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China Scholarship Council (CSC) Scholarship Program

CSC-CSIRO 2020

Project Opportunities

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1 Agriculture and Food

1.1 Self-learning and navigated UAVs for IoT data capture

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CSIRO Business Unit	Agriculture and Food
Project Location	Australia, Australian Capital Territory - Black Mountain
Project suitable for type of candidate	PhD Student
Project title	Self-learning and navigated UAVs for IoT data capture
Research area	Physiology and anatomy of wheat. The project will provide fundamental knowledge about how roots and shoots respond to gravity.
Project description	<p>How plants respond to gravity is key to determining its shape. We have already identified wheat mutants with altered root and shoot morphologies. The root mutants form the basis of the project to understand gravitropic responses in wheat and to initiate cloning of the underlying genes. The student will:</p> <ul style="list-style-type: none"> • Confirm mutant phenotypes and in doing so become familiar with techniques for analysing roots; • Select a mutant as the focus of the project; • Characterise the physiology of the mutant in detail; • Determine the genetics of the mutation; • Map the chromosomal location of the selected mutation and initiate methods for gene cloning.
Skills required from candidate	<ul style="list-style-type: none"> • A background in genetics; • Experience in growing plants for experimentation; • Knowledge or experience in molecular biology.
Developmental outcomes for candidate	<p>The student will attain an:</p> <ul style="list-style-type: none"> • Improved understanding of root traits to enhance crop productivity; • Access to novel wheat mutants; • Exposure to a range of methods including root analysis, genetic mapping and gene cloning; • Publications in reputable journals; • Access to advanced research facilities and working with friendly colleagues.
Additional comments	Root and shoot morphologies are important for determining how well a plant acquires water and nutrients (roots) and how they intercept light for photosynthesis (shoots). While the work is largely fundamental in nature, it will provide a basis for determining how to alter plant morphology for improved wheat yields.

1.2 High Digestible Sorghum Grain with enhanced functionality

CSIRO Supervisor	Dr Jean-Philippe Ral
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CSIRO Business Unit	Agriculture and Food
Project Location	Australia, Australian Capital Territory - Black Mountain
Project suitable for type of candidate	PhD Student
Project title	High Digestible Sorghum Grain with enhanced functionality
Research area	Tailoring Sorghum starch degradation to increase quality of premium grain and grain-based food and feed products.
Project description	Sorghum is the world's fifth-most important cereal crop and barley and is able to grow in soils that are quite poorly nourished, with an unreliable water supply and had several nutritional benefits including good source of dietary fibre, high potassium and gluten free. However, its major constraint is the digestibility of starch. We have shown that enhanced amylase content may be advantageous for grain digestibility. This project seeks to understand the impact of elevated levels of alpha-amylase in Sorghum on grain development, germination and quality by generating and studying Sorghum lines with enhanced amylase activity.
Skills required from candidate	<ul style="list-style-type: none"> • Masters or Honours degree in plant biology, molecular genetics or biochemistry or an equivalent qualification; • Ability to work effectively as part of a multi-disciplinary research team; • Motivation and discipline to carry out autonomous research under close supervision; • Strong analytical skills; • Demonstrated skills in protein biochemistry; • Knowledge of Carbohydrate biochemistry and/or Knowledge of Plant Molecular Biology.
Developmental outcomes for candidate	<ul style="list-style-type: none"> • Gain a rare combination of academic and applied knowledge opening numerous opportunities for future career development; • Scientific recognition within a team with strong publication record, regular presence in major international conferences and rigorous intellectual property management; • Understanding research innovation and commercialisation; • Develop strong international network (Europe, Canada, Philippines, and USA).
Additional comments	The student should have an excellent understanding of English language and a good level of written and oral communication skills. The project will be closely link to the CSIRO-CAS extension project "Development of cereal crops with improved health benefits."

1.3 Transformational RNAi technology for insect control

CSIRO Supervisor	Dr Lingling Gao
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CSIRO Business Unit	Agriculture and Food
Project Location	Australia, Western Australia - Floreat
Project suitable for type of candidate	Either PhD Student or Scholar
Project title	Transformational RNAi technology for insect control
Research area	Biotechnology for crop protection against insect pests
Project description	Insects cause severe damage to crops. CSIRO is both the discoverer of RNA interference (RNAi) based gene silencing in plants and owner of RNAi technologies. This project is to examine the potential of novel RNAi technology developed by CSIRO scientists in the control of sap-sucking insects. The project involves the comparison between the traditional hpRNAi and the newly developed RNAi technologies in the plant-mediated gene silencing in both sap-sucking and chewing insects.
Skills required from candidate	<ul style="list-style-type: none"> • Basic knowledge in plant or insect biology; • Experiences in basic molecular technology; • Strong interest in learning new technologies.
Developmental outcomes for candidate	The students or scholars will work in a dynamic and productive group which specialises in plant molecular biology and biotechnology. The students or scholars will gain extensive knowledge of molecular biology, develop a range of skills in modern biotechnologies, and have opportunities to publish papers and establish long-term collaborations.
Additional comments	We have successfully hosted a number of Chinese students/scholars in the past. Our group is multicultural and majorities are native English speakers and others are from different countries. This provides great environment to practice English. The students also have some opportunities to take English classes provided free by local communities.

