香港浸會大學
HONG KONG BAPTIST UNIVERSITY

Institute for Innovation and Translation
創新及轉化研究院

GREEN TECH AT HKBU

Translating Innovation & Creativity for Impact

Contents

GREEN TECH

leading the change for a sustainable tomorrow,
steering humankind to
a safer, healthier, and greener future.

HONG KONG BAPTIST UNIVERSITY

Hong Kong Baptist University (HKBU) is committed to the pursuit of excellence in education, research and service to the community. As one of Asia's finest institutions of higher learning, HKBU is dedicated to nurturing future generations of civically engaged community members, and it provides them with a broad-based, transdisciplinary and creative education. Its seven faculties/schools offer a wide array of programmes across a diverse range of disciplines, from the arts, business, communication, and social sciences to science and technology, Chinese medicine and sport.

HKBU offers an education and research environment that fosters technological progress with a focus on the human dimensions. At the same time, the University is using technology to push the envelope of human imagination in the arts and cultural sphere. Coupled with our unceasing efforts to achieve breakthroughs in science and Chinese medicine, HKBU strives to contribute to the building of a better world and a more compassionate society.

OUR STRATEGIC CLUSTERS

Art, Culture and Creative Media

Film, Literary Arts, Music, Visual/Media Arts

Data Analytics and AI

Enabler for applications such as journalism, business and finance, science and art

Health, Chinese Medicine and Drug Discovery

Chinese medicine, Chemistry, Microbiology, Ageing, Physical Education

Humanities and Cultures

Philosophy, Literature, Geography, History, Political Science, Communication, Economics and the like

Institute for
Innovation and Translation
創新及轉化研究院

TRANSLATING INNOVATION & CREATIVITY FOR IMPACT

The Institute for Innovation and Translation (IIT) at HKBU is dedicated to driving innovations, research and development, technology translation, and applications to enable HKBU to respond to emerging challenges and opportunities globally, nationally, and under the aegis of the Hong Kong Special Administrative Region of the People's Republic of China's top policy priority on innovation and technology development.

We strive to bridge the gap in technology readiness between academic innovation and industry applications in order to bring HKBU's innovations for the well-being of the society.

IIT comprises

Innovation and Entrepreneurship

Technology Translation

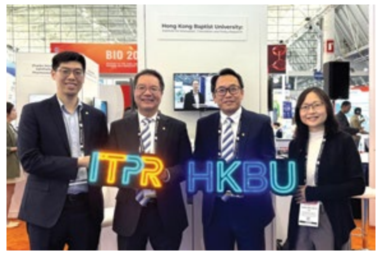
each being instrumental in fostering a vibrant ecosystem at HKBU conducive to technology translation and collaborations.

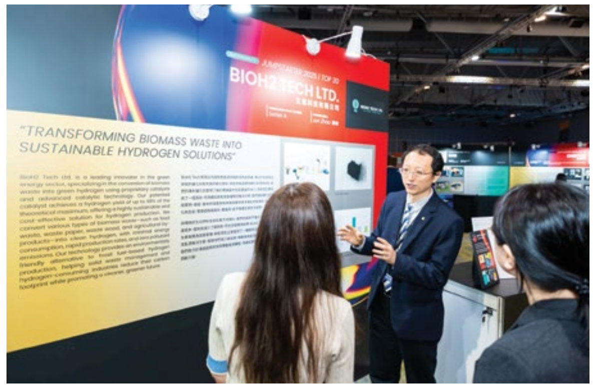
The all-round business development, scientific, and policy research support will anchor HKBU's robust and sustainable development.

STRATEGIC ALLIANCE AND GLOBAL ENGAGEMENT

Accelerating Technology Translation and Application

To bridge the gap in technology readiness between academia and industry in technology development, IIT strives to enhance HKBU's innovation capacity and our research and technology development capabilities through proactive outreach and engagement with strategic partners and investors. We achieve this by establishing collaborative platforms, engaging stakeholders, facilitating high-impact innovation, and conducting multidisciplinary R&D.





IIT offers support and resources to mature technology and start-ups of HKBU in realising their potential to generate social, economic, and cultural impacts. To showcase the potential of technology, IIT identifies anchor events in different industries to participate and demonstrate technology applications to industry players and investors.

TECHNOLOGY TRANSLATION

Anchoring Technology Application

IIT offers infrastructure to support HKBU's translational research.

We provide resources and expertise for technology development and demonstration, while we also serve as a training hub to cultivate the next generation of scientists and researchers.

Our aim is to equip them with the necessary skill set and know-how for technology applications. Our flagship translational infrastructures include:

01

Wu Jieh Yee Institute of Translational Chinese Medicine Research (WJY ITCMR)

Located at the Hong Kong Science Park, the primary mission of WJY ITCMR is to become a recognised world-class centre for innovative research in Chinese medicine. Equipped with state-of-the-art research infrastructure, WJY ITCMR supports cutting-edge and cross-disciplinary collaborations with high-quality translational research and deliverables, generating significant regional and global impact in the healthcare industry.

02

CHRYSALIS HKBU Art Tech Incubation Hub

Located at the Jockey Club Creative Arts Centre (JCCAC), CHRYSALIS is dedicated to fostering the incubation of cutting-edge Art Tech projects and entrepreneurial activities by providing a creative environment for our innovators and artists.

We support technology development and streamline the process of translation and demonstration, with the aim to bridge the gap between artistic vision and technological innovation.

PLATFORM

In the pursuit of sustainable solutions for our planet, the role of collaborative platforms and robust infrastructure cannot be overstated. Green technology thrives on the synergy of diverse expertise, cutting-edge facilities, and strategic partnerships that span institutions and borders.

By fostering collaborations between universities, research institutes, and industry leaders, we accelerate the development and deployment of innovative technologies that address environmental challenges.

State-of-the-art laboratories and research centres provide the essential tools and environments where groundbreaking ideas can be nurtured and transformed into real-world applications. This section highlights the key players and infrastructures that form the backbone of our green technology initiatives, driving progress towards a sustainable future.

Damo Academy
Harnessing AI and data science to tackle environmental challenges

TUM (Technical University of Munich)
Engineering sustainable solutions for energy and urban development

Fraunhofer-Gesellschaft
represented by its
Fraunhofer institutes (IGB, IMTE, IMWS, IWKS, UMSICHT)
Pioneering applied research in environmental and sustainable technologies

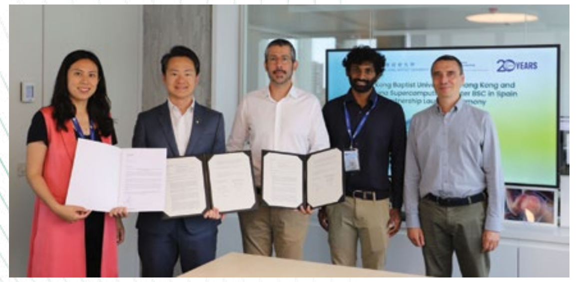
Leibniz Institute for Catalysis (LIKAT)
Advancing catalysis for green and sustainable chemistry

Barcelona Supercomputing Center (BSC)
Empowering environmental research with supercomputing capabilities

Nanyang Technological University (NTU)
Leading interdisciplinary research in energy and environmental sustainability

National University of Singapore (NUS)
Driving innovation in solar energy and sustainable urban systems

Agency for Science, Technology and Research (A*STAR)
Spearheading research in sustainable technologies and green innovations



INFRASTRUCTURE

Sino-Forest Applied Research Centre for Pearl River Delta Environment
Focusing on regional environmental monitoring and solutions

Croucher Institute for Environmental Sciences
Advancing environmental sciences through interdisciplinary research

The Asian Energy Studies Centre (AESC)
Focusing on energy studies in Asia

Institute of Advanced Materials (IAM)
Developing advanced materials for sustainability

Institute of Bioresource and Agriculture (IBA)
Promoting sustainable agriculture and bioresource utilisation

Research and Development Centre for Natural Health Products
Innovating in natural and sustainable health solutions

Centre for Geo-computation Studies
Advancing geo-spatial research for sustainability

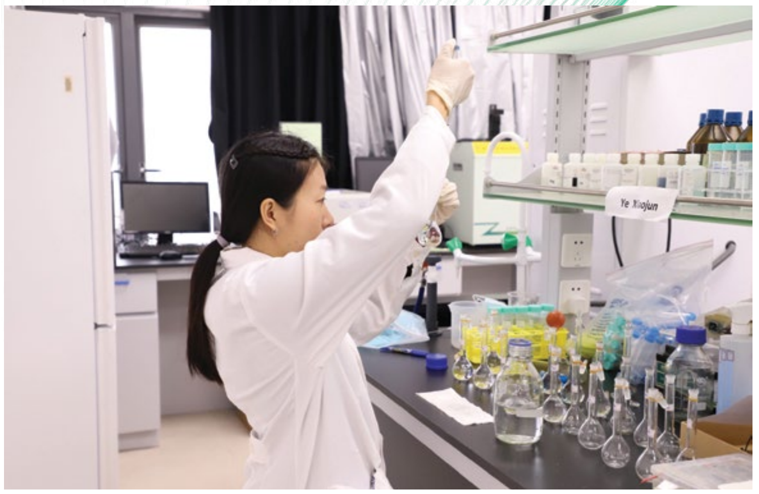
Centre for China Urban and Regional Studies
Studying urban planning in China

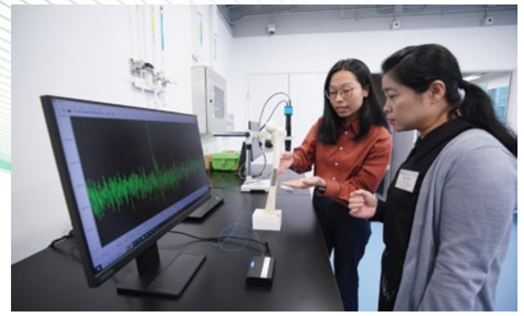
Centre for Sustainable Development Studies (CSDS)
Promoting eco-social balance research

Zhuhai Key Laboratory of Agricultural Product Quality and Food Safety
Ensuring agricultural product quality and food safety

Biodiversity Research Centre of Hengqin
Conserving biodiversity in Hengqin

BNBU Interdisciplinary Research Hub on Eco-environmental Data of Zhuhai
Analysing eco-environmental data for sustainable practices





OUR INNOVATIVE ENDEAVOURS AND START-UPS

Innovating for a Sustainable Future: HKBU's Pioneering Green Technologies

> ***"The greatest threat to our planet is the belief that someone else will save it."***
>
> Robert Swan, OBE, Polar Explorer & Environmental Leader

As the world faces mounting environmental challenges, the need for green technology has never been more urgent. At HKBU, we believe that scientific innovation is essential to building a sustainable future. Through dedicated research and collaboration, our researchers have developed a suite of pioneering green technologies that turn environmental challenges into opportunities for positive change.

