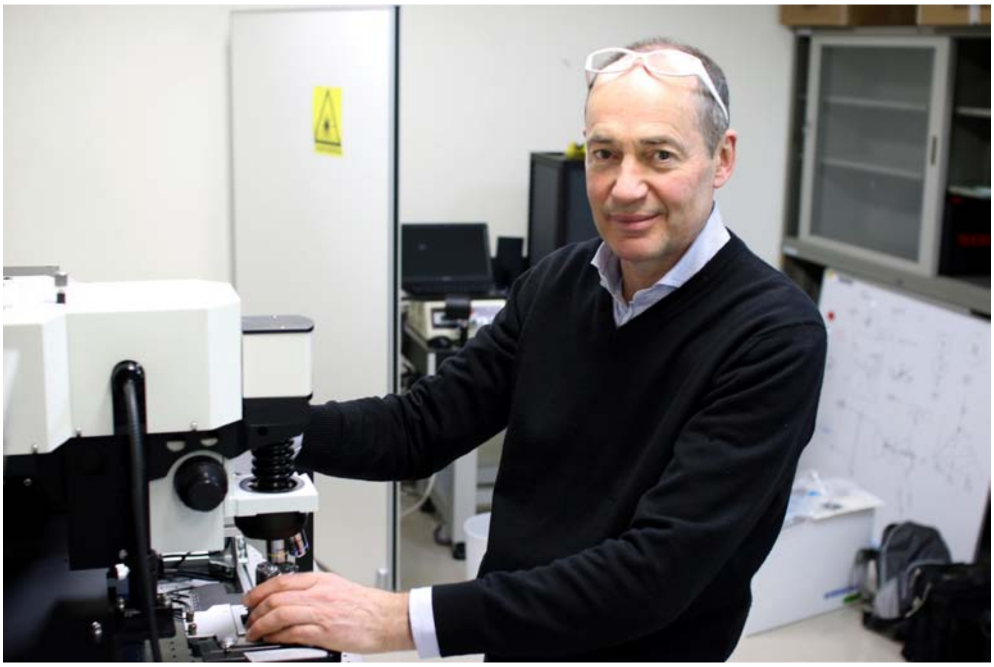
OKAYAMA UNIVERSITY e-Bulletin



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Contents

News

Okayama University and International Atomic Energy Agency sign an agreement for the development of Boron Neutron Capture Therapy (BNCT) for cancer therapy

Okayama University and the International Atomic Energy Agency (IAEA) concluded an agreement on 26 October 2016 for the development of boron neutron capture therapy (BNCT)—a new approach to cancer treatment.

IAEA Director Venkatesh (left) with President Morita (middle) and Executive Director Yamamoto signing the agreement

President Kiyoshi Morita and Executive Director/ Vice President of Research Shin-ichi Yamamoto from Okayama University and Dr Meera Venkatesh, Director of the Division of Physical and Chemical Sciences in the Department of Nuclear Sciences and Applications at IAEA, signed the agreement at a ceremony held at Okayama University. Notably, this is the first agreement in the world to be concluded on BNCT with the IAEA.

Commemorative photograph of the participants in the signing ceremony.

"It is an enormous honor to conclude a cooperative agreement on boron neutron capture therapy," said President Morita during his speech at the ceremony. "BNCT is a cancer treatment with great potential, and a therapy resulting from the fortuitous encounter of modern elementary particle physics with new pharmaceutical cellular biology. I am confident that this agreement will further strengthen the relationship between Okayama University and IAEA, and lead to new developments in BNCT."

Executive Director Yamamoto emphasized his hope that a broad range of knowledge will be shared in the field of radiotherapy, saying, "BNCT is a technology integrating the medical, pharmaceutical and physical sciences. Through this agreement with the IAEA, we aim to contribute to education and research in this innovative field."

In her speech, Director Venkatesh said, "The IAEA is committed to accelerate and enlarge the contribution of atomic energy to peace, health and development around the world. There have been many important advances in cancer therapy recently, but still with numerous challenges ahead. The IAEA Member States will also benefit from cooperation with internationally recognized institutions, such as Okayama University.

We have not seen much progress in BNCT for a few decades. However, the 'Side Event' we organized during the IAEA's General Conference in September 2016 urged us to re-examine the current status of this therapy, focusing in particular on the recent development of new boron compounds and effective neutron sources generated in accelerators."

Professor Hideki Matsui of the Graduate School of Medicine, Dentistry and Pharmaceutical Sciences, who has developed a boron compound that can reach cancer cell nuclei, said, "BNCT may be the most promising cancer treatment available. If a compound containing B-10 can be injected into each cancer cell which is then exposed to a neutron beam, the cancer cell can be killed by the boron-neutron reaction within the cell."

Importantly, Okayama University and the IAEA already have cooperative relationship even prior to the conclusion of this agreement, having previously organized previously two joint symposia; Okayama University inviting specialists from the IAEA; organizing an international workshop in 2015 titled, 'The Current and a Future of Radiation'; and a symposium in 2016 titled, 'The Current and a Future of Radiation and External Beam Therapy'.

