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中国科学院 上海高等研究院
SHANGHAI ADVANCED RESEARCH INSTITUTE, CHINESE ACADEMY OF SCIENCES

UNNC - SARI, CAS Doctoral Training Partnership

It's essential that you have contacted the [UNNC](#) and/or [SARI](#) supervisors before applying.

Formal applications should follow the instructions in '[How to apply](#)' section.

Research areas

- 1) Energy Storage and Conversion
- 2) Energy and Environment
- 3) Advanced Materials
- 4) Sustainable Conversion

Potential PhD topics

PhD topic	Development of an additively manufactured multifunctional SiC ceramic foam for Joule heated catalytic reactions
SARI Supervisor	Prof. Dr. Lei ZHENG
UNNC Supervisor(s)	Dr Kean How CHEAH
Short introduction & description of PhD project	According to International Energy Agency (IEA), chemical industry is the largest energy consumer and the third largest direct CO₂ emission source. By using a suitable catalyst (such as Rh-, Pt-, and Ni-based), CO₂ reforming of methane provides significant environmental benefits as two major greenhouse gases, i.e. CO₂ and methane, are consumed to produce synthesis gas. By replacing fossil fuel combustion, Joule heating, driving by renewable energy, has intrinsically high thermal efficiency and ensures excellent heat transfer for endothermic reactions towards process intensification, making it an attractive strategy to implement in the catalytic reactor. Nevertheless, the issues of uniform heating, mechanical strength, and thermal stability of the state-of-the-art catalyst washcoated ceramic foam remain the key limitations for the development of a high-performance reactor system. This project aims to develop a multifunctional SiC based ceramic foam, which has the desired properties to serve as the key enabling tool for efficient Joule heated catalytic reactions. The research content will cover: (1) Formulation of a polycarbosilane based photopolymer resin mixture for 3D printing of precursor for SiC ceramic foam; (2) Characterizations of the multifunctional SiC ceramic foam to elucidate the catalytic activity, electrically conductivity, porosity, mechanical strength, etc; (3) Application of the newly developed SiC ceramic foam in a Joule-heated catalytic reactor and evaluation of its performance and efficiency. The potential PhD candidate is expected to work in both institutions. UNNC has the facilities for additive manufacturing studies while SARI has facilities for catalytic reaction related studies.

Contact points	Informal inquiries may be addressed to Dr Kean How CHEAH (kean-how.cheah@nottingham.edu.cn) and Dr Lei ZHENG (zhengl@sari.ac.cn).
PhD topic	Laser-Additive Manufacturing of Porous Ni-Based Alloys for Alkaline Water Electrolysis
SARI Supervisor	Prof. ZU Lianhai
UNNC Supervisor(s)	Dr. Reza Shoja Razavi
Short introduction & description of PhD project	This PhD project aims to engineer next-generation electrodes for high-current-density alkaline water electrolysis (ALK/AEMWE) by innovating at the interface of advanced manufacturing and electrochemistry. The core challenge is to overcome the performance limitations imposed by conventional, coarse nickel substrates. To address this, the research will employ laser additive manufacturing (LPBF) to fabricate porous Ni-based alloy structures with precisely designed hierarchical porosity. These tailored 3D architectures will serve as optimized platforms to enhance catalyst loading, improve charge/mass transport, and strengthen catalyst-substrate integration. The primary PhD training and advanced manufacturing research will be conducted at the University of Nottingham Ningbo China (UNNC), focusing on laser processing–structure relationships and porous electrode design. Electrochemical evaluation, catalyst integration, and electrolyzer-level performance assessment (including HER/OER activity, durability, and MEA/device testing) will be carried out at the Shanghai Advanced Research Institute (SARI), Chinese Academy of Sciences, leveraging SARI’s full pipeline from catalyst and porous electrode engineering to electrolyzer device development, as well as access to Shanghai Synchrotron Radiation Facility for advanced characterization. This collaboration bridges laser additive manufacturing with practical alkaline water electrolysis, establishing feasible design principles for next-generation porous metal electrodes.
Contact points	Informal inquiries may be addressed to Dr. Reza Shoja Razavi (Sayed-Reza.Shoja-Razavi@nottingham.edu.cn) and Prof. ZU Lianhai (zulh@sari.ac.cn).
PhD topic	Global Surface CO₂ Flux Estimation Based on the Integration of Unsupervised Machine Learning and Atmospheric Chemical Transport Models
SARI Supervisor	Prof. Mingquan WANG Prof. Qianrong GU
UNNC Supervisor(s)	Prof. Xiangjian HE
Short introduction & description of PhD project	Since the Industrial Revolution, anthropogenic CO₂ emissions have disrupted the natural equilibrium between CO₂ sources and sinks in the global carbon cycle. This imbalance has led to the progressive accumulation of CO₂ in the atmosphere and a steady increase in its concentration, which remains the dominant driver of contemporary climate change. Consequently, obtaining accurate estimates of the global distribution of surface–atmosphere CO₂ exchange fluxes constitutes a critical data foundation for evaluating the current state and future trajectory of global warming and for designing effective mitigation strategies. Conventionally, global surface CO₂ flux distributions are inferred by combining atmospheric chemical transport models with data assimilation techniques. These methods use CO₂ concentration observations from satellite missions and ground-based networks, constrained by meteorological fields, to perform inverse modelling of surface CO₂ fluxes. Despite their widespread use, such approaches suffer from two major limitations: extremely high computational

