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Misasa International Symposium 2015

March 6-8, 2015
Comprehensive Exploration of the Solar System

Organized by Professor Eizo Nakamura, Pheasant Memorial Laboratory, Institute for Study of the Earth's Interior, Okayama University, Misasa, Tottori, Japan.

http://sympo.misasa.okayama-u.ac.jp/misasa_v/?lang=ja/

The theme of MISASA V was analyses of extra-terrestrial materials provided by sample-return missions, and insights regarding the evolution of recently sampled asteroids and meteorites, that are possible through comprehensive textural, geochemical, and geochronological analyses.

The symposium brought together experts from a wide range of earth, planetary, and space sciences to discuss research related to future solar system exploration in missions such as HAYABUSA 1 & 2, OSIRIS-REx, and MARS2020.

The participants discussed recent scientific achievements investigating sample return materials and meteorites, for example from asteroid Itokawa and the Chelyabinsk meteorite. The symposium enabled attendees to share their knowledge and gain new perspectives in this multidisciplinary setting.

Poster session at the Misasa International Symposium 2015

Oral presentation at the Misasa International Symposium 2015

News

The 1st Okayama University and King Faisal University's Workshop on Environmental and Life Science

Okayama University and Saudi Arabia's King Faisal University held their first joint workshop on "Workshop on Environmental and Life Science" under the auspices of the Royal Embassy of Saudi Arabia at the International House on November 13th. The workshop covered topics that included discussions on promoting advanced sciences for agriculture, food and the environment in collaboration with an oil-producing country in the Middle East.

14 teachers in total from both university's conducted presentations with the topic "Agricultural and Life Science" in the morning, and "Environmental Science" in the afternoon. There were active discussions on each topic.

The group of visitors from the King Faisal University visited the Tsushima Campus and associated facilities and laboratories at the Institute of Plant Science and Resources the following day. In addition to compliments given to Executive Director and Vice-President Nam-ho Huh, in charge of education, there was the exchange of opinions with regard to future exchanges.

The participants of the workshop

A presentation

Inspecting the Center for Engineering Innovation

Representatives of King Faisal University complimenting Executive Director Huh

News

High-performance Terahertz Project kick-off symposium

On 8 January 2015, the Institut national de la recherche scientifiqu (INRS), Quebec, Canada—international center of excellence in optics research—and Okayama University held the *Global Future With Canada-based INRS Session-High-Performance Terahertz Project Kickoff Symposium* at Okayama University.

Executive Director Responsible for Research and URA Professor Shuichi Furuya describing research at Okayama University.

The symposium was held to discuss technological developments and new findings related to biotechnology based on terahertz wavelength technology and to formulate ideas on initiating new international joint research.

Professor Tsuneyuki Ozaki describing INRS research.

Okayama University Deputy Vice-Executive Director (Research) and University Research Administrator (URA) Professor Shuichi Furuya and INRS Professor Tsuneyuki Ozaki introduced their respective organizations. Researchers from both universities described their research in talks on innovative technological developments and basic research in areas including terahertz engineering and the life sciences.

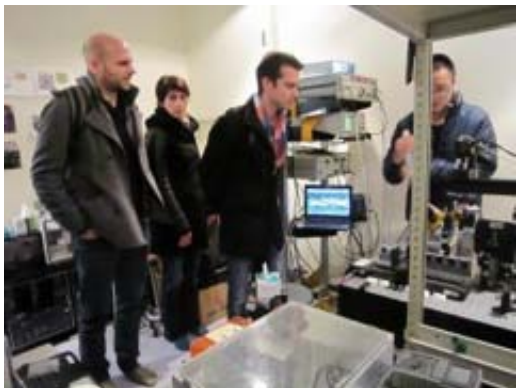
INRS researchers also toured some research facilities at Okayama University including the Graduate School of Natural Science and Technology's Measurement System Engineering Laboratory, where Associate Professor Toshihiko Kiwa described how he invented his terahertz chemical microscope.

Participants at the symposium

The two universities have held regular meetings and in depth technical discussions at each other's campuses since 2015. Notably, INRS is one of the few

organizations in North America with high-power laser facilities and is internationally acknowledged for its cutting-edge research in lasers.

The universities plan to continue exchanges of personnel with the long term aim of becoming leading centers for optical technology.



INRS researchers examining the terahertz chemical microscope invented by Associate Professor Toshihiko Kiwa

Further inquiries

Associate Professor Toshihiko Kiwa, Graduate School of Natural Science and Technology (Engineering), Okayama University.

News

Symposium held on "The current and future state of radiation"

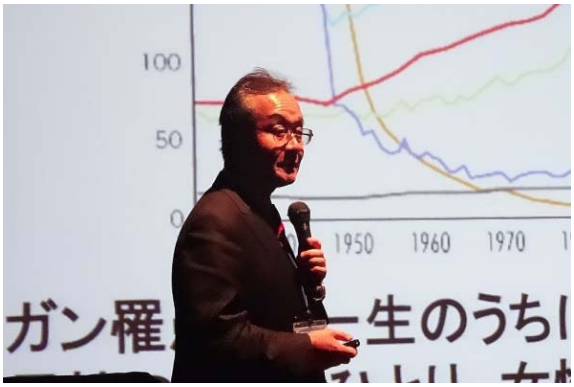
An international symposium entitled "The current and future state of radiation" was held at Walt Hall in Kagamino-cho, a northern town of Okayama Prefecture, and was jointly-hosted by Okayama University, Japan Atomic Energy Agency and Kagamino-cho. It should be noted that these three organizations reached a formal agreement of collaboration in February 2015. This symposium aimed to gather perspectives for the utilization of neutron radiation in cancer therapy, called the Boron-Neutron Capture Therapy (BNCT), and the management of radioactive waste.

Opening address delivered by Prof. S. Yamamoto, Vice-President of Okayama University

The vice-president, Professor S. Yamamoto, delivered the opening address, and talked about the implication of the symposium and the recent research topics in Okayama University.

