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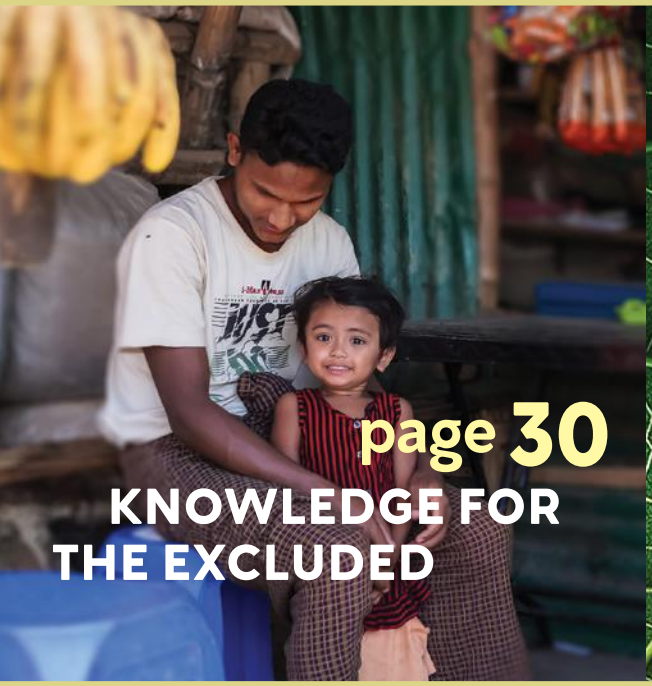

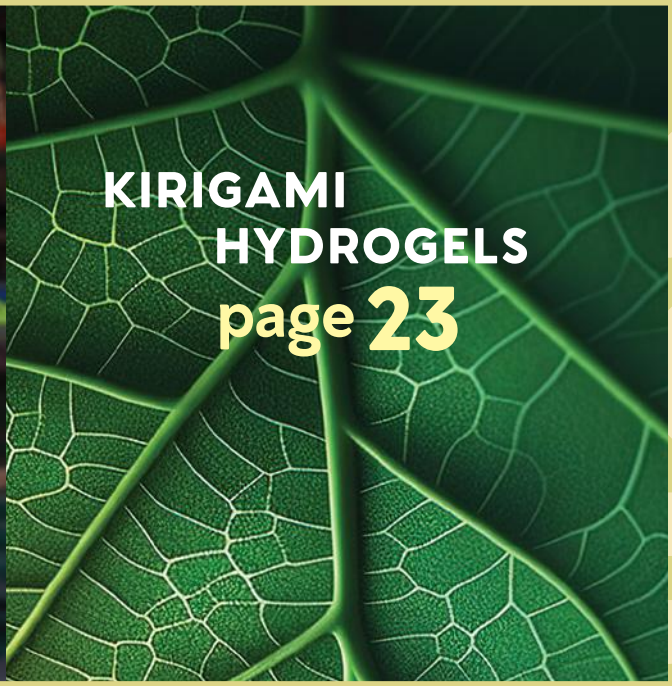

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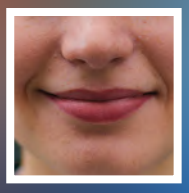

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Welcome to asia RESEARCH NEWS 2025

We are pleased to bring you Asia Research News 2025 magazine in our 21st year communicating science for Asia.

Recently, I recalled the first issue and reflected on our decision to publish a print magazine. At that time, I often travelled on United Kingdom country trade missions. Helpful officers at the embassies organised events and meetings, which enabled me to meet academic and industry leaders including company presidents, university vice-chancellors, and renowned scientists. On one occasion, the Vice-President of one of Asia's leading universities said that he believed our services were valuable but that we needed more print materials. That was a fair observation as everything we did then was online, from the press release platform to writing, media outreach, and news monitoring. Around the same time, other universities had expressed concern about the 24/7 news cycle. Research takes years, yet online news travels fast, sometimes too fast.

This is why with Asia Research News magazine, we provide a space to better appreciate new research findings, while still keeping in tune with the fast online realm. Hard-earned advances in knowledge deserve a longer shelf life. So, we publish once a year and promote widely. In print, sent to scholars across Asia and at key science and innovation conferences, on social media in multiple languages reaching 190 countries, and online at our platform of 25M search impressions a year.

Therefore, sit back, get a cup of coffee, and let us take you back to a 4,000-year-old mystery in the desert and to space, 13 billion years ago in search of black holes. Travel to the future where brilliant minds are pushing the needle towards better transportation and healthier lives, while levelling up our day-to-day materials and electronics, even taking inspiration from elephants and geckos.

We would love to hear from you. Have you been inspired by these scientists or have an inspiring story to tell? Get in touch at info@asiaresearchnews.com.

Beyond the magazine, explore our Newsroom for daily press releases from research institutions, join our community, and journey with us to communicate and nurture knowledge.

Magdeline Pokar
Founder and CEO

Magdeline Pokar

THE HUNT FOR SINGLE-ELECTRON BONDS

A century-old theory proposed by Nobel laureate Linus Pauling has been proven by scientists in Japan.

Covalent bonds, in which two atoms are bound together by sharing a pair of electrons, form the scaffolding that underpins the majority of organic compounds. In 1931, the Nobel laureate Linus Pauling suggested that covalent bonds made from just a single, unpaired electron could exist, but these single-electron bonds would likely be much weaker than a standard covalent bond involving a pair of electrons.

Since then, single-electron bonds have been observed, but never in carbon or hydrogen — the hunt for one-electron bonds shared between carbon atoms has stymied scientists.

Now, a team of researchers from Hokkaido University has isolated a compound in which a single electron is shared between two carbon atoms in a remarkably stable covalent bond, known as a sigma bond. Their findings are published in the journal *Nature*.

"Elucidating the nature of single-electron sigma-bonds between two carbon atoms is essential to gain a deeper understanding of chemical-bonding theories and would provide further insights into chemical reactions," explains Yusuke Ishigaki of the Department of Chemistry at Hokkaido University, who co-authored the study.

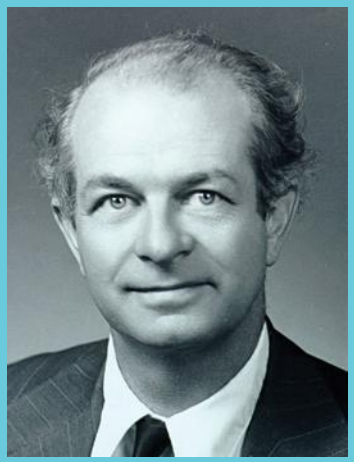
The single-electron bond was formed by subjecting a derivative of hexaphenylethane, which contains an extremely stretched out paired-electron covalent bond between two carbon atoms, to an oxidation reaction in the presence of iodine. The reaction produced dark violet-coloured crystals of an iodine salt.

Credit: Yusuke Ishigaki

Using an X-ray diffractor to study the sigma bond.

The team used X-ray diffraction analysis to study the crystals and found that the carbon atoms in them were extremely close together, suggesting the presence of single-electron covalent bonds between carbon atoms. They were then able to confirm this using a form of chemical analysis called Raman spectroscopy.

"These results thus constitute the first piece of experimental evidence for a carbon-carbon single-electron covalent bond, which can be expected to pave the way for further developments of the chemistry of this scarcely-explored type of bonding," says Takuya Shimajiri, the lead author of the paper and now at the University of Tokyo.



Credit: Oregon State University/ via Wikimedia Commons

Linus Pauling is the only person who won two undivided Nobel Prizes - in Chemistry in 1954 and the Peace Prize in 1962.

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Public Relations & Communications Division

SHAPE MATTERS

Ultrasound charging for biomedical devices penetrates the body better and researchers have shown that the receiver's shape improves energy transfer.

Ultrasound-based wireless power transfer is becoming a more attractive option to power implanted biomedical devices because it could overcome many of the limitations and challenges facing other wireless charging approaches. Now, a study published in *Nano Energy* has shown that the shape of the implanted receiver can significantly increase the efficiency of power harvesting from the ultrasound beam.

Current wireless charging technologies use either electromagnetic or radio waves to charge the batteries of implanted biomedical devices, such as pacemakers and cochlear implants. But these approaches lose a significant amount of power travelling through tissue, making them less efficient for deeper devices. They are also associated with potential problems, from tissue heating to immune effects.

Ultrasound can penetrate deeper into tissues without losing as much energy or causing major side effects. Jin Ho Chang from the Daegu Gyeongbuk Institute of Science and Technology in the Republic of Korea led a team of researchers in investigating how to improve ultrasound energy harvesting by altering the size, shape, and position of the implanted piezoelectric receiver.

They found that positioning the receiver within the focal area of a focused ultrasound beam significantly increased the efficiency of the energy transfer.

The piezoelectric receiver generated different phases of electrical signals depending on what part of the ultrasound beam it interacted with. The most efficient energy transfer took place in the beam's main lobe. In other words, larger wasn't necessarily better, even though a larger receiver would interact with more of the ultrasound beam.

Based on these conditions, an oblong-shaped ultrasound transmitter and receiver was developed. This transmitter forms a wide main lobe at the focal point, and the receiver matches the transmitted beam's output energy with high efficiency.

"The combination of a focused beam and a well-matched receiver allows oblong-shaped ultrasound transmitter and receiver to achieve significantly higher energy delivery compared to conventional ultrasound-based wireless power transfer systems," Chang says.

The system's efficiency was tested both under water and through 50 mm of porcine tissue. The oblong receiver was able to fully charge a battery through the tissue in 1.8 hours, which is well within the range required for commercial batteries.

"We believe that these findings will be a stepping stone for a significant advance in ultrasound-based wireless power transfer technology," says Chang. "Its innovative design and demonstrated effectiveness hold tremendous potential for powering the next generation of deep implantable biomedical devices."

Did you know?

A cochlear implant is an electronic device that assists people with hearing issues to sense sound. Implanted at an early stage of life, it could help young children hear, comprehend, and speak better than those who receive the device later in life.

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Further information

THE ELEPHANT ON THE WALL

Inspired by elephants, researchers grow fungus in elephant-skin patterns to create better insulation for buildings.

Keeping cool or warm is a daily issue for many. With climate change, this becomes an urgent matter for millions. Looking for environmentally friendly solutions, Singapore scientists have developed new wood-decaying-fungus tiles with an elephant-skin-inspired design. This offers a better approach than energy-intensive cooling or insulation using environmentally harmful materials.

"The materials currently used in walls to keep a pleasant temperature indoors consist essentially of glass wool for thermal insulation, and tile or paint with white colour for reflecting the sunlight. But glass wool and ceramic tiles or paint are materials produced using expensive processes and using non-biodegradable materials," explains Hortense Le Ferrand from Nanyang Technological University, who led the research funded by the National Research Foundation Singapore and ETH Zurich Switzerland.

"We combine elements of biomimicry with bioengineering by using a living material, which is a wood-decaying fungus, to produce the product," says Le Ferrand. The team first developed designs that mimic the texture of elephant skin, which has bumps and wrinkles for water to flow and evaporate, creating a cooling effect. They tested different designs with computer simulations to find an optimal pattern for insulation.

