UNNC-NIMTE, CAS Doctoral Training Partnership

It's essential that you have contacted the UNNC and/or NIMTE supervisors and agreed on a suitable collaborative PhD topic before submitting an application.

Formal applications should follow the instructions in 'How to apply' section.

Research areas

- New Material Science
- Advanced Manufacturing
- Electrical Machines and Drives
- Composite Materials
- Computer Science

Available PhD topics

PhD topic	Development of electrocatalyst for CO_2 conversion to value-added chemicals at elevated temperatures
NIMTE Supervisor	Prof. Wei Wu
UNNC Supervisor(s)	Prof. Mengxia Xu
Short introduction & description of the PhD project	This project aims to develop a carbon-negative electrochemical process for the direct conversion of CO_2 into olefins, such as ethylene, at intermediate temperatures (350–500 °C). The technology offers a decarbonization pathway for large-volume chemical products, including plastics and sustainable aviation fuels (SAF). The approach will use a protonic ceramic membrane reactor (PCMR) that integrates CO_2 reduction to olefins at the cathode with concurrent steam splitting at the anode. The project will comprise two main tasks: (1) the development—through synthesis, evaluation, and screening—of a highly active and selective catalyst for CO_2-to-olefin conversion; and (2) the fabrication and testing of a PCMR integrated with the catalyst.
Contact points	Informal inquiries may be addressed to Prof. Mengxia Xu (mengxia.xu@nottingham.edu.cn) and Prof. Wei Wu (wei.wu@nimte.ac.cn).

PhD topic	**Semiconductor-based composite SERS substrate–Microfluidic chip integrated platform for high-sensitivity, low-cost, and nondestructive detection of pathological biomarkers**
NIMTE Supervisor	Prof. Jie LIN
UNNC Supervisor(s)	Prof. Yong REN
Short introduction & description of the PhD project	In the early diagnosis and therapeutic monitoring of cancers, neurodegenerative disorders, and infections, pathological biomarkers are often characterized by low abundance, pronounced matrix interference, and substantial interindividual variability. These features impose practical constraints on conventional immunoassays or chromatographic methods in terms of required sample volume, preprocessing complexity, detection timeliness, and field deployment. Accordingly, there is a growing need for rapid detection technologies that combine high sensitivity, strong interference tolerance, and chip level integrability, which is central to the advancement of precision diagnostics and point-of-care testing (POCT). Surface-enhanced Raman spectroscopy (SERS) possesses fingerprinting capabilities and high-sensitivity detection properties, offering broad prospects for the efficient identification of pathological biomarkers. Traditionally, SERS has relied on noble metal nanostructures, such as Au and Ag, to deliver strong electromagnetic enhancement. When incident light excites localized surface plasmon resonance (LSPR) on the metal surface, intense electromagnetic hot spots are generated on nanoparticle surfaces and, in particular, within interparticle nanogaps, leading to substantial amplification of Raman signals from nearby molecules. By tailoring nanostructure morphology and assembly architectures, hot spots intensity and density can be engineered, thereby optimizing overall signal performance. Beyond electromagnetic amplification, chemical enhancement can arise from charge transfer (CT) between the adsorbed molecule and the substrate, which modifies Raman polarizability and selectively enhances certain vibrational modes. Semiconductor materials such as TiO_2, ZnO, and MoS_2 possess suitable band gaps and energy level structures that can support resonance-assisted charge transfer with adsorbed species, thereby increasing the scattering intensity of specific Raman bands. Although semiconductor-based substrates typically provide weaker enhancement than noble metal substrates, they often offer advantages in peak stability and signal reproducibility. In biomarker analysis, analytical specificity often depends not only on the recognition element itself, but more critically on whether sample pretreatment can effectively isolate the target from abundant interferents in complex matrices. In liquid biopsy samples such as peripheral blood or cerebrospinal fluid, the key advantages are minimal invasiveness and repeatable, longitudinal monitoring. However, the informative analytes are typically present at extremely low abundance and are embedded in strong background signals, which makes direct assays prone to limited signal-to-noise ratios and compromised specificity. Microfluidics is therefore well suited as a front-end, on-chip module for sample processing and enrichment. Within microscale channels, it can execute separation, enrichment, washing, and directed transport, delivering target components to downstream readout with higher purity and a more controllable spatial distribution. Microfluidic sorting strategies can be broadly categorized into active and passive approaches. Active sorting applies external fields, such as electric, magnetic, acoustic, or optical forces, to impart additional manipulation. While offering high sorting precision, it often requires more complex integration, such as embedded electrodes, and may affect cell viability. Passive sorting, by contrast, relies on device geometry and hydrodynamic effects for separation, including microfiltration, deterministic lateral displacement (DLD), and inertial microfluidics. These methods generally provide simpler

