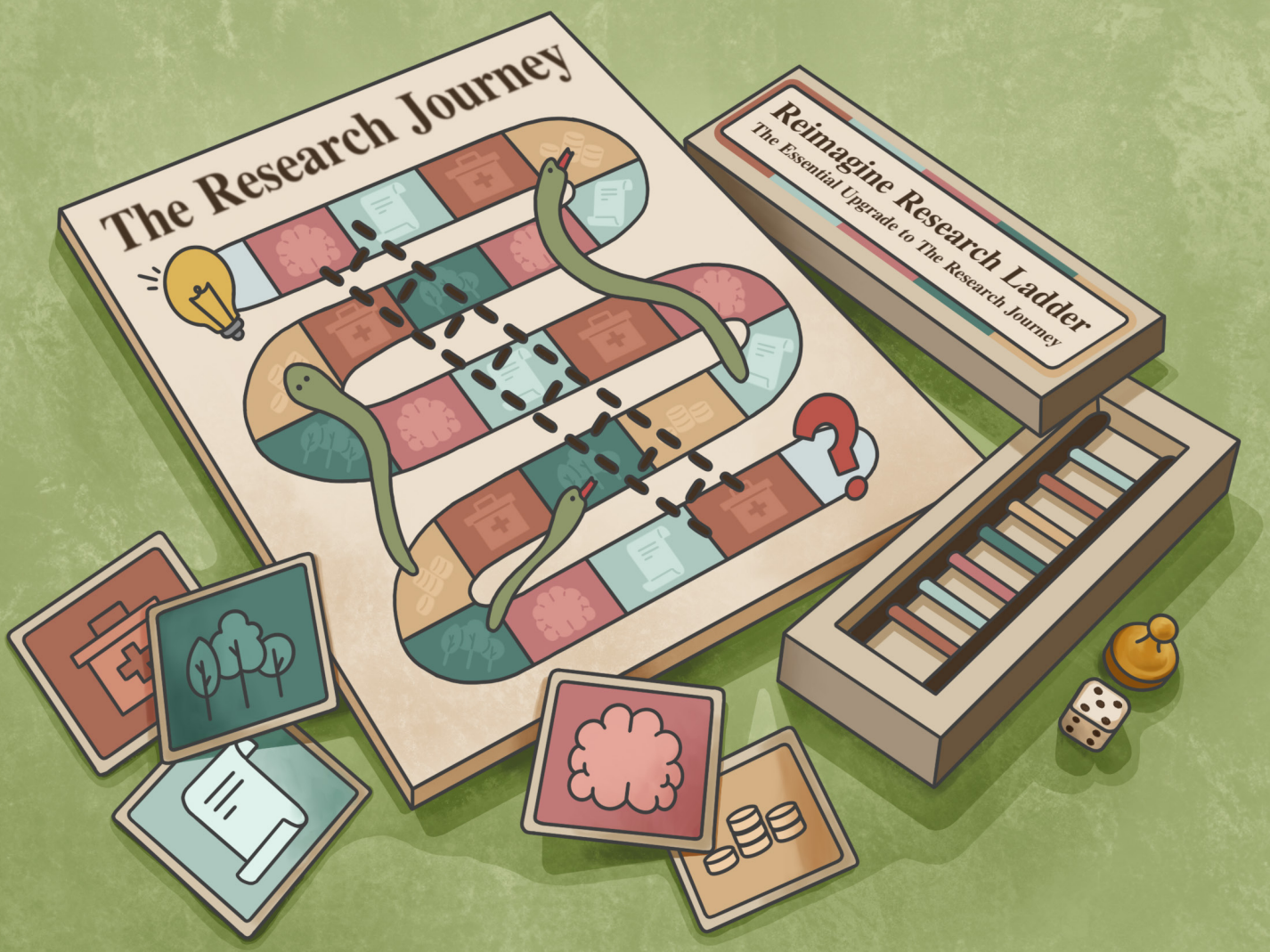
NUS RESEARCH in brief

July 2021 | Issue 5

NUS National University of Singapore



COVER STORY
NUS Reimagine Research Initiative to seed research ideas in emerging areas

NEW INITIATIVES
NUS and Shell join hands to advance decarbonisation solutions

RESEARCH HIGHLIGHTS
Beating the city heat: A social science study in urban Asia

From the Deputy President (Research & Technology)

The Reimagine Research Initiative kicked off in late 2020 to enable NUS researchers to address society's most pressing needs – many of which have emerged, or were amplified, during the ongoing Covid-19 pandemic. The need to conduct business and education remotely, for example, was an acute problem that, on the surface, could be addressed by adopting video communication tools and virtual workspaces. However, it also entailed a significant shift in behaviours, and underlying implications quickly surfaced. Data protection and information security became an immediate concern, supply chain resilience was tested, and people around the globe had to overcome a sense of isolation, to work from home whilst retaining workplace relationships and networks.

NUS is well positioned to understand and address such multifaceted challenges. The Reimagine Research Initiative invites our researchers to take a holistic approach to pressing questions, by embarking on interdisciplinary research that will ultimately produce impactful, yet accessible solutions.