Our breakthroughs in catalytic green hydrogen generation from biomass, and green recycling of shell waste have redefined traditional food waste management, making it more efficient while minimising pollution. By developing processes to convert waste into valuable materials, we are contributing to a circular economy that reduces both landfill and resource depletion.

Central to these advancements are our cutting-edge functional materials, designed for pigment retention, water purification, anti-corrosion, and sustainability. These materials not only drive our green technologies but also offer scalable solutions for industries and communities striving for sustainability.

Beyond research, HKBU fosters an entrepreneurial spirit by supporting start-ups dedicated to sustainable products and processes. From eco-friendly coatings to smart recycling systems, our innovators are translating laboratory discoveries into real-world impact, shaping a more resilient and eco-friendly society.

Green technology is not just a scientific pursuit—it is a shared commitment to the future of our planet. Join us as we work together to create a cleaner, more sustainable world for generations to come.

USING ENGINEERED BIOCHAR TO ACTIVATE PEROXYMONOSULFATE FOR REMOVING OXYTETRACYCLINE FROM WASTEWATER

Key Highlights

Metal-free biochar engineered from anaerobic digestate achieves **100% removal** of antibiotic oxytetracycline in wastewater by activating peroxymonosulfate (PMS). Outperforms unmodified biochar (52% removal) and avoids toxic metal catalysts. Sustainable solution for pharmaceutical contamination.

The Challenge

- Antibiotics like oxytetracycline contaminate water sources, harming ecosystems
- Conventional removal methods use **toxic metal catalysts** (e.g. cobalt, iron)
- Unmodified biochar only removes **52%** of oxytetracycline
- Metal catalysts leave secondary pollution and face regulatory restrictions
- Limited sustainable options for antibiotic-laden wastewater

Our Breakthrough Technology

- **Engineered digestate-derived biochar**: Synthesised from anaerobic digestion byproducts
- **Nitrogen enhancement**: Pyrrolic nitrogen modification boosts PMS activation efficiency
- **Metal-free oxidation**: Activates PMS to degrade oxytetracycline **without heavy metals**
- **Complete contaminant removal**: Achieves **100% oxytetracycline degradation** vs. 52% with standard biochar
- **Waste-to-resource**: Valorises digestate (organic waste) into functional material

Industry Applications

- **Wastewater treatment plants**: Remove antibiotics from municipal/industrial effluents
- **Pharmaceutical manufacturing**: Treat antibiotic-contaminated process water
- **Aquaculture farms**: Mitigate antibiotic pollution in discharge water
- **Agricultural operations**: Remediate livestock wastewater containing veterinary antibiotics
- **Environmental remediation services**: Deploy for contaminated river/sediment cleanup

Environmental Impact

- **Eliminates secondary pollution**: No toxic metal residues vs. conventional catalysts
- **Waste valorisation**: Converts anaerobic digestate (waste) into functional biochar
- **Prevents antibiotic resistance**: 100% removal reduces environmental antibiotic exposure
- **Carbon-negative process**: Biochar production sequesters carbon long-term
- **Circular economy**: Uses waste digestate to clean wastewater, closing resource loops

Business Benefits

- **Lower compliance costs**: Meets stringent regulations on metal discharge
- **Reduced operational expenses**: Uses low-cost digestate vs. commercial catalysts
- **New revenue streams**: Sell engineered biochar to wastewater facilities
- **IP monetisation**: Patentable metal-free activation technology
- **ESG alignment**: Enhances sustainability credentials for pharma/farming sectors


Environmental Pollution

Engineered digestate-derived biochar mediated peroxymonosulfate activation for oxytetracycline removal in sustainable wastewater remediation

Highlights

Access publication

PROJECT-IN-CHARGE

Professor Zhao Jun
Associate Professor, Department of Biology and
Director of Sino-Forest Applied Research Centre for
Pearl River Delta Environment (ARCE)

HYDROTHERMAL TREATMENT EFFECTIVELY REDUCES MICROPLASTICS IN FOOD WASTE DIGESTATE

Key Highlights

Hydrothermal carbonisation (HTC) at 200°C achieves **90% removal** of microplastics from food waste digestate, reducing contamination from **1,400 particles/kg** to minimal levels. Effective on PP, PS, and PET polymers. Low-energy solution prevents environmental spread of microplastics.

The Challenge

- Food waste digestate contains **1,400 microplastic particles/kg**
- Dominant polymers: PET (60.45%), PP (21.47%), PS (18.08%)
- Particle sharpes: Fibers, Films, Fragments, Flakes, and Spheres at 0.5-1.0 mm (highest risk for ecosystems)
- Current solutions show limited efficacy (43.7-99.4%) or high energy costs
- Land application spreads microplastics to agricultural systems

Our Breakthrough Technology

- **HTC treatment**: 200°C processing for 6 hours
- **90% removal efficiency** for mixed microplastics (PP/PS/PET)
- **Particle size reduction**: Breaks larger particles into smaller, degradable fragments
- **Polymer-specific effects**: Significant discolouration of PS + chemical breakdown of PET
- **Material transformation**: Converts digestate to hydrochar (carbon content increase: 39.3% → 43.5%)
- **Operational simplicity**: Single-step, low-energy process

Industry Applications

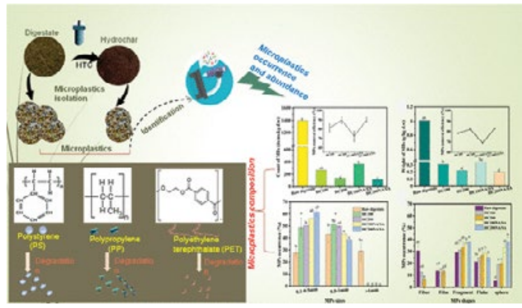
- **Anaerobic digestion plants**: Treat digestate before land application (O.PARK1, Hong Kong)
- **Organic fertiliser producers**: Ensure microplastic-free products
- **Wastewater treatment**: Process sludge contaminated with microplastics
- **Agricultural sector**: Safely recycle nutrient-rich digestate
- **Environmental remediation**: Clean microplastics from contaminated soils
- **Circular economy initiatives**: Integrate with food waste valorisation systems

Environmental Impact

- **90% reduction** in microplastic load from digestate
- Prevents transfer of **~1,260 particles/kg** to agricultural soils
- Eliminates ecosystem risks from persistent polymers (PET/PP/PS)
- **Chemical transformation**: Breaks down PET polymers during treatment
- **Carbon sequestration**: Increases carbon content in hydrochar by 10.7%
- **Low-energy process**: Consumes less energy than pyrolysis (500°C) or liquefaction (400°C)

Business Benefits

- **Cost savings**: Lower energy vs. pyrolysis (500°C) or liquefaction (400°C)
- **New revenue**: Sell microplastic-free hydrochar as soil amendment
- **Regulatory compliance**: Meet emerging microplastic standards for fertilisers
- **Waste processing fees**: Charge premium for digestate treatment
- **Operational efficiency**: Single-step process reduces handling costs
- **IP potential**: Patentable HTC parameters for polymer-specific degradation
- **Market differentiation**: First solution targeting digestate microplastics



Access publication

PROJECT-IN-CHARGE

Professor Zhao Jun
Associate Professor, Department of Biology and
Director of Sino-Forest Applied Research Centre for
Pearl River Delta Environment (ARCE)

BIOH2 TECH LIMITED

Design and Optimisation of Integrated Catalytic Systems for Biomass-to-Hydrogen Conversion

Key Highlights

BioH2 Tech Limited is pioneering the transformation of waste management and energy production, creating a more sustainable future through innovative technology and cost-effective solutions.

The Challenge

The world faces two critical environmental challenges:

- Over 50% of solid waste is biowaste, creating massive disposal problems
- Current hydrogen production relies 96% on fossil fuels, contradicting global carbon neutrality goals

Our Breakthrough Technology

BioH2 Tech Limited has developed revolutionary catalytic technology that:

- Converts biomass waste into clean hydrogen energy
- Achieves 88% theoretical yield efficiency
- Operates at low temperature (<200°C) and pressure (30 Bar) in less than 3 hours
- Significantly reduces production costs

Industry Applications

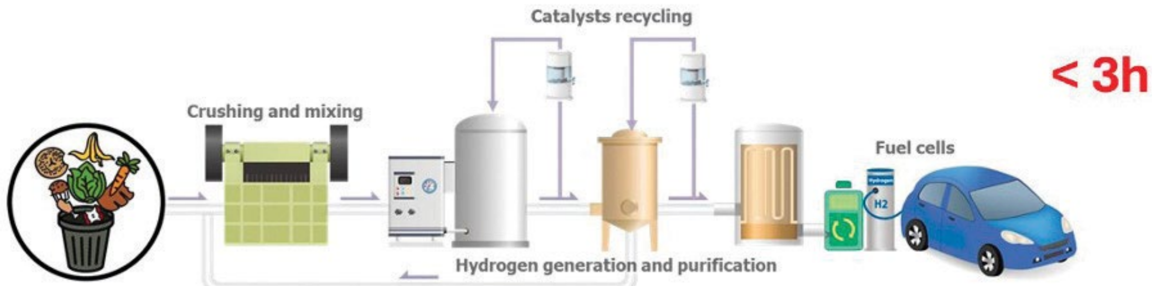
Our innovative process delivers substantial cost savings:

- Industry standard: \$3–6 per kilogram
- BioH2 Tech: \$1.8–3.3 per kilogram, saved up to 45% cost reduction

Business Benefits

Our solution creates value across multiple dimensions:

- Reduces waste management costs
- Supports carbon neutrality goals



FOUNDER

Professor Zhao Jun
Associate Professor, Department of Biology and Director of Sino-Forest Applied Research Centre for Pearl River Delta Environment (ARCE)

POWER OF CLAY CATALYSTS FOR CONVERTING MIXED PLASTIC WASTE INTO FUEL AND ENERGY

Key Highlights

Innovative catalytic technology converts plastic waste into fuel and energy through a cyclic recycling process. Addresses plastic pollution while recovering valuable resources, supporting sustainable waste management and energy production. Scalable for industrial use.

