The University of Hong Kong
Technology Transfer Office

VERSITECH LTD.
The University Technology Transfer Company

TechXfer

TTO NEWSLETTER SPECIAL EDITION

inventions Geneva

HKU'S AWARD-WINNING INVENTIONS IN 2022

GOLD MEDALS

- Fast-reconfigurable large-area interference lithography nanopatterning platform
- A customizable in-manhole sampling robot for sewage surveillance
- 3D Printed Reef Tile
- Light-Triggered Drug Delivery System

SILVER MEDALS

- Anti-Covid-19 stainless steel
- Disinfection Robots
- Method of purifying nanodiamonds (NDs) and application for oral hygiene
- Micro Mist Scale mouthguard cleaning device
- Non-contact, non-radiation device that accurately locates multiple implants in a patient's body
- Nucleic Acid Aptamers for Malaria Diagnosis
- NevGro® - a Dietary Supplement for Brain Health

BRONZE MEDAL

- PD1-Based Vaccine for Infection and Cancer Cure by Potentiating Host Immunity

GOLD MEDALS

Fast-reconfigurable large-area interference lithography nanopatterning platform

The invention was developed by Dr. Wen-Di Li, Ph.D. student Mr. Zhuofei Gan, and other team members from the Department of Mechanical Engineering, Faculty of Engineering of HKU.

Deterministic nanostructures are essential in augmented reality (AR) glasses, head-up displays, biosensors, meta-optics, and many other applications. Low-cost and fast fabrication of these fine nanostructures over a large area is challenging using existing mask aligners and electron beam lithography machines.

Dr. Wen-Di Li and his team from the Department of Mechanical Engineering invented a novel fast-reconfigurable and actively stabilized interference nanopatterning platform to support the development and production of emerging nanostructured devices. This new technology adopts flexible laser beam splitting and delivery that allows unprecedented motorized automation for fast adjusting the lattice, periodicity, and geometry of nanopatterns. The other key feature is the active interference pattern stabilization with a closed-loop feedback algorithm and hardware, which enables high-quality wafer-scale fabrication of high-aspect-ratio nanostructures with sub-50-nm feature sizes, and allows reliable prediction and analysis of patterning quality through a numerical exposure model.

This invention transforms the long-existing conventional interference lithography technique, which can only be used as an experimental setup in optics labs, into a computer-controlled turn-key nanopatterning machine with the patterning cost and processing time both reduced by more than 10 times when compared with the best electron beam writers.

The team has established a spin-off company, InterLitho Technology Limited, with the support from the TSSSU program and the HKSTP Incu-Tech program, to further commercialize nanopatterning products based on this invention, as well as other innovative nanofabrication solutions developed at HKU.

(Left to right) Dr. Wen-Di Li and Ph.D. student Mr. Zhuofei Gan

the nanopatterning prototype

A customizable in-manhole sampling robot for sewage surveillance

The invention was developed by Professor Tong Zhang and the team from Civil Engineering of HKU together with the Drainage Services Department of HKSAR and the Environmental Protection Department of HKSAR

Professor Tong Zhang

the compact auto-sampler to collect sewage samples

For COVID-19, sewage surveillance is a cost-effective way of measuring prevalence and finding asymptomatic patients. Traditional auto-sampling devices are large and cumbersome, and difficult to use in built-up areas. A new compact auto-sampler has been invented that can easily be mounted underneath manhole covers to collect sewage samples.

Initially, the pump in sampler works by purging and expelling rubbish through the filter. It then starts to collect sewage sample from the manholes until the sensor lights up. Any excess amount of sample in the temporary container is pumped out until the threshold level has been met. The magnetic valve is then opened to allow the sample to be transported to the sewage container.

As well as requiring less manpower to operate and lower costs to use, the new sampling robot is lightweight and small in size. Once set up, the robot can operate automatically. It has rechargeable batteries, making it effective for long-term underground use. The associated Android app, which was also invented by the team, allows for customizable control on a smart phone, such as setting starting time, sampling interval and sampling volume. The app also offers real-time display and feedback, with central and remote monitoring features.

The invention has been used successfully to detect and control the spread of COVID-19 in Hong Kong.

GOLD MEDALS

3D Printed Reef Tile

The invention was developed by a research team led by Professor David Baker from the School of Biological Sciences, Faculty of Science of HKU.