A major research thrust at NUS is Sustainability and Urban Solutions. Mitigating the impact of climate change and rising sea levels through coastal defence, urban design, nature-based solutions, and the development of 'green energy' technologies, will be imperative for Singapore and the region to meet current climate and environmental goals.

To this end, NUS has embarked on a number of research partnerships and programmes in recent months focused on these urgent issues. We will be working with Shell to develop methods to convert carbon dioxide into cleaner fuels and chemicals. We will also be leading a consortium of industry and government bodies, including PUB, to better understand the impact of climate change on Singapore's low-lying coastal areas.

In addition, we are excited to partner with NTU and industry to establish the new Sustainable Tropical Data Centre Testbed (STDCT), an innovation hub and testbed facility helmed by the Coolest.SG consortium. The programme, which will be hosted at NUS, aims to develop sustainable cooling solutions for data centres in the tropics.

As the world adjusts to a reality redefined by the Covid-19 pandemic and the mounting climate crisis, NUS will continue to lend its collective expertise and knowledge to these areas; to ask the important questions, devise innovative solutions, and pursue new avenues for interdisciplinary collaboration and industry partnership.

Professor Chen Tsuhan
Deputy President (Research & Technology)

NUS Research in Numbers

10878
Research publications

Our researchers collaborated with

3537
institutes and universities from

166
countries

4
Research Centres of Excellence

5
Corporate Laboratories

17
Schools and Faculties

30
Research Institutes and Centres

$821.1m*
Total research funds awarded by external sources

$336.15m* From industry and other government sources (local and overseas)

$273.53m* Awarded by the National Research Foundation

$211.38m* Total awarded by the Ministry of Education

NUS Research is centred on eight integrative research clusters. These are ageing, Asian studies, biomedical science and translational medicine, finance and risk management, integrative sustainability solutions, maritime, materials science and smart nation.

764
Patent applications

167
Patents granted

439
Invention disclosures

130
Technology licences executed

Our researchers work to innovate and develop solutions that meet the present and emerging needs of Singapore, Asia, and the world.

*Based on FY2020. All other data based on Calendar Year 2020.

The Reimagine Research Initiative is designed to enable researchers to circumvent hurdles in taking their ideas from problem to solution on the fastest path possible, akin to a ladder in a game of snakes and ladders.

NUS Reimagine Research Initiative to seed research ideas in emerging areas

NUS has launched a new 'Reimagine Research Initiative' to provide seed funding for research in emerging areas, and to enable its researchers to capture opportunities in the post-COVID-19 era.

The initiative provides seed funding to support up to 20 interdisciplinary project ideas each year. These projects would require researchers to work together, and dedicate collective knowledge, expertise, and research capabilities towards finding solutions to some of the most challenging questions of our time. The goal is to cultivate 100 forward-looking project teams in five years.

Interdisciplinary education at the University recently took a bold leap forward with the new NUS College of Humanities and Sciences being established last year, now, interdisciplinary research is also being championed with the new Reimagine Research Initiative that funds compelling proposals that tackle a myriad of modern challenges.

The seed funding will allow research groups to build the groundwork of their interdisciplinary projects and to yield initial results. With this strong foundation, they can go on to secure additional funding externally to bring their projects to fruition, and ultimately benefit the wider community.

"We hope to bring about a shift in mindset among our researchers. Today, most multidisciplinary research efforts involved placing disciplinary insights side by side, or with a small degree of integration, to address problems. The Reimagine Research Initiative is conceptualised to motivate our researchers to push the knowledge frontier even further by harmonising their expertise to create powerful, unconventional solutions that we cannot yet imagine," said Professor Chen Tsuhan, NUS Deputy President (Research and Technology).

A NEED TO REIMAGINE RESEARCH

COVID-19 has been a turning point in society. As an all-encompassing problem, it not only sent shockwaves through the fields of medicine and public health, but has had major implications in policies, human behaviour, the economy, the environment, and much more.

However, the pandemic is just one example of a modern cross-disciplinary problem. Many more complex challenges on the horizon need collaborative solutions. Tackling pressing issues like climate change, food security, and data privacy will require integrated knowledge, skills, and insights from different domains. Funding, facilitating, and finding solutions to these modern problems is the objective of the Reimagine Research Initiative.

"While the University will continue to invest in basic research, solving these multifaceted challenges for society requires a conversation among researchers of different disciplines. As a comprehensive university that offers a diverse spectrum of specialities, NUS is in the ideal position to initiate integrative approaches to address these problems more effectively, as we have a diverse talent pool to draw from," Prof Chen added.

TEAM-BASED, INTERDISCIPLINARY, PROBLEM-DRIVEN RESEARCH

The new Reimagine Research Initiative will encourage problem-driven research. The initiative also supports multidisciplinary teams, which allows complex issues to be approached from multiple perspectives, and will allow researchers to continue to build cross-faculty networks towards interdisciplinary research.