These activities were important for this agreement on research and education program on BNCT. Professor Matsui and Professor Yasuaki Ichikawa of the Organization for Research Promotion & Collaboration are engaging in further cooperative activities with the IAEA.

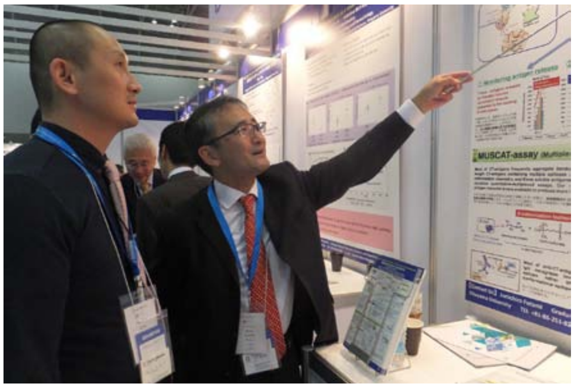
Further information

Okayama University website
http://www.okayama-u.ac.jp/eng/news/index_id6296.html

News

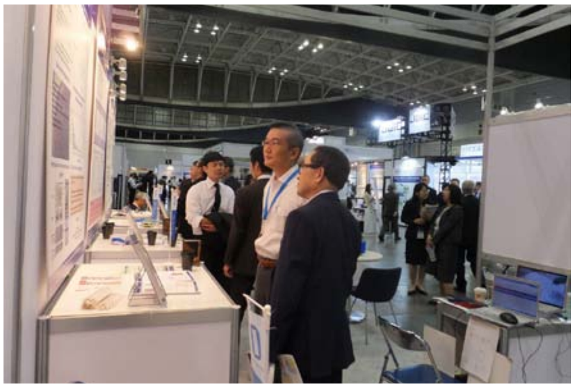
Okayama University participates in Asia's Biggest Bio-Business Event: 'Bio Japan 2016'

Okayama University participated in Asia's biggest bio-business event: 'Bio Japan 2016 World Business Forum' held at Pacifico Yokohama on 12-14 October 2017, where it presented the results of advanced research in areas including medicine, drug development, and biomedical engineering, as well as giving details about Okayama University's Biobank Project, which collects and offers biological samples for research.



Associate Professor Futami (right) explaining evaluation of tumor immune response

Associate Professor Junichiro Futami of the Medical Bioengineering at the Graduate School of Natural Science and Technology, has developed highly sensitive antibody-detecting diagnostic agents for quantifying the degree of activation of tumor immunological response through a simple blood test. He announced that by using this diagnostic agent, it is possible to provide important data for evaluating treatment plan options for cancer immunotherapy, for which there is considerable individual variation.

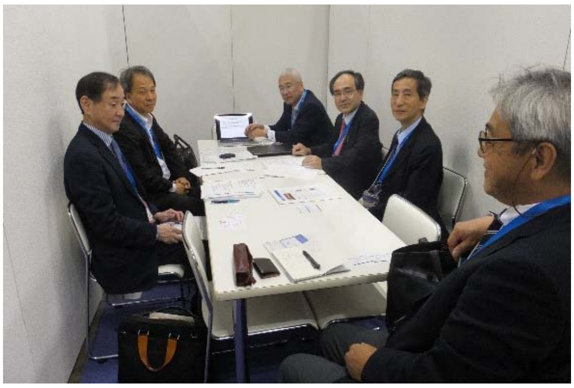


Associate Professor Tani (left) explaining ergothioneine production

Associate Professor Akio Tani of the Institute of Plant science and Resources, has discovered that predominant bacterial symbionts (Methylobacterium species) on plant surfaces utilize methanol emitted from plants to accumulate large quantities of ergothioneine (EGT)— a very expensive antioxidative amino acid that animals cannot synthesize. He explained that by using these bacteria, it is possible to produce EGT inexpensively compared with conventional methods using chemical synthesis. EGT has a wide range of potential applications including as a material for cosmetics, and supplements.

Audience listening to Professor Seno's presentation

Professor Masaharu Seno of the Medical Biomedical Engineering at the Graduate School of Natural Science and Technology, has developed a technique for using normal iPS cells to create cancer stem cells exhibiting a wide range of properties. In to order to verify the validity of his technique, Professor Seno has proposed novel mouse models for cancer to assess potential drug delivery systems and antitumor agents that can be evaluated concurrently with the immune system.



Okayama University representatives (right side) consulting with medical organization representatives

In addition, he presented clinical results of a novel diagnostic and prognostic biomarker for patients with sepsis, and results from molecular targeting techniques using theranostics (Therapy + Diagnosis), and the concept of the Okayama University Hospital Biobank.

At the exhibitor presentation, Okayama University gave six lectures, with a total of 370 people attending the event.

Finally, the University also conducted matching meetings with pharmaceutical companies and medical/pharmaceutical related organizations interested in research at Okayama University, and exchanged views for technology transfer and joint research.

