Hokkaido University Times

Hokkaido University's E-Newsletter

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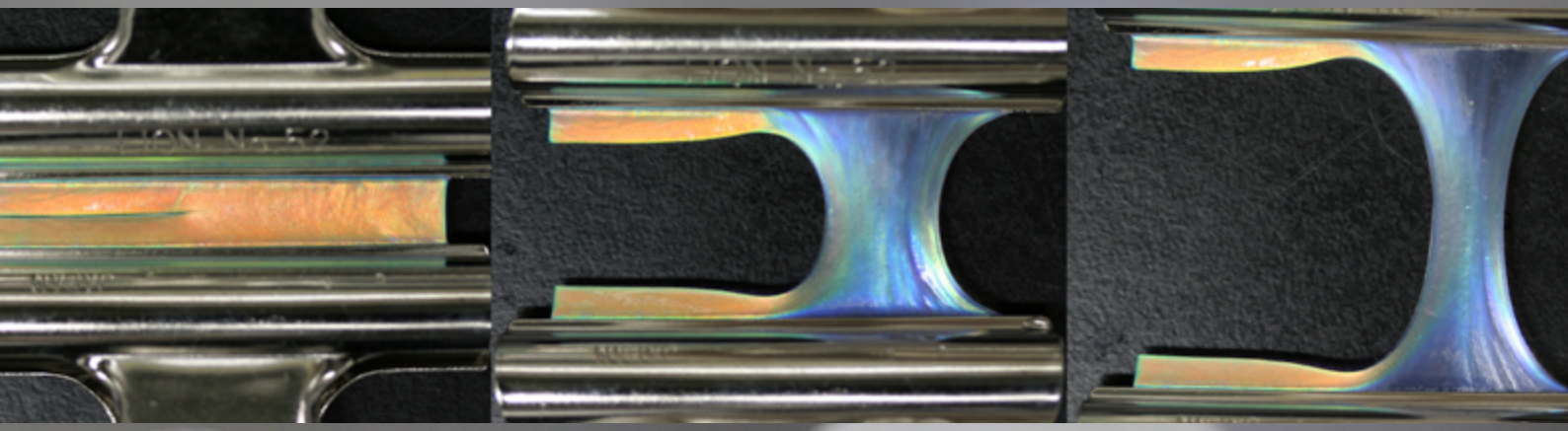
Cover photo:
#HokudaiSnowFes winning photo by Vivek Shilimkar, Graduate School of Environmental Science

March 2018 | Issue 5

Focus on Soft Matter



Division of Soft Matter to be established

The Graduate School of Life Science at Hokkaido University will formally establish the Division of Soft Matter in April 2018. This division is a development stemming from the university's Global Station for Soft Matter, which was established in April 2016 to further the development of soft matter.

The study of soft matter, an up-and-coming interdisciplinary field, refers to study of soft substances such as polymers, gels, and biological materials that can be used for a wide range of applications, from the creation of artificial tissues to tough rubbers for industry. Soft matter has already revolutionized industries, for example through the creation of liquid crystals used in LCDs, and Hokkaido University will act as a leading institution in the education and research of the field.

Master's and PhD students of the Division of Soft Matter will receive interdisciplinary training in physics, chemistry, biology and applied science. The division will be composed of five laboratories: Soft Matter Materials Science, Biomolecular Soft Matter, Soft Matter Biophysics, Soft Matter Medical Science, and Functional Soft Matter.

We are very excited to see the study of these materials being facilitated at the university, and look forward to research breakthroughs to come.

Tackling Global Issues vol. 1

Soft Matter: Material of the Future

The university's research magazine series named "Tackling Global Issues" was published online on March 23rd. This magazine series focuses on research contributing to the resolution of global issues such as an aging society, environmental pollution and resource shortages.

This first issue spotlights the research field of soft matter, an interdisciplinary

field attracting attention from chemists, physicists, biologists and engineers. We introduce 11 researchers mainly based within the university's Global Station of Soft Matter. It also includes a roundtable talk by globally prominent experts in soft matter science and 2 contributed articles.

We hope the readers of this magazine will gain insight into how Hokkaido University is striving to solve global issues by promoting joint research that transcends the boundaries of nations and academic fields. Spearheading soft matter research is a mighty challenge, but scientists are striving for goals and innovation in this field.

Please have a read and spread the word!

Ambassador and Partner activities in Europe

On March 2nd, the inaugural meeting for the Hokkaido University (HU) Alumni Association of Europe and Appointment Ceremony for the HU Ambassador and Partner System was held at the University of Helsinki in Finland. The appointment ceremony celebrated two new HU Ambassadors, Prof. Bakhtiyor Anvarovich Islamov (Tashkent State Economic University, Uzbekistan) and Prof. Gulmira Sultangalieva (Head of the Department of World History, al-Farabi Kazakh National University, Kazakhstan).