Lecture given by Ms Irena Mele, Special Advisor of IAEA

Ms Irena Mele, special advisor in the department of Nuclear Energy at the International Atomic Energy Agency (IAEA), gave a lecture on principles and good practice for the safe and efficient management of radioactive waste. Mr A. Izumo, public information specialist at the department of Nuclear Energy, IAEA, discussed the importance of communication and stakeholders' involvement as a prerequisite for building public confidence in radioactive waste management.



Lecture given by Prof. H. Matsui, Okayama University

Recently, BNCT has become a very attractive cancer therapy. The treatment works using a medical agent including a boron isotope (B-10) which is dosed to cancer cells before neutron radiation is applied, and the cancer cells are killed by fission rays (for example α-rays and Li-nucleus rays). Prof. H. Matsui from the Graduate School of Medicine, Dentistry and Pharmaceutical Sciences,

Okayama University, and Prof. J. Hiratsuka of Kawasaki Medical School (the president of the Japan Society of Neutron Capture Therapy), gave a clear perspective of the current state and the future scope of BNCT.

The audience were very engaged by the interesting talks and up-to-date information with respect to the future of radiation in medicine.

Enthusiastically-participating audience

[Correspondence]
Graduate School of Environmental and Life Science,
Okayama University
Prof. Yasuaki Ichikawa
TEL : +81-86-251-8853
e-mail : yiyi08@cc.okayama-u.ac.jp
http://www.gels.okayama-u.ac.jp/index_e.html

News

From molecular diagnostics to target therapies

With the focus on 'From molecular diagnostics to target therapies', the 8th International Symposium for Future Technology: Creating better human health and society frontiers in cancer research was hosted by the Graduate School of Natural Science and Technology on February 6th 2015.

As the executive organizer, Prof. Masaharu Seno organized five special lectures and a poster session. Okayama University recently signed a mutual agreement with Wayne State University and the Karmanos Cancer Institute, USA, and their invited representative, Manohar Ratnam, chaired one of the invited lectures.

Three of the keynote lectures were given by Japanese eminent scientists. Takahiro Ochiya, chief of the Division of Molecular and Cellular Medicine, National Cancer Center Research Institute, lectured on the potential usefulness of extracellular miRNAs as biomarkers and therapeutic tools in cancer. His lecture was entitled 'The impact of exosomal transfer of microRNAs'. Noriko Gotoh from the Cancer Research Institute at Kanazawa University discussed the 'Novel molecular targets for breast and lung cancer stem cells' in his lecture. Ikuo Fujii of the Graduate School of Science, Osaka Prefecture University, lectured on 'Post-antibody drugs: generation of molecular- targeting peptides "*MicroAntibodies*" by phage- displayed libraries'.

Mugdha Patki, invited from Wayne State University and the Karmanos Cancer Institute, also gave a lecture on the 'Novel role of the glucocorticoid receptor in the treatment of advanced non-small cell lung adenocarcinoma'. Hiromi Tanaka, from the Indiana University School of

Dr. Takahiro Ochiya

Dr. Manohar Ratnam

Dr. Noriko Gotoh

Medicine, described 'The potential utility of telomere-related aberrations for cancer diagnosis' during his session.

Seno's collaborators Tomonari Kasai, Takayuki Kudoh, Satoshi Hirohata, Toshiaki Ohara, Yosihaki Iwasaki and Hiroki Kakuta, in promotion of 'The Cancer Stem Cell Research Project' at Okayama University, presented their work during short poster presentations.

All of the sessions produced thought-provoking insights and enthusiastic discussion on the forefront research of cancer stem cells. In total over one hundred people attended the conference, including the lecturers.

The 9th International Symposium is scheduled for February 2016, and will focus again on this most advanced field of high-quality and innovative cancer research.

[Correspondence]
Graduate School of Natural Science and Technology, Okayama University
Prof. Masaharu Seno
TEL : +81-86-251-8216
e-mail : mseno@okayama-u.ac.jp
http://www.cyber.biotech.okayama-u.ac.jp/senolab/e_kenkyuu.html

News

Okayama University Special Movie ”Craftmanship of OKAYAMA"

Recently, a movie clip showing student life at Okayama was made.
Okayama University was first founded in the Chūgoku and Shikoku regions. There are two campuses within the city, and there are also facilities in the areas of Higashiyama, Hirai, Kurashiki, and Misasa. In Okayama Prefecture,which is blessed with the fortune of having a warm climate and views of the mountains and ocean, and basks in traditional Japanese culture, you can enjoy a student lifestyle overflowing with creativity.

▼ URL
https://www.youtube.com/watch?v=KU3hOIXS5kk&feature=youtu.be

Feature

The Institute for Study of the Earth's Interior, Okayama University

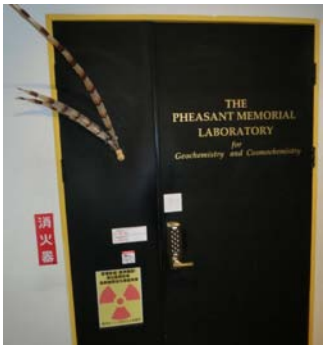
Insights into 'comprehensive analysis' based research at one of the world's pioneering planetary science institutes located in a quite historical Japanese hot spring town

Eizo Nakamura,
Director, Professor of Geochemistry of the Institute Study of the Earth's Interior (ISEI), and
Head of the Pheasant Memorial Laboratory for Geochemistry and Cosmochemistry
Okayama University at Misasa

Professor Eizo Nakamura Head of the Okayama University Pheasant Memory Laboratory (PML), Institute for Study of the Earth's Interior (ISEI) with a sample from the Chelyabinsk meteor that landed in Russia in February 2013.

Pheasant Memory Laboratory (PML)

Professor Eizo Nakamura is the head of the Okayama University's Pheasant Memory Laboratory (PML) at ISEI located in Misasa Town, Tottori Prefecture—a small town renowned for its hot springs [1]. Nakamura is internationally recognized for his pioneering contributions to research on elucidating the origin, evolution, and dynamics of the solar system. "I believe that the 21st century will be the 'era of solar system exploration'", says Nakamura. "It is an exciting time in solar system research as was highlighted during the Misasa International Symposium 2015 we organized recently."



