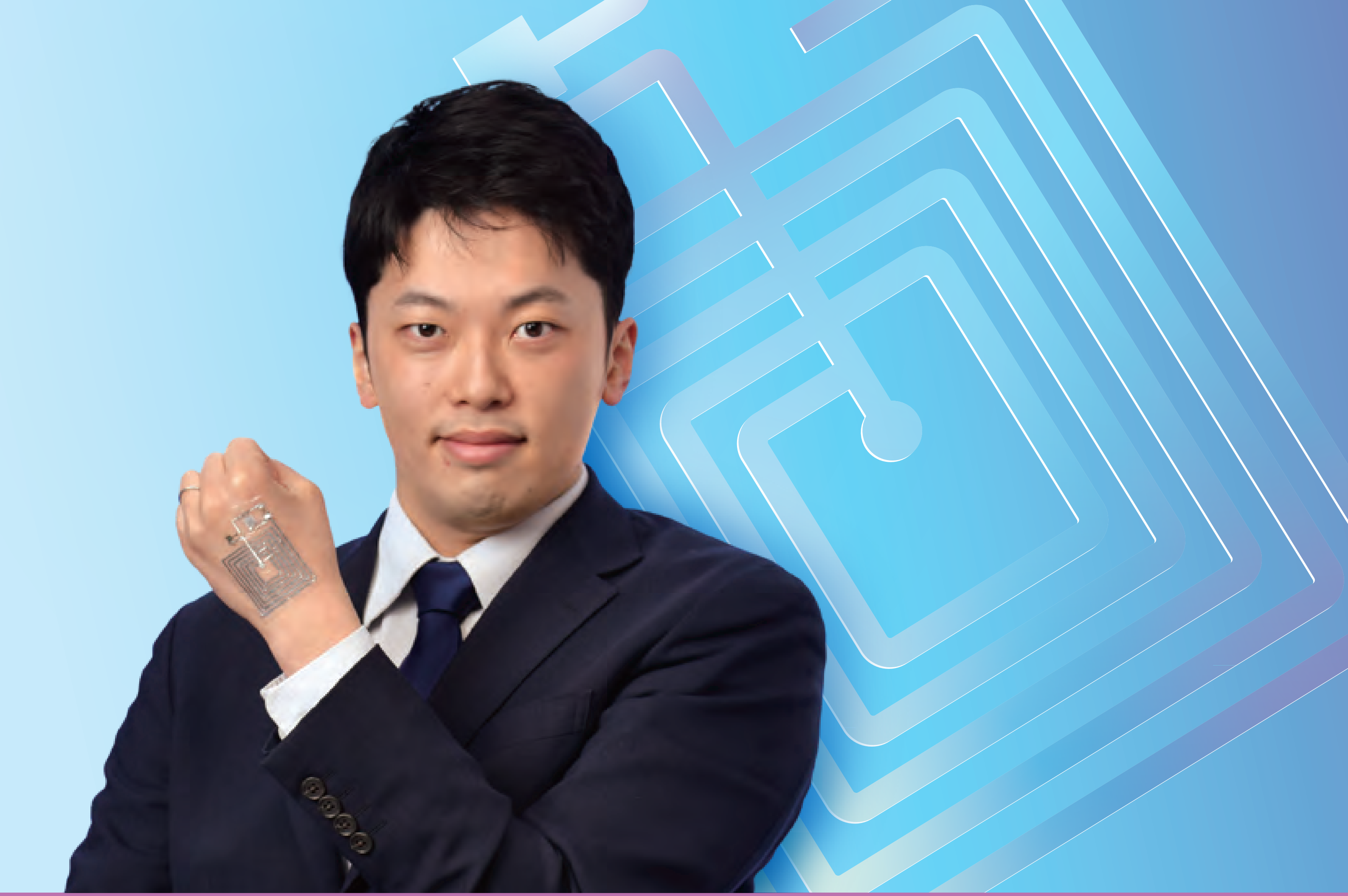
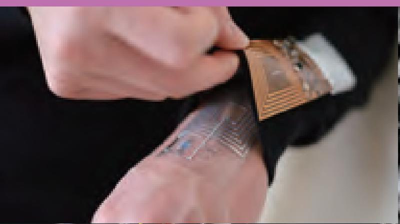
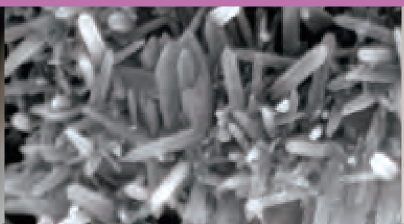
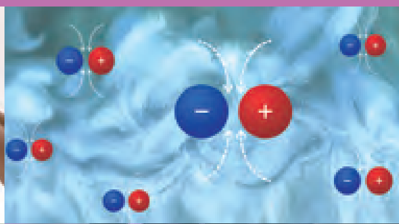


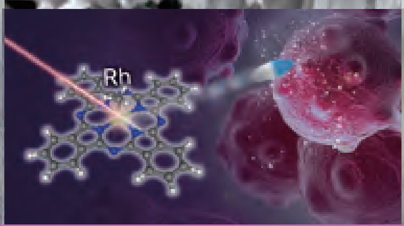
UTokyo-IIS Bulletin

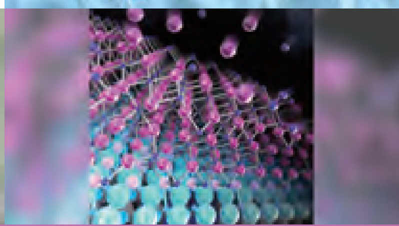
Vol.11 April 2023

Institute of Industrial Science, The University of Tokyo





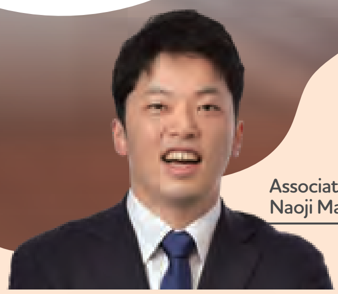



東京大学生産技術研究所
Institute of Industrial Science, The University of Tokyo

Developing

A Young Frontrunner Defying

Our lives are surrounded by several electronic devices, such as smartphones, PCs, and dazzling digital billboards. Most people do not question the conventional school of thought that such devices are meant to be rigid. However, Associate Professor Naoji Matsuhisa of UTokyo-IIS has challenged this thought and seeks to develop soft and stretchable electronics.



Associate Professor
Naoji Matsuhisa

A Future Forged by Soft Wearable Devices

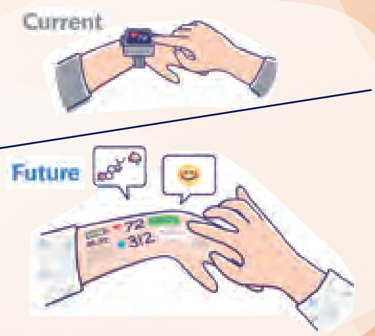
Wearable devices have gained a lot of attention as extended applications of flexible electronics.