2 Data61

2.1 3D Reconstruction from Stereo or Multiple 2D Images

CSIRO Supervisor	Dr Changming Sun
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CSIRO Business Unit	Data61
Project Location	Australia, New South Wales - Marsfield
Project suitable for type of candidate	Either PhD Student or Scholar
Project title	3D Reconstruction from Stereo or Multiple 2D Images
Research area	Computer vision, image analysis, pattern recognition
Project description	3D shape reconstruction and analysis have a wide range of applications. These may include 3D plant modeling/analysis, 3D insect modeling/classification, animal shape analysis, or shape modelling of other objects. The objective of this project is to develop advanced techniques, algorithms, and systems for 3D reconstruction of objects from multiple 2D images and to develop capabilities to analyse such 3D data. The 3D models can be used for measurement and characterization of objects.
Skills required from candidate	<ul style="list-style-type: none">• A degree in computer science, mathematics, or engineering (or equivalent);• Image processing/image analysis or computer vision course or experience is preferred;• C or C++ language preferred;• Python or other languages are also acceptable.
Developmental outcomes for candidate	<ul style="list-style-type: none">• One or more new algorithms developed for 3D reconstruction from images;• One or more conference or journal papers submitted/published on the algorithms developed;• Exposure to high-impact research challenges and scientific expertise in multiple disciplines;• Improved image processing and computer vision skills;• Improved skills in scientific communication in English.
Additional comments	Supervisor's homepage: http://vision-cdc.csiro.au/changming.sun

2.2 Image Analysis for Biological or Medical Applications

CSIRO Supervisor	Dr Changming Sun
CSIRO Supervisor contact details	changming.sun@csiro.au +61 2 9325 3207
CSIRO Business Unit	Data61
Project Location	Australia, New South Wales - Marsfield
Project suitable for type of candidate	Either PhD Student or Scholar
Project title	Image Analysis for Biological or Medical Applications
Research area	Computer vision, image analysis, pattern recognition, deep learning
Project description	Image segmentation is the most important component for image analysis. It distinguishes objects from background in images and the segmented objects can be further analysed. For example, in the area of biotech imaging, accurate measurements about the main characteristics of cells or nuclei are essential. The purpose of this study is to develop advanced algorithms for separating objects of interest from background of images in the broader context of image segmentation, including biological or biomedical/medical images.
Skills required from candidate	<ul style="list-style-type: none"> • A degree in computer science, mathematics, or engineering (or equivalent); • Image processing/image analysis or computer vision course or experience is preferred; • C or C++ language preferred; Python or other languages are also acceptable.
Developmental outcomes for candidate	<ul style="list-style-type: none"> • One or more new algorithms developed for image analysis/segmentation; • One or more conference or journal papers submitted/published on the algorithms developed; • Exposure to high-impact research challenges and scientific expertise in multiple disciplines; • Improved image processing and computer vision skills; • Improved skills in scientific communication in English.
Additional comments	Supervisor's homepage: http://vision-cdc.csiro.au/changming.sun

2.3 Advection-diffusion lattice Boltzmann modified to model smooth, curved surfaces

CSIRO Supervisor	Dr Gerald Pereira
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CSIRO Business Unit	Data61
Project Location	Australia, Victoria - Clayton
Project suitable for type of candidate	Either PhD or Scholar
Project title	Advection-diffusion lattice Boltzmann modified to model smooth, curved surfaces
Research area	Lattice Boltzmann (LB) is a computational technique for fluids. It is grid-based and so sometimes incompatible with modelling smooth surfaces.
Project description	<p>The Advection-Diffusion LB technique is a lattice based computational technique solved on cartesian grids for modelling advection and mass or heat transfer. Since it is grid-based smooth boundaries are approximated by step-stair boundaries. We will modify the LB to accurately model smooth surfaces. The student/visitor will follow this plan:</p> <ul style="list-style-type: none"> • Understand the inherent problems of LB (especially when solving problems with smooth, curved boundaries); • Understand the method I am proposing to overcome the issues; • Implement the technique in 2D and 3D LB algorithms; • Validate on suitable test problems and apply to real-world problems. <p>Write research publication (report, paper) on this method.</p>
Skills required from candidate	<p>Some knowledge of computational fluid dynamics.</p> <ul style="list-style-type: none"> • Experience/degree in applied mathematics, theoretical physics or computational methodologies; • Some evidence of previous algorithm development or programming (languages such as C, Matlab or Fortran are desirable).
Developmental outcomes for candidate	<p>The student/visitor will work in a dynamic area which is intensively being used world-wide (i.e. LB methods). It has applications in diverse fields such as energy (oil/gas production, ground water flow), manufacturing (production of absorbent/porous materials), micro and nanofluidics. The student will get valuable mentoring, supervision and experience in algorithm and mathematical model development, and also increase and develop their programming skills. In addition, international journal publication(s) is a concrete aim of this project.</p>
Additional comments	Supervisor's homepage: https://people.csiro.au/P/G/Gerald-Pereira

2.4 Adaptive Data Augmentation for Text Classification

CSIRO Supervisor	Dr Chang Xu
CSIRO Supervisor contact details	Chang.Xu@data61.csiro.au
CSIRO Business Unit	Data61
Project Location	Australia, New South Wales - Marsfield
Project suitable for type of candidate	PhD Student
Project title	Adaptive Data Augmentation for Text Classification
Research area	Natural language processing, Deep reinforcement learning, Adversarial machine learning
Project description	Text classification is typically done via Machine Learning. To obtain good classifiers, we need to annotate large amounts of text for training, a manual process making building classifiers for new datasets very difficult. Text Data Augmentation (TDA) is an emerging technique for getting more training data by generating new data from existing data. While there are existing TDA methods, selecting the effective ones for a dataset is currently a manual process, as they may not adapt well to new datasets. This project aims to develop novel TDA techniques that can adaptively find the optimal augmentation strategies for a target dataset.
Skills required from candidate	<ul style="list-style-type: none"> • A background in natural language processing and machine learning would be advantageous; • The applicant should also have good communication skills and good programming skills (for example, familiar with deep learning libraries such as PyTorch and TensorFlow).
Developmental outcomes for candidate	The student will gain substantial experience in developing deep learning models for natural language processing tasks by leveraging recent advances in deep reinforcement learning and adversarial machine learning. The student will be able to publish in top NLP/AI/ML conferences (e.g., ACL, AAAI, ICLR), and have impact on real-world projects.
Additional comments	Supervisor's homepage: https://people.csiro.au/X/C/Chang-Xu

