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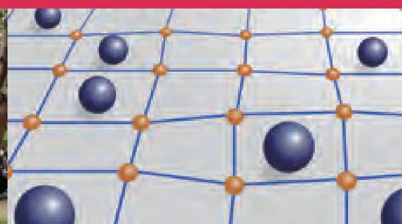
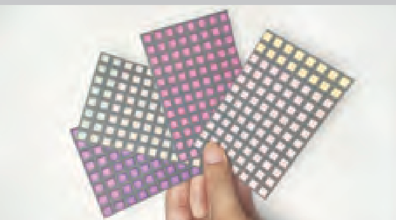
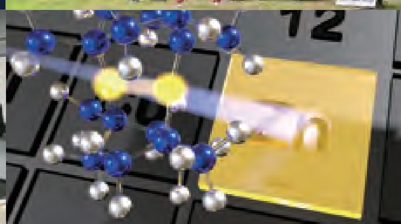
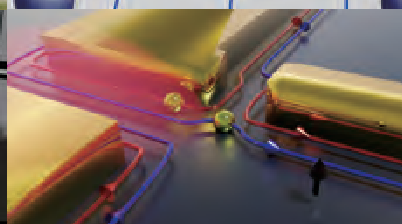
Institute of Industrial Science, The University of Tokyo



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

Breakthrough in atomic-scale

Succeeding in observing in real time how crystalline materials break with the use of electron microscope and microdevice

Scientists have long grappled with the challenge of observing how industrial materials deform and break at an atomic scale. This was seen as daunting, if not impossible, leading many researchers to focus on developing algorithms for simulating failure mechanisms. However, Associate Professor Eita Tochigi of UTokyo-IIS has astonished his peers by achieving real-time observations of how crystalline materials deform and break at an atomic scale. He utilized Transmission Electron Microscopy (TEM) in conjunction with a Micro Electro Mechanical System (MEMS).

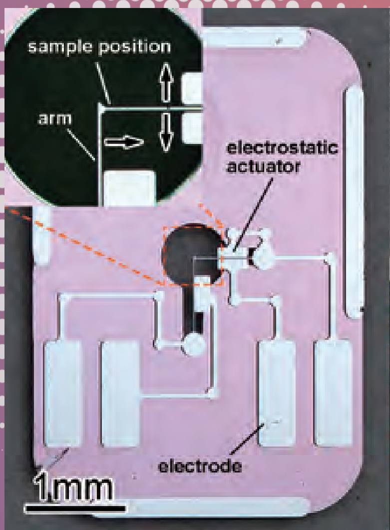
An accidental TEM researcher meets MEMS expert

As a fourth-year student at Hokkaido University, Tochigi joined a laboratory dedicated to transmission electron microscope (TEM) research, but without excitement, because the field was not his first choice. He gradually developed an interest in observing how things deform and break, eventually advancing to the University of Tokyo's Graduate School of Engineering, where he earned a doctoral degree in material engineering in 2011.

After a two-year stint as a postdoctoral researcher at the Lawrence Berkeley National Laboratory in the United States, he served as an assistant professor at the UTokyo graduate school, researching TEM at the laboratory of Professor Yuichi Ikuhara from 2013 to 2021. It was during this period that he had a fateful encounter. "I met Professor Hiroyuki Fujita, a renowned MEMS professional affiliated with IIS (before his retirement in 2018)," Tochigi said. "Having only researched TEM, I didn't know anything about MEMS."

The collaboration between the Ikuhara and Fujita research groups, coming from different fields, ultimately resolved the thorny issue of placing and controlling samples in a tiny holder (measuring a few millimeters) inside the TEM apparatus when a load is applied. This collaboration led to the development of the so-called in situ mechanical test system for atomic-resolution transmission electron microscopy, driven and controlled by a new device using MEMS technology.

"It took five to six years to develop this technology, a process that involved refining the MEMS device and figuring out the optimal method for placing samples in the microscope," Tochigi explained. He highlighted the challenges faced in making the microscope — a technology developed in the 1930s — suitable for achieving real-time, direct observation of atomic behavior.



MEMS loading device for TEM.

'Something weird is happening'

One day, Tochigi was observing a ceramic material with the just-completed advanced scanning TEM — a device that transmits a beam of electrons through the sample, collecting resulting signals underneath to create images of its crystalline structures. As he applied pressure with an indenter tip to the sample, he was astonished. "At first, I thought I observed a weird phenomenon," he said, describing how the ceramic material fractured on an atomic scale.

"The phenomenon was totally unexpected, because it differed from what past simulations showed," he recalled. This marked the first instance of any researcher observing a fracture on an atomic scale. Tochigi and other researchers later confirmed that the arrangement of molecules within ceramic grains influences the way a fracture propagates.

