

FUSION

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THE POTENTIAL OF
TECHNOLOGY AND DESIGN

YEAR OF THE TIGER LIGHTING UP CHINATOWN

Find out more about the theme
behind this year's design

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Prof Erwin Viray has in store for the future

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VISIT TO THE SINGAPORE AIRSHOW 2022

BY SHAWN GOH



Coming from a family of five, the cost of education has gradually placed an immense financial strain on my parents. Prior to receiving the grant, I was considering doing part-time work to alleviate my parents' financial burden. Receiving the Lockheed Martin-SUTD Study Grant has allowed me to better focus on my studies and aspirations. It also gave me the opportunity to visit the Lockheed Martin chalet at the Singapore Airshow 2022, which was a humbling experience.

As the fighter jets flew by for the impressive flying display, leaving trails that temporarily marked the sky, I was reminded of the incredibly tiny and insignificant presence we have as humans while simultaneously highlighting the awe-inspiring potential of the technology we can build. The experience in the F35

simulator — we learnt about the capabilities and features of the fifth-generation strike fighter — was an eye-opener.

We were also honoured by the presence of Mr Andrew Linstead, Vice President and Regional Executive of Lockheed Martin's Asian division, who taught us how the creation of the F35 was only possible with a mind-boggling 9 million lines of code.

Overall, the visit to the Lockheed Martin chalet at the Singapore Airshow 2022 has allowed me to further appreciate the possibilities of technology, even as I became acquainted with the team that made the Lockheed Martin-SUTD Study Grant possible. I am extremely thankful to the amazing people at Lockheed Martin for bestowing this study grant to me and making the visit to the Singapore Airshow such a memorable experience.



2 022 marks the second year that Chinese New Year (CNY) celebrations have been affected by the pandemic. However, the tiger is well-known for its power and strength, hence may the Year of the Tiger inspire the courage and spirit to emerge stronger and better in the new year. This is a theme that the 12-student team from SUTD incorporated into their designs for this year's Chinatown CNY Street light-up. Led by Sharmayne Lim and Jonathan Leong, the team included Kong Mei Jia, Sarah Phua, Tan Jia Yue, Leon Puah, Justin Eng, Lyvia Anabelle Simano, Ng Ming Liang, Theresa Lam, Arturo Castillo and Kuan Yi Heng. Assisted by student coordinator Janelle Ho, the team was guided by Dr Zheng Kai,

CHINATOWN STREET LIGHT UP FOR THE YEAR OF THE TIGER

Faculty Fellow from the Architecture and Sustainable Design pillar.

