



TechXfer

TTO NEWSLETTER

Special
Edition



Hong Kong Winners 2021

International Exhibition of Inventions of Geneva 2021



HKU WINS ELEVEN GOLD AND SILVER MEDALS AT 2021 INVENTIONS GENEVA EVALUATION DAYS

HKU's award-winning inventions in 2021

Gold Medal with Congratulations of the Jury

- Flu-based COVID-19 Vaccine

Gold Medals

- Innovative Sewage Testing Tool for SARS-CoV-2
- Direct Thermal Charging Cell (DTCC) Light-controlled Contamination-free Fluidic Processor
- Ultra-Strong and Ductile Steel with Low Price and Easy Manufacturing

Silver Medals

- A Nanofibrous Composite Membrane Air Filter
- A Soft Underwater Manipulation System
- Microfluidic Platform for Metastasis Detection and Drug Discovery
- Momentus Robotics – MR-safe Actuators
- Universal Fracture Healing Accelerator for External Fixators
- Llewellyn and Partners – BIM Warehouse

of Hong Kong inventors were widely recognized by the jury at the International Exhibition of Inventions of Geneva, which saw more than 350 exhibitors present their inventions this year. Hong Kong teams won a total of 136 awards in Geneva, including 14 Gold Medals with Congratulations of the Jury, 47 Gold Medals, 62 Silver Medals and 13 Bronze Medals.

The Hong Kong delegation included inventions by universities, secondary schools, R&D centres, start-ups and government departments, which Mrs Lam said reflected the strength of Hong Kong's innovation and R&D.

Also in attendance at the May 17 reception were Secretary for Innovation and Technology Alfred Sit, Permanent Secretary for Innovation and Technology Annie Choi, and Commissioner for Innovation and Technology Ms Rebecca Pun.



“I would like to congratulate each and every one of the team members who won awards. Your work has contributed immense value to the world and we are proud of you all.”

The technology that has been transferred from the University into the wider world by our researchers and PIs is important and inspiring, even more so as it has been conducted during this unparalleled time of Covid-19 when normal work and communications have been greatly hampered.

As you read these stories and achievements, remember that your work can also gain similar recognition and have a global impact. At the HKUTTO, we are now actively seeking new teams to participate in the transfer of technology. Your team can become one of the growing number of research teams who are working with us to bring their work out of the laboratory and into the hands of the public, contributing to building a better world as well as bringing financial rewards to you and your team.

On May 17, the Chief Executive Mrs Carrie Lam hosted the CE's Reception for Awardees of the International Exhibition of Inventions of Geneva 2021. The event was held to honour the achievements of Hong Kong researchers and their success at the exhibition, where they received multiple awards.

The International Exhibition of Inventions of Geneva is the world's largest exhibition dedicated solely to inventions. The contributions





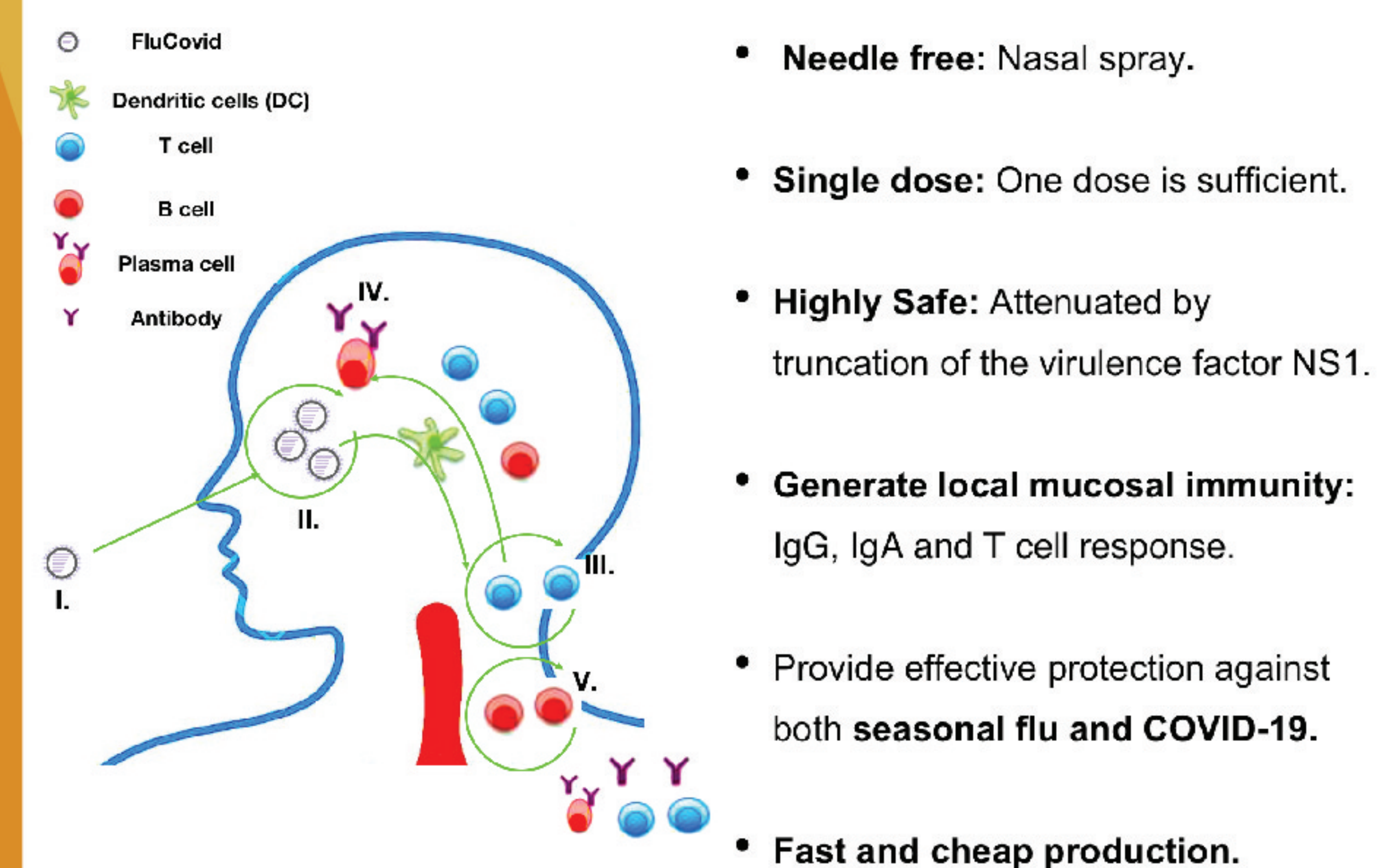
Flu-based COVID-19 Vaccine

COVID-19 has reached every part of the world over the last year and a half, killing millions, incapacitating many more and bringing economies and lives to a standstill. The race has been on to find effective vaccines to protect populations and enable the world to restart. Now, the emergence of a new vaccine is set to bring high protection in an easier and faster way while at the same time providing strong protection against another virus that kills millions every year: the flu.

FluCovid vaccine is an influenza-based vaccine for COVID-19 that can immunize against both the flu and COVID-19. The vaccine is the first nasal spray for COVID-19 in clinical trial. The FluCovid vaccine has several unique features and benefits. It is administered as a nasal spray, which makes it easy to use and less stressful for patients and the lack of need for a needle makes it easier for children to take. It is a flexible vaccine with flu surface proteins that can be changed to work against whichever strain of the flu is prevalent at the time, providing protection against both seasonal flu and COVID-19. Like conventional flu vaccines, FluCovid vaccine can be made from embryonated chicken eggs and MDCK cells, which makes it easy to produce. The vaccine can be quickly modified when necessary to deal with new variants. Unlike some other vaccines, it is more easy to store and transport, as it does not need to be stored at ultra-low temperatures. In the future, the FluCovid vaccine can be used to boost the immunity of patients who have received other COVID-19 vaccines.

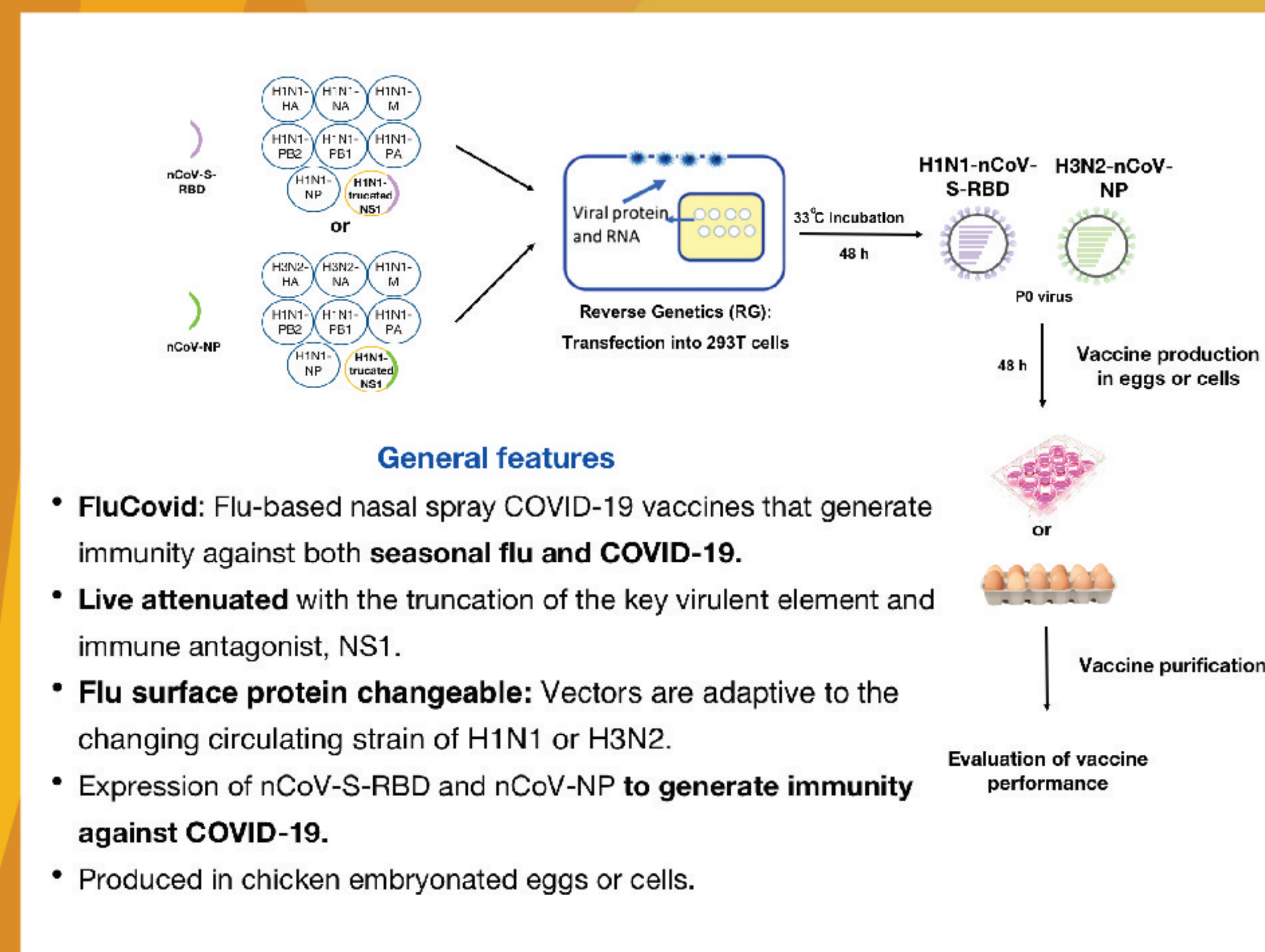
The effectiveness of FluCovid is enhanced by being a nasal spray. Pathogens live in nasal mucous, so the vaccine can block viral pathogens before they infect cells.

