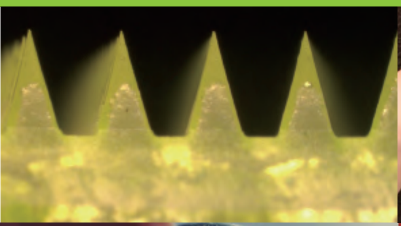
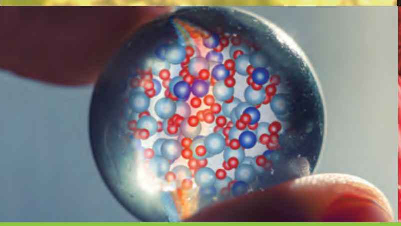
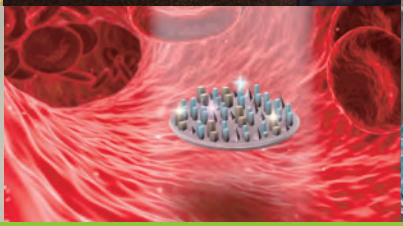
UTokyo-IIS Bulletin

Vol.7 February 2021

Institute of Industrial Science, The University of Tokyo





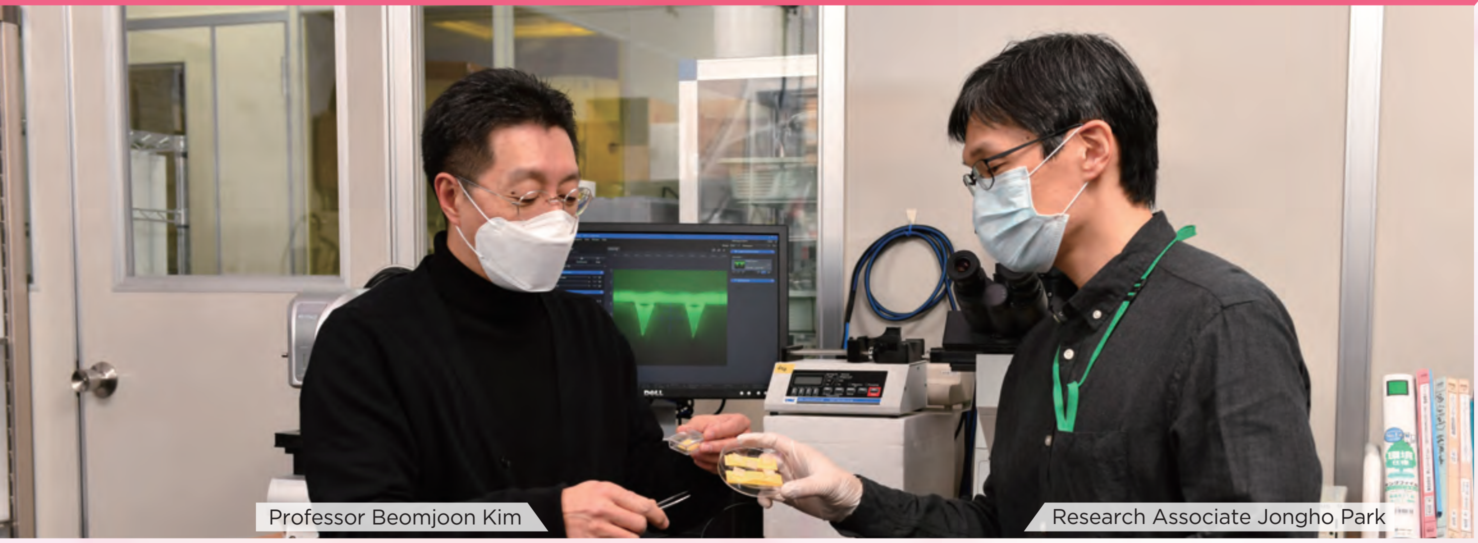


東京大学生産技術研究所
Institute of Industrial Science, The University of Tokyo

Captivated by

Professor Kim tackles COVID-19 with innovative microneedles for testing and delivering vaccines.

With the COVID-19 pandemic having entered its second year, researchers across the globe are racing to develop technologies to stop further spread of the potentially deadly virus. Professor Beomjoon Kim of the Institute of Industrial Science, the University of Tokyo (UTokyo-IIS) is no exception: He is applying his research on microneedles to easy-to-use, safe, rapid and cheaper approaches to antigen/antibody testing and vaccine delivery.



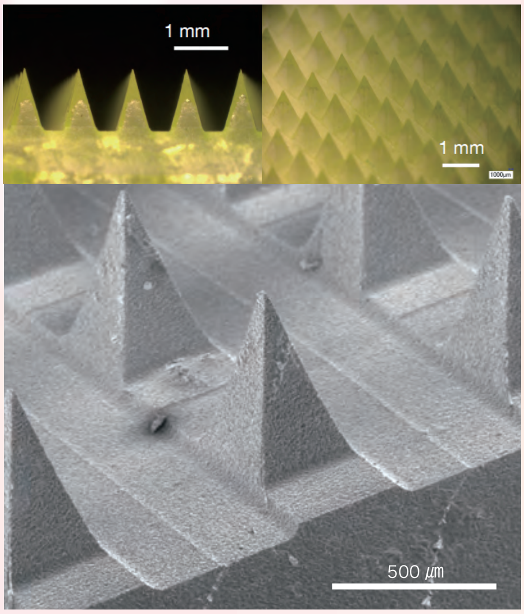
Inspection of active pharmaceutical ingredient molecules inside biodegradable micro needle arrays with fluorescence microscopy