But for Tochigi, witnessing the phenomenon at an atomic scale is not the end goal; rather, it marks the beginning of elucidating the mechanisms behind crystalline defects such as dislocation and deformation twinning in crystal lattices. Dislocation refers to a crystal defect involving an abrupt change in the arrangement of atoms within a crystal structure, while deformation twinning involves the intergrowth of two or more crystal grains, creating either a reflected image of each other or rotation between them.

Tochigi can now produce a video demonstrating how crystal defects occur using his scanning TEM system, departing from the still images most scientists are familiar with. The maximum resolution of the system allows observation of an atom as small as 40 picometers.

"While I might have sounded as if I held a monopoly over the technique, my intention is to encourage many researchers to take an interest in direct atomic-scale observation and stimulate greater research in this field," Tochigi said.

exploration

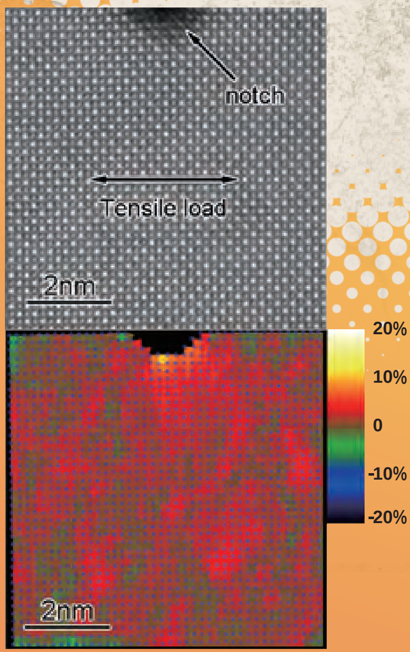
Associate Professor Eita Tochigi

Exploring real-world uses for jet engine blades

Tochigi's project is fundamentally oriented towards basic research, yet it holds the potential for practical applications in designing and manufacturing more robust industrial materials in the future. Crystalline materials, known for their robustness and high heat resistance, are ideal for various applications, including electronic devices, light-emitting elements, optical components, and energy conversion elements, as well as structural materials. For instance, ceramic materials find applications in both small devices like smartphones and large structural materials for buildings.

Ensuring the development of robust and safe materials is crucial, especially in applications like jet engine turbine blades. These blades often utilize nickel-based superalloys coated with ceramics. Exposed to stresses during engine operations, such as rapid heating and cooling, damaged turbine blades can lead to catastrophic engine failure.

To prevent such failures and create more robust materials, understanding the atomic-scale mechanism of ceramic sintering is vital, Tochigi said. Ceramic materials are composed of powders that coalesce during the process of sintering, forming grain boundaries. The movement of these grain boundaries influences the size of the grain, and is closely related to the material's strength and functions. In 2022, Tochigi and his colleagues at UTokyo published an article on their research results in the British journal *Nature Communications*.



(Upper)
Scanning TEM image of $SrTiO_3$ single crystal under loading.
(Bottom)
Strain map (exx). [1]
[1]E. Tochigi, T. Sato, N. Shibata, H. Fujita, Y. Ikuhara, *Microsc. Microanal.* 26, S2, 1838-1840 (2020).

Expanding the research horizons with TEM

As an immediate goal, Tochigi wants to refine direct atomic-scale observation technology, making it applicable to various specimens, such as polymers.

"Currently, TEM faces limitations in observing organic and polymer materials," Tochigi explained. "If we can achieve atomic-scale observation of polymers, interest in our technology will undoubtedly increase. I hope to collaborate with other researchers to advance my research."

Further information Tochigi Laboratory **https://sites.google.com/g.ecc.u-tokyo.ac.jp/nanoscale-strength**

Reference Jiake Wei, Bin Feng, Eita Tochigi, Naoya Shibata, Yuichi Ikuta,
"Direct imaging of the disconnection climb mediated point defects absorption by a grain boundary",
Nature Communications **(2022), DOI:10.1038/s41467-022-29162-2**

Short Dialogue

Associate Professor Tochigi ×

Associate Professor Minami ▶P4-5

I am struck by how inward-looking Japanese students can be.
When I was a postdoc and a research assistant professor in the US, the lab had many international students and researchers.
When I established my own lab at IIS, I was determined to make it globally oriented,
and I succeeded in attracting international researchers..

I am very concerned about attracting students and researchers from around the world.
A failure in this regard impedes international exchange in the academic field.
I am also worried about Japanese students, many of whom regard research jobs as unattractive.
As a young researcher, my mission is to conduct research that appeals to young people.

Yes, as young researchers, we have to bring innovations to Japan,
which seems to have rested on its past spectacular achievements for too long.

