KYOTO UNIVERSITY

Research Activities 2012

Vol.2 No.1 March

Contents

Front cover: Yoshida Campus, Kyoto University in Spring

Message from the President

President
Hiroshi Matsumoto

2011 was a year that saw change and reform occur throughout the whole of Japanese society in the wake of the devastating earthquake and tsunami disaster of March 11 and the consequent disaster at the Fukushima Daiichi Nuclear Power Plant. In the face of those tragic events, Kyoto University is also resolved to change and evolve in order to fulfill our duty as a university and effectively respond to society's needs.

Since its foundation in 1897, Kyoto University has been dedicated to cultivating a liberal and vibrant academic environment conducive to quality education, interdisciplinary dialogue and groundbreaking research. As a result of those efforts we have become recognized as one of the most diverse research-oriented universities in Japan. The strength of our approach is testified by the accolades conferred on our alumni and researchers, notably seven Nobel Prize laureates, two Fields Medalists and one Gauss Prize laureate.

In this publication I am proud to present some prominent examples of our most recent research accomplishments. I am confident that these projects deserve their place in Kyoto University's legacy of innovative world-leading research, and I hope that you will enjoy reading about them. I also hope that this brochure will function as one small part of our efforts to effectively convey the wealth of knowledge generated at Kyoto University beyond our campuses, so that it can be effectively employed for the benefit of international society, industry, academia and the world at large.

March 2012

H. Matsumoto

Hiroshi Matsumoto

Establishment of Kyoto University

Kyoto University was established in June of 1897 as the second national university in Japan. The first reason for the founding of the new university was the increasing number of people who hoped to matriculate at the University of Tokyo, the only imperial university at that time. The second was the need to foster talented leaders urgently in need as a rapidly developing industrial nation.

[top] The Clock Tower, as seen in 1925
[middle and bottom] The original university library (built in 1899)
*Photos are preserved in the Kyoto University Archives

History of Kyoto

Kyoto was the capital of Japan from 794 to 1868. At the time of its establishment by Emperor Kammu, Kyoto was called Heian-kyo which literally means, in Chinese characters, a "peaceful and tranquil capital." It is surrounded by mountains on three sides – north, west and east. Because of this geographic location, the people of Kyoto are able to enjoy nature in its four very distinct seasons reflected in the rich cultural history of seasonal rituals and festivals that remain vibrant to this day.

After the Meiji Restoration in 1868, the capital was transferred to Edo, which was soon renamed Tokyo. It was a sudden change and the population once dropped dramatically and the city entered into a state of depression. But Kyoto soon flourished again, not as a political center but as a cultural, educational, and economical center with progressive development in the industrial sector.

Kyoto was the place for Japan's first elementary and junior high schools, the first kindergarten, and the first public library. Development of the first hydroelectric power plant and trams as well as Japan's first industrial exposition was conducted.

Kyoto, the Old and the New

As a city associated with a distinct nostalgia, its citizens are often understood as traditional and conservative, but in fact, they also have innovative mind for adopting new ideas. On one side, Kyoto is characterized by its long history and its importance as a cultural center can hardly be exaggerated. On the other, it is also well known as a modern city with a progressive outlook and numerous high-tech companies. Such elements are supported by the fact that Kyoto has long been a city of academics, and a university town with a large student population. Of the approximately 1,470,000 people living in Kyoto, some 10% are students of the city's thirty-seven universities and colleges.

Style and Characteristics

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

Kyoto University is a national university which places particular emphasis on the tradition of academic freedom and self-reliant learning. At its official opening, the first president of the university, Hiroji Kinoshita, delivered a speech declaring that "this university is neither a branch nor a small-scale model of its forerunner, the Imperial University of Tokyo", and expressed that the ideal university is to have a unique character. Academic freedom and an educational system centered on student autonomy are the chief characteristics of our university. His beliefs have been passed on to each of our students and have inspired the lives of many.

Sight Visit: The Philosopher's Path

About a 15-minute walk from Kyoto University takes you to Ginkakuji (Silver pavilion), a World Heritage site, and just before you reach the pavilion, visitors are met with the north end of a path. It lies beside a branch of the Lake Biwa Canal running from north to south for about 2 km along the stream, attracting many tourists throughout the year with its seasonal beauty: cherry blossoms in spring, fireflies in summer, colored leaves in fall and camellias in winter.

The Philosopher's Path was named after an episode of well-known philosopher Kitaro Nishida (1870-1945), who used to stroll along this path and ponder over material for new poetry. Originally, it was first known as the path of meditation.

In prewar days, a small group of philosophers including Nishida and his colleague, Hajime Tanabe formed the Kyoto School of Philosophy to advocate the incorporation of Western philosophy into Eastern thought and seek the balance between the two ways of thinking. The conflict between non-Western peoples and the globalization of Western culture has lost none of its potency. The varied and mutually stimulating philosophers of the Kyoto School still exert a strong attraction today.

Photos: [upper-right]The Philosopher's Path in spring,
[Lower-right]Kitaro Nishida (1870-1945)

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

Yoshida Campus

Katsura Campus

Uji Campus

Facilities

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

Faculty, Staff & Students

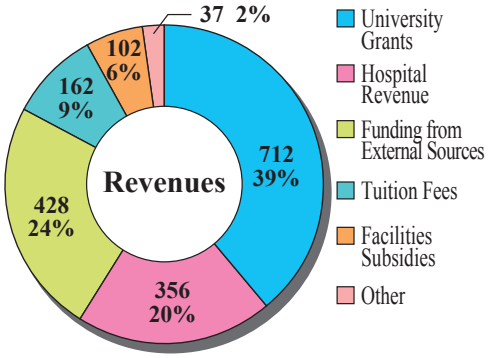
as of May 2011

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

Budget

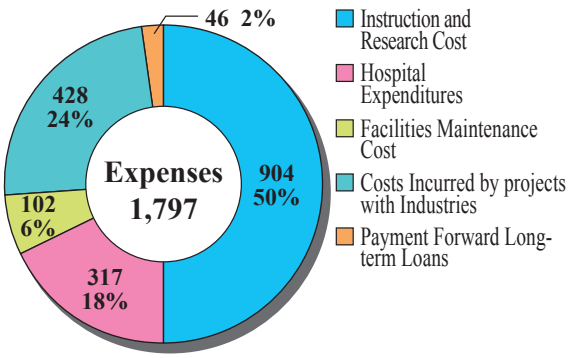
Revenues in Fiscal Year 2010

Unit: U.S. million dollars (US$1=¥81.45)



Expenses in Fiscal Year 2010

Unit: U.S. million dollars (US$1=¥81.45)



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

2 Japan Prizes | 2 Kyoto Prizes

*Photos provided by Japan Prize Foundation

*Photos provided by Inamori Foundation

Makoto Nagao	Masatoshi Takeichi	Chushiro Hayashi	Kiyoshi Ito	Shinya Yamanaka
2005	2005	1995	1998	2010

University Establishments in Japan

Kyoto University operates a wide variety of facilities located throughout the nation, ranging from field stations and observatories to region-based research laboratories. Each of them serves as unique and indispensable resources that support the research activities of Kyoto University. The university is particularly renowned for its rich achievements stemming from its wide range of fieldwork.

Area Ⅰ [Kyoto Prefecture]

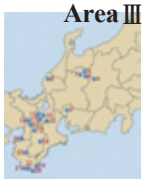
1. Maizuru Fisherise Research Station (F.S.E.R.C.)
2. Livestock Farm (Agr.)
3. Ashiu Forest Research Station (F.S.E.R.C.)
4. Laboratory of Crop Evolution (Agr.)
5. Uji Campus

Abbreviations

D.P.R.I. --- Disaster Prevention Research Institute
Sci. --- Graduate School of Science
Eng. --- Graduate School of Engineering
R.I.S.H. --- Research Institute for Sustainable Humanosphere
Agr. --- Graduate School of Agriculture
F.S.E.R.C. --- Field Science Education and Research Center

Area Ⅱ [Hokkaido Prefecture]

1. Hokkaido Forest Research Station, Shibecha-ku, Hokkaido
2. Hokkaido Forest Research Station, Shiranuka-ku, Hokkaido (F.S.E.R.C.)



Area Ⅲ

3. Ogata Wave Observatory, Niigata (D.P.R.I.)
4. Kiso Biological Research Institute, Fukushima, Nagano (Sci.)
5. Kamitakara Observatory, Gifu (D.P.R.I.)
6. Hodaka Sedimentation Observatory, Gifu (D.P.R.I.)
7. Hida Observatory, Kamitakara, Gifu (Sci.)
8. Hokuriku Observatory, Fukui (D.P.R.I.)
9. Primate Research Institute, Inuyama, Aichi
10. Center for Ecological Research, Otsu, Shiga
11. Research Center for Environmental Quality Control (Eng.)
12. Shigaraki MU Observatory (R.I.S.H)
13. Osakayama Observatory, Otsu, Shiga (D.P.R.I.)
14. Abuyama Observatory, Takatsuki, Osaka (D.P.R.I.)
15. Experimental Farm, Takatsuki, Osaka (Agr.)
16. Research Reactor Institute, Kumatori, Osaka
17. Donzurubo Observatory, Nara (D.P.R.I.)
18. Ouda Station of Department of Astronomy, Ouda, Nara (Sci.)
19. Kii-Oshima Research Station, Wakayama (F.S.E.R.C.)
20. Shinomisaki Wind Effect Laboratory, Wakayama (D.P.R.I.)
21. Shirahama Oceanographic Observatory, Wakayama (D.P.R.I.)
22. Seto Marine Biological Laboratory, Wakayama (F.S.E.R.C.)
23. Wakayama Forest Research Station, Wakayama (F.S.E.R.C.)