Professor Beomjoon Kim of UTokyo-IIS's Center for Interdisciplinary Research on Micro-Nano Methods became captivated by the microworld after enrolling at the institute for a master's degree upon graduation from Seoul National University in 1993. "In those days, Japan was a manufacturing superpower and had started to follow in the footstep of the United States on research into Micro-Electro-Mechanical Systems," Kim said, referring to miniaturized devices with tiny sensors, actuators and microelectronics on silicon wafers. "I initially intended to stay at UTokyo-IIS only for my master's degree, but my research was so exciting that I carried on for a doctorate instead of going to the United States, which was norm for South Korean students."

After researching about tiny sensors at France's National Center for Scientific Research (CNRS) and Twente University in the Netherlands, Kim returned to UTokyo-IIS in 2000 as an associate professor. Since then, his dedication to the tiny world has culminated in the development of microneedles, including porous microneedles for diabetes diagnostics that can penetrate human skin painlessly and extract interstitial fluid, a biofluid between blood vessels and cells. The extraction is done by capillary action, or the movement of fluid within the spaces of a porous material due to the forces of adhesion, cohesion and surface tension. The microneedles are biodegradable, making them safe to use even if they break inside the body.

As COVID-19 swept the globe during 2020, Kim wondered if his invention could help the battle against the raging pandemic. "Luckily for me, UTokyo-IIS researchers are developing a diagnostic sensor for COVID-19 antigens/antibodies as well as a vaccine," he said, referring to Project Professors Chieko Kai and Misako Yoneda. These researchers are conducting mouse experiments involving the antigen/antibody testing kit for COVID-19. The results of these experiments are expected to be announced soon.

"It might take a few years before we can use microneedles to deliver the vaccine being developed at UTokyo-IIS because vaccine development requires testing on humans," Kim said. "But once its development is complete, this will be a revolutionary delivery method because the vaccine does not need to be kept at freezing temperatures: the vaccine will be freeze-dried for storage. A person can then simply apply a microneedle patch to their skin, without the help of medical professionals."



a tiny world

How can porous microneedles be useful?

"When a mosquito bites you, it doesn't hurt but the area becomes itchy later," Kim said. "This is because the tip of the mosquito's sharp, straw-like mouth that pierces the skin is about 60 micrometers in diameter. Even the tiniest metal injection needle available for insulin injections is 180 micrometers in diameter, which can be painful for patients."

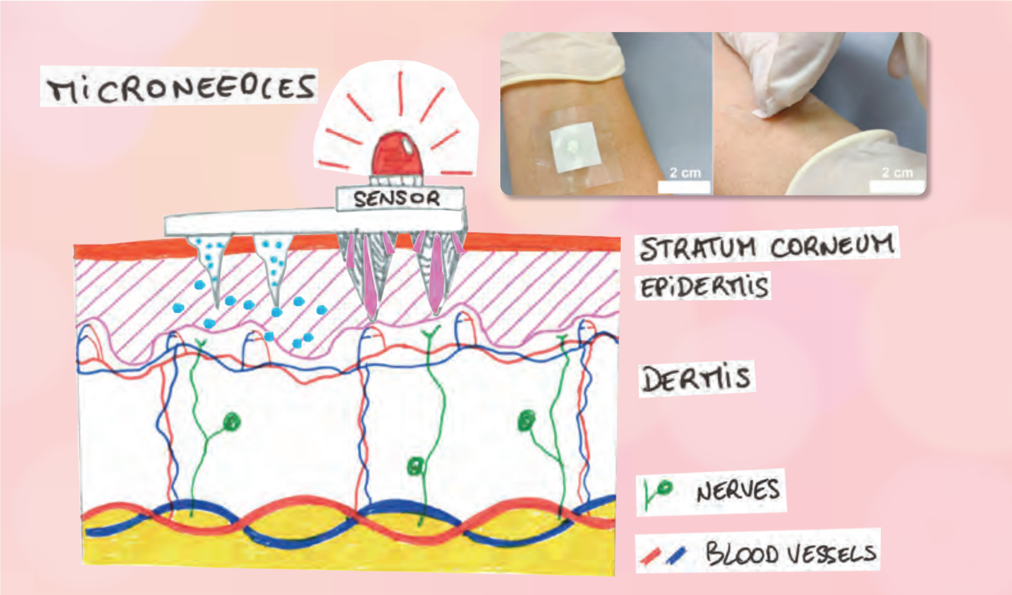
Kim's team developed microneedles less than 50 micrometers in diameter at the tip and 0.8 millimeters long, enough to reach the epidermis, where interstitial fluid can be found. The team focused on interstitial fluid as a biomarker because 95 percent of its constituents are the same as the blood plasma normally used for such a purpose.

Competition to make innovative microneedles has intensified in recent years, but Kim's microneedles still stand out. His diabetic diagnostics kit was the first to have porous needles using biodegradable polymers on a paper substrate, by which biofluid in the epidermis is extracted and delivered to the sensor on the paper's reverse side through a tiny channel to precisely gauge the glucose level. The sensor's color changes depending on the glucose concentration, and getting a result takes only a few minutes.