The vaccine originated as a better way to fight the flu. The only existing intranasal flu attenuated vaccine contains a virulence gene called NS1, which could allow the virus to multiply and spread around the body. The FluCovid vaccine removed the NS1 which stops the virus in the upper airways so that it cannot spread to the lungs and further into the body. When NS1 is removed, the live virus contained in the vaccine is weakened and can only reproduce once in the cells of the upper respiratory airways. In place of the NS1, the research team put the gene of the surface Spike protein receptor binding domain of COVID-19, which



- **Needle free:** Nasal spray.
- **Single dose:** One dose is sufficient.
- **Highly Safe:** Attenuated by truncation of the virulence factor NS1.
- **Generate local mucosal immunity:** IgG, IgA and T cell response.
- Provide effective protection against both **seasonal flu and COVID-19**.
- **Fast and cheap production.**

The features of flu-based nasal spray COVID-19 vaccines



The advantages of flu-based nasal spray COVID-19 vaccines

can also be replaced with that of any other virus. This makes the FluCovid vaccine a safe mucosal vaccine platform that can be used for multiple purposes. Other vaccines that are injected into muscles are likely not as effective at providing immunity to the respiratory tract and in particular to the upper respiratory tract. The nasal spray is designed specifically to do this.

The FluCovid vaccine was invented by the research team led by Professor Honglin Chen, Professor Kwok Yung Yuen, Professor Zhiwei Chen and Dr Pui Wang, all from the Department of Microbiology, Li Ka Shing Faculty of Medicine of the University of Hong Kong. It was developed by the University of Hong Kong in collaboration with the Coalition for Epidemic Preparedness (CEPI).

Innovative Sewage Testing Tool for SARS-CoV-2

The COVID-19 pandemic has pushed researchers in new directions in their efforts to detect and control the virus and protect people from infection. Since late 2020, a multidisciplinary team led by Professor Tong Zhang of the Department of Civil Engineering has been working to detect the virus in sewage. Sewage inspection has gained popularity in recent years as a way of identifying the presence of viruses and infectious diseases that might otherwise be undetected. Professor Zhang's team has been using a new sewage test protocol to track the presence of the virus in Hong Kong's sewers. The samples are collected from different areas and are then tested using nucleic acid tests.

This sewage testing has proved useful for three key purposes. It provides an early warning of a COVID-19 outbreak, as the presence of the virus in sewage can reflect the overall spread of the virus in the community. It can also track the development of a community outbreak, and it also serves as an additional way to monitor housing estates that have a cluster of infections.

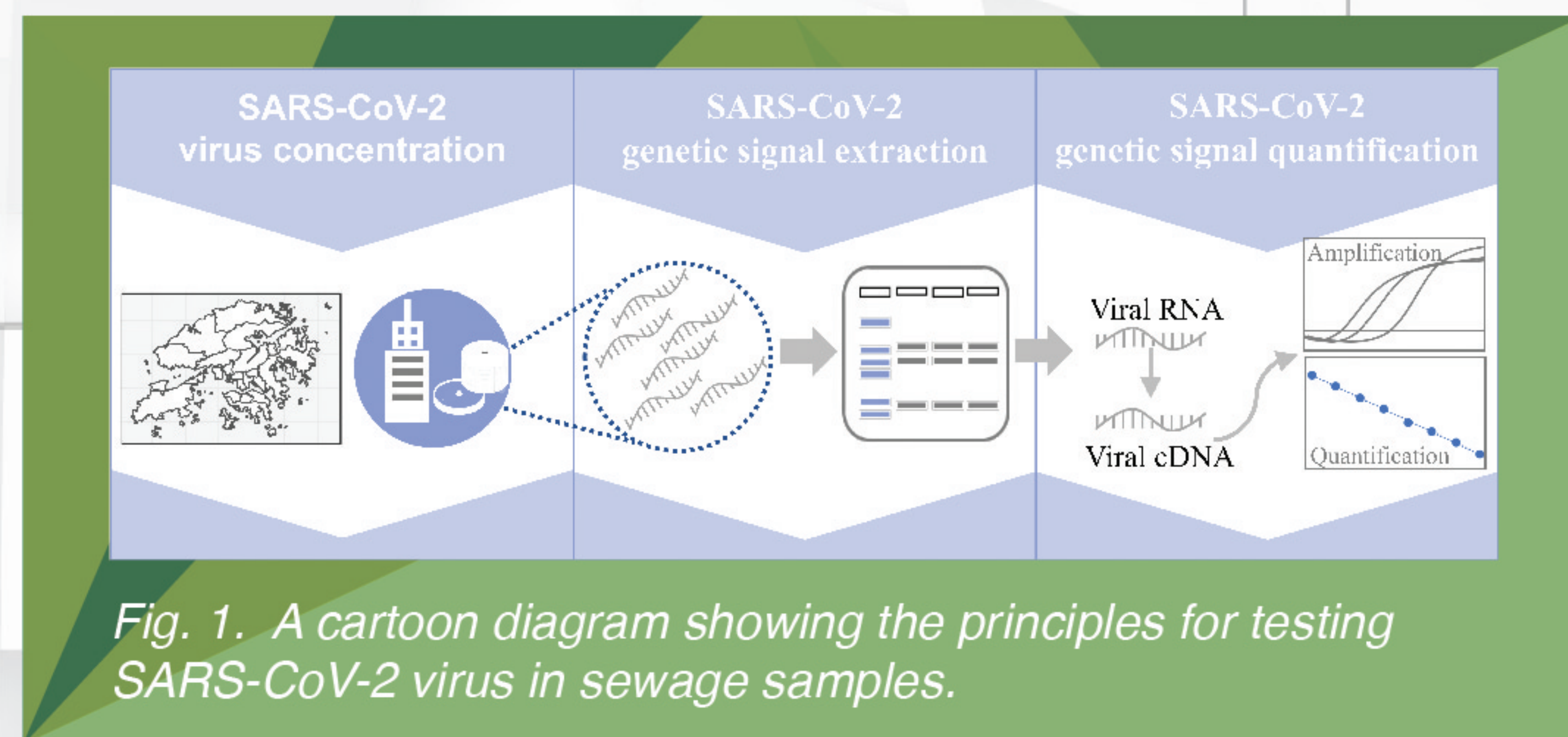


Fig. 1. A cartoon diagram showing the principles for testing SARS-CoV-2 virus in sewage samples.

As the volume of data collected increases, the team will be able to develop a systematic method for early warning, tracking and evaluation of the spread of the virus, which will be a useful tool to assist in decision-making with regard to finding the best ways to fight the virus.

The research was funded by the Health and Medical Research Fund of the Food and Health Bureau and supported by the Environment Bureau. The team also worked with the Drainage Services Department and the Environmental Protection Department as they sought to identify the virus in the unique Hong Kong building environment.

Direct Thermal Charging Cell (DTCC)

As the world heats up due to climate change, more attention is being paid to reducing emissions and cutting usage. But what if we could use alternative energy sources that are completely sustainable, even including human body heat? That's what Dr Tony Shien-Ping Feng and his team at the Department of Mechanical Engineering have been working on. Their new invention is called the DTCC - Direct thermal Charging Cell, and it can convert heat into electricity. Heat occurs naturally in the environment at a low-grade level from living organisms, from solar-thermal and geothermal energy, and from industrial processes. More than 60% of the world's primary energy input from all sources is wasted as heat. The DTCC provides a compact and low-cost way to convert this low-grade heat to electricity, potentially allowing the conversion of many more different sources of heat.

The DTCC has many useful applications, including powering smart energy devices. It can be used to recycle low-grade heat from the compressors and condensers in heating, ventilation and air-conditioning systems, turning it into electricity that can be used to power electrical devices. It can use the waste heat from hot water pipes to create electricity. It can be fitted into window frames to use solar thermal energy to power electrochromic windows. Most ingeniously, the DTCC will soon be able to use body heat to power the kind of wearable electronic body devices that are used to monitor body health, such as blood sugar levels and blood pressure. It can also be used to power life-saving equipment for use in remote outdoor environments.