Next, they 3D-printed a tile in plastic and used that to create a silicone mould of the design. They could then grow fungus in the mould to create the final biodegradable tiles. The process is straightforward and doesn't require advanced equipment.

"Using waste biomass, in our case bamboo microfibres, and a natural common fungus, the tiles are part of a circular economy. Because they're made of natural materials, they're entirely biodegradable. But the

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Nanyang Technological University

The [tiles] are made of natural materials, therefore entirely biodegradable, while the special properties of the fungus also make them weather-resistant.


Credit: PRAB1988 via Wikimediacommons

special properties of the fungus also make them weather-resistant," says Le Ferrand.

The design of the tiles means that the textured front of the tiles heats more slowly and cools more quickly than the flat backside. Using them on the outside of buildings would thus help insulate from heat coming in while letting the building cool down. The tiles cool even more effectively when they're wet, making them especially useful in tropical environments like Singapore.

"This approach challenges traditional construction industries. The tiles and the process bring us closer to nature while placing human needs and well-being at the centre of the technology," says Le Ferrand.

The research was published in the *Journal of Cleaner Production* and *IOP Conference Series: Earth and Environmental Science*. The scientists collaborated with Singapore companies, bioSEA Ltd for design and Mykillio, for commercialisation of the tiles.


Credit: Eugene Soh

Sample fungus tiles inspired by elephant skin

Credit: Scot Nelson via Flickr

PUSHING THE NEEDLE TOWARDS GREENER, SAFER TRANSPORT

Three researchers at Xi'an Jiaotong-Liverpool University (XJTLU) are pioneering diverse technologies for greener, safer, and more efficient transport.

Transport causes one-fifth to one-quarter of all global carbon dioxide (CO_2) emissions. Road travel is responsible for three-quarters of transport emissions, meaning that road vehicles alone cause around 15% of global CO_2 emissions.

Despite initiatives to make cities more walkable and promote the use of public transport, road vehicles aren't going anywhere. The International Energy Agency (IEA) predicts that by 2070 global transport will double, car ownership will increase by 60%, and the demand for aviation will triple.

With a growing global population, increasing incomes, and growing freight volumes, we need a better solution than "just walk there." The world needs transport that can be powered without polluting the planet.

Powering greener cars

At Xi'an Jiaotong-Liverpool University (XJTLU), Xi Chen is among the researchers whose work may help address this problem. "As a researcher, I'm driven by the pursuit of knowledge and the desire to contribute to solutions that can have a positive impact on society and the environment," Chen says.

Chen's work focuses on energy storage, one of the key challenges in the global energy transition. She's working to improve lithium-ion batteries, the most commonly used battery technology today.

"What separates lithium-ion batteries from other batteries is their high and fast-growing energy density, relatively low self-discharge, and the ability to be recharged thousands of times, making them ideal for portable electronics and electric vehicles," Chen explains. But the technology is also plagued with challenges, such as well-publicised cases of battery fires and concerns around material waste due to their relatively short life cycle.

"One of the biggest problems in the development of energy storage is the need for materials with higher energy densities, faster charging capabilities, longer life cycles, and improved safety," says Chen. "The scalability of production and the environmental impact of battery manufacturing and disposal are also significant obstacles."

To address these challenges, Chen is trying to develop a special electrolyte that improves the cycling performance of a specific type of lithium battery. With her colleagues at XJTLU, she has already demonstrated the new electrolyte's potential to make lithium batteries stabler and higher performing.

One of the biggest problems in the development of energy storage is the need for materials with higher energy densities, faster charging capabilities, longer life cycles, and improved safety.

Credit: XJTLU

Xi Chen is working to improve lithium-ion batteries for better stability and performance.

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Further information

"The real world is unpredictable, with moving cars, people and animals and constantly changing factors like weather, and lighting conditions. An autonomous system has to adapt to these in real time.

Smarter cars

The future of transport isn't just about going green. By some estimates, almost 95% of road accidents are caused by human error. Despite the major hurdles facing them, driverless cars could improve road safety and make transport more efficient.

Fan Zhu, an expert in robotics at XJTLU, says that AI-driven robotics have enormous potential to improve human life and enterprise. "My research emphasises enhancing human-robot interaction, enabling robots to work more effectively and intuitively alongside humans in dynamic environments," says Zhu.

That includes on the road. Zhu says autonomous navigation could reduce accidents, optimise route planning and fuel consumption, and offer greater freedom and mobility for people with physical limitations.

Credit: XJTLU

Fan Zhu is developing algorithms for sensor fusion and environmental perception to improve autonomous vehicles.

But there are complex challenges when it comes to designing systems clever enough to navigate a dynamic, ever-changing world. "The real world is unpredictable, with constantly changing factors like weather, lighting conditions, and traffic patterns," says Zhu. "An autonomous system has to adapt to these variations in real time, requiring sophisticated perception and decision-making capabilities."

The challenge is made even more complicated by the presence of moving obstacles, including other cars, pedestrians, and animals. An autonomous driving system has to sift through data gleaned from sensors to interpret what's around it and make fast decisions in these environments.

"Sensors can produce noisy or ambiguous data due to interference, occlusion, or limitations in resolution," says Zhu. "Developing algorithms that can effectively interpret and make decisions based on uncertain information is a significant challenge." Add to that the difficulties of navigating in three dimensions, as well as the difficulty of processing all this information in real time, and it becomes clear how big the challenge is.

There's also a moral dimension to programming autonomous vehicles, says Zhu, since they have to make decisions where human lives are at stake.

Zhu's work involves developing algorithms for sensor fusion — melding visual, acoustic, and tactile cues, for example — and environmental perception, with a view to improving the accuracy and reliability of these vehicles.

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Xi'an Jiaotong-Liverpool University

Taking to the water

These sorts of innovations won't just be useful on land. Xiaohui Zhu from XJTLU's department of computing says autonomous navigation could also revolutionise marine transport.

"By leveraging advanced technologies in AI, sensors, and GPS, unmanned surface vehicles (USVs) can navigate the seas and rivers more efficiently than ever before," says Zhu. That means a "significant reduction in human error," which is a major cause of transport accidents on waterways.

Zhu's work focuses on integrating AI and robotics in USVs to make them better adapted to diverse aquatic environments — in particular, enabling them to sense their environment accurately and make quick, complex decisions for autonomous navigation and obstacle avoidance.

"Traditional methods based on deterministic rules can solve some problems in autonomous navigation, but there are too many uncertainties and unknown scenarios," says Zhu. "Relying on AI methods is an important approach for addressing these uncertainties."

Zhu's work isn't all offshore. Together with Higer Bus Company Limited and the automotive vision company Foresight, Zhu is co-leading a major project to develop multi-sensor 3D perception for autonomous buses. "This research will significantly strengthen the sensing ability of vehicles, especially in adverse weather conditions, which is essential for autonomous driving," Zhu concludes.

Credit: XJTLU

Xiaohui Zhu focuses on integrating AI and robotics in USVs to make them better adapted to diverse aquatic environments.

By leveraging advanced technologies in AI, sensors, and GPS, unmanned surface vehicles can navigate the seas and rivers more efficiently than ever before.

Passenger ferry Sunflower Shiretoko sailed autonomously for 750 kilometres in 2022.

Credit: Wikimedia Commons CC BY-SA 4.0

Assoc Prof Dr Xiaohui Zhu | Xiaohui.Zhu@xjtlu.edu.cn
Xi'an Jiaotong-Liverpool University

AI PREDICTS THE PROPERTIES OF POLYMERS

The algorithm uses data from existing materials to accurately predict the strength and flexibility of new unknown polymers.

Polymers such as polypropylene are found in everything, from computers to cars. Because of their ubiquity, it is vital to know how each newly developed polymer will perform under different conditions.

Predicting the mechanical properties of new polymers, such as their tensile strength or flexibility, usually involves putting them through destructive and costly physical tests. Now, scientists from Japan's National Institute for Materials Science (NIMS) have shown how machine learning can determine what to expect from a new polymer. Their study was published in the journal *Science and Technology of Advanced Materials*.

"Machine learning can be applied to data from existing materials to predict the properties of unknown materials," study authors Ryo Tamura, Kenji Nagata, and Takashi Nakanishi explain. "However, to achieve accurate predictions, it's essential to use descriptors that correctly represent the features of these materials."

Polymers have a complex structure that is further altered during the process of molding them into the shape of the end product. Therefore, it was important for the team to adequately capture the details of the polymers' structure with X-ray diffraction and to ensure that the machine learning algorithm could identify the most important descriptors in that data.

To that end, they analysed two datasets. The first dataset was X-ray diffraction data from 15 types of polymers subjected to a range of temperatures, and the second was data from polymers with elastomers. The mechanical properties analysed included stiffness, elasticity, the temperature at which the material starts to deform, and how much it would stretch before breaking.

The team found that the machine learning analysis accurately linked features in the X-ray diffraction imagery with specific material properties of the polymers, with some easy to predict and some more challenging.

"We believe our study will offer a non-destructive alternative to conventional polymer testing methods, and it can also be used to understand properties of other materials, both inorganic and organic," the NIMS researchers say.

Further information

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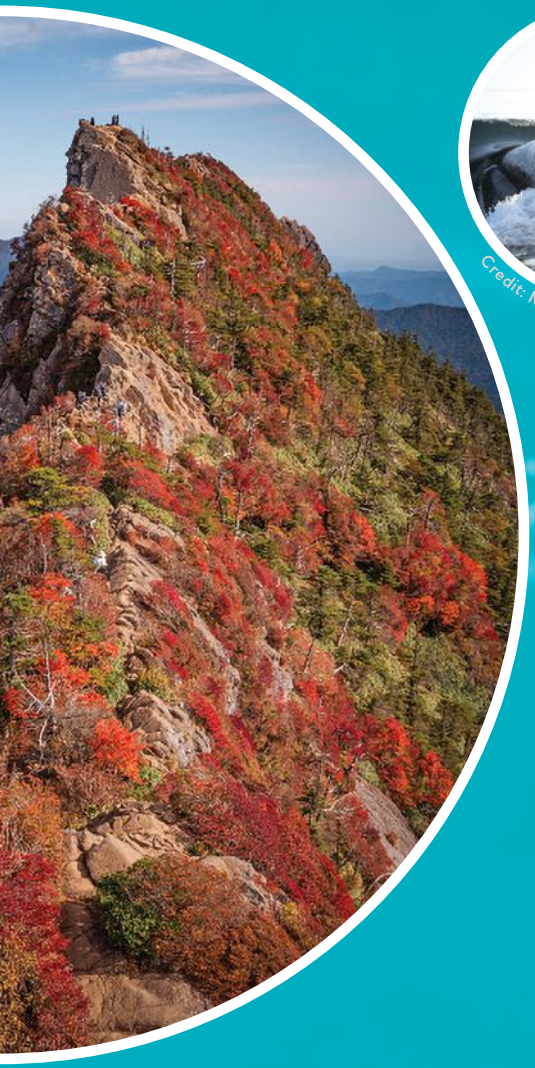

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Whales in long-distance relationships

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Decoding dead stars' "heartbeats"

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Visionaries shaping a new Myanmar