Currently, wearable devices such as smart watches are becoming increasingly popular. Data that could only be obtained once a week or once a month previously, can now be obtained 24 hours a day. The obtained data can facilitate the detection of diseases such as atrial fibrillation and Alzheimer's disease at early stages with high accuracy. However, as the benefits of wearable devices are becoming increasingly apparent, so too is a major barrier to their adoption, i.e., their "rigidity." There are only a limited number of locations on the body where rigid devices can be placed, such as the wrists, fingers, and ears. Furthermore, many people may feel uncomfortable wearing such devices.

A soft wearable device that has the same mechanical properties as that of the skin, can stick to the body surface, significantly reducing discomfort. It is expected that even those who struggle to understand the implications of wearing such devices, such as babies and people with dementia, will be able to wear them without discomfort.

Another key advantage is improved adhesion to the skin, which can dramatically improve the quality of the bio-signals that the device acquires. Soft electronic devices can conform to small wrinkles of the skin, resulting in a large contacting surface area between the device and the skin. A larger contact area results in a stronger adhesive force, which in turn increases the device's ability to track the movements of the skin surface. This will significantly reduce the signal noise caused by exercise and other activities.

The COVID-19 pandemic has stressed, yet again, the importance of at-home medical care. As the population continues to age, it is expected that the number of people who will have difficulties visiting medical institutions will also increase. This will also increase the number of locations where medical care cannot be secured. Hence, soft wearable devices are expected to become increasingly important in the future, as the demand for high-precision healthcare monitoring and reduced burden on medical staff increases.



Progressive Utilization in the Field of Robotics

Stretchable electronics will potentially also play an active role in the field of robotics.

Soft robots are new types of robots that are mechanically as soft as humans or animals. This kind of technology may also play a significant role at disaster sites. Unlike factory robots that handle parts with a fixed shape, robots at disaster sites require adaptable responses, such as grabbing debris and waste, turning valves and levers, or lifting injured people. Arms made of soft and stretchable materials are able to grab objects adaptively and gently. The installation of a soft sensor on the robotic hand surface will enable the robot to determine the hardness and the texture of the object that needs to be grabbed. This will allow it to gauge important information, such as the amount of grip strength required.

Reference

Tokihiko Shimura, Shun Sato, Peter Zalar and Naoji Matsuhisa
"Engineering the Comfort-of-Wear for Next Generation Wearables"
Advanced Electronic Materials **(2022), DOI: 10.1002/aelm.202200512**

Further information

Matsuhisa Laboratory
https://www.naojimatsuhisa.com/

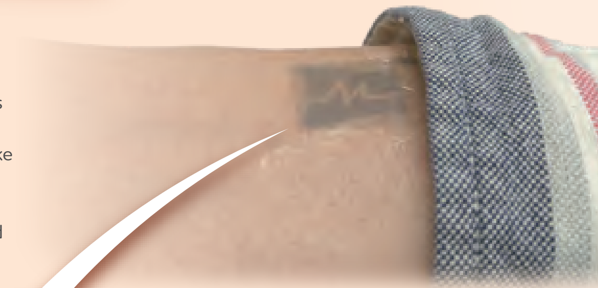
Soft Electronics

Conventional Notions in The Field of Electronics

Revolutionizing How Electronics and Humans Connect

Associate Professor Matsuhisa is also exploring novel ways to bring joy to people using soft electronic devices. "We are currently developing a display that adheres to the skin, which we think can be used for applications such as digital makeup. It will have the ability to automatically adjust its color according to the brightness of its surroundings, or create facial expressions, such as when one is nervous. We are unsure if it will be useful, but we hope that people will find it amusing. If we actually succeed in attaching these devices, high-performance biosensors can be installed together. Such devices can obtain high-accuracy biometric information and lead to social impact on a large scale."

Associate Professor Matsuhisa has indicated that soft electronics, which defy the conventional idea that electronics must be hard, have the potential to change the very way that people view electronics. "For example, people may feel like hugging stuffed animals because they are soft, but they may not feel the same way toward a hard PC. People perceive rigid devices to be cold and non-living and cannot help but consider them as foreign objects. However, we believe that when electronic devices become soft, just like living things, then we will develop a sense of familiarity toward them, just like we do toward stuffed toys. We believe that such feelings will change our relationship with computers, how we connect with electronics, and how we think about the data obtained from electronics."



A display that adheres to skin wrinkles (under development). The color becomes darker when the power supply is turned on.

Wide-Ranging Research, from Basic to Applied Research: Forging the Future of Stretchable Electronics

Due to the collaborative research he has conducted with researchers across various fields, Associate Professor Matsuhisa has presented a variety of results that are not limited to a single field. What he prioritizes most in collaborative research is for his collaborators to feel a mutual bond and sense of connectedness with each other.

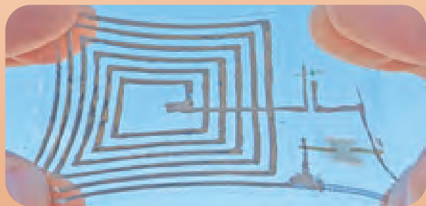
"I feel that a strong human bond and the desire to conduct research specifically with another person leads to great results. When I was a post-doctoral researcher at Stanford University, I became good friends with a battery researcher at a house party. The joint research we conducted afterwards led to research on stretchable lithium-ion batteries."

Associate Professor Matsuhisa conducts a variety of research that ranges from the development of basic materials to the construction of devices with full-scale practical applications. The following are research topics that he is currently working on.

"Semiconductors are usually hard silicon materials, but flexible semiconductors have recently been put to practical use. Ever since then, we have developed next-generation semiconductors that are stretchable, and are focusing on the development of electronic devices that utilize these semiconductors.

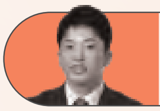
"Another topic is the development of electronic devices that one would not even perceive upon seeing or touching. We are applying a special fabrication process that integrates with the skin to create a device that feels like it isn't there but is actually there."

Associate Professor Matsuhisa's policy is to use any material as long as it stretches. He spoke about his desire to further develop stretchable electronics. He adds, "For example, inorganic materials are highly stable, but not soft. Meanwhile, organic materials have limited stability. Achieving stretchable electronics requires using the right materials in the right place. Hence, we would be interested in using a variety of materials."

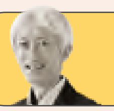


Flexible wireless sensor and display system

Short Dialogue



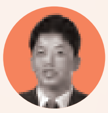
Associate Professsor Matsuhisa ×



Professsor Tatsuma

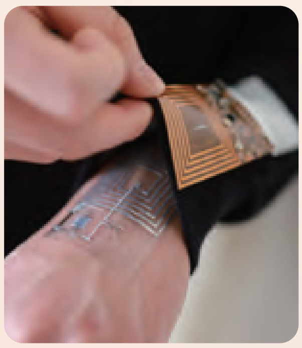
▶ P4-5

I think that a wonderful aspect of this research is that it is not only interesting, but also useful.
In our laboratory, we are conducting research on translucent solar cells, photodetectors, and quantum dot LED displays.
It would be interesting to add flexibility to such devices in the future too.



That is exactly one of the research themes that we are working on currently.
I believe that there are various methods to achieve this, such as mixing soft organic materials with inorganic quantum dots.

