueous deposition baths. The researchers modified the porous silicon by using organic molecules. In addition, they found that the organic molecules modified on the porous silicon wall must be hydrophobic, otherwise metal electrodeposition would not proceed within the template. For instance, they succeeded in the formation of dispersed platinum nanoparticles supported within a porous silicon matrix.
int.icc.kyoto-u.ac.jp/?p=1820

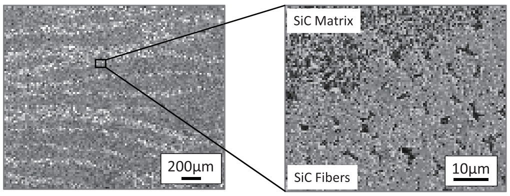
Ductile Porous SiC Ceramics with Fiber Reinforcement

Novel silicon carbide composites with high temperature oxygen-resitance

Associate Professor Tatsuya Hinoki – Institute of Advanced Energy

Silicon carbide ceramics are very attractive engineering ceramics, particularly for high temperature use and nuclear applications due to its tolerance to high temperatures, oxygen resistance, chemical stability, low activation, radiation resistance and so on. However the application of silicon carbide ceramics is limited due to its brittle features, leading to the development of Novel silicon carbide composites by the Hinoki research group. The material consists of silicon carbide fibers and a porous silicon carbide matrix as shown in the following figure. The composites show pseudo-ductile behavior and complex fracture behavior due to frictional stress at the debonded fiber/matrix interface.

int.icc.kyoto-u.ac.jp/?p=1725



[Right] SEM images of the novel silicon carbide composites with porous matrix

ENERGY & ENVIRONMENT

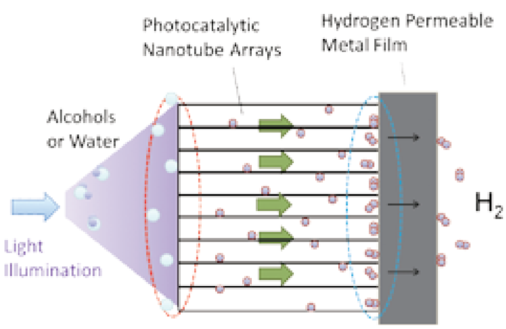
Photocatalytic Membrane Reactor Based on Integration of Hydrogen Generation and Separation Functions

A new hydrogen separation membrane for fuel cell application

Professor Kazumi Matsushige – Graduate School of Engineering
Dr. Kei Noda – Graduate School of Engineering

Prof Kazumi Matsushige and Dr. Kei Noda have recently developed a new photocatalytic hydrogen separation membrane, where hydrogen generation and separation functions are integrated inside a single membrane. This membrane consists of anodized titanium dioxide (TiO_2) nanotube arrays (TNAs) and a hydrogen permeable metal film. In this membrane, hydrogen can be generated photocatalytically from alcohol or water on the surface of TNAs under ultraviolet illumination and the generated H_2 can be separated from other byproduct gases through the hydrogen permeable metal film. Thus, the generation and separation of hydrogen is simultaneously achieved in a single membrane. This technique is promising for realizing further miniaturization and low temperature operations of hydrogen reformers.

int.icc.kyoto-u.ac.jp/?p=1836



Rational Molecular Design of Organic Dyes for Highly Efficient Dye

Sensitized solar cells using Intramolecular B–N coordination as a key scaffold

Associate Professor Atsushi Wakamiya – Institute for Chemical Research

Associate Prof Atsushi Wakamiya and his research team have disclosed a new molecular design concept of organic dyes for dye-sensitized solar cells (DSSC) in which π-electron accepting unit containning an intramolecular boron-nitrogen (B-N) bond is used as a key skeleton (Fig. 1). The introduction of the intramolecular B-N bond enables the tuning of the electronic structure of organic dyes to increase its pi-electron accepting capacity. As a model compound of this molecular design concept, the researchers synthesized boryl-substituted thienylthiazole-containing organic dye. The DSSC using this compound showed a high incident photon-to-current efficiency (IPCE) of over 90% in the 410-550 nm region and with an overall conversion efficiency of 5.99%. The electronic structure of the present systems can be easily tuned by the substituent on the boron atom, suggesting the potential for more red-shifted absorption and higher overall conversion efficiency.