Entrance to Pheasant Memorial Laboratory (PML) with the pheasant's feathers.

Eizo Nakamura with research staff inside a clean room at the Okayama University Pheasant Memory Laboratory (PML), Institute for Study of the Earth's Interior (ISEI).

Nakamura's words reflect recent scientific advances in solar system research in part facilitated by unprecedented developments in engineering and technology to launch and remotely control sophisticated scientific analytical instruments onboard spacecraft for on-site scientific measurements of the physical properties of asteroids, comets, and

planets including Mars. Important milestones in solar system research include the sample return mission of Japan's Hayabusa probe launched 2003 to touch the surface of the asteroid 25143 Itokawa; the on-site science of NASA's Curiosity, Mars Science Laboratory mission that landed at the Gale Crater on Mars in 2012; and the European Space Agency 'comet chaser' Rosetta Mission launched in 2004 that succeeded in landing the probe Philae onto the surface Comet 67P/Churyumov-Gerasimenko in November 2014 as it hurtles towards the sun.

The history of the Institute for Study of the Earth's Interior (ISEI) goes back to 1939 and the establishment of the 'Misasa Hot Spring Rehabilitation Center, Okayama Medical College'. Then after several reorganizations, the ISEI was set up in 1985 as a 'Nationwide Joint-use Research Center'. "The reason the PML is called the 'pheasant memory laboratory' is because many years ago we found a dead pheasant near the lab," explains Nakamura. "Hence the 'pheasant memorial lab'. In fact, the pheasant's tail feathers decorate the entrance to one of the clean rooms to PML!" (see photograph below).

Research and education programs

"Our 'comprehensive analysis' based research at PML has made unique and pioneering contributions to human knowledge of the physico-chemical properties of terrestrial and extra-terrestrial materials," explains Nakamura. "Our staff consist of tenured faculty as well as highly motivated interns and doctoral students from all over the world." Educational scholarships

Eizo Nakamura with research staff inside a clean room at the Okayama University Pheasant Memory Laboratory (PML), Institute for Study of the Earth's Interior (ISEI).

Eizo Nakamura in the focused ion beam system (FIB) room with images of the particles retrieved by the Hayabusa mission from a near-Earth asteroid 25143 Itokawa.

Poster session at the Misasa V International Symposium 2015 (http://sympo.misasa.okayama-u.ac.jp/misasa_v/)

offered at ISEI include the 5-year doctoral course at the Division of Earth and Planetary Materials Science [2] and the Misasa International Student Intern Program [3]. “This was the first such five year integrated Ph.D. course in Japan,” says Nakamura. “Education and research is conducted in English so we attract many highly talented young people from overseas. The selection criteria, structure of courses, and welfare facilities are based on my personal experiences of studying for my doctorate at The University of Toronto and the Australian National University, post graduate research at Department des Sciences de la Terre, Universites de Paris 6 & 7, and lecturing at institutes including Harvard University. I know what it is like to be a student in a foreign country.”

Research facilities

Research at PML is conducted using state of the art analytical instruments housed in dedicated cleanrooms with unique air flow systems to prevent contamination of samples [4]. “In my early years at ISEI I expended a lot of time and effort in designing and constructing the clean rooms,” says Nakamura. “The facilities are unique. They cannot be bought off the shelf. The ISEI infrastructure is the result of years of exhaustive, evolutionary trial and error experiments with all my colleagues at Misasa to produce the most comprehensive facilities in the world. We share these instruments with colleagues all over the world including NASA, ESA, and Russia.”

The experimental facilities at ISEI are maintained by so-called ‘super technicians’, who have doctorates and can allocate time to conduct their own research in addition to their other duties. “This idea resulted by the need to create a ‘post-doc safety net’,” says Nakamura. “We have funding to hire 10 super technicians.”

Research highlights and the future

Nakamura and colleagues analyzed the particles retrieved by the Hayabusa mission to a near-Earth asteroid 25143 Itokawa [5, 6]. The results—the first reported analysis of grains taken directly from a solar body in space—showed craters 100-200 nm in size and particles stuck to the asteroid surface. The analysis suggests that a combination of disaggregation, cratering, melting, adhesion, agglutination, and implantation/sputtering affect the asteroid surface as a result of bombardment by sub-micrometer sized particles in space. The researchers suggest that "the chemistry and textures of Itokawa's surface reflect long-term bombardment of equilibrated chondritic material, at scales of 1e−9 to 1e4 meters". They add that impact processes in general play a central role in the evolution of planetary bodies.

Nakamura and colleagues will also analyze the results of the Hayabusa 2- launched by JAXA in late

2014 for a return mission to dock with C-type asteroid 1999JU2 on 2018 and return to Earth in 2020.

Another project is focused on solving the mysteries of the Chelyabinsk meteor that illuminated the skies over Russia in February 2013 [see photograph].

What does the future hold? Nakamura has his gaze on the hot water fluid permeating the surface of Misasa—one of the most famous hot springs with a history going back several hundred years [7]. "The hot spring water emanating here comes from deep inside the Earth," says Nakamura. "So it carries a lot of information about the crust, mantle ultimately the origin of the Earth, and life. Recently, we have been analyzing the local hot spring water for insights about the origin of life and its use for treatment of medical ailments."

Further information

[1] Institute for Study of the Earth's Interior Okayama University:
http://www.misasa.okayama-u.ac.jp/eng/

[2] Misasa V International Conference 2015 (Comprehensive Exploration of the Solar System) :
http://sympo.misasa.okayama-u.ac.jp/misasa_v/

[3] Misasa International Student Intern Program:
http://www.misasa.okayama-u.ac.jp/~misip/intern.php

[4] Experimental facilities:
http://www.misasa.okayama-u.ac.jp/eng/facilities/#fa_top

[5] Okayama University e-Bulletin: Research Highlights
Evolving planets get a bumpy ride,
http://www.okayama-u.ac.jp/user/kouhou/ebulletin/pdf/vol1.pdf

[6] Eizo Nakamura et.al, "Space environment of an asteroid preserved on micrograins returned by the Hayabusa spacecraft", *Proceedings of the National Academy of Science* 109, E624-E629 (2012).