The Challenge

- Accumulation of non-recyclable plastic waste
- Environmental contamination from disposal
- Energy-intensive traditional processing
- Limited value recovery from mixed plastics
- Need for circular economy solutions

Our Breakthrough Technology

- Advanced catalytic conversion process with low-temperature
- Cyclic recycling system design
- Integrated output purification
- Optimised for mixed plastic waste
- Energy recovery mechanism

Industry Applications

- Waste management: Municipal/industrial plastic waste valorisation
- Energy sector: Sustainable diesel for transport; hydrogen for fuel cells
- Chemical industry: Feedstock recovery (olefins, aromatics)
- Marine/island communities: Off-grid plastic-to-energy solutions
- ESG compliance: Helps industries achieve carbon-neutral targets

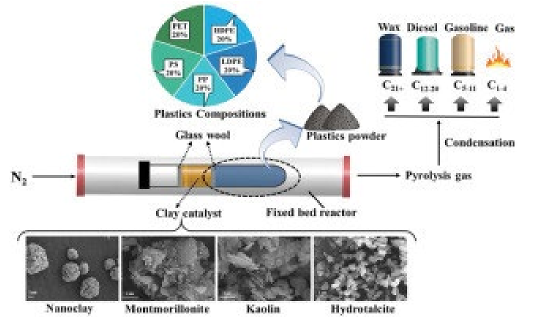
Access publication

Environmental Impact

- Waste diversion: The technology will reduce Hong Kong's carbon emissions by ~2%, produce ~680,000 tons of non-fossil fuel oil per year and reduce the flow of 58,764 tons of plastic waste into the ocean if the 2000t/d plastic waste can be recycled using our technology
- Carbon reduction: Pyrolysis of mixed plastic waste emits 50% less CO_2 eq. than energy recovery by incineration
- Minimises pollution from waste
- Recovers energy resources
- Supports circular economy

Business Benefits

- New revenue from waste valorisation
- Reduced processing costs
- Energy production opportunities
- Regulatory compliance support
- Sustainable market positioning



PROJECT-IN-CHARGE

Professor Zhao Jun
Associate Professor, Department of Biology and Director of Sino-Forest Applied Research Centre for Pearl River Delta Environment (ARCE)

BIODEGRADABLE POLYESTER BIOSYNTHESIS FROM LIPIDS

Key Highlights

Our innovative bioprocess converts lipid waste streams, such as waste cooking oil, into high-performance biodegradable polyesters, including polyhydroxyalkanoates (PHA). With optimised fermentation technology, we enhance yield while reducing production time, offering an eco-friendly alternative to conventional plastics for both single-use and durable applications.

The Challenge

- 400 million tonnes of plastics produced annually, with very low recycling rates
- Landfill overflow, aquatic ecosystem pollution, and GHG emissions from plastic incineration
- Current biodegradable polyesters remain 3–6 times more expensive than conventional plastics

Our Breakthrough Technology

- Utilises a diverse array of lipid waste streams to significantly cut costs and improve yields
- Our master fermentation formula manipulates feedstock to produce versatile co-polymers for broad applications

Industry Applications

Potential applications in:

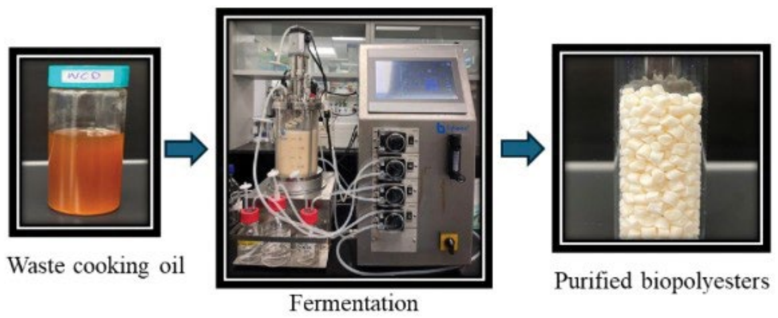
- Packaging: Biodegradable films, bags
- Medical: Implants, drug delivery systems
- Agriculture: Mulch films, biodegradable plant pots

Environmental Impact

- Reduces plastic waste & marine pollution
- Cuts GHG emissions (~2.7 kg CO2/kg plastic avoided)
- Upcycles lipid waste into high-value biopolyesters

Business Benefits

- Lower production costs via lipid waste feedstock
- Market-ready PHA with competitive mechanical and thermal properties
- Fully biodegradable, reducing producer responsibility risks



PROJECT-IN-CHARGE

Professor Pradhan Nirakar
Assistant Professor
Department of Biology

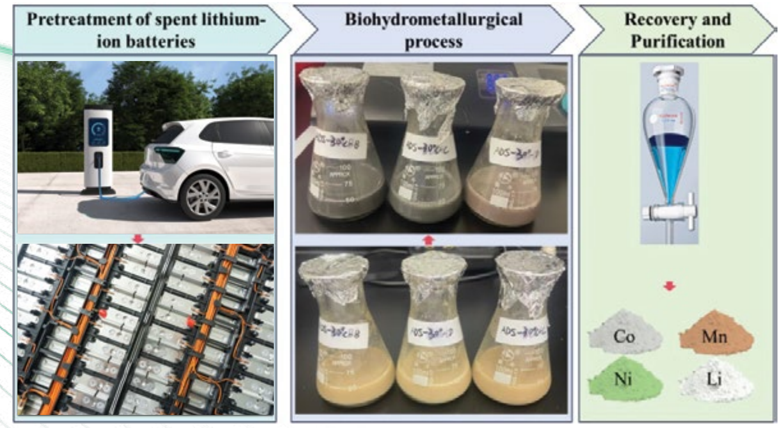
BIOHYDROMETALLURGICAL RECOVERY OF CRITICAL METALS FROM SPENT EV BATTERIES

Key Highlights

Novel biohydrometallurgical process using an enriched acidophilic microbial consortium to recover Li, Co, Ni, and Mn from spent EV batteries. Targets >85% recovery at >95% purity with biogenic H_2SO_4, replacing energy-intensive pyro- and hydrometallurgy and enabling a circular economy.

The Challenge

- Global lithium-ion battery (LIB) recycling rates stagnate at ~5%
- Energy and chemical-intensive pyro- and hydrometallurgical processes with toxic emissions and low Li and Mn recovery
- Geopolitical supply risks for Co, Li, Ni due to concentrated mining



Our Breakthrough Technology

- Novel microbial consortium generates biogenic H_2SO_4 via sulfur oxidation, replacing inorganic acids
- Achieves >85% metal recovery efficiency from LIB black mass

Industry Applications

- Recovery of critical metals from end-of-life LIBs
- Other potential applications in recovering precious metals from printed circuit boards of laptops, smartphones, and other portable devices

Environmental Impact

- Cuts CO_2 emissions by replacing energy and chemical-intensive pyro-and hydrometallurgical processes
- Minimises toxic waste and landfill leaching risks
- Reduces ore mining demand

Business Benefits

- Cost savings via lower energy and chemical inputs vs. traditional methods
- Monetises waste streams via high-purity metal resale

PROJECT-IN-CHARGE

Professor Pradhan Nirakar
Assistant Professor
Department of Biology

GREEN RECYCLING OF SHELL WASTE

Key Highlights

Crustacean shell waste from the food industry consists of valuable resources, including chitin, a major biomaterial with potential uses in the biomedical, food, and packaging industries. This substance can also be converted into chitosan and small molecules for additional applications.

The Challenge

The established method for recycling crustacean shell waste consumes a large quantity of chemicals and generates a significant amount of chemical waste. Moreover, the chemicals used are hazardous, and their excessive use may reduce the quality of the chitinous products.