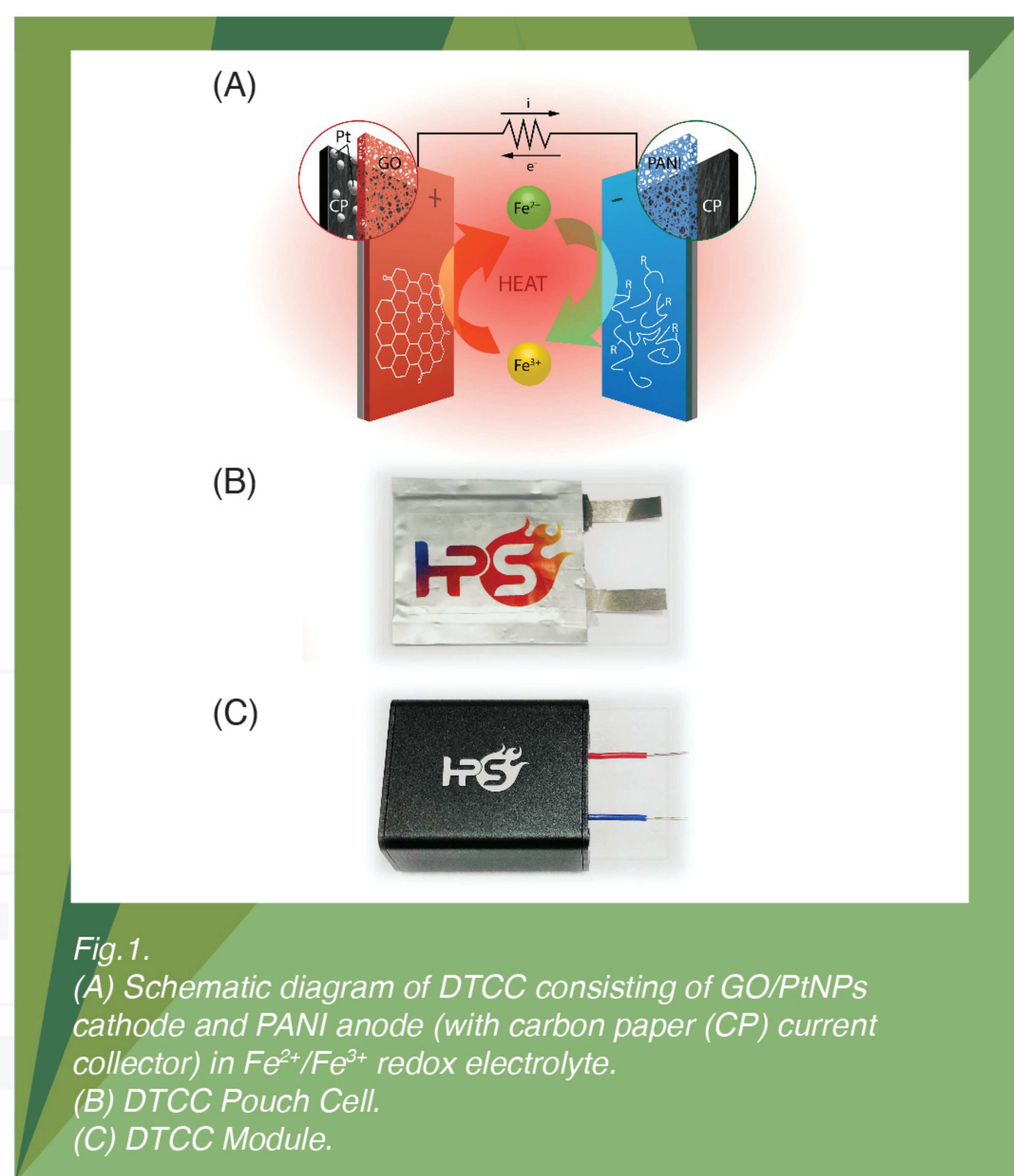


Fig. 1. (A) Schematic diagram of DTCC consisting of GO/PtNPs cathode and PANI anode (with carbon paper (CP) current collector) in Fe^{2+}/Fe^{3+} redox electrolyte. (B) DTCC Pouch Cell. (C) DTCC Module.

"Efficient low grade heat recovery can help to reduce green gas emissions, but current technologies to convert this heat to electricity is still far from optimum," explains Dr Feng. "DTCC yields a conversion efficiency of over 3.5%, surpassing all existing thermo-electrochemical and thermo-electric systems, which is either too costly or complicated, or too low in efficiency for everyday applications. DTCC is a revolutionary design with great potential in smart and sustainable energy devices."

Light-controlled Contamination-free Fluidic Processor

Frontline medical workers run into many risks in their daily working lives, a hazard that has been brought into the spotlight during the COVID-19 pandemic, which has exposed many of them to the risk of infection on a daily basis. The WHO estimates that healthcare workers are up to 32 times more likely to be infected with Ebola, for example. With the advent of a newly invented technique that allows contactless manipulation of liquids, frontline medical workers can now be safeguarded from many of the hazardous substances they need to deal with in their work.

The invention was created by Mr Li Wei, Professor Wang Liquiu and Dr Tang Xin of the Department of Mechanical Engineering and consists of a light-controlled contamination-free fluidic processor with a two-layer photo-responsive platform. Using light as a stimulating force, the processor allows contactless manipulation for moving, merging, dispensing and splitting liquids. The two-layer platform consists of a superomniphobic surface that interacts with fluids without any friction and a photothermal pyroelectric layer that senses the light stimuli and converts into a force that moves, splits and dispenses the fluids. The device can be used in many advanced medical and industrial applications, including DNA analysis, proteomics, chemical synthesis and drug discovery, among others. It can be used with different types of

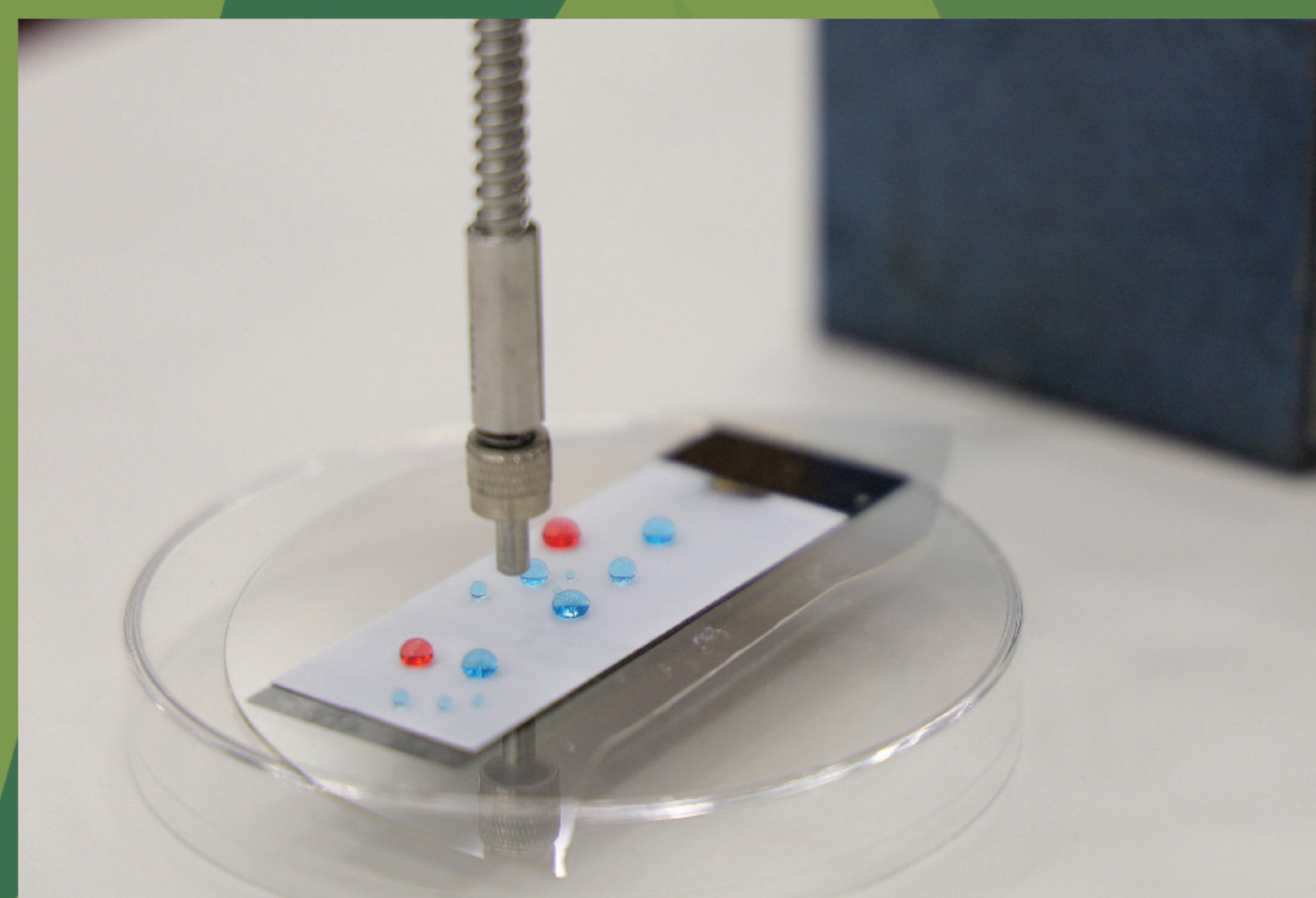


Fig. 1. Light-controlled contamination-free fluidic processor.

liquids including water, alcohol, alkanes and silicone oil.

"Testing infections viruses and bacteria is highly risky, sometimes event fatal," explains Professor Wang... "A blood droplet from an Ebola patient can infect medical workers through the skin. The device functions as a 'magic' wetting-proof hand to navigate, fuse, pinch and cleave fluids on demand.