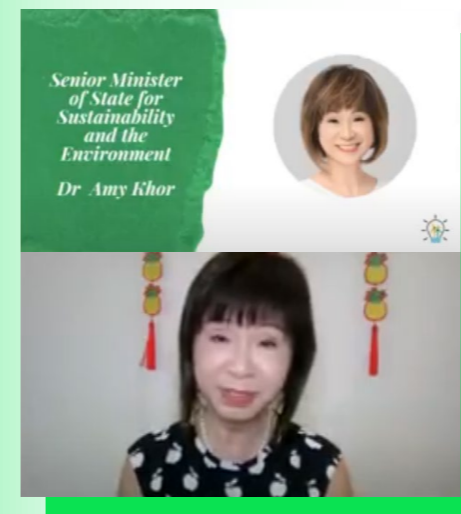
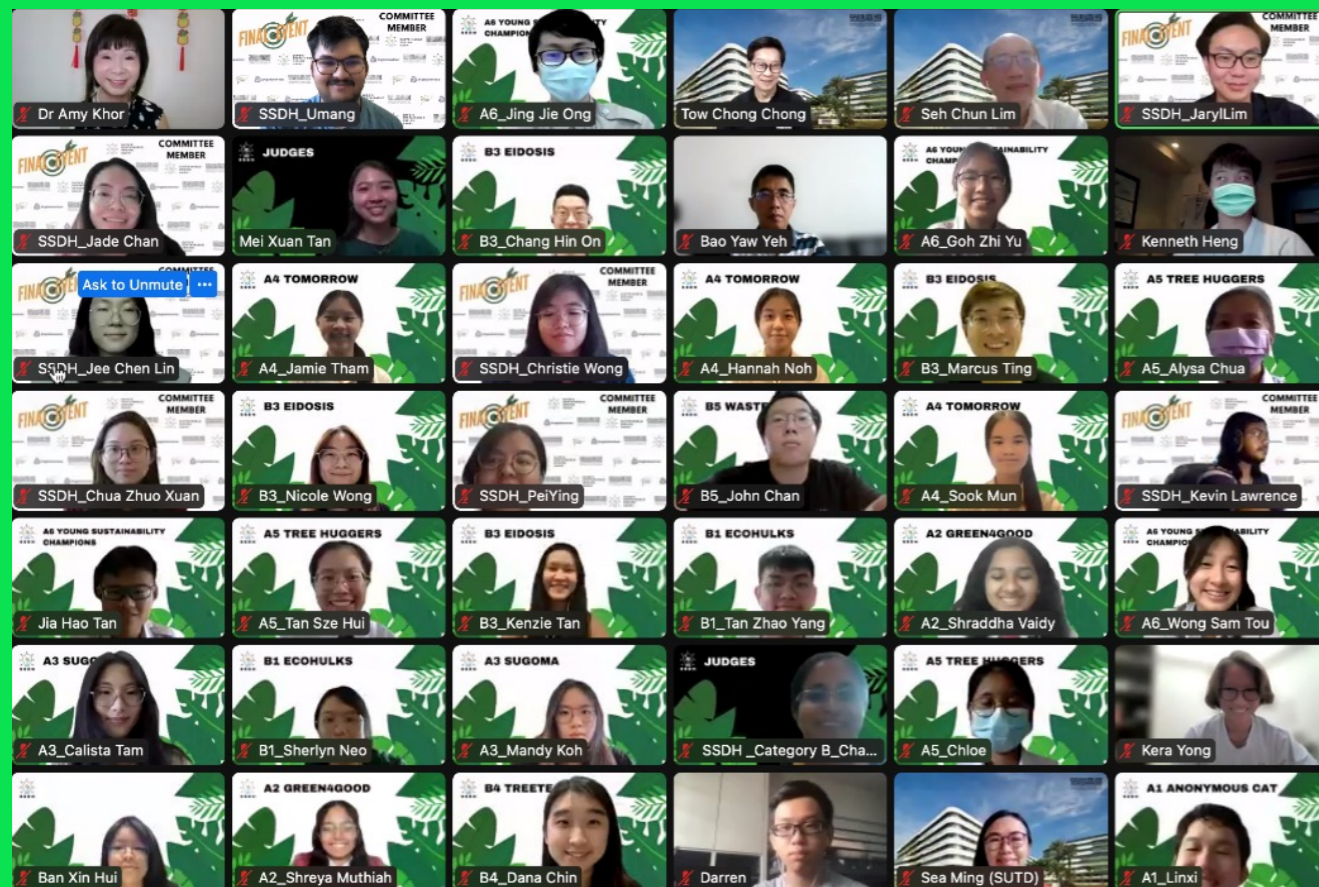
The students referenced Bengal tigers, one of the most powerful hunters to keep congruent to their theme of strength and vitality. These tigers are known for their stripes that are unique to each individual, similar to human fingerprints. Throughout the light-up installation, there are tigers in a variety of stances, some leaping, some crouching or walking, to demonstrate their dynamism. At the same time, there are tigers that are at rest, symbolising the importance for people to remember to take a break when they are burnt out or overwhelmed by work and life during this pandemic.

Jonathan Leong, a Freshmore student who co-led the design team, said: "Our initial ideas were about bringing the notions of family, community and celebrating the arrival of the Tiger year. As a first-year student, I hope that we were able to translate what we aspired to inspire accurately. I was excited to see how our artworks and models turn into a physical installation for all to enjoy!"