	system architectures, easier integration, and clearer pathways toward scalable manufacturing. This project aims to develop an integrated detection platform that combines semiconductor based composite SERS substrate with microfluidic chip, enabling high sensitivity, low sample volume, and reproducible analysis of pathological biomarkers in complex biological specimens. Through interfacial engineering, electromagnetic and chemical enhancement can be synergistically coupled to further improve SERS performance. For example, controlling the crystallographic facet orientation and defect states of semiconductors can modulate the separation and transport efficiency of photoinduced charge carriers, thereby strengthening chemical sensitization. Alternatively, constructing metal–semiconductor heterojunctions, such as p–n junctions or Schottky junctions, can generate a built-in electric field at the interface that promotes electron and hole separation, which likewise benefits the efficiency of Raman enhancement modulation. In parallel, a passive microfluidic strategy will be employed, leveraging capillary forces and structured channels to realize self driven sample transport, target enrichment, and a homogenized reaction environment. Hydrophilic channel architectures enable automatic sample uptake and distribution, meeting detection requirements with only microliter-scale volumes and thereby substantially reducing consumption of biological specimens. Within microscale channels, the high surface-area-to-volume ratio and short diffusion lengths support rapid and efficient reactions. In addition, structural guidance, narrow constriction regions, or functionalized packing materials can be used to enrich target molecules and achieve localized preconcentration. This approach supports predictable hot spots distributions and reduced background interference without external pumps or complicated operation. The integrated platform is applicable to early screening and therapeutic monitoring across multiple major diseases and can be deployed in diverse clinical settings. For neurodegenerative disorders, it can target biomarkers associated with Alzheimer's disease, such as amyloid beta (Aβ) and tau in cerebrospinal fluid or peripheral biofluids, and leverage the fingerprint information from SERS together with interfacial CT sensitization on composite substrates to achieve highly specific identification under complex backgrounds. In oncology, circulating tumor cells (CTCs) and their associated molecular phenotypes in peripheral blood can serve as primary targets, combining microfluidic separation and enrichment with single-cell or multicomponent spectral readout by SERS for early detection, assessment of recurrence and metastasis risk, and longitudinal tracking of treatment response. When applied to infectious disease surveillance, the platform can target pathogen nucleic acids, proteins, or characteristic metabolites, using microfluidics for rapid pretreatment and enrichment and SERS for rapid discrimination, with potential for multiplexed detection. Beyond these domains, cardiovascular and inflammation-related applications can be supported through rapid testing of indicators such as C-reactive protein (CRP) and cardiac troponins.
Contact points	Informal inquiries may be addressed to Prof Yong REN (Yong.ren@nottingham.edu.cn) and Prof Jie LIN (linjie@nimte.ac.cn)
PhD topic	**Materials and devices, performance optimization, and optoelectronic mechanism research of perovskite solar cells**
NIMTE Supervisor	Prof. Ziyi GE
UNNC Supervisor(s)	Prof. Tao WU