The initiative promotes research in areas such as environmental sensing for better safety and health, outbreak preparedness and prediction, food security and supply chain resilience, human behaviours and societal impact, systems dynamics, physical and IT security, and more. Since its establishment, 21 projects have been supported.

A tiny smart chip with sensors can be placed on plants like choy sum to monitor plant growth and health in real-time.

One such project looks into the development of small wearables for plants using novel sensor technologies. These sensors will collect signals from plants about their well-being and growth, and the data will be used to train AI algorithms. The resulting database will then be used to simulate plant growth conditions in urban farms and to predict their growth outcomes.

This project aims to build an infrastructure where researchers can use the signal database to predict the growth of plants in response to environmental changes. Optimal growth conditions for different varieties can be catered for, while best-fitting varieties can be selected for a set of environmental conditions. This research could be applied in breeding desirable crop plant varieties to improve food security.

Another project seeks to make cities more resilient to disease outbreaks, as well as environmental degradation, social upheavals, supply chain disruptions, and failures in infrastructure.

Due to the multidisciplinary nature of this research, the project team comprises experts from different fields, ranging from public policy and risk management, to computing, engineering and physics, all working together to address the complex issues.

The project's findings could help policymakers determine the best protections against environmental, societal and technological threats. The researchers hope the work will eventually establish Singapore as a leader in the use of complexity science in the governance of smart cities.

Through the Reimagine Research Initiative, NUS researchers can now make a direct impact by providing solutions to the many needs that are confounding society and the economy.

Applications for the Reimagine Research Initiative are accepted on a regular basis. NUS researchers who are interested to apply can find out more via the QR code.

NUS and Shell join hands to advance decarbonisation solutions

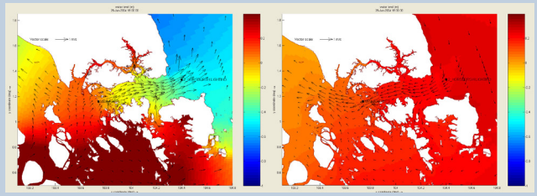
Researchers from the National University of Singapore (NUS) and international energy giant Shell will jointly develop novel processes to use carbon dioxide, a byproduct of industrial processes, to produce fuels and chemicals for the energy industry. Supported by the National Research Foundation Singapore (NRF), this S$4.6 million research programme was formalised by all three parties at a ceremony held on 14 May, 2021.

This three-year research programme aims to electrochemically produce ethanol and n-propanol from carbon dioxide – a gas that is commonly released into the atmosphere. Ethanol and n-propanol can be blended with gasoline to deliver cleaner burning fuels. These two fuels can further be dehydrated to produce ethylene and propylene respectively, which are commercially important molecules that are used in producing polymers that go into everyday products like medical equipment and houseware items. By effectively converting carbon dioxide into other useful products, this research can help reduce carbon emissions and its impact on the environment.

The study will be led by Associate Professor Jason Yeo Boon Siang from the NUS Department of Chemistry, who is one of the authorities in the field of carbon dioxide reduction. Promising results generated in lab experiments will be scaled up in future. This collaboration with Shell's Long Range Research Group is brought together by the Shell City Solutions Living Lab in Singapore, which helps city stakeholders navigate the energy transition and identify pathways towards a lower carbon future.

This latest research initiative complements NUS' focus on pioneering sustainable solutions to combat global challenges like climate change, and aligns well with Shell's overarching ambition to be a net-zero emissions energy business by 2050 or sooner, in step with society and with customers. Successful outcomes from this research programme will also support Singapore's carbon emissions reduction targets, which is a focus area under the Research, Innovation and Enterprise (RIE) 2025 Plan.

Modelling for coastal defence



To better assess the impact of climate change on Singapore's coastal areas, a consortium led by NUS has been appointed by national water agency PUB to develop a model capable of evaluating both inland and coastal flood risks in tandem.

Together with water management solutions provider Hydroinformatics Institute (H2i), the NUS researchers led by Professor Philip Liu, Distinguished Professor from NUS Civil and Environmental Engineering, will work on a state-of-the-art Coastal-Inland Flood Model based on the nation's densely built-up and urbanised environment. PUB officers will work closely with the project team during the entire project duration to share their experience with existing modelling systems.

The purpose-built model will enable holistic flood risk assessment by estimating the combined effects of extreme sea levels and inland floods caused by intense rainfall. It will aid PUB in the planning of coastal adaptation measures, to evaluate the effectiveness of the proposed coastal protection infrastructure, as well as for operations management.

NUS and Johnson Controls embark on S$5 million research to co-create people-centric smart building systems

The National University of Singapore (NUS) and Johnson Controls, the global leader for smart, healthy and sustainable buildings, will embark on a joint collaboration on smart buildings research. Johnson Controls will commit about S$5 million into this research programme, and teams from both organisations will work together to address industry-wide challenges.

The NUS School of Design and Environment (SDE) will kick off with the first research project in April 2021. It will be led by Assistant Professor Clayton Miller from its Department of Building and will use machine learning to accelerate the conversion of Internet of Things (IoT) data into the BRICK Schema, a standardising model for data labels in buildings.

