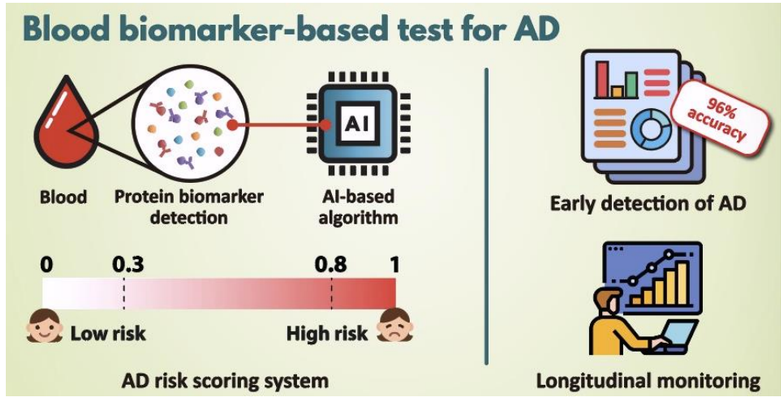
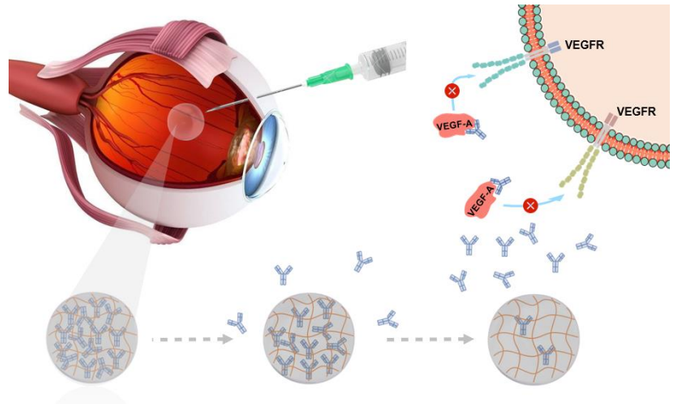
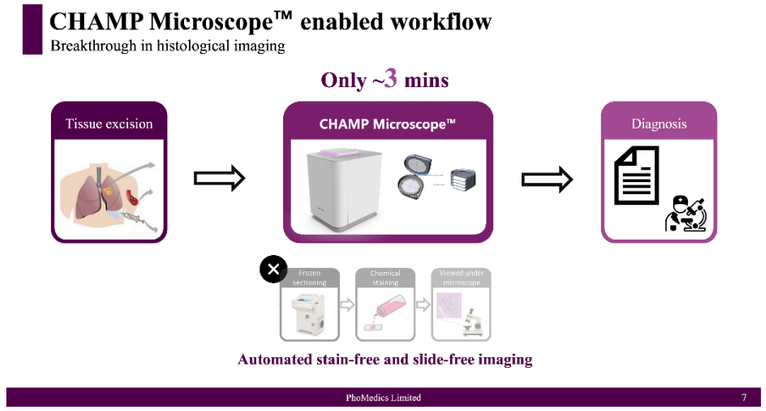
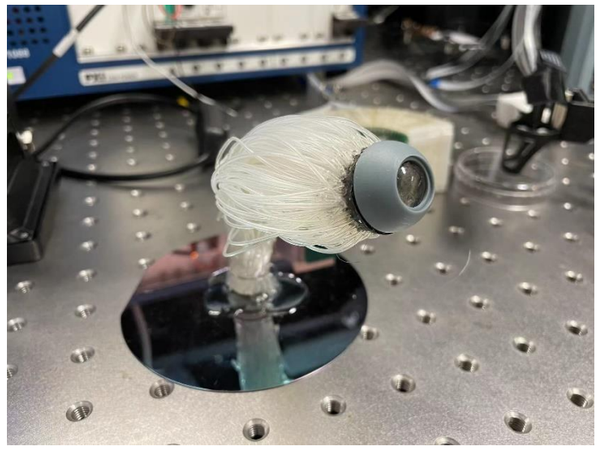
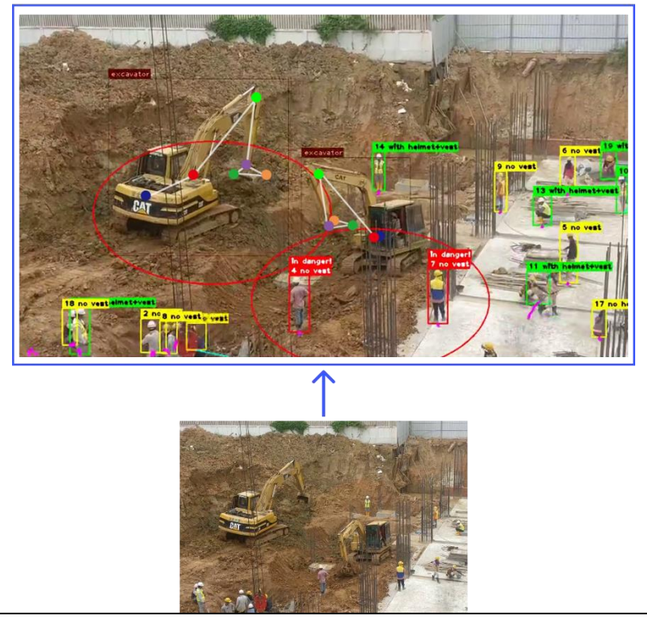
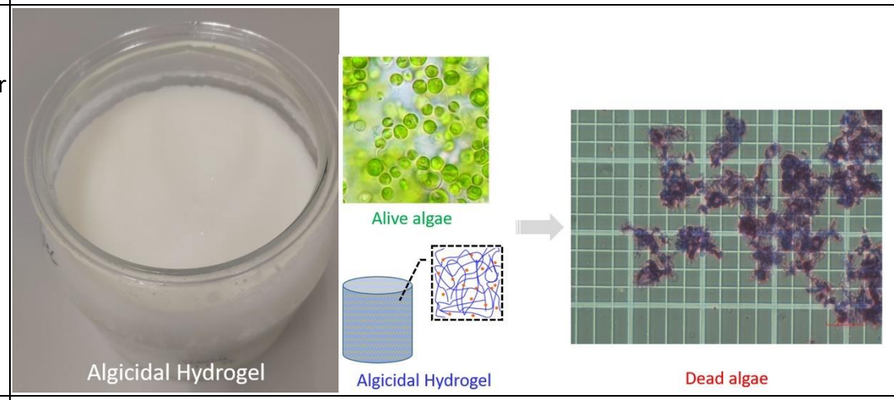
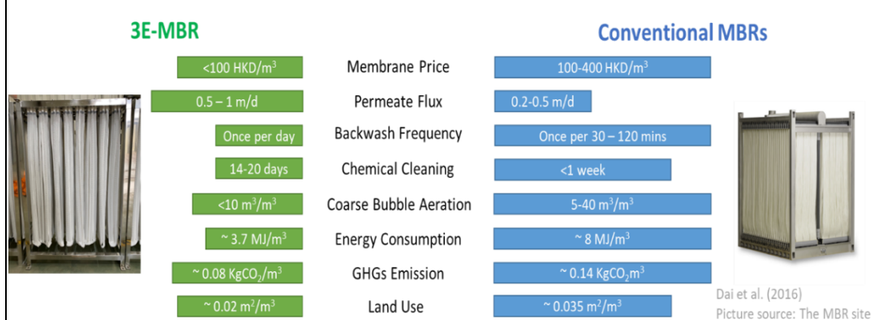
香港科技大學
THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY

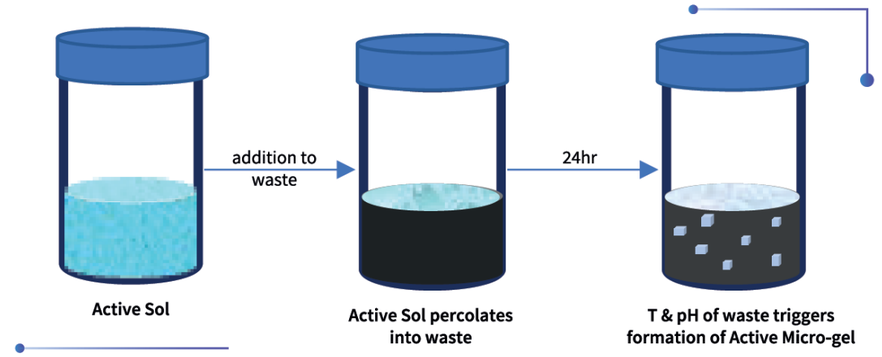
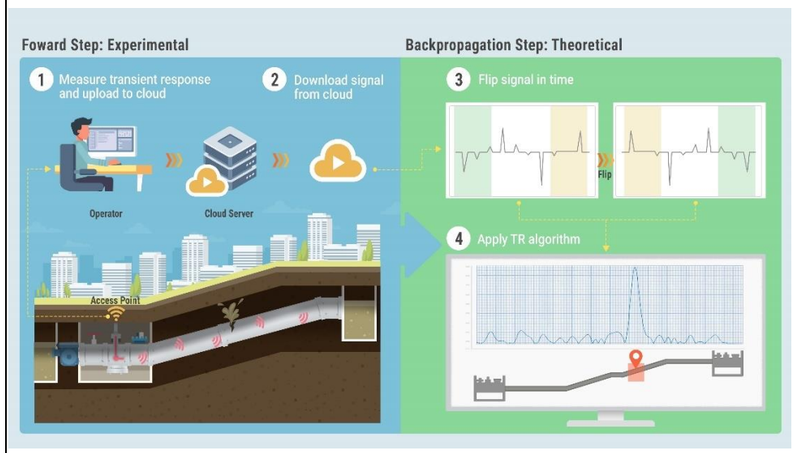
HKUST Projects in the 48th Geneva International Exhibition of Invention

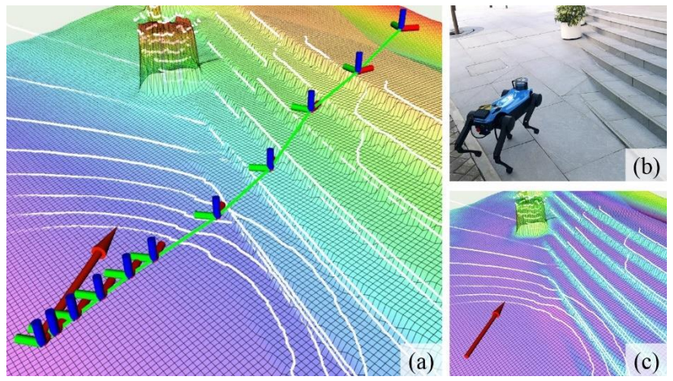
Invention and Award	Description	Key technology edges	Image
Protein biomarkers for assessing Alzheimer's disease Prize of the Chinese Delegation for Invention and Innovation Gold Medal with Congratulations of the Jury	A biomarker-based detection system can identify Alzheimer's disease early in aging populations. Cognitact is translating cutting-edge proteomic research into risk prediction, diagnostic, and monitoring tools for Alzheimer's disease (AD). By utilizing world-leading proteomics and machine learning algorithms, we can diagnose AD 5-10 years before symptoms manifest by detecting changes in blood biomarker levels. Additionally, we offer long-term biomarker monitoring to aid in disease management and provide personalized therapeutic recommendations.	● Detect Alzheimer's disease 5 to 10 years before symptoms manifest ● Up to 96% accurate detection of Alzheimer's disease ● Cost-effective, faster, and less invasive Facilitate monitoring of disease progression	
Advanced polymer-based therapeutics for chronic disease Gold Medal with Congratulations of the Jury	Polymer-based therapeutic is an emerging class of new modality for chronic disease management. Individuals with chronic diseases often have to rely on complicated multi-dose or ineffective treatment. With aging population, the management of chronic diseases is posing an increasing economic and social burden. Our technology is a versatile polymer-based platform to provide long-acting highly potent therapeutics by controlled polymer architecture. Current products address dry eye disease, age-related macular degeneration and osteoarthritis. Planning first-in-human clinical study for two products in 2024.	● Significantly improve clinical signs of moderate to severe dry eye (>70million patients globally) ● Extend efficacy of protein drug from 1 month to 6 months for sight threatening eye disease like AMD and DME (>50 million patients globally) Enable sustained relief of symptoms for at least 6 months by a single treatment for osteoarthritis (affects 15% adults globally)	

Metal 3D printing by ultrasonic excitation and active temperature control Gold Medal with Congratulations of the Jury	Breaking through the barriers of metal 3D printing with ultrasonic excitation and active temperature control. The 3DK Ultrasonic SLM 3D Printer uses ultrasonic waves to influence molten metal material on a molecular level, resulting in structurally sound manufacturing without the need for extra heat treatment processes, able to achieve high-quality products in a faster and cost-efficient way. The 3DK USLM V1 can get your product out to market in less than half the time it takes for any other metal 3D printer in the industry.	● It's up to 10 times faster manufacturing ● 200 times more durable ● 20 times fewer CO2 emissions than conventional manufacturing Gradient control of mechanical properties	