int.icc.kyoto-u.ac.jp/?p=1863

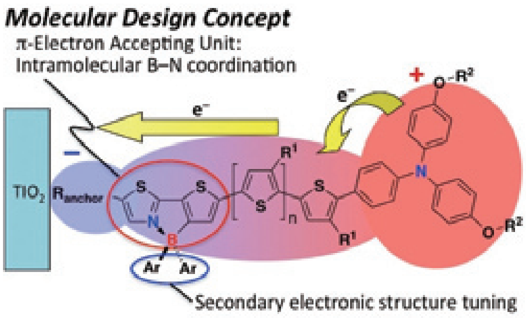


Fig 1. Molecular design concept using π-electron accepting unit containing an intramolecular B–N coordination bond as a key skeleton.

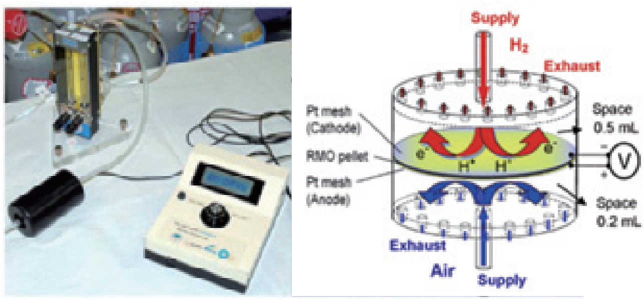
Sensoring Hydrogen Gas Concentration at Room Temperature Using Electrolyte Made of Proton Conductive Manganese Dioxide

Hydrogen fuel type automobile in near future needs simple H_2 sensor for the fuel meter

Associate Professor Hideki Koyanaka – iCeMS
Assistant Professor Yoshikatsu Ueda – RISH

Hydrogen gas promises to be a major clean fuel in the near future. Thus, sensors that can measure the concentrations of hydrogen gas covering a wide dynamic range (e.g. 1-99.9%) are in demand for its production, storage, and utilization. However, it is difficult to directly measure hydrogen gas concentrations greater than 10% using conventional sensors. Associate Prof Hideki Koyanaka and Assistant Prof Yoshikatsu Ueda have introduced a simple sensor using an electrolyte made of proton conductive manganese dioxide that enables in-situ measurements of hydrogen gas concentrations within a wide range of 0.1-99.9% at room temperature.

int.icc.kyoto-u.ac.jp/?p=1704



OTHERS

A Topology Optimization Method Based on the Level Set Method Incorporating a Fictitious Interface Energy

Professor Shinji Nishiwaki – Graduate School of Engineering
Assistant Professor Kazuhiro Izui – Graduate School of Engineering

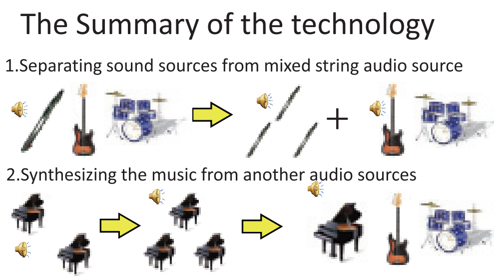
Prof Shinji Nishiwaki and his research team have proposed a new topology optimization method, which can adjust the geometrical complexity of optimal configurations, using the level set method and incorporating a fictitious interface energy derived from the phase field method. First, a topology optimization problem is formulated based on the level set method, and the method of regularizing the optimization problem by introducing fictitious interface energy is explained. Next, the reaction–diffusion equation that updates the level set function is derived and an optimization algorithm is then constructed, which uses the finite element method to solve the equilibrium equations and the reaction–diffusion equation when updating the level set function. Finally, several optimum design examples are shown to confirm the validity and utility of the proposed topology optimization method.

