

Research project and supervisory team

Supervisory Team	Dr. Mengxia Xu (UNNC) Prof. Tao Wu (UNNC) Prof. Xiaolei Fan (UNNC)
Short introduction & description of research project	<p>Title: Development of High-Performance Catalysts for Electrochemical CO₂ Reduction Reaction to Liquid Fuels</p> <p>Description: This PhD project focuses on the developing advanced catalysts for the electrochemical reduction of CO₂ (CO₂RR) into liquid fuels such as formic acid and ethanol. State-of-the-art <i>in situ</i> spectroscopic techniques (e.g., FTIR, XPS, XAFS) combined with density functional theory (DFT) calculations will be applied to unravel the reaction mechanisms and guide the rational design of next-generation electrocatalysts with improved selectivity, activity, and stability. By harnessing renewable electricity in the CO₂ reduction process, this study provides a sustainable solution for reducing CO₂ emissions while producing valuable chemical feedstocks. The research aligns with global efforts to advance CO₂ utilization technologies, and supports the transition to a circular carbon economy.</p>
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Supervisory Team	Qingxin Zhang , Bencan Tang , Cheng Heng Pang
Short introduction & description of research project	<p>This PhD focuses on a next-generation platform for sustained ocular drug delivery using therapeutic, drug-eluting contact lenses. The work brings together biomaterials, formulation, digital manufacturing, and modelling to create a translation-ready lens that delivers reliable, comfortable, long-acting therapy.</p> <p>We will design PDMS (silicone) micro-architectures—porous layers or micro-reservoirs—that localise drug in the lens periphery while preserving optical clarity, wearer comfort, and oxygen transmissibility (Dk/t). Hydrophilic surface treatments will be applied to improve wettability and reduce deposition without introducing haze or friction.</p> <p>Clinically relevant drugs will be carried by biodegradable PLGA nanoparticles whose size, polymer composition, and surface chemistry are tuned to minimise burst and enable multi-day, programmable dosing. Robust analytical methods will quantify drug loading, encapsulation efficiency, and stability.</p> <p>Dose will be placed precisely by inkjet or other digital patterning methods that protect a clear optic zone, and in-line, non-destructive quality control using NIR or Raman dose mapping together with OCT or white-light profilometry, and will verify dose uniformity, registration, and thickness budgets suitable for scale-up.</p> <p>A mechanistic model that couples Fickian diffusion in PDMS, PLGA erosion, and tear-flow convection will guide design and will be calibrated against simulated tear flow with blink shear. Cross-cutting themes include Quality-by-Design and sustainability, with process mass intensity, solvent recovery, energy use, and a simple life-cycle assessment informing greener choices throughout development.</p>
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Supervisory Team	Wai Siong Chai Dominic Foo
Short introduction & description of research project	<p>The transition to sustainable aviation fuel (SAF) is critical in addressing the global challenge of reducing greenhouse gas (GHG) emissions in the aviation sector, which accounts for approximately 2-3% of global CO₂ emissions. Biomass waste, an abundant and underutilized resource, offers immense potential as a feedstock for SAF production, aligning with the principles of renewable energy and circular economy. This research project focuses on developing an innovative process for the efficient conversion of biomass waste into SAF through microwave-assisted pyrolysis integrated with advanced catalytic techniques.</p>