Label-free histological imaging method and system Gold Medal	Transforming the healthcare system by creating intelligent solutions to complex issues. CHAMP Microscope is able to provide medical doctors with accurate information about the surgical margin during cancer surgery. The specific UV-laser wavelength chosen can generate rich endogenous contrast between cell nuclei and cytoplasm and visualize individual cells without tissue slicing and chemical staining. Deep-CHAMP is a semi-supervised deep learning algorithm that virtually stains grayscale CHAMP images into highly accurate histological images that simulate images obtained in the conventional one-week comprehensive report. The solutions have already been adopted by public and private hospitals in Hong Kong.	● CHAMP Microscope is capable of reducing the time required for histological imaging from 30 min to 3 min ● The virtually stained images reach over 95% when compared to the clinical gold standard ● CHAMP Miscroscope is non-organ specific which can be used to image most organs and tissues including lipid-rich tissues	
Nanowire-based artificial retina for visual prosthesis and robotics Gold Medal	A nanowire-based artificial retina is a technology designed to restore vision for individuals suffering from retinal diseases. This device consists of an array of optoelectronic nanowires that mimic the function of photoreceptor cells in the retina, converting light into electrical signals that can be transmitted to the brain. The use of semiconductor nanowire, a material with excellent light absorption and conversion properties, has shown promise in improving the efficiency and function of these nanowires. The artificial retina with optoelectronic nanowires has the potential to restore vision for individuals with impaired vision or blindness caused by retinal diseases.	● Hemispherical shape: The artificial retina has been designed to have a hemispherical shape, similar to the shape of the human eye. This allows for easier integration with the eye ● High resolution: The artificial retina has a high resolution (0.4 billion pixels/cm^2), even higher than that of the human retina ● Self-powered device: The artificial retina is a self-powered device, meaning that it does not require an external power source to function	

Vision-based monitoring of construction site for worker safety protection Gold Medal	Vison-based monitoring system enhances construction site safety by tracking the individual worker's behavior at work. AutoSafe's technology tracks construction workers and ensures they wear necessary protective equipment through an integrated framework and in-house deep neural networks. The system also includes a human-centric incident reporting system for missing PPE and unsafe behavior, which adapts to site-specific requirements.	• Multi-camera coordination for continuous worker trajectory tracking over wide areas • 13% higher accuracy of PPE compliance checking over baseline algorithms • Integrating AI with Digital Works Supervision System for incident logging and alerting	