If the variety of materials used increases, so too will the range of their applications.
We are always happy to provide the metal and semiconductor nanoparticles that we are currently developing, if they will be useful.



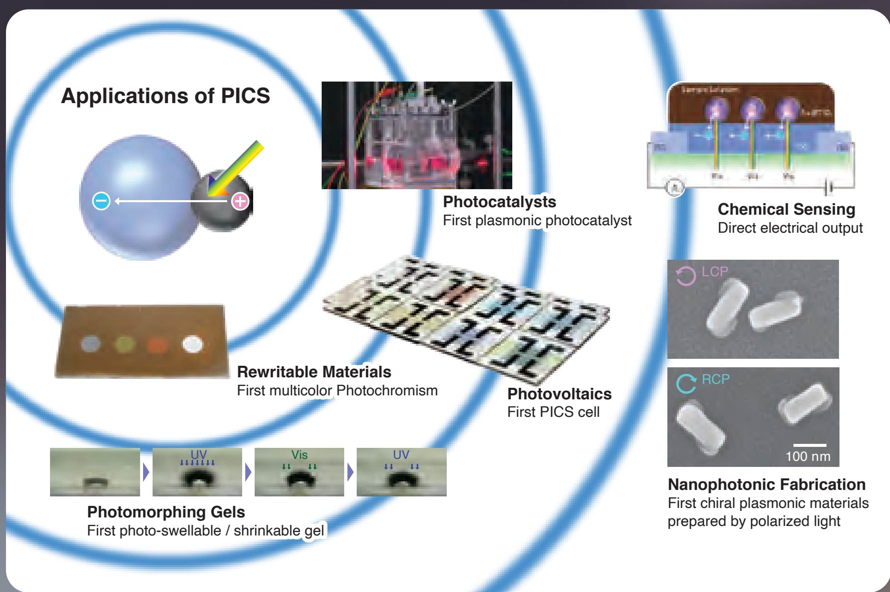
Mastering Light Manipulation through Nanomaterials

Advancing Photonic Science and Technology Through the Discovery of Novel Interactions Between Nanoparticles and Light

Japan is one of the world leaders in materials science—an area of research that integrates knowledge from various disciplines, including chemistry and physics, to design, develop, and evaluate new materials that contribute to society. The country has made invaluable contributions toward photocatalysts, carbon fibers, carbon nanotubes, and blue LEDs, all of which are widely used materials in our daily lives. Our institute—UTokyo-IIS—has also contributed significantly toward such developments.
One of the core techniques in modern materials science is the ability to control substances at the nanoscale. At our institute, Professor Tetsu Tatsuma is conducting research aimed at developing nanomaterials with unprecedented functions.

Plasmon-Induced Charge Separation Transfers Electrons from Nanoparticles to Semiconductors

Prof. Tatsuma focuses on the ability to manipulate light at will. A variety of functions can be realized by controlling and utilizing the interaction between light and nanostructures.
Prof. Tatsuma mainly deals with very small metal particles, called metal nanoparticles, which are less than 100 nm in size. These metal nanoparticles are smaller than the wavelength of visible light (approximately 380 nm to 750 nm). Light is a type of electromagnetic wave, and it propagates through space as a vibration of electric and magnetic fields. When light hits metal, it is typically reflected by the metal's free electrons. However, metal nanoparticles absorb light owing to a phenomenon called "plasmon resonance," whereby the oscillation of the free electrons in the metal nanoparticles resonates with the oscillation of the light's electric field. Depending on the size and shape of the nanoparticle, different wavelengths of light can resonate. This is similar to how violins produce high-pitched (short-wavelength) sounds, whereas double basses produce low-pitched (long-wavelength) sounds. This means that it is possible to create nanoparticles that resonate with specific colors of light by controlling their size and shape.
In 2003, Prof. Tatsuma's group discovered a new phenomenon involving plasmon resonance. It was found that upon combining metal nanoparticles with semiconductors, plasmon resonance causes electron transfer from the nanoparticles to the semiconductor, resulting in the separation of positive and negative charges. This phenomenon was named "plasmon-induced charge separation" (PICS) by Prof. Tatsuma, who continues to study the mechanism and its potential applications.



Reference "Polarized Light: A Simple Route to Highly Chiral Materials" **https://www.iis.u-tokyo.ac.jp/en/news/2896/**

Further information Tatsuma Group **http://www.iis.u-tokyo.ac.jp/~tatsuma/**

Development of Solar Cells and Photocatalysts with Novel Operating Mechanisms

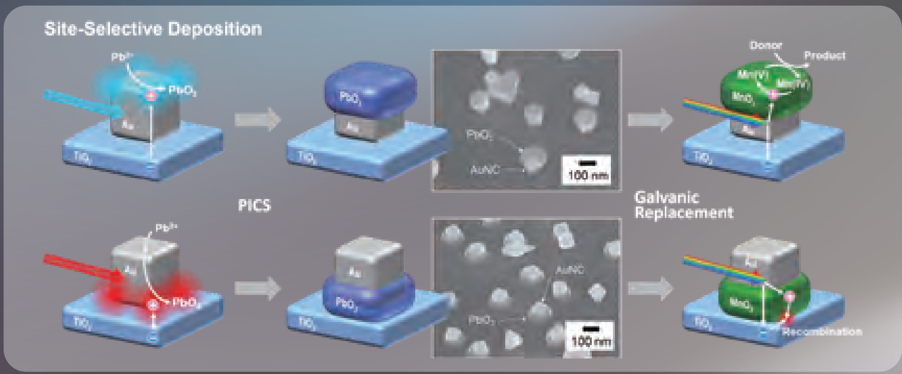
One of the main applications of PICS is photocatalysis. Photocatalysts are materials that can trigger chemical reactions using energy from light. This concept is based on a phenomenon discovered at our institute by the distinguished Prof. Akira Fujishima of the University of Tokyo. Currently, many practical photocatalysts use titanium dioxide. However, this material can only absorb ultraviolet light. Metal nanoparticles could allow the utilization of various other wavelengths of light for photocatalysis.
Essentially, PICS uses light energy to separate positive and negative charges, thereby allowing the induction of oxidation and reduction reactions, respectively, using visible light. Additionally, if these positive and negative charges are collected separately, they can be converted into electricity. Prof. Tatsuma and his team have already combined gold or silver nanoparticles with semiconductors such as titanium dioxide to develop "plasmon photocatalysts," solar cells, and photodetectors, thereby laying the foundation for various applications.

Creating Complex Nanomaterials from the Bottom Up

PICs can further be used to create intricate nanostructures. In conventional light-based processing, there is a limitation called the "diffraction limit," which prevents the manipulation of features smaller than the wavelength of light. However, by using plasmon resonance, light can be confined as "optical near-field," around particles smaller than the wavelength of light. Optical near-field is similar to light, but it does not propagate and is present around the surface of an object at a distance of less than one wavelength of light.
For example, when silver nanocubes are placed on titanium dioxide and illuminated with light of a specific wavelength, their position can be selected such that the optical near-field is confined. When positive and negative charges are separated at the confined position, the positive charges can be used to induce oxidation reactions. In this manner, metal oxides can be attached to specific positions by oxidizing metal ions in a solution. By placing metal oxides that promote chemical reactions at advantageous positions, we can improve the efficiency and selectivity of plasmon photocatalysts.