	costs and substantial uncertainty in the posterior flux estimates, which remains heavily dependent on the accuracy of two prior fields—the prior modelled atmospheric CO₂ concentrations and the prior surface CO₂ flux estimates. Leveraging recent advances in artificial intelligence, my PhD research aims to supplant the data assimilation component conventionally integrated with atmospheric chemical transport models by employing unsupervised machine learning methodologies, thereby eliminating dependence on prior surface CO₂ flux estimates. By utilizing global atmospheric CO₂ concentration observations and available CO₂ flux measurements under meteorological forcing, the proposed framework seeks to deliver more accurate, robust, and less prior-biased estimates of the global surface–atmosphere CO₂ flux distribution.
Contact points	Informal inquiries may be addressed to Prof. Xiangjian HE (Sean.He@nottingham.edu.cn), Prof. Mingquan WANG (wangmq@sari.ac.cn) and Prof. Qianrong GU (guqr@sari.ac.cn).
PhD topic	Laser-Synthesized High-Entropy Alloy Nanocatalysts for Advanced Water Oxidation
SARI Supervisor	Prof. YANG Qingfeng
UNNC Supervisor(s)	Dr. Reza Shoja Razavi
Short introduction & description of PhD project	This project aims to pioneer a new class of nanocatalysts for the degradation of persistent organic pollutants in water by leveraging the unique capabilities of Pulsed Laser Ablation in Liquid (PLAL). The research will focus on synthesizing high-entropy alloy (HEA) nanoparticles—comprising four or more principal elements (e.g., Fe, Co, Ni, Cu, Mn)—in a single-step, chemical-free process. PLAL ensures the creation of oxide-free, defect-rich surfaces with non-equilibrium compositions, which are hypothesized to offer exceptional activity and stability in activating peroxymonosulfate (PMS) or ozone for advanced oxidation processes. The project will systematically explore the vast HEA compositional space, correlate laser parameters with nanoparticle characteristics, and evaluate catalytic performance against model pollutants (e.g., dyes, pharmaceuticals). This work seeks to establish a novel, laser-driven platform for designing next-generation water treatment catalysts with unparalleled efficiency.
Contact points	Informal inquiries may be addressed to Dr. Reza Shoja Razavi (Sayed-Reza.Shoja-Razavi@nottingham.edu.cn) and Prof. YANG Qingfeng (yangqf@sari.ac.cn).
PhD topic	Probing Functionalized Particle Dynamics in Organic Solar Cells with In Situ GIWAXS/GISAXS during Solution-Sheared Film Formation
SARI Supervisor	Prof. YANG Chunming
UNNC Supervisor(s)	Dr Guang Li
Short introduction & description of PhD project	The PhD project is situated at the interdisciplinary frontier of fluid dynamics and new energy materials. It innovatively proposes utilizing a solution shear field to drive functionalized particles for the active control of dynamic film formation and nanoscale morphology in organic photovoltaic active layers. Functionalized particles will be designed, synthesized, and incorporated. By coupling a blade-coating process with in situ GIWAXS/GISAXS characterization, the research will real-time reveal the evolution mechanisms of particle distribution, crystallization, and phase separation within the shear flow. The goal is to establish a quantitative "process-particle-morphology" relationship, develop a novel chemical engineering methodology for precise