International Development Research Centre

How tissues grow with defined structures

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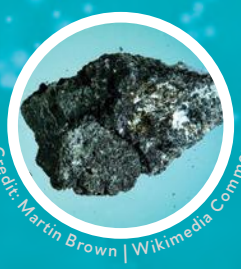

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What's inside the moon

Ehime University


Credit: NOIRLab/NSF/AURA/M. Garlick

Earliest twin quasars found
Kavli IPMU, The University of Tokyo

Protecting science in times of crisis
International Science Council
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Balancing cell membrane
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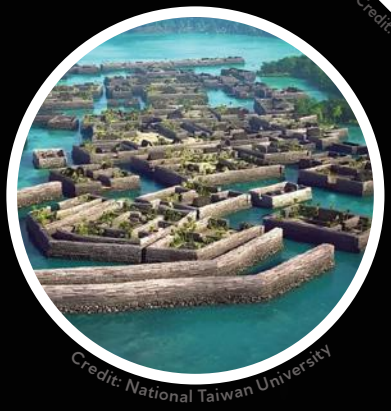
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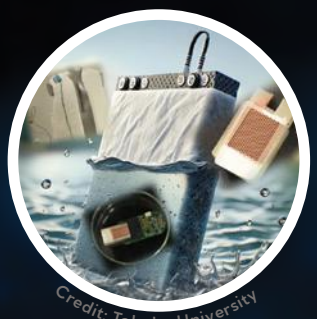
Paper-based battery for wearable devices

Tohoku University



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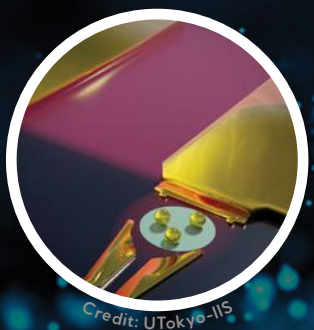
Illuminating crystals

Science and Technology of Advanced Materials Journal

Quantum electronics leap

Institute of Industrial Science
The University of Tokyo



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Credit:SUTD

3D-printed meals

Singapore University of Technology and Design

Staying cool in a warming planet

City University of Hong Kong

Credit: City University of Hong Kong

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Blue energy future

Osaka University

SENSING SHAPE WITHOUT TOUCH

Touch sensors for robots and bionic applications can now work from 100 mm away, offering new sensitivity for 3D recognition and wireless data transmission.

A new type of touch sensor for robotics and other bio-mimicking (bionic) applications is so sensitive that it works from up to 100 mm away, without direct contact between the sensor and the objects being detected.

Electronic skins have become a crucial element in bionic robots, allowing robotic systems to analyse an object's shape, and to pick it up and move it.

Researchers at Qingdao University in China, with collaborators elsewhere in China and South Korea, developed a sensor that detects interference in the electric field between an object and the sensor from 5 mm to 100 mm away. They described their innovation in the journal *Science and Technology of Advanced Materials*.

"To bring greater sensitivity and versatility to the sensor, we have developed new composite films with surprising and very useful electrical properties," says Xinlin Li of the Qingdao University team.

The most surprising finding came when the researchers combined two materials with a high dielectric constant — a measure of their response to electric fields. This composite had an unexpectedly low dielectric constant, a counter-intuitive result ideally suited to making a sensor that is more sensitive to electric fields.

The composite of graphitic carbon nitride and polydimethylsiloxane, a silicone polymer, was then 3D-printed into a grid that could detect objects before contact. The researchers tested its capabilities using their fingers.

"The performance was outstanding, in terms of sensitivity, speed of response, and robust stability through many cycles of use," says Li. "This opens new possibilities in wearable objects, electronic skin, and remotely controlling devices."

The scientists incorporated the sensor into a printed circuit board allowing data to be transmitted over 4G networks used by mobile phones and other devices.

They now plan to develop the technology for mass production and explore further possibilities like gesture recognition, obstacle avoidance, and applications in intelligent medical care.

Credit: STAM

3D finger recognition and data transmission to a mobile phone.

Credit: iStock | natasaadzic

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STAM Editorial Office

KIRIGAMI HYDROGELS RISE FROM CELLULOSE FILM

Nanopapers that swell into larger 3D structures pave the path towards designs of intelligent materials like robotic sensors and tissue engineering.

Hydrogels have a network of water-attracting (hydrophilic) molecules, allowing their structure to swell substantially when exposed to water. Researchers Daisuke Nakagawa and Itsuo Hanasaki from Tokyo University of Agriculture and Technology (TUAT) are looking into new options for making "kirigami hydrogels" that swell into complex 3D structures.

This emerging materials field is named after the Japanese art of cutting papers. It involves patterns cut into a nanopaper that can later swell into hydrogels with varied applications, including tissue engineering. The research is published in the journal *Science and Technology of Advanced Materials*.

The researchers worked with an initially dry film composed of nanofibres of cellulose, the natural material that forms much of the structure of plant cell walls. They used laser processing to cut patterns into the nanopaper.

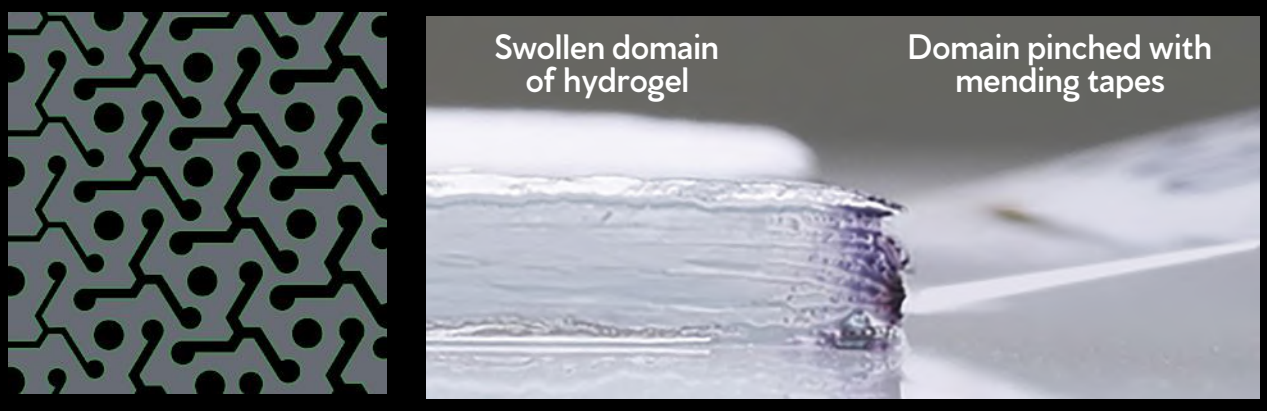
This particular design of the kirigami pattern works in such a way that the width increases when stretched lengthwise.

"As kirigami literally means the cut design of papers, it was originally intended for thin sheet structures. Our two-dimensional mechanism manifests when the thickness of the sheet is sufficient, enabling a three-dimensional hydrogel structure to emerge when swelled. This allows easy storage in the dry state before use, without keeping the same water content level of the hydrogel," says Hanasaki.

Furthermore, this property is maintained even with repeated use.

Potential applications for the adaptive hydrogels include soft components of robotic technologies, soft switches, and sensors. Hydrogels are also being explored for medical applications, such as tissue engineering, wound dressings, drug delivery systems, and materials that can adapt flexibly to movement and growth.

"Keeping the designed characteristics while showing adaptivity to the environmental condition is advantageous for the development of multifunctionality," Hanasaki concludes.



They used lasers to cut structures into the film (left), allowing it to swell into complex 3D structures (right) when water is added.

Credit: Modified from original image by STAM

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SOLVING CLIMATE MYSTERIES WITH CORALS

Tsuyoshi Watanabe uses corals to understand the environment of the past and what it can tell us about people living then.

Corals are animals that live in shallow tropical waters. They spawn around the time of a full moon, and the larvae attach themselves to the seabed and start building a skeleton made of calcium. Then they divide and spread out as a colony, eventually forming a coral reef. The reefs can exist for thousands of years, even after the coral has died.

Corals have a symbiotic relationship with algae called zooxanthellae. The algae produce food through photosynthesis, and the coral provides the algae with shelter. Excess nutrients, expelled as mucus, attract microorganisms and the fish and shellfish that prey on them, building a rich ecosystem around a coral reef. Over time, corals become deeply engraved with the history of the global environment and human civilisations.

Turning back time

Tsuyoshi Watanabe, a Senior Lecturer at Hokkaido University's Faculty of Science, specialises in coral dating and climate change research. He and his team slice coral skeletons into thin sections and then study the coral's annual rings, which are similar to the growth rings of trees. Samples from each ring are then ground into a fine powder and dissolved in acid to produce carbon dioxide. The team measures the isotope ratios of oxygen and carbon to get an idea of the environment the coral lived in, such as water temperature and precipitation levels. Combining this data with historical records can tell us about how people lived in particular periods.

For example, in 2019 Watanabe's team published a study about the fall of the Akkadian Empire, which was founded in Mesopotamia about 4,600 years ago. The Akkadian Empire flourished for about 400 years, but then collapsed suddenly. It was located in a prosperous agricultural region, but coral data revealed that there was a time when dry winter winds blew continuously for up to three months. The prolonged dryness may have made the area uninhabitable, leading to the empire's demise.

Unearthing fossilised corals in the Mesopotamian region.

Credit: Tsuyoshi Watanabe

The Akkadian Empire was founded in Mesopotamia about 4,600 years ago but collapsed suddenly.

Further information

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> **We are all born alone. Then we start a family, get friends, and establish settlements and countries. When you think about it this way, corals and people are very similar. Both have gradually created the environment in which they live.**

Hearts and minds

Watanabe and his team repurposed a closed primary school on Kikai Island in Japan to create the KIKAI Institute for Coral Reef Sciences in 2015. In collaboration with local communities, the team has also used theatre to spread information and teach people about corals. Kikai is a coral reef island, and for generations the inhabitants have lived off fish from the reefs, built walls and tombs from coral, and developed songs and dances about harmony with the coral ecosystem.

"I realised that we should interpret the data not just as a prediction of the future but also of whether people's hearts and minds will follow this vision of society. It's important to think together about what kind of future we would like to achieve or accept. Through theatre, we can reach deeper into the minds of the people in the past and what kind of future the people here identify with," explains Watanabe. He's been approached to build coral research and education centres on other islands as well. "I feel that what's happening here is a good cycle for both the researchers and the people."

Following in coral's footsteps

Corals span space and time, from the fleeting to the immense. The larvae are just a few millimetres, free-floating for about a week before attaching to the seabed, but large reefs can be thousands of kilometres in size and exist for thousands of years. "Since the Industrial Revolution, people have been burning fossil fuels and changing the planet's climate. Corals have adapted to changes in the past, but if human-induced climate change happens faster than corals can adapt, then we'll have a tough future ahead of us," laments Watanabe.

Credit: Miho Nagao

Watanabe with mass spectrometer for measuring isotope ratios in corals.

Did you know?