Further information

English page
http://www.okayama-u.ac.jp/eng/news/index_id6356.html

Japanese page
http://www.okayama-u.ac.jp/tp/news/news_id6224.html

News

Japan's Six National Universities Network (SUN)/ International Education & Research System (SixERS) Signs International Exchange Agreement with Excellence League of China

On 28 November 2017, Six National Universities Network (SUN)/ International Education & Research System (SixERS) (SUN/SixERS Consortium) in Japan and the Excellence League (Excellence 9) of China signed an international exchange agreement. Masaru Araki, Director of SUN/SixERS Consortium, and Okayama University Executive Director and Vice President (Social Responsibility and International Affairs), and Qingnian Wang, South China University of Technology Director of International Office, co-signed the agreement.


Director Wang of South China University of Technology (left) and Executive Director and Vice President Araki of Okayama University shake hands

On the next day, 29 November, a commemorative ceremony was held in Kyoto in partnership with the Japan-China University Education Exchange Meeting. About 140 persons attended, including Consul General Li Tianran of the Consulate General of the People's Republic of China in Osaka, and representatives from the Excellence League, the Consortium of Six National Universities in Japan, and the Japan-China University Education Exchange Meeting. Advancements in academic exchanges between the Consortium and the League are being highly anticipated as a result of this agreement.


Representatives of the Excellence League in China and the Six National Universities Network (SUN)/ International Education & Research System (SixERS) Consortium, in Japan

Further information

English
http://www.okayama-u.ac.jp/eng/news/index_id6425.html

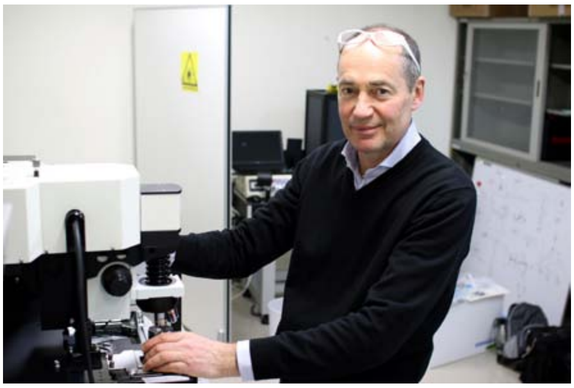
Japanese page
http://www.okayama-u.ac.jp/tp/news/news_id6326.html

SixERS Consortium website (Japanese)
http://sixers.jp/

▪ Feature

Planetary science: Extreme heat and pressure to yield unique insights into the origin of gaseous planets

Okayama University's Institute for Planetary Materials (IPM) is one of the world's premier institutes conducting fundamental research on planetary systems science. Its mission is to integrate solar system studies for better understanding of the distribution, origin and interaction of planetary materials, including the origin of life.



Andrew Jephcoat
Division for Basic Planetary Materials Science
Institute for Planetary Materials, Okayama University, Misasa, Tottori.

Laser-Heated Diamond-Anvil Cell (DAC)

Andrew Jephcoat is at the Division for Basic Planetary Materials Science and leading IPM's research on the evolution of the solar system with laboratory studies recreating the extremes of pressure (P) and temperature (T) existing in the deep interiors of planets.

Over the years, diamond-anvil cells (DAC's) have been widely used to reproduce the environment at core of the Earth for example, with high temperatures and pressures up to 1000's of degrees and over 300 GPa.

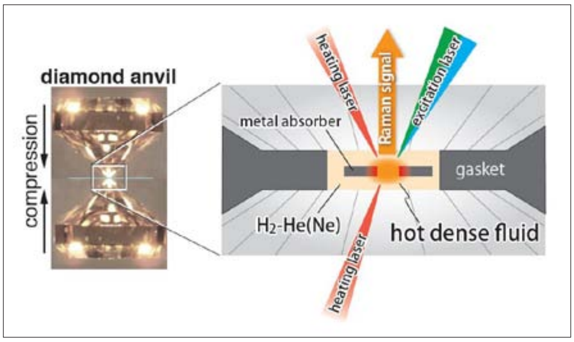


Figure 1. The Diamond-Anvil Cell (DAC). [Left] Gem-quality diamond anvils used to create high pressure and temperature in the laboratory. [Right] A cross-section of the trapped sample showing confining gasket and heating (pump laser and diagnostic Raman excitation laser. A metal absorber, with a hole 1/5 size of a human hair, will be used to heat the a dense fluid of hydrogen mixtures representative of Jupiter's shallow interior.

Mysteries of "gas giant" planets

Recently, however, the target of high P-T research has shifted to investigating the interior of so-called 'gas giants' like Jupiter and Saturn. Notably, stars and the universe consist mainly of hydrogen (H_2) and helium (He), and it is thought that the high temperature and high pressure regions inside such planets are composed of mainly these hot, dense fluids, surrounding a small rocky, possibly solid core, itself at ultrahigh pressure and temperature (Figure 2). There are still many uncertainties about the compositional changes in these molecular fluid planetary envelopes under extremes of P and T.