As well as protecting workers, the technology also reduces the risk of contamination and cuts costs by reducing or potentially replacing the need for the disposable plastic materials used in testing, and the cost of disposing of the toxic waste left on them.

The team hopes to integrate the technology with artificial intelligence to create a fully automatic liquid processing system.

Ultra-Strong and Ductile Steel with Low Price and Easy Manufacturing

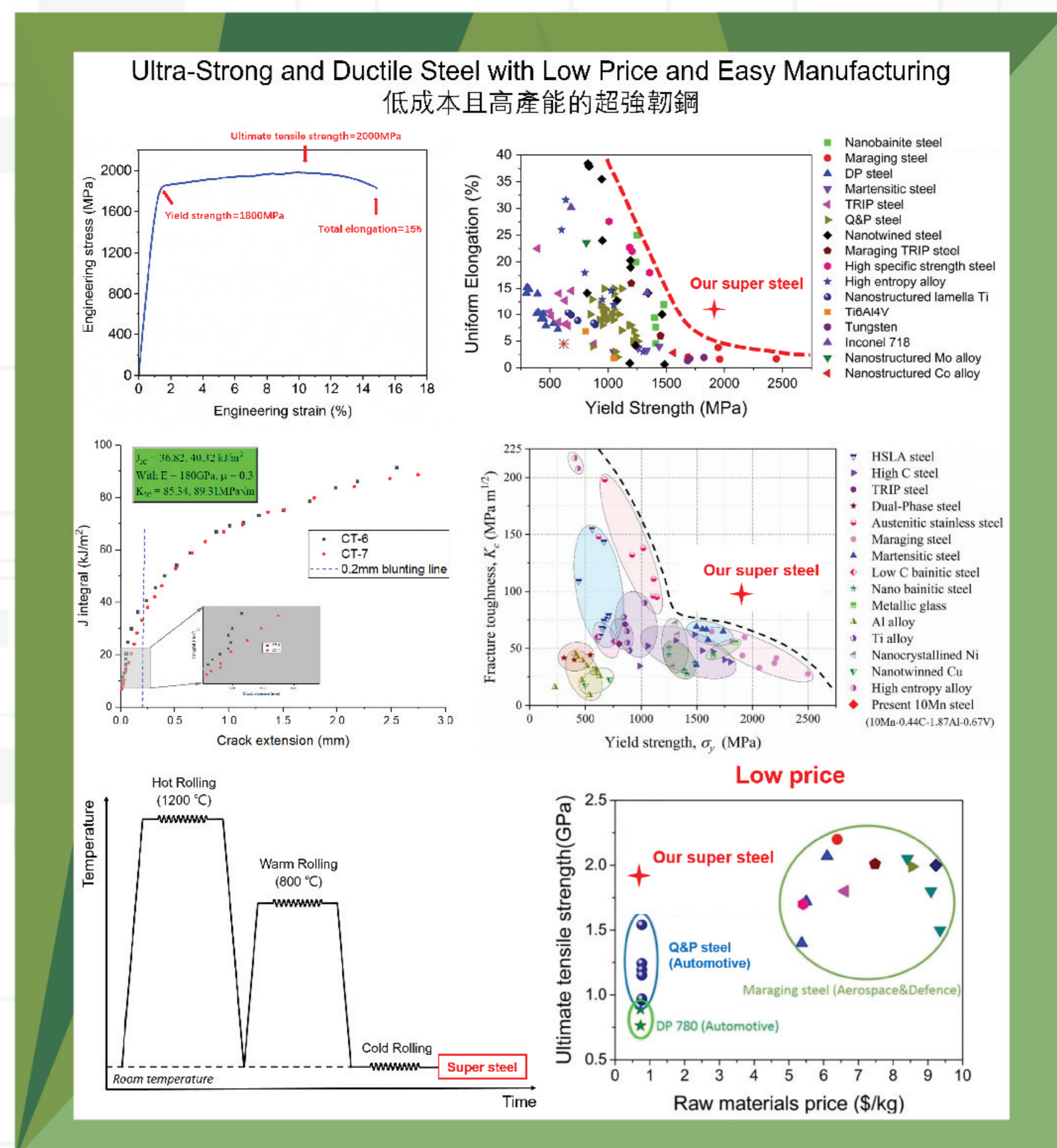
Making stronger and better steel has been a challenge facing material scientists and engineers for a long time. The problem has been finding a way to simultaneously increase the alloy's three key features of flexibility, strength and toughness without reducing the effectiveness of any one feature, while at the same time maintaining the material's lightness and cost effectiveness. Previous attempts have found that improving the performance of one property undermines the effectiveness of one or more of the others.

A new breakthrough has been achieved by Professor Huang Mingxin of the Department of Mechanical Engineering in collaboration with the Lawrence Berkeley National Lab. The Super Steel project achieves an unprecedented strength-toughness combination. The new super D&P steel is made using a new deformed and partitioned methods that greatly increases its resistance to fracturing without affecting its strength.

"...we attained an unprecedented strength-toughness combination which can address a major challenge in safety-critical industrial applications - to attain an ultra-high fracture toughness so as to prevent catastrophic premature fracture of structural materials," explains Professor Huang.

The new steel is also cost effective, with its raw materials costing just 20 percent of the maraging steel that is currently used in the aerospace

industry. The team is working with industry partners to build prototypes of high-strength bridge cable, bullet-proof vests and car springs, and also shows the potential for use in lightweight automobile and military vehicles, aerospace and for high-strength nuts and bolts.



A Nanofibrous Composite Membrane Air Filter

Billions of face masks have been used and discarded since the outbreak of COVID-19. Now, the environmental impact of face masks can be greatly reduced thanks to the invention of a reusable face mask by a team of undergraduate students from the Department of Civil Engineering, led by Mr Junwei Zhang and Ms Yan Tung Lo and supervised by Professor Chuyang Tang and Dr Hao Guo.

The team made new high performing filters for the masks that can be re-used after rinsing in ethanol and then drying them. The filters are made from a nanofibrous material that removes particles more efficiently than the filters used in other face masks. The filters are made using a technique called electrospinning, which results in filters that have higher uniformity and better filtration ability. The resultant nanofibres are much smaller than the melt-blown fibres used in most other face masks, allowing more air pollutants to be removed.

These new nanofibrous filters achieve much higher levels of particle removal compared to other masks, removing more than 90% of 0.3-um

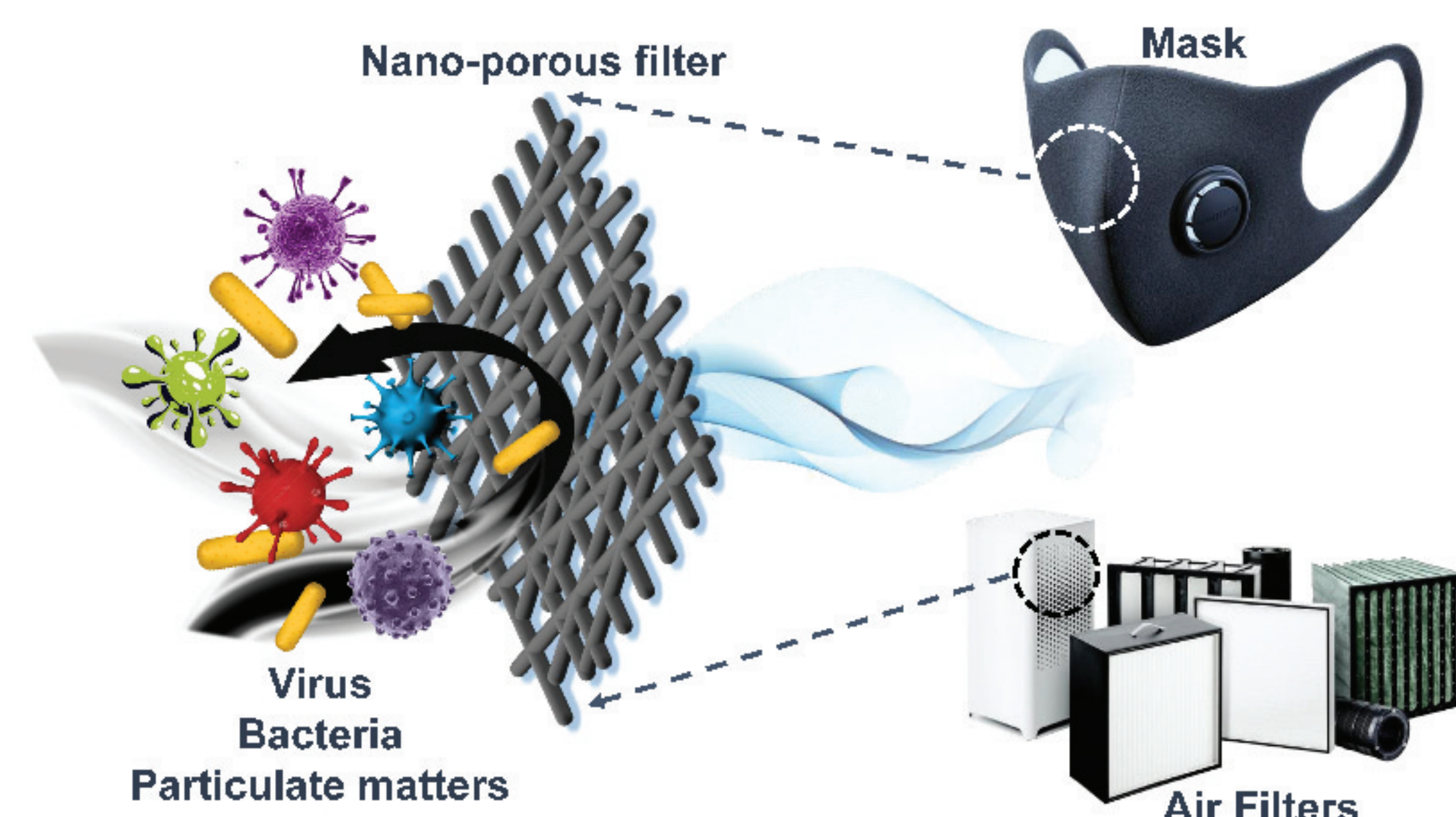


Fig. 1. Illustration of the nanofibrous filter for air pollutants removal and its potential applications for various air filtration products.

particles compared to less than 50 percent for single-use masks. Once used, they can be washed with ethanol to disinfect the filters and, after heat drying, they are reusable with the same filtration efficiency.