Coral skeletons help scientists determine past climate. There are two oxygen isotopes in ocean water: oxygen-16 (O-16) and oxygen-18 (O-18). Ice sheets store more O-16, so when there is more ice around, there is less O-16 in the seawater. Corals use seawater to build their skeletons, thus these will have more O-18 during cooler periods.

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Further information

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Credit: Korean Royal Culture Cuisine Foundation

KEEPING ROYAL CUISINE ALIVE

Hwang Hye-seong (5 July 1920 – 14 December 2006) was an expert on Korean royal court cuisine. Formerly an assistant professor of nutritional science, Hwang met the last kitchen court lady in the Joseon Dynasty, Han Hui-sun, and learned about the culinary traditions of the royal court from her. She founded the Institute of Korean Royal Cuisine in 1971 and was appointed the Technical Expert of Cultural Properties the following year. In a career spanning thirty years, she produced several publications on Korean royal court cuisine, made presentations in the media, and conducted courses all over the world.

HEART-SAVING DRUGS FROM FUNGI

Akira Endo (14 November 1933 – 5 June 2024) was a Japanese biochemist. In 1973, he discovered the first statin, called mevastatin, which lowered cholesterol levels in the blood. His work laid the foundation for the development of statins to help patients with high cholesterol and reduce their risk of heart disease or stroke. The discovery supported his hypothesis that fungi produce chemicals that inhibit cholesterol synthesis and ward off parasites. Endo did not derive any financial benefit from his discovery, yet revolutionised heart disease and stroke prevention and saved millions of lives.

Credit: Japan MEXT via Wikimedia Commons (CC BY 4.0)

Credit: Live History India via Wikimedia Commons (CC BY-SA 4.0)

A PHYSICS CAREER BUILT ON CLAY

Purnima Sinha (12 October 1927 – 11 July 2015) was the first Bengali woman to receive a doctorate in physics from Calcutta University. She analysed clay structures using X-ray equipment that she built from salvaged World War II-era parts. Her research and subsequent efforts led to a complete classification of more than fifty clay samples. Her later work at Stanford University's "Origin of Life" project uncovered a connection between the X-ray structure of clay and the patterns in DNA. Outside the laboratory, she translated science books into Bengali and was also a talented musician who played the tabla, an instrument usually played by men.

Discover more GIANTS IN HISTORY

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A WRINKLE FOR LIGHT

A new model for light emission from ultrathin materials could ease the development of photonic devices and quantum technology.

Stretching or bending, which is better? A lucky discovery led researchers to a new understanding of how ultrathin materials absorb and reflect light. The new model — if confirmed — could change the way ultrathin materials are developed and used.

The discovery came when researchers at the United Kingdom's National Physical Laboratory were examining thin semiconducting materials known as transition metal dichalcogenides (TMDs). These materials have potential applications in nanoelectronics and quantum computing, but two-dimensional TMDs are especially interesting because of their ability to absorb and emit light. Bending or stretching these materials can result in the emission of individual photons from specific areas, which is extremely useful for secure quantum communication. Their findings were published in the journal *Science and Technology of Advanced Materials*.

The team was using these materials to test an instrument when they made an unexpected discovery. "When we started this study, we were simply trying to use the localised light emission from wrinkles as a way to test the resolution of our instrument but experimental science is full of surprises!" says lead author Sebastian Wood. "It wasn't possible to explain the results we found using existing models, so this stimulated us to think further."

Existing models proposed that single-photon emission by TMD materials was a result of the strain on the materials, but they don't distinguish between strain caused by stretching or bending. The team's detailed analysis enabled them to differentiate the two types of strain. "We propose that bending is more important than stretching for achieving localised emission, which has major implications for how the materials are developed and used," explains Wood.

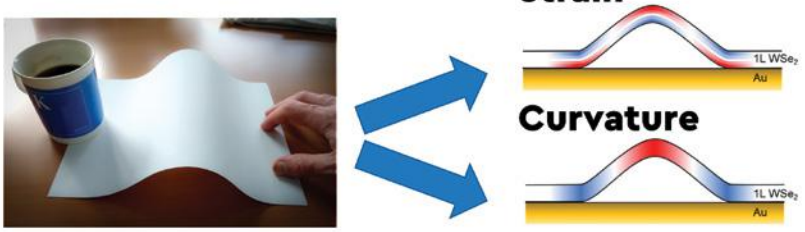
"Discovering that the accepted models in literature were not able to explain our results presented an exciting challenge. We had to think again about the fundamental physics of the experiment, resulting in this important insight," adds Wood. "The next step is for other groups to scrutinise our work and reproduce our results. We're also discussing with some other research groups about a theoretical study of the proposed model."

If confirmed, researchers can use the curvature of ultrathin TMD materials to control photon emission, offering a valuable tool for engineering optoelectronic materials and quantum technology.

Did you know?

TMDs are a family of thin semiconducting materials which can absorb and emit light. Bending or stretching them can emit individual photons from specific areas, which is useful for secure quantum communication.

Credit: NPL Management Ltd



Schematic diagram illustrating the distinction between strain and curvature in wrinkled material.

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STAM Editorial Office

The Knowledge for Democracy Myanmar (K4DM) initiative supports scholars to develop their knowledge and skills in leadership, public policy, federalism, applied social sciences, migration, digital rights and safety, and higher education.

Initially launched in 2017 by Global Affairs Canada and Canada's International Development Research Centre, K4DM helped strengthen local research and analytical capacity of Myanmar scholars to address decades of systematic underinvestment in higher education and research. The military coup in February 2021 brought new setbacks and a second phase of K4DM was launched in 2022 to protect gains in Myanmar's civil society and nurture a new generation of scholars for an inclusive Myanmar.

KNOWLEDGE FOR THE EXCLUDED

An inclusive Myanmar must include all voices. One voice is from the Rohingya, who have faced persecution for many years. IDRC's Knowledge for Democracy Myanmar supports scholars and research from and about the Rohingya people to generate evidence-based policy advice and empower a new generation of thought leaders.

Credit: K4DM / Center for Climate Change and Environmental Health (3CEH), Asian University for Women (AUW)

Asia Research News is K4DM's communications consultant.

Further information
Knowledge for Democracy Myanmar (K4DM) initiative | myanmar@idrc.ca
International Development Research Centre (IDRC)
K4DM.CA

Life in the camps

Cox's Bazar is the world's largest refugee camp, home to almost a million refugees. Here, seven scientists from the Asian University for Women (AUW) have been looking into issues the communities face, ranging from human-elephant conflict to child marriages.

Mosaddika Mounin's review of the education landscape for refugees at the camp can be adapted for refugees worldwide. She collected data from teachers, parents, and students at primary and secondary levels to assess the education environment, calibre of educators, the education path, and options for higher education, mapping out existing challenges with suggestions for enhancing refugee education and support mechanisms.

Fires at Cox's Bazar have made international news headlines and are a constant hazard. Parmin Fatema's research sheds light on how this affects the community. Many interviewees believe the massive fires were acts of arson while smaller fires stem from overcrowding within the camp. The impact goes beyond physical damage as people interviewed have been traumatised and have a pervasive fear of recurring disasters.

Overcrowding also enables diseases to spread easily. Taslima Razzak studied the impact of indoor pollution and found levels of humidity, particles, and air quality surpassing the World Health Organisation (WHO) guidelines, and a worrying correlation with respiratory ailments such as coughing, breathing difficulties, asthma, and tuberculosis and infectious skin conditions.

Credit: K4DM / Center for Climate Change and Environmental Health (3CEH), Asian University for Women

Parmin Fatema (front) and Taslima Razak presenting their research on the impact of fires and indoor pollution.

Mosaddika Mounin (left) and her colleagues, Sadia Salim (middle) and Tahiya Tasnim (right), conducted their research at AUW's Center for Climate Change and Environmental Health. The poster visualised two sides of life women face in pursuing education: on the left are difficulties including bullying, teasing, harassment, and kidnapping while the right side represents hope that education brings towards building a brighter tomorrow.

Credit: K4DM / Center for Climate Change and Environmental Health (3CEH), Asian University for Women (AUW)

Refugees at Cox's Bazar used to rely on firewood to survive. Now they have access to gas through an initiative by international organisations, the Bangladesh government, and partners. The shift improved air quality in the camps, reduced risks for women who gathered wood, and helped rehabilitate the forests.

Photo taken on a K4DM visit to Cox's Bazar.

Nazifa Rafa examined energy access and the importance of empowering refugees to shape sustainable energy solutions in humanitarian efforts. Her interviews revealed how issues with food security, health, education, access to clean water, and gender inequalities impede progress towards the United Nations' Sustainable Development Goals and underscored the need for inclusive policies and interventions.

The refugee camp was built near the natural habitat of endangered wild Asian elephants. Human needs for shelter have come at the price of deforestation, leading to human-elephant conflicts that resulted in serious injuries and deaths. In response, the Elephant Response Teams and Watchtowers were set up to warn people when elephants are nearby and to avoid them. While these are effective, Nafisa Islam's research still shows a significant increase in conflicts since 2015.

WHO data shows that worldwide, a mother or mother-to-be dies every 2 minutes due to pregnancy or childbirth complications, with almost 95% occurring in low or lower-middle-income countries. Access to health professionals can mean life or death for the mother and baby. So what is it like in refugee camps? Omar Salma has been gathering information about where women choose to give birth, and why they made that decision. After speaking to about 400 women, she found that a substantial majority opted for home deliveries and a number of factors played into the decision, from socioeconomic status and education levels to accessibility of and trust in healthcare providers.

Looking further into the issue, Tofrida Rahaman talked to 400 adolescents and young adults about child marriage and teenage pregnancy. Despite seeing a decline in the past decade, the United Nations Children's Fund (UNICEF) reported that globally one in five girls have been married under the age of 18. At the camp, despite a high awareness of the legal marriage age and family planning, a significant majority of teenagers had already experienced pregnancy before turning 18. She learnt the reasons aggravating this is insecurity, poverty, and illiteracy compounded by cultural and social norms, family honour, and limited legal protection.

Credit: Dr Edgard Rodriguez

Credit: K4DM / Center for Climate Change and Environmental Health (3CEH), Asian University for Women (AUW)

Elephant warning sign made of recycled plastic at a camp in Cox's Bazar. Elephants need hundreds of kilos of vegetation each day and roam a large area in search of food and water, bringing them in conflict with humans.

Photos taken on a K4DM visit to Cox's Bazar.

Every Rohingya person I've met is looking for a brighter future for themselves and their families. In today's world, they need to have access to higher education.

Edgard Rodriguez, IDRC

Displaced lives

Education is key to a nation's future. Yet, going to school can be dangerous or impossible in times of conflict. To continue their education, many Myanmar students have turned to online solutions provided by Myanmar innovators. For Rohingya students, years of persecution have made it even more difficult for many to qualify for higher education, depriving them of training and access other students take for granted.

To assist Rohingya students in their transition to higher education, K4DM partnered with a Myanmar non-governmental organisation and Parami University, a virtual university for Myanmar students, for a university preparation programme. The programme improved students' English and mathematical skills and enabled access and training on computer usage and set-ups for online interviews and classes. Upon acceptance to the university, students have a follow-up programme that includes mentorship, monthly counselling, and additional support to fill knowledge gaps.