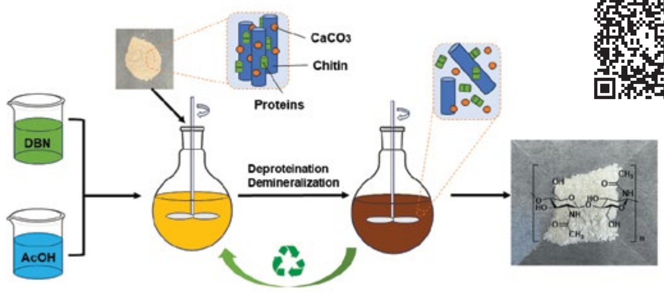
Our Breakthrough Technology

- Our technology utilises a non-hazardous, environmental friendly extractant that can extract high purity and quality chitin
- The extraction process is very straightforward compared to the established method
- Unlike the common extractants used for the chitin isolation, our extractant is recyclable, reducing chemical waste

Industry Applications

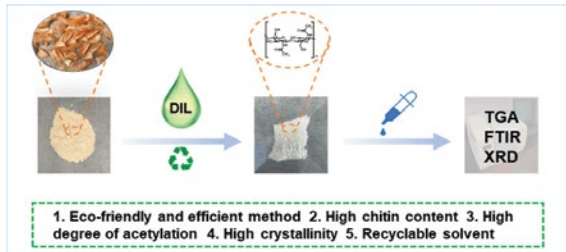
- Chitin can be used to make bioplastics, wound-healing materials and materials for tissue engineering purposes
- Chitin can be easily converted to chitosan, which has applications including biopesticides, food preservatives, food packaging materials, dietary supplements and other healthcare materials
- Chitin can be converted to small molecules such as ammonia and levulinic acid which are major feedstock chemicals

Access publication



Environmental Impact

- Shell waste is difficult to process using conventional waste treatment method
- This project could provide a cost-effective way to reduce the significant amount of shell waste from restaurants and the food industry
- Chitin and chitosan are essential polymers of the future to generate bio-renewable and biodegradable healthcare and packaging materials, potentially substituting the hazardous, petroleum-based plastics



Business Benefits

- Chitin and its derivative chitosan are high-valued chemicals with relatively strong market price and future need in many industries
- Our process can generate high quality chitin at low financial cost, due to the usage of a non-hazardous and recyclable extractant

PROJECT-IN-CHARGE

Professor Matthew Lui
Assistant Professor
Department of Chemistry

BEASTIBITE LIMITED

Key Highlights

- Revolutionising waste management
- Transforming waste into wealth, naturally

The Challenge

- Plastic waste crisis: The world faces a mounting plastic waste problem, with major synthetic polymers like PE, PET, PP, PS, and PLA contributing significantly to environmental pollution
- Food waste crisis: The Greater Bay Area, a major business and tourist hub, generates substantial food waste, necessitating effective management solutions

Our Breakthrough Technology

Our innovative technology utilises insects to accelerate the biodegradation of both plastic and food waste. We have developed an enhancer from food waste that increases the rate at which insects consume plastic by around 75%, while maintaining their reproductive ability even when consuming plastic. We have also developed a new and more straightforward method to produce essential materials from the resulting insects.

Key Benefits

- Sustainable resource generation: Our technology extracts valuable materials from mealworms, including protein-rich feedstock and organic materials, supporting a circular economy
- Environmental impact: By enhancing biodegradation, we reduce reliance on traditional waste management methods, promoting a healthier environment

FOUNDERS

Professor Matthew Lui
Assistant Professor
Department of Chemistry

Dr Danny Chi-man Leong
Assistant Professor
Faculty of Science and Technology-Environmental Science
Beijing Normal–Hong Kong Baptist University

BRIGHT HUB TECHNOLOGY COMPANY LIMITED

Thermostable Pigment Nano-Coatings for Sustainable, Energy Saving Solutions

Key Highlights

Dedicated to transforming industries with our groundbreaking Ultrasound-Resonated Nanofiber Coating Technology, our patented solution integrates advanced nanofibers to create coloured and transparent coatings as well as paint additives with exceptional thermostability, durability, water repellence, and resistance to environmental degradation. We are proud that our research has earned not only two international invention awards but also a certification aligned with Sustainable Development Goals.

The Challenge

- Traditional materials struggle to withstand harsh conditions and drastic temperature change
- Frequent replacements drive up operational costs
- Environmental regulations demand sustainable solutions

Our Breakthrough Technology

- Enhanced thermostability
- Superior durability upon drastic temperature changes
- Water repelling properties
- Resistance to environmental degradation
- Coloured or transparent options

Industry Applications

- Construction: Enhanced building material longevity
- Pharmaceutical: Improved drug delivery and pill packaging
- Cosmetics: Advanced product preservation

Environmental Impact

Extended product lifecycle and reduced carbon footprint

Business Benefits

- Reduced operational costs and improved product performance
- Certified green production
- Compliance with environmental regulations

FOUNDER

Professor Ken Leung
Associate Professor
Department of Chemistry

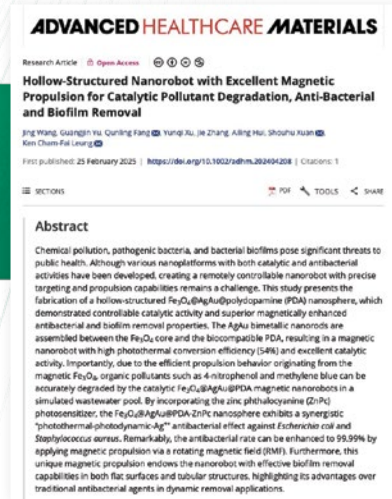
HOLLOW-STRUCTURED NANOROBOT WITH EXCELLENT MAGNETIC PROPULSION FOR CATALYTIC POLLUTANT DEGRADATION, ANTI-BACTERIAL AND BIOFILM REMOVAL

Key Highlights

Hollow-structured Fe_3O_4@AgAu@PDA nanorobots with magnetic propulsion achieve 99.99% antibacterial rates against E. coli/S. aureus and degrade organic pollutants (4-nitrophenol, methylene blue). Their magnetically enhanced propulsion enables precise navigation in complex environments, offering a sustainable solution for water treatment and medical sanitation.

The Challenge

- Chemical pollutants and drug-resistant bacteria/biofilms threaten public health
- Existing nanocatalysts lack precise spatiotemporal control and dynamic removal capabilities
- Traditional antibiotics face resistance issues; biofilms shield bacteria from treatments
- Passive diffusion limits efficiency in large-scale or confined-space applications



Access publication

PROJECT-IN-CHARGE

Professor Ken Leung
Associate Professor
Department of Chemistry

The Our Breakthrough Technology

- **Hollow structure**: Iron oxide-gold-silver alloy-polydopamine (Fe_3O_4@AgAu@PDA) nanospheres with high surface area and photothermal efficiency (54%)
- **Magnetic propulsion**: Rotating magnetic fields enable targeted navigation and swarm control
- **Triple-action**: Synergistic "photothermal-photodynamic-metal ion" mechanism degrades pollutants and kills pathogens
- **Dynamic biofilm removal**: Physically disrupts biofilms in flat surfaces and complex tubing

Industry Applications

- Wastewater treatment
- Medical device sanitisation
- Surface disinfection as antibacterial coating
- Biomedical

Environmental Impact

- Efficient degradation of persistent pollutants below regulatory limits
- Reduces reliance on chemical disinfectants and antibiotics, minimising ecological toxicity
- Biocompatible components (Fe_3O_4, PDA) ensure environmental safety
- Scalable: Estimates show 1 kg treats 1000 m^3 wastewater in minutes at experimental concentrations

Business Benefits

- **Reduced resistance**: Non-antibiotic mechanism avoids drug-resistance development
- **Versatility**: Single platform addresses pollutants, bacteria, and biofilms dynamically
- **Recovery & reuse**: Magnetic properties simplify retrieval and potential reuse of nanorobots
- **Lower operational costs**: Rapid treatment times reduce energy and labour requirements

GREEN DRAG-REDUCING HULL COATING: SHARK SKIN-LIKE, ANTI-CORROSION, DECONTAMINATION AND ENERGY SAVING

Key Highlights

This project addresses drag and biofouling in shipping, responsible for 3% of global carbon emissions. Our sharkskin mimetic coating reduces drag by 13% and achieves ~100% fouling release, serve over 20 years. This innovation could cut CO_2 emissions by 130 million tons annually and save 32.5 million tons of fuel.

The Challenge

1. **Drag**: In shipping, drag increases fuel consumption and carbon emissions, impacting efficiency
2. **Biofouling**: Organism accumulation on hulls increases surface roughness, drag and biocorrosion
3. **Corrosion**: Corrosion significantly reduces vessel longevity and elevates maintenance costs
4. **Manufacturing difficulties**: Biomimetic surfaces cut drag, but replicating their micro-textures in mass production is difficult

Our Breakthrough Technology

- **World-first passive solution**: Our coating provides topology-specific drag reduction and durability without needing extra systems or energy
- **Extended service life**: Matches the lifespan of ship hulls, effectively transitioning delicate biomimetic technology for long-term marine use
- **Reusability**: Green fouling release properties maintain drag reduction post-cleaning, cutting maintenance costs by up to $275 billion annually
- **Patented production methods**: Facilitates cost-effective mass production of complex 3D architectures

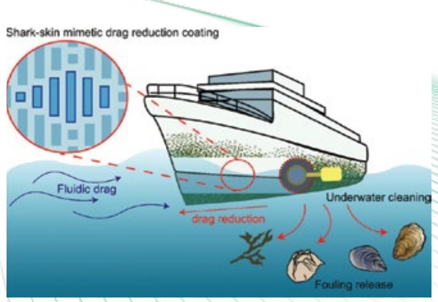
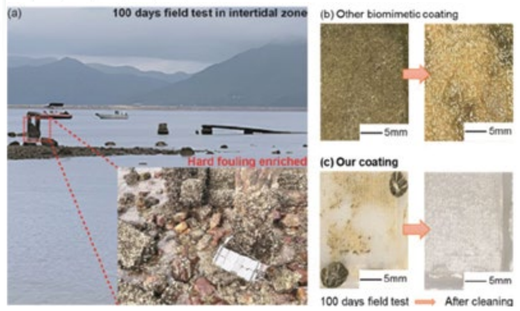


Fig. 1. Overview of our marine coating design, demonstrating its topology-specific drag reduction and fouling release capabilities.

Industry Applications

- Marine stability: Maintains coating integrity and functionality under daily marine conditions
- Corrosion resistance: Acts as a durable barrier against moisture
- Cleaning compatibility: Integrates with conventional fouling release systems, enhancing user flexibility and eliminating the needs of recoating
- Sustainability and longevity: Weather-resistance and anti-aging properties, minimising environmental impact from degradation; fully recyclable upon hull disposal



(a) Validation of our coating via a 100-day field test. Comparison of fouling release performance between a biomimetic coating made from other material (b) and our proposed coating (c). Images show conditions before (left) and after 100-bar water jet cleaning (right). Our coating successfully achieves nearly 100% fouling removal while maintaining consistent drag reduction performance.