NUS and NTU launch first-of-its-kind tropical data centre testbed

The National University of Singapore (NUS) and Nanyang Technological University, Singapore (NTU Singapore), together with key stakeholders in Singapore's data centre industry, have established a new S$23 million research programme to develop innovative and sustainable cooling solutions for data centres located in tropical locations. A state-of-the-art testbed facility will be set up in NUS to promote co-creation and demonstration of such advanced cooling technologies.

The new Sustainable Tropical Data Centre Testbed (STDCT) – the first of its kind in the tropics – will serve as an innovation hub for the academia and industry to work together to future-proof

the region's data centre industry. Curated by the Cooling Energy Science and Technology Singapore (CoolestSG) Consortium hosted at NUS, this programme will see researchers develop and demonstrate energy-efficient cooling technologies to achieve breakthroughs in the tropical data centre environment. The testbed facility is expected to be operational by 1 October 2021.

Professor Liu Bin conferred the Royal Society of Chemistry's Centenary Prize

NUS Vice President (Research and Technology) Professor Liu Bin has been conferred the Royal Society of Chemistry's Centenary Prize this year. She was honoured for her work in the innovative design and synthesis of organic molecules and nanomaterials to advance biomedical research and applications, as well as for excellence in communication.

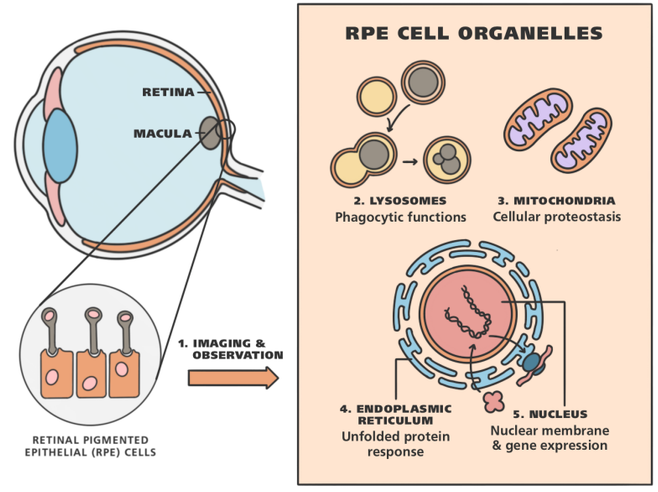
The Royal Society of Chemistry's prizes have recognised excellence in the chemical sciences for more than 150 years. The Centenary Prize, first established in 1947, is an award granted annually to outstanding chemists, who are also exceptional communicators, from outside the United Kingdom. Winners are given a £5,000 cash prize, and a medal. 50 previous winners of a Royal Society of Chemistry Prize have gone on to win Nobel Prizes for their pioneering work, including 2019 Nobel laureate John B Goodenough.

On receiving the prize, Prof Liu said, "I am deeply honoured to receive this award, especially when I look at the list of the past awardees. Many of them are my role models since I was a graduate student. I would like to take this opportunity to thank my research team and collaborators and all those who have supported and inspired me through my career so far."

Prof Liu, who is also the Head of NUS Chemical and Biomolecular Engineering, leads a multidisciplinary team that has built a series of technology platforms to advance biomedical research with practical applications in sensing, imaging and image-guided therapy. Recently, her research group discovered that impurities can significantly contribute to the optical properties of many organic compounds. This opens up new opportunities to develop high-performance luminescent materials.

Dr Helen Pain, Chief Executive of the Royal Society of Chemistry, said, "From developing vaccines for COVID-19 to continuing to work towards a more sustainable world – the contribution of chemical scientists has never been more tangible or important. Professor Liu's work is a prime example of what we are so passionate about and we are proud to recognise her contribution with this prize."

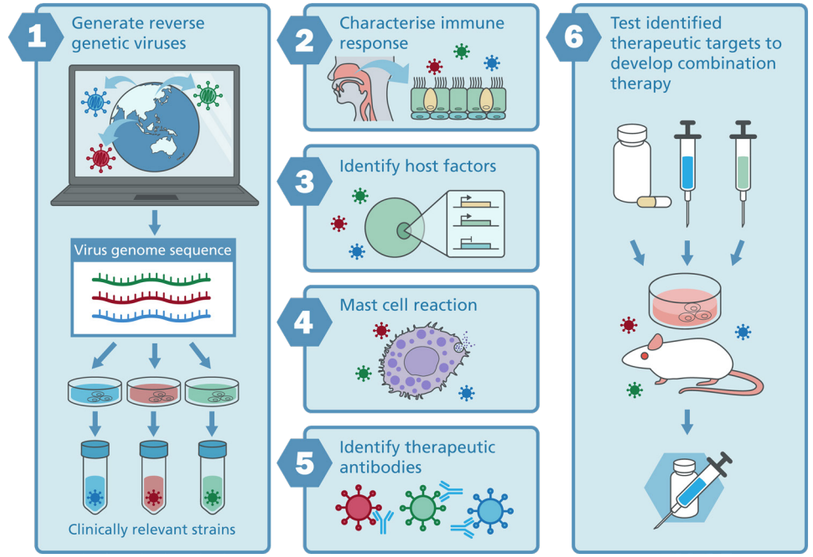
Collaborative Grants



Two NUS-led teams, from the Mechanobiology Institute, NUS (MBI), and Duke-NUS Medical School, were awarded MOE AcRF Tier 3 Grants in 2021. The grant scheme enables high-impact, multi-disciplinary collaborative research in a variety of scientific disciplines.