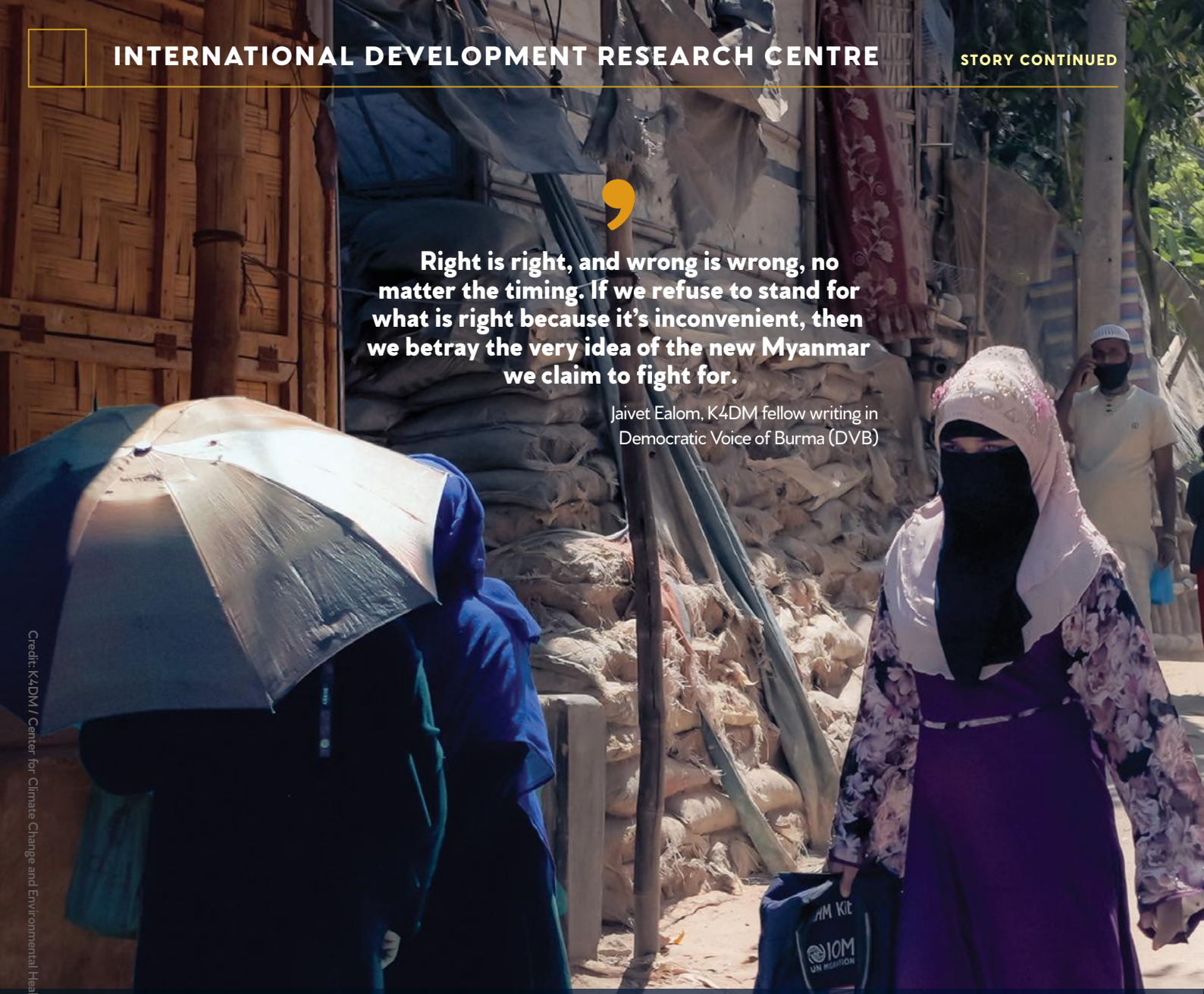
In a focus group discussion, Rohingya students expressed their joy in being able to pursue their dreams of a university education and the support it brings. "We have each other. We have a community of young students like ourselves. We talk about our challenges but also our dreams. One day, we will meet each other and have a trip together."

"Every Rohingya person I've met is looking for a brighter future for themselves and their families. In today's world, they need to have access to higher education. Yet, few international donors or host countries have been able to fulfil this aspiration from young refugees," says Edgard Rodriguez, Myanmar lead at IDRC's Asia Regional Office.

With other partners like Spring University Myanmar, K4DM supported a young policy fellows programme which has over 100 Myanmar students graduated from its online certificate course. In addition, The SecDev Foundation is diving into Myanmar's digital space, focusing on areas ranging from education to cybercrime and security. Their research highlighted issues students and teachers face such as security constraints, cyberbullying, poor computing devices, and lack of electricity and internet connectivity, which are compounded by the digital divide across locations and gender. For example, some towns get access for up to 8 hours while ethnic regions have only 4 hours of power; meanwhile, women have also expressed more apprehension about being online.

Credit: K4DM / Center for Climate Change and Environmental Health (3CEH), Asian University for Women (AUW)

Photo taken on a K4DM visit to Cox's Bazar.



Right is right, and wrong is wrong, no matter the timing. If we refuse to stand for what is right because it's inconvenient, then we betray the very idea of the new Myanmar we claim to fight for.

Jaivet Ealom, K4DM fellow writing in Democratic Voice of Burma (DVB)

Credit: K4DM / Center for Climate Change and Environmental Health (3CEH), Asian University for Women (AUW)

Language is also a barrier as most resources are in English, further hindering access to knowledge. Inadequate classroom interaction is another issue since education entities are constantly monitored by the military. For personal safety, teachers and students turn off their webcams and conceal their real identities. However, this takes away teachers' ability to see students' facial expressions to monitor understanding, and the increased reliance on audio also means shyer students get left behind.

Additionally, K4DM partners are delving deeper into diplomacy, the mental health of refugees, and evolving public opinions. In 2025, Malaysia will assume Chairmanship of the Association of Southeast Asian Nations with a pledge to enhance regional cooperation. Experts from the Asia-Europe Institute at University Malaya will be working with the Malaysian Advisory Group on Myanmar to advocate policies and potential diplomatic solutions. At Thailand's Chiang Mai University, Nyi Nyi Kyaw, former IDRC Research Chair on Forced Displacement in Southeast Asia, has been looking into the mental health of Rohingya refugees. Meanwhile, researchers at Universitas Indonesia's Asian Research Center have supported Rohingya scholars continuing their research and will be analysing shifting public attitudes towards Rohingya refugees in Muslim-majority Indonesia and Malaysia, countries once perceived as safe havens for Rohingya people.

Rohingya scholars advocating in Canada

In 2012, John Jonaid was studying Physics at Sittwe University in Myanmar when violence erupted which saw his friends and family killed. Overnight, John became a refugee fleeing Rakhine state, moving to India, China, Indonesia, and Malaysia. He finally settled in Canada as a journalist and human rights advocate after a decade searching for freedom. Under a K4DM fellowship, Jonaid continued voicing the plight of the Rohingya people at The Parliamentary Centre, Canada's premier non-governmental organisation dedicated to supporting inclusive democracy globally, even as his public writings and

Photo taken on a K4DM visit to Cox's Bazar.

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If someone sees the Rohingya's old photos, those photos will tell him or her the history of the Rohingya. How they looked. How their culture looked. When these things are seen, their understanding of the Rohingya will be awakened.

Rohingya elder, on Ek Khaale

Credit: Greg Constantine

talks continue to put his family in danger. Jonaid also co-founded The Archipelago Magazine and the Humans in Flight project, a platform for refugees to narrate their journeys, and has published articles in international media like the BBC (British Broadcasting Corporation), CBC (Canadian Broadcasting Corporation), and Al Jazeera. He is currently in a graduate programme at Carleton University researching elements connected with migration and diaspora in a globally connected world.

Fearing for his life, Jaivet Ealom left Myanmar in 2013 and travelled through six countries seeking asylum. He is the only person known to have successfully escaped from Australia's Manus Island Detention Centre, detailed in his book "Escape from Manus Prison: One man's daring quest for freedom." Now based in Toronto, he was a K4DM fellow at the Myanmar Policy and Community Knowledge (MyPACK) Hub at the University of Toronto's Asian Institute. Having recently graduated in political science and economics, he is the interim CEO at the Rohingya Centre of Canada and is currently working with a group to form the Rohingya Consultative Council. He serves as an advisor to the Ministry of Human Rights at the National Unity Government of Myanmar.

Ek Khaale, the Rohingya expression for "Once Upon A Time," is a storytelling and visual restoration project launched in 2021 by photographer Greg Constantine. He has worked with Rohingya youth and elders to expose the unseen past from old photographs, family collections, documents, letters, and illustrations combined with historical materials from a variety of public and private archives. With support from K4DM, Ek Khaale has been presented and exhibited in Thailand and Canada in a series which engaged the public, policymakers, students, and Myanmar communities, providing opportunities for shared Myanmar narratives.

K4DM.CA

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Further information

NEW TWIST TO GECKO-INSPIRED ROBOTS

The sticky secret of a gecko's foot has inspired scientists to develop robots that can pick up and release fragile objects without damage.

The subtle adhesive forces that allow geckos to seemingly defy gravity, cling to walls, and walk across ceilings have inspired a team of researchers in South Korea to build a robotic device that can pick up and release delicate materials without damage.

The team, based at Kyungpook National University and Dong-A University, published their research work in *Science and Technology of Advanced Materials*. The researchers are hoping it can be applied to the transfer of objects by robotic systems.

The gecko's innate adhesive ability to climb walls has drawn the attention of many researchers. An artificial mushroom-shaped dry adhesive that mimics this mechanism has been used to robotically pick up materials. However, the force needed to detach the adhesive from the material's surface can lead to its damage, especially if the material is fragile, such as glass.

"There have been problems in getting the adhesive to detach easily," explained Seung Hoon Yoo, first author of the research article.

The team resolved this problem by using a vacuum-powered device, made of soft silicon rubber. In order to detach the dry adhesive without damaging the fragile object, a new method was introduced, involving a twisting and lifting motion that pulls the dry adhesive off of the glass surface. The addition of this twisting motion caused a ten-fold reduction in the force required for detachment.

"We expect our research will garner significant interest from the industry, since many companies are very interested in using dry adhesives for temporary attachment and movement of components, especially in robotic applications," said Sung Ho Lee, one of the study's authors.