Cooperative target tracking and signal propagation learning using mobile sensors Gold Medal	Tracking app to raise the public's awareness and spirit of mutual help and build a dementia-friendly community. By adopting both crowdsourcing and Bluetooth positioning technology, the elderly with dementia only need to wear a portable tracker, and caregivers who have downloaded the tracker app can detect the Bluetooth signal. This technology is especially suitable for places with high population density. The more people download the tacker app, the more detailed and accurate the location can be detected. The mobile app and the entire system adopt "Privacy by Design" to protect user privacy. The app is available at Google Play and App Store.	• The first to use mobile sensors to track by leveraging temporal information and target cooperation • High level of personal privacy • More than 30% lower tracking error • Fewer sensors for high accuracy in positioning sensors	
AimGel - Platform for activation and expansion of diverse immune cells, for both ex-vivo and in-vivo uses Gold Medal	AimGel - Artificial cells for ex-vivo live cell expansion and manipulation in cell therapy. AimGel is an "artificial cell" providing optimal presentation of signaling molecules to support cell therapeutics manufacturing. It consists of soft hydrogel core and fluid lipid shell, enabling controlled release of recombinant proteins or peptide derivatives for signaling. We adopted microfluidics technology for the high throughput production of uniform-sized microbeads and our proprietary technology for the coating of lipid and protein around the beads.	• Improve T-cell growth 2X faster and 4X more cells than existing materials • Customizable with diverse signals based on user needs, expanding the potential of cell therapeutics • Compatible with existing cell producing workflow, minimizing the switching cost	

Audio technology for signal-noise separation Silver Medal	Kite 2 provides premium hearing aid capabilities with the user-friendliness of Bluetooth earphones. Kite 2 is the next-generation smart personal sound amplifier with smartphone connectivity. Premium audio processing algorithms running on a high-performance 28-nanometer chip with unnoticeable delay let you hear what you want to hear. Personalized Sound and patented Intelligent Noise Reduction technology enable a comfortable listening experience-even in noisy environments.	• Intelligent Noise Reduction: Incus noise reduction technology is able to process 64 channels/second with 1ms algorithm latency • Two Directional Modes: Can focus on 60-degree angle with 30 times amplification to help users to hear more clearly within the angle range • Comfort for Own Voice: Able to reduce own voice max to 16dB to maintain more natural sound while listening to ourselves	
Algicidal hydrogel to inhibit algal growth without adverse effects on aquatic organisms Silver Medal	The Algicidal Hydrogel revolutionizes the current algal bloom treatment strategies. It discloses a long-acting algae-solving hydrogel containing safe and environment friendly bioactive ingredients, which can effectively reduce algal blooms and their impact on human health. Algicidal Hydrogel's low manufacturing cost and aquarium environmental compatibility allow it to be used on a large scale in different water bodies and can significantly reduce maintenance and labor costs for removing algal blooms.	• Able to apply in fresh water and seawater to inhibit algal growth up to 99% • 1/3 the cost of the current algal bloom chemical treatment methods • Two kilograms of Algicidal Hydrogel is sufficient to prevent algal growth in a 1500 m3 seawater reservoir	