Professor David Baker

Coral reefs around the world are under serious threat. Without action to save them, more than 90 percent of coral reefs will be lost by 2050. The United Nations has designated this as the decade of ecosystem restoration. archiREEF is restoring marine ecosystems using a new invention based on novel materials and unique designs created using 3D printing. The 3D printed reef tile is made from terracotta. Corals can be attached to the surface of the tile and they can then be grown as part of a solid framework on the seabed.

These tiles are modular and customizable to suit the environment. They survive four times better than natural substrates on the ocean floor. The surface of the reef tile is biocompatible and marine organisms attach better to terracotta than to concrete. The tiles can also mitigate the effects of stressors such as sedimentation, leading to a better conservation outcome.

The tiles are being used in a pilot project in the United Arab Emirates. This year, the tiles will be used for blue carbon ecosystems and blue carbon enhancement for use to restore other types of habitats such as oyster reefs, mangrove forests and sea grass beds.

3D Printed Reef Tile

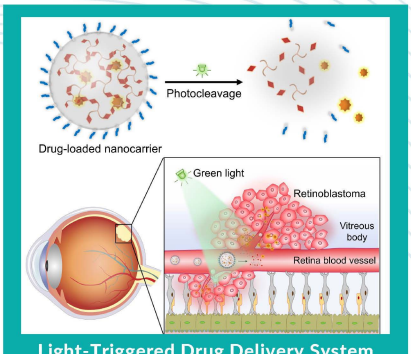
the key features

- sedimentation prevention
- higher coral survivorship
- environmentally friendly
- cost and time effective
- customizable design
- easy underwater assembly

Light-Triggered Drug Delivery System

The invention was developed by a research team led by Dr Weiping Wang from Dr Li Dak-Sum Research Centre and Department of Pharmacology and Pharmacy, LKS Faculty of Medicine, HKU.

Dr Weiping Wang



Light-Triggered Drug Delivery System

The aggressive cancer retinoblastoma kills thousands of children each year. Those who survive often lose one or both eyes, or suffer serious visual impairment. Treatment typically involves invasive surgery. Patients with retinoblastoma and other diseases of the eye are in urgent need of more non-invasive treatments and yet out of thousands of current clinical trials for eye treatments, only 68 live trials target retinoblastoma and of those, only ten of them are trialling non-invasive treatments.

Trilumix is a newly invented simple, effective and non-invasive drug delivery system that can be used to treat eye diseases such as retinoblastoma. It allows anti-cancer drugs to be delivered through the bloodstream with pinpoint precision to where they are needed, and without the need for invasive procedures.

The doctor can decide exactly where the drug is released by shining a green light at the treatment area in the patient's eye. When the drug delivery systems pass through the spot, the drugs are released and accumulated in the eye. This allows tumour cells to be killed efficiently and with minimized side effects.

Trilumix has already shown significant therapeutic effects in an animal model.

SILVER MEDALS

Anti-Covid-19 stainless steel

The invention was developed by Professor Mingxin Huang and Mr Litao Liu from the Department of Mechanical Engineering, Faculty of Engineering, and Dr Alex Wing Hong Chin, Research Assistant Professor and Professor Leo Lit Man Poon of the School of Public Health, Faculty of Medicine, of HKU.

Professor Mingxin Huang

When people infected with COVID-19 (SARS-CoV-2) breathe, speak, cough or sneeze, they can emit virus-loaded droplets that can settle on and contaminate contact surfaces in public areas, such as door handles, stair railings and lift buttons, leading to contact transmission. These surfaces are frequently made from stainless steel. Droplets can be detected on such surfaces for up to three days.

Ordinary stainless steel has no antimicrobial properties. By changing its chemical composition and microstructure, a new invention has successfully inactivated SARS-CoV-2 on stainless steel surfaces. The virus was rabidly inactivated on surfaces of pure copper (Cu) and stainless steel with a high Cu content of approximately 10% by weight. The inactivation was achieved by using Cu ions that were released from Cu-rich precipitates, enabling the broad-spectrum antimicrobial properties.