Area Ⅳ

24. Tottori Observatory, Tottori (D.P.R.I.)
25. Tokuyama Experimental Station, Tokuyama, Yamaguchi (F.S.E.R.C.)
26. Tokushima Observatory, Tokushima (D.P.R.I.)
27. Tokushima Landslide Observatory, Tokushima (D.P.R.I.)
28. Beppu Geothermal Research Laboratory, Beppu, Oita (Sci.)
29. Aso Volcanological Laboratory, Aso, Kumamoto (Sci.)
30. Miyazaki Observatory, Miyazaki (D.P.R.I.)
31. Koshima Field-Station, Koshima, Miyazaki (P.R.I.)
32. Sakurajima Geothermal Research Center, Kagoshima (D.P.R.I.)
33. Yakushima Field-Station, Kamiyakucho, Kagoshima (P.R.I.)

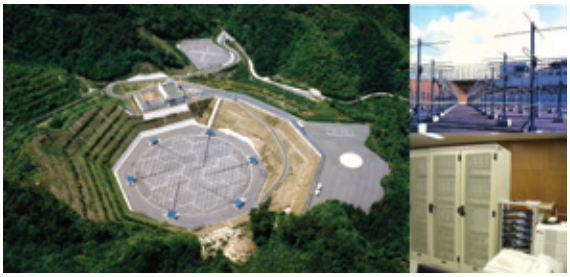
Branch Office in Tokyo

The Tokyo Office offers meeting spaces in a central location for students, alumni, professors and others of KU to conduct constructive networking activities for the expansion of the university's academic activities.

The Shigaraki MU Observatory

The middle and upper atmosphere radar (MU radar), located at the latitude of 136.1°E and longitude of 34.9°N, is a major observation facility at the Shigaraki MU Observatory, and part of the Research Institute for Sustainable Humanosphere (RISH) at Kyoto University. The MU radar is one of the most powerful VHF-band atmospheric radars to observe the lower, middle, and upper atmospheres. It has been used by both national and international researchers as a collaborative research facility since 1984 to study variabilities of the Earth's atmosphere from the fields of meteorology, upper atmosphere physics, astronomy, and space physics. The novel techniques of the MU radar has been applied to the development of various other types of atmospheric radars. Many of them and other instruments are operated at the Shigaraki MU Observatory, which is becoming a world leading facility for atmospheric observation.

www.rish.kyoto-u.ac.jp/mu/en/index.html



[left] Areal view of the MU radar [top right] Antenna array [bottom right] Multi-channel digital receiver system

[left] Instruments installed at the Shigaraki MU Observatory Reyleigh/Raman lidar [top right] Lower Troposphere Radar [bottom center] Lower Thermosphere Profiler Radar [bottom right] A speaker for RASS observation

The Kumamoto Sanctuary
Wildlife Research Center (WRC) of Kyoto University

Director
Masaki Tomonaga

The Kumamoto Sanctuary (KS) was established on August 1st, 2011, as a facility within the Wildlife Research Center (WRC) of Kyoto University.

KS is the largest institute for chimpanzees in Japan.

The WRC aims to attain a balanced coexistence among the inhabitants of the global community. The KS mission is to conduct basic scientific studies of endangered and threatened species of animals, to gain a better understanding of how to protect them and their natural habitats, while also improving their health and life expectancy in captivity. The focus is on developing interdisciplinary approaches that involve the life sciences, fieldwork techniques and other disciplines. Work is also conducted with zoo and aquarium networks to develop and carry out environmental education programs geared toward future generations. Consistent with the ideologies of the WRC, KS does not perform any form of invasive medical, drug or physiological tests that would require unnatural behavior or be a cause for stress.

KS performs cutting-edge research in the fields of comparative cognitive science, gerontology, welfare science, and evolutionary biology as one of the Joint Usage Research Centers for Collaborative Research at Kyoto University.

www.wrc.kyoto-u.ac.jp/kumasan/indexE.html

OPIR:
The Organization for the Promotion of International Relations

Director General
Junichi Mori

The purpose of the OPIR is to coordinate and seek to maximize the mutual benefits that may be attained between Kyoto University and its partner institutions.

Serving as the international strategy headquarters, it makes decisions regarding international exchange matters for Kyoto University.

It also oversees several long existing international exchange committees.

www.opir.kyoto-u.ac.jp/e/index.html

Missions are: **1)** To gather information and coordinate international activities for the promotion of international relations at the university-wide level. **2)** To support international activities organized by other faculties and expand multi-faceted academic exchange through involvement with international university alliances. **3)** To improve the infrastructure for the recruitment of international students and researchers. **4)** To cultivate administrative skills for international exchange activities and enhance organizational quality.

Building Stronger International Ties Among Universities

Kyoto University hosted the AEARU* 17th Annual General Meeting and 29th Board of Directors Meeting for 2011. Also held for the first time was the 1st AEARU Symposium on the Culture of Chinese Characters during December 14-16. The next association event will be the 30th Board of Directors Meeting, scheduled to take place in May 2012 at Nanjing University.

[left] AEARU 17th Annual General Meeting and 29th Board of Directors Meeting December 14, 2011 [right] Participants in front of the Clock Tower Centennial Hall

*AEARU

The Association of East Asian Research Universities is a group of 17 major universities of the region dedicated to the development of higher education and research, and the encouraging of cultural, economic and social progress.

International Conferences Recently Attended

The Science and Technology in Society (STS) Forum 2011

www.kyoto-u.ac.jp/en/news_data/h/h1/news7/2011/111003_3.htm

(The details of the next forum have not been finalized)

7th Forum for Chinese and Japanese University Presidents

www.kyoto-u.ac.jp/en/news_data/h/h1/news7/2011/111014_2.htm

(The next forum will be held in China at Xiamen University in 2013)

Other Major Networks

The Association of Pacific Rim Universities (APRU) :

- 42 leading research universities located throughout the Pacific Rim.

International Association of Universities (IAU) :

- the UNESCO (United Nations Educational, Scientific and Cultural Organization) based worldwide association of higher education institutions.

VKCO:
Vietnam National University, Hanoi – Kyoto University Collaboration Office

Initiated with the purpose of developing closer academic ties between Japan and Vietnam under the Japanese government's Global 30* project, the VKCO has been set up directly under the Vietnam National University in Hanoi, to assist interested parties within the two nations to explore their networking interests and expand their horizons.

*Global 30 – is a MEXT (Ministry of Education, Culture, Sports, Science and Technology) outreach project with the aim of establishing a solid support network for overseas students who wish to study at Japanese universities.

Director
Toshihiko Shine

Activities

- Providing a portal to detailed information on all Japanese universities.
- Organizing education fairs throughout Vietnam.
- Assisting communications via video conferencing services.

[left] VKCO's first year foundation and Japanese educational global 30 seminar – held on September 17, 2011 at Vietnam National University, Hanoi

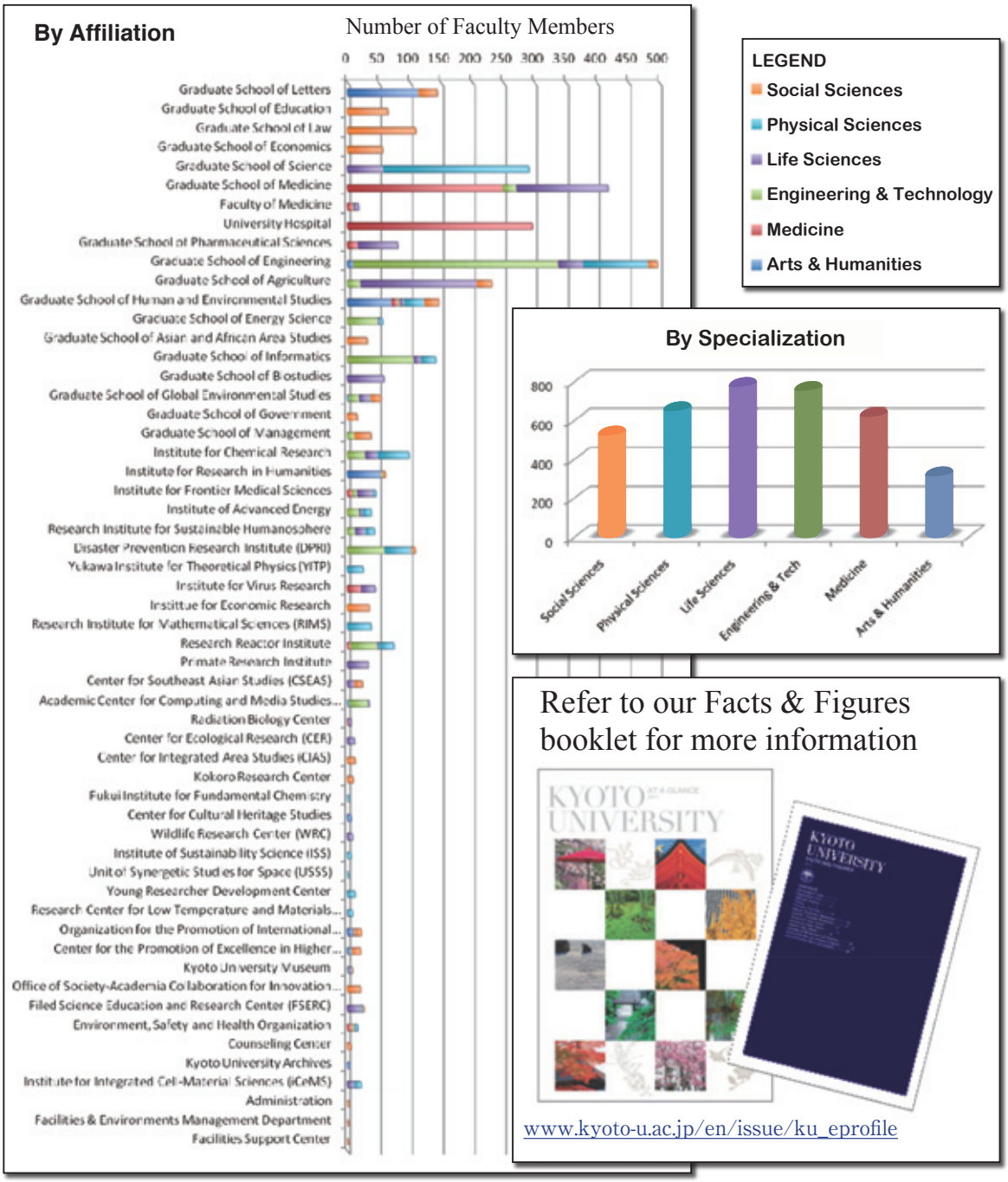
The Office in Hanoi

Office facilities are open for use by lecturers, students and staff of Japanese and Vietnamese universities, for selected purposes. Available are conference rooms, video conferencing systems and reference materials.