While 90 percent of Kim's competitors use metal molds to cure polymers to make microneedles, his microneedles can be made with a 3D printer, allowing the formation of any shape desired. Intensive research has already addressed microneedle strength and structure problems. Microneedles for diabetic diagnostics kits must be strong enough to penetrate into the epidermis, and holes in the needle adjusted properly to extract the biofluid.

This mechanism can directly be applied to COVID-19 testing and vaccine delivery. The sensor under development uses fluorescent molecules so antigens and antibodies – which are sometimes difficult to detect because of their low concentration – can be detected about 10 times more accurately. Antibody tests, unlike PCR testing, are not suitable for determining if a person is infected with SARS-CoV-2 (the virus triggering COVID-19) because people take days or weeks to develop antibodies. But these tests could play a key role in determining the overall prevalence of COVID-19 in general populations, which is an epidemiologically significant task. After clearing a few technical hurdles, the tests will likely go on the market.

Using microneedles for vaccinations has much wider implications. "We can deliver not only vaccines for COVID-19 but also other vaccines when our research is successfully completed. It is painless, easy for lay people to use, and can be stored without freezing, so they are very affordable," Kim said. UTokyo-IIS is currently conducting joint research with medical institutions and private firms to put microneedles to practical use, which is expected to take a few years. "We will be able to deliver vaccines to children in Africa very easily, which would be a huge contribution to society," Kim said.



Ultimate goal is to use microneedles for preventive medicine

Going forward, Kim plans to continue researching microneedles for preventive medicine. "It's said that one-third of the world's population is prediabetic," Kim said. "Of them, 80 percent are unaware they are prediabetic. People could use a microneedle patch at home and at any time so they can regularly monitor their glucose levels." Kim is conducting research on a microneedle patch capable of simultaneously gauging levels of other heath indicators, such as cholesterol. "Medical professionals are increasingly focusing on preventive medicine," Kim said. "Microneedles will certainly be crucial for preventive treatments."

Away from his research lab, Kim wants to master several foreign languages. "When I first came here, I could not speak Japanese because studying in Japan was not my initial plan. I learned the language by watching TV," he said. "I want to learn Chinese next, and also become more fluent in Japanese when I retire because the grammar still sometimes trips me up. Learning a foreign language is vital as that opens the door to learning about a country's history and culture."

Further information Kim Laboratory
http://www.kimlab.iis.u-tokyo.ac.jp/english/index.html

Race against time

Project Professor Misako Yoneda

Project Professor Yoneda takes a step closer to producing a much more effective COVID-19 vaccine available with a groundbreaking approach.

Since the global outbreak of COVID-19 in 2020, hundreds of drug makers have been racing against time to make safe, effective vaccines available to stop the pandemic, which has claimed over 2 million lives. While most of the vaccines being administered or tested are inactivated, Project Professor Misako Yoneda, an applied veterinary science specialist at UTokyo-IIS, is taking a unique approach: developing a live, recombinant vaccine by using the measles virus as a vector.

While conducting experiments a few years ago, Yoneda realized how effective a recombinant measles virus was in preventing Nipah virus infection, a zoonotic illness found mostly in Bangladesh and India. As the COVID-19 pandemic raged in 2020, Yoneda decided to apply genetic engineering technology that uses the measles virus as a vector to develop a live vaccine against COVID-19.

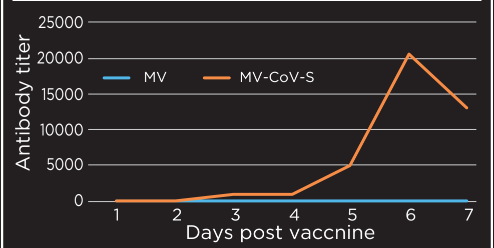
In September 2020, Yoneda's research team started experiments on engineering a suitable virus for the vaccine at a high-level biosafety lab with a grant from the Japan Agency for Medical Research and Development. Within a couple of months, the team succeeded in synthesizing a recombinant measles virus expressing S protein, a COVID-19 antigen (the pathogen we are trying to vaccine against). Experiments using hamsters have proven the recombinant measles virus' effectiveness in preventing COVID-19 infection. Production of an actual vaccine using the virus is scheduled to begin soon, with the aim of starting animal testing in 2021 and Phase-1 clinical trials by early 2022.

"A live vaccine can induce virtually lifelong immunity against COVID-19," Yoneda said. "So, people don't have to get vaccinated regularly – say once every six months or every year – as required to maintain immunity with inactivated vaccines."

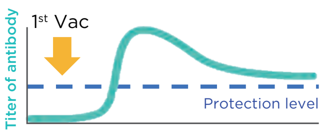
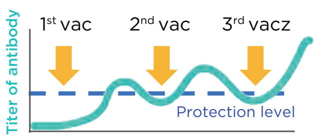
Live vaccines, which use a version of the living virus that has been weakened, are known to induce both antibodies (blood proteins produced in response to an antigen) and cell-mediated immunity, which can provide long-lasting protection against an antigen. Cell-mediated immunity is an immune response in which certain cells are mobilized to destroy antigens in the infected cells. So far, the only live COVID-19 vaccine authorized for use is an adenovirus-vectored vaccine, which Yoneda said is safer, but less effective, than the vaccine she is developing.