[7] Misasa Onsen:
http://spa-misasa.jp/eng/index.html

Research Highlights

Vitamin C transport in plants: AtPHT4;4 required for photo-inhibition tolerance

Vitamin C (ascorbate) is an antioxidant and coenzyme for a number of metabolic reactions in living organisms. In plant chloroplasts, high vitamin C levels are required to overcome photo-inhibition caused by strong light.

Although vitamin C is synthesized in the mitochondria, the molecular mechanisms underlying vitamin C transport into chloroplasts are poorly understood.

Now, Takaaki Miyaji, Yoshinori Moriyama, and Jian Feng Ma at Okayama University, together with Takashi Kuromori at RIKEN and colleagues, have shown that AtPHT4;4, a member of the phosphate transporter 4 family of *Arabidopsis thaliana*, functions as a vitamin C transporter.

The team found that proteoliposomes containing purified AtPHT4;4 protein exhibited membrane potential ($\Delta\Psi$)- and Cl^--dependent vitamin C uptake (Fig. 1). AtPHT4;4 protein was expressed abundantly in the chloroplast envelope membranes (Fig. 2). Knocking out *AtPHT4;4* resulted in decreased levels of vitamin C in the chloroplasts. The heat dissipation process of excessive energy during photosynthesis also decreased in the mutants.

These results indicate that AtPHT4;4 protein is a vitamin C transporter at the envelope

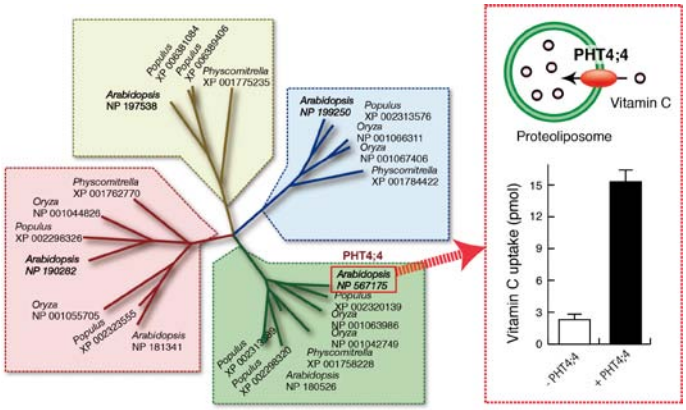


Figure 1. AtPHT4;4 is a vitamin C transporter in *Arabidopsis*.
(*Left*) Phylogenetic tree of the plant PHT4 family. (*Right*) Vitamin C uptake by proteoliposomes containing AtPHT4;4 or no AtPHT4;4.

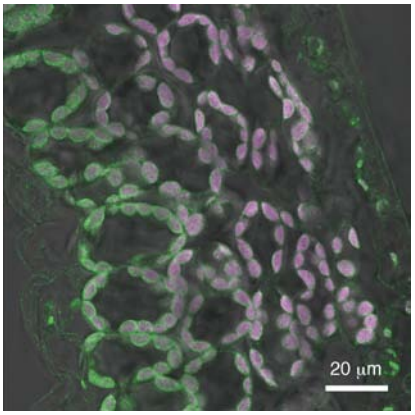


Figure 2. AtPHT4;4 is abundantly expressed in the envelope membranes of chloroplasts from the leaves of *Arabidopsis*.
The fluorescence signals of AtPHT4;4 and chlorophyll are shown in green and magenta, respectively.

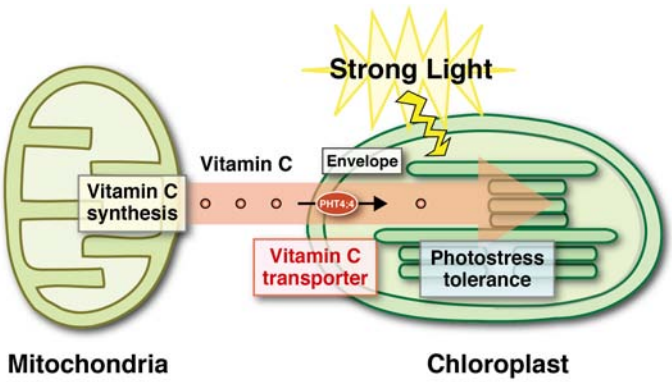


Figure 3. The mechasism of vitamin C transport in chloroplast.
Upon strong light, the PHT4;4 at the envelope membranes takes up vitamin C from mitochondria, which is required for photostress tolerance.

membranes of chloroplasts, which is required for tolerance to strong light stress (Fig. 3). This is the first report regarding the identification of a vitamin C transporter in plants.

This research could help guide the development of heritable transporter genetic modification technology, which may provide a means of developing photo-inhibition tolerant plants.

Reference:

- Takaaki Miyaji[1], Takashi Kuromori[2], Yu Takeuchi[3], Naoki Yamaji[4], Kengo Yokosho[4], Atsushi Shimazawa[3], Eriko Sugimoto[2], Hiroshi Omote[3], Jian Feng Ma[4], Kazuo Shinozaki[2] and Yoshinori Moriyama[1,3]
- AtPHT4;4 is a chloroplast-localized ascorbate transporter in *Arabidopsis*
- *Nature Communications* 6, DOI: 10.1038/ncomms6928 (2015)
- http://www.nature.com/ncomms/2015/150105/ncomms6928/full/ncomms6928.html
- [1]Advanced Science Research Center, Okayama University. [2]Gene Discovery Research Group, RIKEN Center for Sustainable Resource Science. [3]Department of Membrane Biochemistry, Okayama University Graduate School of Medicine, Dentistry and Pharmaceutical Sciences. [4]Institute of Plant Science and Resources, Okayama University.