Short introduction & description of the PhD project	Flexible perovskite solar cells (f-PSCs) have become an important technology for promoting China's green and low-carbon goals due to their lightweight, simple preparation process, low production cost, and excellent flexibility. However, its industrialization is still limited by the bottleneck of materials and preparation. This project will focus on developing electrode materials with high conductivity and excellent flexibility, as well as hole transport layer materials that match them. We will conduct in-depth research on the film formation mechanism of large-area flexible perovskite films, explore perovskite crystallization control strategies, design high-performance self-healing materials, enhance the mechanical durability of flexible perovskite films, optimize module processes, and promote the development of high-performance flexible photovoltaic module integration technology.
Contact points	Informal inquiries may be addressed to Prof. Ziyi GE (geziyi@nimte.ac.cn) and Prof. Ruixiang PENG (pengrx@nimte.ac.cn).
PhD topic	**Co-Design and Digital-Twin Enabled Development of Multifunctional Meta-Structures for Integrated Electrified Vehicle Platforms**
NIMTE Supervisor	Prof. Jinhong YU
UNNC Supervisor(s)	Dr. Amin Farrokh Abadi
Short introduction & description of the PhD project	The rapid electrification of the automotive industry is critically dependent on advancing battery pack technology, where key challenges in thermal management, crash safety, and vibrational durability persist. Current designs often rely on separate, add-on subsystems to address each issue, leading to excessive weight, complexity, and inefficient use of space. This PhD project proposes a paradigm shift by investigating the integrated design, manufacturing, and characterization of novel **multifunctional cellular composite structures**. The core innovation lies in leveraging high-thermal-conductivity composites engineered into optimized cellular architectures to create a single, lightweight load-bearing component that simultaneously acts as a thermal spreader, energy absorber, and vibration damper for battery modules. **Project Description** This interdisciplinary project sits at the confluence of materials science, composite mechanics, thermal engineering, and structural optimization. The primary goal is to develop a novel class of **"battery-in-structure"** solutions that enhance the performance, safety, and energy density of electric vehicle (EV) battery packs. The research will systematically address the following pillars: 1. **Multifunctional Material & Topology Design:** Utilizing multi-objective topology optimization and computational micromechanics to architect periodic cellular structures (e.g., lattices, honeycombs) made from continuous fiber-reinforced composites with tailored thermal conductivity. The optimization will simultaneously maximize effective thermal conductance, specific energy absorption, and structural damping. 2. **Advanced Manufacturing & Processing:** Exploring and down-selecting viable manufacturing routes, such as advanced additive manufacturing (3D printing) of composites or tailored moulding techniques, to accurately fabricate the designed complex geometries with high fidelity and material integrity. 3. **Experimental Characterization & Validation:** Establishing a rigorous testing protocol to evaluate the multifunctional performance. This will include

	thermal conductivity mapping, quasi-static and dynamic crush testing for energy absorption, and vibrational analysis under simulated road profiles. Advanced full-field measurement techniques like Digital Image Correlation (DIC) will be employed. 4. **Modeling & Simulation:** Developing and validating high-fidelity multiphysics Finite Element Models (FEM) to simulate the coupled thermal-mechanical response. The models will be calibrated against experimental data to create a predictive digital twin of the system. The successful outcome of this project will be a validated, prototype-level multifunctional composite structure alongside a robust design and modeling framework. This work aims to contribute fundamental knowledge to the field of multifunctional composites and provide a direct technological pathway towards lighter, safer, and more efficient EV battery systems, ultimately supporting the broader goals of sustainable transportation.
Contact points	Informal inquiries may be addressed to Dr. Amin Farrokhabadi (amin-farrokh.abadi@nottingham.edu.cn) and Prof. Jinhong YU (yujinhong@nimte.ac.cn).
PhD topic	**Co-Design and Digital-Twin Enabled Development of Multifunctional Meta-Structures for Integrated Electrified Vehicle Platforms**
NIMTE Supervisor	Prof. Wenge ZHENG
UNNC Supervisor(s)	Dr. Amin Farrokh Abadi
Short introduction & description of the PhD project	The rapid electrification of the automotive industry is critically dependent on advancing battery pack technology, where key challenges in thermal management, crash safety, and vibrational durability persist. Current designs often rely on separate, add-on subsystems to address each issue, leading to excessive weight, complexity, and inefficient use of space. This PhD project proposes a paradigm shift by investigating the integrated design, manufacturing, and characterization of novel **multifunctional cellular composite structures**. The core innovation lies in leveraging high-thermal-conductivity composites engineered into optimized cellular architectures to create a single, lightweight load-bearing component that simultaneously acts as a thermal spreader, energy absorber, and vibration damper for battery modules. **Project Description** This interdisciplinary project sits at the confluence of materials science, composite mechanics, thermal engineering, and structural optimization. The primary goal is to develop a novel class of **"battery-in-structure"** solutions that enhance the performance, safety, and energy density of electric vehicle (EV) battery packs. The research will systematically address the following pillars: 1. **Multifunctional Material & Topology Design:** Utilizing multi-objective topology optimization and computational micromechanics to architect periodic cellular structures (e.g., lattices, honeycombs) made from continuous fiber-reinforced composites with tailored thermal conductivity. The optimization will simultaneously maximize effective thermal conductance, specific energy absorption, and structural damping. 2. **Advanced Manufacturing & Processing:** Exploring and down-selecting viable manufacturing routes, such as advanced additive manufacturing (3D printing)