	<p>Microwave-assisted pyrolysis (MAP) has emerged as a transformative technology due to its unique rapid and uniform heating capabilities, leading to higher energy efficiency, enhanced product quality, and reduced production costs compared to conventional pyrolysis methods. By tailoring catalytic materials such as metal oxides and zeolites for this process, the quality of bio-oil can be significantly improved, making it more suitable for SAF production. Despite promising advancements, critical knowledge gaps remain, particularly in understanding the kinetic mechanisms of microwave pyrolysis and optimizing catalytic materials to maximize hydrocarbon yields.</p> <p>This project will address these gaps by (1) screening the MAP parameters for maximum SAF-range vapour yield, (2) developing advanced catalysts to upgrade the vapour phase to SAF, and (3) conducting comprehensive techno-economic (TEA) and life cycle assessments (LCA) to evaluate the environmental and socio-economic impacts of the entire conversion process. The outcomes will not only advance the fundamental understanding of SAF production technologies but also provide actionable insights for scaling up this process for industrial applications.</p> <p>By bridging the gap between academic innovation and practical implementation, this project aims to contribute significantly to the aviation industry's goal of achieving net-zero carbon emissions by 2050, paving the way for a more sustainable future.</p>
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<p>Supervisory Team</p>	<p>Dr. Fathima Jerosha Ifthikar Ahmed (https://research.nottingham.edu.cn/en/persons/fathima-jerosha-ifthikar-ahmed) Dr. Binjie HU (https://research.nottingham.edu.cn/en/persons/binjie-hu) Dr. Ubong Jerome Etim</p>
<p>Short introduction & description of research project</p>	<p>This PhD project, titled "Valorisation of Slaughterhouse Waste through Pyrolysis and Water Treatment Integration," addresses the critical environmental challenge posed by the global meat industry's growing waste output. Current disposal methods like landfill and incineration are unsustainable, causing soil pollution, greenhouse gas emissions, and heavily polluted wastewater. This project proposes an innovative, circular economy solution that transforms this waste into valuable resources, moving beyond the linear "take-produce-dispose" model.</p> <p>The core innovation is an integrated system employing a 'Waste Control Through Waste' approach. It synergistically couples Anaerobic Digestion (AD) and Pyrolysis to process slaughterhouse byproducts. The AD unit converts organic waste into biogas for renewable energy, while the residual sludge is processed via pyrolysis into high-performance biochar. This specially engineered biochar is then utilized as a catalyst in Advanced Oxidation Processes (AOPs) to</p>

efficiently treat the complex slaughterhouse wastewater, enabling water reuse and effectively closing the waste loop.

The project's objectives are to: 1) synthesize and characterize cost-effective biochar from slaughterhouse sludge tailored for wastewater treatment; 2) assess the efficiency of this biochar in enhancing AOPs to degrade stubborn pollutants; and 3) optimize biogas production by integrating tailored plant waste additives into the AD process to boost yield and stability.

Key innovations include the precise engineering of a waste-derived biochar catalyst, a mechanistic approach to co-digestion for enhanced biogas production, and the novel, modular integration of these processes into a single, scalable system. The system outperforms conventional methods by **achieving 85% COD removal, 90% pathogen reduction, and 30% lower operational costs, while enabling water reuse, renewable energy production and provide a compact, land-saving solution suitable for space-constrained industrial settings.** With pilot-scale validation, strong industrial adoption potential, and alignment with UN Sustainable Development Goals (SDGs 6, 7, and 12), this research aims to deliver a sustainable, economically viable blueprint for the meat industry's transition to a circular economy, simultaneously recovering resources, reducing environmental impact, and generating renewable energy.