A Soft Underwater Manipulation System

A new soft underwater manipulation system has been invented that will allow underwater operations to be conducted across a wider number of uses and at a lower cost.

The new soft underwater manipulation system is designed to be used with inspection-class remotely operated vehicles, or ROVs. These ROVs are used in general underwater operations, such as for underwater sampling or underwater construction.

The new system offers several advantages over existing underwater manipulators. Firstly, it has a compact overall design and once in the water, it weighs nothing. Secondly, it can operate independently of ambient water pressure, enabling it to be used in a large range of water depths. Thirdly, it has precision control and has an embedded sensor. Finally, it is low in cost and easy to use, which will make it attractive and accessible to a wider customer base.

The invention was created by Dr Zhong Shen, Dr Xiaojiao Chen, Ms Jing Li, Mr Runzhi Zhang, Mr Yafei Zhao, Ms Hua Zhong and Professor Zheng Wang.

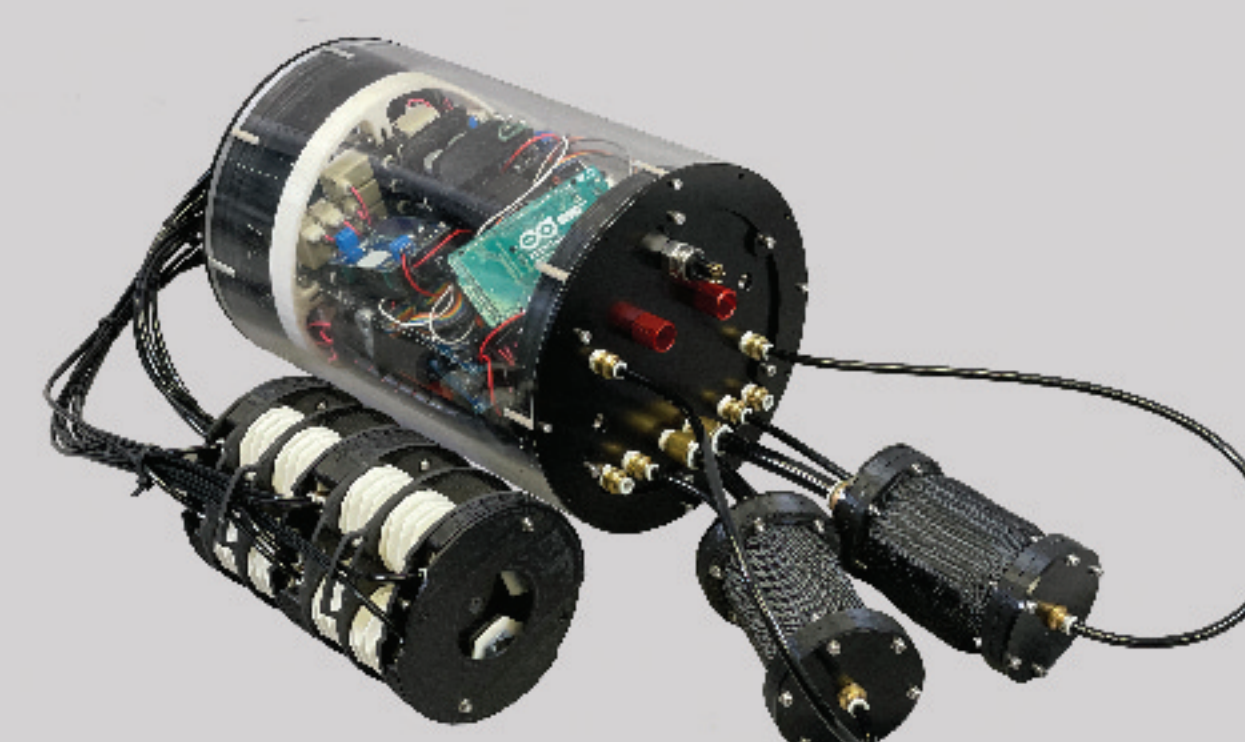


Fig. 1. Soft underwater arm

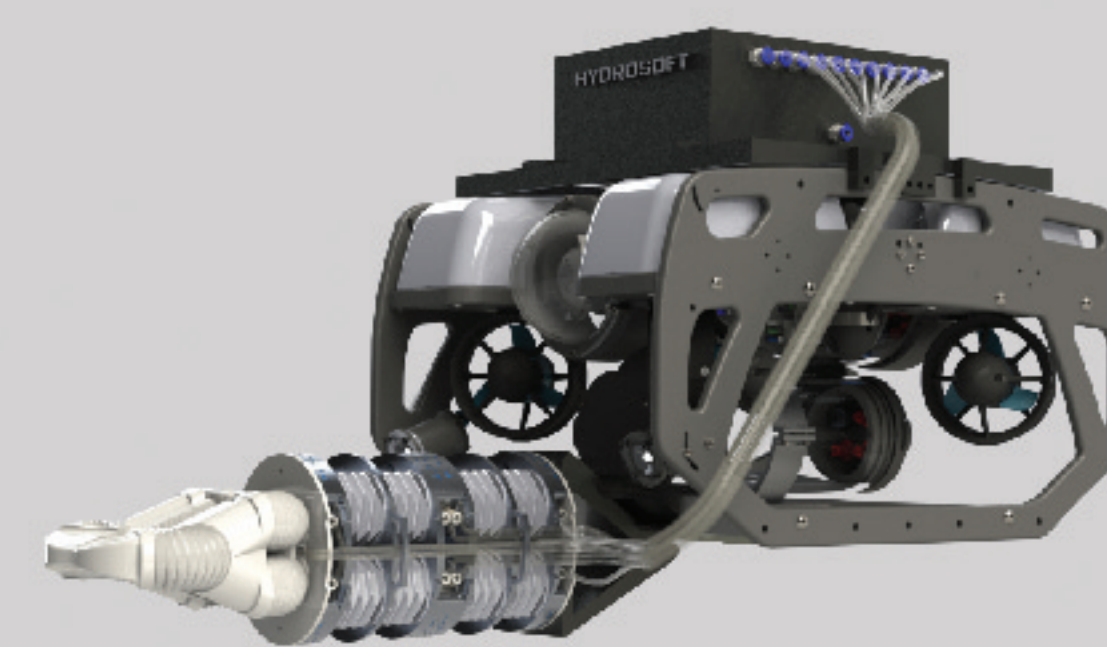


Fig. 2. Underwater manipulation system



Fig.3. Manipulation system mounted on a inspection-class ROV

Microfluidic Platform for Metastasis Detection and Drug Discovery

Improved diagnosis and screening for some of the most prevalent cancers in society, as well as drug screening, can now be conducted thanks to the development of a new microfluidic tool. The tool can be used to check the biochemical and biophysical characteristics of individual cells to identify metastatic and non-metastatic cells.

The invention is particularly effective for ovarian, colorectal, gastric and prostate cancers.

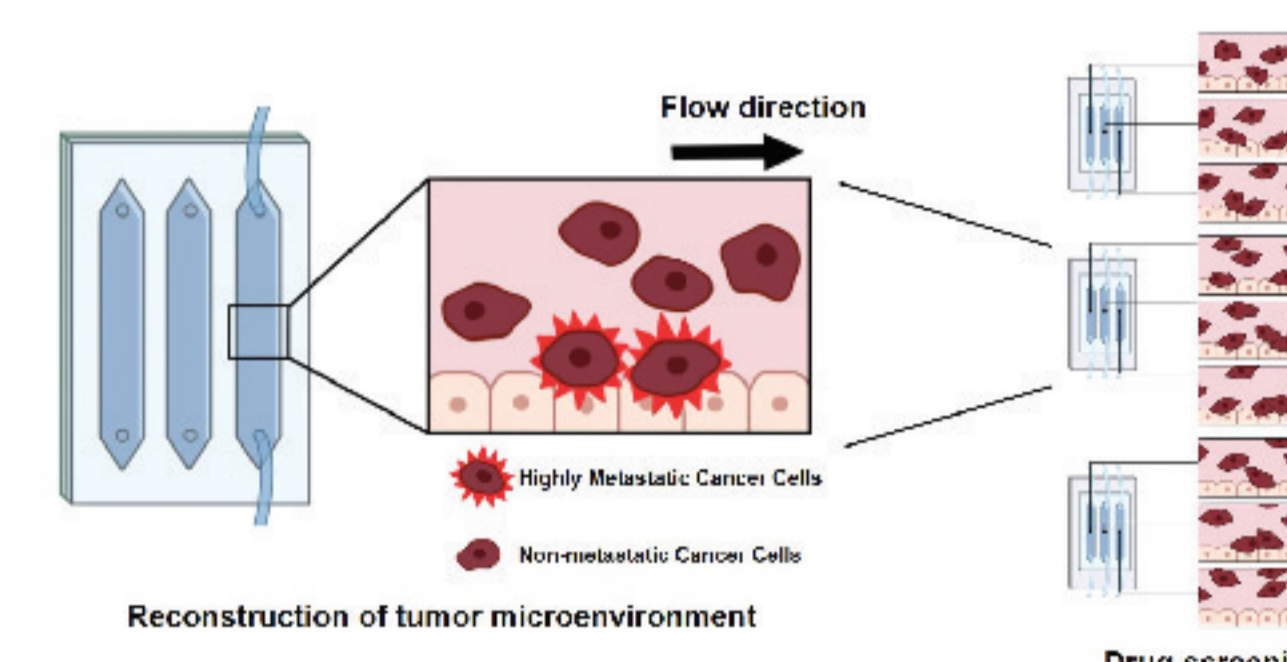
The tool was created by Dr Shanshan Li, Dr Ms Ka-man Ip, Dr Kei Shuen Tang and Professor Ho-Cheung Shu working under the leadership of Professor Alice Sze Tsai Wong from the School of Biological Sciences of the Faculty of Science.