On the other hand, inactivated vaccines induce only antibodies, resulting in weak and temporary effects.

Anti-CoV-S antibody titer in vaccinated hamsters



Hamsters were vaccinated twice with measles vaccine (MV) or Covid19-S expressing measles vaccine (MV-CoV-S). Anti-S antibodies were increased highly in the hamsters vaccinated with Covid19-S expressing vaccine. The data of antibody titer was shown as average of 5 hamsters. This result suggested our recombinant vaccine can induce immune response to COVID-19 strongly.

	Live vaccine	Inactivated vaccine
	Attenuated virus Replicate in the host Induce antibody and cellular immune response	Inactivated form of virus, protein etc. Non-replicating in the host Induce only antibody
1. Development	Takes time for safety testing	Capable of rapid preparation
2. Effectiveness	Strong immune response Long-term vaccine efficacy	Weak, transient Short-term vaccine efficacy
		
3. Safety	Potential reversion to virulence	Non-replicating
4. Economical aspect	Lower cost of manufacturing	Need Large number of vaccine

Titer of antibody is decreased in a short period.

Seasonal vaccination is also required.

Overcoming shortfalls of live vaccines

Live vaccines are not without drawbacks, however. They use living viruses that can potentially turn toxic once they enter the human body. It therefore takes a longer time to ensure their safety than inactivated vaccines, whose virus particles have no disease-producing capability.

Yoneda's research team has already addressed the safety issue. "The measles virus has been used for measles vaccination around the world since the 1960s," she said. "Since its safety has long been established, there is no problem in using it as a vector." A vector is a means of delivering an antigen that invades human cells to insert the antigen's code. In fact, the Nipah vaccine Yoneda was involved in developing was confirmed safe, and is scheduled to be put to practical use shortly in collaboration with the Coalition of Epidemic Preparedness Innovations (CEPI), a global partnership to accelerate the development of vaccines against emerging infectious diseases.

Another technical issue is how to insert the S protein, the main antigen component in SARS-CoV-2 (the virus triggering COVID-19), into the vector through genetic engineering.

Yoneda used the same technique developed at UTokyo-IIS that was used in developing the Nipah vaccine. "Until recently, it was considered difficult to make genetically engineered viruses from negative-strand RNA viruses like the measles virus," she said. But UTokyo-IIS succeeded several years ago in synthesizing a recombinant virus from measles virus genes with the help of so-called supporting plasmids (genetic structures in a cell that can replicate independently of chromosomes). That made genetic engineering much easier.

Trying to clear last hurdle

Yoneda said the last hurdle – which could be the biggest one – for her team's COVID-19 vaccine is to find a pharmaceutical company that is willing to market the vaccine when all clinical trials are completed. "It costs much more to develop live vaccines because we have to make sure they are safe for people," she said.

Also, the number of vaccine doses required for the global population is much smaller than that for inactivated vaccines, because live vaccines can provide lifelong immunity with a few shots. This sounds like good news, but for many drug makers it means live vaccines are not commercially viable. "We might need a philanthropic organization like the Bill & Melinda Gates Foundation to make this vaccine available to society," Yoneda said, adding that several attempts to persuade drug makers to produce and market her team's COVID-19 vaccine have failed.

She also hopes the Pharmaceuticals and Medical Devices Agency (PMDA), Japan's drug approval authority, will quickly approve her team's vaccine, because the merits of making it widely available outweigh any attendant risks. The United States and many other nations have approved COVID-19 vaccines made by drug makers such as Pfizer/BioNTech and Moderna for emergency use. "We are conducting conversations about our vaccine with PMDA," Yoneda said, adding that her team expects to finish Phase 1 of three-stage clinical testing in a few months after it starts.

Making contributions to society with her research

Yoneda began research on viruses when she was a doctoral student at UTokyo's Graduate School of Agricultural and Life Sciences. Her original interest was not in vaccines, but in how viruses are host-specific, meaning how viruses can cause sickness in certain animals, but not others. She became deeply involved in developing a vaccine after studying the Nipah virus. Yoneda visited an epidemic area in Bangladesh on a separate project to develop a quick test kit for the virus. "I was astonished to see the hygiene and health conditions in the area," she said. "I really wanted to help them with the vaccine we have developed."

Yoneda believes she can also make a difference for people in developing nations with the COVID-19 vaccine she is developing. "It is a huge chance for me to contribute to society," she said. "I want to build on the technologies and knowledge I have acquired so that I can help make the world a better place to live in."

International collaboration continues under COVID-19

UTokyo-IIS and MESA+ Institute, University of Twente: partners in nanotechnology research

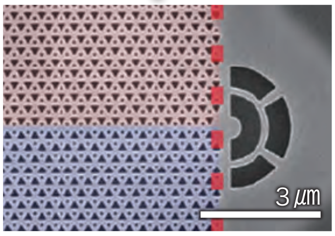
Professor Toshiharu Kishi, Director General

On October 5, 2020, UTokyo-IIS signed a Memorandum of Understanding with the University of Twente's MESA+ Institute, which is a leading nanotechnology research institute in the Netherlands and one of the largest of its kind in the world.