News&Views

- Foyer C.H. Redox homeostasis: Opening up ascorbate transport.
  Nature Plants 1, DOI: 10.1038/nplants.2014.122 (2015).
  http://www.nature.com/articles/nplants201412

Spotlight

- Fernie A.R., Tóth S.Z. Identification of the elusive chloroplast ascorbate transporter extends the substrate specificity of the PHT family. *Molecular Plants* 8 (5) 674-676 (2015).
  http://www.cell.com/molecular-plant/abstract/S1674-2052(15)00134-3

Research Highlights

One-step preparation of thermally-stable silica-coated platinum/graphene composite

Graphene-supported noble metal (Metal/G) composites are used as catalysts in organic synthesis, fuel cells, super capacitors, solar cells, and sensors. However, Metal/G composites react readily with oxygen to eliminate gaseous carbon oxides upon heating. Therefore, the development of thermally durable Metal/G is of great importance.

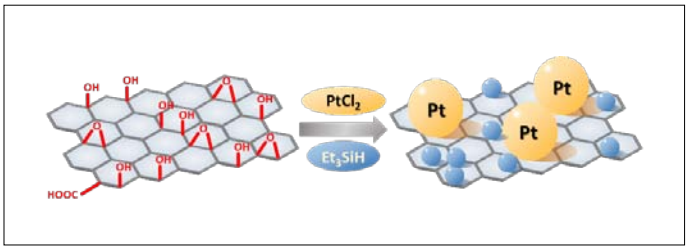


Figure 1: One-step preparation of silica-coated Pt/G composite.

Yuta Nishina at Okayama University and co-workers focused on the development of a one-pot synthesis of silica-coated platium/graphene (Pt/G) composites with high thermal durability. To achieve this, hydrosilane was used as dual-role reagent for Pt nanoparticle formation and silica coating on the graphene (Figure 1).

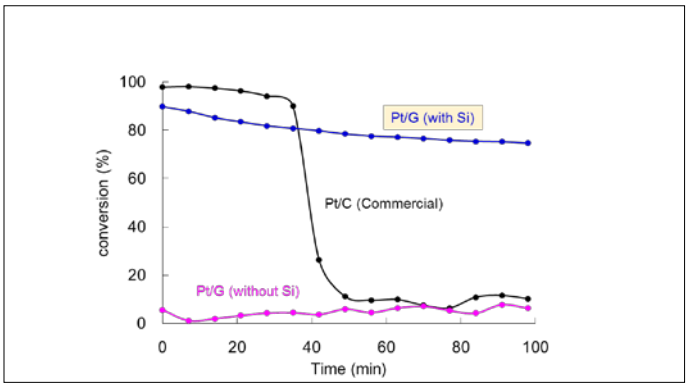


Figure 2: Evaluation of catalytic activity in methane oxidation at 400 °C.

The thermal resistance of the Pt/G composite was evaluated by a catalytic methane oxidation reaction at 400 °C. Compared with commercially-available Pt/carbon composite, whose catalytic activity decreased significantly after 40 min, the silica-coated Pt/G maintained its activity for more than 2 hours. The Pt/G prepared without hydrosilane did not show high activity at any point (Figure 2).

The recovered catalysts were analyzed, and the team found that almost all the carbon atoms in the commercial Pt/carbon composite disappeared. They also observed the aggregation of Pt particles. On the other hand, silica-coated Pt/G composite maintained its structure throughout (Figure 3).

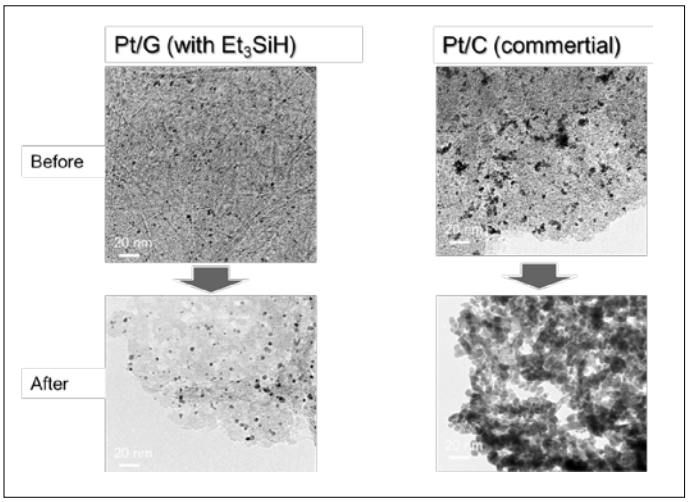


Figure 3: Observation of Pt/G and Pt/C before and after the methane oxidation by Transmission Electron Microscope.

The silica coating strategy should be applicable not only for Pt, but also for other noble metals. The prolonged stability of Metal/G composite will help to reduce global noble metal consumption.

Reference:

- Authors: Akinori Saito, Hiromi Tsuji, Iwao Shimoyama, Ken-ichi Shimizu and Yuta Nishina.
- Title of original paper: Highly durable carbon-supported Pt catalysts prepared by hydrosilane-assisted nanoparticle deposition and surface functionalization.
- Journal, volume, pages and year: *Chemical Communications* **51**, 5883-5886 (2015).
- Digital Object Identifier (DOI): 10.1039/C4CC10298C
- Journal website: http://pubs.rsc.org/en/content/articlelanding/2014/cc/c4cc10298c#!divAbstract
- Affiliations: Research Core for Interdisciplinary Sciences, Okayama University.
- Department website: http://www.tt.vbl.okayama-u.ac.jp/

Research Highlights

High-*Tc* superconductivity found under high pressure

Drastic enhancement of superconducting transition temperature (*Tc*) can be induced by placing materials under high pressure, state Yoshihiro Kubozono and his team at Okayama University.

In previous studies, Metal-intercalated FeSe's prepared using liquid ammonia technique showed very high *Tc* of 30 - 45 K. With an increase in FeSe plane spacing (*d*), the *Tc* increased rapidly, showing that the increase in two-dimensionality leads to the higher *Tc*.