2.5 Context-aware Image Analysis

CSIRO Supervisor	Dr Qing Liu
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CSIRO Business Unit	Data61
Project Location	Australia, Tasmania - Sandy Bay
Project suitable for type of candidate	Either PhD Student or Scholar
Project title	Context-aware Image Analysis
Research area	Image Processing, Data Management, Semantic analysis
Project description	With the popular use of social networks, the increasing literatures have exposed rich resources of semantic information conveyed by online user generated content: the images and the associated texts (captions or tags). The conventional visual features are hard to represent images' semantic information. Recent methods improve the performance of different visual-based concept classification by making use of the texts surrounding an image that provide valuable information. For this visiting opportunity, the student/scholar would explore research in how to leverage the text and visual information towards context-aware analysis and/or search. Findings will be reported in international peer-reviewed journals.
Skills required from candidate	<ul style="list-style-type: none"> • Outstanding track record in data analysis including image processing, semantic analysis; • Sound programming skills including java and/or python for data processing and algorithm implementation; • Good communication and writing skill in English for paper publication and presentation.
Developmental outcomes for candidate	<ul style="list-style-type: none"> • Improved capability for advanced data analysis research; • Enhanced skills to carry independent research; • Good exposure to various Data61 research teams and other CSIRO business units to understand real world problems.
Additional comments	Supervisor's homepage: https://people.csiro.au/L/Q/Q-Liu

2.6 Large Scale Distributed Stream Processing

CSIRO Supervisor	Dr Qing Liu
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CSIRO Business Unit	Data61
Project Location	Australia, Tasmania - Sandy Bay
Project suitable for type of candidate	Either PhD Student or Scholar
Project title	Large Scale Distributed Stream Processing
Research area	Big Data, Data Stream, Distributed System, Query Optimization
Project description	Many industries, including health-care, e-commerce, insurance, transportation have taken use of Big Data analytics to make critical decisions. It requires efficiently processing large scale dynamically changing data at near real-time. However, there are a few open challenges due to the complexity involved in large scale streaming data including scalability and heterogeneity. For this visiting opportunity, the student/scholar would explore research in how to model large scale single and/or multiple data streams in a distributed environment and develop query optimization techniques accordingly.
Skills required from candidate	<ul style="list-style-type: none"> • Outstanding track record in data analysis including streaming processing, query optimization; • Sound programming skills including java and/or python for data processing and algorithm implementation; • Good communication and writing skill in English for paper publication and presentation.
Developmental outcomes for candidate	<ul style="list-style-type: none"> • Improved capability for advanced data analysis research in Big Data Streaming; • Enhanced skills to carry independent research; • Good exposure to various Data61 research teams and other CSIRO business units to understand real world problems.
Additional comments	Supervisor's homepage: https://people.csiro.au/L/Q/Q-Liu

2.7 Knowledge Modeling and Behaviour Analytics Based on Multi-Interdependent Data Sources

CSIRO Supervisor	Dr Chi Hung Chi
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CSIRO Business Unit	Data61
Project Location	Australia, Tasmania - Sandy Bay
Project suitable for type of candidate	Either PhD Student or Scholar
Project title	Knowledge Modeling and Behaviour Analytics Based on Multi-Interdependent Data Sources
Research area	Machine Learning and Data Mining ontology engineering Knowledge Fusion Knowledge Graph and Modeling
Project description	<p>In AI and Big Data, one important direction is human-machine collaboration for actionable, explainable analytics. To do this, expert knowledge will first be captured in domain specific ontology. Then using deep learning techniques, this ontology will be evolved and adapted as the knowledge model of an entity. Through data service composition, behaviour knowledge flow graph will be created for subsequent prescriptive analytics. This project aims for both fundamental science research as well as real life problem solving. Focus of the research includes:</p> <ul style="list-style-type: none"> • Data driven ontology adaption and model coupling; • Knowledge fusion and knowledge graph; • Data service composition and behaviour analytics.
Skills required from candidate	Good mathematics and/or software service system background Data engineering skills (from crawling to management) Prefer to have knowledge in data fusion, graph theory, machine learning and data mining
Developmental outcomes for candidate	This is a research project, with top journal publication as deliverables. In addition, students/scholars will gain the experience of how to extract science questions from real-life situations, to research and develop innovative technologies to address science questions, and to map research results back to solve real-life problems.
Additional comments	The project is expected to be at least one year. It can take more than one person.

2.8 Privacy Preserving Under Intelligence Sharing and AI

CSIRO Supervisor	Dr Chi Hung Chi
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CSIRO Business Unit	Data61
Project Location	Australia, Tasmania - Sandy Bay
Project suitable for type of candidate	Either PhD Student or Scholar
Project title	Privacy Preserving Under Intelligence Sharing and AI
Research area	Privacy Preserving Artificial Intelligence Knowledge Fusion Knowledge Graph and Modeling
Project description	With advances in digital economy and smart cities, privacy preserving has already been a growing concern. This problem is intensified by (i) social network where people actually take an active role in data sharing, and (ii) by machine learning where personal inference is often done by third parties. Current research on privacy preserving mainly focuses on information entropy, with less on requirements and risks. The aim of this project is to shift privacy preserving from technology-centric to human/requirements-centric. It will investigate how human should be and can be in the loop of privacy preserving, including data/knowledge sovereignty and subsequent risks.
Skills required from candidate	Information theory Data fusion and integration Data analytics and statistics
Developmental outcomes for candidate	This is a research project, with top journal publication as deliverables. In addition, students/scholars will gain the experience of how to extract science questions from real-life situations, to research and develop innovative technologies to address science questions, and to map research results back to solve real-life problems.
Additional comments	The project is expected to be at least one year. It can take more than one person.