"This MoU aims at making the tie between MESA+ and UTokyo-IIS stronger, particularly in the field of nanoscience and nanotechnologies," says Prof. Kazuhiko Hirakawa, professor of Quantum Semiconductor Electronics at UTokyo-IIS.

According to Prof. Toshiharu Kishi, Director General of UTokyo-IIS, "Nanotechnology is becoming an essential basis for modern electronics, chemistry, biology, and various other fields. Indeed, nanotechnology has become a significant portion of our research activities at UTokyo-IIS."

Prof. Wilfred van der Wiel, professor of Nano Electronics and Director of the Center for Brain-Inspired Nano Systems at MESA+, used to be a postdoctoral fellow at UTokyo as well as Sakigake Fellow (PRESTO Fellow) of the Japan Science and Technology Agency (JST). His desire to continue working with nanotech researchers at UTokyo has helped to grow the relationship.



Topological photonic crystal: A novel way to manipulate photons based on topology

UTokyo-IIS and MESA+ have in common an interdisciplinary approach, which brings together researchers across disciplines such as physics, chemistry, bioscience, nanoeletronics and nanophotonics. UTokyo-IIS and MESA+ researchers already collaborate in a EU-Japan project called EUJO-LIMMS (Europe-Japan Opening of Laboratory of Integrated Micro Mechatronic Systems), as well as in nanophotonics research at a more individual level. The MoU is expected to further strengthen the collaboration between the two institutes, by facilitating exchange of researchers and students as well as sharing of important infrastructures for nanotechnology research.

The signing ceremony was conducted online in the presence of His Excellency Mr. Peter van der Vliet, the Ambassador of the Kingdom of the Netherlands in Japan, in a very friendly atmosphere. Professor Albert van den Berg, Scientific Director of MESA+, and Professor Kishi signed the MoU simultaneously and had a virtual handshake while being physically more than 9,000km apart.

As a surprise gift for the occasion, UTokyo-IIS received a heap of tulip bulbs from MESA+. The planting ceremony was organized on November 26, 2020 as an UTokyo-IIS International Mixer event, where some 40 international and Japanese students, faculty and staff gathered on a beautiful sunny day and worked side by side to plant the tulips in front of the main research building of UTokyo-IIS.

"We believe they will be blooming beautifully in spring as a symbol of our friendship," says Satoshi Iwamoto, professor of Quantum Nanophotonics at UTokyo-IIS.

On March 24 and 25, 2021, UTokyo-IIS and MESA+ plan to host an online technical workshop. Even though Tokyo has returned to emergency mode under COVID-19 pandemic in January 2021, international collaboration will find new ways to go on.

Further information https://www.iis.u-tokyo.ac.jp/en/news/3380/

Age of Cyber-archeology

Associate Professor Oishi breathes new life into Tutankhamun artifacts with use of 3D measurement and image processing technologies

Cyber-archaeology, which creates a digital simulation of the past, is revolutionizing how archaeologists preserve and restore ancient artifacts. Associate Professor Takeshi Oishi of UTokyo-IIS, an expert in 3D measurement and image processing, is working closely with the Grand Egyptian Museum to devise a cutting-edge way to showcase a chariot that might have carried ancient Egyptian king Tutankhamun.

Associate Professor
Takeshi Oishi

A team led by Associate Professor Takeshi Oishi of the Department of Informatics and Electronics has used cutting-edge technology to substantiate a hypothesis that one of six chariots excavated from Tutankhamun's tomb originally had an overhead canopy. The discovery makes it the world's oldest known chariot – a two-wheeled, horse-drawn vehicle generally used in racing or warfare – with a canopy.

Oishi's team digitally reconstructed the chariot with the canopy, which had long been considered unrelated artifacts and thus displayed separately, for exhibition at the Grand Egyptian Museum scheduled to open in Cairo in 2021.

"Based on 3D data we gathered from the chariot and the wooden canopy, we tried to digitally connect both artifacts by stretching the four poles supporting the canopy. The poles perfectly fit with four cavities on the chariot," Oishi said. Conducting such a project using the real artifacts – which date back to around 1330 B.C. – would be extremely difficult given their fragility, but the team's 3D digital reconstruction unlocked a mystery that emerged many years after the tomb was discovered in 1922. "It is really satisfying that a technique only we can do is helping make new archaeological discoveries," Oishi said.

The museum is considering introducing augmented reality and virtual reality technologies that would enable museum visitors that have smartphones to see how the chariot might have been used in ancient Egypt. The team plans to cooperate with the museum to develop suitable content for the display.

This project is part of the Grand Egyptian Museum Joint Conservation Project to transport artifacts stored elsewhere to the new museum. Under this project, sponsored by the Japan International Cooperation Agency, the project group, including archaeologists, trains local staff tasked with conserving and restoring artifacts in Egypt. Oishi's team has also trained local staff how to conduct 3D measurements with a structured-light scanner, which uses projected patterns and a camera system to measure an object's 3D shape. The project's achievements were recognized in November 2020 by the 27th Yomiuri International Cooperation Awards sponsored by The Yomiuri Shimbun newspaper.