Until recently, the limit of *Tc* was recognized as 45 K, because of a saturation of *Tc* – *d* plot[1]. Sun *et al.* conducted a study during which, in the pressure-induced high-*Tc* superconducting phase for two metal doped FeSe materials ($Tl_{0.6}Rb_{0.4}Fe_{1.67}Se_2$ and $K_{0.8}Fe_{1.7}Se_2$), the maximum *Tc* reached 48 K[2]. However, such behavior has rarely been reported because it is extremely difficult to conduct the necessary experiments.

In a recent study, Kubozono and his team applied high-pressure to ammoniated Cs doped FeSe ($(NH_3)_yCs_{0.4}FeSe$) material. They measured the temperature dependence of resistance under pressures of between 0 – 41 GPa.

Figure 1. The $(NH_3)_yCs_{0.4}FeSe$ sample prepared by liquid ammonia technique.

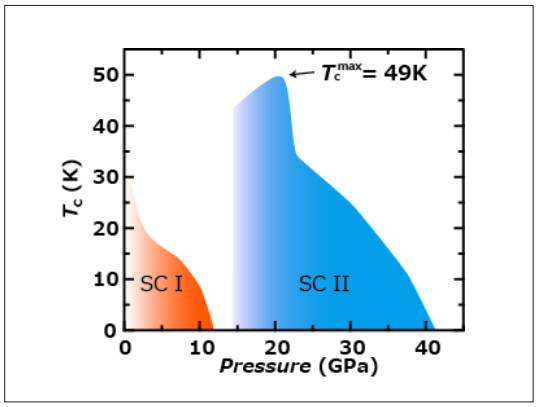


Figure 2: Phase diagram of $(NH_3)_yCs_{0.4}FeSe$.

The *Tc* of $(NH_3)_yCs_{0.4}FeSe$ (31 K at ambient pressure) gradually decreased with increasing pressure, and no superconductivity was observed down to 4.2 K at 11 - 13 GPa. The superconductivity reemerged rapidly above 13 GPa, and a dome-like pressure-dependence of *Tc* was found at 15 - 41 GPa. The maximum *Tc* reached 49 K at 21 GPa.

The emergence of high-*Tc* phase under high pressure may be characteristic for all metal doped FeSe materials, which may provide a hint for realizing higher *Tc* superconductors in two-dimensional layered materials in future.

[1] S. Hosono *et al. J. Phys. Soc. Jpn*. 83, 113704 (2014).
http://journals.jps.jp/doi/pdf/10.7566/JPSJ.83.113704

[2] L. Sun *et al. Nature* 483, 67 (2012).
http://www.ncbi.nlm.nih.gov/pubmed/22367543

Reference:

- Authors: M. Izumi, L. Zheng, Y. Sakai, H. Goto, M. Sakata, Y. Nakamoto, H. L. T. Nguyen, T. Kagayama, K. Shimizu, S. Araki, T. C. Kobayashi, T. Kambe, D. Gu, J. Guo, J. Liu, Y. Li, L. Sun, K. Prassides, Y. Kubozono
- Title of original paper: Emergence of double-dome superconductivity in ammoniated metal-doped FeSe
- Journal, volume, pages and year: *Scientific Reports* 5, 9477 (2015).
- Digital Object Identifier (DOI): 10.1038/srep09477
- http://www.nature.com/srep/2015/150330/srep09477/full/srep09477.html?WT.ec_id=SREP-639-20150407
- Affiliations: Research Laboratory for Surface Science, Okayama University and six Research groups
- Department website: http://interfa.rlss.okayama-u.ac.jp/index.html

Research Highlights

Electronic structure of optimally doped novel superconductor La(O,F)BiS_2

The newly-discovered layered superconductor, Ln(O,F)BiS_2, discovered in 2012, achieves a maximum *T*c of 10.6 K. The superconductivity emerges by carrier doping to the parent compound.

There have been no reports on the direct observation of the electronic structure of Ln(O,F)BiS_2 in the optimal doping range, which is an important factor to consider in a discussion of the superconducting mechanism.

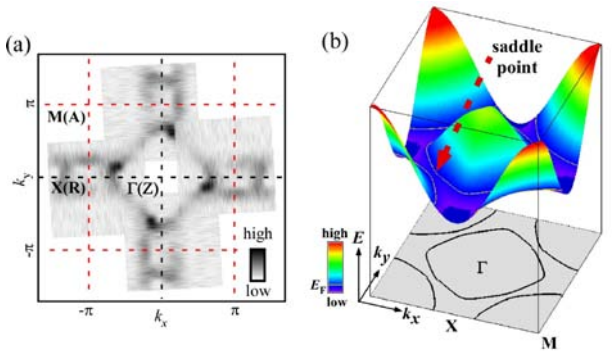


Figure caption: (a) Experimentally determined Fermi surface (black part) and (b) schematic view of the overall band structure of La(O,F)BiS_2 predicted by first principles calculations.

Now, Kensei Terashima and colleagues at Okayama University have clarified the electronic structure of nearly optimal doped La(O,F)BiS_2.

The team grew single crystal samples by a flux method. They then performed photoemission experiments at BL-28A of Photon Factory and BL25SU of SPring-8.

The Fermi surface topology of optimally doped BiS_2 is about to change due to the presence of van Hove singularity (saddle point) in its electronic structure, which agrees well with the prediction by first principles calculations which take the spin-orbit coupling into account.

The optimal *T*c could be realized by E_F-crossing of the van Hove singularity in the density of states. On the other hand, despite its higher DOS, *T*c of optimally-doped La(O,F)BiS_2 is lower than that of the related compound, under-doped Nd(O,F)BiS_2. Thus there are probably other factors also enhancing *T*c in this system, which will need to be clarified by further study.