The technique of creating nanostructures by stacking atoms or molecules through chemical synthesis is called the bottom-up method. Currently, the most widely used nanofabrication techniques are top-down methods, which involve processing large materials to create the desired nanomaterial. However, such methods require large and expensive equipment, resulting in significant costs, time, and energy consumption.

Discussing the advantages of the bottom-up method, Prof. Tatsuma says, "Top-down methods require high cost and energy, and it is difficult to achieve fine and complex three-dimensional structures beyond the diffraction limit. Using the bottom-up approach, we can achieve low-cost fabrication of nanoscale three-dimensional structures, making mass production much easier."

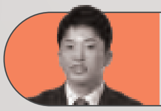


Yearning to Discover Applications Unique to Each Phenomenon

Prof. Tatsuma has collaborated with many universities and companies through joint research. He believes that collaborations are not only a shortcut to practical applications and commercialization but also an opportunity to understand one's role in research and academia.
Tatsuma spoke about his motivation for research, saying, "Rather than taking it upon ourselves to produce practical applications, I believe that it is our job to find new phenomena and elucidate the mechanisms behind them to pave the way for applications. I yearn to discover new materials and find applications unique to these phenomena."
Prof. Tatsuma expects that nanomaterials capable of controlling light will have potential applications in the future as metamaterials. Metamaterials are materials with properties beyond those found in natural materials, such as the ability to control light freely. They have drawn attention as a technology that can lead to ultra-high-resolution lenses, glasses that overlay artificial images on actual views, and transparent spaceships that appear in science fiction, among others. Although the use of metamaterials to control visible light, which has a relatively short wavelength as compared to other electromagnetic waves, is difficult at present, the goal of discovering potential applications is what drives Prof. Tatsuma. His efforts aim to create nanomaterials that interact more strongly with light by utilizing the interaction between visible light and metal nanoparticles and connecting them to metamaterials.
Prof. Tatsuma shares his aspirations for the future, stating, "It may take time to bring metamaterials to practical fruition, but I am, nevertheless, committed to continuing my research while I determine the most effective path forward to ensure that my research will lead to such new technologies."

Short Dialogue


Professsor Tatsuma


Associate Professsor Matsuhisa ▶P2-3


Nowadays, smartphones are equipped with highly advanced cameras.
We could use them to create a practical ultra-high-sensitivity sensor by combining them with nanomaterials that change color depending on the surroundings.
By the way, I have recently noticed a strong trend toward demanding practical applications of research in a short amount of time. What are your thoughts on this current situation?


I believe that it is ideal to leave researchers to work diligently on research topics they are genuinely interested in and let potential practical applications arise as a natural consequence.
It is concerning that funding seems to be focused on several research fields with practical applications.
Each researcher's pursuit of their unique interests contributes towards gradual advancement of the research field, and thereby leads to novel discoveries, one step at a time.


It has been a year since I took up my position at the Institute of Industrial Science, and I feel that the environment here is conducive to conducting in-depth research on topics of interest.
Giving a serious thought to what you just said, Professor Tatsuma,
I intend to thoroughly enjoy the research journey that lies ahead.

Why is the formation of the first hub of One Health, One world in Asia significant?

How does temperature changes impact on health risk to heat-related hazards in Bangladesh?

The 1st International Symposium on One Health, One World

The One Health, One World Organization (OHOW) held The 1st International Symposium on One Health, One World in Pattaya, Thailand from December 8 to 10, 2022.

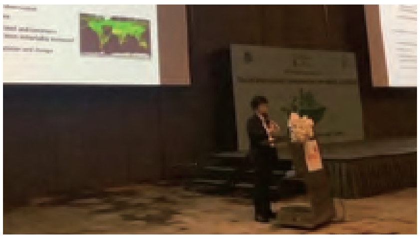
Members of OHOW from UTokyo-IIS

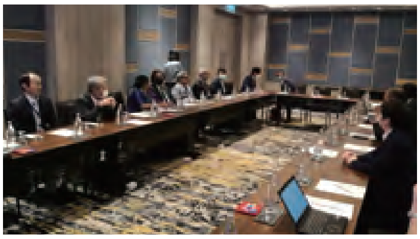
"One Health, One World," proposed as the Manhattan Declaration in 2004, is recognized as a comprehensive scientific concept that encompasses human and animal health, the global environment, urban safety, and urban environmental management.
This symposium was organized by the Regional Office for Urban Safety (RNUS), which was established at the Asian Institute of Technology (AIT) in 2002 to improve urban disaster prevention in the Asian region and to build a human network for the purpose, and has continued for 20 years.
OHOW took over the International Symposium on New Technologies for Urban Safety of Mega Cities in Asia (USMCA), which had been held for 20 years.

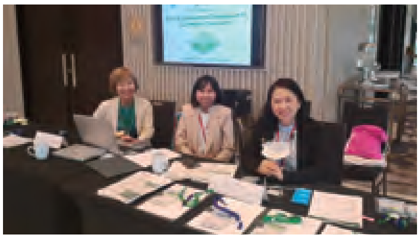
The three-day symposium featured six keynote speeches and 76 research presentations on such topics as natural disasters and infectious diseases, transportation and human mobility, structural and geotechnical engineering for human safety, infrastructure health monitoring, public health and climate change, and ecosystem monitoring using remote sensing and GIS.
There were 101 participants from 15 countries including Japan, Thailand, Nepal, India, Bangladesh, Myanmar, Indonesia, Cambodia, Philippines, Vietnam, China, Pakistan, Iran, Sweden, and New Zealand.
Among 44 presentations by young researchers and students, four were awarded as the best presenters.

It was the first time in three years since the 19th USMCA that the conference was held face-to-face, providing an opportunity to reunite with old acquaintances and meet researchers in new fields, while at the same time providing a meaningful discussion for the comprehensive and coordinated development of related academic fields to address the various risks facing society from human, animal and global environments that OHOW targets.
The second meeting is scheduled to be held in Dhaka, Bangladesh, in December 2023.

How lessons learned from recent disasters in Japan contribute to future disaster countermeasures?







Reference OHOW: The 1st International Symposium on One Health, One World **https://ohow2022.sciforum.net/**

Further information OHOW **https://ohow.iis.u-tokyo.ac.jp/**

Coral Rescue - Conserve Together

Project Researcher
Tomomi Sayuda,
UTokyo-IIS

Research Affiliate
Tai Chong Toh,
National University of Singapore

Research Associate
Sam Shu Qin,
National University of Singapore

Coral Rescue is an experience design project to encourage the general public in coral conservation. The self-growing coral kit helps to grow corals at home and bring the home-grown corals back to the ocean. This encourages new interactions with nature to protect marine biodiversity.

On 8 December 2022, DLX Design Lab, Institute of Industrial Science (IIS), The University of Tokyo (UTokyo) and The Division of Industrial Design (DID) under the College of Design and Engineering as well as the Tropical Marine Science Institute (TMSI) of the National University of Singapore (NUS) released "Coral Rescue - Conserve Together".

The project's aim is to encourage the general public to engage in coral conservation thereby contributing to maintaining marine biodiversity, now and in the future.