Environmental Impact

- **Greenhouse gas reduction**: Our sharkskin-inspired coating reduces drag by 13%, enhancing velocity by 15%. This can potentially prevent 1% of global CO_2 emissions, saving 32.5 million tons of fuel and reducing emissions by 130 million tons annually
- **Marine-friendly fouling release**: Utilises low surface energy materials for nearly 100% fouling removal without biocides or releasing harmful micro-paints, safeguarding ocean health
- **Sustainability**: Matches the lifespan of ship hulls, minimising maintenance needs and promoting eco-friendly maritime practices

PROJECT-IN-CHARGE

Professor Ren Kangning
Associate Head and Professor
Department of Chemistry

Business Benefits

- **Monopolistic product offering**: First film-type hull coating, integrating drag reduction, fouling release, and anticorrosion properties
- **Market growth potential**: Positioned to capture a significant share of the $10.20 billion marine coatings market by integrating antifouling and anticorrosion segments
- **Cost-effective manufacturing**: Ultra-low production cost under $10/m^2 with a rapid 5-minute fabrication cycle
- **Eco-friendly solution**: Biocide-free and effective in various marine environments, aligning with global environmental policy

APPLICATION OF SPECIAL WETTABILITY MATERIALS IN MULTI-SCENARIO OIL-WATER SEPARATION

Key Highlights

To address the separation challenges of complex oil-water systems, develop one-dimensional to two-dimensional special wettability materials, achieving gradual optimisation from granular particles to mesh-like porous structures, thereby efficiently solving complex oil-water separation problems.

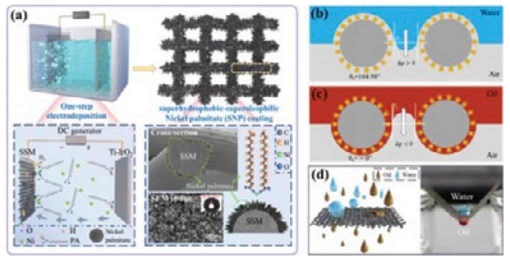


Figure 1. Design principle of the stainless steel mesh (SSM) with special wettability. (a) Schematic illustration of the preparation of superhydrophobic-superoleophilic SSM. Schematic diagram of water (b) and oil (c) wetting models. (d) Schematic of the oil-water separation mechanism on the across the SSM.

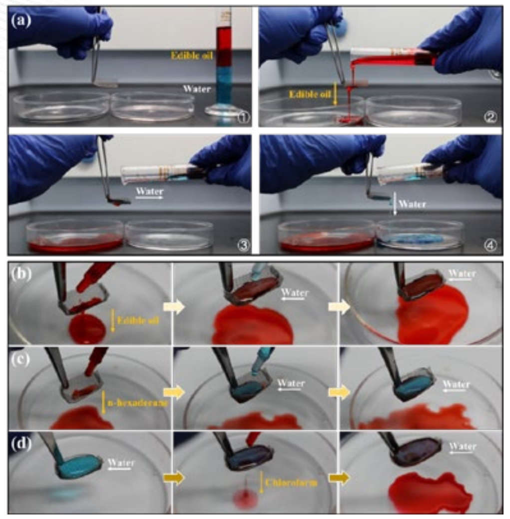


Figure 2. Investigations of oil-water separation of superhydrophobic- superoleophilic SSM. (a) Edible oil-water separation process using open oil-water separation device. (b) Edible oil-water, (c) n-hexadecane-water and (d) chloroform-water separation process using closed oil-water separation device.

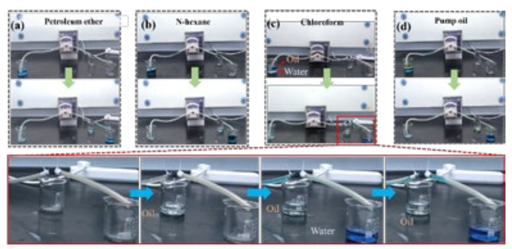


Figure 3. Oil-water separation process of superhydrophobic- superoleophilic SSM: Dynamic separation processes for petroleum ether-water, n-hexane-water, n-hexadecane-water, and pump oil-water systems.

PROJECT-IN-CHARGE

Professor Ren Kangning
Associate Head and Professor
Department of Chemistry

The Challenge

The main challenges facing new functional materials with special wettability include achieving scalability and large-scale application, ensuring environmental adaptability and long-term stability in practical use, attaining high separation flux, integrating multifunctional and intelligent features, and validating their applicability in complex oil-water systems.

Our Breakthrough Technology

- Select two-dimensional substrate materials with high mechanical strength, corrosion resistance, and ease of processing
- Prevent the detachment or deactivation of functional groups through chemical bonding or covalent modification
- Enhance the superhydrophobic-superoleophilic properties of material surfaces to promote rapid oil-water separation and flow, thereby reducing interfacial resistance
- Integrate antibacterial, anti-corrosion, and anti-fouling, and self-cleaning functions
- Construct simulated environments containing emulsified oil, high salinity, and high temperature to carry out dynamic separation tests

Industry Applications

- Marine oil spill recovery: Efficient oil-water separation to reduce environmental pollution
- Industrial wastewater treatment: Remove oils and organic pollutants to improve water quality
- Petrochemical industry: Oil-water separation and recovery to reduce energy consumption and costs
- Food processing: Fat separation to ensure product quality and safety
- Environmental protection: Wastewater purification and resource recycling

Environmental Impact

- Effectively reduce oil pollution in water bodies and soil, protecting the ecological environment
- Reduce reliance on traditional chemical agents and minimise the risk of secondary pollution
- Promote oil-water separation and resource recovery to advance the development of a circular economy
- Material design tends toward green and environmentally friendly approaches, reducing environmental burden and waste accumulation

Business Benefits

- Improve oil-water separation efficiency and reduce operating costs
- Extend equipment service life and reduce maintenance frequency
- Promote resource recovery and increase economic benefits
- Comply with environmental regulations and enhance the company's corporate social responsibility image
- Expand market share in marine oil spill and industrial wastewater treatment

INNOVATIVE "BAITING" STRATEGIES FOR RAPID DETECTION OF TOXIC DISINFECTION BYPRODUCTS IN WATER TREATMENT

Key Highlights

While disinfection ensures water safety, it can also lead to the formation of harmful byproducts. Our team has explored a novel 'baiting' technique designed to rapidly detect and identify toxic chemicals produced during water treatment. This approach enhances our understanding of water-related risks and strengthens public health protection.

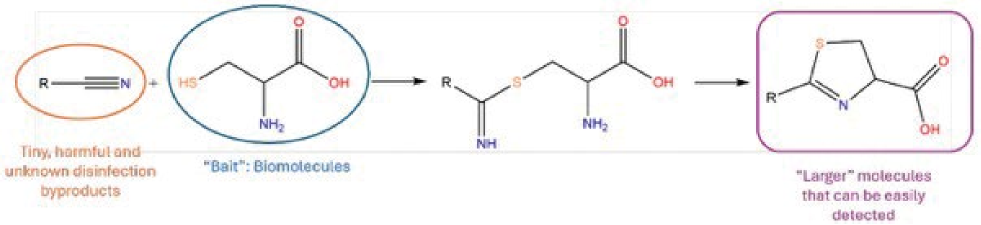


Figure 1. A schematic illustration of the "baiting" technique designed to detect harmful disinfection byproducts in water. This approach leverages nucleophilic biomolecule moieties to selectively capture toxic compounds, facilitating their identification and analysis using advanced instrumentation.

The Challenge

- Water treatment produces a vast array of unknown chemicals
- The toxicity of many of these byproducts remains uncertain
- Due to their complexity and variety, identifying and monitoring each harmful chemical individually is nearly impossible
- Ensuring long-term water safety remains a major challenge, as continuous monitoring of these potential health risks is difficult

Our Breakthrough Technology

- We use nucleophilic moieties of biomolecules as "bait" to capture harmful byproducts generated during water treatment
- This approach ensures that the detected chemicals are more likely to be toxic and relevant to health
- It also makes tiny, hard-to-detect molecules more "visible" and easier to analyse using advanced tools like high-resolution mass spectrometry

Industry Applications

- Our detection methods can be applied globally to monitor harmful disinfection byproducts in drinking water
- These chemicals can be added to watch lists for improved tracking and regulation
- This approach supports international efforts to strengthen water safety regulations
- It also holds potential as a biomimetic reduction technique for controlling and mitigating disinfection byproducts (DBPs)

Environmental Impact

- This technology has helped identify toxic chemicals, such as 2-butene-1, 4-dial, in treated water
- These discoveries contribute to the development of a global monitoring system for disinfection byproducts
- Future research can investigate the frequency of these chemicals, their toxicity in lab animals, and potential human exposure
- Understanding these factors will provide insight into the long-term effects of drinking water contaminants

Business Benefits

- Our technology could pave the way for water safety test kits, enabling quick and reliable detection of harmful byproducts
- These practical tools help businesses ensure safe, clean water
- This innovation creates new opportunities in environmental monitoring and public health sectors

PROJECT-IN-CHARGE

Professor Kelvin Leung
Head and Professor
Department of Chemistry

MODEL TO PREDICT FREQUENCY OF HEAT WAVE AND AIR POLLUTION CO-OCCURRENCE IN CHINA

Key Highlights

Exposure to co-occurrence of air pollution and heat extremes is likely to induce amplified damages to both human health and ecosystem. This study identifies the relationship between co-occurrence of heat wave and O_3 pollution in China and large-scale climate patterns, which offers preseasonal hints.

The Challenge

Understanding the climate drivers behind regional co-occurrence of heat and O_3 extremes remains limited. Purely statistical models lack physical interpretability and robustness, while coupled chemistry–climate simulations demand heavy computational resources.