For example, the Galileo entry probe (7/12/95) sampled Jupiter's atmosphere and revealed unexpected depletion of the trace rare gas neon (Ne). Theoretical models recently predicted (Refs. 1,2) that hot, dense helium fluid could separate from fluid metallic hydrogen in the deep interior of the gas giants, forming "hot helium rain" and dragging neon preferentially dissolved within it to deeper regions of the planet (Figure 2). In addition, the observed excess luminosity of Saturn for its current age, might also result from the additional gravitational internal energy source that such helium segregation could provide. "We need to begin to try to observe this process and other possible molecular reactions that are important to gain insights into the interior structure of such planets."

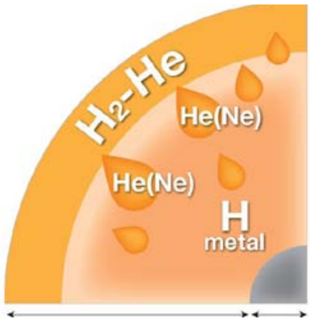


Figure 2. A cross-section of a "typical" gas giant planet. For Jupiter the mean radius is ~70,000 km, approximately 11 times the size of Earth. The Galileo probe in 1996 revealed unexpected neon depletion in the atmosphere. One explanation that needs to be tested is that neon alloys with helium and "rains out" of a metallic hydrogen layer, somewhere within Jupiter's (and Saturn's) interior.

Aims and approach of research using diamond anvil cells at IPM

The IPM group are designing experiments (Figure 3) on the H_2-He-Ne system for up to 200 GPa-6000 K (much higher than previous experiments at 10 GPa-500 K) to try to observe the behaviour by making measurements using laser Raman scattering with the DAC. "These experiments are challenging because hot hydrogen is extremely reactive and difficult to confine, diffusing into the diamond anvils." "If we can hold P and T steady for long enough, we might observe this elusive phase separation." (Figure 4.) Our work under static conditions compliments transient laser-shock experiments on pre-compressed He-H_2 targets.

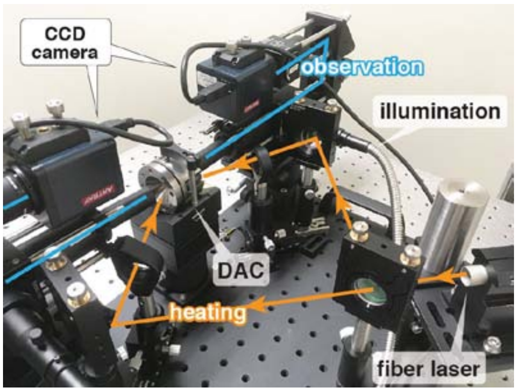


Figure 3. The optical components of the laser-heating system for the DAC at IPM showing the 200W infra-red fibre laser source operating at 1070nm (orange) and the beam path of collected light (blue) for Raman scattering and imaging.

Plans and expectations

Since July 2016 NASA's JUNO spacecraft has been mapping Jupiter's magnetic and gravitational fields in order to understand better its interior structure, core mass, and origin of the magnetic field. Clarifying the correlation and behavior of H-He mixtures with other trace molecular species mixtures at even moderate depths, is expected to be a major advance in understanding the interior and chemical composition of Jupiter and Saturn. These DAC methods can be applied to a range of planetary materials, including organics and water and will add to accumulated human knowledge on the origin of planets and other solar-system bodies.

This is an epic project to unlock the secrets of origin of Jupiter and other planets in the solar system.

Ref. 1 Wilson, H. F & B. Militzer, Sequestration of noble gases in giant planet interiors, *Phys. Rev. Lett.*, 121101 (2010).

Ref. 2. Morales, M. A., S. Hamel, K. caspersen & E. Schwegler, Hydrogen-helium demixing from first principles: From diamond anvil cells to planetary interiors, *Phys. Rev. B.*, **87**, 174105 (2013).

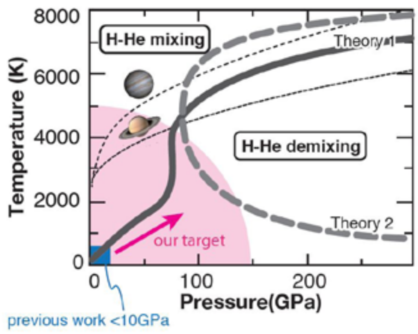


Figure 4. There are different predictions for position of the P-T envelope where hydrogen and helium "de-mix" with pressure and temperature (see Ref. 2). In the DAC, only a small region of the hydrogen-helium phase diagram has been explored so far (dark blue square). With new static methods for generation of P and T in the DAC we hope to extend the range studied by perhaps an order of magnitude (pink region) toward the predicted "de-mixing" boundaries (solid and dashed grey curves).