Low energy electrical odor control of sludge (LEEO) technology Silver Medal	Low energy electrical odor control for sludge clearance. Controlling odor in wastewater treatment plants (WWTPs) is a major challenge due to the toxicity and corrosive properties of hydrogen sulfide (H2S), a primary source of odor. Conventional methods for odor control are costly and often ineffective. However, a new technology called Low Energy Electrical Odor Control (LEEO) has been developed to suppress sludge odor formation at the source. This innovative technology offers advantages like a small footprint, ease of operation, and zero chemical usage.	• LEEO provides effective H2S inhibition for at least 5 days at 38°C • LEEO improves sludge dewaterability by 20-30% • LEEO requires neither chemical addition nor production of secondary pollutantss • LEEO has a short treatment time of 10-15 minutes	
Economic energy efficient membrane bioreactor Silver Medal	Low carbon footprint solution for wastewater treatment. As a new category of MBRs, 3E-MBR uses the biological layer as the “second membrane” to achieve efficient solid-liquid separation. Compared to conventional MBs that use costly materials like polyvinylidene fluoride (PDF) and polytetrafluoroethylene (PTFE) , 3E-MBR uses more economical material mesh with a larger pore size of 10-100 um as the membrane, which can dramatically reduce the investment and operational cost of conventional MBRs.	• Stably operate for at least 21 days with out any form of chemical cleaning • Only requests a chemical cleaning frequency of once per month with 500 - 1000 pm NaClO • Reduce ~50% cumulative energy consumption, ~45% land use, ~40% greenhouse gas emission, 33% particulate matter emission, and over	

		90% chemical dosing over conventional MBRs	
Odor control in sludge treatment facilities using disinfectant-dosing liquid-gel Silver Medal	The liquid-gel dosing technology provides a reliable, efficient, and sustainable solution for odor control in waste handling facilities. Disinfectant-Dosing LiquidGel technology is an active liquid colloidal sol containing sanitizing and deodorizing compounds that transforms into active microgels under the influence of temperature, pH and salt concentration, trapping the sanitizing and deodorizing compounds in the gel network. It has the effect of quickly killing and inhibiting the activities of the microorganisms that produce odor and can quickly and effectively control odor and improve the odor control performance of sewage treatment plants. Since fewer doses are required, significant cost savings can be achieved and safety can be improved by reducing the risk of exposure to hazardous chemicals.	• Provide rapid and effective odor control in waste handling facilities • Offer a long lasting odor remediation performance • Require 80% less chemical amount and cost saving • Extend the lifespan of the plant's infrastructure and reduce equipment repairs and replacements • Flexible and compatible with existing equipment in the waste handling facilities	