	of composites or tailored moulding techniques, to accurately fabricate the designed complex geometries with high fidelity and material integrity. 3. **Experimental Characterization & Validation:** Establishing a rigorous testing protocol to evaluate the multifunctional performance. This will include thermal conductivity mapping, quasi-static and dynamic crush testing for energy absorption, and vibrational analysis under simulated road profiles. Advanced full-field measurement techniques like Digital Image Correlation (DIC) will be employed. 4. **Modeling & Simulation:** Developing and validating high-fidelity multiphysics Finite Element Models (FEM) to simulate the coupled thermal-mechanical response. The models will be calibrated against experimental data to create a predictive digital twin of the system. The successful outcome of this project will be a validated, prototype-level multifunctional composite structure alongside a robust design and modeling framework. This work aims to contribute fundamental knowledge to the field of multifunctional composites and provide a direct technological pathway towards lighter, safer, and more efficient EV battery systems, ultimately supporting the broader goals of sustainable transportation.
Contact points	Informal inquiries may be addressed to Dr. Amin Farrokhabadi (amin-farrokh.abadi@nottingham.edu.cn) and Prof. Wenge ZHENG (wgzheng@nimte.ac.cn).
PhD topic	**Development of Smart, Biodegradable Bone Implants Using Engineered Cellular Metallic Structures**
NIMTE Supervisor	Prof. Lijing Yang
UNNC Supervisor(s)	Dr. Amin Farrokh Abadi
Short introduction & description of the PhD project	This research project addresses a critical challenge in orthopedic surgery: the need for bone implants that provide temporary mechanical support and then safely dissolve, eliminating the necessity for secondary removal surgery and mitigating issues like stress-shielding. Current permanent implants, while strong, can hinder long-term bone health and require additional interventions. The proposed solution is the development of a new generation of **smart, biodegradable implants** made from advanced metallic alloys. The core innovation lies in a **triple-integrated approach** that synergizes **material science**, **architectural design**, and **predictive intelligence**. Instead of a solid metal piece, the implant will feature an optimized **cellular or lattice structure**. This engineered architecture serves multiple purposes: it reduces the implant's overall stiffness to better match natural bone and prevent stress-shielding, creates interconnected pores for blood vessel ingrowth and new bone formation (osseointegration), and provides a high surface area to actively control the degradation rate of the metal. The project will employ a comprehensive **computational-experimental methodology**. It begins with computer-aided design and multi-physics simulation to model the implant's mechanical performance and degradation behavior in the physiological environment. Advanced manufacturing techniques, such as metal 3D printing, will be used to fabricate these complex porous structures with precision. The implants will then undergo rigorous laboratory testing, including mechanical strength assessment,