Further information

1. IPM website
   http://www.misasa.okayama-u.ac.jp/eng/

2. Nasa website
   https://www.nasa.gov/mission_pages/juno/overview/index.html

3. Okayama e-Bulletin vol.11 June 2015
   http://www.okayama-u.ac.jp/user/kouhou/ebulletin/pdf/vol11.pdf

▪ Research Highlights

Reducing phosphorus in rice grain for sustainable and environmental-friendly agriculture

Application of phosphorus fertilizers is necessary to sustain high crop production in modern agriculture. Research has shown that the most of the phosphorus absorbed by the roots is finally allocated to the grains, which remove large part of phosphorus in soil at harvest. Phosphorus in cereal grains is stored in the form of a chemical named phytic acid, however, this form cannot be digested by human and most animals, resulting in excretion of phytic acid to the environment, which causes water pollution or 'eutrophication'. Furthermore, phytic acid forms a strong complex with zinc and iron, which will decrease the availability of these metals. Therefore, reducing phosphorus accumulation in grains is an urgent demand for sustainable and environmental-friendly agriculture.

Jian Feng Ma of Okayama University and colleagues report a possible solution to this dilemma by controlling the flow of phosphorus into grain. Specifically, the researchers identified a phosphorus transporter (SPDT) that acts as a switch at the rice nodes, which is a hub for distribution of mineral elements. SPDT is a novel transporter identified so far. Importantly, Ma and his colleagues found that knockout of this gene can reduce phytic acid concentration in the grains by 20% without yield penalty. By contrast, more P was delivered to the straw, which will increase soil phosphorus by returning them to soils.

This strategy found in rice may be also available in other cereal crops. The researchers are confident that this approach to recycling of phosphorus and reduction in eutrophication of water will be an important factor for sustainable and environmental-friendly agriculture in future.

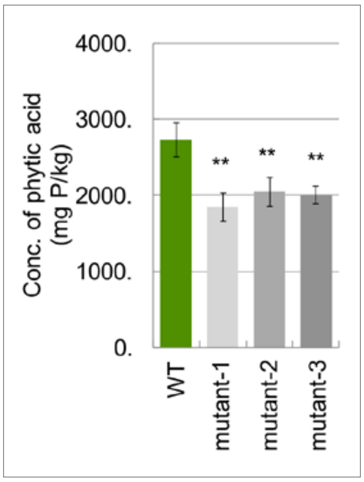


Figure 1
Effect of knockout of *SPDT* gene on phytic acid concentration in rice grains

Figure 2
Rice grains of wild-type rice and *spdt* mutant

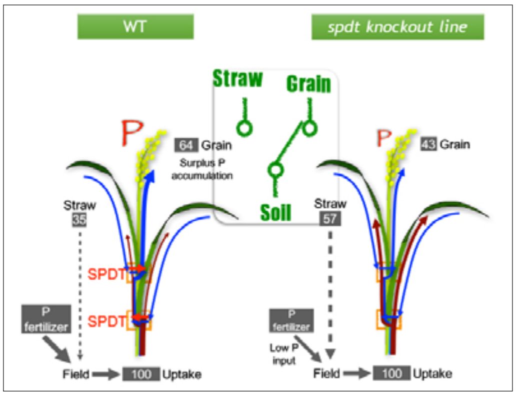


Figure 3
A scheme for the role of SPDT transporter in distribution of phosphorus in rice node

Reference:

Naoki Yamaji[1]*, Yuma Takemoto[1]*, Takaaki Miyaji[2], Namiki Mitani-Ueno[1], Kaoru T. Yoshida[3] and Jian Feng Ma[1]*, Reducing phosphorus accumulation in rice grains with an impaired transporter in the node, Nature 541, 92, January 2017.

doi:10.1038/nature20610

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3. Graduate School of Agricultural and Life Sciences, The University of Tokyo, Bunkyo-ku, Tokyo 113-8657, Japan.

Corresponding author:
E-mail address: maj@rib.okayama-u.ac.jp (Jian Feng Ma).

Reference (Okayama Univ. e-Bulletin): Professor Jian Feng Ma's team

- Vol.17 Professor Jian Feng Ma receives the 2016 Corresponding Membership Award from the American Society of Plant Biologists (ASPB)
  http://www.okayama-u.ac.jp/user/kouhou/ebulletin/news/vol17/news_001.html
- Vol.16 Professors Jian Feng Ma and Naoki Yamaji receive "Highly Cited Researchers 2015" Award
  http://www.okayama-u.ac.jp/user/kouhou/ebulletin/news/vol16/news_001.html
- Vol.13 Preferential distribution of silicon to rice grains
  http://www.okayama-u.ac.jp/user/kouhou/ebulletin/research_highlights/vol13/highlights_001.html
- Vol.12 Plants feel stress!
  http://www.okayama-u.ac.jp/user/kouhou/ebulletin/feature/vol12/feature_001.html
- Vol.11 Vitamin C transport in plants: AtPHT4;4 required for photo-inhibiti on tolerance
  http://www.okayama-u.ac.jp/user/kouhou/ebulletin/research_highlights/vol11/highlights_001.html
- Vol.9 Arsenic toxicity: Reducing accumulation in rice grains
  http://www.okayama-u.ac.jp/user/kouhou/ebulletin/research_highlights/vol9/highlights_004.html
- Vol.5 How rice plants deal with environmental changes in manganese
  http://www.okayama-u.ac.jp/user/kouhou/ebulletin/research_highlights/vol5/highlights_002.html
- Vol.1 Identification of a rice transporter for manganese and cadmium uptake
  http://www.okayama-u.ac.jp/user/kouhou/ebulletin/research_highlights/vol1/highlights_003.html