Associate Professor　Tsuyoshi Minami

Sense the Unseen

Handy, low-cost sensors developed to detect chemical information of molecules, ions, virus for food analysis and health maintenance

In recent years, there has been increasing demand for the examination of molecules, ions, bacteria, viruses, and other things invisible to the naked eye that can influence humans both positively and negatively. Until now, identifying them has required bulky, expensive equipment and specialized knowledge. However, Associate Professor Tsuyoshi Minami of UTokyo-IIS is changing all that with the introduction of handy, low-cost sensors that rely on pigmentary change or electronic chips.

Pursuit of sensors that can make people happy

Associate Professor Tsuyoshi Minami says his ultimate goal is to develop sensors capable of bringing joy to people, particularly those that enable them to enjoy foods at their best in terms of flavor and tastiness, or in order to promote good health.

"As a gourmet, I appreciate aged beef, but excessive aging can spoil the meat," Minami explained, using the meat as an example to illustrate the applicability of his sensors. "Traditionally, we rely on our sense of smell to check for spoilage, a practice I consider outdated for the 21st century. My sensors can identify umami components such as glutamate, which gives beef its savory flavor, through pigmentary changes in reagents." Minami further noted that his sensors can be tailored to detect molecules related to physical and mental conditions, such as blood sugar and cortisol (a steroid hormone that can impact sleep, mood, and energy levels).

Acquiring diverse specialized knowledge

Before joining IIS in 2016, Minami acquired expertise in a different field, which might be unusual for a researcher. He is confident that his experience helped him develop cutting-edge sensors.

Hailing from a family with a scientific background, Minami joined his high school's chemistry club, where he investigated air pollution by using reagents to gauge the level of photochemical smog. "From my high school days, I wanted to see something invisible to the naked eye," Minami said. After entering Saitama University's undergraduate and master's programs to study sensors, he earned a doctoral degree from Tokyo Metropolitan University's Graduate School of Urban Environmental Sciences in 2011.

Minami then went to Bowling Green State University to learn about machine learning, which was not widely applied in the field of supramolecular chemistry at the time, to combine it with his expertise in sensing. After working as a postdoctoral research fellow and a research assistant professor at Bowling Green for three years, he decided to study how to make sensing devices from the viewpoint of supramolecular chemists. Minami returned to Japan in 2014 and landed a job as an assistant professor at Yamagata University to research organic electronics, a field far from his original area of chemistry.

"The field of sensors is cross-disciplinary," Minami said. "It is important to delve into a limited area, but it is also vital to broaden your horizons. Researching sensors requires knowledge not only in synthetic chemistry, but also in electronic devices and reagents, which I managed to acquire. So, I am confident that I have created my own research field."

Further information

Minami Laboratory **https://www.tminami.iis.u-tokyo.ac.jp/en/**

Reference

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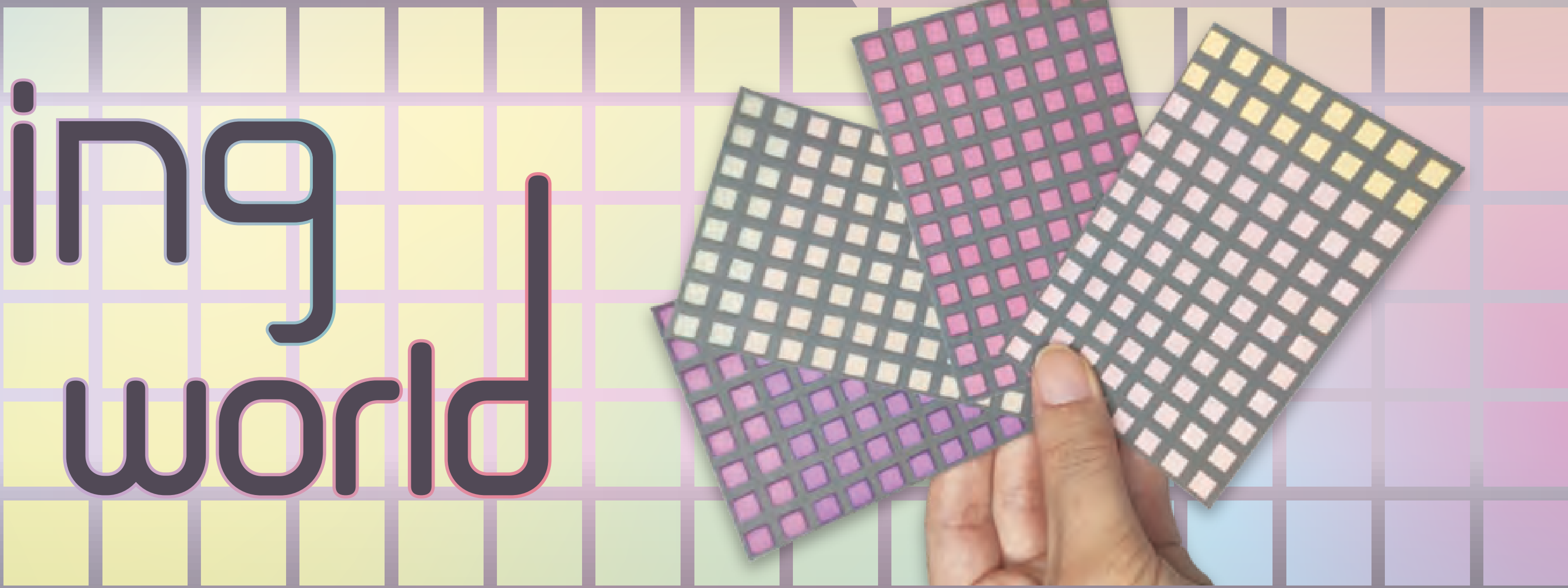
"96-Well Microtiter Plate Made of Paper: A Printed Chemosensor Array for Quantitative Detection of Saccharides",
Analytical Chemistry **(2021), DOI: 10.1021/acs.analchem.0c04291**