Comput. Methods Appl. Mech. Engrg. 199 (2010) 2876–2891

Analysis-and-Manipulation Approach to Pitch and Duration of Musical Instrument Sounds Without Distorting Timbral Characteristics

Professor Hitoshi G. Okuno – Graduate School of Informatics

The aim of the technology is to manipulate the pitch and duration of a musical instrument sound with minimal distortion to timbral features. It also provides a method to superimpose two musical instrument sounds. The user can choose and mix any instrument timbre like a sound palette, and then replace some parts of the musical performance with it. The technology consists of three steps: (1) "Analysis": Separation of signals from a musical instrument by using an integrated instrument sound model of harmonic and non-harmonic structures while extracting timbral features. It also obtains the residue. (2) "Manipulation": Manipulation of pitch, duration, and non-harmonic structure to create a new sound from signals of any musical instrument and (3) "Synthesis": Synthesizing harmonic and non-harmonic signals for the new sound and adding them to the residue to get a new performance.
int.icc.kyoto-u.ac.jp/?p=1181



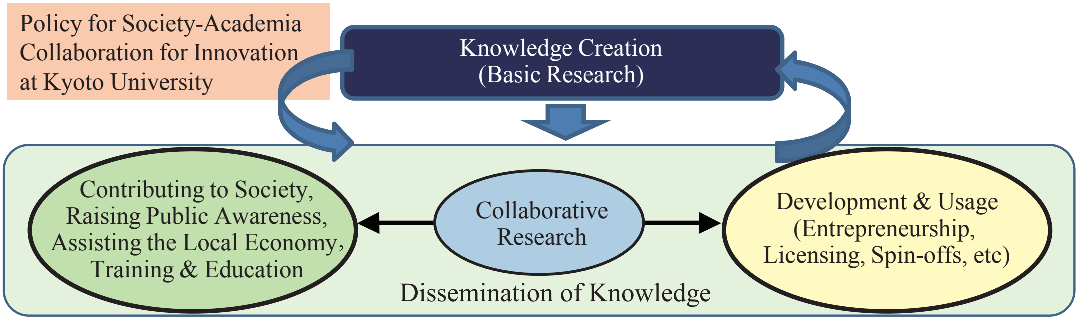
For further information of available technologies：
www.kyoto-u.ac.jp/en/research

SACI : Office of Society-Academia Collaboration for Innovation

Collaboration with foreign universities and industries remains robust, enabling the research and education at Kyoto University to be all the more effective, attractive and fruitful. The **SACI** works to establish an effective network with universities, technology transfer organizations and private corporations throughout the world.

Established to promote collaboration between industry-government-academia, the threefold mission of our office is about: 1) Promoting collaborative research between academia, industries and the government 2) Supporting business startups by researchers and students 3) Managing and maximizing on the university's intellectual properties.

Director
Keisuke Makino



European Representative Office in London

In February 2009, Kyoto University opened its first overseas operating base in Europe, to promote the university's industry-academia collaboration activities.

The main function of the representative office is to be the base for planning and execution of international collaboration activities with leading universities and companies of the UK and other European countries.

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Mail: saci@kyoto-u.eu

Professor **Toshio Nomura**

Notable R&D for Technology Transfer

The SACI operates and maintains a website with access to a database of various technologies developed by Kyoto University.