Smart time-reversal technology for effective health monitoring of sewerage lines Silver Medal	The TR methodology involves a forward step where actively generated waves in pipe systems are sensed, followed by a backpropagation step where the chronological order of sensed waves is reversed and re-emitted into a model. Time reversed waves are able to retrace their forward path and refocus at scattering source(s) such defects and boundaries. In the systems that we investigated, the problems that have been identified includes leakage, air pocket, deteriorated lining.	• The technology uses fast-traveling waves for rapid diagnostic testing, around 1000 times faster than roving sensors • The TR methodology is non-disruptive and non-intrusive, eliminating service interruption, isolation of rising mains, and contamination risks • The technology offers controllable localization resolution and allows for the development of automated and autonomous processes	
Flexible high-voidage ultrathin membranes for sweat biomarkers detection Bronze Medal	An ultra-thin skin patch that tracks your health condition through sweat biomarkers and directly transmits to mobile app for real-time and continuous monitoring. The patented advanced material (i.e., UHMWPE) is a high breathability and hydrophobicity, providing a strong and robust platform for further incorporation of biomolecular recognizers and organic transistor to create a comprehensive wearable system that is non-existent in the market right now. Coupled with the developed IoT system, it aims to provide efficient and personalized healthcare monitoring. The solution is under validation trail with ASICS Institute of Sports Science and notable sports teams in Hong Kong and recently part of the Forbes Asia Top 100 to Watch List 2022.	• Non-invasive and novel: biochemicals monitoring that improves convenience significantly and enrich the existing wearable ecosystem • One-of-a-kind polyethylene: Highly breathable, ultra-thin thickness (i.e., 1/3000 of human hair) materials, yet having specific tensile strength 25x than stainless steel at the same mass • Personalized and preventive: through our PE-algorithm, it provides a real-time alert on users' app nearby their threshold level	

An integrated large-scale nano-gas sensor array for air quality monitoring and odor detection Bronze Medal	We utilize honeycomb-like nanostructures as substrate to build a new type of high-performance gas sensor and realize a novel monolithically integrated large-scale nanostructured gas sensor array chip. The nanostructured substrate provides a large surface-to-volume ratio that enables the measurement of extremely low gas concentrations (down to part-per-trillion) that conventional gas sensing instruments, such as PID and EC, cannot achieve. Unlike conventional gas sensors which have large size and poor selectivity and mostly being individual sensors, our sensor array chip is capable of distinguishing different kinds of gases and odors, assisted with artificial intelligence. This function is very similar to the mammalian olfactory organ of the nose. Our device can find broad applications including environmental safety, food safety, healthcare, etc.	• Ultra-low concentration (part-per-trillion level) of volatile organic compounds (VOCs) and inorganic gases measurement • High selectivity and AI/ML driven data calibration and classification of multiple gases and odors • Low-power consumption semiconductor devices • Low-cost instruments for the IAS (Indoor Air Quality) Standards • Broad applications in environmental safety, food safety, and healthcare, etc.	