Oishi has been researching technologies to help conserve and restore archaeological sites and artifacts since he was a graduate school student 20 years ago. He has participated in many archaeological projects including those involving the Great Buddha statue in Nara, Japan; Roman temples in Italy; and the Angkor Thom temple complex in Cambodia. Oishi's lack of expertise in archaeology is actually an advantage of sorts because he has the freedom to enter any area of this academic field, be it in Europe, Asia, or the Middle East. "It is fascinating that computer-assisted calculations let us see things other people have never seen before," Oishi said, adding that the team's 3D analytical and image-processing technology has no parallel in the world.

Nara Great Buddha Mar. 2001

Going forward, Oishi plans to focus on developing automated 3D measurement technologies with the use of robotics. "We are measuring the treasures of humankind," Oishi said. "Developing advanced analytic tools and robots that can measure artifacts safely and automatically will be crucial."

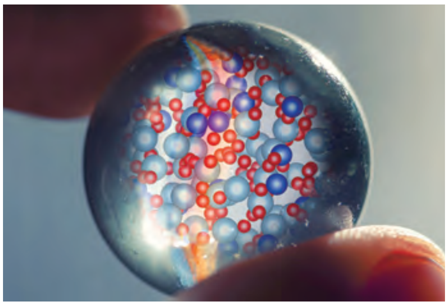
Further information Oishi Laboratory
https://www.cvl.iis.u-tokyo.ac.jp/

Professor Teruyasu Mizoguchi

Looking Inside the Glass

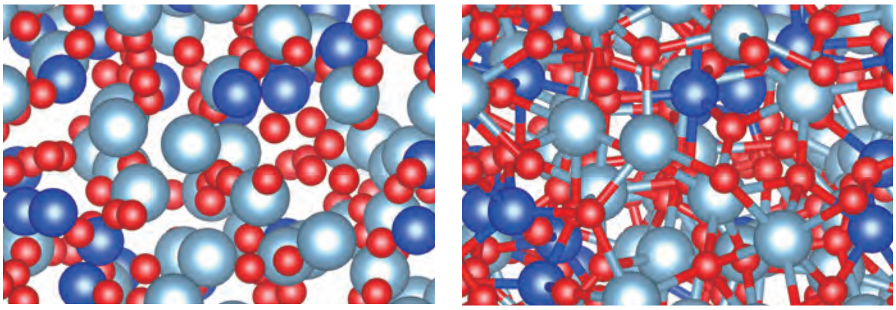
Scientists at The University of Tokyo study aluminosilicate glass to determine its complex local structure with unprecedented detail. This work may lead to tougher and more inexpensive glass for touchscreens and solar arrays.

A team of researchers from UTokyo-IIS used advanced electron spectroscopy and computer simulations to better understand the internal atomic structure of aluminosilicate glass. They found complex coordination networks among aluminum atoms within phase-separated regions. This work may open the possibility for improved glasses for smart device touchscreens.



As the demand for smartphones, tablets, and solar panels increases, so too will the need for more high-quality, tough, transparent glass. One of the candidate materials for these applications is called aluminosilicate glass, which is made of aluminum, silicon, and oxygen. As with all amorphous materials, the glass does not form a simple lattice but exists more like a disordered "frozen liquid." However, intricate structures can still form between that have not yet been analyzed by scientists.

Now, a team of researchers at UTokyo-IIS have used electron energy loss fine structure spectroscopy with a scanning transmission electron microscope to reveal the local arrangement of atoms within a glass made of 50% aluminum oxide (Al_2O_3) and 50% silicon dioxide (SiO_2). "We chose to study this system because it is known to phase separate into aluminum-rich and silicon-rich regions" first author Kun-Yen Liao says. When imaging with an electron microscope, some emitted electrons undergo inelastic scattering, which causes them to lose some of their original kinetic energy. The amount of energy dissipated varies based on the location and type of atom or cluster of atoms in the glass sample it hit. Electron loss spectroscopy is sensitive enough to tell the difference between aluminum coordinated in tetrahedral as opposed to octahedral clusters. By fitting the profile of the electron energy loss fine structure spectra pixel by pixel, the abundance of the various aluminum structures was determined with nanometer precision. The team also used computer simulations to interpret the data. "Aluminosilicate glasses can be manufactured to resist high temperatures and compressive stresses. This makes them useful for a wide range of industrial and consumer applications, such as touch displays, safety glass, and photovoltaics," senior author Teruyasu Mizoguchi says. Because aluminosilicate is also naturally occurring, this technique can also be used for geological research.



Atomic structure of glass represented by spheres. Light and deep blue spheres represent aluminum and silicon, respectively, and red sphere represents oxygen. Sticks in the right figure represent bonds between a pair of atoms. Inside the glass, it seems that the atoms are placing randomly as shown in left figure, but by a careful observation, it is found that silicon and aluminum are coordinated by a specific number of oxygens as shown in the right Figure. The present study revealed a spatial distribution of "number of bonds" for aluminum inside the glass.

Reference

Kunyen Liao, Atsunobu Masuno, Ayako Taguchi, Hiroki Moriwake, Hiroyuki Inoue, and Teruyasu Mizoguchi
"Revealing Spatial Distribution of Al Coordinated Species in a Phase-separated Aluminosilicate Glass by STEM-EELS"
***The Journal of Physical Chemistry Letters* (2020), DOI: 10.1021/acs.jpclett.0c02687**

Laser-Powered Nanomotors Chart Their Own Course

Research Associate Yoshito Tanaka

A team of scientists led by the University of Tokyo develop light-driven nanomotors that can operate without the need for focused lasers—work that may allow for increasingly miniaturized robots and microfluidics controlled entirely by light.