Yui Sasaki, Yijing Zhang, Haonan Fan, Kohei Ohshiro, Qi Zhou, Wei Tang, Xiaojun Lyu, Tsuyoshi Minami,
"Accurate cortisol detection in human saliva by an extended-gate-type organic transistor functionalized with a molecularly imprinted polymer",
Sensors and Actuators B: Chemical **(2023), DOI: 10.1016/j.snb.2023.133458**



ing world

Utilizing expertise on organic electronics, chemistry, AI

In his sensor research, Minami leverages his expertise in supramolecular chemistry, organic electronics, and machine learning. His research has a dual focus: to develop sensors with broader applications in society, and to target academic advancement.

The development for detecting substances such as nutrients involves the following steps: 1) Selecting a reagent capable of detecting the target molecule; 2) Placing the reagent in a standard inkjet printer tank; 3) Printing a sheet of paper with the reagent in a mesh pattern (sensor array: a group of sensors deployed in a specific geometric pattern); 4) Applying a sample containing target molecules to the sheet and waiting for any pigmentary changes. This method allows for sensing without the need for an electron microscope or analysis device, thus enabling individuals to perform tests at home without the need for specialized knowledge.

The academic pursuit, meanwhile, centers on supramolecular chemistry, a field inspired by the molecular recognition phenomena of living organisms, to create supramolecular materials (assembly of molecules held together by intermolecular interactions). It also involves the design and synthesis of molecules for developing materials, as well as developing electronic devices and chips, including organic transistor-based chemical sensor.

Minami is paying particular attention to the development of sensor devices capable of detecting physiologically active substances, which is crucial for understanding biological phenomena, or those that can detect environmental pollutants electrically and optically.

In conjunction with this research, he is developing technology to simultaneously analyze multiple samples for various target species. This technology is designed to analyze the various signaling responses collected by molecular sensor arrays through chemometrics (the science of extracting information from chemical systems by data-driven means), which is based on statistics and machine learning.

Aiming to develop a 'Doraemon gadget'

A source of inspiration for Minami is Doraemon, a globally renowned Japanese manga character hailing from the 22nd century who uses futuristic gadgets to help his friend. "I don't believe I can replicate Doraemon's gadgets precisely," Minami expressed with a smile. "However, creating one of Doraemon's gadgets might be feasible — a pair of glasses that can identify only edible items when you're stranded on a desert island. My sensors may become capable of distinguishing between edible and non-edible items."

Although he faces many challenges in his future research, Minami is determined to accomplish his ambitious goals with the students and researchers who have joined his laboratory from around the world. "Ultimately, I aspire to develop a device capable of mimicking the functions within our bodies — complex systems acquired through natural evolution," Minami said. "It would be exciting if our team could integrate a healing function (similar to capability derived from natural processes) into the device."

Short Dialogue

Associate Professor Minami

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Associate Professor Tochigi ▶P2-3

Unlocking the mysteries of the tiny world is fascinating.
The most enjoyable moments for me are when I conduct experiments; that's when I encounter new things.
Whenever I discover peculiar phenomena, I feel the urge to explain them.
I feel unsatisfied otherwise.

We learn in high school that the world is made up of molecules and ions.
I feel happy when pigmentary changes occur in a sensor that I designed, because it shows the presence of molecules.
I also get energized when my sensors do not work, because failures often provide useful insights and lead to new discoveries.