For more information about the office, visit
http://english.vkco.vnu.edu.vn/

Address: 3rd floor, G7 Building, VNU, Hanoi
144 Xuan Thuy Street, Cau Giay District, Hanoi
Tel: + 84-4-6681-5384; +84-972-532-896
Email: vkco_office@vnu.edu.vn

Diversity of Research at Kyoto University



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

KURENAI: the Information Repository at Kyoto University

The Kyoto University Research Information Repository (KURENAI) is operated by the Kyoto University Library Network, containing and preserving peer-reviewed journal articles, theses, departmental bulletin papers and the full range of other scholarly works produced at Kyoto University, with the purpose of making them available to the public via the web.

As of 2010, the repository has accumulated over 80,000 articles and 100 journals. Over 1.1 million items have been downloaded.

The KURENAI is regarded highly among institutional repositories throughout the world. It was ranked the number 1 repository in Japan and 8th in the world by the "Ranking Web of World Repositories" conducted in July 2011, by the Consejo Superior de Investigaciones Científicas, a research institute in Spain.

京都大学学術情報リポジトリ
KURENAI 紅
Kyoto University Research Information Repository

repository.kulib.kyoto-u.ac.jp/dspace/?locale=en

KYOTO-U Open Course Ware

OCW (Open Course Ware) is a project begun at Kyoto University in 2005, making the university's lectures widely available through the internet. Its purpose is to expand educational opportunities to people such as students, staffs, teachers not only within Kyoto University but also at other universities, researchers of associated societies, senior high school students as well as members of the general public who wish to further their personal knowledge. We feel that it is also important to improve the global visibility of Kyoto University by providing access to its culture and traditions not only in English but also in Japanese. The OCW aims to contribute to the human knowledge-pool and expand its networks with other countries through communications.

ocw.kyoto-u.ac.jp/Welcome-to-Kyoto-U-OCW?set_language=en

Kyoto University joins iTunes U

On November 2011, Kyoto University announced the availability of its educational content on iTunes U, a dedicated area within the iTunes Store. Kyoto University has made over 86 collections such as course lectures, English references, and open seminars available as a free download on iTunes U.

Kyoto University content available on iTunes U includes the most recent symposium "Recovering from the Earthquake– Building a stronger and safer country," course lectures from Nobel Prize winner and renown Honorary Professor of Physics Toshihide Masukawa, "Introduction to Japanese Culture" intended for international students studying in Japan, and last lectures from Kyoto Universities tenure professors. Kyoto University is excited to be able to make the great education offered at the university campus, on iTunes U for everyone to enjoy.

Tokku – Three Super Special Consortia led by Kyoto University
Supporting the Development of Cutting-edge Medical Care

Super Special Consortia are centered around particularly innovative research discoveries with the potential of making a great impact on humanity. They are chosen as research areas of high priority by the Ministry of Health, Labor and Welfare.

With the full support of the government, these projects enjoy a freedom from certain time-consuming controls, paving the way for rapid development. In addition to the easing of regulations on research fund usage, consortia formed through this program enjoy the ability to communicate directly with the Ministry of Health, Labor and Welfare, about applying to have pharmaceuticals and/or medical devices approved while still in the developmental stages of the project.

A public call for entries and selection of projects was conducted by the Council for the Promotion of Health Research, which consists of four ministers, including the State Minister in Charge of Science and Technology Policy, and other experts.

Drug discovery projects based on control of intercellular signal transduction, targeting intractable diseases

This Special Research Initiative for Drug Discovery for Intractable Diseases is aimed primarily at the development of new therapeutic approaches for patients with intractable diseases, which consists of 3 internationally reputed projects as follows. Because of the very small number of patients with rare intractable diseases, the development of treatments for such diseases would provide limited business benefits to pharmaceutical companies. Therefore, this issue must be addressed by the national government and society, and especially by universities, as a priority area of medical research.

Project 1: Research project for bioactive peptides expected for effective drugs toward intractable diseases.
Project 2: Research project for controlled-release DDS selectively elevating local concentration of active substances.
Project 3: Research project for innovative anti-cancer immunotherapy with cell therapy.

Principal Investigator: **Kazuwa Nakao**, M.D., Ph.D.
Director, EBM Research Center
Professor, Graduate School of Medicine, Kyoto University

Innovative Medical Imaging Device Development Projects

Medical imaging technologies led the medical care of the 20th century, together with genetic medicine. The following four projects, based on innovative "imaging" technologies, promote the development of two diagnostic and two therapeutic systems for early diagnosis and advanced treatment respectively, in order to meet the needs of society.

Project 1: Optical Imaging System Development
Project 2: PET (Positron Emission Tomography) System Development
Project 3: Four-dimensional Radiotherapy System Development
Project 4: BNCT (Boron Neutron Capture Therapy) System Development

Principal Investigator: **Masahiro Hiraoka**, M.D., Ph.D.
Professor, Graduate School of Medicine, Kyoto University

iPS cell Projects

For their pluripotency, iPS cells (iPSCs) can be potential sources for cell-based therapy. Patient-specific iPSCs can be generated from the cells which can easily be sampled from an appropriate part of a patient's body. Theoretically, the target cells for transplantation can be made available from these iPSCs which can avoid rejection by the immune system when they are returned to the patient. In addition, expectations are high for such generated iPSCs to contribute to drug development and modeling for intractable diseases.

Based on this innovative technology which originated in Japan, we aim to realize advanced regenerative medicine for healthy longevity in the coming ageing society.

Project 1: Establishment of evaluation system for side effect and/or toxicology of drug candidate, which is more effective than conventional methods with animal models.
Project 2: *In vitro* modeling of intractable diseases and establishment of drug screening systems based on the patient-specific iPSCs.
Project 3: Establishment of the strategy for cell-based therapy for nerve, cardiovascular, and blood diseases.

Principal Investigator: **Shinya Yamanaka**, M.D., Ph.D.
Director,
Center for iPS Cell Research and Application (CiRA)
Professor, Institute for Integrated Cell-Material Sciences, Kyoto University

Medical Innovation Center

Director
Shu Narumiya

The Kyoto University Graduate School of Medicine established the Medical Innovation Center (MIC) to promote the study of human medicine through integrated medical research conducted between university and pharmaceutical companies with state-of-the-art technologies for the discovery of new drugs, leading the way for the creation of new health care systems, particularly in innovative therapeutics.

Based on collaborative research conducted between whole companies and the university focusing on specific disease areas, the MIC aims to identify drug targets that are truly useful in clinical research, using the technologies available to analyze the extensive patient information and clinical samples collected at the university's medical school and hospital. This creates links between the discoveries on the basic structures and mechanisms of living organisms – a tradition at the Kyoto University Graduate School of Medicine – with the elucidation of the mechanisms behind human diseases.

www.med.kyoto-u.ac.jp/mic/

MIC Medical Innovation Center

Ongoing Joint Research Programs with Private Companies

TK project – with Takeda Pharmaceutical Co. Ltd

The Takeda-Kyoto University (TK) project was begun in April 2011 as a five-year R&D project focusing on the discovery of new drugs that act on the central nervous system to treat obesity and schizophrenia. Obesity has become a leading preventable cause of death worldwide and one of the most serious public health problems in the 21st century. As of 2011, around 24 million people worldwide have been affected by Schizophrenia. Under the supervision of Profs Nakao, Kangawa and Sawa of Kyoto University, this project provides a great opportunity to develop innovative drugs to cure patients through the discovery of new targets, indentifying translational biomarkers and conducting clinical research by utilizing all findings, knowledge, research capabilities and assets from Kyoto University, Takeda and their worldwide networks.

DSK project – with Dainippon-Sumitomo Pharma Co. Ltd

Cancer is thought to be inevitable in organisms that have flexible mechanisms in regulating development, growth and tissue repair. The malignant behavior of cancer cells, however, must be controllable in some way. In this project sponsored by Dainippon Sumitomo Pharma Co. Ltd. we have focused on promising areas of cancer research (e.g. angiogenesis, invasion, metastasis, hypoxia-response, epigenetics, alternative splicing, and bioinformatics) to elucidate the common features and molecular bases of malignant phenotypes associated with cancer cells. Our aim is to develop this knowledge for clinical use as rapidly as possible.

www.dsk.med.kyoto-u.ac.jp/english/index.html

TMK project – with Mitsubishi Tanabe Pharma Co. Ltd

Chronic kidney disease (CKD) is a worldwide public health problem, and the number of patients affected with this disease has continued to increase. One of the reasons for the increase is the lack of effective treatments with which to deter the progression of CKD.

Our aim is to clarify the molecular mechanisms underlying kidney disease progression and to identify the potential therapeutic targets for CKD.

We further try to generate relevant animal models for human CKD, which will provide us with important information to explore the molecular pathogenesis of CKD.

The TMK project consists of three projects selected from applications, and two additional internal labs within Kyoto University.

MIC Related project: AK project – with Astellas Pharma Inc.

Kyoto University and Astellas Pharma Inc. has conducted research at the innovation center for immunoregulation technologies and new drugs for future generations incorporating the most advanced, fundamental and clinical immunology research and drug discovery technologies for the global needs in the field of innovative immunoregulation drugs. This project has started since 2007, in response to the adaptation to the program – "Formation of Innovation center for fusion of Advanced Technologies"– funded by the Japan Science and Technology Agency (JST) under the MEXT. The AK project has its own research laboratories on the medical school campus, with basic research scientists from the university and drug discovery scientists from Astellas working with clinical research scientists from clinical departments.