✓ Drug Discovery
✓ Diagnosis

Fig. 1. Our microfluidic device for drug discovery and diagnosis

A. Differential capturing of cancer cells with different metastatic potentials for drug screening



B. Advantages of our microfluidic device over other research models

	Animal models	2D models	3D models	Other Microfluidic platform	Our Platform
Easy operation	✗	✓✓	✓	✓✓	✓✓
Clinical relevance	✓✓	✗	✓✓	✓✓	✓✓✓
Assay time	✗	✓	✓	✓	✓✓✓
Cost	✗	✓✓	✓	✓	✓

Fig 2. The microfluidic platform enables the capture of highly metastatic tumor cells with several advantages over other existing methods

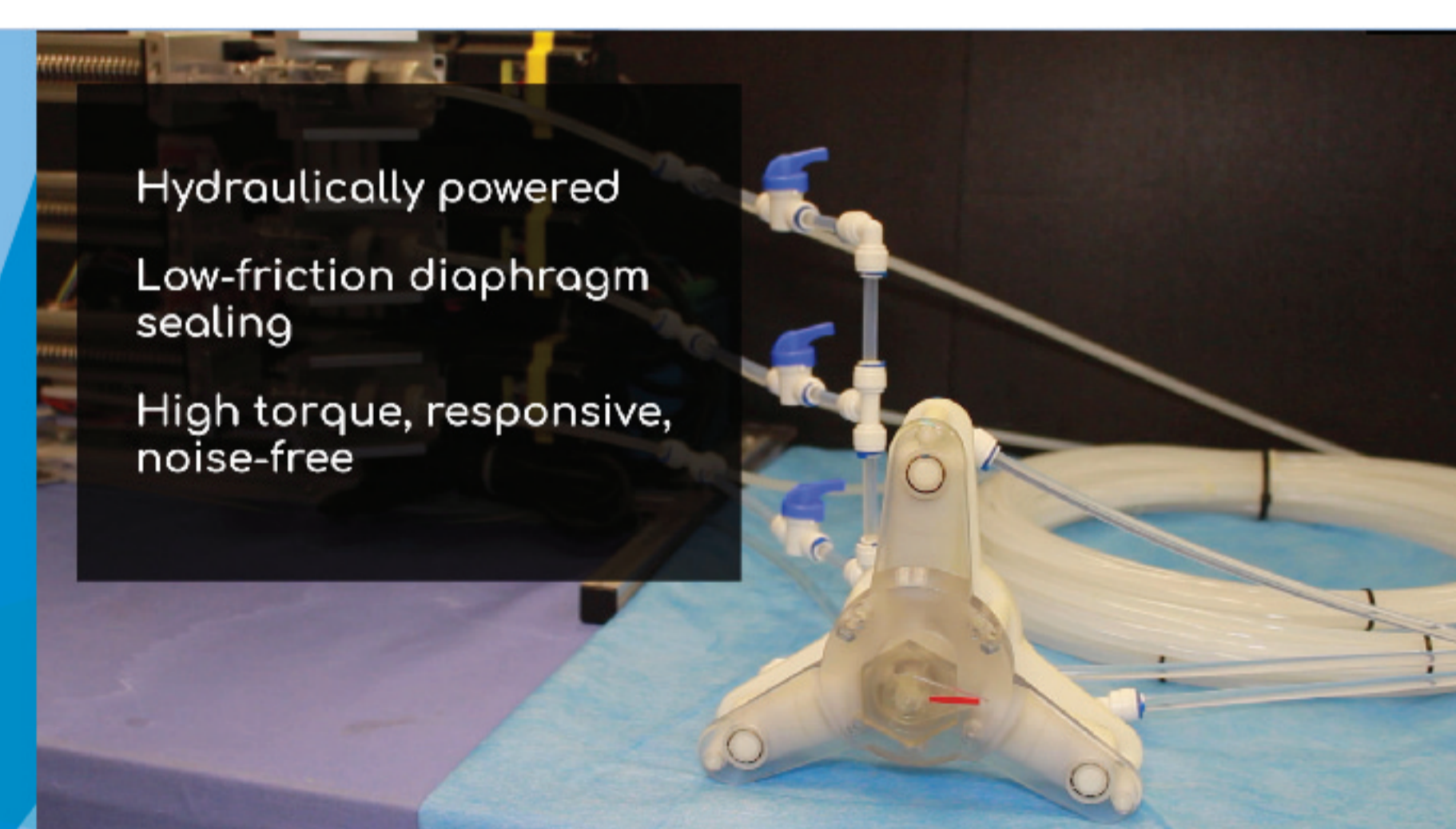
Momentum Robotics – MR-safe Actuators

Newly formed company Momentum Robotics is bringing to market hydraulic motors and custom robotic systems that can be used safely within the magnetic resonance imaging (MRI) environment. The invention can greatly increase the precision with which surgeons can operate by allowing robotic parts in the MRI room to be controlled from a distance of up to 10 metres away in the control room. The invention is metal-free, making it safe to use in the MRI's magnetic environment.

The system was created by Professor Ka-Wai Kwok, Dr Guo Ziyang, Dr Dong Ziyang, Dr Lee Kit Hang Brian, Mr Ho Justin Di-lang and Mr Tang Wai Lun of the Department of Mechanical Engineering.

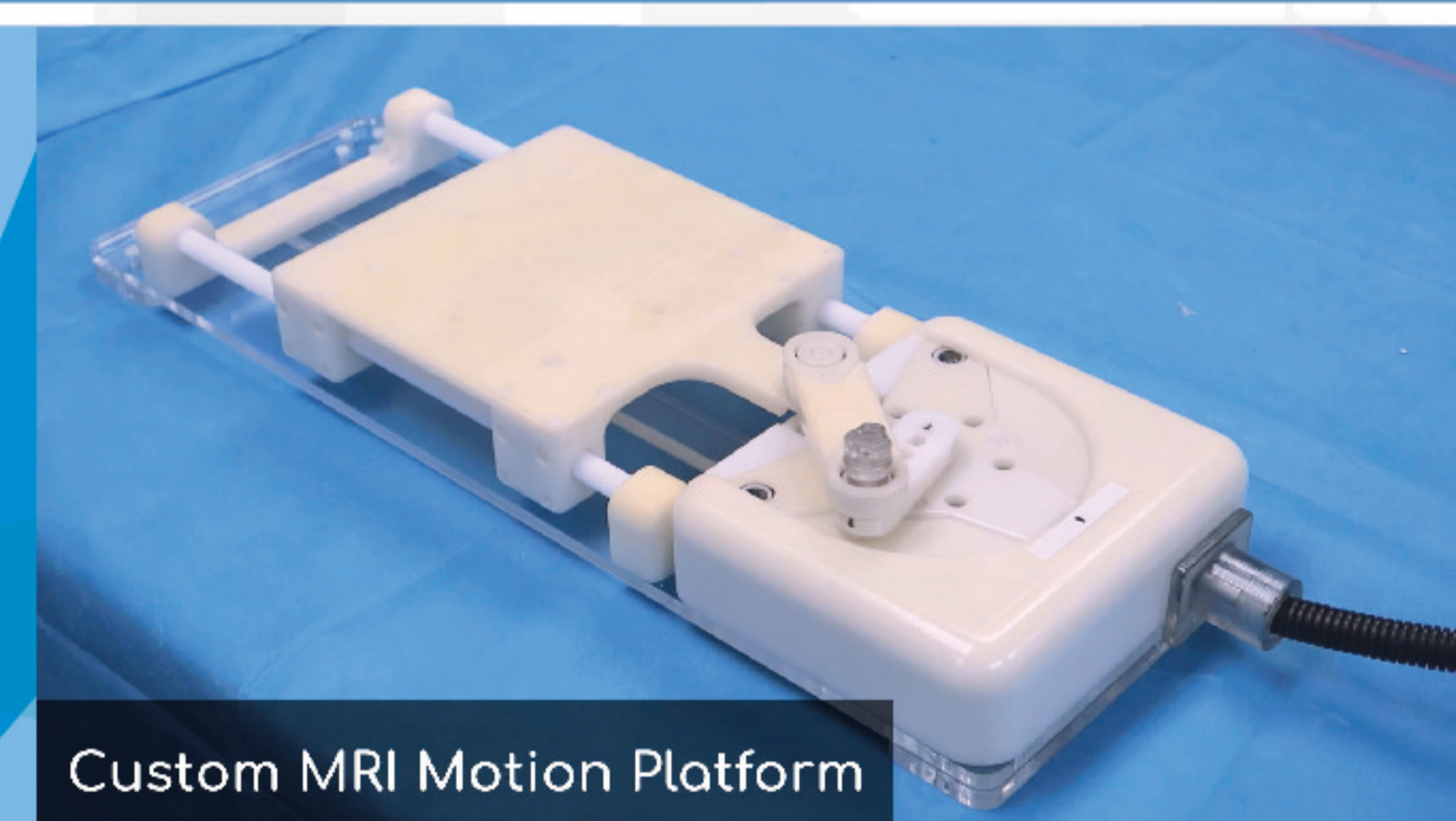
The technology will be particularly useful in stereotactic neurosurgery, which is used to treat highly complex conditions including Parkinson's Disease, severe depression and essential tremor where surgical precision is paramount. The new invention can help to avoid the need for frequent manual adjustments of the stereotactic frame or for moving the patient during surgery.