The technologies are at various stages of development and the site is intended to be a one-stop place to go for companies interested in collaborating with Kyoto University.

int.saci.kyoto-u.ac.jp

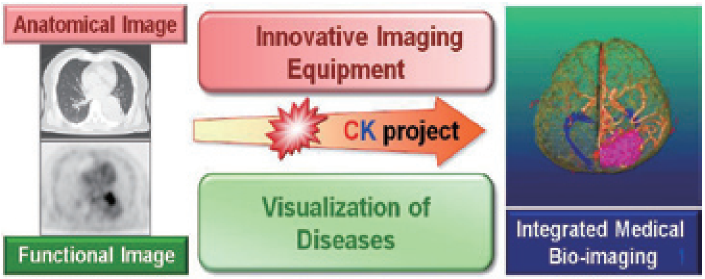
CK Joint Project with Canon

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

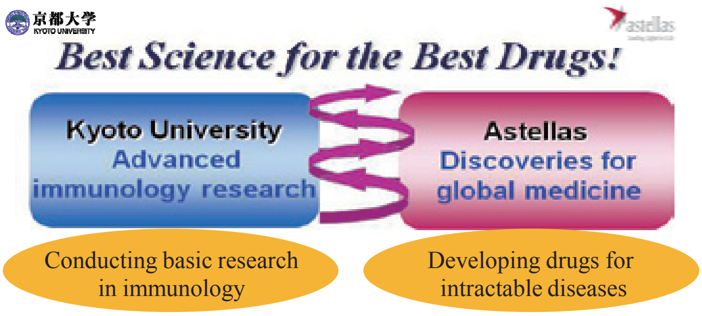
AK Joint Project with Astellas

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

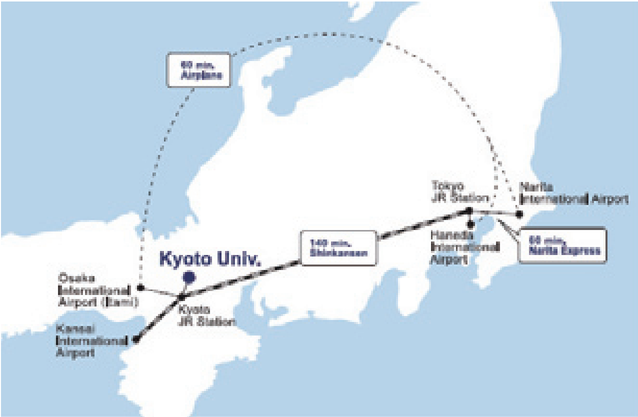
- Innovating drug development systems.
- Identifying and validating new drug targets.
- Developing new drugs for allergies, autoimmune diseases, cancer, and immuno-suppression.
- Nurturing young talents comprehensive for drug discovery and intellectual properties.
- Funded by the MEXT for the promotion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

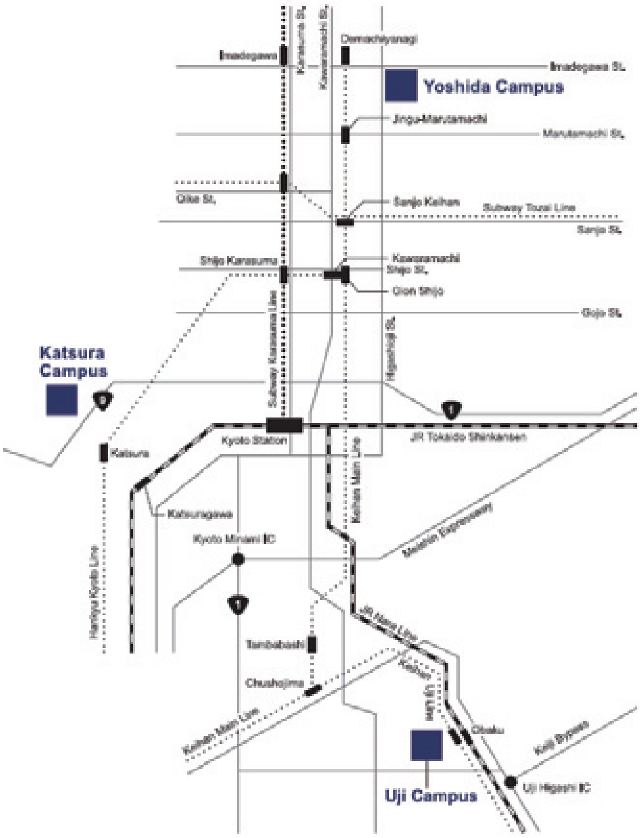
Project Members:
45 Researchers and Postdocs
(KU and worldwide)
MD: 19
PhD (Non-MD): 26
52 Researchers (Astellas)
3 Intellectual property managers
14 Technical assistants