Kyoto University Medical Science and Business Liaison organization (KUMBL) is an organization set up in 2004 in conjunction with the Kyoto University Office of Society-Academia Collaboration for Innovation (SACI), and has contributed to promotional activities in collaboration with industries ever since. The volume of work is wide-ranging and includes assistance for the set-up of material transfer agreements and technology transfers, support for the development of practical applications of technologies, as well as the enrichment of education on intellectual property rights and management.

www.med.kyoto-u.ac.jp/KUMBL/e/index.html

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.

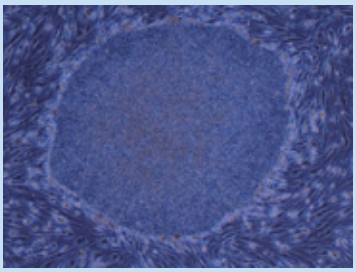
www.cira.kyoto-u.ac.jp/e/index.html

Director
Shinya Yamanaka

iPS Cell Bank Project

CiRA's focus for fiscal 2012, which starts on April 1, 2012, is placed on the establishment of an iPS cell bank for cell transplantation. The bank will store clinical-grade iPS cells from somatic cells of donors who have particular HLA (human leukocyte antigen) types. We plan to use the Facility for iPS Cell Therapy (FiT), a cell processing center built inside our research building, for the iPS cell bank project.

Facility for iPS Cell Therapy (FiT)



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 2 patents in the U.S.

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.

CiRA research building

Urban transport policies for sustainable and liveable cities

Professor **Eiichi Taniguchi**

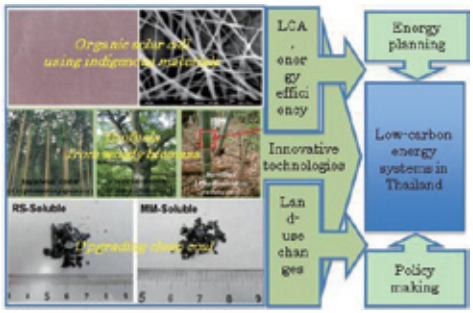
The Urban Policy Unit for Low-carbon Society conducts research and provides educational courses on urban transport policies with the aim of reducing their negative environmental impact as well as creating safer and healthier communities. Studies focus on developing effective policies to encourage the use of public transport, including subways, tramways and buses over cars, by integrating urban transport and land-use planning. The process of implementing sustainable transport policies requires public-private partnerships to get all stakeholders involved in identifying problems, in finding approaches and solutions, and in evaluating and implementing policy measures. Also, technical innovations including ICT (Information and Communication Technology) and ITS (Intelligent Transport Systems) are helpful in promoting sustainable transport policies. For example, ITS based multimodal transport systems of feeder bus services and LRT (Light Rail Transit) are effective in providing better mobility, reducing CO_2 emissions and traffic congestion. Moreover, the reallocation of road space to public transport, bicycles and pedestrians can contribute to a boost in the culture, communication and sport activities within urban areas. These transport systems encourage the elderly, children and those without driver's licences to these modes of transport. The unit conducts collaborative research with municipalities and industries to form sustainable transport policies, while also offering extended courses to urban transport planners and operators to encourage the development of sustainable and liveable cities.

Developing low-carbon energy systems in Thailand

Planner/Director, Prof. **Keiichi Ishihara** Graduate School of Energy Science

Mitigating greenhouse gas emissions from the economic growth of developing countries (such as Thailand) is of key importance for the global environment. We have been collaborating with Japanese and Thai research groups to develop low-carbon technologies that exploit the natural advantages of Thailand – including organic solar cells, biofuels from woody biomass, as well as by upgrading clean coal and land-use changes. Furthermore, low-carbon energy scenarios have been discussed with stakeholders in Thailand based on life cycle analysis and the technologies that were developed. As a result of the joint project, in 2012 the research team will present two scenarios (moderate and accelerated) projected out to 2030, driving towards a low-carbon society in Thailand. Other participating institutes are King Mongkut's University of Technology Thonburi (TH), Rajamangala University of Technology Thanyaburi (TH), Chulalongkorn University (TH), the National Institute of Advanced Industrial Science and Technology (JP) and the National Institute for Agro-Environmental Sciences (JP). This joint project is partially supported by the MEXT, Strategic Funds for the Promotion of Science and Technology, from FY2009 through 2011.

www.japanthailand.wordpress.com



Global COE Programs:

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

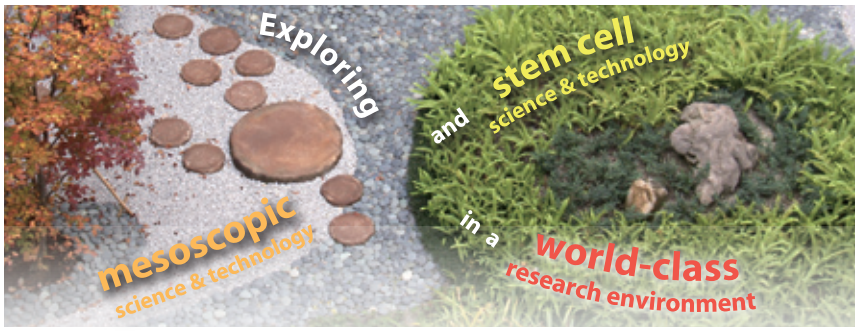
Category : Mechanical, civil engineering, architectural and other fields of engineering (Since 2008)
Title : **Global Center for Education and Research on Human Security Engineering for Asia Megacities**
Leader : Professor Yuzuru Matsuoka,
Graduate School of Engineering
URL : hse.gcoe.kyoto-u.ac.jp

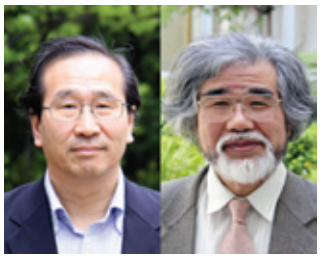
Category : Social sciences (Since 2008)
Title : **Global Center of Excellence for Reconstruction of the Intimate and Public Spheres in 21st Century Asia**
Leader : Professor Emiko Ochiai,
Graduate School of Letters
URL : www.gcoe-intimacy.jp

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

Institute for Integrated Cell-Material Sciences (iCeMS)



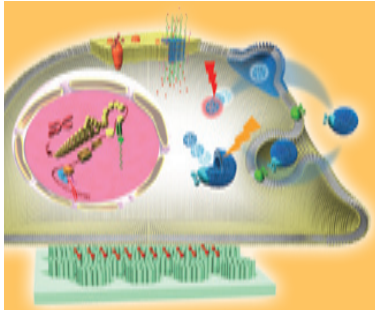


[left] Deputy Director **Susumu Kitagawa**, [right] Director **Norio Nakatsuji**

wpi
World Premier International Research Center Initiative

iCeMS
KYOTO UNIVERSITY
WPI Research Center

- Launched in 2007 as part of a science ministry initiative
- One of six forefront research institutes nationwide
- Led by **Norio Nakatsuji**, Japan's human ES cell pioneer
- **Susumu Kitagawa**, **Shinya Yamanaka**, and others on staff



- Combining cell biology, chemistry, and physics
- Investigating multimolecular structures within cells and artificial materials
- International research groups
- Ample opportunities for young scientists to take the lead
- Work leading to innovations in medicine, pharmaceuticals, the environment, and industry

pathmaking science

global outlook

- Active partnerships with a wide range of influential international research institutions
- Sponsoring joint symposia, short and long term researcher exchanges, and satellite labs
- New journal, *Biomaterials Science*, launched with the Royal Society of Chemistry (UK)

Photos: Welcoming the NCBS director (above) and attending a joint symposium at Heidelberg Univ.

www.icems.kyoto-u.ac.jp

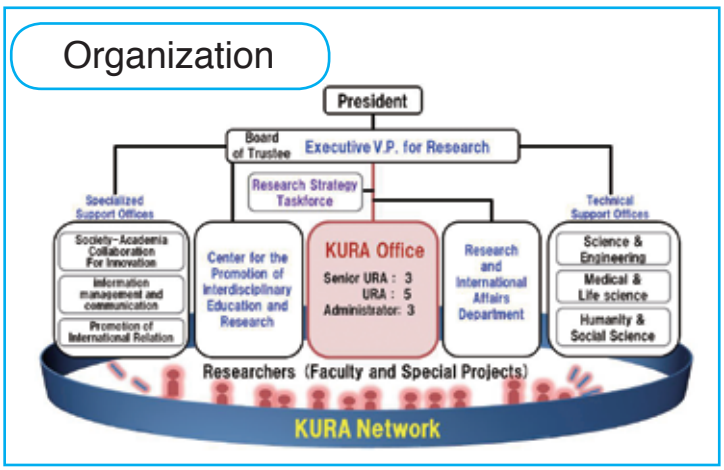
Kyoto University Research Administration Office (KURA)