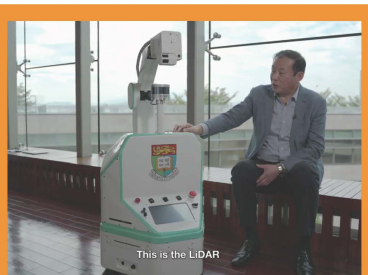
Large amounts of Cu-rich precipitates are permanently present in the steel matrix, which enables this anti-pathogen stainless steel to inactivate pathogen microbes, even when its surface is continuously soiled. The anti-pathogen stainless steel can be mass produced using existing mature powder metallurgy technologies. Tests show that this anti-COVID-19 stainless steel is also effective at inactivating H1N1 and E.coli.

Sample of the anti-COVID-19 high Cu stainless steel that can kill the severe acute respiratory syndrome coronavirus 2 (SARS-Cov-2) on its surface.

Disinfection Robots

The invention was developed by Professor Ning Xi from the Department of Industrial and Manufacturing Systems Engineering, Faculty of Engineering of HKU.

Professor Ning Xi



Professor Ning XI with the prototype of the disinfection robots

Since the onset of COVID-19, the importance of disinfection has been increasingly recognized. UVC light is an effective way to perform disinfection. However, often the surfaces that need to be disinfected are large, such as airports, waiting rooms and other busy public areas. In these cases, disinfection takes a long time and needs to be carried out frequently to be effective.

A new disinfection robot has been invented to work in these types of environments. The robot consists of an omni-directional mobile base and a manipulator. The robot arm brings the UVC light very close to the surface to be cleaned, which allows a disinfection rate of 99.5% within a couple of seconds. The robot is equipped with a light-up LiDAR that allows the robot to navigate its position by itself. It also has ultrasound which allows it to automatically avoid obstacles, such as when people get too close to the robot. In this case, the sensor can detect the presence and automatically shuts off the UVC light to prevent any accidents. The robot operates according to a pre-planned route. Colour coding shows which surfaces have been disinfected. The dosage can also be modified to ensure enough UV light has been delivered to achieve the required dosage for effective cleaning.

SILVER MEDALS

Method of purifying nanodiamonds (NDs) and application for oral hygiene

SAAO was developed by Dr Zhiqin Chu, Assistant Professor and Tongtong Zhang from the Department of Electrical & Electronic Engineering, Faculty of Engineering of HKU.

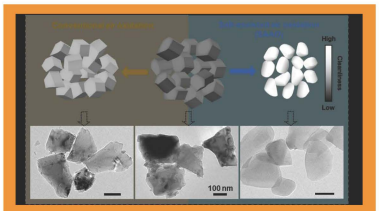
Nansoscale diamond particles, known as nanodiamonds or NDs, have outstanding qualities that are useful in a broad range of potential applications ranging from basic science to industry. However, the impurities found in ND, such as disordered carbons, makes them unsuitable for many uses, and it is not easy to eliminate the impurities using existing methods such as conventional air oxidation.

A new invention offers a simple, reliable, and reproducible purification method, namely, salt-assisted air oxidation (SAAO). It requires mixing the NDs with a specific amount of salt crystals, such as sodium chloride, prior to conventional oxidation. This leaves the original shard-like shape of the NDs with a clean surface and allows them to be manufactured in large quantities and at low cost.

This invention will significantly enhance the scope of NDs for use in various scientific and industrial fields, particularly in demanding areas such as biomedical applications that require stable and sound surface functionalities.

The invention has also been tested in systematic microbiological studies of high-quality NDs on several oral and systemically important pathogens, where they demonstrated their usefulness in inhibiting biofilm formation and disrupting preformed biofilms, paving the way for their potential use as drug carriers or additives in the human oral cavity.

Dr Zhiqin Chu

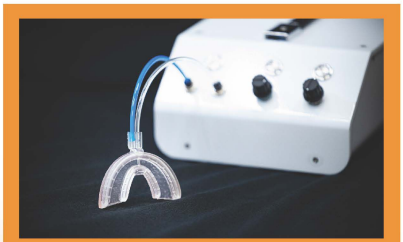


NDs purified by the salt-assisted air oxidation (SAAO) method

Micro Mist Scale mouth guard cleaning device

It was invented by Dr James Kit-hon Tsoi, Associate Professor and his team, from the Faculty of Dentistry, HKU.

Dr James Kit-hon Tsoi



Prototype of mouth guard device with micro-scale mist injection function

Many elderly people have poor oral hygiene, and they are suffering from various chronic diseases that reduce their mobility. Thus, this further hampered elderly's ability to clean their oral cavity thoroughly. Nearly 50% of elderly are diagnosed with moderate to severe periodontal diseases, which are linked to Alzheimer's, heart and kidney diseases. As lifespans increase, the number of people aged 60 or over will globally reach an estimated 2.1 billion by 2050.