Reference:

- Authors: K. Terashima[1,2], J. Sonoyama[1], T. Wakita[1,2], M. Sunagawa[1], K. Ono[3], H. Kumigashira[3], T. Muro[4], M. Nagao[5], S. Watauchi[5], I. Tanaka[5], H. Okazaki[6], Y. Takano[6], O. Miura[7], Y. Mizuguchi[7], H. Usui[8], K. Suzuki[8], K. Kuroki[8], Y. Muraoka[1,2], and T. Yokoya[1,2]
- Title of original paper: Proximity to Fermi-surface topological change in superconducting $LaO_{0.54}F_{0.46}BiS_2$
- Journal, volume, pages and year: *Physical Review B* **90**, 220512(R) (2014).
- Digital Object Identifier (DOI): 10.1103/PhysRevB.90.220512

- Journal website: journals.aps.org/prb/abstract/10.1103/PhysRevB.90.220512
- Affiliations: [1]Graduate School of Natural Science and Technology, and Research Laboratory for Surface Science, Okayama University., [2]Research Center of New Functional Materials for Energy Production, Storage, and Transport, Okayama University., [3]High Energy Accelerator Research Organization (KEK), Photon Factory., [4]Japan Synchrotron Radiation Research Institute (JASRI)/SPring-8., [5]Center for Crystal Science and Technology, University of Yamanashi., [6]National Institute for Materials Science., [7]Department of Electrical and Electronic Engineering, Tokyo Metropolitan University., [8]Department of Physics, Osaka University.
- Department website: http://www.science.okayama-u.ac.jp/~surface/eng

Intellectual Property and Enterprise

Preparation of rigid polymer nanofibers by new crystallization method

Tetsuya Uchida
Graduate School of Natural Science and Technology
Okayama University

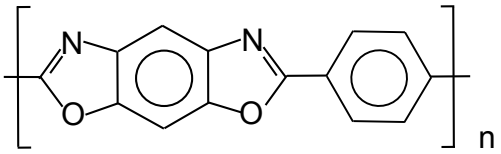


Fig.1 Structure of Poly(p-phenylene benzobisoxazole) (PBO)

Poly(p-phenylene benzobisoxazole) (PBO) (Fig. 1) is a rigid polymer in which the molecular chains are unable to fold. PBO fibers have excellent physical properties, including high strength, a high elastic modulus, and high thermal stability.

However, nanofibers with diameters of less than 100 nm and aspect ratios higher than 100 have attracted attention recently because of potential applications in many areas, including high efficiency filters, organic electronics, electromagnetic shield materials, compact batteries, and high-performance polymer composite. Methods for the preparation of nanofibers include conjugated melt spinning, melt-blowing, and electro spinning, with the lattermost being the most versatile.

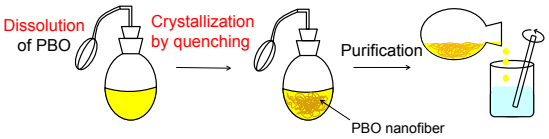


Fig.2 Method for preparing PBO nanofibers

However, these methods require not only specialized equipment but also high voltages. Furthermore, using conventional nanofiber preparation methods for a rigid polymer such as PBO is difficult because it is insoluble in organic solvents, and soluble only in concentrated sulfuric acid and other similar acids.

We previously reported that single crystals with different forms can be produced by crystallizing PBO from dilute solutions in concentrated sulfuric acid. Here, we have used this result to develop new method for preparing PBO nanofibers with an average diameter of approximately 50 nm (Fig.3; Table1) via crystallization from a dilute solution in sulfuric acid (Fig.2).

Table 1 Properties of the PBO nanofibers

Diameter	53 ± 22 nm
Length	6.7 ± 1.1 μm
Specific surface area	88.4 g/m^2

Furthermore, we prepared a PBO nanofiber mat by a simple method using filtration and a vacuum heating press. The PBO nanofiber mat (Fig.3) exhibited excellent mechanical properties such as high thermal stability and high porosity. Notably, the thermal diffusivity was anisotropic, with the magnitude in the in-plane direction of the film greater than that in the thickness direction (Table 2).

Table 2 Physical Properties of the PBO nanofiber mat

	Physical property
Density	1.10 ± 0.07 g/cm^3
Porosity	28.7% ± 4.2 %
Elastic modulus	1.48 ± 0.14 GPa
Thermal resistance:	
5% weight loss	610 °C
10% weight loss	650 °C
Specific surface area	42.6 g/m2
Thermal diffusivity: In-plane direction	5.36 ± 0.38×10^{-6} m^2/s
Thickness direction	0.29 ± 0.04×10^{-6} m^2/s

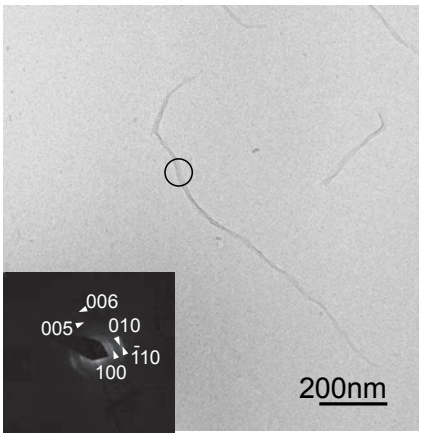


Fig.3 TEM image of PBO nanofibers and an electron diffraction image of the circled area (lower left)

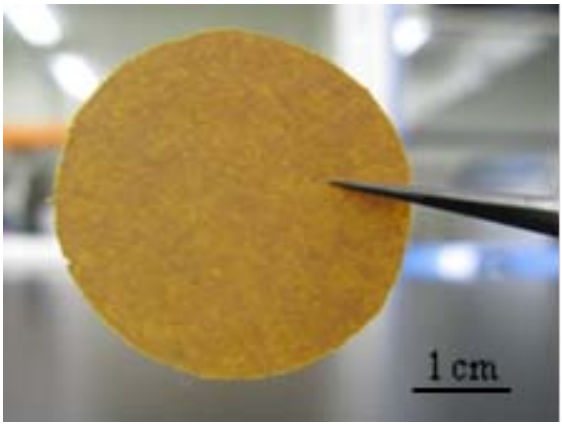


Fig. 3 Photo of the PBO nanofiber mat

Applications

PBO nanofibers: High performance nano-filler for polymer composite (high thermal stability, high thermal conductivity, electrically non-conductive, high elastic modulus, high strength)

PBO nanofiber mats: highly thermally stabile nanofiber filter, highly thermally conductive nanofiber sheet.