	degradation analysis in simulated body fluid, and biological evaluation with bone cells to ensure safety and effectiveness. The collected data will feed into a machine learning model to create a predictive digital twin, enabling the intelligent design of future patient-specific implants. The ultimate goal is to create a **dynamic, multifunctional implant** that seamlessly interacts with the body: it carries load initially, guides tissue regeneration, and gracefully dissolves at a rate synchronized with the natural bone healing process. This research aims to establish a new paradigm for intelligent orthopedic solutions, paving the way for personalized, more efficient, and patient-friendly treatments.
Contact points	Informal inquiries may be addressed to Dr. Amin Farrokhabadi (amin-farrokh.abadi@nottingham.edu.cn) and Prof. Lijing Yang (yanglj@nimte.ac.cn).
PhD topic	**Laser Additive Manufacturing of 3D Micro-Architectures for Advanced Gas Sensors**
NIMTE Supervisor	Prof. Yuchuan CHENG
UNNC Supervisor(s)	Dr. Reza Shoja Razavi
Short introduction & description of the PhD project	This project establishes a collaborative platform to explore novel gas sensor designs by combining laser additive manufacturing with functional materials science. The research will focus on using Laser Powder Bed Fusion (LPBF) to design and fabricate three-dimensional metallic micro-architectures. These structures aim to provide an optimized porous scaffold or platform with high surface area and tailored geometry. The PhD candidate will work on optimizing the LPBF process parameters to achieve these designed structures with good fidelity and stability. This 3D-printed platform will then serve as a substrate for advanced functionalization conducted at NIMTE, targeting enhanced performance in gas sensing applications. This collaborative approach provides a flexible foundation to develop a new generation of sensors, with the specific sensing materials and mechanisms to be refined based on the student's progress and the combined expertise of both research groups.
Contact points	Informal inquiries may be addressed to Dr. Reza Shoja Razavi (Sayed-Reza.Shoja-Razavi@nottingham.edu.cn) and Prof. CHENG Yuchuan (yccheng@nimte.ac.cn).
PhD topic	**Topology Optimization of Ultrasonic Horns for Modal Decoupling and Robust Support**
NIMTE Supervisor	Prof. Silu CHEN
UNNC Supervisor(s)	Prof. Jian YANG
Short introduction & description of the PhD project	Ultrasonic horns constitute the core energy-transmission components in high-precision applications such as advanced machining and robotic surgery. The performance and reliability of these systems critically depend on the effective suppression of parasitic vibration modes and the accurate localization of displacement nodes. Under high-power excitation, however, pronounced thermo-mechanical coupling induces modal interaction and nodal drift, resulting in energy leakage and excessive dissipation at clamping interfaces. To overcome these challenges, the coming research would like to propose a topology-optimization-based design framework for ultrasonic horns with intrinsically enhanced modal decoupling and thermo-mechanical robustness. By revealing the dynamic

	redistribution of strain energy under coupled thermal and mechanical perturbations, a robust sensitivity analysis will be integrated to guide the topological evolution toward multiple synergistic objectives. This design paradigm is expected to effectively mitigate impedance mismatch in high-power ultrasonic systems and establishes a fundamental methodology for the development of next-generation high-Q, ultra-low-loss acoustic resonators.
Contact points	Informal inquiries may be addressed to Prof. Silu Chen (chensilu@nimte.ac.cn) and Prof Jian YANG (Jian.Yang@nottingham.edu.cn).
PhD topic	**Study on Low-Temperature Densification and Reliability of SiC_f/SiC Composites Using Low Neutron Toxicity Sintering Aids**
NIMTE Supervisor	Prof. Yinsheng Li
UNNC Supervisor(s)	Prof. Hao Chen
Short introduction & description of the PhD project	Silicon carbide fiber-reinforced silicon carbide matrix composites (SiC_f/SiC) are highly valued for their exceptional high-temperature creep resistance, corrosion resistance, and radiation tolerance, making them crucial materials for high-safety cladding in harsh environments within the nuclear energy sector. The Nano Infiltration and Transient Eutectic (NITE) process is a significant method for fabricating SiC_f/SiC composites. However, key challenges hindering its application in nuclear energy include the introduction of sintering aids with high neutron absorption cross-sections and the detrimental effects of high densification temperatures on fiber integrity and mechanical performance. In this research subject, we propose the use of metal oxides with low neutron absorption cross-sections (such as Al_2O_3 and ZrO_2) as efficient sintering aids. By employing electric field-assisted rapid sintering techniques at lower temperatures, we aim to achieve densification of SiC_f/SiC while protecting the fibers and obtaining excellent mechanical properties. This study will investigate the physicochemical processes involved in the formation of liquid phases by the metal oxide aids, revealing the factors influencing the densification of SiC_f/SiC composites and clarifying the mechanisms of liquid-phase sintering. Furthermore, by examining the composition-microstructure-mechanical property relationships of SiC_f/SiC composites, we will elucidate the interaction principles between fibers, interfaces, and matrices under stress conditions, uncovering the failure mechanisms of the composites. This understanding will guide the optimization of microstructural design to enhance the mechanical performance of the composites. Finally, by studying the interactions between energetic particles and SiC_f/SiC composites at the atomic scale, we aim to clarify the irradiation damage mechanisms of materials in extreme environments. This research subject will provide theoretical support for the design and preparation of NITE-SiC_f/SiC composites.
Contact points	Informal inquiries may be addressed to Prof. Yinsheng Li (liyinsheng@nimte.ac.cn) and Dr. Hao Chen (Hao.Chen@nottingham.edu.cn).
PhD topic	**Radiative cooling based upon the optical modulation of optical materials and the dual-band spectral manipulation of thin film system.**