That's right.
New ideas emerge when I observe new phenomena with my own eyes.
I then plan the next steps to elucidate what is causing crystal defects.

Smart Bridge between Tokyo and Arizona:
A Collaborative Journey in Sustainable Urban Mobility


Associate Professor Yudai Honma

Two researchers from UTokyo-IIS and Arizona State University (ASU) have embarked on an impressive collaborative research project in Sustainable Urban Mobility.
The workshop they organized highlighted discussions on pathways to the future of this field.
What contributions can Japan make towards building a sustainable society, a universal challenge? Insights into this question are found in their collaborative efforts.

What are the "Pathways to the Future" in Sustainable Urban Mobility? Transport researchers around the world are striving to answer this question.

Associate Professor Yudai Honma from IIS and Associate Professor Xuesong Zhou from ASU are at the forefront of this endeavor. They collaborate to unravel the complexities of Sustainable Urban Mobility through mathematical modeling. Their research encompasses a variety of topics, including the dynamic location analysis of electric vehicle infrastructure, outlier detection in traffic data, and the development of open data for detailed road network datasets.

Thanks to funding from both JSPS and NSF grants, they organized the NSF Workshop titled "Discover the 'Pathways to the Future' - Connecting Communities through Sustainable Urban Mobility." This event, held on October 15th in Phoenix, Arizona, was co-hosted by the ITS Center at IIS, ASU, and the Maricopa Association of Governments. It marked a significant milestone in the field.

The workshop featured keynotes from renowned transportation researchers Dr. David Boyce and Dr. Hani Mahmassani, whose contributions to transportation are highly influential. Professor Takashi Oguchi, Director of the ITS Center at IIS, and Honma delivered a notable presentation titled "Strategic Innovation: Japan's Interdisciplinary Approach to Sustainable Mobility." The event included panel discussions on AI and new technologies, and future student-led panels, attracting nearly 100 in-person attendees and close to 300 online participants. It was an exceptional opportunity for participants to engage and collaborate closely.

During his sabbatical in Arizona, Honma observed that Arizona is at the forefront of smart mobility, as seen in its widespread use of autonomous vehicles. This showcases a vision of future transportation from a Japanese perspective. Japan excels in cross-disciplinary collaboration, evident in strategic innovations in sustainable mobility and autonomous vehicles. The country's expertise in high-speed rail technology and the presence of numerous global automobile companies also indicate its significant potential contribution to sustainable smart mobility worldwide.

This collaborative research and workshop underscore the global effort towards sustainable urban mobility, showcasing unique strengths and contributions. The researchers are exploring various concrete strategies to deepen ties between IIS and ASU, aiming to establish themselves as global hubs in the transportation sector. A *"smart bridge"* is steadily forming between Tokyo and Arizona, paving the way for future advancements.

Further information

Honma Laboratory **http://www.honma-lab.iis.u-tokyo.ac.jp/**

NSF Workshop titled "Discover the 'Pathways to the Future' - Connecting Communities through Sustainable Urban Mobility."
https://sites.google.com/asu.edu/pathwayss2future/home

A Toast with German Beer and Japanese Food!

UTokyo-IIS and TUDa students enjoy Continental-supported academic exchange program

Prof. Hasegawa and some participants in the academic exchange program

On November 30, 2023, some 25 students from various laboratories gathered around food and drinks at IIS. They all had something in common – the Continental academic exchange program between IIS and Technical University of Darmstadt (TUDa) in Germany. Under the program, the two institutions exchange some research students each year with the financial support from Continental. Since 2018, 12 IIS students and 14 TUDa students have participated in the program.

The IIS students who had already returned from Darmstadt talked fondly about their experience while others who had been selected or were interested in applying to the program eagerly listened and asked various questions, all in an open and friendly environment. Also present were three students who had recently arrived from TUDa under the academic exchange program.

The event was organized by the Office of International and Corporate Relations together with the International Relations Team at IIS, and was hosted by Professor Yosuke Hasegawa, who also spent 2 years in TUDa about 10 years ago under the Overseas Research Fellowship program of the Japan Society for the Promotion of Science.

The collaboration between IIS and TUDa, which formally started in 2017 with an Agreement on Academic Exchange between the two institutes, continues to grow.

"People are very relaxed here and I like it. This event is a great opportunity to interact with people outside of the laboratory." Louis Sterker
hosted by Shoji Takeuchi Laboratory

"You must be more respectful of the professors here compared to Germany, but I like it. There are many international people in my lab." Philipp Gassmann
hosted by Masahiro Nomura Laboratory

"I have studied Japanese for five years and it helps that I can speak the language. Japanese classes are very popular at TU Darmstadt." Yannik Sebastian Hayn
hosted by Kazuo Goda Laboratory

TU Darmstadt students at a New Year social event on campus

PENTA: Pursuing a Nomadic Lifestyle

Researchers at UTokyo-IIS have developed a self-built architectural prototype that is lightweight and easy to construct, using 3D printed (Additive Manufactured: AM) aluminum alloy joints.