	film morphology optimization via fluid engineering, and provide new strategies for fabricating high-efficiency, stable photovoltaic devices.
Contact points	Informal inquiries may be addressed to Dr Guang Li (guang.li@nottingham.edu.cn) and Prof. Yang Chunming (yangcm@sari.ac.cn).
PhD topic	AI treatment and analysis of experimental data to optimize the parameters of polymer processing
SARI Supervisor	Dr. Fenggang BIAN
UNNC Supervisor(s)	Dr. Kok Hoong Wong
Short introduction & description of PhD project	Synchrotron Small Angle X-ray Scattering is a important tool to characterize the nanostructure of polymers. As is well known, the nanostructures are related with the properties of polymers. The information of polymers' nanostructure can be obtained by the synchrotron in-situ SAXS/WAXS. The optimized processing parameters will be possible by the nanostructure information from the synchrotron in-situ SAXS/WAXS. A large of data will be acquired by adjusting the parameters of processing. The data will be treated by AI program to obtain the optimum parameters of polymers processing.
Contact points	Informal inquiries may be addressed to Dr Kok Hoong Wong (kok-hoong.wong@nottingham.edu.cn) and Dr Fenggang Bian (bianfg@sari.ac.cn).
PhD topic	Carbon emissions accounting and responsibility reallocation
SARI Supervisor	Dr. Wei Wei
UNNC Supervisor(s)	Prof. Tao Wu
Short introduction & description of PhD project	Climate change mitigation requires not only accurate quantification of carbon emissions, but also fair and transparent allocation of emission responsibilities across countries. Carbon emissions accounting has therefore become a central tool in understanding the distribution of emissions within global production, consumption and trade systems. However, existing accounting approaches often focus on emission measurement itself, while the issue of responsibility allocation remains contested, particularly in the context of countries at different stages of economic development. This PhD project aims to investigate carbon emissions accounting and responsibility reallocation within a comprehensive analytical framework. The research will examine how different accounting perspectives can influence the attribution of emission responsibilities, and explore alternative approaches for reallocating responsibilities in a way that enhances transparency and interpretability. Quantitative analysis methods will be employed to assess cross-country differences in emissions and responsibility outcomes, while maintaining consistency with established carbon accounting principles. By linking carbon emissions accounting with responsibility reallocation, this project seeks to contribute to ongoing academic debates on carbon responsibility and climate governance. The findings are expected to provide methodological insights that support more informed international comparisons and policy-relevant discussions on emission responsibility sharing.
Contact points	Informal inquiries may be addressed to Prof Tao Wu (tao.wu@nottingham.edu.cn) and Dr Wei Wei (weiwei@sari.ac.cn).