2.9 Online learning driven, multi-purpose, standoff cyber situational awareness

CSIRO Supervisor	Dr Shenghong Li
CSIRO Supervisor contact details	shenghong.li@csiro.au, +61 2 93724629 wei.ni@csiro.au, +61 2 93724646
CSIRO Business Unit	Data61
Project Location	Australia, New South Wales - Marsfield
Project suitable for type of candidate	Either PhD Student or Scholar
Project title	Online learning driven, multi-purpose, standoff cyber situational awareness
Research area	Cyber situational awareness, machine learning, deep learning, wireless network
Project description	Wireless network exhibits strong vulnerability to various attacks due to its broadcast nature. Cyber situational awareness of wireless networks is indispensable to improve the robustness of wireless networks. The awareness includes: who are around (identity), what their hidden underlying patterns (behaviour) are to explore the vulnerabilities of the network (e.g., for DDoS or APT), and whether they cooperate to launch collusion attacks (strategy). This project will deliver a novel learning-driven multi-sensor system, where new deep learning techniques will be developed to learn from captured signals and cyber information encapsulated to fingerprint adversaries, infer their behaviours and predict their next moves.
Skills required from candidate	<ul style="list-style-type: none"> • Background in signal processing, tele-communication, wireless communication, or computer science; • Research experience in wireless network and/or cyper-security; • Knowledge and experiences in machine learning; • Good communication skills, the ability to present results to different audiences; • Ability to think creatively, to work collaboratively and to perform tasks under minimal supervision.
Developmental outcomes for candidate	The student/scholar will acquire expert knowledge in wireless situational awareness and be capable of applying cutting-edge technologies to tackle the threats facing wireless networks, advancing his/her career as a specialist in the cybersecurity domain. Multiple high quality papers will be published in reputable IEEE Transactions and Journals.
Additional comments	Supervisor's homepage: https://people.csiro.au/L/S/Shenghong-Li

2.10 Self-learning and navigated UAVs for IoT data capture

CSIRO Supervisor	Dr Wei Ni
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CSIRO Business Unit	Data61
Project Location	Australia, New South Wales - Marsfield
Project suitable for type of candidate	PhD Student
Project title	Self-learning and navigated UAVs for IoT data capture
Research area	UAV control, Internet-of-Things (IoT), wireless communication, machine learning, and signal processing
Project description	UAVs can provide an effective means to collect important data collected from IoT sensors, e.g., those deployed in the Great Barrer Reef. A problem yet to be addressed is auto-navigation of the UAVs which are expected to self-adapting to fast changing ocean tidal conditions. Auto-navigation leads the UAVs to the right sensory devices at the right time to minimise the buffer overflow and subsequent data loss. This project will develop onboard learning to enable UAVs to navigate under fast-changing ocean conditions and minimise data losses. New learning and partial observable Markov decision process will be delivered onboard inside UAV's processors.
Skills required from candidate	<ul style="list-style-type: none"> • Signal processing; • Machine Learning, and reinforcement learning; • Python programming; • Matlab programming.
Developmental outcomes for candidate	The scientific outcome will include new deep reinforcement learning or partial-observable Markov decision process frameworks for online control and self-navigation of UAVs in hostile environments. Impact will be generated through two quality publications in high-impact IEEE journals, and two to three quality conference papers in IEEE flagship conferences.
Additional comments	Wei Ni is the Group Leader, Cybernetics Group, Cyber-Physical Systems (CPS) Program, Adjunct Professor at the University of Technology Sydney (UTS), and Honorary Professor at Macquarie University. Wei is an Editor for IEEE Transactions on Wireless Communications, and the Vice-Chair, IEEE Vehicular Technology Society (VTS) New South Wales (NSW) Chapter.

2.11 Machine Learning for Reconfigurable Intelligent Metasurfaces

CSIRO Supervisor	Dr Wei Ni
CSIRO Supervisor contact details	wei.ni@csiro.au +61 2 9372 4646
CSIRO Business Unit	Data61
Project Location	Australia, New South Wales - Marsfield
Project suitable for type of candidate	PhD Student
Project title	Machine Learning for Reconfigurable Intelligent Metasurfaces
Research area	<ul style="list-style-type: none"> • Signal processing; • Optimization; • Machine learning; • Wireless communication.
Project description	<p>“Reconfigurable metasurfaces” are highly desired for manipulating mmWave waveforms but have not been demonstrated at these very high frequency bands. A key enabler for using such metasurfaces is the ability to recover real-time signal information (using signal detection or tracking and processing), make immediate analytical decisions, and then command/control the change (reconfiguration) of the signals via intelligent means, i.e. artificial intelligence (AI), with a signal based focus. This project will create an innovative signal processing framework to design and control metasurfaces. Specialised designs of online learning will address the challenges of scale and electrophysical characteristics of the metasurfaces.</p>
Skills required from candidate	<ul style="list-style-type: none"> • Signal processing and optimization (e.g., linear programming, integer programming, and convex optimisation); • Machine learning and deep (reinforcement) learning; • Wireless communication system; • Python; • Matlab.
Developmental outcomes for candidate	<p>The outcomes are expected to be:</p> <ul style="list-style-type: none"> • New scientific knowledge and technologies of machine learning, AI, and metasurface (for advanced materials); • New impact, including at least two papers accepted in high-impact journals; • two papers accepted top-ranked international conferences in the field.
Additional comments	<p>Wei Ni is the Group Leader, Cybernetics Group, Cyber-Physical Systems (CPS) Program, Adjunct Professor at the University of Technology Sydney (UTS), and Honorary Professor at Macquarie University. Wei is an Editor for IEEE Transactions on Wireless Communications, and the Vice-Chair, IEEE Vehicular Technology Society (VTS) New South Wales (NSW) Chapter.</p>