Further information

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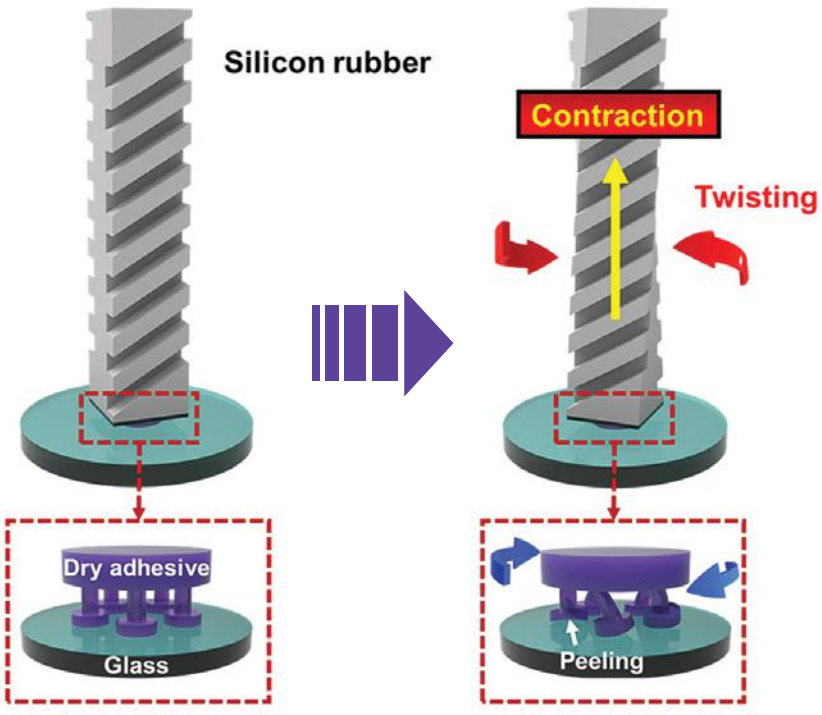
Did you know?

The secret of a gecko's foot lies in its protein-coated tiny hairs. Each hair divides into branches that end in flat triangular pads, so small that their molecules create weak forces of attraction with the surface it is climbing. This force known as van der Waals is what holds the gecko in place.

Gecko's can climb vertical surfaces at up to 77 cm/s. That's almost 2 miles per hour.



The robotic device has a vertical silicon rubber (left) with dry adhesive separated into several triangular pads. The pads stick to the glass as they are pressed down and peel off with upward twisting motion (right).

Credit: Modified from original image by STAM

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STAM Editorial Office

UNLOCKING THE SECRETS TO A LONGER, HEALTHIER LIFE

At Duke-NUS Medical School scientists are pioneering breakthroughs in precision medicine and regenerative therapies, targeting everything from muscle loss to dramatically extending our years of health.

As populations grow older, societies face mounting social, economic, and health challenges, making it increasingly urgent to find interventions to slow the effects of ageing.

The proportion of Singapore residents aged 65 and above grew from 7.2% in 2000 to 16% in 2021 and is projected to reach 24.1% by 2030. This demographic shift highlights the need for significant infrastructural and personal care resources. Longer life expectancy also brings with it a need to prevent physical decline and frailty in older adults.

One way scientists from Duke-NUS' Centre for Ageing Research and Education are tackling this is by developing novel *AI screening tools to identify senior citizens most at risk of falling* and reducing that risk through tailored, multi-modal and multi-component interventions, work that is underway in a randomised clinical trial.

Scientists at Singapore's only graduate-entry medical school are also harnessing regenerative medicine to improve the quality of life of ageing populations. By developing therapies that target the root causes of ageing, such as muscle degeneration and impaired tissue repair, they hope to extend not just lifespan but also healthspan — the period during which people remain active and independent. These interventions could yield vast social and economic benefits, reducing the burden on healthcare systems while enhancing the lives of the elderly.

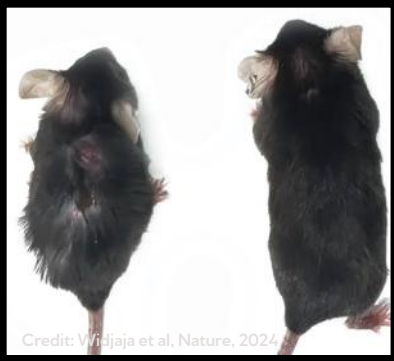
Is a protein the hidden enemy of youth?

In earlier work, researchers from Duke-NUS had linked the protein interleukin-11 (IL11) with inflammation in the heart, kidneys, liver, and lungs. Then, they discovered that IL11 levels rise with age, promoting inflammation and accelerating ageing.

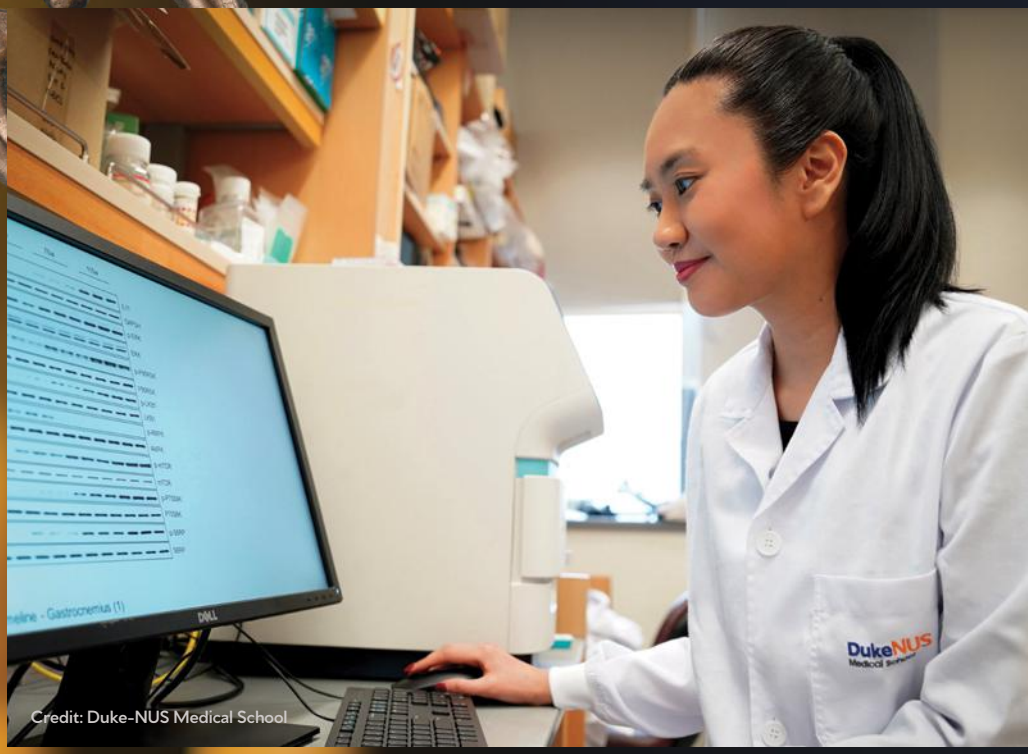
In experiments on mice, the researchers either genetically prevented the production of IL11 or treated the mice with a drug that removed the protein. These interventions extended the mice's healthspan (the number of years lived in good health) and lifespan (time lived) by up to 25%, in both sexes.

The researchers nicknamed the treated mice "supermodel grannies " because they appeared younger, were healthier, and developed fewer cancers than untreated mice. They also demonstrated improved metabolism and muscle function, had healthier fur, and got lower scores on frailty tests.

With this data, which was published in *Nature*, the researchers plan to advance the drug into human trials to see whether it would have the same anti-ageing effect without causing side effects. "Although our work was done in mice, we hope that these findings will be highly relevant to human health," says the study's lead author, Anissa Widjaja of Duke-NUS' Cardiovascular and Metabolic Disorders Programme.



Two mice, both the same age. The one on the left has aged normally, but the one on the right has been given an anti-ageing drug.



Anissa Widjaja looks at a western blot, a technique used to identify specific proteins.

Growing neurons to fight degeneration

The brain is the most intricate organ in the human body and a vital part of who we are. But with age, brain cells lose the regenerative abilities to help them recover when they're damaged by ageing or disease. A new method developed by scientists at the GK Goh Centre for Neuroscience at Duke-NUS, which was established through a S$5 million gift from the GK Goh family, makes it possible to grow specific neurons from stem cells in the lab, offering new hope for treating conditions like Alzheimer's, Parkinson's, and stroke.

The team has successfully grown norepinephrine neurons — specialised cells that control functions like memory and movement. These neurons are particularly vulnerable to degeneration in diseases such as Alzheimer's and Parkinson's, often deteriorating long before symptoms appear.

"With these functional brain cells, we can study how they age and uncover their roles in neurodegenerative conditions. The insights we gain will help find new and more effective therapies to treat brain diseases and perhaps even slow the ageing process," explains Zhang Suchun, director of the centre and one of the study's authors.

In addition, the researchers used such stem-cell-derived neurons to repair brain tissue in stroke patients. They transplanted neurons into damaged areas using a chemical mixture which protected the cells from inflammation in the stroke-affected brain. Over 30 days, the transplanted neurons survived, matured, and restored damaged tissue.

The method, published in *Advanced Science*, has since been licensed, and the team plans to start preclinical safety studies using the same approach in Parkinson's disease.

Regenerated neurons viewed under microscope.

Assist Prof Anissa Widjaja
Signature Research Programme in Cardiovascular & Metabolic Disorders

Prof Zhang Suchun
Signature Research Programme in Neuroscience & Behavioural Disorders

Further information

Artistic conceptual image of bats flying in the starry night: The flaming fire symbolises inflammation in response to danger or microbial signals. Bats have naturally evolved to extinguish the inflammation fire.

Credit: Qi Su

Credit: Duke-NUS Medical School

Matae Ahn (right) investigated the similarities between the human and bat immune responses in the search of new treatments.

Bats' immune mysteries: Nature's blueprint for resilience

Bats are remarkable among mammals for their long lifespan and resilience against age-related diseases. Their unique immune system allows them to coexist with viruses without falling ill, a trait that intrigued scientists at Duke-NUS' Emerging Infectious Diseases Programme.

The researchers, led by Wang Linfa, discovered that bats control inflammation through a protein called ASC2. This protein dampens the activity of inflammasomes, key immune system components that can trigger harmful inflammation during viral infections in humans.

"This suggests that the high activity of ASC2 is a key mechanism by which bats keep inflammation under control, with implications for their long lifespan and unique status as a reservoir for viruses," explains Matae Ahn, a Duke-NUS MD-PhD graduate, senior research fellow and first author of the study published in *Cell*.

Wang, senior author of the study says, "Whether we're talking about Ebola or a coronavirus, it's not the virus that kills us. It is the inflammation triggered by the virus that can be lethal."

Unlike humans, bats keep inflammation in check. When scientists compared the bat ASC2 protein to the human version, they found four key differences that make the bat protein more effective at limiting inflammation.

Paratus Sciences, a biotech startup based in New York and Singapore focused on unlocking novel disease targets and accelerating drug discovery by leveraging the extraordinary adaptive biology of bats, has in-licensed the IP underlying the ASC2 work, and is translating these discoveries into a new class of anti-inflammatory drugs. Paratus Sciences is also collaborating with Wang's group on a broader investigation of bat immunology and viral tolerance for new insights with therapeutic potential.

Further information

Prof Wang Linfa
Signature Research Programme in Emerging Infectious Diseases

Dr Matae Ahn
Signature Research Programme in Emerging Infectious Diseases

Muscle health matters

Sarcopenia, a condition causing the gradual loss of muscle mass and strength, is a growing public health concern affecting millions of older adults. Researchers at Duke-NUS have made a promising discovery that could improve treatments for this debilitating condition.