Now a newly invented device can help elderly and disabled people manage their oral hygiene effectively and painlessly. This will also help them to increase their social interaction, and improve their confidence and physiological health.

The new "Plaque cleaning apparatus using dental 3D printing technique by micro-mist" is a specific device for elderly and disabled. It uses a micro-sized mist to remove initial plaque from the teeth safely using kinetic energy generated at high speed. The device combines a personalised 3D-printed mouth guard that holds air and water via small channels with a specially-designed outlet, and generates only a tiny amount of micro-scale mist precisely on the plaque area without the need for rinsing. Thus, it enables an effective cut of the oral bacterial infection while reducing the risk of aspiration.

SILVER MEDALS

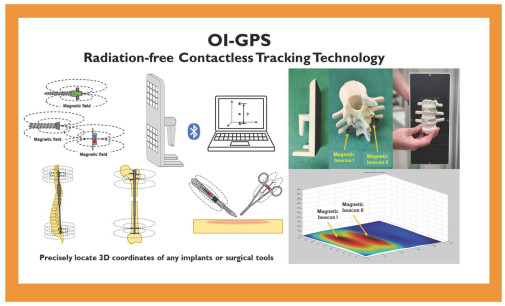
Non-contact, non-radiation device that accurately locates multiple implants in a patient's body

It was developed by the research team of Dr Weichen Qi, Associate Professor Jason Pui Yin Cheung and Dr Teng Grace Zhang from the Department of Orthopaedics & Traumatology, Faculty of Medicine of HKU.

More than 5 percent of adolescents in China suffer from scoliosis. In severe cases, scoliosis can result in cosmetic deformities, restricted heart and lung function and premature death. In such cases, corrective surgery may be required. X-rays are widely used to monitor surgical implants, but they are bulky, expose patients to radiation and not easy for surgeons to evaluate the changes needed as the child grows.

The newly invented OI-GPS solves these problems. The OI-GPS is a contact- and radiation free mobile sensing technology that precisely locates the spatial coordinates of surgical implants in the patient's body. To use the system, the surgeon places magnetic beacons at the head of the screws during surgery. Once these are in place, surgeons can use a handheld probe to see the 3D location of the implants in the spine. During each elongation session, the surgeon can easily compare the models to previous versions, enabling him to quickly make adjustments when needed to improve outcomes. The system is safety enhancing, as it provides quick information about any mechanical faults. It can also be used to evaluate limb-lengthening surgery and to position surgical implements during procedures.

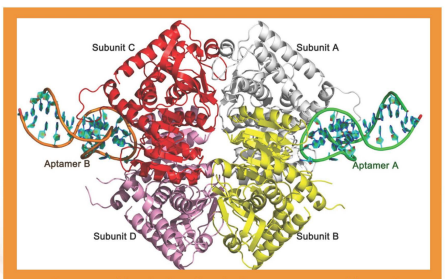
(left to right) Professor Jason Pui Yin Cheung, Dr Teng Grace Zhang and Dr Weichen Qi



Nucleic Acid Aptamers for Malaria Diagnosis

It was developed by a research team led by Professor Julian A. Tanner from the School of Biomedical Sciences, Faculty of Medicine of HKU.

Professor Julian A. Tanner



Structural basis for discriminatory recognition of Plasmodium lactate dehydrogenase by a DNA aptamer

Malaria is a mosquito-borne infectious disease that affects humans and other animals. The disease is caused by single-celled micro-organisms of the plasmodium group. Cases have been rising in recent years and increased to 240 million in 2020. Malaria is a preventable disease and early diagnosis and treatment is crucial to prevent death. Some improvements in managing malaria have been seen with the use of antibody-based lateral rapid diagnostics, but DNA aptamers can be used as an alternative to antibodies and offer several advantages. They are stronger, cheaper and easier to manufacture compared to antibody-based options.

Two new types of DNA aptamers have been invented. Both were developed using in vitro evolution methods. These aptamers are highly specific to the biomarkers and are built on a precise understanding of the molecular biology that explains exactly how that aptamer binds to the protein. This provides an excellent foundation for their applications in clinical diagnostics.