The next step will be the development of a robot that can be used in other surgical applications, such as treatment planning for the radiotherapy of tumours.



Hydraulically powered
Low-friction diaphragm sealing
High torque, responsive, noise-free

Fig. 1. Momentum Robotics develops specialised actuators for robotics applications within the magnetic resonance imaging (MRI) environment. Each MR-safe actuator is designed with high performance hydraulic transmission for responsive and noise-free motion.



Custom MRI Motion Platform

Fig. 2. A custom MR-safe motion platform developed for simulating patient respiration for validating treatment protocols in 4D radiation therapy of tumours.

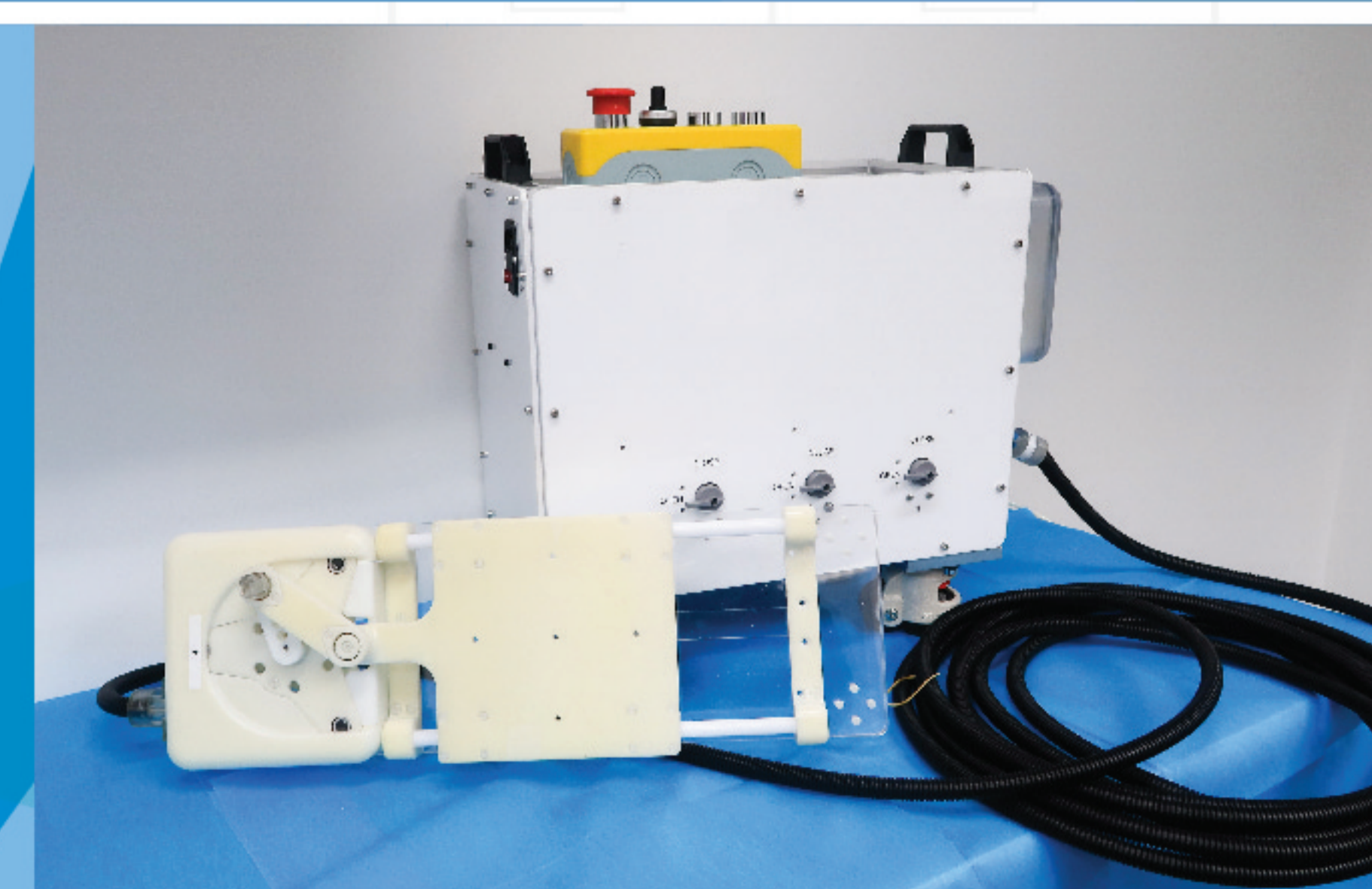


Fig. 3. A custom MR-safe motion platform with hydraulic connection and controlling console.

Universal Fracture Healing Accelerator for External Fixators

Faster healing for fractures has now been made possible thanks to a new invention: the Universal Fracture Healing Accelerator for External Fixators.

Up to 10 percent of fractures do not rejoin, and other fractures often face delayed union. By creating a weight-bearing like micromotion at the site of the fracture, this new accelerator can lead to faster healing and more successful fracture unions. It speeds up fracture healing by 20 percent and cannot be adapted to suit different external fixators. The plug-in device is compact enough to fit different condition, and the micromotion is completely computer-assisted, which allows it to be programed to create personalized treatment regimes.

The device was built by Professor Frankie Ka-Li Leung, Dr Weichen Qi and Dr Xiaoreng Feng of the Department of Orthopaedics and Traumatology of the Faculty of Medicine.

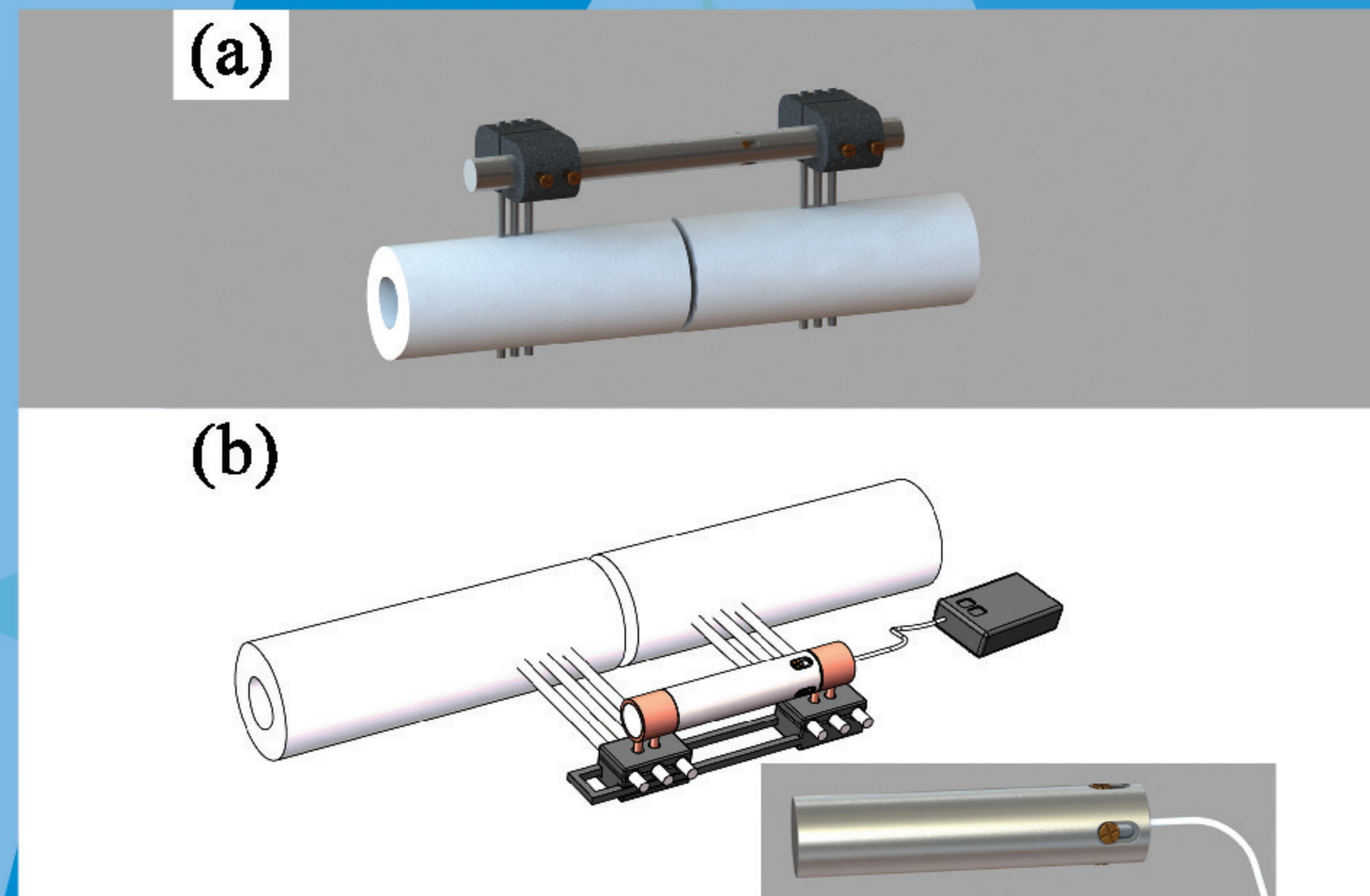


Fig. 1. The technology is available in two product forms: (a) an integrated micromotion external fixator; (b) Micromotion modules that can be adapted to different external retainers by connection rings.