Research Highlights

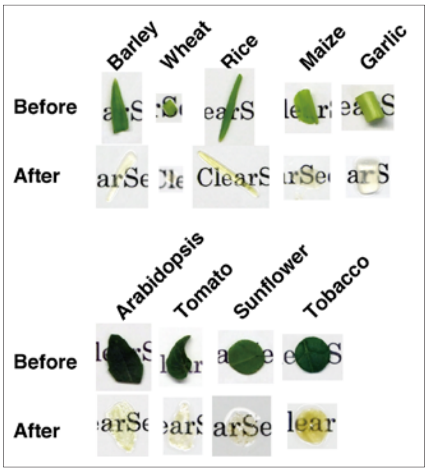
Quick immunohistochemistry with clearing detects epigenetic changes

Epigenetic changes in plant tissues are detected using a comparatively fast immunohistochemical method developed at Okayama University in Japan

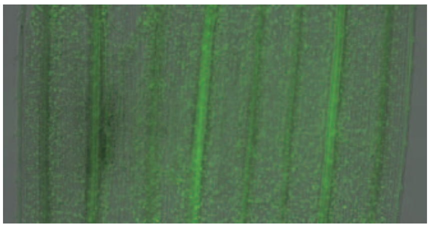
Some inheritable traits stem from changes in how genes are expressed without affecting the DNA sequence, such as modifications to histones, the proteins responsible for ordering DNA into structural units or 'nucleosomes' that fit into cells. Okayama University researchers have now developed a technique that is sensitive enough to detect epigenetic changes while avoiding some of the drawbacks of previous techniques, such as poor sample penetration and lengthy preparation times.

The researchers based their approach on immunohistochemical staining, which uses the selective binding of antigens to specific proteins for imaging. Previous attempts with immunohistochemical staining have met with limited success due to autofluorescence interfering with signals and poor antibody permeability into the cells. One previous attempt successfully removed lipids, colours and cell walls, allowing antibodies access to the cells without errant autofluroescence, but took 7-9 weeks to complete and only proved successful in detecting the most abundant cell protein, which has a far stronger immunosignal than the targeted epigenetic modifications.

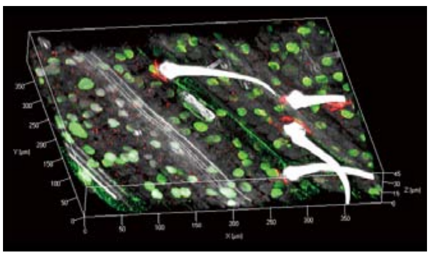
Kiyotaka Nagaki, Naoki Yamaji and Minoru Murata combined the use of enzymes (e) to digest cell walls and aid permeability with 2-propanol (Pro) and a "ClearSee" clearing treatments to make the leaf samples transparent (ePro-ClearSee). They demonstrated the technique on a range of samples including dicot and monocot species as either whole leaves, perforated leaves, cropped disc shapes and strips, identifying pros and cons for the different leaf shapes for different studies.



Clearing of leaves by the ePro-ClearSee method.
Leaves of five monocot and four dicot species were cleared by the ePro-ClearSee method. Leaves before and after clearing are indicated.

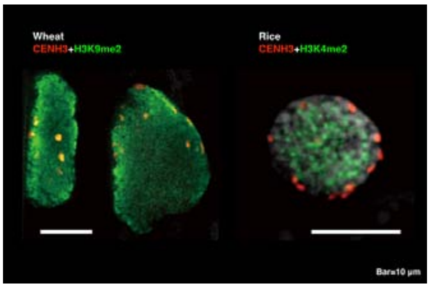


Immunohistochemistry with the ePro-ClearSee method.
Signals of methylated histone (green) were shown on a bright field image of a wheat leaf.



A 3D image of a wheat leaf stained by the ePro-ClearSee method.
Signals of methylated histone (green) and centromere specific histone variant (red) were shown on DAPI stained nuclei (gray).

“ePro-ClearSee method enabled the detection of immunosignals 200 μ m deep in plant tissues without the need for sectioning for a short period of time,” they explain in their report of the technique, concluding that it may be applicable to other types of analysis as well.