Their study, published in *Autophagy*, shows that maintaining optimal levels of the protein DEAF1 (Deformed Epidermal Autoregulatory Factor-1) is essential for effective muscle repair and regeneration. DEAF1 plays a key role in regulating autophagy, the process by which cells remove and recycle damaged components.

As we age, muscle stem cells become less effective at repairing and regenerating muscle tissue, contributing to muscle loss in sarcopenia. The study found that DEAF1, controlled by proteins known as FOXOs, helps muscle stem cells maintain balanced autophagy levels. This allows the muscle stem cells to stay healthy and perform their critical role in muscle repair. However, FOXO activity decreases with age, leading to an imbalance in DEAF1 and impaired muscle repair, notes Tang Hong-Wen, senior author of the study.

FOXO activators have demonstrated promise in restoring DEAF1 equilibrium, boosting muscle stem cell activity, and promoting muscle regeneration in preclinical trials. These findings could pave the way for new medicines to treat sarcopenia and other muscle-degenerative disorders by enhancing muscle repair processes and improving overall muscle health.

Credit: Duke-NUS Medical School

Tang Hong-Wen (standing) and his team discovered that DEAF1 plays a key role in sarcopenia and cancer-related muscle wasting.

Here at Duke-NUS, we aren't just focused on extending life. We want our research to enhance how individuals and communities experience their later years.

From combatting a fear of falling and the chronic inflammation we accumulate with age to restoring mobility, cognition and metabolism, our innovations lead to practical health solutions. These efforts empower older adults, and others worldwide, to lead fuller, more vibrant lives for longer.

Patrick Tan,
Senior Vice-Dean for Research at Duke-NUS

Drip feeding an *Eonycteris spelaea*, or cave nectar bat, a special food mixture that replicates their natural diet.

Credit: Duke-NUS Medical School

Assist Prof Tang Hong-Wen
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A NEW SPIN ON MATERIALS

Electron spin states can now be efficiently explored at much higher resolution, opening new opportunities for faster electronics including quantum computers.

Researchers Koichiro Yaji and Shunsuke Tsuda at the National Institute for Materials Science (NIMS) in Japan have developed an improved type of microscope that can visualise key aspects of electron spin states in materials. Their work was published in the journal *Science and Technology of Advanced Materials: Methods* (STAM-M).

The quantum mechanical property of electrons called spin is more complex than the spin of objects in our everyday world. The spin states of electrons impact the electronic and magnetic behaviour of the materials they are part of.

The technology developed by Yaji and Tsuda is known as imaging-type spin-resolved photoemission microscopy (iSPEM). It uses the interaction of light with the electrons in a material to detect the relative alignment of the electron spins. It is particularly focused on electron spin polarisation — the extent to which electron spins are collectively aligned in a specific direction.

The team's iSPEM machine consists of three interconnected ultra-high vacuum chambers for preparing and analysing the sample. Electrons are emitted from the sample by absorbing light energy, accelerated through the apparatus, and then analysed by interaction with a spin filter crystal. The results are displayed as images, which experts can use to glean the necessary information about the electron spin states in the sample.

"Compared to conventional machines, our iSPEM machine drastically improves the data acquisition efficiency by ten thousand times, with more than ten times improvement in spatial resolution," says Yaji.

This advance could promote improvements in information processing and other electronic devices, as part of the fast-developing field known as spintronics. In spintronics applications, the spin state of electrons is utilised to store and process information, in addition to the traditional use of electric charge.

"This could lead to more energy-efficient and faster electronic devices, including quantum computers," says Yaji. Applying the subtleties of quantum mechanical behaviour to computing is at the forefront of efforts to take computing powers to another level. Until now, most advances have been restricted to arcane demonstrations rather than practical applications. Mastering the understanding, control, and visualisation of electron spin could be a significant step forward.

"We now plan to use our machine to investigate the possibilities for developing a new generation of electron spin-based devices, because it will let us look into the properties of tiny and structurally complex samples previously hidden from view," Yaji concludes.

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TRAVELLING BACK TO THE EARLY UNIVERSE

Astronomer John Silverman works just outside of Tokyo but spends his days with some of the world's biggest telescopes in Hawaii, Chile, and space to study the earliest black holes in the Universe.

In 2023, John Silverman and his team downloaded telescope data about the depths of the Universe that had never been seen before. Silverman couldn't directly collect the data because the telescope that was used, the James Webb Space Telescope, is orbiting the Sun around 1.5 million kilometres from Earth.

But why does the telescope have to be in outer space?

We often see historical pictures of famous astronomers peeking through handmade telescopes, scribbling observations in their notebooks. But despite everything they learned, the view of stars and galaxies through those telescopes wasn't enough to answer some deeper questions. What are stars made of? Why do galaxies have strange shapes? To answer those questions, telescopes needed to evolve.

"The larger the telescope, the greater its resolution," said Silverman, a professor at the University of Tokyo Kavli Institute for the Physics and Mathematics of the Universe. "You can look at where stars are forming, where there's the gas that produces those stars, and how that gas gets to the centre of galaxies. There, it can grow the black hole and also the bulge, a dense region of stars surrounding the black hole."

Ever since he was a PhD student, Silverman has been using telescopes to find out how black holes were born. "We're looking for the relationship between the black hole and the bulge. Do they grow from a common fuel supply? To see the details of these components of galaxies, you need a large telescope."

The background on this page is the Carina Nebula, a group of young stars hidden inside clouds of dust and gas, visible in infrared light with high resolution instruments. It was one of the first images released by NASA from the James Webb telescope. The data helps scientists understand how our Sun formed and how radiation from nearby large stars affect the development of planets.

Credit: NASA, ESA, CSA, STScI, Megan Reiter (Rice University), with image processing by Joseph DePasquale (STScI), Anton M. Koekemoer (STScI)

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John Silverman of Kavli IPMU.

"We need large telescopes to look at where the stars are forming, where there is gas producing those stars, how that gas gets to the center of galaxies and where black holes can grow.

Basically, telescopes have become bigger to enable us to see further into the cosmos. This is important for Silverman, because his work focuses on the earliest black holes in the Universe. Even though light moves extremely quickly, the huge distances involved mean that the light from around those black holes takes a very long time to reach us. When the James Webb Space Telescope captures light from galaxies very far away, it's looking back at those galaxies as they existed billions of years ago.

Placing the telescopes in space also eliminates a long list of problems that face land-based telescopes. For example, light is blurred and scattered by the atmosphere, and terrestrial telescopes also face interference from heat and light sources on Earth, as well as being unusable on cloudy or rainy days.

The data Silverman got from the James Webb Space Telescope was about two massive galaxies hosting actively growing black holes called quasars. They're located about 13 billion years away, in the furthest reaches of the Universe, which means the light the telescope collected left around one billion years after the Big Bang.

When gas falls into a black hole, it becomes incredibly hot and emits extremely bright light. This had created a challenge for Silverman's team. Although these galaxies had already been discovered through the Subaru Telescope in Hawaii, the light was too bright. Even the Hubble Space Telescope couldn't eliminate the bright light from the quasar so the researchers would be able to see the stars surrounding the black hole.

Scientists believe that there's a relationship between a black hole and the mass of its host galaxy. By comparing black holes in galaxies nearer to Earth with the ones in the distant galaxies Silverman's team studied, they can assemble a picture of how black holes have evolved since the early days of the Universe.

Credit: NASA, ESA, and The Hubble Heritage Team (STScI/AURA)

Arp 87 is a stunning pair of interacting galaxies. Stars, gas, and dust flow from the large spiral galaxy, NGC 380 8, forming an enveloping arm around its companion. The shapes of both galaxies have been distorted by their gravitational interaction. Arp 87 is located in the constellation Leo, the Lion, approximately 300 million light-years from Earth. The corkscrew shape of the tidal material, which is also seen in other interacting galaxies, suggests that some stars and gas drawn from the larger galaxy have been caught in the gravitational pull of the smaller one. This image was taken in February 2007 with Hubble's Wide Field Planetary Camera 2 detector.

Source: ESA/Hubble
Credit: NASA, ESA, and
The Hubble Heritage Team (STScI/AURA)

The Large and Small Magellanic Clouds, two companion galaxies to our own Milky Way galaxy, can be seen as bright smudges in the night sky in the centre of the photograph.

Antennas of the Atacama Large Millimeter/submillimeter Array (ALMA) on the Chajnantor Plateau in the Chilean Andes.

Source: ESO | Credit: ESO/C. Malin

Did you know?

The James Webb Space Telescope is located at the second Lagrange point, or L2, a point in space where the orbit stays aligned with the Earth as it moves around the Sun. This allows researchers on Earth to have continuous communication with the telescope. Currently, the telescope receives new command sequences and sends data twice a day.

Credit: ESO/C. Malin

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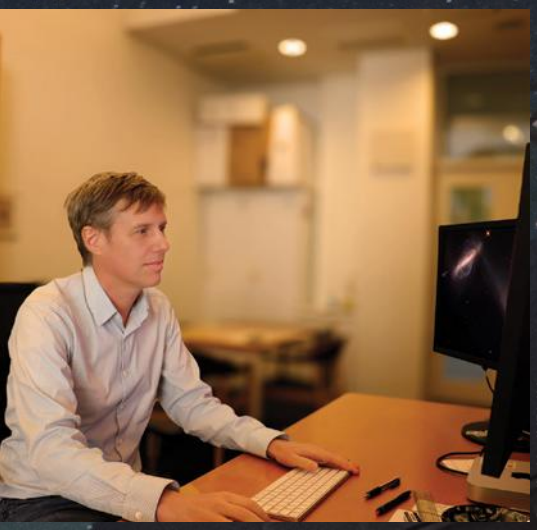
We're looking for the relationship between the black hole and the bulge, a dense region of stars surrounding the black hole. Do they grow from a common fuel supply?

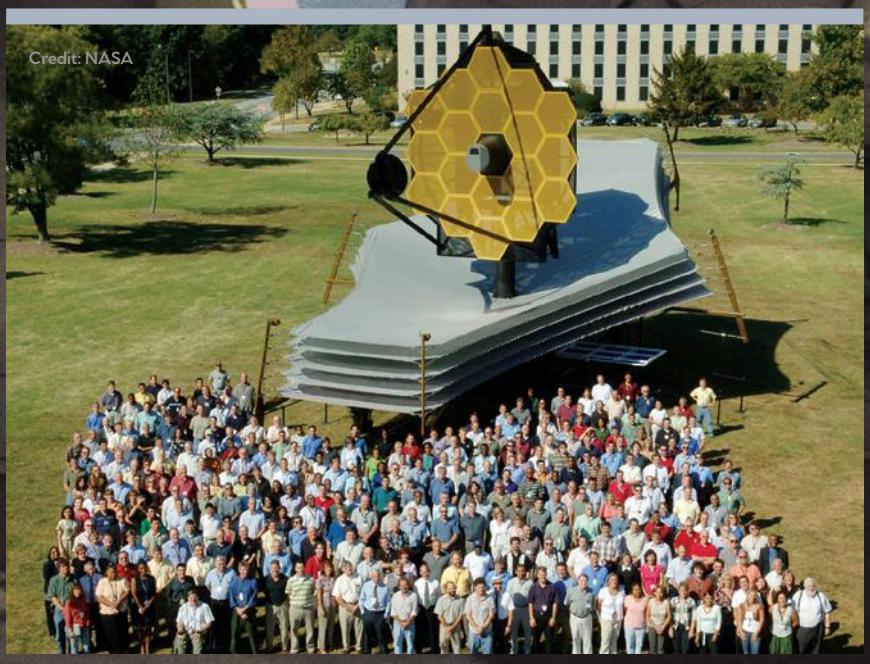


Credit: Kavli IPMU

The James Webb Space Telescope isn't the first big telescope Silverman has worked with. He has also used the Atacama Large Millimeter/submillimeter Array (ALMA), a giant telescope in Chile which researchers use to study the molecular properties of gas and dust in space. ALMA also doesn't look like the telescopes you can buy in a shop. It consists of an array of 66 giant radio antennas stretching between 7 metres and 12 metres across and spread across 16 kilometres on the Chajnantor plateau.