In their project titled "Endomembrane System Architecture, Dynamics, and Functions in Aging Cells and Tissues", A/Prof Tony Kanchanawong and Prof. Rong Li, from MBI, will seek to understand how biophysical changes in endomembrane networks that occur during aging, lead to the biochemical changes that define age-related deterioration of cells. Their studies will be conducted on retinal pigmented epithelial (RPE) cells, as these cells provide an ideal model system to investigate age-dependent changes and potential therapeutic targets for age-related macular degeneration (AMD).

The second project awarded, titled "Human parainfluenza virus: Developing a toolkit to prevent and treat a neglected respiratory viral infection", will seek to characterise the human innate immune response to human parainfluenza virus (HPIV) infection. HPIV is a major cause of acute respiratory tract infections, yet there remains no vaccine or treatment available against it. The project, led by Prof Gavin Smith from Duke-NUS, will seek to identify therapeutic anti-HPIV monoclonal antibodies for the potential development of viable treatments.



Beating the city heat: A social science study in urban Asia

Climate change has sent global temperatures rising with an alarming number of extreme heat incidents putting the lives of urban dwellers in Asian cities at risk. Experts predict that heat will be among the most serious global health crises after the current pandemic. In spite of this, little has been written on the history or social and cultural engagement with heat in Asia, with scant historical temperature data collected.

Now, a team of researchers led by Associate Professor Gregory Clancey, Leader of the Science, Technology, and Society Cluster at NUS Asia Research Institute (ARI), has launched a project titled 'Heat in Urban Asia' to study temperature changes, methods of heat alleviation, as well as the social, economic and health impacts of hazardous heat in the four cities of Singapore, Hong Kong, Delhi and Wuhan. This is the first and arguably the most ambitious effort to understand urban heat from a humanities and social science perspective, not only in Asia, but worldwide.

View of outdoor condensing units of air-conditioning systems at a backlane in Singapore, with glass-cladded air-conditioned skyscrapers in the background. (Photo: Chang Jiat Hwee)

City heat – a hitherto underdeveloped topic in social science

The interdisciplinary project which started in July 2019 involves scholars from a range of social and physical science backgrounds, such as historians, as well as social and natural scientists. Research will centre on the following questions: (1) How, where, and to what degree have heat islands developed in Singapore and comparable Asian cities from the pre-colonial period to the present, and what is the trajectory of change?; and (2) How have different cultural, social, technical, design and planning practices been relieved or exacerbated by urban heat?

The project takes a three-pronged approach. The first examines Urban Heat Island Effect and the influence of city planning, design and infrastructure building on the phenomenon's escalation or mitigation. Researchers will collect a comprehensive record of temperatures in the targeted cities, including missing historical temperature data. Importantly, this will allow experts to track heat over a longer time period than is currently available and for detailed urban heat comparisons between urban, peri-urban and control sites.

The second part addresses the lived experiences of heat in urban Asia, with researchers looking at everyday practices of living with heat vis-à-vis changes to the design and planning of the built environment, and how such practices interact with other forms of material culture and cultural practices (e.g., consuming cold drinks are a common way to reduce heat). Political and social processes that have shaped our exposure to heat, and ways in which people keep cool using low-energy, daily alternatives to current technologies will also be studied.

The final component focuses on collating records on extreme heat events including heatwaves, studying their social, health and economic consequences and examining the evolving frequency and intensity of the growing environmental hazard.

To help the public learn about how urbanisation patterns can exacerbate heat, the team plans to create an open-access interactive web platform containing oral history testimonies, archival documents, historic maps, images and videos, in collaboration with NUS Libraries. To be launched in July, it will also serve as an educational resource for the general public and students to learn about the history of Singapore and other cities in novel ways.

Developing solutions for growing sustainable cities

Researchers from NUS Design and Environment and Yale-NUS College have joined hands with ETH Zurich and other Singapore universities to embark on Future Cities Lab Global (FCL Global) – an international, interdisciplinary research collaboration that aims to develop solutions to help cities and their surrounding regions achieve sustainable growth.

Launched in December 2020, the five-year collaborative venture seeks to address the globally significant challenges of expanding urbanisation, where existing cities are fast growing and new cities are emerging in the face of rapid population growth. Tapping on the deep expertise of 120 engineers, architects, environmental scientists, economists and social scientists from Singapore and Switzerland, the collaboration builds on the work of the now-completed Future Cities Laboratory Programme which focused on cities and their development.