3 Energy

3.1 Direct electrocatalytic CO₂ conversion from carbamate

CSIRO Supervisor	Dr Kangkang Li
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CSIRO Business Unit	Energy
Project Location	Australia, New South Wales - Newcastle
Project suitable for type of candidate	PhD Student
Project title	Direct electrocatalytic CO ₂ conversion from carbamate
Research area	Post combustion CO ₂ Capture and electrocatalytic CO ₂ conversion
Project description	The project entails an innovative concept of direct electrocatalytic CO ₂ conversion from carbamate which integrates amine-based CO ₂ capture and electrocatalytic CO ₂ conversion into one process. It promises to significantly reduce the energy requirement of amine regeneration, whilst directly converting the captured CO ₂ into valuable chemicals/fuels. This challenging and potentially game-changing research builds upon the group's existing chemical expertise and engineering capabilities. The student will conduct experiments of electrocatalysts development and perform flow battery-based CO ₂ conversion process, aiming at efficiently and selectively convert CO ₂ into valuable chemicals with possible low energy. The work will be conducted in accordance with CSIRO practices.
Skills required from candidate	<ul style="list-style-type: none"> • (Electro-)chemical engineering; • Electrochemistry; • Material science and engineering; • Catalyst synthesis and characterisation.
Developmental outcomes for candidate	The student will be in a multi-disciplinary and multi-cultural working environment in CSIRO Energy Newcastle where he can access to talented researchers and engineers, a range of low emission energy technologies and well-equipped laboratories. The innovative nature of this project will have large potential to generate high-quality scientific journal papers.
Additional comments	The group has a very close collaboration with local Universities, e.g. University of Newcastle, UNSW to which the student will be introduced. The group has hosted a large number of PhD-students from China through the CSC-scheme and has ample experience in the practical aspects of Chinese student supervision.

3.2 Electrochemically-mediated amine regeneration and hydrogen production in amine-based system

CSIRO Supervisor	Dr Kangkang Li
CSIRO Supervisor contact details	kangkang.li@csiro.au +61 469 223 499
CSIRO Business Unit	Energy
Project Location	Australia, New South Wales - Newcastle
Project suitable for type of candidate	PhD Student
Project title	Electrochemically-mediated amine regeneration and hydrogen production in amine-based system
Research area	Low emission energy technology; Post-combustion CO ₂ capture; CO ₂ capture and H ₂ production from amine system
Project description	The project entails a promising concept that integrates CO ₂ capture and H ₂ production into amine-based system through an electrochemical route. This integrated electrochemical system provides the opportunity of amine-based CO ₂ capture being a renewable electricity storage system. It also facilitates the CO ₂ utilisation of on-site, on-demand synthesis of carbon fuels through hydrogenation process. This challenging research builds upon the group's existing (electro-)chemistry expertise and engineering capabilities in amine-based CO ₂ capture technology. The student will conduct experiments and perform process modelling that will characterise and optimise the integrated CO ₂ capture and H ₂ production process with possible low energy requirement.
Skills required from candidate	(Electro-)chemical engineering, Electrochemistry Material science and engineering Catalyst synthesis and characterisation
Developmental outcomes for candidate	The student will be in a multi-disciplinary and multi-cultural working environment in CSIRO Energy Newcastle where he can access to talented researchers and engineers, a range of low emission energy technologies and well-equipped laboratories. The innovative nature of this project will have large potential to generate high-quality scientific journal papers.
Additional comments	The group has a very close collaboration with local Universities, e.g. University of Newcastle, UNSW to which the student will be introduced. The group has hosted a large number of PhD-students from China through the CSC-scheme and has ample experience in the practical aspects of Chinese student supervision.

3.3 Understanding microbial coal to methane transformations

CSIRO Supervisor	Dr Se Gong
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CSIRO Business Unit	Energy
Project Location	Australia, New South Wales - North Ryde
Project suitable for type of candidate	PhD Student
Project title	Understanding microbial coal to methane transformations
Research area	This project sits in the nexus between geochemistry and microbiology
Project description	The degradation of organic matter in coal is poorly characterised. Currently, only the terminal parts of the pathway are well understood. The project will grow anaerobic microbes from Australian coal seams on coals from eastern Australian coal basins, measuring metabolites produced into the formation water. It will require the use of an anaerobic chamber, molecular biology, bioinformatics and LC-MS. We anticipate such a study will result in high impact papers which we aim to publish in international scientific journals.
Skills required from candidate	Laboratory experience, along with skill and experience with LCMS is essential. Skills and experience in: geochemistry, molecular biology, microbiology, bioinformatics or anaerobic microbiology, would be beneficial but are not required.
Developmental outcomes for candidate	The successful candidate will have an opportunity to work with, and learn from, a multidisciplinary team of microbiologists, geochemists and geologists. The successful candidate will also have an opportunity to learn new skills including paper writing, coding using python along with microbiology and geochemistry.
Additional comments	The successful candidate will have an opportunity to study with other postgraduates in our team co-supervised with Macquarie University.