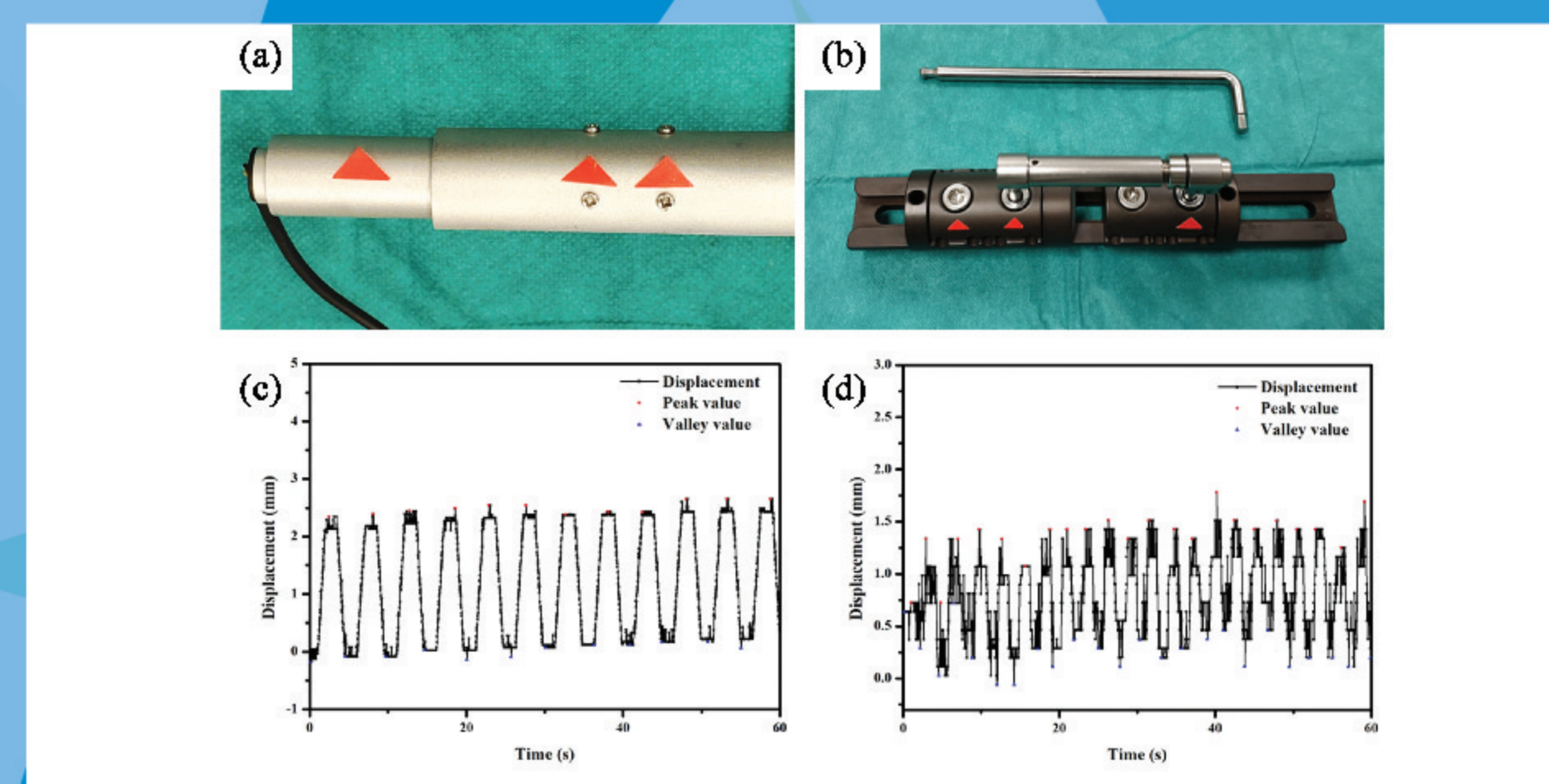


Fig. 2. When compared to a manually operated product, the MMU provides a more uniform mechanical stimulation to the fracture site, measures the actual movement and providing real-time feedback for automatic correction.

Llewellyn and Partners – BIM Warehouse

Now a new blockchain solution can create a seamless stream of building data to be shared securely and efficiently among key participants.

The digital solution is named BIM Warehouse and it was developed by Llewellyn and Partners Company Limited, a firm founded by Ir Dr Llewellyn Tang, Associate Professor in BIM (Building Information Modelling) in the Department of Real Estate and Construction of the Faculty of Engineering.

Powered by AI, BIM and blockchain technology developed by the company, the system streamlines project management and asset information in a secure way by storing, allocating and trading them on a cloud-based platform. This allows data including copyrights, contracts and authorizations to be securely handled and shared. It also allows participants of the blockchain to examine the building during its different phases of construction, which helps them to make accurate and timely decisions.

BIM Warehouse is ISO compliant and operates as a B2B2C e-commerce and warehousing platform. It was designed for the Architecture, Engineering, Construction and Operation and Owner (AECO) and real estate industry. The impetus behind the development of the technology was to unify the logistics and supply chain of AECO industry resources, as well as achieving lower operational costs and improved security.

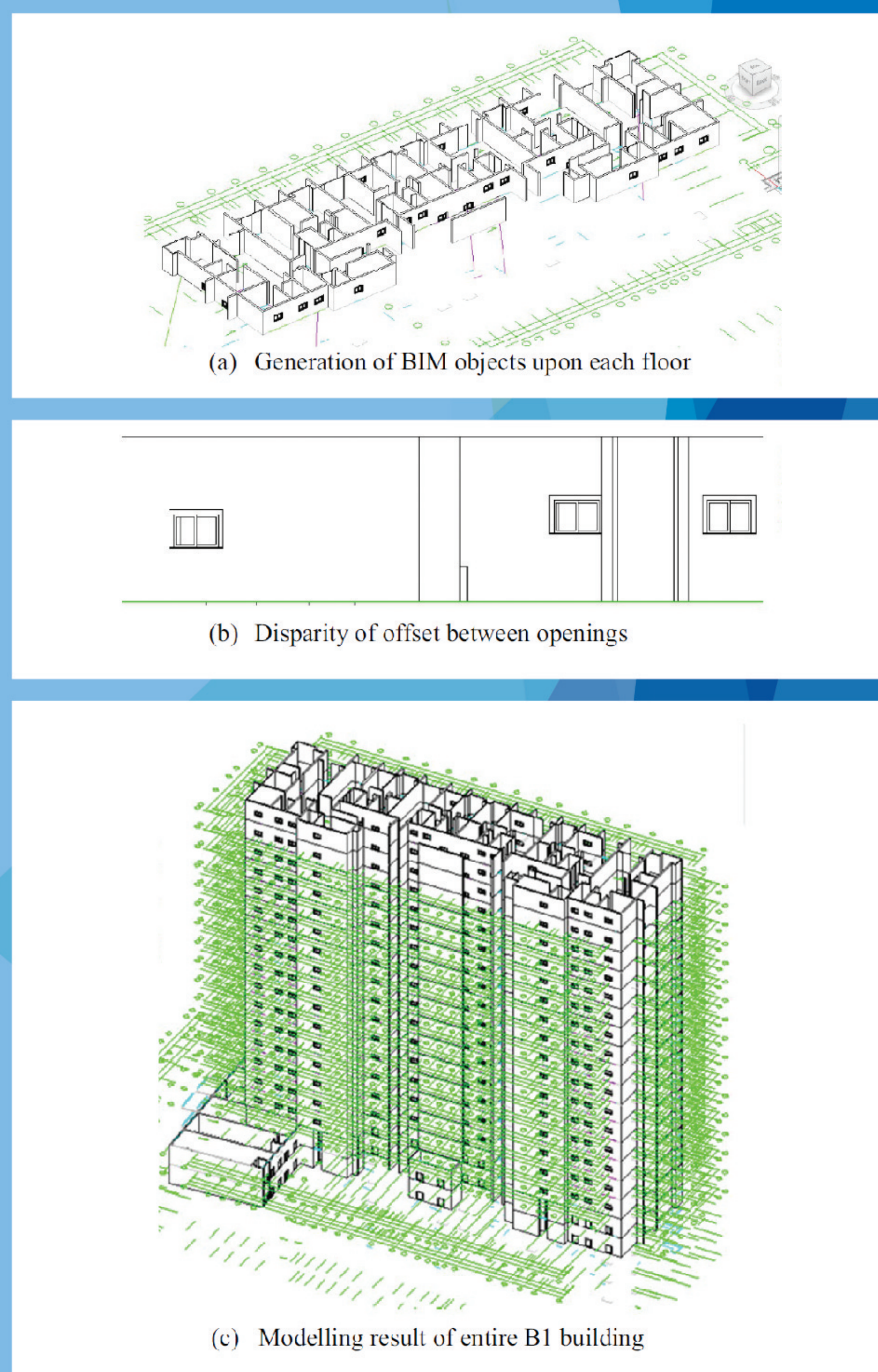


Fig. 1. AutoBIM – the software for 3D BIM Model rapidly generation from the 2D CAD Drawings powered by A.I. Technology [BSI Kitemark™ for BIM Software (ISO19650) Certified by BSI UK]

BRING OUR RESEARCH RESULTS TO THE BIG WIDE WORLD

The Technology Transfer Office (TTO) of the University of Hong Kong provides support to the University's PIs and teams who want to share the benefits of their inventions with the wider world. We help you to bring your technology out of the laboratory and into the marketplace, where its benefits can be shared with society.

TTO'S ROLE IN GENEVA 2021

We are delighted to have been able to assist the award-winners in participating in the International Exhibition of Inventions of Geneva 2021. The TTO covered all the costs of participation of the attendees and assisted the participants, including making the arrangements for the submission of their inventions, handling all of the administration involved, and providing whatever assistance was required every step of the way. While the Geneva exhibition was held virtually this year, the TTO also helps to make travel arrangements and cover travel expenses.

YOUR VISION, OUR MISSION

Would you like to participate in next year's exhibition?

We are ready and waiting to help you!

Contact us and let us know what you are working on, and we will help you to take the next steps.

You can contact us by email (info@tto.hku.hk) or telephone (2299 0111).

We look forward to hearing from you!



HKU Technology Transfer Office (HKUTTO)



HKUTechnologyTransferOffice



HKUTTO



<http://www.tto.hku.hk>



(852) 2299 0111