Photograph: Shunji Yamanaka

Thanks to IIS researchers, a nomadic lifestyle free from mortgages may become a life option.

The researchers have developed a prototype of a house that can be self-assembled without the use of heavy construction equipment. This architecture, offering a balance between the durability of a house and the mobility of a tent, can be freely disassembled and reassembled. The structure's isometric 60mm-diameter aluminum frame reduces weight, and aluminum alloy joints, fabricated by 3D printing (additive manufacturing), simplify construction, enabling four people to assemble the structure in about two days.

Aluminum alloy joints, fabricated by 3D printing (additive manufacturing)

Lightweight building frames that can be easily assembled are in demand for disaster recovery housing, hospitals in developing countries, glamping, and many other applications. Prefabricated units are the most common solution, but they have the problem that the unit space is uniform in size, making it difficult to ensure flexibility in planning. Historically, the geodesic dome invented by the American Inventor (Architect) Buckminster Fuller was a prominent example of such a lightweight space frame, but it could only create a spherical space.

The team's method uses a tetrahedron (structurally advantageous and composed of triangles, similar to the geodesic dome) and a deformable pentahedron with a square base. These can be combined to form a hybrid space frame. Using 3D printing, the angles of the members at the joints can be freely adjusted, allowing for a variety of forms beyond the spherical.

By replacing sets of joints, the overall form can be transformed, allowing the scale to be changed and the shape to be adapted to changing uses and site geometries. The exterior walls, fitting any external shape of the space frame, can be made from standardized, same-sized equilateral triangular panels, which can be transparent, opaque, or insulated. Attached to the aluminum pipes with gasket rubber, these panels ensure a watertight surface.

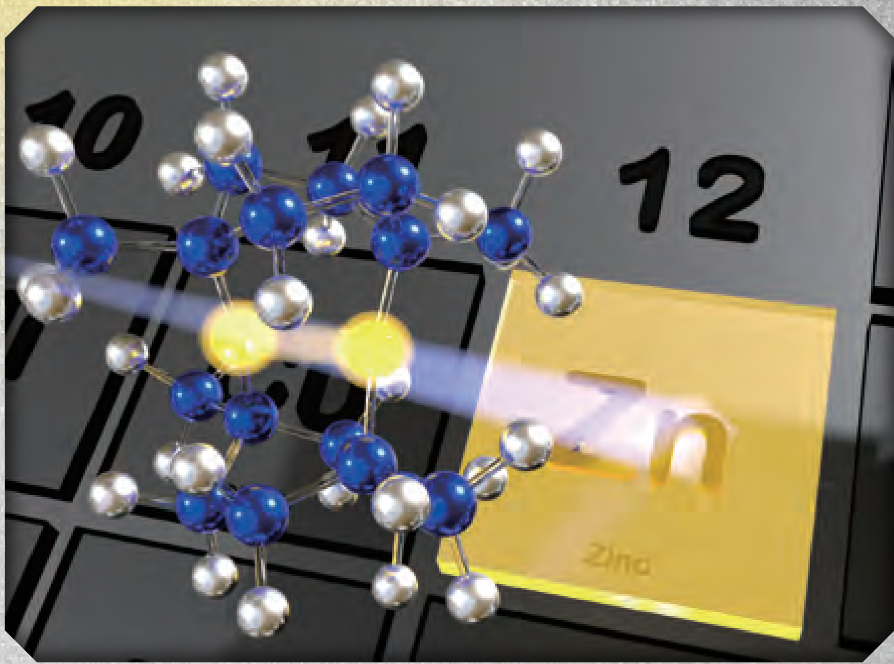
Future research aims to enhance the environmental performance of the prototype and possibly lead to the creation of a venture company to market the parts, supporting the vision of a flexible, nomadic lifestyle, free from traditional housing constraints.

Further information Imai Laboratory **http://www.imai-lab.iis.u-tokyo.ac.jp/**

Bringing out the color in zinc

Professor
Yusuke Sunada

Researchers from UTokyo-IIS, synthesize a two-center zinc complex that absorbs visible light as a solid and in solution.



Zinc is an important element that is found widely in biological systems, is cheap to manufacture relative to other metals, and has low toxicity. However, unlike other similar metals that exhibit a variety of vibrant colors in metal complexes, seeing different colors for zinc materials was not thought possible.

In a study published recently in *Angewandte Chemie International Edition*, researchers from IIS, have synthesized a complex with two zinc ions that does exhibit color—greatly expanding the potential properties of zinc complexes.