This will be achieved through a mixture of design artifacts and activities enabling us to reach a wide range of people. We have designed a self-growing coral kit (which would be publicly accessible) that enables anyone to cultivate coral at home. The self-growing coral kit is a water tank with a designed rig to help with coral nurturing. Different coral species should be used in reef restoration initiatives to maximize the recovery of marine biodiversity and ecosystem functioning. Corals are slow growing. Depending on the coral's species, they can take approximately 3 - 6 months to reach a suitable size for transplantation to the reefs. Once the home-grown coral reaches an appropriate size it can be returned to the sea by experienced divers. We have also developed a workshop format to educate people about the issues and encourage engagement. For this, we have created support tools such as displays of local Singapore corals and flashcards related to coral research. In the future, we would like to build an online network to enhance activities between researchers and local volunteers.

The main challenges faced by researchers in coral conservation include the cost of coral restoration, climate change impacts and the lack of support from the general public. In Singapore, the existence of corals is not widely recognized because of the lack of seawater transparency. Singaporeans are accustomed to city life and they are not really aware of the existence of coral reefs nearby. With this Coral Rescue project, we are hoping to enhance the general public's awareness and support for the conservation process.

The lead design researcher is Tomomi Sayuda from the DLX Design Lab at UTokyo-IIS, who has been kindly hosted at NUS by the DID and the Keio-NUS CUTE Center. The project has been informed and inspired by the coral conservation research activities of TMSI at NUS, in particular those undertaken by Dr Tai Chong Toh and Sam Shu Qin.

Further information

Design-Led X Platform **https://www.designlab.ac/**
Coral Rescue - Conserve Together - / Open Access Coral Conservation **https://youtu.be/HAgyZzuPwyE**

Radical new treatment system lights up cancer therapy

Researchers from UTokyo-IIS have developed a streamlined photo-uncaging system for photodynamic cancer therapy, using a pulse of light for tumor-specific activation of a cancer-fighting agent.

One approach to treating cancer is photodynamic therapy using photo-uncaging systems, in which light is used to activate a cancer-fighting agent *in situ* at the tumor. However, suitable agents must be stable under visible light, have an anti-tumor effect in low-oxygen environments, and have the ability to be activated by low-energy tissue-penetrative red light – a combination of properties that is difficult to achieve. Now, a team from IIS has developed a new platform that uses, for the first time, organorhodium(III) phthalocyanine complexes to achieve this combination of traits.

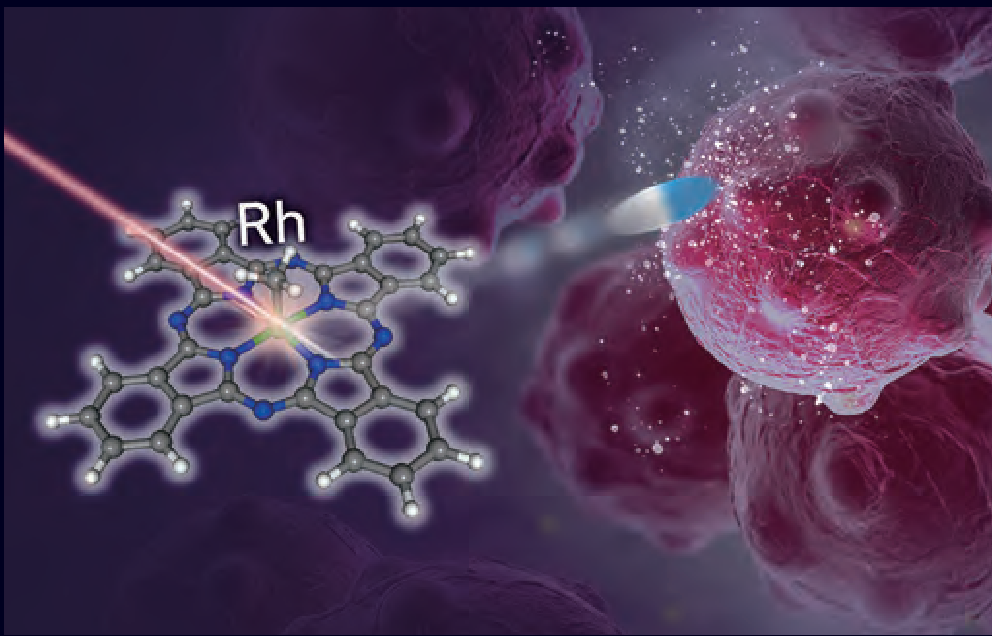
Conventional photodynamic techniques depend on the formation of reactive oxygen species to destroy tumor cells, but many tumors contain environments that lack oxygen. Photo-uncaging systems, where the agent is administered in an inactive form and then activated, or "uncaged", in the location of the tumor, address this issue. They uncage alkyl radicals, which are known to be capable of inducing cell death both with and without the presence of oxygen. Alkyl radicals are converted into terminal aldehydes in the presence of oxygen, and these terminal aldehydes can also induce cell death. The team used molecules called "organorhodium(III) phthalocyanine (Pc) complexes" to develop, for the first time, a novel platform for photo-uncaging therapy.

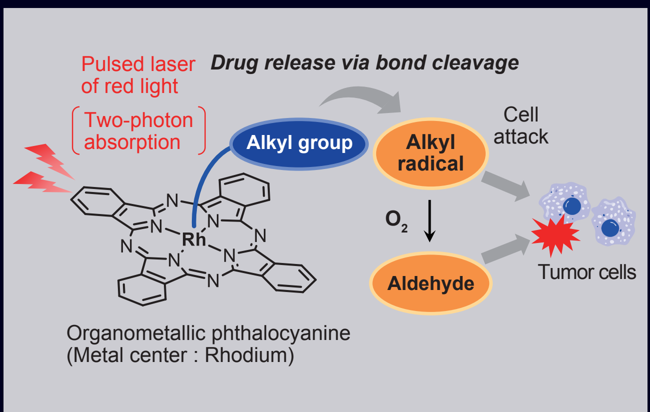
"The organorhodium(III) phthalocyanine (Pc) complexes we developed are highly stable under ambient light during the processes of synthesis, purification, and measurement, but can be activated by a laser that gives out nanosecond pulses of red light," explains lead author Kei Murata. These nanosecond-pulsing lasers (pulsing for a billionth of a second) are relatively easy for medical staff to handle.

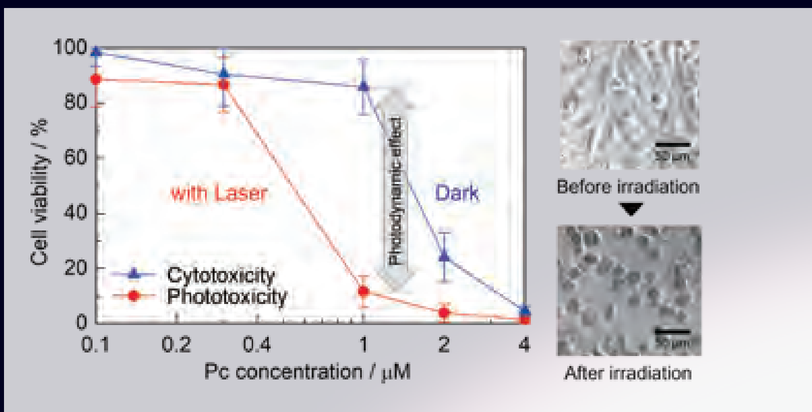
They went on to show that the compounds that were released after the organorhodium (III) phthalocyanine (Pc) complexes were activated showed toxicity to HeLa cells, a cell line developed from cancer, indicating that these compounds would have the ability to fight cancer if released inside a tumor.