NIMTE Supervisor	Prof. Hongtao Cao
UNNC Supervisor(s)	Prof. Hao Chen
Short introduction & description of the PhD project	The application of radiative cooling can be traced back to ancient time as the ancestors made ice in the nocturnal time even the ambient temperature is above 0 ℃. This approach can passively decrease the ambient temperature through heat radiation without energy consumption, providing a solution to compensate problems raised by global warming. The scientific concept of radiative cooling first came up in 1826, whose critical point is to enhance the heat exchange between the Earth and the outer space within the atmospheric window (AW, 3-5, 8-13, 16-28 μm), while prevent the systemic solar irradiance absorption (0.2-2.5 μm). Therefore, the project mainly focuses on the spectral manipulation of thin film system. Besides, considering the performance optimization and integration of the designed film system, the project also involves the optical modulation of the relative materials, including the broadening of the absorption band and the enlargement of the resonance dielectric refractive index. This project will focus on two major optical dimensions on (i) high reflection in solar irradiance range and (ii) selective absorption in infrared regime.
Contact points	Informal inquiries may be addressed to Prof. Hongtao Cao (h_cao@nimte.ac.cn) and Prof. Hao Chen (Hao.Chen@nottingham.edu.cn).
PhD topic	**Research on thermal-sprayed functional ceramic coatings with photothermal property**
NIMTE Supervisor	Prof. Hua Li
UNNC Supervisor(s)	Prof. Hao Chen
Short introduction & description of the PhD project	Photothermal materials hold immense potential in many applications ranging from energy conversion to thermal management systems. The ability to harness and manipulate photothermal effect in ceramic coatings can contribute to groundbreaking advancements in renewable energy, environmental engineering, smart material design, and other fields. Thermal spraying presents a versatile and effective method for fabricating these functional ceramic coatings. It allows for the deposition of coatings on a wide range of substrates, regardless of their melting points, providing a significant advantage in terms of material compatibility. Meanwhile, it offers the advantage of engineering coatings with specific microstructures and tailored properties. The main objective of this project is to develop and optimise ceramic coatings that demonstrate superior photothermal efficiency and durability via thermal spraying. By harnessing the advantages of thermal spraying, this project aims to deliver transformative solutions that are economically viable and technologically advanced, setting new benchmarks in the field of photothermal ceramic coatings.
Contact points	Informal inquiries may be addressed to Prof. Hua Li (lihua@nimte.ac.cn) and Prof. Hao Chen (Hao.Chen@nottingham.edu.cn).