3.4 Household occupant behaviour modelling for energy efficient house design

CSIRO Supervisor	Dr Dong Chen
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CSIRO Business Unit	Energy
Project Location	Australia, Victoria - Clayton
Project suitable for type of candidate	Either PhD Student or Scholar
Project title	Household occupant behaviour modelling for energy efficient house design
Research area	Occupant behaviour modelling methodology for residential building energy efficiency and energy rating.
Project description	<p>This proposed research project will investigate household occupant behaviour modelling methodologies for energy efficient residential building designs for low-carbon living. Expected deliverables:</p> <ul style="list-style-type: none"> • A report or a scientific paper on household occupant behaviour modelling methods for energy efficient residential building designs. Required activities; • Reviewing different methodologies for household occupant behaviour modelling; • Compare the advantages and disadvantages of different household occupant behaviour modelling methodologies; • Recommend household occupant behaviour modelling methodologies for energy efficient residential building designs, especially for house energy rating scheme.
Skills required from candidate	Experiences in thermal and energy systems for low carbon living; Skill in scientific computation software program development Evidence of English language proficiency.
Developmental outcomes for candidate	Nationwide house energy rating (NatHERS) scheme in Australia has been over two decades which CSIRO is the main technical contributor. The candidate will be able to learn from Australian experiences which can potentially be very useful for energy efficient housing and low carbon living in China.
Additional comments	Supervisor's homepage: https://research.csiro.au/energyrating/the-team/profile-dr-dong-chen-principal-research-scientist/

3.5 Thermo-electrochemical energy conversion

CSIRO Supervisor	Dr Laura Yin
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CSIRO Business Unit	Energy
Project Location	Australia, New South Wales - Newcastle
Project suitable for type of candidate	Either PhD Student or Scholar
Project title	Thermo-electrochemical energy conversion
Research area	Conversion of low-grade waste heat from industrial plants into electricity
Project description	This project involves innovative and impactful research on converting low-grade waste heat, which is not being properly utilized and discharged to environment, into electricity. Aiming to efficiently and continuously generate electricity from low-end thermal energy sources, the students will conduct experimental and theoretical study including developing working electrolytes, characterizing electrode materials and optimizing cell configurations for high power output. High quality scientific papers and relevant patents are promising on this challenging and beneficial project.
Skills required from candidate	<ul style="list-style-type: none"> • (Thermo-)Electrochemistry; • Materials Electrochemistry; • Redox and Coordination Chemistry.
Developmental outcomes for candidate	The students will be working in well-equipped laboratory at CSIRO Energy Centre in Newcastle under supervision of experts in low emission technologies and electrochemistry, experiencing multi-disciplinary research and multicultural environment. The scholarship provides the students scientific research opportunities as well as broad communication within CSIRO and universities in Australia.
Additional comments	The group has been hosted numerous visiting scholars and students through CSC scheme and other subsidized programme between China and Australia. Close and productive collaborations have been developed with University of Newcastle on cultivating joint PhD students.

3.6 Organic matter characterisation for Chinese and Australian gas shales

CSIRO Supervisor	Dr Zhongsheng Li
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CSIRO Business Unit	Energy
Project Location	Australia, New South Wales - North Ryde
Project suitable for type of candidate	Either PhD Student or Scholar
Project title	Organic matter characterisation for Chinese and Australian gas shales
Research area	Organic petrology, shale gas reservoir characterisation, petroleum generation, accumulation and storage mechanisms and controlling factors. organic matter hosted porosity.
Project description	This project will be looking at thermal maturity, maceral compositions, porosities of organic matter in a suite of gas shales or oil shales from one of major shale gas basin in China. Through a detailed reservoir characterisation program, the role and influence of dispersed organic matter on shale gas/oil generation potential, accumulation and storage as well as what major controlling factors will be identified and assessed. Then a comparison to Australian shale gas will also be discussed. Expected deliverables will be a final report and one journal paper. The student/Scholar can choose any topics from above to suit his/her study.
Skills required from candidate	Sound knowledge and proper training on petroleum geology or engineering, or spectroscopic chemistry. organic petrology and geochemistry will be a bonus. Good reading, writing and spoken English.
Developmental outcomes for candidate	The PhD student/Scholar will gain first-class hands-on research experience at CSIRO, and well equipped with better knowledge and understanding in shale gas/oil research for his/her future career.
Additional comments	Supervisor's homepage: https://people.csiro.au/L/Z/Zhongsheng-Li

3.7 Direct capture of CO₂ from air and conversion to methane

CSIRO Supervisor	Dr Ali Kiani
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CSIRO Business Unit	Energy
Project Location	Australia, New South Wales - Newcastle
Project suitable for type of candidate	Either PhD Student or Scholar
Project title	Direct capture of CO ₂ from air and conversion to methane
Research area	Negative emission technologies, CO ₂ capture from air and its utilisation
Project description	Direct capture of CO ₂ from air (DAC) and its catalytic conversion to synthetic fuels such as methane is recently of significant interest. However due to low concentration of CO ₂ in air, DAC needs to be revolutionised. Using liquid based absorption process would provide interesting potentials, however in order to make this process economically viable, conventional liquid absorbents and contactors need to be replaced by innovative and more energy efficient absorbents and liquid-gas contactors. Also an efficient integration of DAC with fuel synthesis such as methanation would be required. The PhD student/scholar would work and develop the innovative ideas on these.
Skills required from candidate	The qualified student/scholar would preferably have: <ul style="list-style-type: none"> • A qualification in chemical engineering or other areas relevant to CO₂ capture, from a top university; • A good understanding of the liquid based absorption process and CO₂ absorption/adsorption; • A sound knowledge and background in transfer phenomena specifically the mass transfer in gas-liquid systems and/or reaction engineering; • A willingness to present the results in the shape of journal publication.
Developmental outcomes for candidate	The student/scholar would be exposed to quality research work and high calibre scientists in the area of CO ₂ capture and utilisation. Also they have the opportunity to develop their understanding and knowledge about the newly emerging area of CO ₂ capture from air and its utilisation, and further establish their career.
Additional comments	Direct capture of CO ₂ from air is currently a challenging process, which requires researchers to apply their current skills and also develop their understanding of the fundamentals of capture process further. This would be best achieved by the active collaboration between researchers working in this area from around the world.