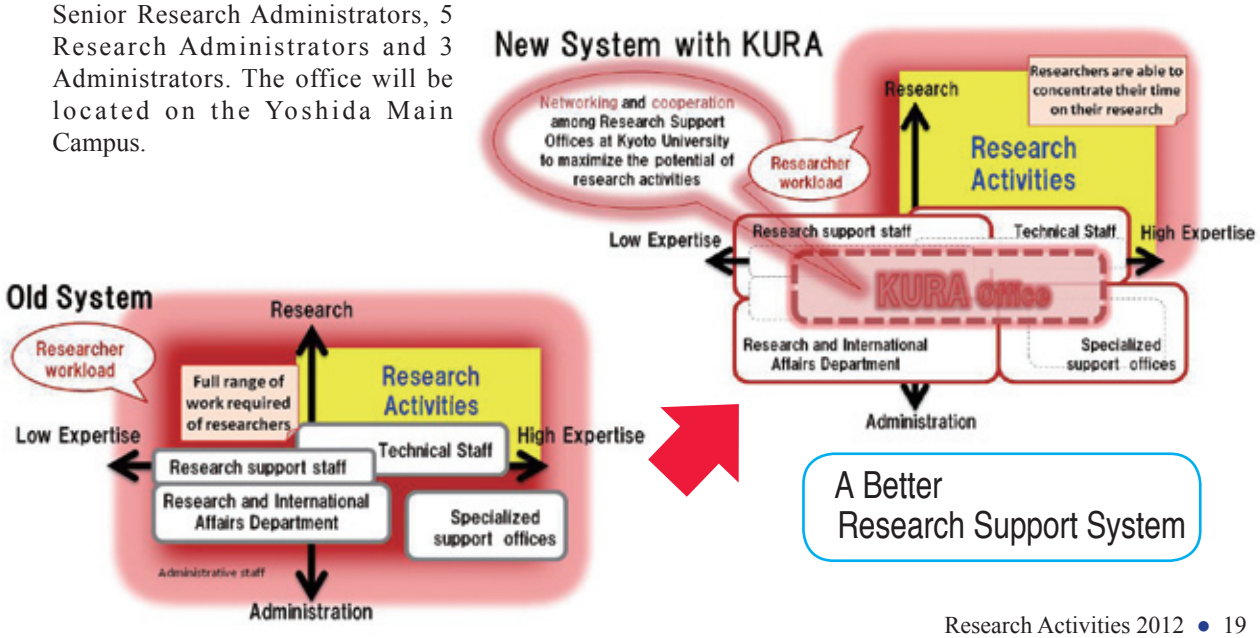
As part of a new national governmental movement, the KURA office will open in April 2012 as an organization to provide consistent research support for the planning of projects, obtaining of research funds, project execution and conducting of public relations. The aim behind the establishment of the KURA office is to ease the non-research related burden (administrative work) currently imposed on researchers, by formulating a well organized research support network. To achieve this aim, the KURA office strives to network and collaborate with the existing research support offices at Kyoto University.

KURA office member as of February

For the promotion of research, the KURA office collaborates with the faculties, institutes and research centers within Kyoto University, as well as with external national/international research organizations including industries. Through these activities the KURA office is expected to form a firm basis of URA system which is not well recognized at the moment in Japan and to develop training programs for URA.

As of April 1, 2012, the KURA office is scheduled to consist of 3 Senior Research Administrators, 5 Research Administrators and 3 Administrators. The office will be located on the Yoshida Main Campus.





Hakubi Project

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.

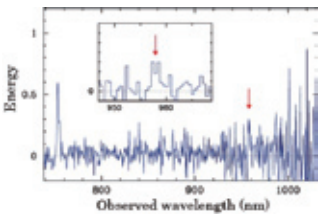
Business Groups: Challenging the Anglo-American Multidivisional Enterprise?

Associate Professor Asli M. Colpan

Business groups have not enjoyed an honorable reputation in social science literature as they are often seen as a second-best functional substitute for the Anglo-American multidivisional enterprise. Despite early contributions to industrialization, their prolonged resilience is argued to be harmful to economic wellbeing. Prof. Asli Colpan, together with her colleagues Professors Takashi Hikino and James R. Lincoln, aimed to strengthen the scholarly and policy-oriented understanding of the business groups in their *Oxford Handbook of Business Groups* published by Oxford University Press in 2010. The volume that underpinned the competitive capabilities of business groups was the first systematic and analytical examination of the complex evolutionary paths followed by the world's largest groups. Prof. Colpan is currently trying to pin down the exact conditions under which business groups can make positive contributions to the economy by thorough examination of the resilience of this organizational form.

Abundant Carbon in a Galaxy at 12.5 Billion Light-years Away

Associate Professor Tohru Nagao



The spectrum of TN J0924-2201 obtained with the Subaru Telescope. The red arrows point to the carbon signature.

The history of the formation of galaxies is one of the world's greatest unsolved mysteries. Understanding the chemical properties of early galaxies is a key to revealing the story of the Universe's evolution. Recently Dr. Nagao and his international collaborators succeeded in obtaining a deep optical spectrum of a galaxy 12.5 billion light-years away (TN J0924-2201, the most distant radio galaxy confirmed), with the Subaru Telescope, to view its chemical properties at a time when the age of the Universe was only 1 billion-years old. They detected a spectroscopic signature suggesting an abundant presence of carbon. The amount turned out to be higher than that which was expected to be present at the earliest phases of the galaxy's chemical evolution. This suggests the age of this galaxy being at least a few hundred million-years old, even at such an early phase of the Universe's timeline. This discovery has been published in *Astronomy and Astrophysics* (Matsuoka, Nagao, et al., 2011, Vol.532, Page.L10), and also appeared in a number of newspapers.

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

The term, *Hakubi*, literally means "white eyebrows" in Japanese. The project is named ater a legend in *Shu* (蜀), one of the states of 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 application for the fourth batch will open in March, 2012.

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

Tachibana Award
– for the Most Outstanding Female Researchers at Kyoto University

Kyoto University established the award in 2008, as a system to acknowledge the outstanding research achievements of young women researchers at Kyoto University in the fields of humanities, social sciences, and natural sciences. By publicly honoring researchers who have made excellent accomplishments in their research, the award aims to further motivate them, as well as future generations of women researchers following in their path, to contribute to the diversity of scientific research not only at Kyoto University but throughout Japan and the world.

Award Winners

Year	Name / Current Affiliation	Research Topics
2008	**Yoshiko En'yo** [right], Assoc. Prof., Yukawa Institute for Theoretical Physics	Mysterious Phenomena in the Micro-World – The Cluster Structure of the Atom Core –
	Sakiko Honjo [left], Doctoral Student, Graduate School of Biostudies	Molecular Mechanism of Life Extension through Dietary Control
2009	**Asli M. Colpan** [center, right], Assoc. Prof. , of the Endowed Chair at the Graduate School of Management	Theoretical and Empirical Cross-national Research on "Business Groups"
	Hiroko Watanabe [center, left], Doctoral Student, Graduate School of Science	Observational Research on Microstructure of Umbra Dot in the Sunspot
2010	**Youko Hamazaki** [left], Assoc. Prof., Graduate School of Medicine	Study of thymic epithelial cell proliferation and differentiation and self-tolerance mechanism
	Kyoko Kitamura [right], Doctoral Student, Graduate School of Engineering	Extreme micro-scale focusing by photonic crystal laser
2011	**Kaori Shiojiri** [left], Assistant Prof., Hakubi Center	Ecological interaction networks triggered by plant volatiles
	Sakie Suzuki [right], Doctoral Student, Graduate School of Science	Study on quantum link invariants using universal invariants

■ Origins of the *Tachibana* Award name

The Tachibana, an evergreen citrus indigenous to Japan, has been highly valued since ancient times as a symbol of eternity, and is often the motif in traditional family crests. The Japanese Order of Culture is also designed in the image of the five cyclic petals of the flower, likening the qualities of the evergreen with the longevity of culture. Named with these images in mind, the *Tachibana* Award is conferred in the hopes that the scientific activities of the outstanding female researchers who receive it will remain resilient.

Development and Evolutionary Foundation of Human Mind

New perspectives on cognitive development in humans from the prenatal period

Masako Myowa-Yamakoshi - Graduate School of Education

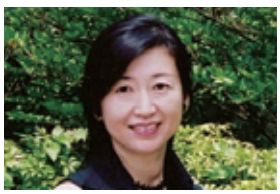
The human mind, which is not physically visible like human morphological characteristics, is a product of evolution. How have we evolved our unique minds? What has caused the differences that exist between humans and non-human primates? To address these questions, Myowa-Yamakoshi and research teams have taken an evolutionary approach, 'Comparative Cognitive Developmental Science': Comparing the development of social cognition in humans and non-human primates from their prenatal periods. Such an approach enables us to reveal the biology behind the characteristics of the human mind, both shared with non-human primates and uniquely human.

One of the findings has been the evolutionary root of human imitation. Humans have created and use a vast assortment of tools, and have also developed an extensive array of ways to communicate with each other. Imitation plays a key role in supporting human cultural traditions by facilitating the transmission of knowledge and skills from one generation to another. Myowa-Yamakoshi and colleagues have revealed that the imitative capacity is common to humans and chimpanzees in their early stages of life. However, chimpanzees do not develop their imitative abilities in the same manner as humans: Chimpanzee imitation is less accurate than human imitation. These findings suggest that the ability to imitate a broad range of whole-body actions seems to be an ability that evolved after the human lineage separated from that of chimpanzees. Such a remarkable species difference of visual-motor information processing may be reflected in the different social-cognitive abilities of the two species. The recent findings supporting this hypothesis are published online in Nature Communications in 2012.

www.educ.kyoto-u.ac.jp/myowa/en/index.html

A Japan-based Global Study of Racial Representations

Crossing disciplinary and national boundaries



Professor Yasuko Takezawa - Institute for Research in Humanities

Professor Yasuko Takezawa has led numerous collaborative research projects on race and ethnicity over her ten years at the Institute for Research in Humanities. The institute was the first to implement the now nation-wide grant program for such global collaborations. Takezawa currently leads a five-year research project – A Japan-based Global Study of Racial Representations.

Takezawa offers fresh insights into the field of race and ethnic studies by examining the 'invisible races' found in East Asia, such as the *burakumin* and Korean nationals in Japan, with a focus on their non-visual representations. She also analyzes scientific and counter representations. In doing so, she attempts to verify the ways in which these different forms of representation interact with each other to construct a socially recognized racial identity.

This project is truly multi-/interdisciplinary, bringing together an unprecedented team of scholars in a wide range of disciplines ranging from cultural anthropology to history of science, to genetics and physical anthropology. The fruits of such interdisciplinary collaborations are available in: *Racial Representations in Asia* (Kyoto University Press and Trans Pacific Press, 2011), which will soon be followed by additional volumes.