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Short introduction & description of research project	<p>This project addresses a critical challenge in the fight against climate change: the corrosion of carbon steel pipelines used in Carbon Capture and Storage (CCS). While geologic sequestration of CO₂ is essential for achieving carbon neutrality, the process is severely hampered by the corrosive nature of supercritical CO₂, which damages the very infrastructure needed to transport it. Current corrosion inhibitors are often toxic, expensive, and synthetically complex. This project proposes a groundbreaking, sustainable solution by developing a novel class of eco-friendly corrosion inhibitors derived from the CO₂ itself. The research will be highly interdisciplinary, spanning catalysis, organic synthesis, and materials science. The first phase involves catalytically converting waste CO₂ into formate salts using advanced homogeneous or heterogeneous catalysts. Subsequently, synthetic routes would be developed to transform the formate into nitrogen-rich, N-formylated compounds (e.g., N-formylamines, amides), which are prime candidates for effective corrosion inhibition. Finally, the performance of these novel compounds will be rigorously evaluated under high-pressure, hydrodynamic conditions simulating real CCS environments using electrochemical techniques and surface analysis. This project offers a unique opportunity to make a significant scientific contribution by creating a circular economy for CO₂, turning a harmful waste product into a protective agent, and directly enabling the safe deployment of vital CCS technology.</p>
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Supervisory Team	<p>The supervisory team, led by Dr. Yong SUN (AI fusion, machine learning, multimodal data fusion, and CO₂ capture), supported by Prof Philip HALL (greenhouse systems, green waste management and utilization) and Prof. Jonathan D. Hirst (computational modeling and plant physiology), combines expertise in theoretical and applied research. Dr. Sun will guide AI fusion and DAC system development, Prof Hall Philip will oversee system integration and validation, and Prof. Hirst will support AI assisted molecular and physiological modeling, ensuring a well-rounded approach to the project's success.</p> <p>Dr Yong SUN: Yong Sun - University of Nottingham Ningbo China Prof Philip HALL: Philip Hall - University of Nottingham Ningbo China Prof Jonathan D Hirst: Staff Listing - The University of Nottingham</p>
Short introduction & description of research project	<p>This project aims to create a low-carbon, intelligent greenhouse system for high-value C3 plants (such as kale, watercress, and chrysanthemum) in Zhejiang Province. The system integrates smart direct air CO₂ capture and reuse through</p>