★Contact: Mototaka Senda, Ph.D.,
US & EU Representative of Intellectual Property Office,
Okayama University, 2450 Peralta Blvd. #119, Fremont,
CA 94536, USA
Email: takasenda@okayama-u.ac.jp

Topics : Letters from alumni

Dr. Nan bin Md Sahar

Senior Lecturer, Department of Computer Engineering, Faculty of Electric and Electronic Engineering (FKEE), Tun Hussein Onn University Malaysia (UTHM)

I completed my doctorate in 2010 at the Advanced System Safety Lab under the supervision of Professor Suzuki Kazuhiko. At the time, Associate Professor Munesawa Yoshiomi and Associate Professor Minowa Hirotsugu also e to supervised my research. Currently, I am a Senior Lecturer at the Department of Computer Engineering, Faculty of Electric and Electronic Engineering (FKEE), Tun Hussein Onn University Malaysia (UTHM). In addition to being a senior lecturer, I am also in charge of the only supercomputer lab at the university.

Enjoying full blossoming sakura with my wife Nurliza binti Md Nor during Hanami at Handayama Park, Okayama.

I was accompanied by my wife, Nurliza binti Md Nor during my studies at Okayama University. After my wife graduated from high school in Malaysia, she was offered to an opportunity to study in Japan with a Mombukagakusho scholarship under the 'Look East Policy' inspired by Tun Dr. Mahathir Mohamad, the former prime minister of Malaysia. She completed a Japanese Preparation Course at University Malaya for two years before being accepted to study medicine at the Faculty of Medicine, Tottori University. My wife had always wanted to become a doctor since childhood, and Japan was her country of choice due to the advanced technology used in medicine.

My wife (Nurliza binti Md Nor) with doctors and staff at the Obstetric & Gynecology Department, Okayama University Hospital.

Six years as a medical student in Japan were undoubtedly hard for my wife but being surrounded by many friendly and supportive lecturers and friends, the tough path as the only foreign student in the School of Medicine was barely felt. For the first two years of my doctorate, my wife worked as a Junior Resident at Okayama Saiseikai General Hospital, which is situated very near to Okayama University, after successfully passing Japan's national examination for medical practitioner (Ishi Kokka Shiken) and obtained her doctor's license. Then she became a Senior Resident at Okayama University Hospital at the Department of Obstetrics & Gynecology.

Although my wife only worked at Okayama Hospital for a less than a year before we had to return to Malaysia, she will always remember the invaluable experience gained under Professor Hiramatsu Yuji , Assistant Professor Kusumoto Tomoyuki and others.

Nurliza binti Md Nor now works as a medical officer at the Department of Obstetrics and Gynecology of Sultanah Nora Ismail Hospital, Batu Pahat, Johor, and next year will further her studies by enrolling on a master's program.

Topics : Okayama Travelogue

Okayama Hakuto-the sweet and fragrant peach grown in 'Land of Sunshine'

Okayama Prefecture is referred to as the 'Land of Sunshine' because of more than 2100 hours of daylight each year. This mild climate make Okayama well suited for the cultivation of peaches. Notably, approximately 50% of peaches grown in Japan are cultivated in Okayama with the most famous of the family of large peaches being the Okayama 'Shimizu Hakuto'—a large, sweet peach with a distinctive fragrance and white peel and pulp. In fact, Okayama growers produce about 2,889 tonnes of 'Shimizu Hakuto' peaches per year using a cultivation area of 250 hectares.

Okayama 'Hakuto' peaches with distinctive white peel and pink regions.

The history of peach cultivation in Okayama can be traced back to the Meiji Period of the 1800's when peaches were brought to Okayama from China. Attempts at large scale cultivation of the famous Hakuto started in the early 1900's.

The reasons why the peel of Hakuto peaches is white and why they are so sweet are due to the unique cultivation process developed by the peach farmers of Okayama. As the peaches grow, they are covered with small paper bags that have an opening at the bottom to allow light to reach only the bottom end of the peaches. Another factor is careful control of water supply to the soil where his peach trees grow. So the combination of the long sunlight hours and careful crop management by the peach farmers results in sweet, fragrant peaches with a white outer peel and inner juicy pulp. The Hakuto are harvested in late July and early August.

An Okayama 'Hakuto' peach with the distinctive white peel and pink region ready for harvesting.

Further information

Okayama Prefectural International Tourism: http://www.okayama-japan.jp/en/

Topics : Club Activities

Okayama University Archery Club

"The Club was set up in 1971," says the serving captain and 3rd year physics student Yuta Kobayashi. "Skilled archers are usually physically strong and able to concentrate and focus on the target as they pull the bow. Archery can be enjoyed throughout one's lifetime. "

Okayama University Archery Club members win first place in a completion in 2014.

The club currently has 12 members. Nine are engineering majors and only two have previous experience of archery. So most of the members are new to the sport. "Some of the reasons why students started archery at university include sports facilities for doing archery had not been available before, and another reason is the desire to try something new," says Kobayashi. "Some students start archery because it's cool!"

Okayama University Archery Club practice session.

Kobayashi points out that anyone—irrespective of age or physical build—can master and do well at archery. With regular practice even complete beginners can take part in intercollegiate and national tournaments.

Members of the club practice daily in the evenings from around four thirty. The members watch each other during the practice sessions to give feedback about style and so on.

All the members take part in the five annual tournaments organized by the All Japan Student Archery Federation and six tournaments of the 'five university competition'. Individual club members also take part in prefectural competitions. Notably, both the men's and women's teams won first place in the 'five university competition' in 2014.