UGV-Quadrupedal robot autonomous delivery project Bronze Medal	Autonomous mapping and navigation solution for complex urban social environments with human-interactive behaviors. An efficient terrain reconstruction and evaluation module considers robot's locomotion capabilities for energy-efficient path planning in real time. An interactive navigation module predicts human trajectories and generates safe behaviors for moving through crowds. The framework may also benefit other robotic applications, such as patrolling guiding and reusing.	• Improves terrain reconstruction performance and reduce error by over 40% • Reduce planning times by 3 orders of magnitude on complex terrain • Increase crowd navigation success rate by over 10% and improves human compatibility by 20% • Recovers all occluded regions and provides dense elevation maps with uncertainty values	
HiNW as a light disinfection technology for rapid microbial disinfection at low energy consumption Bronze Medal	HiNW is a disruptive innovation, with higher safety, lower energy consumption, and more material/user/environmental friendliness, to current light disinfection technologies. It can prevent hospital-acquired infections without toxic chemicals by using an optimal combination of lighting and light programs to rapidly inactivate bacteria by targeting multiple cellular sites to disinfect high-touch surfaces. By combining different lighting sources rather than a single lighting source, it reduces the possibility of microbial resistance. It can also reduce energy consumption without ozone generating, achieving better material compatibility due to the extremely low light dose required, and thus safer than traditional UV light sterilizers.	• Disruptive innovation to existing photo disinfection technologies, with higher safety, lower energy consumption and more material & user & environmental friendliness • Harmless to the human body. It significantly reduces damage to skin, eyes and material surfaces compared with traditional UV sterilizers • High efficiency. It exhibits 99.99% bactericidal activity against a wide range of microorganisms within a 5-minute exposure time	

Composition for treating neurodegenerative disease or neuropathological condition Bronze Medal	Herbal supplement to prevent early-stage memory decline that occurs in aging populations. Synaptic plasticity, a key process through which the brain adjusts how neurons communicate, is the first brain function weakened during aging and neurodegeneration. The loss of this function leads to breakdown of neuronal networks, eventually causing memory loss and cognitive impairment. To tackle this root cause of synaptic dysfunctions, we use advanced molecular neuroscience research tools to identify natural herbs that can specifically promote synaptic plasticity.	• Natural herbs with clinical use in forgetfulness • Screened by molecular neuroscience platforms • Active ingredients promote synaptic functions • Well-defined dosages that are safe for routine use	