Dramatic color changes are often used to demonstrate chemical reactions for fun; however, they can also have important uses in indicators, sensing, and smart materials. For certain metal complexes these changes happen because visible light has just the right energy to move electrons between the orbitals—the parts of the atom structure that accommodate the electrons. However, the energy gap between such orbitals of zinc's most stable ion is much larger than the energy of visible light, so the electrons can't be moved between the orbitals—and therefore can't produce color.

Researchers from IIS, have now shown that bringing a second zinc atom into play can result in a material that is yellow, both as a solid and when dissolved into solution.

The researchers carefully designed two molecules containing silicon atoms that provided perfect docking stations for the zinc ions to slot into. Both zinc–silyl complexes supported two zinc atoms but at different distances apart.

"We used two systems to show that the zinc atoms work together to create a complex that absorbs light in the visible spectrum," explains lead author of the study Yoshimasa Wada. "In the first system the zinc atoms were relatively far apart—5.71 angstroms—and the material was colorless. While in the second system, they were much closer together—2.93 angstroms—and the zinc material was yellow."

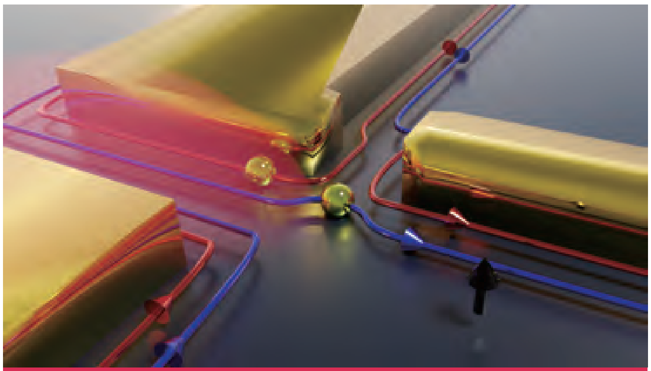
In the system where the zinc atoms were closer together, they were able to combine their orbitals so that the energy needed for their electrons to rearrange was in the visible region. On a large scale this meant that both the solid and solution of the second complex appeared yellow.

"The observed interaction between the zinc centers broadens the potential properties of zinc complexes," says Yusuke Sunada, senior author. "We believe our findings will open up a whole new family of interesting materials."

Zinc can now add visible light interaction to its list of useful properties. Given the prevalence of zinc in biology and its low toxicity, this could open up new uses for zinc in biosensing and biocatalysis.

Reference

Yoshimasa Wada,* Takahiro Maruchi, Reon Ishii, and Yusuke Sunada*
"Visible Light Responsive Dinuclear Zinc Complex Consisting of Proximally Arranged Two d^{10}-Zinc Centers"
Angew. Chem. Int. Ed. **62, e202310571 (2023), DOI:10.1002/anie.202310571**



Communing with Nothingness

A research team led by Kazuhiko Hirakawa developed an integrated nanoscale device that can interact with quantum fluctuations present in empty space. By combining a resonator with a 2D electron gas, they made a device that might be used for future quantum sensors or computers.

Nano Letters (2023), DOI: 10.1021/acs.nanolett.3c02272

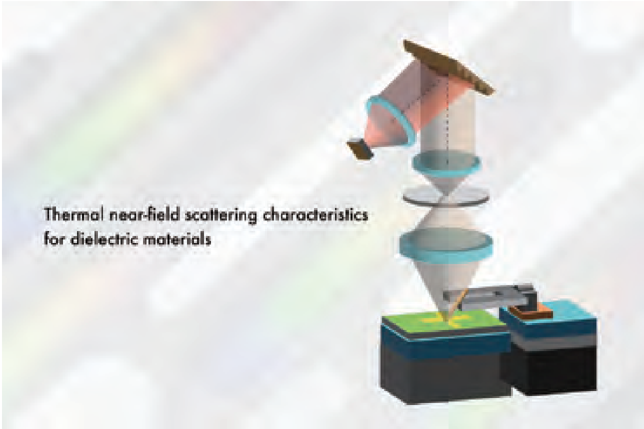
Further information https://www.iis.u-tokyo.ac.jp/en/news/4356/

UTokyo Researchers Imagine Future See-Through Objects

At UTokyo-IIS, DLX Design Lab, in collaboration with a team of researchers led by Professor Tetsu Tatsuma, has produced a five-minute video summarising the technology for creating nanoparticles using an innovative approach with light and the future possibilities it offers. The video introduces in an easy-to-understand manner how these tiny particles may in the future lead to new materials called 'metamaterials' that can freely manipulate light and perform unique properties, such as making materials appear transparent.