PhD topic	1,3-propanediol production using glucose and glycerol as co-substrates
SARI Supervisor	Jian Hao
UNNC Supervisor(s)	Enrico Marsili
Short introduction & description of PhD project	1,3-Propanediol (1,3-PDO) is a versatile C3 diol serving as a building block of polytrimethylene terephthalate (PTT), a high-performance polyester prized in textiles, carpets, and engineering plastics. Its low toxicity and humectant properties also drive demand in cosmetics, personal care, and polyurethane formulations. Current research on bio-based 1,3-PDO synthesis primarily focuses on using glycerol as the carbon source. However, glycerol feedstock costs fluctuate with the biodiesel market. To enhance 1,3-PDO productivity from glycerol, glucose can be introduced as a co-substrate. Glucose catabolism supplies NADH, ATP and building blocks for the cell, thereby enabling the drive of all glycerol into the 1,3-PDO pathway. Under this strategy, the theoretical conversion of glycerol to 1,3-PDO would approach 100%. This proposal aims to develop <i>Klebsiella pneumoniae</i> biofilms as an efficient microbial cell factory for the production of 1,3-propanediol (1,3-PDO) using glucose and glycerol as co-substrates. In the first part of the project, the candidate will grow <i>K. pneumoniae</i> biofilms under laboratory conditions and optimize the experimental conditions for production of 1,3-PDO in the biofilms. In the second part of the project, the candidate will scale-up production to 1 L and 5 L biofilm bioreactors to obtain sufficient material for pre-commercial testing. In this project, the student will have access to both laboratories at SARI and UNNC, which include high-end facilities for biofilm characterization and analysis of fermentation products.
Contact points	Informal inquiries may be addressed to Assoc Prof Enrico Marsili (enrico.marsili@nottingham.edu.cn) and Prof Jian Hao (haoj@sari.ac.cn).
PhD topic	Study on the tribological properties and mechanism of action of nano additives in lubricating grease system
SARI Supervisor	Prof. Jiusheng Li
UNNC Supervisor(s)	Dr. Kok Hoong Wong
Short introduction & description of PhD project	Focus on the urgent need for high-performance lubricating grease in advanced equipment such as robots and high-speed trains, this study will conduct a series of investigations on the tribological properties, micro-structural changes, and lubrication mechanisms of nano-additives in different grease systems.
Contact points	Informal inquiries may be addressed to Prof. Jiusheng (lijs@sari.ac.cn) and Dr. Kok Hoong Wong (kok-hoong.wong@nottingham.edu.cn)
PhD topic	Preparation and regulation of high-performance materials for seawater uranium extraction
SARI Supervisor	Prof. Jixiang Li
UNNC Supervisor(s)	Prof. Jun He
Short introduction & description of PhD project	Uranium resources are strategic raw materials for the development of nuclear energy. At present, the demand for uranium in industrial countries is also increasing. However, the total reserves of terrestrial uranium are very limited, and thus it is necessary to find new sources of uranium. There are nearly 4.5 billion tons of uranium in seawater, which is more than 1000 times of land reserves, and may become an inexhaustible uranium resource for

	human beings. However, the high salinity of seawater and the very low uranium concentration (1.8-3.2 ppb) make the extraction of uranium from seawater a very challenging scientific and technological problem. In summary, based on the principle of coordination chemistry, this project intends to construct a ligand library for uranium extraction from seawater, optimize and screen highly selected uranyl ligands at the molecular level, and then carry out material forming and performance regulation. It is aimed to provide several high-performance materials for seawater uranium extraction.
Contact points	Informal inquiries may be addressed to Jixiang Li (lijixiang@sari.ac.cn) and Jun He (jun.he@nottingham.edu.cn).

Other potential supervisors

UNNC		
Profile	Research area(s)	Email
Dr. Ruslan Melentiev	Advanced Materials	Ruslan.melentiev@nottingham.edu.cn
SARI, CAS		
Profile	Research area(s)	Email
Prof. LI Jun	Energy Storage and Conversion	lijun@sari.ac.cn
Researcher LI Lina	Energy and Environment	liln@sari.ac.cn
Prof. Dr. Fei Song	Advanced Materials	songf@sari.ac.cn
Prof. WU Longlong	Advanced Materials	wull@sari.ac.cn
Researcher WANG Maoyu	Energy Storage and Conversion	wangmy@sari.ac.cn