THE STUDENT-ORGANISED SUTD SUSTAINABLE DESIGN HACK 2022

BY JARYL LIM



“...as designers and engineers, we are makers of the technological world, and it is our responsibility to contribute to a sustainable world.”

Eleven SUTD students from SUTD Greenprint organised the inaugural edition of the SUTD Sustainable Design Hack, with guidance from Science, Math & Technology Senior Lecturer, Dr Tan Mei Xuan.

With the generous sponsorship from SUTD and Anglo American, the sustainability hackathon aimed to raise environmental awareness about the UN Sustainable Development Goals (SDGs) among pre-tertiary and tertiary students. Taking place from 1 January 2022 to 27 February 2022, the hackathon saw 150 participants from Category A (secondary school, junior colleges and polytechnics), and Category B (universities).

Despite its inaugural run, it was over-subscribed, receiving over 200 applications for only 150 slots. The participants had two months to work together to come up with ideas and prototypes for the hackathon. In addition, there were also two major events during that period — a design thinking workshop, where participants were trained by Design Odyssey members on how to use the Big-Design framework, and a speaker’s session, where prominent sustainability practitioners visited to share their insights. The hackathon concluded with a finale event, which was graced by Dr Amy Khor, the Senior Minister of State for the Ministry of Sustainability and the Environment, and SUTD President, Professor Chong Tow Chong.

Dr Khor shared that she was delighted to see SUTD organising this hackathon, where students are able to apply design thinking principles to address sustainability challenges. She added her hopes that this event will inspire and connect like-minded young people and foster a community of youths with a passion for the environment and sustainable causes.

The winning teams comprised students from National Junior College for Category A, for their hydropower renewable energy idea, and students from the National University of Singapore for Category B, for their approach to inculcating a sustainable lifestyle. A joint SMU and SUTD team also came in third place for their category.

In his closing remarks, Prof Chong mentioned “sustainability is not a task for the distant future, nor is it something we can expect to receive passively... as designers and engineers, we are makers of the technological world, and it is our responsibility to contribute to a sustainable world.”

The organising committee hopes this hackathon has inspired many participants to continue their push to taking sustainable individual action, that will persist for years to come.

INTERVIEW WITH SUTD'S NEW CHIEF SUSTAINABILITY OFFICER, PROF ERWIN VIRAY



To drive SUTD's multi-faceted Sustainability Plan (SSP), Professor Erwin Viray, was appointed as SUTD's new Chief Sustainability Officer (CSO). Here is a short interview with him, to understand more about the SSP and what he has planned to bring forward.

Q: Why did SUTD suddenly decide to launch a Sustainability Plan?

A: Since its establishment, SUTD has always placed strong emphasis and investments on sustainability. That is why we had put in measures during the building of our campus to ensure that it would be certified Green Mark Platinum right from the start. One of SUTD's four main pillars, Architecture and Sustainability Design, also has the word 'Sustainability' in it, indicating our early focus on this area. The SSP came about because we felt it would be good to put all our efforts in sustainability into a holistic and strategic plan where we can develop a proper framework with key goals and track our progress towards achieving them.

Q: Can you give a quick recap on what is the SSP?

A: The SSP is a long-term holistic plan that aims to leverage on technology and design thinking to build a more sustainable and happier world by design. We hope to make it an inclusive plan where even our faculty, students and staff can moot ideas and influence key decisions in our sustainability agenda. The SSP has three key areas of focus:

- to transform our campus into a green experimental testbed for new sustainable technologies, which we are calling OASIS – Open Arena for Sustainability Innovation and Solutions;
- to launch a new research initiative on Circular Economy to generate sustainable products and software solutions;
- and thirdly, to provide hands-on sustainability education for students.

Q: Please share more about OASIS.