Apart from her collaborative research projects, Takezawa also pursues her various interests in the evolution of race as a concept, Asian Americans and their identities, and the development of multiculturalism in Japan.

takezawa.zinbun.kyoto-u.ac.jp/english/
race.zinbun.kyoto-u.ac.jp/?lang=en

First Stars Heavy but Not Monstrous

Researchers recreate universe's first star

Associate Professor Kazuyuki Omukai - Graduate School of Science

It is widely believed that the first stars were formed when the age of the universe was a few hundred million years old. At birth, the first stars were just tiny embryos - protostars - with masses of about one percent of the sun. The protostar is then thought to grow by accumulating the surrounding hot gas, but how much gas it can acquire has been largely unknown. Our new computer simulated study has revealed the entire process of the fist stars' growth over a hundred thousand years until they become truly active stars undergoing nuclear fusion.

Astrophysicists had previously thought that the first stars could grow huge, to as much as a few hundred times the sun in mass. It was found however, that the star regulates its own growth by emitting intensive radiation, according to the new study. The simulation showed highly dynamical features of this process. When the star grew to as large as 20 times that of the sun, it shined very bright, almost equivalent to a cluster of a hundred thousand sun-like stars. Ultra-violet light from the luminous star then quickly heated up the gas in the vicinity to above ten thousand degrees in temperature. The hot bubble launched a high speed gas flow outward, which eventually evacuated the surrounding 'parent' gas cloud from which the star was born. There remained a star with a mass, 43 times that of the sun. Such ordinary massive stars, ordinary in the sense that there are indeed such stars with similar masses in the present-day universe, finally resolve the long-standing problem of explaining the observed elemental abundances of very old stars in our Galaxy.

www-tap.scphys.kyoto-u.ac.jp/~hosokawa/firststarstop_e.html

Relay Race with Single Hydrogen Atoms

New ways of manipulating matter

Associate Professor Hiroshi Okuyama - Graduate School of Science

A relay reaction of hydrogen atoms at the single-molecule level has been observed in real space. This way of manipulating matter could open up new ways to exchange information between novel molecular devices in future electronics. An athletic relay race is a competition where each member of a team sprints a short distance with the baton before passing it onwards to the next team member. This collective way of transporting something rapidly is not a human-only activity and invention – a similar relay mechanism exists at the atomic scale, facilitating the transport of hydrogen atoms and protons in hydrogen bonded networks such as liquid water, biological systems and functional compounds. However, direct visual observation of this important transfer process in these situations is extremely difficult because of the high complexity of their environments.

Hiroshi Okuyama and his colleagues discovered that the relay reaction also occurs in molecular chains assembled on a metal surface. This new setup allowed the researchers to gain insight into the relay reactions at the single-atom level and view the process using a scanning tunneling microscope (STM). By sending a pulse of electrons through a water molecule at one end of the chain, hydrogen atoms propagate one by one along the chain like dominoes in motion. The result is that a hydrogen atom has been transferred from one end to the other via the relay mechanism. The demonstrated control of the atom transfer along these molecular chains not only sheds new insight on a fundamental problem. It could also open up new ways to exchange information between novel molecular devices in future electronics by passing around hydrogen atoms.

kuchem.kyoto-u.ac.jp/hyoumen/e/

Production of High Quality Human Embryonic Stem Cell Lines at Kyoto University

Genetic changes mapped in a diverse sample of ES Cells by international collaboration as a major step toward medical applications

Associate Professor Hirofumi Suemori - Institute for Frontier Medical Sciences
Professor Norio Nakatsuji - Director, Institute for Integrated Cell-Material Sciences

Human embryonic stem (hES) cell lines can proliferate indefinitely and differentiate into all kinds of tissues in the body. Therefore, they are considered to have great potential in medical research and applications such as cell transplantation therapy and drug discovery. Since we began deriving hES cell lines in 2003 at the Institute for Frontier Medical Sciences, we have established five hES cell lines, named KhES-1, KhES-2, KhES-3, KhES-4 and KhES-5. They have been studied extensively and characterized in detail, and so far distributed for use in over 50 research projects. We have now started a project to produce higher quality hES cell lines which can be used in clinical applications.

However, genetic changes can occur during prolonged proliferation in culture, and they cause potential risks in clinical applications. Thus, an international collaboration by the International Stem Cell Initiative (ISCI) including our group at Kyoto University began in 2008 to identify genetic changes that occur during the culture of many ethnically diverse hES cell lines. The effort, led by Prof. Peter Andrews of the University of Sheffield, analyzed 125 human ES cell lines including our five hES cell lines and 11 human induced pluripotent stem (iPS) cell lines collected from 38 laboratories across 19 countries. The study published online in *Nature Biotechnology* on Nov 27, 2011 (vol. 29, 1132-1144) revealed that most cell lines remained karyotypically normal, but change in karyotype during prolonged culture, especially in chromosomes 1, 12, 17 and 20. Copy number analysis using SNP arrays also showed that amplification of a small genomic region on chromosome 20 was found in over 20% of cell lines. These findings can be used for the accurate and cost-effective quality control of cell lines, which are needed in the application of stem cell technologies to regenerative medicine.

www.icems.kyoto-u.ac.jp/e/pr/2011/11/28-nr1.html
www.frontier.kyoto-u.ac.jp/es01/topE.htm

Mouse Genome Protection

Understanding the role of the miwi protein

Professor Shinichiro Chuma - Institute for Frontier Medical Sciences

The germline is the cell lineage that transmits genetic information to the next generation. Genetic and epigenetic changes in the germline affect embryonic development and subsequent offspring, so the genomic stability of germ cells is a critical requirement for maintaining both the individual and the species. Damage to Genomic DNA generally occurs as a consequence of physical or chemical attacks, such as from exposure to ionizing radiation, genotoxic reagents and oxidative stress. Another threat to the genome is the encoding mechanism of the genome itself, namely in the form of mobile transposable elements, which move or duplicate themselves and transpose into new genome positions. We recently discovered, in an international collaboration led by Dr. Ramesh S. Pillai at EMBL, France, the role that a particular protein plays in protecting the genome: specifically, the means by which the Miwi protein silences transposon RNAs in male mice. Among other findings, we demonstrated conclusively that disrupting the mice's capacity to produce the functional Miwi protein with RNA slicer activity leads to an inability to create viable sperm. We provide evidence for Miwi slicer activity directly cleaving transposon messenger RNAs, offering an explanation for the continued maintenance of repeat-derived Piwi proteins interacting with small RNAs (piRNAs) long after transposon silencing is established in germline stem cells. This work builds on earlier studies of our own and by other groups, investigating genomic protection, nearly completing the picture of the Miwi-based transposon silencing mechanism, and proposes that Piwi proteins act in a two-pronged mammalian transposon silencing strategy: one promotes transcriptional repression in the embryo, the other reinforces silencing at the post-transcriptional level after birth, both of which are critical for normal male fertility.

www.kyoto-u.ac.jp/en/news_data/h/h1/news6/2011/111128_1.htm

Visuoauditory Mappings Between High Luminance and High Pitch are Shared by Chimpanzees (*Pan troglodytes*) and Humans

Professor Ikuma Adachi - Primate Research Institute
Professor Tetsuro Matsuzawa - Primate Research Institute

Professor Adachi and his research collaborators have found that humans have innate preferences for certain cross-sensory combinations. For example, they consistently associate higher-pitched sounds with lighter colors, smaller sizes, and spikier shapes. Most notably, toddlers are found to have already formed such pitch-luminance cross-modal correspondences at thier young age. It has been argued that the tendency to systematically match visual and auditory dimensions was a driving factor in the evolution of language.

However, none has yet addressed the crucial question of whether or not non-human animals experience cross-modal correspondences as well. Here, the research team offers the first direct comparison between humans and chimpanzees on their pitch-luminance mapping by testing whether chimpanzees (Pan troglodytes) also associate higher pitch with higher luminance. Thirty-three humans and six chimpanzees were required to sort black and white squares according to their color while hearing irrelevant background sounds that were either high-pitched or low-pitched. Both species performed better when the background sound was congruent (high-pitched for while, low-pitched for black) than when it was incongruent (low-pitched for white, high-pitched for black). Chimpanzees made more mistakes when the background sound was incongruent than when it was congruent. In humans, the effect was evident through increased latencies in the incongruent trials, which was in line with previous research. These results suggest that an inherent tendency to pair high pitch with high luminance hence evolved before the human lineage split from that of chimpanzees. Rather than being a culturally learned or linguistic phenomenon, this mapping constitutes a basic feature of the primate sensory system.

www.pri.kyoto-u.ac.jp/ai/

Using Innovative Imaging Technologies to Preserve the World's Cultural Heritage

Science and technology for art

Professor Ari Ide - Graduate School of Engineering

Located in Kyoto, a city of culture, art and technology, at the Ide Laboratory of the Graduate School of Engineering is central in developing state-of-the-art imaging technologies to digitally record and archive cultural properties in Kyoto and around the globe. Their new high precision scanner system for cultural assets digitizes large artworks such as those on sliding doors (*fusuma*), wall paintings, as well as documents such as antique architectural plans for important historical buildings. The scanner has an extremely high dimensional and color reproduction accuracy. The digitization process has been carefully developed to minimize its intrusive effects by developing appropriate light sources and minimizing the physical bulk of the scanner itself (the lightest machine is less than 30kg). We have also been successful in adding analytical imaging features which enables non-destructive and non-invasive analysis of material composition and color.

In 2011, we collaborated with Ninnaji Temple, a UNESCO-designated World Heritage site and an Important Cultural Property, to digitize on-site and record in microscopic level, the contents of a building from the early Edo Period with wall paintings and sculptures. The world's most advanced analytical imaging technologies were utilized for the recording and preserving of the heritage assets. The database of pigments and colorants from this project hopefully are expected to significantly contribute to our understanding of the art and technologies of the early Edo period.

The research team is currently working in China (Beijing, Xian), the UK (London, Belfast), Korea (Seoul) and Egypt (Giza, Cairo) as well as over 10 sites in Japan, to establish a global network of collaboration to preserve, utilize and pass down to the next generation the world's cultural resources. We hope that this technology from Kyoto will act as a catalyst in encouraging global interest in and renewing discussions on cultural heritage.