3.8 Development of novel materials for solar thermochemical synthesis of ammonia

CSIRO Supervisor	Dr Yanping Sun
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CSIRO Business Unit	Energy
Project Location	Australia, New South Wales - Newcastle
Project suitable for type of candidate	PhD Student
Project title	Development of novel materials for solar thermochemical synthesis of ammonia
Research area	Computational design and preparation of novel materials and then test of these materials for solar thermochemical synthesis of ammonia.
Project description	The objective of the project is to develop novel materials for solar thermochemical synthesis of ammonia. The ammonia synthesis involves the two-step reactions: the material is firstly converted to a nitride using nitrogen and then the nitride is reduced by hydrogen from electrolysis of water to form ammonia (endothermic) driven by concentrated solar thermal energy. This overcomes current industry challenges of high cost, low yield and emission-intensive processes. The novel materials will be designed using combined experimental-theoretical methods. The project not only addresses the crucial issues with solar energy storage but also meets the rising demand of ammonia in agriculture
Skills required from candidate	<ul style="list-style-type: none"> • Solid fundamental knowledge in inorganic material science and chemistry or chemical engineering; • Preferably the student will have some research experience in metal oxide design, synthesis, characterisation and testing.
Developmental outcomes for candidate	<ul style="list-style-type: none"> • First-hand experience in a world-leading concentrated solar thermal facility; • Access to the expertise of experienced solar thermal researchers; • Work experience on the expanding topical research area of solar thermochemical production of ammonia; • Publication of the results in at least one international journal paper relating to the research project.
Additional comments	The proposed process's advantage is to substitute most of the current fossil fuel input to the process with solar energy. This could save up to 81% in fossil fuel input and avoid carbon dioxide emissions by up to 84%, It could become a clean and cost-effective method to produce ammonia.

4 Health and Biosecurity

4.1 Consumers' perceived risks of and attitudes toward antimicrobials resistance

CSIRO Supervisor	Dr Airong Zhang
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CSIRO Business Unit	Health and Biosecurity
Project Location	Australia, Queensland - Dutton Park
Project suitable for type of candidate	PhD Student
Project title	Consumers' perceived risks of and attitudes toward antimicrobials resistance
Research area	Applying social psychological theoretical frameworks including risk perceptions to understand attitudes toward the use of antimicrobials in food production
Project description	Antimicrobial resistance is increasingly becoming one of the most serious threat to human health. If no action taken, AMR will overpass cancer and claim 10 million lives annually by 2050. The AMR transmission from animals to humans through food chain has been identified as a key transmission pathway. The proposed research focuses on investigating consumers' risk perceptions associated with the use of antimicrobials in food production and the factors shaping risk perceptions through what mechanisms. This will provide significant insights in understanding the structural framework of risk perceptions and consumers' attitudes toward the use of antimicrobials in food production.
Skills required from candidate	<ul style="list-style-type: none"> • Qualification/knowledge in social psychology/applied psychology; • Quantitative research methodology; • Advanced statistical analytical skills; • Sound capability in communicating ideas in writing.
Developmental outcomes for candidate	<ul style="list-style-type: none"> • In-depth knowledge of research in food safety and security, biosecurity, and new technology; • Research methodology including social experimental designs; • Analytical skills, especially statistical modelling of survey data; • Preparing paper for peer-reviewed journals.
Additional comments	Supervisor's homepage: https://www.researchgate.net/profile/Airong_Zhang

4.2 Public risk perceptions and attitudes toward antibiotics resistance

CSIRO Supervisor	Dr Airong Zhang
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CSIRO Business Unit	Health and Biosecurity
Project Location	Australia, Queensland - Dutton Park
Project suitable for type of candidate	PhD Student
Project title	Public risk perceptions and attitudes toward antibiotics resistance
Research area	Applying social psychological theoretical frameworks to understand risk perceptions and attitudes toward the use of antibiotics and antibiotics resistance
Project description	<ul style="list-style-type: none"> • Antibiotics resistance occurs when microorganisms such as bacteria become resistance to antibiotics; • Antibiotics resistance is increasingly becoming one of the most serious threat to human health. If no action taken, AMR will overpass cancer and claim 10 million lives annually by 2050; • This project will examine public understanding and risk perceptions of antibiotics resistance; • It will further identify pathways for interventions to tackle antibiotics resistance.
Skills required from candidate	<ul style="list-style-type: none"> • Qualification/knowledge in social psychology/applied psychology; • Quantitative research methodology; • Advanced statistical analytical skills; • Sound capability in communicating ideas in writing.
Developmental outcomes for candidate	<ul style="list-style-type: none"> • In-depth knowledge of research in attitudes and behaviours about antibiotics resistance; • Research methodology including social experimental designs; • Analytical skills, especially statistical modelling of survey data; • Preparing paper for peer-reviewed journals.
Additional comments	Supervisor's homepage: https://www.researchgate.net/profile/Airong_Zhang