Approval to establish the "Hokkaido University European Alumni Association" was also received during the meeting. Prof. Erich J Windhab (ETH Zurich) was appointed as President and Prof. Yasushi Takeda (HU Professor Emeritus, ETH Zurich) as Vice President, both of whom are HU Ambassadors.

The university set up the "HU ELM Association" in 2016, a community consisting of not only HU alumni, but also current and past staff, parents of students, collaborating researchers, and everybody with relations to HU. We think it is important to make connections with HU stronger, especially now that we have organized an alumni association that covers Europe.

STSI kick-off events held at Hokkaido University

On January 11th and 12th, 2018, eight faculty members from the Indian Institute of Technology Hyderabad, Bombay and Madras visited Hokkaido University to attend events to kick-off the STSI Program, which stands for International Research Skills Program for Developing Sustainable Transportation System and Infrastructure. The program was selected earlier this fiscal year as one of the Inter-University Exchange Projects to receive a grant from MEXT for the next five years. It is designed to contribute to the development of human resources capable of engaging in collaborative research between Japan and India to assist in the development of sustainable transportation and infrastructures.

The 1st STSI International Steering Committee Meeting was held on January 11th. The meeting was accompanied by enthusiastic discussions which continued from early in the morning into lunchtime. These discussions helped spark the possibility of further educational and research collaborations between Hokkaido University and IIT-Hyderabad, Bombay, Madras in the coming years. After the meeting, the delegates paid a courtesy visit to President Toyoharu Nawa.

The following day on January 12th, around 45 people participated in the 1st STSI Symposium, which began with an opening address from President Nawa at the Frontier Research in Applied Sciences Building. Prof. Yukinori Kobayashi, Dean of the Graduate School of Engineering and the program director, then made the keynote speech. After which, Prof. Takashi Matsumoto from Hokkaido University, Prof. Ch. Subrahmanyam from IIT Hyderabad, Prof. K.V. Krishna Rao from IIT Bombay and Prof. Amit Kumar from IIT Madras gave presentations on research relevant to the program.

In the afternoon, a STSI basic trial course was provided for both the students who attended the event and IIT students via a TV conference system. The students learned about each other's universities, issues related to infrastructure, and received an introduction to the languages and cultures in Japan and India. It was a good start for them to prepare for their internships in February and March.

STSI

International Research Skills Program for Developing Sustainable Transportation System and Infrastructure

Introducing five new overseas offices

These past couple of months have seen the opening of four new Hokkaido University liaison offices and an overseas office made possible via international collaborations in Asia. These offices act as a base for prospective students to receive information and assistance about entrance examinations and other matters related to enrollment and life in Japan. They also offer support for former international students through alumni association activities and collaborate with other universities to establish partnerships. Hokkaido University faculty members can also utilize these offices for their research.

Hokkaido University has an active Indonesian community, and to address this the opening ceremony of the liaison office in Indonesia (bottom-left) was held at Bogor Agricultural University on January 23rd. One month later, the grand opening ceremony for our liaison office in Thailand (top-right), located at Kasetsart University, was held on February 27th. And following this, the liaison office in the Philippines at the University of the Philippines Diliman (bottom-right) was opened on March 6th. Two offices in China were just opened on March 25th, as the liaison office in Beijing China at the University of Chinese Academy of Sciences and the China Office in Beijing at the Study in Japan Information Center (top-left).

Please click here for more information on our overseas satellite offices.

Spotlight on Research

Exploring the ecological effects of climate change

Say it's summertime, comfortably warm, and we are seated next to a window under the sun's rays. If it were too become a bit too hot, we may decide to stay in the same position but do something to improve the conditions: close the window blinds or turn on the air conditioner for example. Now, if the heat were too extreme, we would probably opt for moving to a different location. This analogy can be applied to all living organisms.

Physiology shows us that every species can live within a certain range of environmental conditions. They perform their best within an optimal range, outside which they begin to have problems. To some extent, species can compensate for these negative effects using adaptive mechanisms such as by modifying their behavior or the timing of biological processes (e.g. earlier blossom of trees). However, if conditions continue to deteriorate, they would eventually reach a point at which they cease to exist at that location. The opposite situation is also possible. A species can colonize previously unsuitable locations that have become suitable. The combination of these opposing processes results in distribution changes that alter biodiversity patterns, species interactions and ultimately the way ecosystems function.

Assistant Professor Jorge Garcia Molinos of Hokkaido University's Arctic Research Center looks at climate change and other human-caused environmental impacts, as well as how these changes alter biodiversity and ecosystems. An important part of this research is performed via computer-based modelling and simulations using big data; this is complemented with field sampling and experiments. For example, Dr. Garcia Molinos is planning to start utilizing mesocosms, small controlled outdoor chamber experiments, at the university's Tomakomai Experimental Forest to test the combined effect of climate change and other impacts, such as habitat degradation and pollution, on freshwater streams.