A: The OASIS comprises three elements:

- (1) Living Lab — This is where testing sustainability innovations by our designers, researchers and industry partners takes place on campus. The data and knowledge produced will be shared among participants.
- (2) Open Arena for Experiential Learning — Opening SUTD's facilities to students and the community as a forum for experiential learning on sustainability prototypes and social initiatives.
- (3) Sustainable Spaces — Converting our campus facilities and amenities into demonstrators for sustainable and smart living spaces.

Additionally, OASIS aims to foster a culture of environmental consciousness and sustainability among our faculty, students, staff and the community, to enhance their lived experiences and build a happier world by design. For example, we have students leading such initiatives through the SUTD Sustainable Design Hack. This hackathon aims to increase awareness and encourage pre-tertiary and tertiary students to brainstorm ideas and develop prototypes to solve UN Sustainable Design Goals.

Q: What is this new research initiative in circular economy? What is circular economy?

A: Circular economy looks at the entire production and consumption lifecycle, and involves sharing, reusing, repairing, refurbishing and recycling of existing materials and products. It aims to reduce the problem of wastage and tackle issues like climate change, pollution, etc.

As a start, SUTD will be partnering SingHealth to explore research and innovation initiatives to achieve a smart, low-carbon status for its campuses at Changi General Hospital and the upcoming integrated general and community hospital campus at Bedok North. A Future Health Living Laboratory will also be set up at the Bedok North new hospital campus to testbed sustainable solutions in building technology, hospital designs and planning. SUTD will also work with SingHealth to provide continual education and training (CET) to SingHealth executives, staff and healthcare students through this partnership.

Q: What kind of sustainability-related education or learning can students look forward to at SUTD?

A: SUTD has launched various new courses pertaining to sustainability, such as the Science for a Sustainable World, which is a core course in the Freshmore curriculum.

There is also Future Health, a new course offered to SUTD Master of Architecture students, which addresses the design of future healthcare architecture in response to urgent issues such as endemic communicable disease, wellbeing and sustainability. We also have about 20 advanced courses specifically addressing sustainability that are currently offered in our pillars and clusters, which we believe can help prepare our students and graduates to contribute towards the green economy.

As our students will have the opportunity to work with healthcare professionals, architects and planners for the future Eastern Integrated Healthcare Campus at the new Healthcare Living Lab, they will be well-equipped with skills in VR platforms and can fabricate mockups to present their ideas and test them. For example, a student designed a 'metabolic' extension to the hospital. Their building leverages embedded sensors and machine intelligence to anticipate and respond to the needs of users. It continually adjusts the micro-climate of interior spaces according to how it is used. This not only helps to conserve energy but also improves the well-being of patients and doctors.

Q: Any last thoughts you want to share about the SSP or being SUTD's new CSO?

A: Sustainability starts with each of us playing our part by the little things we do to improve the world; one action at a time, like how we use water or electricity, what we require for our daily needs, etc. These small acts will add up, like ripples in a pond, slowly cascading outwards to affect our surroundings, helping us to create a happier and more sustainable world.

SUTD'S FUTURE COMMUNICATIONS PROGRAMME SCHOLARS

SUTD has established the Future Communications Research and Development Programme (FCP), which will run from 2021 to 2025. One of its objectives is to support Masters-level scholarships for local students to develop capabilities in Future Communications technologies and we would like to share with you the motivations and plans for some of these scholars.

LEE JIONG LE

Master of Science in Security by Design (MSSD)

SUTD

Jiong Le has a keen interest in 5G as it is a burgeoning field and opens up many new research topics. The FCP scholarship has provided him with an opportunity to dip his toes into the research behind this growing technology.



LEE KAI MIN FRANK

Master of Science in Security by Design (MSSD)

SUTD

Frank majored in engineering and had experience in sensor development. He plans to enter the field of Critical Infrastructure Security to contribute his cybersecurity and technical knowledge to build a safer and more stable Singapore. Taking up the scholarship motivates Frank to strive and excel in his studies as it provides opportunities for him to network within the industry.