Silverman's excitement is clear when he talks about working with ground-based telescopes. "Oh, I love it! As an observer, you wait for the sun to go down, and once it gets dark, you get very excited about what's possible. You can decide what you're going to do with this large telescope standing on this big mountain, high up and away from everything else, and it's nice and quiet with the whole Universe to explore."

Silverman combines data from these telescopes in his research to take advantage of their different abilities. By comparing how the different telescopes see the same galaxies, he and his team can figure out the relationships between gases, star formation, and the black holes at the heart of galaxies.



Credit: NASA

Full-scale James Webb Space Telescope model assembled on the lawn at NASA Goddard Space Flight Center.

HOW VIRUSES EXIT CELLS

A newly designed model system simulates how viruses exit cells, offering potential advancements in targeted drug delivery and biotechnology.

Researchers have developed a model experimental system that mimics how viruses exit cells. The new technology will not only be useful for investigating this important process but could also serve as a useful tool in synthetic biology and other domains of biotechnology. The findings were published in the journal *Science and Technology of Advanced Materials*.

After using a host cell's machinery to replicate, viruses exit through a process called budding. In this process, new virus particles push against the cell membrane, which then wraps around them and pinches off, creating a protective envelope encapsulating protein capsule called a capsid. This allows the viruses to leave the cell and spread to infect other cells.

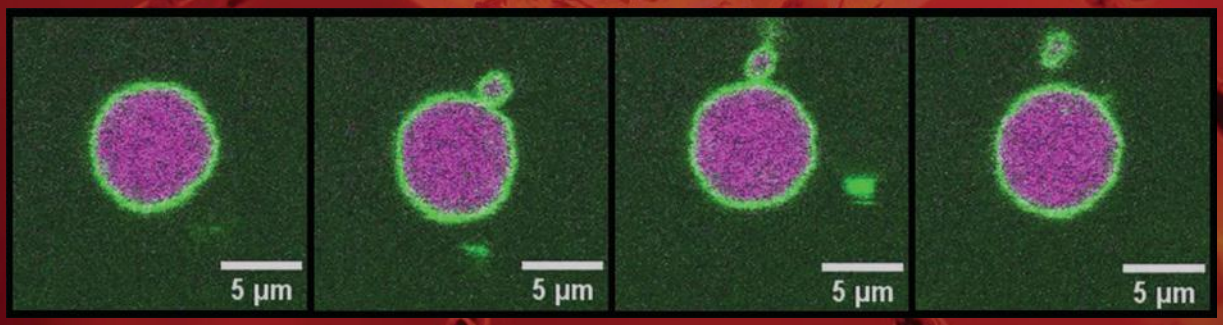
In the study, researchers at the Graduate School of Engineering, Tottori University in Japan created a model of this process using giant unilamellar vesicles (GUVs), which are bubble-like structures made of lipids (fats) that closely resemble cell membranes. The team modified a peptide molecule found in certain viral proteins involved in the infection of host cells. They added a long carbon chain known as an octyl chain to the molecule, creating an anchor that enhances its ability to attach to lipid membranes. When these modified peptides were added to the outside of the GUVs, they induced the formation of smaller daughter vesicles that bud off, mimicking viral capsids – and the daughter vesicles could also encapsulate materials, just like a virus.

"This budding can occur in two ways, from the outside to the inside of the GUV, or from the inside to the outside, depending on where we place the peptides," explains Kazunori Matsuura, who led the study. "This flexibility in how the vesicles bud shows great potential for controlling how these artificial viral capsid systems interact with specific cells."

The presence of the octyl chain is crucial. Without it, the peptides don't induce significant budding, highlighting the importance of these structural features. The researchers also discovered that GUVs composed of more flexible lipids had a higher budding success rate than those made of less flexible lipids.

"The way this budding occurs is similar to how nanoparticles can influence GUVs by increasing surface tension when they adhere to the membrane," says Hiroshi Inaba, co-author of the study. "When the capsids attach to the GUVs, they create a crowded environment that triggers budding as the surface tension rises."

The new artificial viral capsid system not only enhances our understanding of viral behaviour but also paves the way for innovative drug delivery strategies, as well as treatments based on improving intercellular communication and aiding in recovering cellular components. The new model system holds exciting promise for synthetic biology, and the team is now working to make it responsive to external stimuli such as light, which would make the system even more useful in different biotechnological contexts.



Credit: STAM

Budding inside to outside: an experimental system shows how viruses leave an infected cell by generating buds. This allows the viruses to leave the cell and spread to infect other cells.

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IRON AND GAS THERAPY FOR ORAL CANCER

A new treatment with iron nanoparticles and nitric oxide gas shows promise in destroying oral cancer cells.

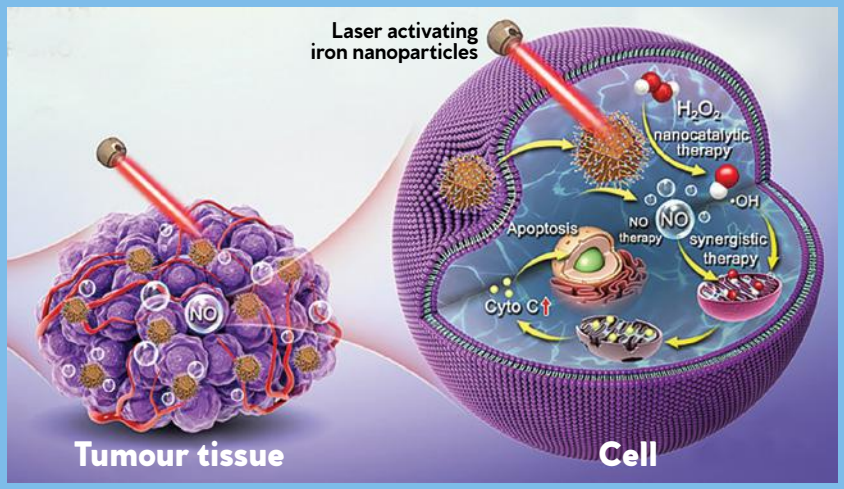
A type of oral cancer called oral squamous cell carcinoma is a very aggressive cancer that tends to spread quickly and to reappear after treatment. Traditional treatments, such as surgery, chemotherapy, and radiation, often have serious side effects, including trouble speaking or eating and painful conditions like mouth sores and dry mouth.

In a study, scientists at Shanghai Jiaotong University School of Medicine found a promising new way to treat this with fewer side effects using a combination of nitric oxide gas therapy and iron nanoparticles. The study was published in *Science and Technology of Advanced Materials*.

"We created tiny iron particles composed of individual iron atoms, designed to interact with hydrogen peroxide — a substance found in elevated levels inside tumour cells," explains Ping Xiong, who led the study. "These iron atoms act as catalysts to convert hydrogen peroxide into highly toxic hydroxyl radicals."

Hydroxyl radicals are extremely reactive and cause intense oxidative stress by damaging cellular components such as DNA and proteins. The iron particles also carried molecules that released nitric oxide gas when activated by near-infrared laser light. The nitric oxide gas amplified the effect of the hydroxyls by triggering apoptosis, a controlled form of cell death crucial for removing damaged cells.

In animal model experiments, a single dose of treatment combined with a laser pulse was found to suppress tumours by around 85.5%, suggesting that the treatment is very effective. "This treatment is highly specific to cancer cells, reducing damage to healthy tissues and minimising side effects, which makes it both more efficient and better tolerated by the body," says Yuting Xie, one of the study's authors.



Credit: Modified from original image by STAM

The team created tiny iron particles to interact with hydrogen peroxide (H_2O_2) — a substance found in tumour cells. The iron particles carry molecules that release nitric oxide (NO) gas activated by laser, which triggers a controlled form of cell death for cancer treatment.

One major difficulty was ensuring that the infrared laser targeted only the tumour, especially in hard-to-reach areas like the sides and bottom of the tongue. The team is exploring ways to improve the precision of the laser treatment to avoid inadvertent damage to the surrounding healthy tissues, which could result in unwanted side effects. One approach being investigated involves developing nanocatalysts that would be administered through an intravenous injection, which could enhance the targeting by interacting with the laser in a more controlled manner.

The researchers are also working on strategies to prevent the cancer from spreading or returning after treatment. By further refining these technologies, they hope to create a more effective and targeted treatment option for this invasive cancer.

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Credit: Nobel Foundation via Wikimedia Commons (Public Domain)

THE PHYSICIST WHO CHALLENGED A LAW

Tsung-Dao Lee (24 November 1926 – 4 August 2024) was awarded the Nobel Prize for Physics in 1957 together with Chen-Ning Yang for their work challenging the symmetry law in subatomic particles. They were the first Chinese Nobel prize winners, with Lee becoming the second-youngest Nobel laureate. Born in Shanghai, he went to the U.S. on scholarship and studied under another Nobel winner, Enrico Fermi. Considered one of the masters in particle physics, he developed a model for studying quantum phenomena. He was also influential in the establishment of the Beijing Electron-Positron Collider and promoting scientific development in China, visiting his home country to give lectures later in his career.

ADVANCING HEALTHCARE IN VIETNAM

Henriette Bui Quang Chieu (1906 – 2012) was inspired to follow in her brother's footsteps and became a doctor after losing her mother to tuberculosis. She studied in France and became the first Vietnamese woman to receive a medical degree. Upon her return to Vietnam, Bui was appointed head of the Department of Midwifery at Cho Lon Hospital in Ho Chi Minh City. A pioneer in gynaecology, she applied acupuncture techniques that she had learned in Japan to obstetrics. As Vietnam was still a French colony, Bui also lobbied for the rights of Vietnamese doctors, nurses, and patients.

Credit: Wikimedia Commons (Public Domain)

Credit: International Society for the Study of Iron in Biology and Medicine

STUDYING BLOOD DISORDERS USING ZEBRAFISH

Barry Paw (29 August 1962 – 28 December 2017) was a biologist and oncologist born in Myanmar who immigrated as a refugee to the U.S. as a child. He discovered several novel genes and their functions in red blood cells. His team was the first to use zebrafish as a model to identify gene mutations that cause anaemia, a method now used for other diseases. His pioneering research also led to new discoveries about blood disorders in humans. He was considered an outstanding mentor who cared deeply about the professional development of his trainees.

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