One of Dr. Garcia Molinos' current projects involves studying the role of management strategies in mitigating the future global impact of climate change on commercial fisheries. As part of an international team of researchers led by Prof. Steven D. Gaines (University of California – Santa Barbara), he simulates scenarios to estimate the extent to which management can compensate

for changes in the productivity and geographical distribution of over 900 global stocks. This will provide insight into how we can effectively manage fisheries. For example, movements of fisheries to different locations, specifically when they cross territorial waters, create complications on an international scale, calling for international cooperation and management. Without these, countries from which the stock is disappearing may lean towards overexploitation, while countries which the stock is moving into may not have regulations in place to manage the exploitation of these resources.

"The results are showing that proactive decision making and adaptive management, which takes into consideration the effects of climate change , can lead to overall healthier fisheries than we have today—and that's good news." Dr. Garcia Molinos commented.

In another study, Dr. Garcia Molinos zooms in closer to the corals, seaweeds and fish surrounding Japan. Together with colleagues from Hokkaido University and the National Institute of Environmental Studies, they are using historical data sets to study changes in relation to climate change. The purpose is to analyze the role of ocean warming and surface currents in explaining the ongoing expansion of tropical corals into temperate coastal waters where they are progressively outcompeting species of seaweed stressed under the warmer conditions. While the expansion of tropical corals is good news in itself because these species are increasingly at risk from climate change in their home waters, seaweeds are very important resources for food production in Japan, not to mention their role in protecting the coast and regulating CO_2 levels.

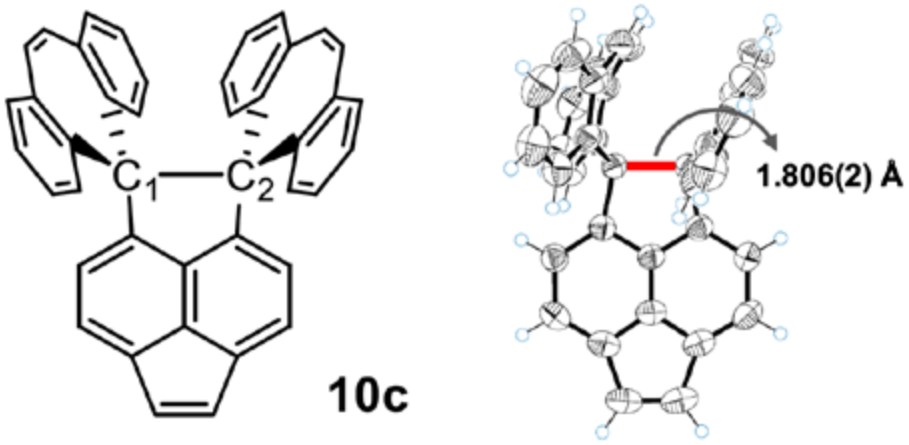
Although many of us are aware of climate change and understand that it is a problem, we may not necessarily act like it is a problem in our daily lives. Dr. Garcia Molinos hopes his research can help breach this gap and demonstrate the practical consequences of human-caused environmental impacts to the general public: "If you say a species is going to disappear, unless it's something emblematic like the panda, many people won't give it a second thought. But, if you say when this species disappears there will be consequences to our daily life, such as altering our diet, maybe people will start thinking about these problems more carefully."

Researcher Details:
Assist. Prof. Jorge Garcia Molinos
Arctic Research Center
Satellite Observation and Modeling Research Group
jorgemolinos@arc.hokudai.ac.jp

Author:
Dr. Katrina-Kay Alaimo

Photographs: Warming is facilitating the expansion of tropical corals (top) into temperate coastal waters in Japan, where they are displacing local seaweeds (bottom), many of which, adapted to colder temperatures, are retreating northwards (Credit: Naoki Kumagai).

New record set for carbon-carbon single bond



Chemical structure of the compound which showed the longest C–C bond.

A stable organic compound has been synthesized with a record length for the bond between its carbon atoms, exceeding the assumed limit.

Hokkaido University researchers have synthesized an organic compound with a longer bond between carbon atoms than ever before—exceeding the assumed limit for carbon–carbon single bond (C–C) lengths. The researchers termed it a "hyper covalent bond."

The novel polycyclic hydrocarbon named 10c is stable, and an X-ray analysis showed that its C–C bond lengths was as long as 1.806 angstroms, longer than the previously reported world records for hydrocarbons.

Chemical bonds are formed between atoms by the transfer or sharing of electrons. Bonds become shorter the more electrons they have participating in their formation. Also, the longer the bond, the weaker it becomes. In such chemical bonds, the C–C single bond length is generally 1.54 angstroms, and altering C–C bond lengths can give organic compounds unique properties.