Our Breakthrough Technology

- We found that springtime warming in the western Pacific Ocean, western Indian Ocean, and Ross Sea primarily regulates the yearly variability of summertime heat wave and O_3 pollution co-occurrence in China
- These findings were validated through coupled chemistry–climate simulations. Based on this, we developed a multivariable regression model that can predict co-occurrence events one season in advance

Industry Applications

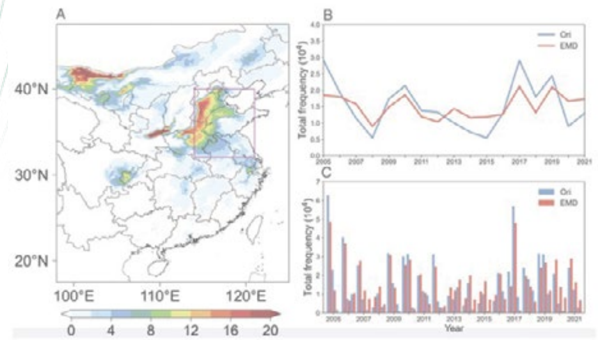
- The model enhances forecasting capabilities for environmental protection agencies, aiding government and public preparedness for simultaneous heat and pollution events
- It supports better resource allocation, strategic planning, and public health responses

Environmental Impact

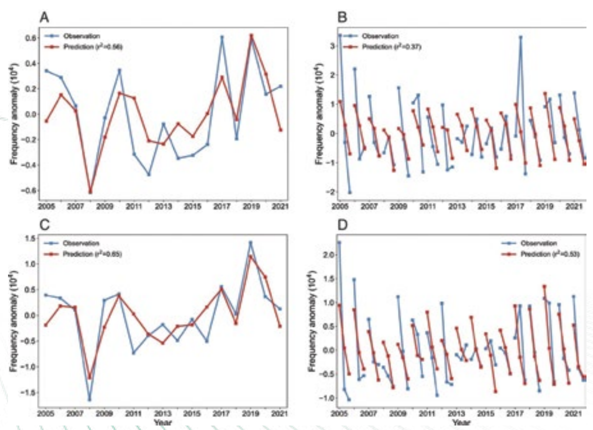
By forecasting co-occurring heat waves and pollution, the model helps governments implement timely emission reduction policies and manage combined environmental and health risks more effectively.

Business Benefits

Unlike resource-intensive simulations, the statistical model offers a cost-effective, low-computation method for seasonal forecasting, enabling efficient and scalable operational use.

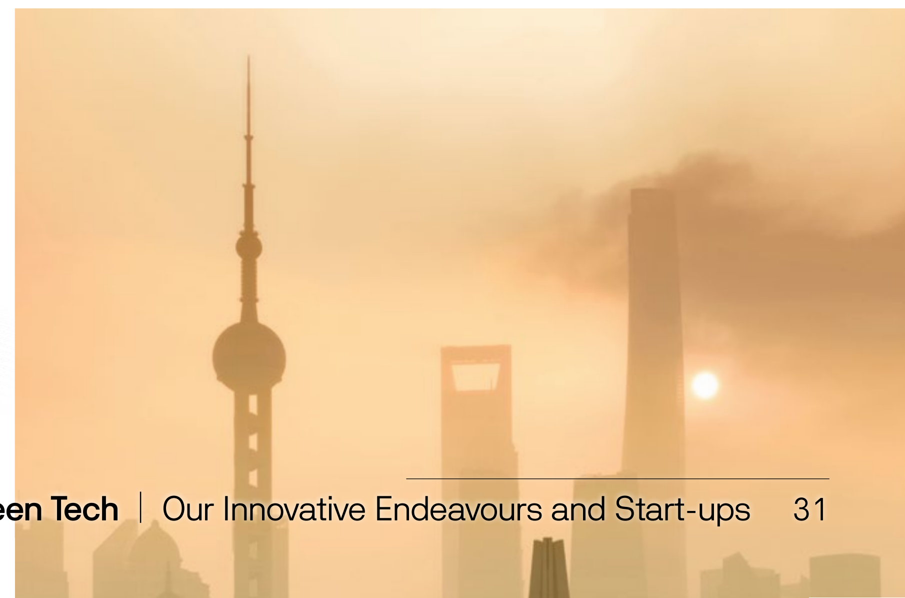


Spatial distribution and temporal variation of HWOP frequency. (A) Spatial distribution of mean HWOP frequency in summer (days/year) over 2005 to 2021 in Central and Eastern China. (B) Interannual variation of original (blue line) and detrended (red line) HWOP frequencies (# per month) in Central and Eastern China. (C) Intermonthly variation of original (blue bars) and detrended (red bars) HWOP frequencies (# per month) in Central and Eastern China. Pink rectangle denotes areas of the NCP, while the area inside the domain represents Central and Eastern China.

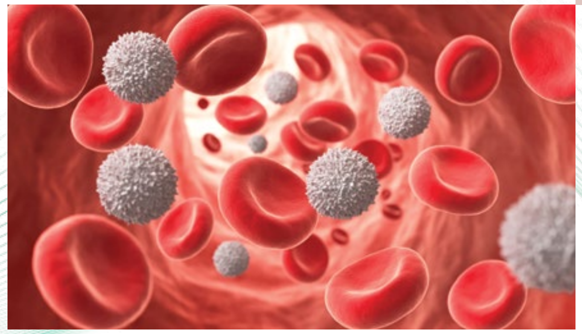


PROJECT-IN-CHARGE

Professor Gao Meng
Professor
Department of Geography



PFOS EXPOSURE HARMS MATERNAL-FETAL METABOLISM AND FETAL BLOOD CELL DEVELOPMENT



Key Highlights

This study reveals how PFOS exposure during pregnancy disrupts maternal-fetal metabolism and fetal hematopoiesis, impacting immune function. Utilising advanced multi-omics and functional assays, it highlights the health risks from environmental pollutants. The findings have significant implications for industry, environmental protection, and sustainable practices, stressing the need for innovative solutions to reduce pollution and safeguard future generations.

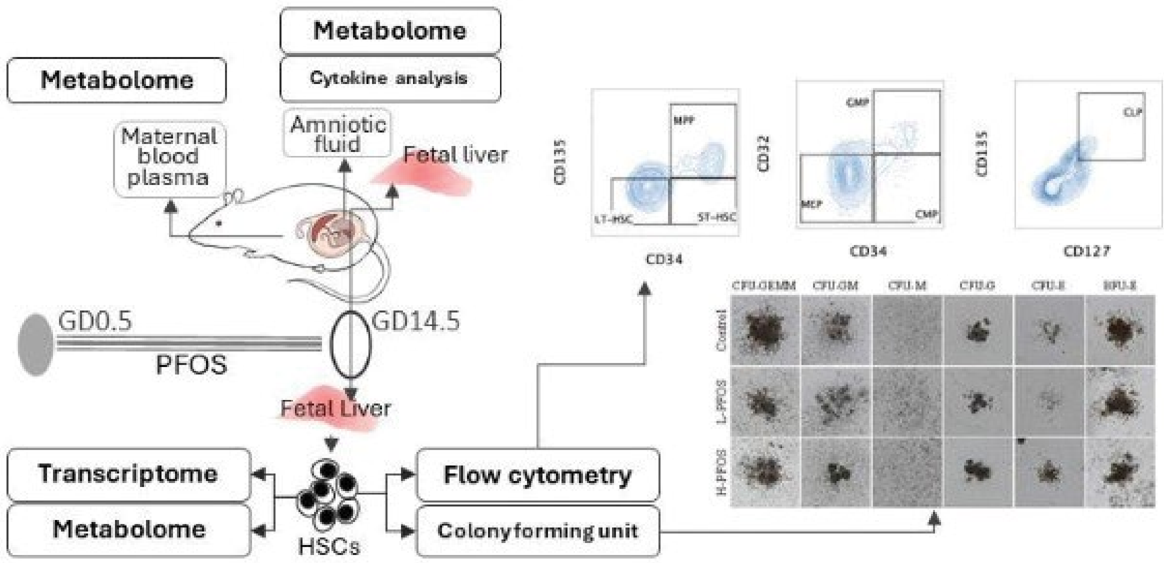
The Challenge

- The main challenge lies in understanding the intricate mechanisms in animals and applying these observations to the general public
- The skewed activation of blood stem cell development raises concerns about long-term immune function, which is vital for addressing the broader implications of environmental pollutants on human health

Our Breakthrough Technology

This study advances the use of a combined multi-omics approach to examine how environmental pollution affects health, providing critical insights into its impact on blood-forming systems in developing fetuses. Understanding these effects enables us to promote sustainable health for future generations.

Access publication



Industry Applications

- Environmental monitoring: Enhanced technologies detect pollutants in water, soil, and air, improving regulatory compliance and public health protection
- Chemical manufacturing: Develop safer, less toxic alternatives to PFOS and other perfluorinated compounds, thereby reducing environmental and health risks
- Pharmaceuticals: Insights into immune development and disruption could inform therapies for disorders linked to pollutant exposure
- Biotechnology: Develop biomarkers or diagnostic tools to detect early PFOS exposure in fetuses or newborns for timely intervention

Environmental Impact

- Fetal development risks: PFOS disrupts maternal-fetal metabolism and hematopoiesis, potentially harming offspring's immune system development. This underscores the necessity for stricter pollution controls to safeguard ecosystems and human populations
- Broader implications: Reducing PFOS and similar pollutants can lessen long-term health risks for future generations by preserving developmental processes, such as hematopoiesis
- Call to action: The findings underscore the need to reduce industrial emissions and improve waste management to limit the spread of chemicals, thereby protecting biodiversity and human health

Business Benefits

- Green technology development: Companies can innovate filtration systems to remove PFOS, addressing contamination at the source
- Bioremediation technologies can degrade PFOS in polluted environments, providing sustainable cleanup solutions
- Sustainability initiatives: Businesses can minimise PFOS release by using alternative chemicals, enhancing corporate social responsibility and appealing to eco-conscious consumers
- Health and economic gains: Reducing pollutant-related health issues improves public health, lowers healthcare costs, and boosts workforce productivity, supporting sustainability goals for long-term human and environmental well-being
- Market opportunities: Green tech firms can market these solutions as proactive against pollution while capitalising on the growing demand for sustainable products

PROJECT-IN-CHARGE

Professor Chris Wong
Associate Dean(Transdisciplinary Development) and
Chair Professor
Department of Biology