Micro-sailboat powered by optical nanomotors is traveling along optical road.

Researchers from UTokyo-IIS have designed novel linear nanomotors that can be moved in controlled directions using light. This work opens the way for new microfluidics, including lab-on-a-chip systems with optically actuated pumps and valves.

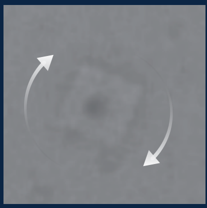
The world of nanoscale machines looks very different to the one containing the contraptions to which we have become accustomed. For example, powering and precisely controlling a motor smaller than a single bacterium can be much more difficult than, say, driving a car.

Now, a team of scientists led by UTokyo-IIS have introduced a system of linear motors made from gold nanorods that can move in a controlled direction when exposed to laser light. Like a sailboat that can move in any desired direction by adjusting the rigging, these nanomotors are not constrained to follow the direction of the light. Rather, they move based on their orientation even when exposed to a laser beam traveling from another angle.

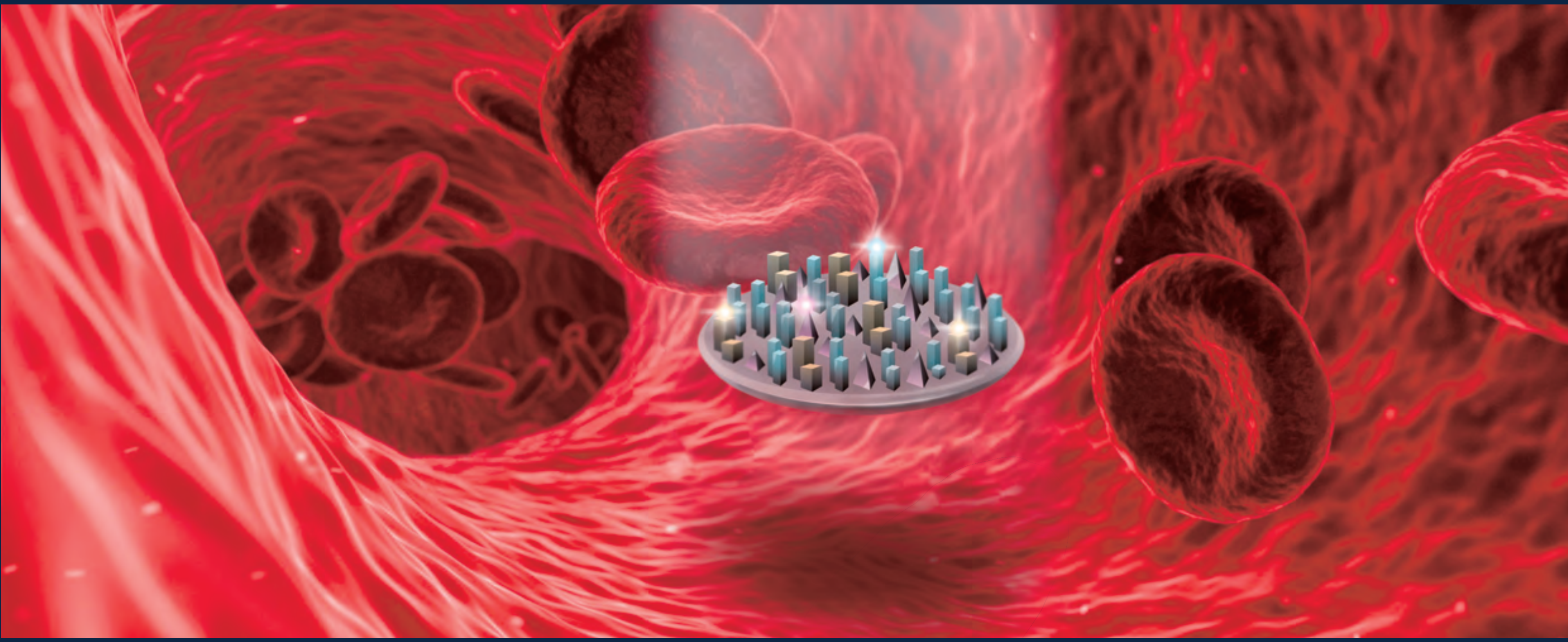
The motion is powered by the lateral optical force created from the sideways scattering of light from the particles. As a result, the need to focus or shape the laser beam with lenses, which was once a difficult task, is eliminated. In addition, motor sizes are not constrained by the wavelength of light, unlike with previous devices.

“Instead of being limited to moving in the direction of laser light or the field gradient, the direction is determined by the orientation of the nanoparticles themselves,” first author Yoshito Tanaka says. The key to this technology is the localized surface plasmon resonance—collective oscillations of free electrons—within periodic arrays of nanorods. These can produce scattered light in a particular direction. “Careful design of the separation between nanorods leads to constructive interference in one direction and destructive interference in the other. This allows us to produce directional scattering to propel the nanomotor,” senior author Tsutomu Shimura says.

The researchers envision using this technology to create a new platform for nano-sized machinery with moving parts that follow predetermined paths while being nudged along by unfocused light. This will greatly reduce the cost and complexity of these devices while also improving precision and reliability.