Previously, other researchers had estimated that the strength of C–C bonds becomes zero, making them completely unstable, when they reach a theoretical limit of 1.803 angstroms in length. But this calculation assumes a linear relationship between bond strength and length.

Yusuke Ishigaki and Takanori Suzuki of Hokkaido University and their team thought it was highly likely they could find a longer C–C bond due to evidence that the relationship between bond strength and length is actually non-linear.

By using what they call a "core-shell strategy," the team first built a theoretical compound in which the core, formed of long and thus weak carbon bonds, was stabilized by an outer shell of fused rings of the organic compound dibenzocycloheptatriene. Changing the structure of the side shell, for example by the bridging or non-bridging of the naphthalene skeleton, can lengthen the distance between the C–C bonds at the core.

The team then synthesized two compounds formed of colorless crystals, which they called 10a and 10b, and a third, called 10c, formed of orange crystals. X-ray analyses indicated long C–C bond lengths in all three compounds, with those in 10c reaching a record length of 1.806 angstroms when heated up to 127C (260.6F).

Although the longest bond was assumed to be unstable, the compound did not degrade even in a solution heated to high temperatures. This stability was supposedly given by the shells protecting the bond.

"By applying 'core-shell strategy' in molecular design, it is highly likely that we could find an even longer C–C bond," says Yusuke Ishigaki. "It's not just about breaking records, it's more about examining the fundamentals of chemistry." The study was published in the Cell Press journal Chem on March 8.

Read the original press release.

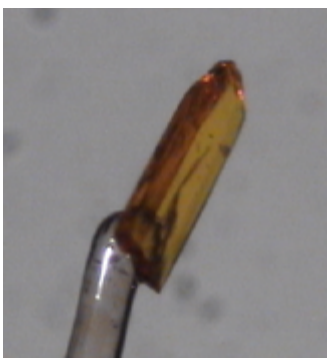


Image of the 10c crystal

ANTS: master manipulators for biodiversity, or sweet treats

Photo by Ryota Kawauchiya

Symbiotic ants manipulate aphid reproduction rates to achieve a specific mix of green and red aphids, maintaining the inferior green aphids which produce the ants' favorite snack.

Ants and aphids coexist in a symbiotic relationship that benefits both species. Ants protect aphids from predators, such as lady bugs and wasps, and aphids secrete nutritious honeydew for ants to eat.

The aphid species *Macrosiphoniella yomogicola* comes in two "morphs" with distinct colors: red and green. When there is more than one physical trait of the same species, it is called polymorphism. Typically, competition for survival would lead to one morph dominating and the others disappearing from the gene pool. However, this rule can be broken in a few circumstances, including if an ant benefits from maintaining a mixture of color morphs.

Previously, Associate Professor Eisuke Hasegawa of Hokkaido University and his colleagues had determined that *Lasius japonicus* ants prefer the nutrient-rich honeydew produced by green morphs. They also found that ants were most attracted to and most vigorously protected colonies with 65% green and 35% red aphids.

In a new study published in the journal *Scientific Reports*, Hasegawa and his students, including Saori Watanabe, investigated how population growth of aphid morphs differs with or without the presence of ants. They found that ants actively manipulate morph populations by improving the reproduction rate of the inferior morph.

In field experiments without the ants' presence, the red morphs had a much higher and superior reproduction rate than green morphs. Thus, red aphids should dominate. However, when ants were introduced to the experiment, the green morph reproduction rate equalized with the red morphs.
The experimental evidence matches what researchers find in the wild: red and green morphs coexisting on the same plant shoots attended by ants.

What remains a mystery is this: if the ants prefer the green morphs' honeydew, why keep the red morphs around at all? Hasegawa explains, "We theorize that the red morphs are able to provide a benefit that the green morphs can't, such as suppressing the development of lower buds on host plants. This might help both the red and green aphids survive and reproduce throughout more of the year, which could maximize long-term harvest of honey-dew from the green aphids."

"In this case, the ants invest in a future benefit by sacrificing the present benefit," the researchers hypothesize. They plan to test this hypothesis next.

Read the original press release.

#HOKUDAISNOWFES

Hokkaido University's Snowman Building Photo Contest

From January 21st to February 4th, the university held a snowman photo contest called HokudaiSnowFes! The Top 5 photographs can be seen below. 1st place received 5,000 yen in gifts cards for the University Co-op, and 1st to 5th place copies of a HokudaiSnowFes calendar. Thank you to everyone who participated! We were really impressed with all of the snowmen that were made, and look forward to hosting the event again next year.

Follow us on:

Editor: Katrina-Kay Alaimo, PhD.
Hokkaido University (https://www.global.hokudai.ac.jp/)
Kita 8, Nishi 5, Kita-ku, Sapporo 060-0808

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