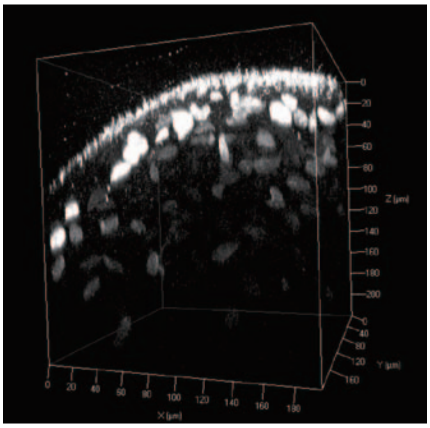


High-resolution analysis of wheat and rice nuclei.
Signals of methylated histone (green) and centromere specific histone variant (red) were shown on DAPI stained nuclei (gray).

Publication and Affiliation

Kiyotaka Nagaki*, Naoki Yamaji and Minoru Murata Investigations into ePro-ClearSee: a simple immunohistochemical method that does not require sectioning of plant samples 2017, *Scientific Reports* **7** 42203

Institute of Plant Science and Resources, Okayama University, Kurashiki 710-0046, Japan.
*Correspondence: nagaki@rib.okayama-u.ac.jp



A immunohistchemical image of a wheat root.
Signals of methylated histone (gray) were shown.

Research Highlights

Growing rice in space: Insights into effect of space environment on seed viability

Successfully sustaining edible plants in space is an important factor for sustaining long-term human habitation in this unique and hostile environment with intense fluctuations in temperature and harmful radiation. Recent research on growing plants in space has highlighted the importance of germination, the stage where seeds grow into plants, with reports of negative effects of the space environment on germination. However, it is still not clear how the space environment effects genes that regulate a plants biological processes during germination. Therefore, understanding the effects of space environment on genes governing germination is expected to give insights into biological mechanisms determining seed viability in space.

Figure 1. Metal containers packing rice seeds. (Photo by NASA)

With this background, Manabu Sugimoto at Okayama University and colleagues compared four groups of rice seeds. Two groups were stored outside the International Space Station (for 13 and 20 months) and the two corresponding groups were stored on Earth. After exposure to space environment, all the groups of rice were germinated on Earth. The researchers designed experiments to determine germination efficiency and variance in genes.

Figure 2. Docking compartment of International Space Station where rice seeds were exposed to outer space. (Photo by NASA).

The researchers found that data from four batches showed that longer exposure of seeds in space yielded to improper and delayed germination. Notably, these seeds also exhibited decrease of long-lived mRNAs. This was an important finding because successful germination requires rapid resumption of metabolic activity.

This research showed that viability of seeds was directly related to the length of time the seeds were exposed to the space environment. Furthermore, optimum germination efficiency was achieved in space by limiting the exposure time of the seeds, where shorter space exposure, led to fewer genetic alterrations in the seeds.

Reference:


Figure 3. Rice seeds stored in space (upper) and on Earth (lower) 5 days after imbibition.

Manabu Sugimoto [a,1], Youko Oono [b,1], Yoshihiro Kawahara [b], Oleg Gusev [c], Masahiko Maekawa [a], Takashi Matsumoto [b], Margarita Levinskikh [d], Vladimir Sychev [d], Natalia Novikova [d], Anatoly Grigoriev [d], Gene expression of rice seeds surviving 13- and 20-month exposure to space environment, *Life Sciences in Space Research* **11**, 10–17, (2016).

http://dx.doi.org/10.1016/j.lssr.2016.10.001

a Institute of Plant Science and Resources, Okayama University, 2-20-1 Chuo, Kurashiki, Okayama 710-0046, Japan

b National Institute of Agrobiological Sciences, 2-1-2 Kannondai, Tsukuba, Ibaraki 305-8602, Japan

c Preventive Medicine & Diagnosis Innovation Program, RIKEN, 2-1 Hirosawa, Wako, Saitama 351-0198, Japan

d Institute of Biomedical Problems of Russian Academy of Sciences, 76a Khorosheevskoe shosse, Moscow 123007, Russia

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Research Highlights

Plants use methionine to respond to environmental stresses

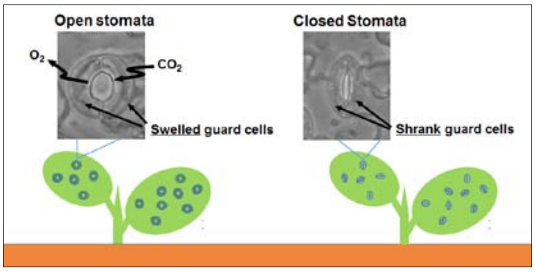

Figure 1:
Stomatal pores are formed by pairs of guard cells, and closing and opening pores are regulated by guard cell volume changes. Stomatal pores are gateways for regulating gas exchange for photosynthesis. When guard cells swell, stomata open. On the other hands, when guard cells shrink, stomata close.

Evidence of the new physiological role of glutamate receptor homologs (GLRs) - plant proteins that share ancestral roots with those in our neural system - has been presented by an international collaboration with researchers at Okayama University.