Supported by Singapore's National Research Foundation (NRF), FCL Global expands the focus to address corridors and networks between cities and the surrounding regions – such as roads, ports, rivers, and airports, as well as their impact on land use and ecology. In addition, the collaboration will be co-hosted in not one, but two research laboratories: ETH Zurich, and Singapore-ETH Centre (SEC) – a partnership established between ETH and NRF at the Campus for Research Excellence and Technological Enterprise (CREATE).

NUS researchers are involved in six of the eight projects that are currently being carried out. These will focus on topics such as green buildings and neighbourhoods in dense urban areas, new technologies for recycling building materials, and solutions to aid tropical coastal cities in Asia that are distressed or at risk of flooding.

Business opportunity in protecting tropical forests: NUS study

Researchers from the NUS Centre for Nature-based Climate Solutions have reported the business potential for carbon finance projects, where tropical forests are protected, and investible carbon generated.

The work, led by Prof Koh Lian Pin and published in Nature Communications in 2021, explored the investment potential in protecting tropical forests in the Americas, Africa and Asia-Pacific. Overall, it was found that a potential return-on-investment of more than US$46 billion a year, based on current carbon market prices, could result from the protection of vulnerable forests in tropical regions, through the sale of carbon credits.

Reflecting the fact that forests in the Asia-Pacific region contain high carbon density, yet are also at high risk of deforestation, this region was found to have the highest number of profitable forest carbon sites. Protecting these

sites will inevitably avoid carbon emission from their deforestation, and thus such carbon finance projects can support both nature conservation and climate change mitigation goals.

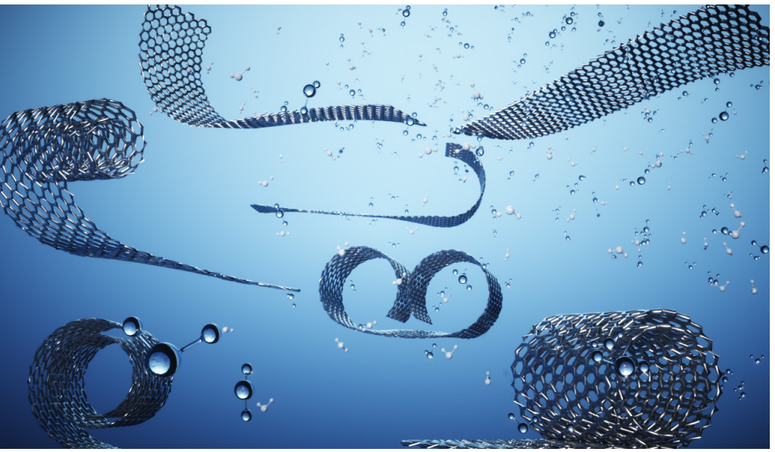
However, with approximately 80% of the forests in these regions deemed financially unviable, the study also highlighted that alternative measures must be implemented in order to protect carbon stocks and biodiversity, in vulnerable forests.

NUS scientists create a new type of intelligent material

Intelligent materials, the latest revolution in the field of materials science, can adapt their properties depending on changes in their surroundings. They can be used in everything from self-healing mobile phone screens, to shape-shifting aeroplane wings, and targeted drug delivery. Delivering drugs to a specific target inside the body using intelligent materials is particularly important for diseases like cancer, as the smart material only releases the drug payload when it detects the presence of a cancer cell, leaving the healthy cells unharmed.

Now, researchers from the Centre for Advanced 2D Materials (CA2DM) at the National University of Singapore (NUS) have created a new class of intelligent materials. It has the structure of a two-dimensional (2D) material, but behaves like an electrolyte – and could be a new way to deliver drugs within the body.

Just like traditional electrolytes, these new "2D-electrolytes" dissociate their atoms in different solvents, and become electrically charged. Furthermore, the arrangement of these materials can be controlled by external factors, such as pH and temperature, which is ideal for targeted drug delivery. The 2D-electrolytes also show promise for other applications that require a material to be responsive to environmental changes,



By altering the pH of the suspensions, the NUS researchers demonstrated the ability of the 2D-electrolyte sheet to roll up into a scroll-like arrangement. This is similar to the way electrically charged polymers undergo transitions from molecular chains to globular objects.

Changing the behaviour of 2D materials

In materials science, a 2D material is a solid material that exists in a single layer of atoms. It can be thought of as an atomically-thin sheet that has a specific height and width, but effectively no depth, hence, it is essentially two-dimensional. On the other hand, an electrolyte is a substance that produces an electrically conducting suspension when dissolved in a solvent, such as water.