The team has developed several diagnostic assays. In the aptamer-tethered enzyme capture (APTEC) assay, the aptamer has proven to be at least as accurate as the best antibody-based methods in diagnosing malaria. Several of these methods can be linked to mobile phone-based diagnostics.

SILVER MEDALS

NevGro® - a Dietary Supplement for Brain Health

This product is co-invented and developed by Ms. Cheng Poh Guat, CEO of Ganofarm R&D Private Limited, Dr. Wong Kah Hui from Universiti Malaya, as well as Dr. Lim Lee Wei and Chong Pit Shan from the Li Ka Shing Faculty of Medicine, The University of Hong Kong.

NevGro® is a dietary supplement for enhancing brain health and the compounds are extracted from Hericium erinaceus or the monkey head mushroom via an innovative aqueous extraction technique. We found that administration of NevGro® alleviated depressive-like symptoms through stimulating the growth of brain cells in the hippocampus, a brain region which is responsible for emotion, learning and memory. Our study further revealed its neuroprotective effects against ataxia, by protecting the brain cells from degeneration in the cerebellum, which controls body coordination and motor function.

BRONZE MEDAL

PD1-Based Vaccine for Infection and Cancer Cure by Potentiating Host Immunity

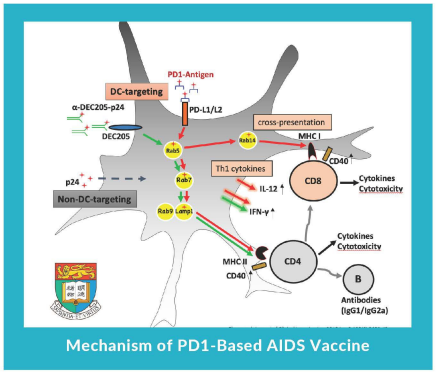
It was developed by the research team of Professor Chen Zhiwei, Dr Zhou Jingying, Dr Tan Zhiwu, Dr Wong Yik Chun, Professor Chen Honglin, Professor Yuen Kwok Yung and Dr Liu Li from the Department of Microbiology, Faculty of Medicine of HKU.

Professor Chen Zhiwei

A new PD-1 based DNA vaccine platform and novel immunotherapy against cancer and infectious diseases has been invented. The platform consists of a PD-1 DNA sequence, a disease-specified DNA and a backbone plasmid. The result is an efficient vaccine that induces strong immune responses against pathogens and cancers. The new vaccine also elicits strong memory responses in both B and T cells, allowing rapid and prolonged protection against viruses and cancers in the future.

DNA vaccines have several key advantages over inactivated live-attenuated or subunit vaccines. New DNA vaccines are cost-effective and can be manufactured quickly in large quantities. They can be constructed more quickly than viral vector vaccines to fight newly emerging pathogens or their variants. DNA vaccines do not cause viral vector-related responses, and can be used repeatedly. DNA vaccines are highly stable at 2 to 8 degrees Celsius, making them much easier to transport and store than mRNA vaccines.

Three vaccines have been developed based on this novel DNA vaccine platform. The Covid-19 vaccine has entered phase 1 clinical trials while the cancer vaccine and HIV vaccine are ready for further clinical trial studies.



Mechanism of PD1-Based AIDS Vaccine

INVENTIONS GENEVA EVALUATION DAYS – VIRTUAL EVENT – MARCH 2022

The International Exhibition of Inventions of Geneva is the most important annual event in the world devoted exclusively to inventions. Innovations are exhibited for the first time.

Industrial and commercial companies, universities, inventors and researchers, associations, private and state organisms and institutions present their inventions, the results of their research and their new products. Manufacturers, commercial traders and financiers will find 1,000 novelties ready to be marketed.

ABOUT US

The Technology Transfer Office (TTO) manages the use of the intellectual property assets of the University of Hong Kong (HKU) by providing patenting, licensing and other commercialisation support to the University's researchers. Acting as the bridge linking HKU to society in the area of technology commercialisation, TTO facilitates industries and businesses to access HKU's powerhouse of knowledge, innovation and expertise through close collaboration.

BRING OUR RESEARCH RESULTS TO A BIGGER WORLD

We are delighted to have been able to assist the award-winners in participating in the International Exhibition of Inventions of Geneva 2022.

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).

HKUTechnologyTransferOffice

HKU Technology Transfer Office

info@tto.hku.hk

https://www.tto.hku.hk

Follow Us on WeChat