NOVEL UV COMPOUND BY JELUMIERE BIOTECH LIMITED

- Safer sunscreen
- Stronger protection
- Sustainable future

Key Highlights

- Our patented UV compound provides high SPF protection that is safer for the skin and more sustainable for the environment
- By chemically binding UV filters to larger particles, it reduces skin absorption and minimises marine impact, offering a cleaner, eco-friendly alternative to conventional chemical sunscreens

The Challenge

- Traditional sunscreens rely on chemical UV filters that penetrate the skin and accumulate in marine ecosystems. These filters are often persistent, non-biodegradable, and linked to coral bleaching and hormonal disruptions
- Consumers and regulators increasingly demand sun care products that are both effective and environmentally responsible

Our Breakthrough Technology

- Patented compound binds UV filters to larger particles, reducing skin absorption and systemic exposure
- Enhances SPF performance while lowering the amount of UV filter needed.
- More biodegradable, breaking down into harmless substances in marine environments, providing a clean-label, safer, and sustainable sun care solution

Industry Applications

- Suitable for sunscreens and daily sun care, especially for sensitive skin
- Ideal for pre- and post-sun repair products
- Appeals to skincare brands focused on green, next-generation UV protection
- Offers licensing opportunities for cosmetic manufacturers developing safe, high-SPF formulations

Environmental Impact

- Reduces accumulation of chemical UV filters in marine ecosystems
- Designed to biodegrade into less harmful substances via environmental microorganisms
- Supports reef- and ocean-friendly formulations with a significantly reduced ecological footprint

Business Benefits

- Delivers strong market differentiation as a science-backed, clean sun care innovation
- Meets rising consumer demand for reef-safe and skin-safe products. Patent protection enables licensing and B2B partnerships
- Scalable for global production and supports direct-to-consumer eco-conscious product sales

FOUNDER

Professor Chiu Man Ying
Associate Professor
Department of Biology

FROM WASTE TO VALUE: HYDROPHOBIC COMPOSITE MATERIALS VIA PVA-MODIFIED INCINERATION OF TEXTILES

Key Highlights

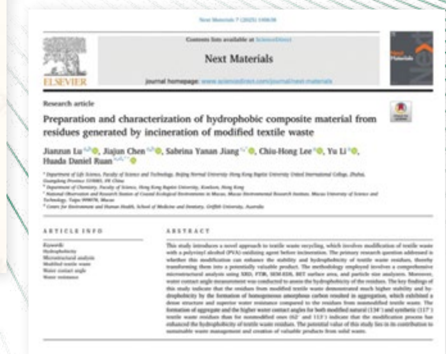
- Incineration of textile waste usually produces unstable hydrophilic residues that are unsuitable for reuse
- Oxidising blended textile wastes with polyvinyl alcohol (PVA) prior to incineration leads to the formation of homogeneous amorphous carbon residues during incineration
- Resulting residues exhibit enhanced stability and hydrophobicity (high water angle) indicating superior water resistance as compared to non-modified residues
- This method transforms blended textile waste into valuable hydrophobic composite materials, offering a sustainable solution for reusing textile waste, aligning with circular economy policy

The Challenge

- Textile waste often comprises of a mixture of natural and synthetic fibers (e.g. cotton-polyester)
- As compounds of different chemical properties have different separation requirements, the recycling processes are technically challenging
- Therefore, diverse composition of textile waste hinders effective recycling and often results in forming lower quality products

Our Breakthrough Technology

PVA-based pre-incineration modification transforms blended textile waste into homogeneous hydrophobic water resisting composite materials during incineration



Industry Applications

- The hydrophobic (water resistant) nature of the composite material can be utilised for applications in construction such as concrete stabiliser
- Incorporating this hydrophobic composite material can enhance durability and resistance to moisture
- Using this hydrophobic composite material as coating can prevent corrosion

Environmental Impact

- **Reduction in landfill waste**: Transforming textile waste into hydrophobic composites diverts significant amounts of waste from landfills, mitigating soil and groundwater contamination risks
- **Lowering carbon emissions**: Utilising waste-derived materials for producing other products can decrease carbon emissions, contributing to climate change mitigation

PROJECT-IN-CHARGE

Dr Donald Chiu-Hong Lee
Associate Professor
Faculty of Science and Technology-
Environmental Science
Beijing Normal-Hong Kong Baptist University

HIGH-PERFORMANCE LOW-COST SPEEK COMPOSITE PROTON EXCHANGE MEMBRANES FOR FUEL CELLS

Key Highlights

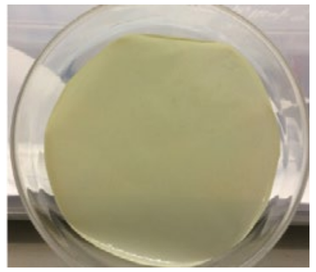
Developed a low-cost, high-performance proton exchange membrane (PEM) using sulfonated polyether ether ketone (SPEEK) and fluorinated graphite. Achieves 3x higher durability and 50% lower cost than commercial Nafion membranes, enabling efficient proton conduction while reducing environmental impact.

The Challenge

- Nafion membranes dominate PEM fuel cells but face high costs (~¥8,000/m^2) and performance drops at low humidity/high temperatures(>80°C)
- Traditional SPEEK membranes suffer from excessive water uptake, leading to swelling and reduced mechanical stability
- Balancing proton conductivity, durability, and cost remains a critical barrier for hydrogen fuel cell commercialisation

Our Breakthrough Technology

- **SPEEK matrix with fluorinated fillers**: Incorporate F-CNTs/CF to create continuous proton pathways and improve mechanical stability
- **Fluorinated graphite integration**: Enhances hydrophobicity, reducing water uptake by **30%** and swelling by **25%** while maintaining proton conductivity
- **Green fabrication**: Solvent-free process minimises environmental footprint
- **AI-optimised crosslinking**: Achieves **0.35 S/cm proton conductivity** at 80°C, outperforming Nafion 117
- **Cost reduction**: 90% lower material costs compared to Nafion, enabling scalable fuel cell adoption
- **Performance boost**: Higher proton conductivity and thermal stability (300°C degradation onset) for longer fuel cell lifespan



Industry Applications

- Transportation: Fuel cells for electric vehicles (EVs) and heavy-duty trucks
- Aviation/marine: Lightweight, high-temperature-resistant membranes for hydrogen-powered drones and zero-emission ships
- Portable power: Compact energy systems for drones and remote devices
- Stationary energy storage: Backup power for telecom towers and data centers

Environmental Impact

- **Reduced fluorine use:** Non-perfluorinated design minimises environmental harm from fluorocarbon production
- **Sustainable materials:** Utilises biomass-derived fillers (e.g. fluorinated graphite) and recyclable SPEEK
- **Lower carbon footprint:** Locally produced, energy-efficient synthesis reduces reliance on imported materials

PROJECT-IN-CHARGE

Dr Ge Mingming
Assistant Professor
Faculty of Science and Technology-Environmental Science
Beijing Normal-Hong Kong Baptist University

NANO-HERO X TECHNOLOGY LIMITED

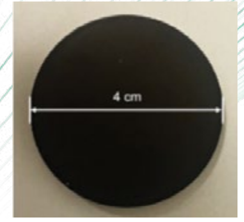
Revolutionising Water Purification with Nano-Electrocatalytic Membrane Reactors

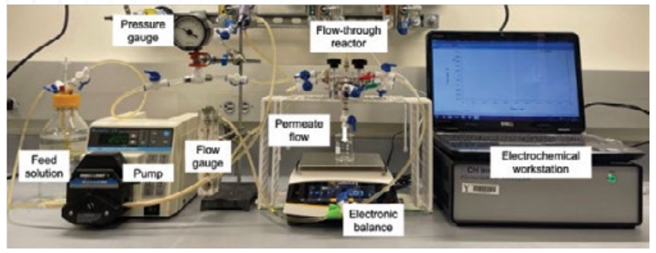
Key Highlights

The key technology is to develop novel electrocatalytic membrane reactor using nano-electrocatalytic membranes as electrodes for efficiently degrading and removing emerging contaminants (ECs) from wastewater, including industrial wastewater, drinking water and etc.

The Challenge

- **Low concentration & persistence**: ECs (e.g. pharmaceuticals, PFAS, microplastics) exist at trace levels (ppb-ppt) and resist standard treatment
- **Insufficient removal**: Existing technologies often lack efficiency, selectivity, or cost-effectiveness for broad-spectrum EC degradation
- **Regulatory non-compliance**: Current methods fail to meet stringent environmental discharge standards and drinking water guidelines





Our Breakthrough Technology

- **Nano-engineered electrodes**: Proprietary membranes function as active electrodes and selective barriers, maximising contaminant contact and reaction efficiency
- **Enhanced electrocatalysis**: Unique nanostructured catalyst coatings generate reactive oxygen species (ROS) at membrane interface for rapid, non-selective degradation
- **Integrated reactor design**: Combines electrochemical oxidation, separation, and advanced oxidation processes (AOPs) in a single, energy-efficient unit
- **Targeted destruction**: Mineralises ECs into harmless byproducts (CO_2, H_2O, ions), not just phase transfer or concentration

Industry Applications

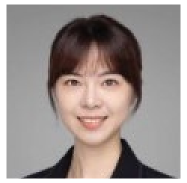
- **Chemical & pharmaceutical manufacturing**: Treat complex process wastewater containing active pharmaceutical ingredients (APIs), solvents, and intermediates
- **Municipal wastewater treatment plants**: Remove ECs from sewage effluent before discharge or reuse
- **Drinking water utilities**: Ensures potable water safety against micropollutants
- **Landfill leachate treatment**: Address highly recalcitrant contaminant mixtures
- **Electronics/semiconductor manufacturing**: Treat ultrapure water rinse water containing trace organics and chelating agents
- **Textile & dye industries**: Remove persistent dyes and auxiliaries

Environmental Impact

- **Protects aquatic ecosystems by preventing EC discharge**
- **Safeguards drinking water sources**
- **Promotes complete mineralisation, minimising toxic byproducts**
- **Reduces chemical** additives (e.g. oxidants, coagulants)