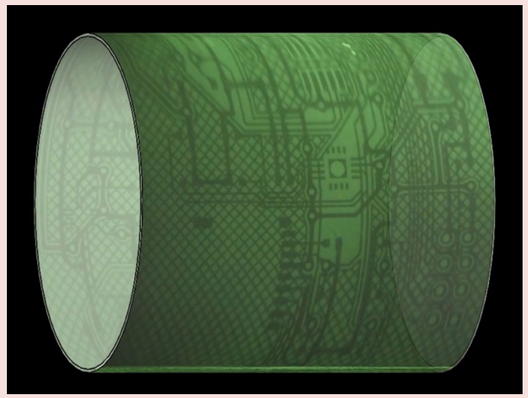
This work represents the first instance where materials are shown to have both 2D structure and properties of electrolytes, with a particular trend to shapeshift their form reversibly in liquid medium. The NUS team achieved this feat by using organic molecules as reactive species to add different functionalities to 2D materials such as graphene and molybdenum disulfide (MoS2).

"There is an uncountable number of ways to functionalise graphene and other 2D materials to transform them into 2D-electrolytes. We hope that our work will inspire scientists from different fields to further explore the properties and possible applications of 2D-electrolytes. We anticipate that as 2D-electrolytes have similarities with biological or natural systems, they are capable of spontaneously self-assemble and cross-link to form nanofibers that are promising for applications in filtration membranes, drug delivery, and smart e-textiles," explained Prof Castro Neto.

The team behind the 2D-electrolytes is led by Professor Antonio Castro Neto, Director of CA2DM, and comprised researchers from CA2DM, as well as the NUS Department of Physics, and the NUS Department of Materials Science and Engineering

Their trailblazing results were published in the prestigious journal Advanced Materials on 12 May 2021.

Ultra-high-resolution X-ray imaging of 3D objects



An international team of researchers, led by Professor Liu Xiaogang from the NUS Department of Chemistry, has created special nanocrystals that emit light after exposure to X-rays, which were embedded into silicone rubber to create a highly flexible X-ray detector that can be wrapped around 3D objects.

The small crystal-embedded rubber gave a high resolution finer than human hair (approximately 30 micrometres in diameter). The team were also able to enhance nanocrystal sensitivity to X-rays by doping them with the rare-earth element terbium. This allowed the nano-crystals to remain luminescent for more than two weeks, and meant images of the objects could be retrieved anytime within the two weeks upon heating.

The research, which was conducted with collaborators from Fuzhou University and The Hong Kong Polytechnic University, could be used not only for healthcare but also to detect defects in electronics, authenticate valuable works of art, or examine archaeological objects at microscopic scale.

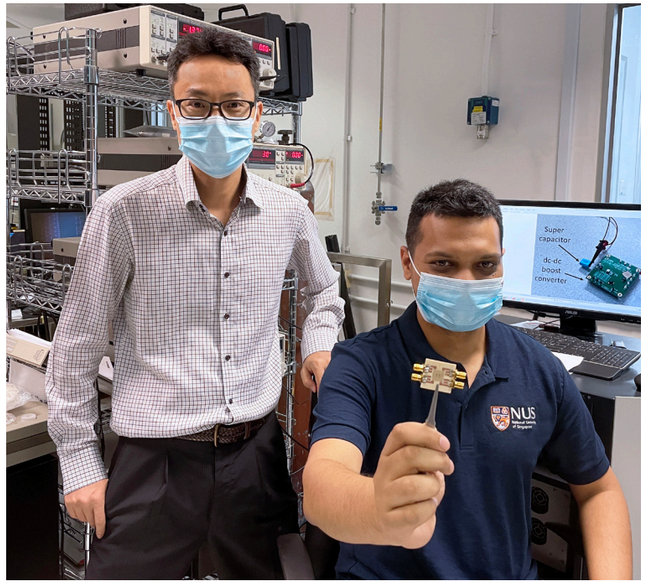
The findings were published in the prestigious journal Nature on 17 February 2021.

NUS engineers harvest WiFi signals to power small electronics

In research led by Professor Hyunsoo Yang from the NUS Department of Electrical and Computer Engineering, a technology was developed that uses tiny smart devices known as spin-torque oscillators (STOs) to harvest and convert wireless radio frequencies into energy to power small electronics.

In their study, the researchers successfully harvested energy using WiFi-band signals to power a light-emitting diode (LED) wirelessly, and without using any battery.

This work was carried out in collaboration with researchers from Japan's Tohoku University, and was published in Nature Communications on 18 May 2021

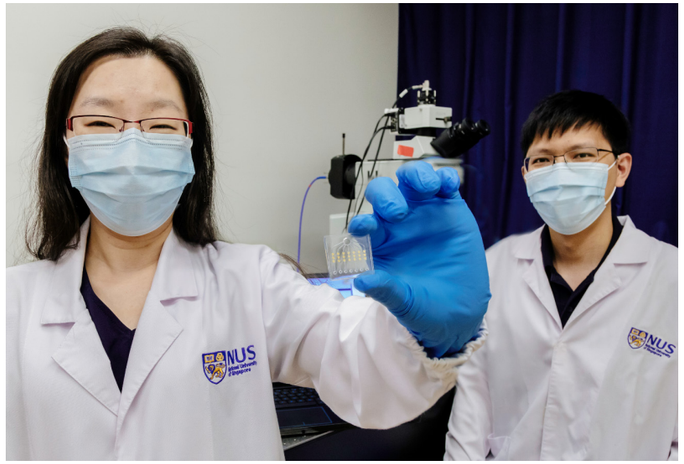


NUS researchers develop world's first blood test for real-time monitoring of cancer treatment success

The ExoSCOPE test accurately classifies disease status and determines treatment outcome within 24 hours after the start of treatment

Cancer patients who are undergoing targeted therapy can look forward to a new blood test that could tell their doctors whether the treatment is working, within one day after the start of the treatment. This will significantly speed up the evaluation process and enable doctors to make adjustments to the treatment plan, if necessary, to improve patients' chances of recovery.