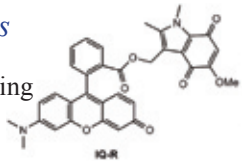
www.kyotoheritage.jp/en/index.html

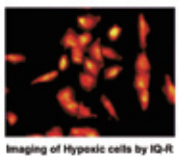
BIOTECHNOLOGY

Indolequinone-Rhodol (IQ-R) Conjugate as a Fluorescent Probe for Hypoxic Tumor Cells

Fluorescent probe for visualization of hypoxic tumor cells

Associate Professor Kazuhito Tanabe - Graduate School of Engineering
Professor Sei-ichi Nishimoto - Graduate School of Engineering




Imaging of Hypoxic cells by IQ-R

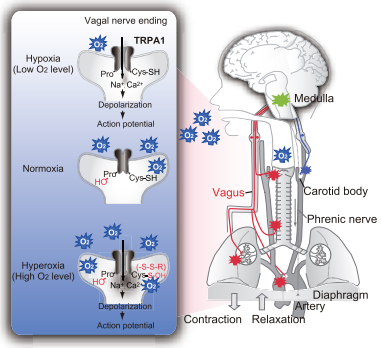
Hypoxia is an important feature of many diseases such as malignant solid tumors, inflammatory diseases and cardiac ischemia. Associate Prof. Tanabe and his research group herein focused on the development of a novel hypoxia-sensitive fluorescent probe, IQ-R, consisting of an indolequinone unit and a rhodol fluorophore. IQ-R has good solubility in water and longer wavelength for absorption and emission, which are favorable for cellular bio-imaging. While the fluorescence of rhodol in the IQ-R conjugate was quenched by the function of intramolecular indolequinone unit, it was restored under hypoxic conditions through the enzymatic one-electron reduction of IQ-R by NADPH:cytochrome P450 reductase to release the nonconjugated free rhodol. When administered to A549 cells, IQ-R was activated and reduced by endogenous reductase preferentially under hypoxic conditions, thereby visualizing hypoxic cancer cells by robust fluorescence.

int.saci.kyoto-u.ac.jp/?p=2300

TRPA1 Underlies a Sensing Mechanism for Oxygen

Applications to clinical treatment of respiratory disorders

Professor Yasuo Mori - School of Global Environmental Studies
Specific Assistant Professor Nobuaki Takahashi - Center for the Promotion of Interdisciplinary Education and Research



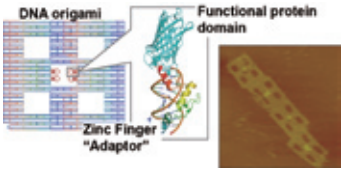
Oxygen (O_2) is a prerequisite for cellular respiration in aerobic organisms but also elicits toxicity. To understand how animals cope with the ambivalent physiological nature of O_2, it is critical to elucidate the neuronal and molecular mechanisms responsible for O_2 sensing. Prof. Mori and Specific Assistant Prof. Takahashi have conducted a systematic evaluation of TRP cation channels using reactive disulfides with different redox potentials to reveal the capability of a TRP channel to sense O_2. O_2-sensing is based upon disparate processes: while prolyl hydroxylases (PHDs) exert O_2-dependent inhibition on the TRP channel activity in normoxia, direct O_2 action overrides the inhibition via the prominent sensitivity of the TRP channel to cysteine-mediated oxidation in hyperoxia. Surprisingly, the TRP channel is activated through relief from the same PHD-mediated inhibition in hypoxia. In mice, gene disruption of the O_2-sensitive TRP channel impedes in vivo activity induced by hyperoxia and hypoxia in the vagus nerve – known to innervate the trachea and lung – and in sensory neurons. The results suggest a novel O_2-sensing mechanism in vagus nerves, and contribute also to understanding respiratory and sensory disorders mediated by defects of TRPA1.

int.saci.kyoto-u.ac.jp/?p=2308

Site-specific Arrangements of Proteins on DNA-origami Structures

Molecular switchboards facilitate arranging of enzymes and receptors in nanometer-scale precision

Professor Takashi Morii - Institute of Advanced Energy
Lecturer Eiji Nakata - Institute of Advanced Energy



DNA nanostructures can be equipped with specific docking sites for proteins. Cellular processes and chemical transformations take place in several reaction steps, with multiple enzymes cooperating in specific fashion to catalyze sequential steps of chemical transformations. Such natural systems are effectively reconstructed in vitro when the individual enzymes are placed in their correct relative orientations. DNA-origami structures can be used as "molecular switchboards" to arrange enzymes and other proteins with nanometer-scale precision.

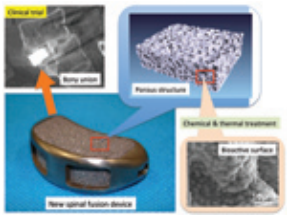
A new method was developed based only on proteins, to locate specific proteins by means of special "adapters" known as zinc-finger proteins. Zinc fingers are suitable site-selective adapters that attach to specific locations within DNA-origami structures. Several different adapters carrying different proteins can bind independently to defined locations on this type of nanostructure.

int.saci.kyoto-u.ac.jp/?p=2319

Development and Clinical Trial of Porous Bioactive Titanium Metal for Lumbar Spinal Fusion

Surgical treatment using a new synthetic material for low back pain

Senior Lecturer Shunsuke Fujibayashi - Kyoto University Hospital
Assistant Professor Mitsuru Takemoto - Kyoto University Hospital



The objective of this study was to establish the efficacy and safety of porous bioactive titanium metal for use in a spinal fusion device, based on a prospective human clinical trial. A high-strength spinal interbody fusion device was manufactured from porous titanium metal. A bioactive surface was produced by simple chemical and thermal treatment. Five patients with unstable lumbar spine disease were treated surgically using this device in a clinical trial approved by the university Ethics Review Committee and the University Hospital Medical Information Network.

Clinical and radiological results were reported at the minimum follow up period of 1 year. Successful bony union was achieved in all cases within 6 months without the need for autologous iliac crest bone grafting. All clinical parameters improved significantly after the operation and no adverse effects were encountered during the follow-up period. Although a larger and longer-term follow-up clinical study is mandatory to reach any firm conclusions, the study results show that this porous bioactive titanium metal is a promising material for spinal fusion devices.

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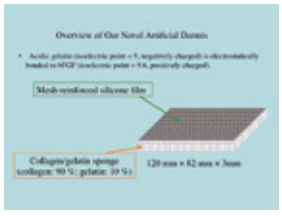
Development of a Novel Artificial Dermis for Sustained Release of Growth Factors

Development and clinical applications of functional artificial dermis

Professor Shigehiko Suzuki - Graduate School of Medicine
Lecturer Naoki Morimoto - Graduate School of Medicine



Professor Suzuki and Lecturer Morimoto developed a novel artificial dermis that adds cell growth factor retention and controlled-release functions to conventional artificial dermis. The researchers confirmed that this novel artificial dermis impregnated with bFGF (basic fibroblast growth factor) had 50% residual bFGF content one week after application (in contrast to 10% for conventional artificial dermis) and 20% residual bFGF content 10 days after application.

The novel artificial dermis incorporating 7 to 14 μg/cm^2 bFGF offered superior wound healing effects over conventional artificial dermis in cases of full-thickness skin defects on mice, chronic skin ulcers (pressure ulcer) on diabetic mice, and mucoperiosteum defects of beagle dogs. This novel artificial dermis is excellent in encouraging wounds to heal and can also be applied to chronic skin ulcers that were conventionally difficult to treat with artificial dermis. Clinical trials have already begun as the first step toward commercialization.

int.saci.kyoto-u.ac.jp/?p=2330

CHEMISTRY

Silicon-based Cross-coupling Reagents for Synthesis of Organic Compounds

Stable but highly reactive novel tetra-organosilicon compounds

Senior Lecturer Yoshiaki Nakao - Graduate School of Engineering
Professor Emeritus Tamejiro Hiyama - Graduate School of Engineering

Senior Lecturer Yoshiaki Nakao and Prof. Emeritus Tamejiro Hiyama have developed 2-(hydroxymethyl) phenyl-substituted tetra-organosilanes (HOMSi®), which undergo cross-coupling reactions. The proximal hydroxy group allows transmetalation of alkyl, alkenyl, and aryl groups on silicon to palladium, nickel, or copper to participate in the cross-coupling reaction under mild conditions employing weak base activators with excellent chemoselectivity. Highly efficient synthesis of functional molecules, such as oligoarenes, can be achieved through iterative cross-coupling/O-deprotection sequences by simply switching their reactivity with orthogonal O-protection/deprotection. Silicon residues of the HOMSi reagents can readily be recovered and reused for the synthesis of the reagents.

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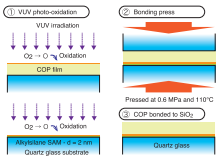
MATERIALS

Photochemical Surface Modification of Organic Materials through Vacuum Ultraviolet Irradiation for Adhesive-less Bonding

Photo-activation bonding of synthetic resin to inorganic substrate

Professor Hiroyuki Sugimura - Graduate School of Engineering
Dr. Hideya Nagata - Graduate School of Engineering



Prof. Hiroyuki Sugimura and Dr. Hideya Nagata have developed an adhesive-less organic-inorganic bonding technology applicable to the production of mechanical, optical, electrical, chemical and bio-logical devices. As schematically illustrated in Fig. 1, bonding is conducted by a simple two-step process. A cyclo-olefine polymer (COP) film and a quartz glass substrate had been activated with vacuum ultra-violet (VUV) irradiation in air (Step 1). Both of the surfaces were oxidized with atomic oxygen species generated by VUV-irradiation so as to be chemically activated. The COP film was adhered to the quartz substrate using only a low-temperature press facing the bonding surfaces (Step 2). A key to attaining the reproducible bonding is an alkyl self-assembled monolayer (SAM), which was VUV-oxidized as well, on the inorganic surface.