Rotation produced by circular arrangement of the nanomotors.



Reference
Yoshito Y. Tanaka*, Pablo Albella, Mohsen Rahmani, Vincenzo Giannini, Stefan A. Maier, Tsutomu Shimura
"Plasmonic linear nanomotor employing lateral optical forces" "
Science Advances(2020), DOI: 10.1126/sciadv.abc3726

A Shock to the PPE System

Kaori Sugihara has shown that the N95 masks used by health care workers to prevent the spread of COVID-19 can be sterilized and recharged using a van de Graaff generator. This work may lead to a much larger supply of personal protective equipment for those most likely to be exposed to the virus.

Soft Matter (**2020**), **DOI: 10.1039/d0sm02004d**

Further information https://www.iis.u-tokyo.ac.jp/en/news/3444/

Ultrasensitive transistor for herbicide detection in water

A research team led by Tsuyoshi Minami have fabricated a tiny electronic sensor that can detect very low levels of a commonly used weed killer in water. A new polymer-based, solid-state transistor can more sensitively detect a weed killer in water than existing hydrogel-based fluorescence sensor chips.

***Chemistry-A Europian Journal*(2020), DOI: 10.1002/chem.202003529**

Further information https://www.iis.u-tokyo.ac.jp/en/news/3427/

Tokyo's Voluntary Standstill May Have Stopped COVID-19 in its Tracks

Research shows that Japan's noncompulsory state of emergency generally succeeded in reducing human movement. A study from a research team led by Yoshihide Sekimoto used mobile phone location data for January–April 2020 to record and plot movement of people in metro Tokyo during the emergence and first wave of COVID-19. They found a movement reduction of over 50%, which in turn limited social contact and slowed infection spread.

***Scientific Reports*(2020), DOI: 10.1038/s41598-020-75033-5**

Further information https://www.iis.u-tokyo.ac.jp/en/news/3393/

0.5°C of additional warming has a huge effect on global aridity

In a simulation study, a research team led by Hyungjun Kim showed that limiting global warming to 1.5°C rather than 2°C will be beneficial in mitigating aridification in many global regions including the Mediterranean, western Europe, and southern Africa. However, the changes are not spatially homogeneous, as shown in how Australia and some parts of Asia are to become wetter rather than drier in the projected warmer futures. The results imply the importance of regional climate information in the effort to support policy making decisions on global warming targets.

***Environmental Research Letters*(2020), DOI: 10.1088/1748-9326/ab9db3**

Further information https://www.iis.u-tokyo.ac.jp/en/news/3353/

UTokyo-IIS

Since its establishment in 1949, the Institute of Industrial Science at the University of Tokyo(UTokyo-IIS) is one of the largest university research institutions in Japan and its history reaches 70 years.

Our multidisciplinary research covers nearly all fields of engineering, and our professors, associate professors, and lecturers each lead dedicated laboratories, about 120 in total. More than 1,000 personnel, comprising approximately 300 faculty members including staffs and 750 graduate students, participate in educational and research activities that are responsible for producing excellent research outcomes and fostering outstanding talent. All our laboratories belong to one of five core research departments and some straddle multiple departments, providing the warp and weft for nine research centers, three collaborative research centers, and two international collaborative research centers. As well as promoting original research in each specialist field, we as an institution encourage cross-disciplinary and international activities. Last year saw the functions of the Chiba Experiment Station transferred from its original home in Nishi-Chiba to our Kashiwa campus, and the launch of the new Design-Led X Platform.

Since the foundation of the Institute, we have been acutely aware that the significance of academic research into engineering lies in its real-world implementation, and together with the seeding of new academic disciplines through enhanced specialization and cross-disciplinary collaboration, we have developed and deployed new technologies that contribute to solving problems in the real world. We have also made it our mission to nurture talented people to shoulder the responsibility of technological development and dissemination, especially in the industrial world. Such a philosophy and sense of mission has been programmed into our DNA since the foundation of the Institute, and we have taken a hands-on approach to address engineering challenges as a pioneer of advocacy for collaboration between industry and academia. We also take pride in the fact that our achievements and proactive stance are widely recognized together with the name *Seiken*.

Professor Toshiharu Kishi, Director General

Society is facing diverse problems today, and expectations are growing for the role that engineering plays in solving these problems. At the same time, the challenge for conventional engineering is that it is unable to make widely-accepted and compelling products with an approach that focuses only on technological development. For such situations that are difficult to address with engineering alone, we are seeking to build a new *Seiken* style—one that contributes to the creation of compelling value through innovation, founded on the pursuit of academic truth as a university research institute, and adding a multidisciplinary approach integrating humanities and sciences that incorporates exit strategies for real-world implementation, to the style that it is long known for: barrier-free, cross-disciplinary, practical industry–academia collaboration, and ambitious international collaboration.

Even though it is the largest of its kind in Japan, *Seiken* is perfectly sized to maintain a strong sense of organizational unity, and through our agility and collective strength as a world-class research institute in the field of engineering, we hope to continue helping to make everyone's dreams come true.

Five Research Departments and Research Centers

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

Large-Scale Experiment and Advanced-Analysis Platform (LEAP)
5-1-5 Kashiwanoha Kashiwa-shi, CHIBA
277-8574, JAPAN
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/