"Our new technology could allow the photochemical generation of a wide variety of alkyl radicals and aldehydes, making possible the site-selective release of various bioactive molecules," says senior author Kazuyuki Ishii. As an improvement on other photo-uncaging systems, it opens an exciting new avenue for the treatment of cancer by phototherapy.

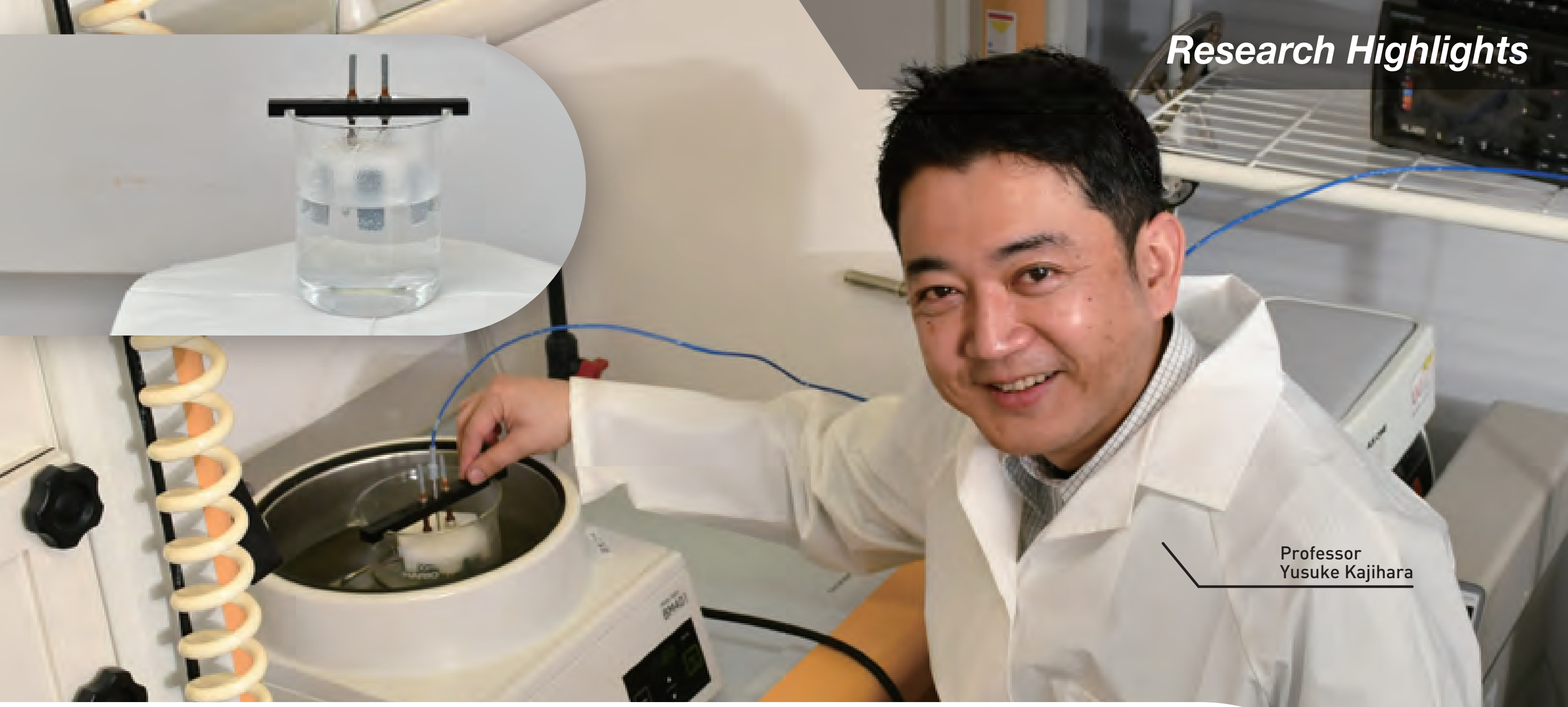
Research Associate
Kei Murata







Reference
Kei Murata*, Yuki Saibe, Mayu Uchida, Mizuki Aono, Ryuji Misawa, Yoshiho Ikeuchi, and Kazuyuki Ishii*
"Two-Photon, Red Light Uncaging of Alkyl Radicals from Organorhodium(III) Phthalocyanine Complexes"
Chemical Communications **(2022), DOI: 10.1039/d2cc03672j**

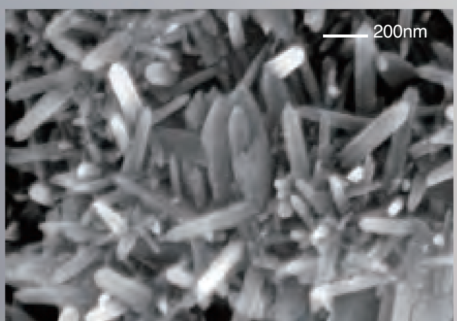


A Rough Start Can Lead to a Strong Bond

Researchers at UTokyo-IIS develop a simple but effective method of bonding polymers with galvanized steel, a material ubiquitous in the automobile industry, to cheaply and easily create a lightweight and durable product.

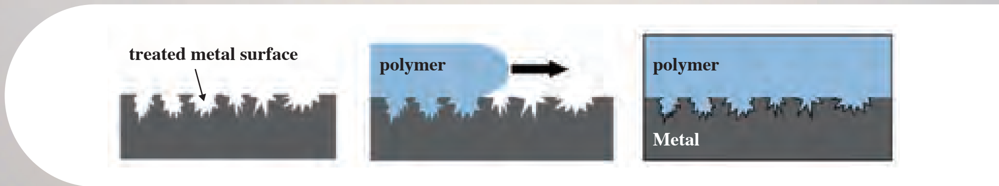
The manufacturing industry is constantly on the lookout for more efficient manufacturing materials, but most new methods to develop such materials created in the lab are not suited for industrial-scale use. Now, investigators from UTokyo-IIS have developed a cheap and simple method of bonding polymers to galvanized steel—steel with a coating of zinc layered over it—to create a lightweight and durable material that can feasibly be produced on an industrial scale.

As the manufacturing sector becomes increasingly incentivized to think about the environmental impact of their processes, new techniques are needed to ensure that parts can be made both sustainably (with a minimum of harsh chemicals and waste) and with a long lifetime before needing to be replaced. Galvanized steel is widely used in the automobile industry owing to its excellent mechanical properties and corrosion resistance. However, because of its weight, polymer-metal composites are being increasingly applied as alternative lightweight materials with high durability. Unfortunately, traditional techniques to bond polymers to galvanized steel are unsuited for mass production as they often require harsh chemicals or specialized equipment.