ELVINA LIOW

Master of Science in Security by Design (MSSD)

SUTD

Elvina has several years of experience in cybersecurity and dealt with various multi-disciplinary organisations to address the growing and evolving cyber risks faced by them. With Singapore undergoing digital evolution into a Smart Nation, it calls for new technologies and security to support this demand. This sparked her interest in pursuing the FCP scholarship programme as upon completion, she will be equipped with reinforced understanding of cybersecurity fundamentals and the right skills and technical capabilities to contribute to the industry in more positive and meaningful ways.



KHOR KAI SHERNG

Master of Engineering (MEng)

NTU

Kai Sherng has a strong passion in robotics. With the FCP scholarship, Kai Sherng was motivated to convert from a part-time to a full-time programme to focus on pursuing his passion for robotics. He aspires to be a Robotics Engineer in the commercial sector after graduation.



SUTD SETS ITS SIGHTS ON CHALCOGENIDE NANOSTRUCTURED DISPLAYS

One of the key components behind next-generation high resolution video displays will be optical nanoantennas.

These devices use nanotechnology to mix and interfere with light beams to produce colour and even holograms.

While optical nanoantennas using silicon or similar materials have produced colour images, the images are fixed and cannot be tuned back and forth. Hence, new materials with tuneable properties are required to exploit optical nanoantennas in high resolution videos.

To address this gap, research teams from SUTD and A*STAR IMRE designed and demonstrated the use of chalcogenide nanostructures to reversibly tune Mie resonances in the visible spectrum. With its width measuring at just 190nm - 1000 times smaller than a single strand of human hair - the chalcogenide nanodisc can be switched between two optical states using heat to induce phase transitions.

Their work "Reversible Tuning of Mie Resonances in the Visible Spectrum" was published in ACS Nano.

"We demonstrate phase change nanodiscs' ability to interfere and manipulate visible light – that is the first step towards a video hologram display,"

explained Associate Professor Robert Simpson, the principal investigator at SUTD.

The technology relies on phase change materials; materials which are more typically

used in data storage devices. Instead of using phase change data storage materials, such as the germanium-antimony-tellurium alloys, the research team explored the use of an Earth abundant material called antimony trisulphide, and demonstrated that the optical properties of antimony trisulphide nanoparticles can be switched at a high speed to create tuneable vivid colours.

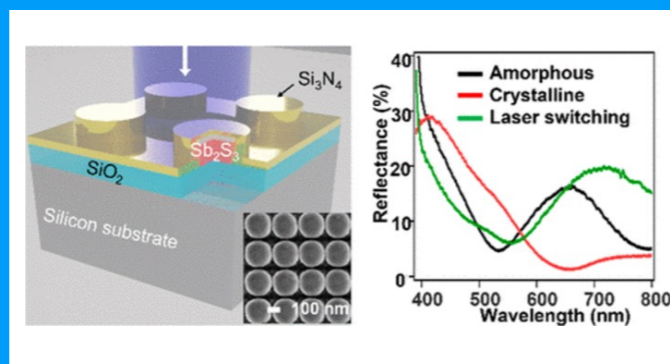


Illustration of the antimony trisulphide programmable metasurface and its reflection spectrum in multiple states.

While this work paves the way towards high resolution colour displays, holographic displays and miniature LIDAR scanning systems, the research team is also excited to extend this new phase change material to other programmable photonics applications and foster collaborations to realise the full potential of antimony trisulphide and related materials.

"Our work clearly demonstrates that reversible switching is possible, but for practical devices, we also need to develop an elegant, integrated system to electrically address and control the optical state of the nanoparticles. We are currently working on these technologies, and hope that this paper will inspire the wider research community to further extend the capabilities of these important chalcogenide nanoparticles," added Associate Prof Simpson.

LOW-COST ELECTROPORATION DEVICE THAT COULD EXPAND GLOBAL ACCESS TO CANCER DRUGS

Researchers from SUTD have developed a microsize-gap multiple-shot electroporation (M2E) device that could improve the effectiveness of delivering cancer drugs at a lower cost, globally.