Business Benefits

- **Achieve and maintain regulatory compliance** avoiding fines
- **Reduce operating costs through** lower energy consumption and minimie chemical usage; reduced sludge disposal costs
- **Enable water reuse and support future regulatory needs**
- **Compact**, modular design allows for easy integration and save space



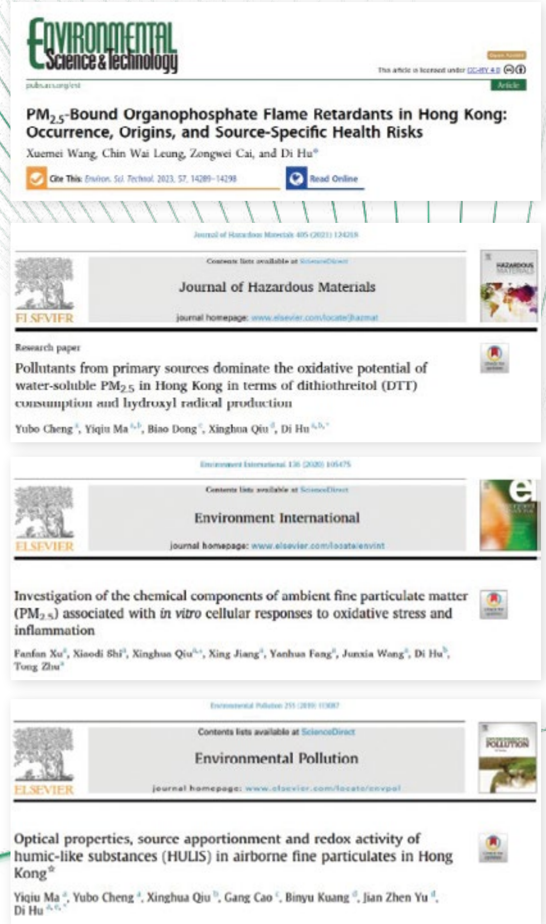
FOUNDER

Dr Zhao Yingcan
Assistant Professor
Faculty of Science and Technology-Environmental Science
Beijing Normal-Hong Kong Baptist University

TOWARDS CLEANER AIR AND HEALTHIER LIVES: A MULTIDISCIPLINARY INVESTIGATION OF $PM_{2.5}$ SOURCES, COMPOSITION, AND HEALTH IMPACTS

Key Highlights

This research employs state-of-the-art facilities and techniques to dissect $PM_{2.5}$'s complex nature, from its diverse sources to its health implications. By integrating atmospheric chemistry and public health, it uncovers how different components like trace metals, flame retardants, and emerging organic pollutants affect human health, paving the way for targeted pollution control and health protection strategies.


Environmental Science & Technology

$PM_{2.5}$-Bound Organophosphate Flame Retardants in Hong Kong: Occurrence, Origins, and Source-Specific Health Risks

Xuemei Wang, Chin Wai Leung, Zongwei Cai, and Di Hu

Journal of Hazardous Materials

Pollutants from primary sources dominate the oxidative potential of water-soluble $PM_{2.5}$ in Hong Kong in terms of dithiothreitol (DTT) consumption and hydroxyl radical production

Yubo Cheng, Yiqiu Ma, Biao Dong, Xinghua Qiu, Di Hu

Environment International

Investigation of the chemical components of ambient fine particulate matter ($PM_{2.5}$) associated with in vitro cellular responses to oxidative stress and inflammation

Fanfan Xu, Xiaodi Shi, Xinghua Qiu, Xing Jiang, Yanhua Fang, Junxia Wang, Di Hu, Tong Zhu

Environmental Pollution

Optical properties, source apportionment and redox activity of humic-like substances (HULIS) in airborne fine particulates in Hong Kong

Yiqiu Ma, Yubo Cheng, Xinghua Qiu, Gang Cao, Binyu Kuang, Jian Zhen Yu, Di Hu

PROJECT-IN-CHARGE

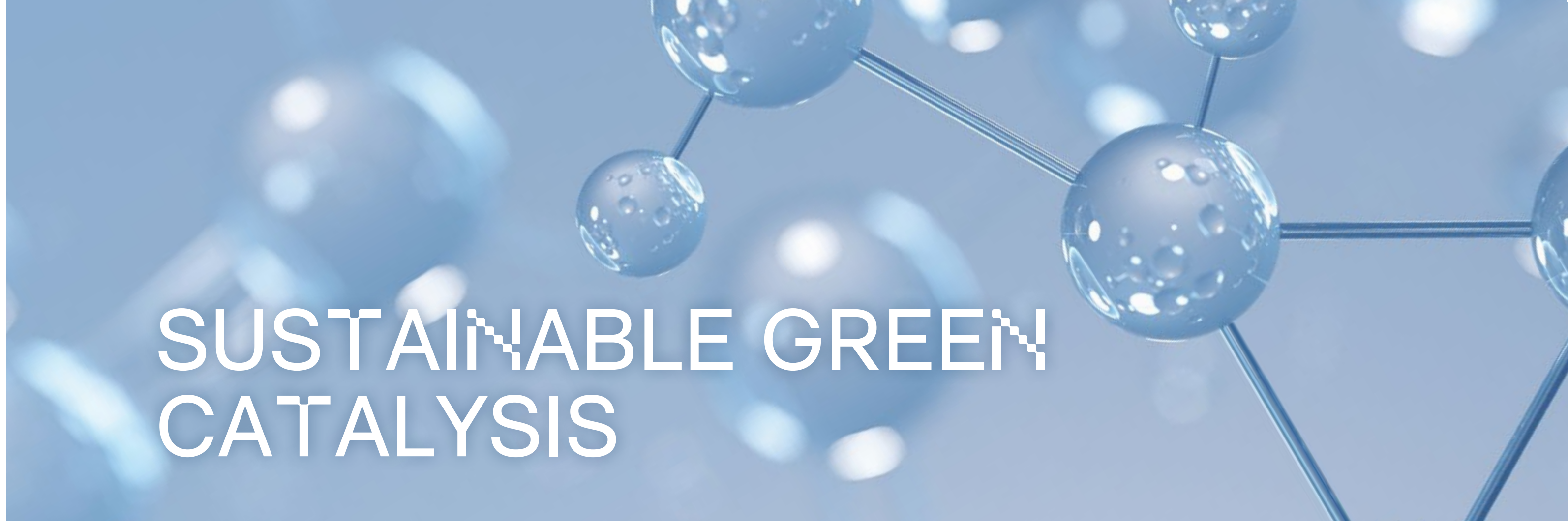
Professor Hu Di
Associate Professor
Department of Chemistry

The Challenge

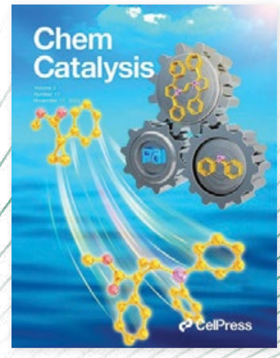
- Unravelling $PM_{2.5}$'s intricate composition to pinpoint toxic components
- Linking specific pollution sources to health issues for targeted action
- Elucidating how atmospheric processes alter $PM_{2.5}$'s toxicity
- Overcoming methodological hurdles in measuring and analysing $PM_{2.5}$ components

Environmental Impact

- Boosts Hong Kong's air quality by targeting major $PM_{2.5}$ sources
- Shields public health by spotting and controlling harmful $PM_{2.5}$ components
- Advances global knowledge of air pollution with new findings
- Sparks innovative tools for monitoring and cutting pollution
- Equips health policies with data to combat air pollution's adverse effects



SUSTAINABLE GREEN CATALYSIS



Key Highlights

Chiral organophosphorus compounds play a key role in sustainable green catalysis by enabling atom-efficient, enantioselective reactions under mild conditions. Their tunable steric and electronic properties enhance reaction efficiency under mild, eco-friendly conditions, reducing energy consumption and hazardous byproducts. These compounds also support greener pharmaceutical and agrochemical synthesis.

The Challenge

Reports about using photoredox/transition metal-catalysed coupling reaction to construct chiral organophosphorus are very limited. This is due to several challenges:

- Avoiding the self-coupling organophosphorus radicals.
- Developing workable redox catalytic cycle between photocatalyst and transition metal catalysts
- Constructing chiral centers (C- or P- centers) through chiral catalytic pocket

Our Breakthrough Technology

- This project aims to develop a more economical and sustainable method for synthesizing novel chiral organophosphorus compounds through easy obtained starting materials through utilising photocatalysis.
- By integrating visible light with transition metals, we provide a promising pathway for efficient synthesis, advancing modern chemistry while addressing environmental concerns and reducing energy consumption

Industry Applications

Chiral organophosphorus compounds show potential applications in medicinal chemistry and asymmetric catalysis.

- Following biological activity testing, these compounds are expected to exhibit diverse medicinal activities, including anticancer, antimicrobial, anti-inflammatory, antiviral bioactivities. The influence of enantiomeric differences on bioactivity will also be explored, aiding chiral drug discovery
- They are also anticipated to exhibitunique catalytic performance in asymmetric catalysis, facilitating the production of various chiral pharmaceutical intermediates

Environmental Impact

The use of photocatalysis for synthesising chiral organophosphorus compounds significantly reduces environmental impact.

- Harnessing visible light to lower energy consumption and greenhouse gas emissions compared to thermocatalysis
- Promoting green transformations from easily obtained non-toxic starting materials
- Reducing side products and chemical waste

Business Benefits

The visible light/transition metal co-catalysed method offers:

- Increased market competitiveness and attracting green investments
- Easier regulatory compliance
- Higher purity and yield of chiral compounds
- Expanded opportunities in pharmaceuticals and functional materials

PROJECT-IN-CHARGE

Professor Wang Jun
Professor
Department of Chemistry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Institute for Innovation and Translation
創新及轉化研究院

(852) 3411 8319
iit@hkbu.edu.hk
https://iit.hkbu.edu.hk/

IIT Website
@hkbuiit
浸大科创
@hkbuiit