Video information: https://vimeo.com/845226045

Further information https://www.iis.u-tokyo.ac.jp/en/news/4266/

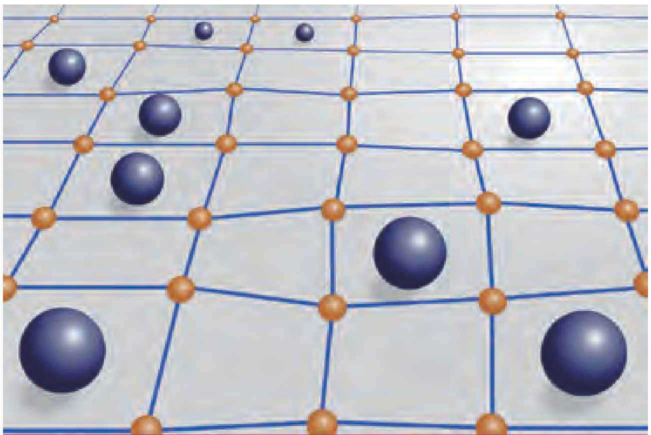


'Hot' new form of microscopy examines materials using evanescent waves

A team of researchers led by Yusuke Kajihara has built a prototype microscope that does not rely on backscattered radiation, instead uses passive detection of thermally excited evanescent waves. They have examined dielectric materials with passive near-field spectroscopy to develop a detection model to further refine the technique, working to develop a new kind of microscopy for examining nanoscopic material surfaces.

Scientific Reports (2023), DOI: 10.1038/s41598-023-44920-y

Further information https://www.iis.u-tokyo.ac.jp/en/news/4350/



Much Ado about Nothing: Insights into Designing Advanced Stimuli-Responsive Materials

A research team led by Kyohei Takae have resolved a long-standing mystery of the elastic heterogeneity exhibited by soft porous materials. They related guest adsorption and desorption to the shape and hardness of domains within metal–organic frameworks, as well as to corresponding entropic and energetic contributors. These findings will be foundational to minimizing the experimental trial-and-error that can hinder the development of advanced batteries and other materials.

Proceedings of the National Academy of Sciences (PNAS) (2023), DOI: 10.1073/pnas.2302561120

Further information https://www.iis.u-tokyo.ac.jp/en/news/4262/

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.

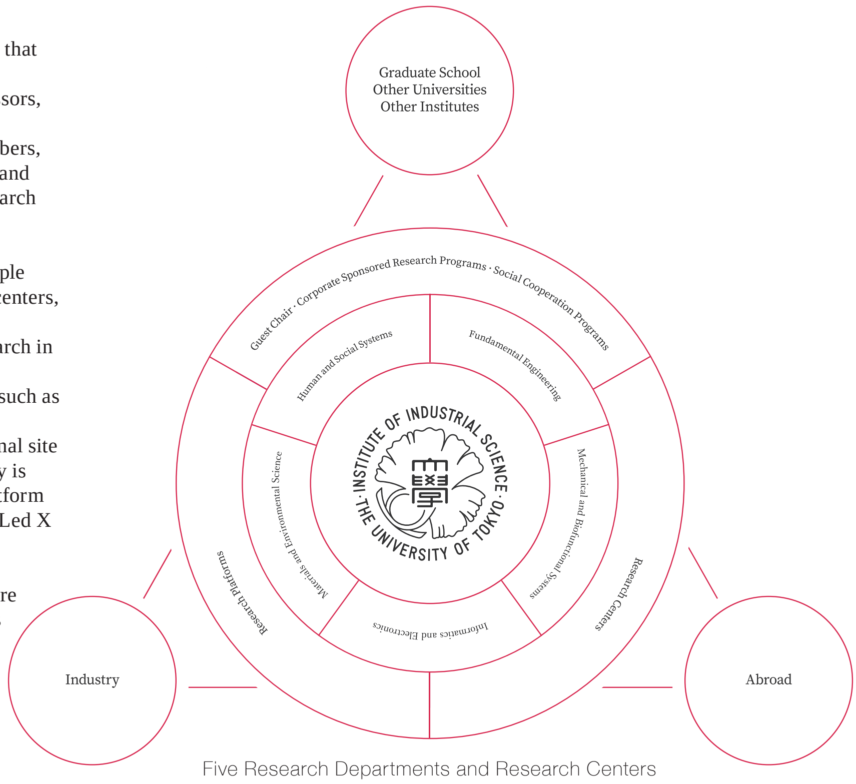
The UTokyo-IIS is a comprehensive engineering research institute that covers almost all fields of engineering, consisting of five research divisions. It has approximately 120 laboratories overseen by professors, associate professors, and lecturers. More than 1,300 personnel, comprising approximately 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.



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