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Optically Transparent Bio-based Nanocomposites

Optically transparent low thermal expansion bendable nanocomposites

Professor Hiroyuki Yano - Research Institute for Sustainable Humanoshere
Researcher Fumiaki Nakatsubo - Research Institute for Sustainable Humanoshere
Assistant Professor Kentaro Abe - Research Institute for Sustainable Humanoshere

Figure 1
[left] Chemically modified pulp fiber sheet
[right] After resin impregnation

Recently, Prof. Yano and his research team were successful in producing a completely transparent crab-shell, keeping its original shape and substantial morphological detail. An important application for the finding is demonstrated in the micro- to mm-scale nanostructured crab shell chitin particles that can be used to process transparent nanocomposites. The incorporation of these chitin particles not only retains the transparency of the matrix resins but also drastically reduces the CTE (coefficients of thermal expansion) of the polymer. Moreover, the optical transmittance of the composite is stable over a large range of temperatures despite significant inhomogeneity at the mm-scale and large changes in the refractive index of the resin in its isolated state. Encouraged by the production of this transparent crab powder sheet, the research team undertook to create optically transparent pulp-fiber composites. The pulp-fiber sheet was acetylated, with care taken to maintain a never-dried condition, and was then dried and impregnated with acrylic resin. Despite the heterogeneous paper structure, the sheet became transparent (see Figure 1, right). Since a nanofibrillation process was unnecessary and the dewatering speed of the acetylated pulp fibers is very high, the production efficiency of optically transparent composites improved drastically.

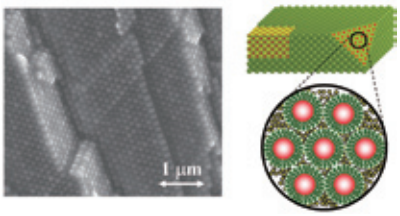
int.saci.kyoto-u.ac.jp/?p=2310

Novel Solid-State Polymer Electrolyte of Colloidal Crystal Decorated with Ionic-Liquid Polymer Brush

On the basis of a completely new concept, a novel solid electrolyte was developed, realizing a bipolar lithium-ion battery

Professor Yoshinobu Tsujii - Institute for Chemical Research
Professor Takaya Sato - Tsuruoka National College of Technology

Prof. Tsujii, Prof. Sato and their research team have successfully fabricated a leak/vapor-free, non-flammable and solid-electrolyte membrane by three-dimensional self-assembly. In this membrane, the hybrid silica particles (PSiPs) with "concentrated" polymer brushes (CPBs) of ionic-liquid polymers assembled themselves into a crystal state in the presence of a small amount of ionic liquid (IL) as a plasticizer. Solidification as well as ionic conduction is owing to the regular array of PSiPs thereby producing, between cores, a high ion-conductive, networked path containing IL. From this point of view, this is completely different from the previously reported electrolyte reinforced with nanoparticles, which are in an amorphous state in IL but not in a crystal. The CPB plays an important role not only in forming such higher-order structures but also in enhancing ionic conduction; a highly ordered structure, that is the face-centered cubic (fcc) crystal, was verified, and its conductivity was in the highest level among solid polymer electrolytes. This solid electrolyte was demonstrated to be successfully applied to a bipolar lithium-ion rechargeable battery operated at room temperature, with a double operation voltage and a capacity at the mAh level.



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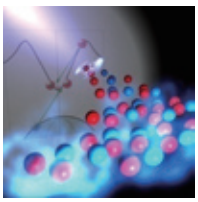
OTHERS

Terahertz Pulse Generates 1,000-Fold Increase in Electron Density

Findings point to advances in transistor and solar cell development



Assistant Professor Hideki Hirori - Institute for Integrated Cell-Material Sciences
Professor Koichiro Tanaka - Institute for Integrated Cell-Material Sciences

The study of carrier multiplication has become an essential part of many-body physics and materials science, since this multiplication directly affects nonlinear transport phenomena in ultra-high-speed transistors and plays a key role in designing efficient solar cells and electroluminescent emitters and highly sensitive photon detectors. Assistant Prof. Hideki Hirori and co-workers observed that when exposed to a single-cycle electric field pulse at the 1000 GHz (terahertz) frequency range, a sample of standard semiconductor material (gallium arsenide, GaAs) burst an avalanche of electron-hole pairs (excitons) 1,000-times more abundant than initial states only on the picosecond (10^{-12} s) time scale. The observed bright luminescence associated with carrier multiplication suggests that carriers coherently driven by a strong electric field can efficiently gain enough kinetic energy to induce a series of impact ionizations. These just-released results with the world strongest terahertz pulses demonstrate the rich potential that lies in the study of terahertz radiation.

int.saci.kyoto-u.ac.jp/?p=2336

SACI Office of Society-Academia Collaboration for Innovation

Missions :

- to promote **collaborative research** between academia, industries and the government
- to support **business startups** by researchers and students
- to manage and utilize the university's **intellectual properties**

Director
Keisuke Makino

Ten New Videos on Notable R&D

SACI has released new videos on our notable R&D, now available for viewing on our website. We welcome companies to develop innovative applications for these technologies.

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

Hideo Saji

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

Takeo Kawabata

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

Mitsuru Hashida

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

Naoki Shinohara

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

Gozoh Tsujimoto

Find out more at www.saci.kyoto-u.ac.jp/en

Advanced Technological Development Laboratories

part of the "RAKUNAN SHINTO" urban planning project – southern Kyoto

Fushimi-ku, Kyoto

This new research facility is scheduled to open its doors in the summer of 2013.

A place to develop chemicals of high-innovative value to bring about a highly anticipated green revolution.

Jointly initiated by Kyoto city, Kyoto University and ASTEM*, the project is funded by the METI**.

*ASTEM: Advanced Scientific Technology & Management Research Institute of Kyoto
**METI: Ministry of Economy, Trade and Industry

The following three projects are the first of more to be housed and supported at this center:

Developing functional nanomaterials

Application of porous coordination polymer technologies developed in Japan and anticipated to lower costs and energy output as well as cleaner production of key chemicals, in the discovery of platinum fuel cell alternatives.

Developing newer optical and electronic materials and structural elements using technologies made possible with femtosecond lasers

Developing circuits that will allow high-performance LED lights to replace all other light sources. Utilizing femtosecond lasers in the world's first non-thermal 3 dimensional processing technologies, this is hoped to raise precision and lower costs of optical device production, which widely affects research in the environment, energy, and countless other fields.

Commercialization of a thioredoxin hybrid

Creating functional foods, cosmetic products and new medical drugs by making full use of thioredoxin; a functional protein discovered in Japan, possessing the ability to suppress inflammation of the mucous membranes in the throat or stomach, protect the skin from UV light, and alleviate allergies.

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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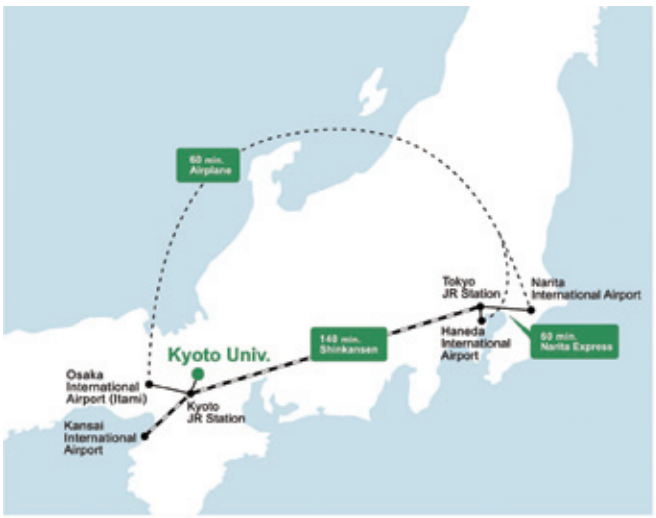
Professor
Toshio Nomura

Access to Kyoto University



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.

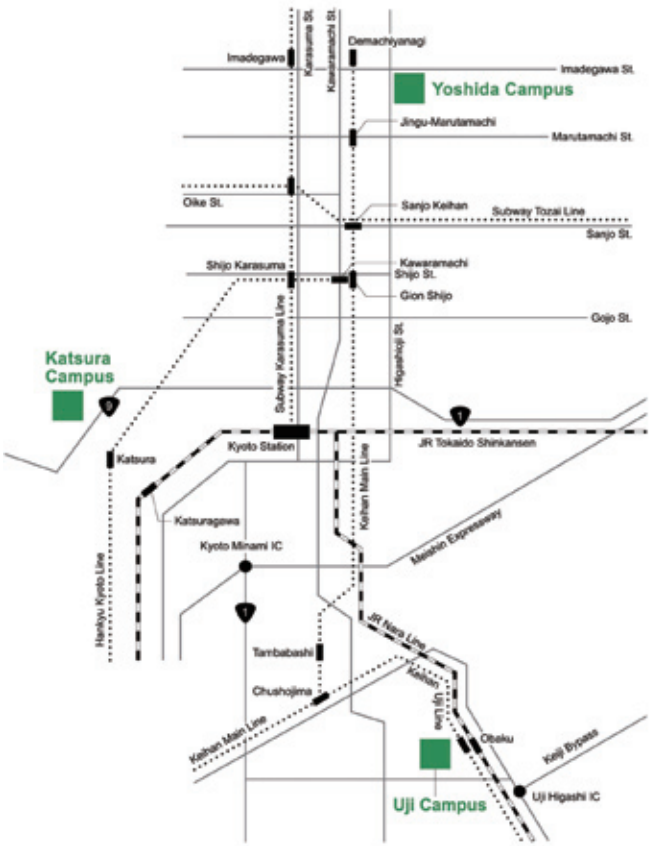
1) Train

JR Airport Express "Haruka"

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

2) Airport Limousine Bus

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



Transportation to Campuses

Yoshida Campus

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

*Bound for Kitaoji Bus Terminal via Higashiyama Street.

Uji Campus

JR Kyoto Station → Local Train: About 20 ~ 25min. JR Nara Line "Obaku" → Uji Campus

Katsura Campus

Hankyu Railway Katsura Station → Keihan Kyoto Kotsu Bus (No. 20 or 20B) City Bus (West No. 6) Get off at "Kyodai Katsura Campus-mae" / Taxi: About 10 min. → Katsura Campus

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