The technology, which is based on a technique termed extracellular vesicle monitoring of small-molecule chemical occupancy and protein expression (ExoSCOPE), takes advantage of extracellular vesicles (EVs) secreted by cancer cells and circulating in blood as a reflective indicator of drug effectiveness in solid tumours. Only a tiny amount of blood is required for analysis, and each test takes less than one hour to complete, yet remains highly accurate.



The work, led by Assistant Professor Shao Huilin and her research team from the Department of Biomedical Engineering and NUS Institute for Health Innovation & Technology (iHealthtech) was first published in the scientific journal Nature Nanotechnology on 8 March 2021.

NUS researchers harness AI to identify cancer cells by their acidity

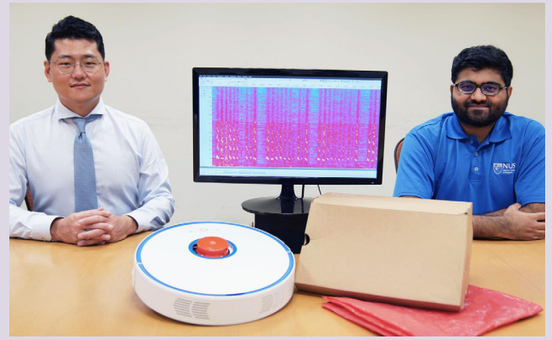
Cancer cells can be distinguished from healthy cells based on the level of acidity, or pH level, inside the cells. Now, NUS researchers have developed a technique determines whether a single cell is healthy or cancerous by analysing its pH using an artificial intelligence approach. Each cancer test can be completed in under 35 minutes, and single cells can be classified with an accuracy rate of more than 95 per cent.

The research, led by Professor Lim Chwee Teck, Director of the NUS Institute for Health Innovation & Technology (iHealthtech), was first published in the journal APL Bioengineering on 16 March 2021.

Robot vacuum cleaners can spy on private conversations

A research team led by Assistant Professor Jun Han from the Department of Computer Science at NUS Computing has demonstrated that the Lidar sensor atop a robot vacuum cleaner can be repurposed as a tool to spy on private conversations at home or in the office.

The work was presented at the Association for Computing Machinery's Conference on Embedded Networked Sensor Systems (SenSys 2020) on 18 November 2020



NUS scientists develop computational tool to help design safer devices

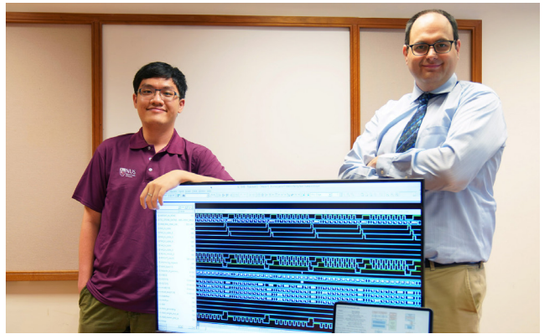
Scientists from the National University of Singapore's School of Computing (NUS Computing) have made it easier to guard against cybercriminals accessing sensitive data through the everyday appliances connected to the internet. They have developed a software tool that can simulate hacker attacks, and provide an automated way to protect the chip design, thus helping designers create more secure computer chips.

Securing chips against hardware attacks

The software works by simulating a physical hardware attack known as laser fault injection. To accomplish this on a real device, the cyber-criminal would first partially disassemble the hardware to gain access to its silicon chip without interrupting its operation. Then, they use a laser to generate a processor error. This throws the gates open, allowing them to extract data and security information.

Previously, it was expensive to protect chips against this kind of attack because they had to be tested manually. If the chip fails the test, the design must start over.

The NUS software, called the Laser fault Attack Benchmark Suite or LABS, can now simulate attacks in a wide variety of situations and demonstrate how the chip reacts. All this can be done without having to manufacture a single chip. This helps chip designers figure out how to repel the attack, and even trick the attackers into thinking they have succeeded. With this software, chip manufacturers will be able to simulate any device, and results are available within minutes.



The NUS scientists, led by Assistant Professor Trevor E. Carlson and Professor Peh Li Shiuan, have made the software open source so researchers and the chip design community can use it, or help make it better.

This project was first presented at the 2020 International Conference on Computer-Aided Design on 3 November 2020.

Office of the Deputy President (Research & Technology)

nus.edu.sg/research