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)





With plenty of English language signage, the Japanese transportation systems offer safe methods of travel.

Access to Kyoto Station from Kansai International Airport

The following is a guide to transportation options from Kansai International Airport to JR (Japan Railway) Kyoto Station. Other methods include shared shuttle taxis (fare required) that take each passenger directly to their desired destination.

1) Train

JR Airport Express "Haruka"
one-way fare: ¥2,980 non-reserved seat
¥3,690 reserved seat

Kansai International Airport → About 75 min. → JR Kyoto Station

2) Airport Limousine Bus

one-way fare: ¥2,500

Kansai International Airport → About 105 min. → JR Kyoto Station

Airport Limousine Bus Time Table
www.kate.co.jp/pc/time_table/time.html

Transportation to Campuses

Yoshida Campus

JR Kyoto Station → Yoshida Campus
City Bus: About 30 min. (*No. 206, ¥220) Get off at "Kyodai Seimon-mae"
Taxi: About 20 min. (around ¥2,000)

*Bound for Kitaoji Bus Terminal via Higashiyama Street.

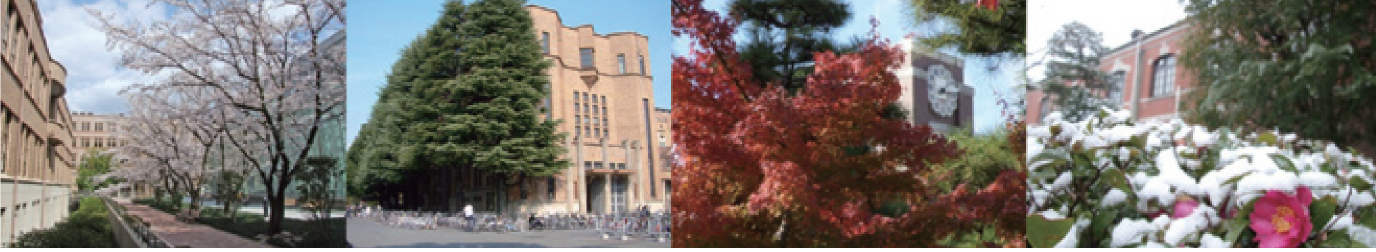
Uji Campus

JR Kyoto Station → Uji Campus
Local Train: About 20 ~ 25min. (¥230)
JR Nara Line Get off at "Obaku"

Katsura Campus

Hankyu Railway Katsura Station → Katsura Campus
City Bus: About 20 min. (No. 6 West, ¥230) Get off at "Kyodai Katsura Campus-mae"
Taxi: About 10 min. (around ¥1,000)

JR Kyoto Station → Katsura Campus
Keihan Bus: About 35 min. (No. 21, 21A, ¥290) Get off at "Kyodai Katsura Campus-mae"
Taxi: About 40 min. (around ¥2,600)



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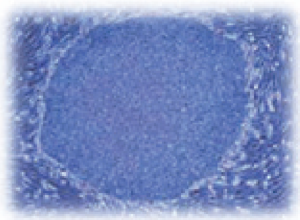
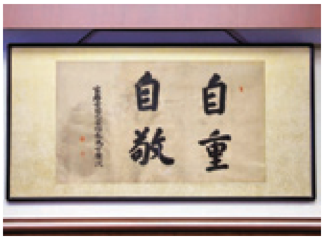
K.Nishida





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