Neural communication, learning, and regulation processes in humans are mediated by glutamate receptors, a type of protein that responds to an amino acid neurotransmitter, glutamate. It has been known that homologs of the glutamate receptors (GLRs) exist in plants, but the detail functional characterisation remained to be done. Now Drs. Dongdong Kong, Heng Cheng Hu, Eiji Okuma, and collaborators in the US, China, Japan, and Korea have demonstrated for the first time that two types of GLR found in Mouse-ear cress (*Arabidopsis*) - GLR3.1 and GLR3.5 - do form ion channels as animal glutamate receptors, - but they respond to methionine, instead of glutamate.

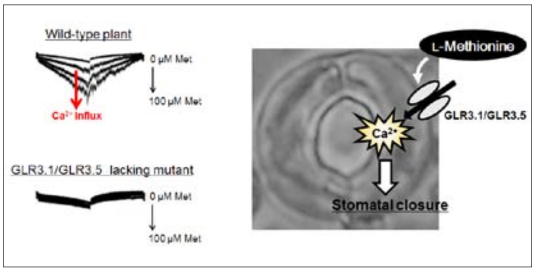

Figure 2 :
(Left) Methionine induces Ca^{2+} influx channel activation in wild-type plants (upper trace) but not in the mutant lacking GLR3.1/GLR3.5 (Lower trace).
(Right) A simplified model indicating the role of GLR3.1/3.5 Ca^{2+} channel and methionine to trigger stomatal closure in *Arabidopsis* plants.

Calcium ion is known to be crucial in the opening and closing of tiny pores on leaf surface, called stomata, which regulate gas exchange for photosynthesis. Kong, Hu, Okuma et al. found that GLR3.1 and GLR3.5 function as methionine-activated calcium ion influx channels that regulate stomatal closure response. They found that Arabidopsis mutant plants lacking GLR3.1 and GLR3.5 showed impairment of methionine-triggered calcium ion currents and stomatal closing. These results identified the new role of methionine as a regulator in plant stress responses.

Previous studies had revealed that reactive oxygen species (ROS) function as second messengers in regulation of stomatal closure. Kong, Hu, Okuma et al. provided evidences that GLR3.1 and GLR3.5 calcium ion channels act independently and upstream of ROS. The authors conclude, "it will be of interest to explore the potential interplay and intrinsic characteristics between the redox-sensitive signalling pathways and the GLR3.1/3.5 channel-mediated Ca^{2+} signalling pathway in plants."

Publication and Affiliation

Dongdong Kong [1,2,3,9], Heng-Cheng Hu [1,9,10], Eiji Okuma [4,9], Yuree Lee [5,9], Hui Sun Lee [6], Shintaro Munemasa [4], Daeshik Cho [1], Chuanli Ju [7], Leah Pedoeim [1], Barbara Rodriguez [1], Juan Wang [7], Wonpil Im [6], Yoshiyuki Murata [4], Zhen-Ming Pei [2], and June M. Kwak [5,8,11,*], L-Met activates Arabidopsis GLR Ca^{2+} channels upstream of ROS production and regulates stomatal movement. 2016, *Cell Reports* **17**, 2553–2561

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■ Topics : Okayama Travelogue

Nagi Museum of Contemporary Art

The Nagi Museum of Contemporary Art—also known as 'Nagi MOCA'—was created in 1994 by internationally renowned architect Arata Isozaki based on a collaboration with artists. The Nagi MOCA is the world's first 'site specific arts museum', consisting of fusion of ideas of art and architecture, with huge exhibits produced by artists that are too large to house in ordinary galleries of arts museums.

The construction of the Nagi Museum of Contemporary Art showed that architects and artists could collaborate to create museums, and is the first arts museum in the world to be become a public facility.

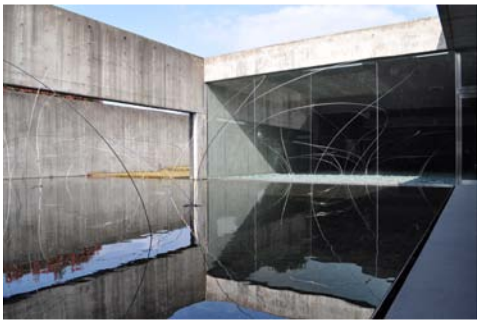
The museum stands at the foot of Mount Nagi and has three exhibition rooms: Shusaku Arakawa building is called "Sun", the Kazuo Okazaki building is "Moon", and the Aiko Miyawaki building is called "Earth". Each building is represented symbolically.

In addition to the permanent work exhibition room, the museum also has a gallery and municipal library. The gallery is used to hold workshops, cafe talks, and mainly exhibitions of contemporary art, as well as musical and dance events both inside and outside the building.


Exterior of the main buildings.


Exhibition room "Sun". Shusaku Arakawa and Madeline Gins


Exhibition room "Moon". Kazuo Okazaki


Exhibition room "Earth". Aiko Miyawaki

Further information

Architect Arata Isozaki
https://matome.naver.jp/odai/2142822203394831501

Website
http://www.town.nagi.okayama.jp/moca/index.html