	<p>biological catalysis and innovative low-energy devices. Utilizing AI-driven, multi-factor regulation and precision cultivation, the project overcomes inefficiencies of traditional, manually operated greenhouses. Its core component is a smart DAC module optimized for Zhejiang's humid climate, which efficiently extracts CO₂ from air using advanced materials, maintains ideal photosynthetic CO₂ levels (500–1000 ppm), and provides condensed water for greenhouse use. The approach uses plant photosynthesis for CO₂ conversion and explores novel electrochemical solutions, significantly improving productivity, resource efficiency, and sustainability in greenhouse farming.</p>
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Supervisory Team	Prof. Philip Hall (UNNC) Dr. Zheng Wang (UNNC) Dr. Jason Li (UNNC)
Short introduction & description of research project	<p>Integrated Crystallization and Separation via Novel Equipment Design</p> <p>Crystallization is a critical purification process in industries such as pharmaceuticals, chemicals, and environmental engineering. However, traditional methods often face challenges related to temperature control, crystal purity, and the inefficiency of downstream separation steps. This project aims to address these issues by developing a novel crystallizer that integrates separation mechanisms directly into the crystallization process. By introducing innovative design features—such as centrifugal force generation—the goal is to pre-concentrate or separate crystals during crystallization, reducing reliance on downstream filtration and eliminating temperature-related challenges. The project will combine computational modeling and experimental validation to achieve its objectives. The candidate will use computational fluid dynamics (CFD) to simulate and optimize the crystallizer design, focusing on fluid dynamics, crystal behavior, and separation efficiency. A prototype will then be developed and tested in the laboratory to validate its performance under real-world conditions. Key outcomes include improved crystal quality, reduced energy consumption, and a more streamlined process workflow, contributing to sustainable and cost-effective manufacturing practices.</p> <p>We are seeking a motivated PhD candidate with a background in chemical engineering, mechanical engineering, or a related field. The ideal candidate will have experience or interest in CFD, experimental design, and process optimization. This project offers an exciting opportunity to pioneer innovative crystallization technology and make a tangible impact on industrial processes.</p>
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Supervisory Team	Kam Loon Fow (UNNC) Lionel O'Young (UNNC) Zeping Wang (UNNC)
Short introduction & description of research project	<p>Optimization of Green Polycondensation Process and Property Enhancement of PBT for High-Value Medical and Textile Applications</p> <p>Area of work Polybutylene terephthalate (PBT) is a high-performance engineering thermoplastic widely used in the industries due to its excellent mechanical, thermal, and chemical properties. It is foreseeable that there is a growing demand for PBT with enhanced properties to meet the needs of advanced applications, particularly in the medical and textile industries. PBT is typically fabricated from the polycondensation of oligomers of terephthalic acid (TPA) and 1,4-butane diol (BDO) and the polycondensation process conditions can be tuned to obtain PBT with the desired properties. However, the existing polycondensation process suffers from several major drawbacks, such as the use of non-removable homogeneous catalysts and non-sustainable petrochemical-based reactants. This project aims to develop a greener polycondensation process for making PBT and/or explore innovative methods to enhance the properties of PBT, making it suitable for high-value applications such as biocompatible medical devices and functionalized textiles.</p> <p>Research objectives This proposed research project will focus on several key themes as exemplified below:</p> <ol style="list-style-type: none"> 1. <i>Optimization of a greener polycondensation process</i> <ul style="list-style-type: none"> • Develop and evaluate the performance of heterogeneous catalysts in the polycondensation process. • Investigate the role of various design parameters in improving the efficiency and sustainability of the polycondensation process. • Develop a reaction model to predict and optimize the properties of PBT, such as polymer molecular weight distribution and thermal stability. 2. <i>Property enhancement for medical and textile applications</i> <ul style="list-style-type: none"> • Incorporate green additives (e.g., nanofillers, chain extenders, antimicrobial agents) to tailor properties of PBT for specific applications. • Evaluate the mechanical, thermal, and chemical properties of enhanced PBT. • Test the biocompatibility of PBT for medical applications and the durability of PBT fibers for textile applications. • Assess biodegradability and recyclability of modified PBT, supporting green chemical principles.
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Supervisory Team	Prof. Bencan Tang (UNNC) Prof. Jonathan D. Hirst (UNNC) Dr Kam Loon Fow (UNNC)
Short introduction & description of research project	<p>Project Title: Development of Automated Flow Chemistry Reaction Platform for the Production of 1,3-Propanediol</p> <p>Developing new reaction technology to realize challenging chemical reactions as such with automatic reaction control would increase the production efficiency of many important chemicals and is to be embraced by chemical industry.</p> <p>This research aims to establish a fully automated intelligent flow chemistry reaction platform for the optimization of reaction conditions and pilot production of important chemicals. The intelligent flow chemistry reaction platform will be based on flow chemistry and Bayesian optimization theory. It will enable the injection of raw materials via an HPLC pump, with parameters such as substrate type, concentration, solvent, and catalyst being controlled. By integrating Bayesian optimization algorithms, the platform will optimize the reaction conditions, leading to the identification of the optimal production conditions. This method will significantly reduce human, material, and time resources during the optimization process. Moreover, when scaling up to production, the flow chemistry equipment can be easily adapted for increased scale and capacity, while minimizing potential hazards and waste in the production process.</p> <p>The ideal candidate would be students with bachelor's and master's degrees from Chemistry and Chemical Engineering. The candidate should have strong interests in flow chemistry, programing and coding, and should have good problem-solving skills, including technical and theoretical problems. We only encourage hardworking and ambitious students to apply for this position.</p>
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Supervisory Team	Prof. Jun He (UNNC)
Short introduction & description of research project	<p>Available PhD research projects</p> <p>The above scholarship is to support research projects outlined under the following themes:</p> <p>Theme: Low-carbon energy</p> <p>Reductant-free low-temperature SCR process development</p> <p>Project brief:</p> <p>This project is to develop a novel reductant-free, low-temperature Selective Catalytic Reduction (SCR) technology using photothermal synergistic catalysis to address high-temperature, energy-intensive traditional SCR systems relying on ammonia or urea. The technology enables efficient NO_x reduction at lower temperature without external reducing agents, enhancing energy efficiency and environmental friendliness. Key innovations should include catalysts designed for enhanced NO adsorption and reactive radical generation, as well as composites that facilitate efficient electron-hole separation. This technology offers a sustainable solution for industrial NO_x control in coal-fired power plants and steel manufacturing, aligning with stringent environmental regulations. The work is expected to advance photothermal catalysis theory, catalyst design, and practical applications, promising reduced energy consumption, lower costs, and mitigated secondary pollution.</p>
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