PhD topic	**Machine Learning-enabled composition and structure design of lightweight wear- and corrosion-resistant metal matrix composites**
NIMTE Supervisor	Prof. Keke Chang
UNNC Supervisor(s)	Prof. Hao Chen
Short introduction & description of the PhD project	This project aims to develop an AI-driven design and optimization loop of lightweight metal matrix composites (MMCs) by integrating machine learning and image recognition technologies. The focus is on using these advanced techniques to improve the wear- and corrosion-resistance of MMCs synergistically. Specifically, the project will explore data-driven methods for predicting phase transformation behaviours, improving interface microstructures, and increasing manufacturing efficiency. The incorporation of image recognition will enable more accurate analysis and characterization of MMCs, and help to establish the interactive relationship of composition-structure-performance. This innovative approach promises to push the boundaries of material science, potentially leading to significant advancements in various modern industrial sectors.
Contact points	Informal inquiries may be addressed to Prof. Keke Chang (changkeke@nimte.ac.cn and Prof. Hao Chen (Hao.Chen@nottingham.edu.cn).
PhD topic	**Multimodal Characterization and Mechanistic Understanding of Failure and Reversible Recovery in Photovoltaic Devices under Service Conditions**
NIMTE Supervisor	Prof. Chuanxiao Xiao
UNNC Supervisor(s)	Prof. John Xu
Short introduction & description of the PhD project	The system operational reliability of photovoltaic devices in renewable energy applications is often limited by failure processes induced under practical working conditions, such as electrical bias, illumination and thermal stress. These failure processes ultimately manifest as degradation in power output and a reduction in photovoltaic conversion efficiency. These failures typically originate from defect formation, charge trapping, and interfacial instabilities, and in some cases exhibit partial or reversible recovery. However, efforts to enhance system operational stability are hindered by an insufficient understanding of the fundamental mechanisms governing the initiation, evolution, and reversibility of degradation. This PhD project aims to systematically identify and elucidate failure and recovery mechanisms in photovoltaic devices under representative working conditions, contributing to reduced efficiency losses and improved operational stability in photovoltaic systems. By integrating comprehensive microscopic characterization with spectroscopic and electrical analyses, the project will establish correlations between device performance degradation and nanoscale physical and chemical evolution. In addition, the project will develop and use in-situ and operando characterization techniques to capture dynamic processes under realistic operating conditions. Particular emphasis will be placed on reversible processes affecting operational stability and long-term performance. The research will focus on two key dimensions: (i) microscopic failure behaviors and their evolutionary process under different operational stresses; (ii) the links between material properties and long-term stability, providing guiding principles and effective strategies for device stability improvement. The outcomes are expected to provide

	insights into reliability and support the development of more stable and efficient renewable energy systems.
Contact points	Informal inquiries may be addressed to Prof. John Xu (John.XU@nottingham.edu.cn) and Prof. Chuanxiao Xiao (cxiao@nimte.ac.cn).
PhD topic	**Design of thin-film nanocomposite membranes (TFN) for effective water treatment**
NIMTE Supervisor	Prof. Jie GAO
UNNC Supervisor(s)	Prof. Yong REN
Short introduction & description of the PhD project	Water scarcity is an important issue worldwide, especially in arid regions. The situation is getting worse in the next decades. To deal with water scarcity, many efforts have been made to safely discharge and reuse the reclaimed wastewater. Thin film composite (TFC) membranes have received enhanced attention among wastewater treatment technologies due to their effectiveness and efficient to remove salts and small organic solutes. However, the selective layer of TFC membranes made from interfacial polymerization is normally difficult to manipulate due to the fast reaction speed between monomers, making the formed membranes difficult to break the trade-off between permeability and selectivity. In this project, novel thin-film nanocomposite (TFN) membranes will be developed for water treatment. This project will focus on three major dimensions on (1) synthesizing nanofillers with uniform size distribution and functional groups; (2) fabricating TFN membranes using optimized nanofillers; and (3) tuning TFN membranes with enhanced rejection and water permeability for water treatment applications.
Contact points	Informal inquiries may be addressed to Prof. Ren (Yong.Ren@nottingham.edu.cn) and Prof. Gao (gaojie0993@nimte.ac.cn).
PhD topic	**Development of efficient and robust Bi-based photoelectrodes for large-scale solar water splitting**
NIMTE Supervisor	Prof. Yongbo Kuang
UNNC Supervisor(s)	Dr. Di HU
Short introduction & description of the PhD project	Harnessing solar energy for sustainable hydrogen production is pivotal in addressing global energy challenges. This PhD project focuses on the innovative development of bismuth (Bi)-based photoelectrodes tailored for large-scale solar water splitting applications. By exploring advanced materials synthesis, nanostructuring techniques, and surface engineering, the research aims to enhance the photoelectrochemical efficiency and durability of Bi-based systems. Candidates will engage in cutting-edge experiments and computational modeling to optimize charge separation and catalytic performance under real-world conditions. The project not only seeks to advance the fundamental understanding of Bi-based photocatalysts but also strives to pave the way for scalable and economically viable solar hydrogen production. Ideal for motivated individuals with a background in materials science, chemistry, or renewable energy, this research offers the opportunity to contribute to a cleaner and more sustainable energy future.