In a study published recently in the Journal of Manufacturing Processes, a team of researchers at IIS demonstrated a method by which a polymer can be bonded to galvanized steel simply by pre-treating the steel with an acid wash and dipping it in hot water. The acid wash strips the outer "passive layer" on the zinc coating of the steel which allows the hot water to form rough nanoscale needle structures on the true surface. The researchers discovered that when a polymer was applied to the treated metal (in a process called injection-molded direct joining), it filled in the tiny gaps and ridges between and within the needle structures creating very strong mechanical linkages. "We found that immersion in hot water was a simple and effective method for producing nanoscale structures on the zinc coating for the polymer to adhere to, but that prior acid-washing to remove the passive layer was a necessary step for this to occur," explains lead author Weiyan Chen.

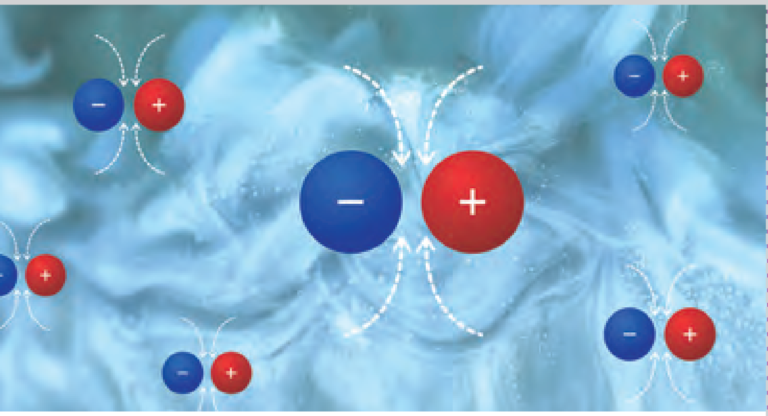
The group also showed how the tensile-shear strength, which indicates how much force the polymer can withstand before being torn off the metal, increased with the complexity of the nanoscale structures on the galvanized steel surface. By optimizing the hot water temperature and treatment time to achieve peak complexity in the nanoscale structuring, the team was able to significantly increase the tensile-shear strength compared with untreated metal. "Our process can be adapted for a wide range of hybrid joining applications, in which metal and plastic parts need to be permanently bonded," says senior author Yusuke Kajihara. "Furthermore, our method does not use harsh chemicals or complicated procedures and thus is suited to the scale-up required for industrial application". This work could lead to optimization of polymer-metal joining which would be a significant asset to the manufacturing industry.



Reference

Weiyan Chen*, Fuminobu Kimura, and Yusuke Kajihara
"Effect of nanostructured zinc coating on high joining strength of polymer/galvanized high-strength steel composite via injection molding"
Journal of Manufacturing Processes **(2023), DOI: 10.1016/j.jmapro.2022.11.044**

Simulations are Starting to Gel



A research team led by Kyohei Takae modified simulations for aggregation of colloidal particles by including hydrodynamical effects of the solvent. They revealed that the final structure was different compared with older predictions, which may help in designing self-assembling “smart materials” such as artificial muscles.

Physical Review Letters (2022), DOI: 10.1103/PhysRevLett.129.248001

Further information https://www.iis.u-tokyo.ac.jp/en/news/4059/

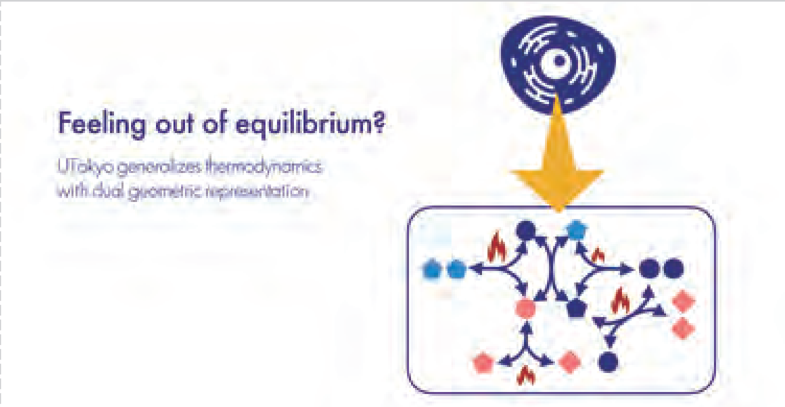
Nerves on the spot: Sensory Neurons in Human Skin Play Key Role in Pigmentation

A research group led by Yoshiho Ikeuchi has found that sensory neurons play an important role in human skin pigmentation and physiology. Specifically, the neurons secrete a protein known as Repulsive Guidance Molecule B (RGMB), which stimulates melanocytes (the cells in skin that produce melanin, which is responsible for skin coloration). This study could lead to the development of new drugs to treat pigmentation disorders.

Cell Reports (2022), DOI: 10.1016/j.celrep.2022.111366

Further information https://www.iis.u-tokyo.ac.jp/en/news/3977/

Feeling Out of Equilibrium in a Dual Geometric World: A novel theory for nonlinear dissipasive phenomena

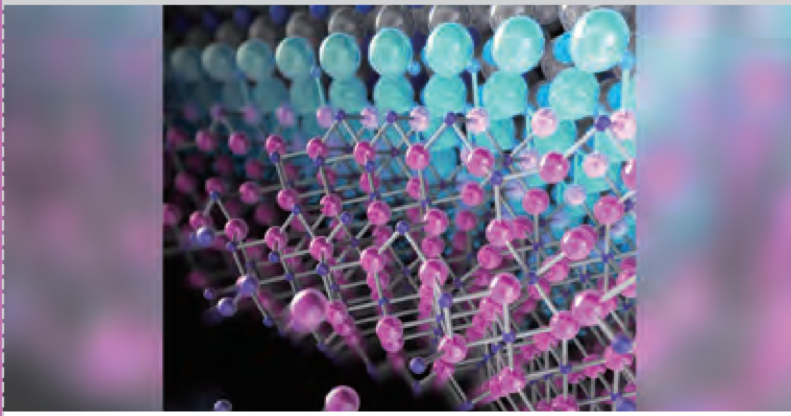


A research team led by Tetsuya J. Kobayashi extended the utility of chemical reaction network theory beyond systems in equilibrium using a mathematical dual geometrical representation. This work may shed light on the nonequilibrium behavior of reaction networks in chemistry and biology.