"One of the goals of the scientific community is to develop a method for cancer drug delivery that is simple, manufacturable and low-cost,"

said Assistant Professor Desmond Loke, the lead investigator of this research.

A way to enhance prospects for cancer drug delivery may be through electroporation – a method in which a very weak electric pulse is applied to cells to temporarily open holes in their membranes. The cancer medicines can be sent in through these holes. The application of electroporation together with cancer drugs could enhance both drug effectiveness and accessibility.

The researchers integrated transparent electrodes into the device to enhance visualisation of cancer drugs. "The narrow gap between electrodes allow us to achieve a sufficiently strong electric field using a few volts rather than several tens of volts applied in traditional electroporation,"

said Assistant Prof Loke. This low voltage, plus electrode transparency, minimise energy consumption and facilitate visibility, which help avoid unsafe usage of the drugs and limited imaging of drug transport during drug testing – both of which are common problems of traditional electroporation systems.

Additionally, in electrochemotherapy applications, tumour cells can be permeabilized by electroporation, thereby enhancing their uptake of chemotherapeutic drugs such as bleomycin and cisplatin.

The researchers tested the M2E device using cancer-drug-related molecules. The device allows cancer cells to show a time window for the uptake of molecules of 2 hours, which is 400% larger than conventional electroporation systems.

Furthermore, it is reusable.

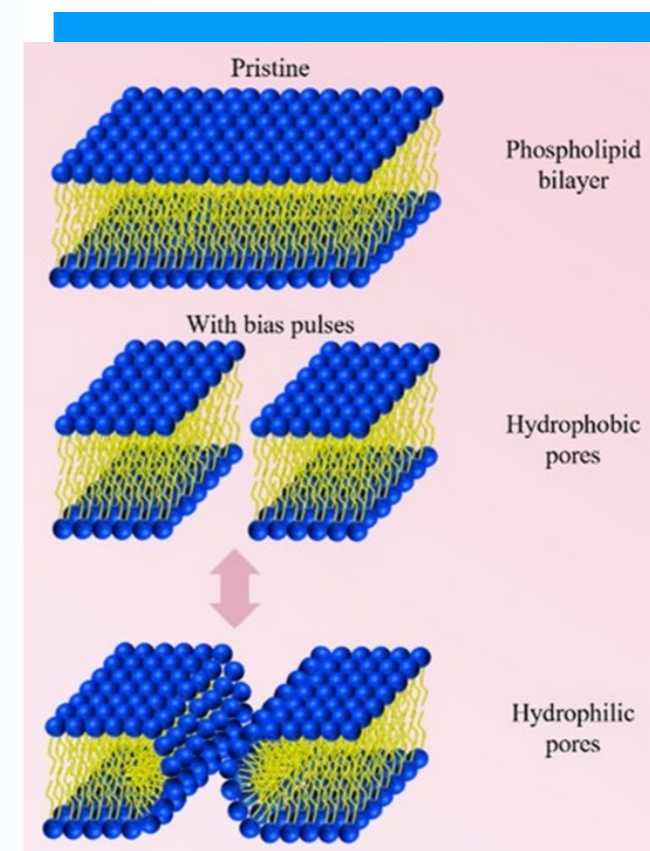
The researchers suggest that the M2E system could work with associated drugs for treating Covid-19 as well.

"The device developed by SUTD doesn't require specialised components, expensive materials or a complicated fabrication process, unlike traditional electroporation machines," Assistant Prof Loke noted.

Optimisations of the M2E system are currently underway and researchers expect that it could take a few years for the device to complete clinical study and be ready for wider use. "We hope the M2E system could provide a path to significantly improve the cancer drug delivery process and allow a more uniform distribution of cancer drugs to under-resourced and underserved regions worldwide," added Assistant Prof Loke.

This work was published

in the journal American Chemical Society (ACS) Omega and other researchers involved are Denise Lee, Sophia Chan, Nemanja Aksic and Natasa Bajalovic, who are also from SUTD.



Schematic of the process of pore formation in phospholipid bilayer after electroporation.



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