Contact points	Informal inquiries may be addressed to Dr Di Hu (di.hu@nottingham.edu.cn) and Prof. Yongbo Kuang (kuangyongbo@nimte.ac.cn)
PhD topic	**Fault-tolerant control and observation for enhanced safety of multirotor vehicles**
NIMTE Supervisor	Prof. Xinmin Chen
UNNC Supervisor(s)	Dr. Donglei Sun
Short introduction & description of the PhD project	Operational safety is the foundation of a booming low-altitude economy, and it poses a great challenge to the safety of individual participating aerial vehicle. Existing multirotor vehicles, such as bi-rotor vehicles and quadrotors, usually lack physical redundancy due to the low number of propellers, and hence without specialized control algorithms, loss-of-control is inevitable when a subset of the propulsion sources fails. To address the safety issue of such vehicles after partial propulsion loss, advanced fault-tolerant control and observation are essential. This project consists of the following tasks: (i) modelling of the aerial vehicles after partial propulsion loss; (ii) state observation of the failed vehicle based on available measurement (IMU, GPS, vision, etc); (iii) advanced control law development for the failed vehicle to hover or land safely; (iv) verification of the developed observation and control algorithms in simulation and indoor environment with motion capture system; and (v) verification of the develop algorithms in outdoor operational environment.
Contact points	Informal inquiries may be addressed to Dr. Donglei Sun (donglei.sun@nottingham.edu.cn) and Prof. Xinmin Chen (chenxinmin@nimte.ac.cn).
PhD topic	**Green, low - carbon and circular recycling project for spent power lithium battery resources**
NIMTE Supervisor	Prof. Gao JIE
UNNC Supervisor(s)	Prof. Philip Hall and Dr Zheng Wang
Short introduction & description of the PhD project	With the rapid development of the global new-energy vehicle industry, the quantity of spent power lithium batteries has surged exponentially. If not properly handled, this will not only lead to the waste of scarce resources such as lithium and cobalt, but also the heavy metals and chemical substances contained within them will cause serious environmental pollution. Against this backdrop, our project was initiated. It aims to achieve the circular reuse of spent power lithium battery resources in a green and low-carbon manner, designed to address the dual challenges of resource conservation and environmental protection.
Contact points	Informal inquiries may be addressed to Dr Zheng Wang (Zheng.Wang@nottingham.edu.cn), Prof. Philip Hall (Philip.HALL@nottingham.edu.cn) and Prof. Gao JIE (gaojie@nimte.ac.cn).
PhD topic	**Enhancing Polycrystalline Diamond Performance through Precision Engineering of Diamond-Diamond Bonding**
NIMTE Supervisor	Prof. Lifen Deng

UNNC Supervisor(s)	Dr. Hainam Do
Short introduction & description of the PhD project	This PhD research aims to fundamentally enhance the properties of polycrystalline diamond (PCD) by shifting from traditional empirical methods to the precision engineering of the diamond-diamond bonding process. The central hypothesis is that the macroscopic performance of PCD is directly governed by the quality of the intergranular bonds between diamond crystals. The project is supposed to answer the following three questions: 1)Mechanistic Deciphering: To unravel the atomic-scale mechanisms and interface evolution during diamond-diamond bonding under high-pressure high-temperature (HPHT) conditions;2)Process-Property Correlation: To establish quantitative links between dynamic sintering parameters, the characteristics of the bonded interfaces (e.g., strength, thickness), and the final mechanical/thermal properties of PCD;3)Alternative Pathway Exploration: To explore and validate novel catalyst alternatives or sintering aids (e.g., non-metallic media) that promote densification and strong diamond-diamond bonding while minimizing detrimental residual phases.
Contact points	Informal inquiries may be addressed to Prof. Lifen Deng (denglifen@nimte.ac.cn) and Dr. Hainam Do (Hainam.Do@nottingham.edu.cn).