Physical Review Research (2022), DOI: 10.1103/PhysRevResearch.4.033208
Physical Review Research (2022), DOI: 10.1103/PhysRevResearch.4.033066

Further information https://www.iis.u-tokyo.ac.jp/en/news/3976/

Upgrading your Computer to Quantum

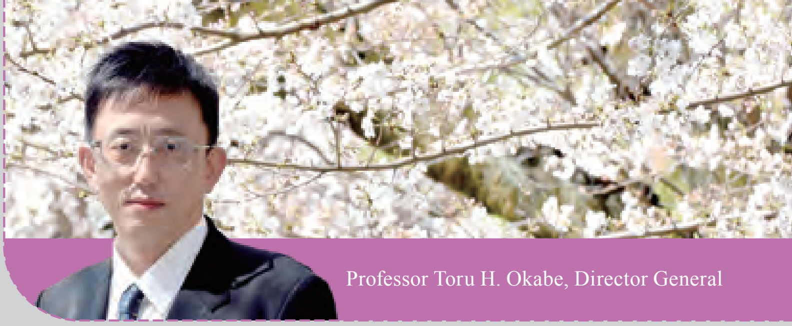


A research team led by Atsushi Kobayashi has demonstrated how a nanoscale layer of superconducting niobium nitride (NbN_x) can be grown directly onto aluminum nitride (AIN). The arrangement of atoms, nitrogen content, and electrical conductivity were found to depend on growth conditions, particularly temperature, and the spacing of atoms in the two materials was sufficiently compatible to produce flat layers. The structural similarity between NbN_x and AIN will facilitate the integration of superconductors into semiconductor optoelectronic devices.

Advanced Materials Interfaces (2022), DOI: 10.1002/admi.202201244

Further information https://www.iis.u-tokyo.ac.jp/en/news/3984/

UTokyo-IIS

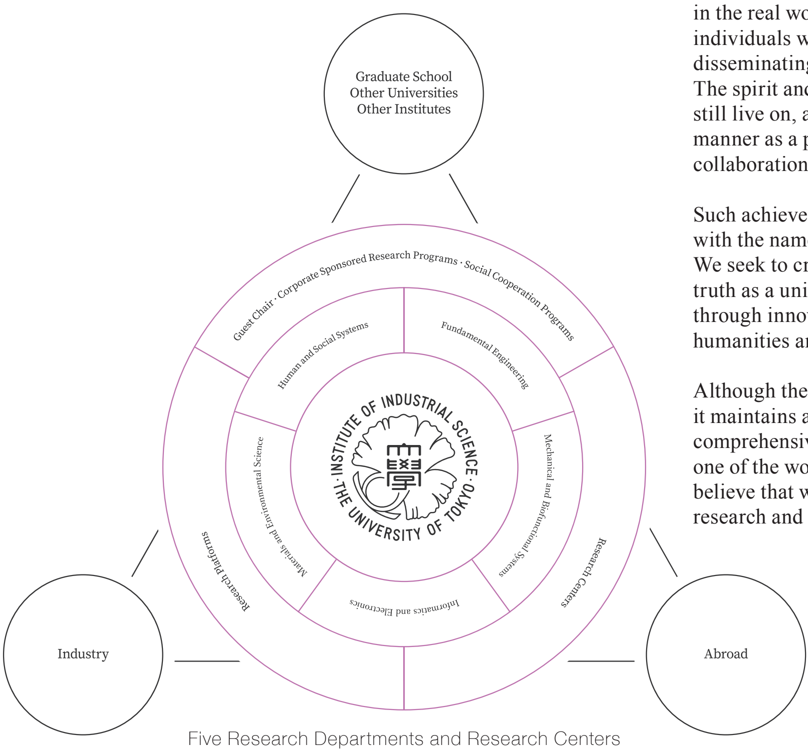


Professor Toru H. Okabe, Director General

Message from the Director General / Scope

The Covid-19 pandemic has transformed our lives, making us realize the limits of science and technology against formidable viruses. At the same time, through remote work and online lectures, we have become more aware of the importance and the future potential of digital transformation (DX). Many issues cannot be solved by technology alone. However, engineering is expected to play an increasingly important role in meeting the challenges of modern society, which has become ever more complicated and diversified.

The Institute of Industrial Science (IIS) at the University of Tokyo is the largest university-affiliated research institute in Japan. With a commitment to pursuing academic truth, the UTokyo-IIS carries out a wide range of educational and research activities, such as cross-disciplinary research that transcends academic boundaries — which is a traditional feature of the UTokyo-IIS — as well as practical industry–academic collaboration, international collaboration, and hands-on research aimed at social implementation.
In 2019, we celebrated our 70th anniversary. During the past 70 years, there have been significant research accomplishments and we have succeeded in producing many outstanding members of society.



Five Research Departments and Research Centers

The UTokyo-IIS is a comprehensive engineering research institute that covers almost all fields of engineering, consisting of five research divisions. It has approximately 120 laboratories overseen by professors, associate professors, and lecturers. More than 1,300 personnel, comprising approximately 250 faculty members, 150 support members, and 900 graduate students and postdocs participate in educational and research activities that are responsible for producing excellent research outcomes and fostering outstanding talent.

Furthermore, there are 3 affiliated research centers that span multiple research departments, 7 internal centers, 2 collaborative research centers, and an international collaborative research center that pursues international joint research. In addition to promoting original research in specialized fields, each laboratory systematically engages in interdisciplinary or international activities by using organizations such as the cross-disciplinary research centers.
In 2017, the Chiba Experiment Station was relocated from its original site in Nishi-Chiba to the Kashiwa Campus, and since 2020, the facility is operating as a Large-scale Experiment and Advanced-analysis Platform (LEAP). In addition, a completely new facility called the "Design-Led X Platform," the first of its kind, has also begun operations in 2017.

Since the foundation of the UTokyo-IIS, we have been acutely aware that the significance of academic research in engineering lies in its real-world implementation. Not only have we created new academic fields through enhanced specialization and collaboration across disciplines, but we have also developed and deployed technologies that can contribute to solving problems in the real world. In addition, we have made it our mission to develop individuals who will shoulder the responsibility of developing and disseminating technology in the industrial world.
The spirit and the sense of mission of the UTokyo-IIS since its establishment still live on, and we tackle various engineering-related issues in a practical manner as a pioneering organization advocating industry–academic collaboration.

Such achievements and such a proactive stance are widely recognized, along with the name *SEIKEN* (short name for IIS in Japanese).
We seek to create a new "*SEIKEN* style" as we continue to pursue academic truth as a university research institute, contribute to the creation of new value through innovation, and aim for a multidisciplinary approach integrating humanities and sciences for implementation in the real world.

Although the UTokyo-IIS is the largest university research institute in Japan, it maintains a strong sense of unity as an organization. Using its agility and comprehensive capabilities, the UTokyo-IIS will continue to fulfill its role as one of the world's top research institutes in the field of engineering. We believe that we will continue to make great contributions to society through research and education.

Institute of Industrial Science, The University of Tokyo (UTokyo-IIS)
https://www.iis.u-tokyo.ac.jp/

Komaba Research Campus（Komaba II Campus）
4-6-1 Komaba Meguro-ku, TOKYO 153-8505, JAPAN
E-mail：koho.iis@gs.mail.u-tokyo.ac.jp

Kashiwa Campus
5-1-5 KASHIWANOHA KASHIWA-SHI, CHIBA 277-8574, JAPAN (Kashiwa Campus)
6-2-3 KASHIWANOHA KASHIWA-SHI, CHIBA 277-0882, JAPAN (Kashiwa II Campus)
E-mail : kashiwa.iis@gs.mail.u-tokyo.ac.jp

Publications ··················
https://issuu.com/utokyo-iis

UTokyo-IIS Bulletin
Institute of Industrial Science,
The University of Tokyo

pro@iis.u-tokyo.ac.jp
https://www.iis.u-tokyo.ac.jp/