4.3 Preventing global spread of weed seeds

CSIRO Supervisor	Dr Riex van Klinken
CSIRO Supervisor contact details	rieks.vanklinken@csiro.au +61 429 125 344
CSIRO Business Unit	Health and Biosecurity
Project Location	Australia, Queensland - Dutton Park
Project suitable for type of candidate	Scholar
Project title	Preventing global spread of weed seeds
Research area	Developing improved diagnostics and pathway analyses to reduce the risk of international weed seed spread.
Project description	<ul style="list-style-type: none"> • The volume of agricultural produce being traded globally continues to increase. With it comes increased risk of international spread of invasive plants and of herbicide-resistant, weed biotypes; • Rapid and reliable detection of seed contaminants is critical in reducing the risk of weed spread, as is a better understanding of how weeds are most likely to be dispersed with trade; • This project will build on existing work in China and Australia on weed seed diagnostics that relies on both morphology and cutting-edge genetic techniques; • In addition, interception and monitoring data at ports will be analysed to better understand risk pathways.
Skills required from candidate	<ul style="list-style-type: none"> • Detailed knowledge in plant taxonomy, seed identification using both morphological and genetic techniques, and invasive plants; • Understanding of international trade in agricultural products, the risk it poses to weed spread, and how it can be addressed through regulation and surveillance; • Extensive experience in monitoring and identification of alien weeds at ports; • Ability to conduct research, including to think independently and conceptually, design and execute research and apply analytical skills; • Ability to prepare journal papers; • Ability to work within a collaborative team, and to build networks.
Developmental outcomes for candidate	<ul style="list-style-type: none"> • Enhanced ability in weed seed diagnostics and pathway analysis; • International networks relevant to reducing the trade-related movement of biosecurity threats; • Scientific publication in an international peer-reviewed journal.
Additional comments	We have already identified Dr Han Xu from the Institute of Plant Quarantine, Chinese Academy of Inspection and Quarantine (CAIQ) as a potential collaborator with the requisite skills. Developing deep and enduring collaborative links with this agency is a strategic priority for our market access research program.

4.4 Biosecurity and market access

CSIRO Supervisor	Dr Rieks van Klinken
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CSIRO Business Unit	Health and Biosecurity
Project Location	Australia, Queensland - Dutton Park
Project suitable for type of candidate	Scholar
Project title	Biosecurity and market access
Research area	Overcoming biosecurity barriers to the global trade in fresh agricultural produce through the development of improved risk management approaches.
Project description	The International Plant Protection Convention, overseen by FAO, is responsible for providing a regulatory and technical framework needed for countries to negotiate safe trade that minimizes the risk of pest movement. Currently most trade is negotiated based on “pest freedom” or the application of an “end point treatment” (e.g. fumigation). This project will focus on the development of an alternative called “systems approaches” which allows multiple risk reducing activities to be combined. Systems approaches offer considerable advantages, including being consistent with modernizing agricultural supply chains, but needs to be supported by improved risk analytics and technologies.
Skills required from candidate	<ul style="list-style-type: none"> • In-depth knowledge of biosecurity, pest risk analysis and market access, as it relates to international trade in horticultural products; • Strong understanding in System Approaches; • Ability to conduct research, including to think independently and conceptually, design and execute research and apply analytical skills; • Ability to prepare journal papers of international quality • Ability to work within a collaborative team, and to build networks.
Developmental outcomes for candidate	<ul style="list-style-type: none"> • Enhanced ability in risk analysis as it applies to development of phytosanitary procedures; • International networks to assist in the collaborative development of harmonized risk analysis approaches needed to support trade; • Scientific publication in an international peer-reviewed journal.
Additional comments	This is a strategic area for CSIRO Health and Biosecurity, and has support of Program Leader. We have already identified Dr Xubin Pan from CAIQ (Chinese Academy of Inspection and Quarantine, and China Agricultural University) as a potential collaborator with the requisite skills.

5 Land and Water

5.1 Risk assessment of short-term industry effluent discharges to aquatic environments

CSIRO Supervisor	Dr Stuart Simpson
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CSIRO Business Unit	Land and Water
Project Location	Australia, New South Wales - Lucas Heights
Project suitable for type of candidate	PhD Student
Project title	Risk assessment of short-term industry effluent discharges to aquatic environments
Research area	Development of short-exposure water quality guidelines that predict how fluctuating exposure conditions influence the toxicity of contaminants to aquatic organisms.
Project description	Discharges of industry wastewater effluents remain one of the greatest sources of pollutants to aquatic environments. Aquatic systems often receive episodic contaminant inputs which result in fluctuating exposures to organisms. How fluctuating contaminant exposures influence the toxicity of waters is poorly understood and impedes the development of effective water quality guidelines. Regulators need guidelines that effectively protect aquatic ecosystems without being over conservative and inflicting unnecessary costs on industries. This project will use state-of-art chemistry and ecotoxicity facilities to develop and validate short-exposure water quality guidelines that are more effective for regulating industrial discharges. Project outputs will include publications.
Skills required from candidate	Training will be provided in all techniques. The student/scholar should have a basic understanding of factors influencing contaminant bioavailability and toxicity. They should have some experience with analysis techniques for contaminants, including quality control and assurance measures. It would be of benefit if they have some experience with biological or ecotoxicity test procedures.
Developmental outcomes for candidate	The student/scholar will gain experience in environmental risk assessment. They will gain skills in chronic toxicity testing with sensitive algae or invertebrates, incorporation of toxicity data into concentration-duration models to better predict the effects of fluctuating exposures, trace contaminant analyses and quality control, and measurements of contaminant bioavailability using techniques.
Additional comments	The project will build on the research undertaken by CSIRO to improve the science underpinning guidelines and regulations. A goal of this research is to build a database of metal concentration-duration effects so that a species sensitivity distribution can be built that incorporates these parameters and better regulate industrial discharges.

5.2 Blending Landsat and MODIS imagery for monthly evapotranspiration mapping

CSIRO Supervisor	Dr Yun Chen
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CSIRO Business Unit	Land and Water
Project Location	Australia, Australian Capital Territory - Black Mountain
Project suitable for type of candidate	Either PhD Student or Scholar
Project title	Blending Landsat and MODIS imagery for monthly evapotranspiration mapping
Research area	Remote sensing (RS), GIS, Big Data, Data Cube (DC), Google Earth Engine (GEE), artificial intelligence (AI), meteorology and hydrology
Project description	The project aims to map spatio-temporal evapotranspiration (AET) dynamics in two selected catchments in Australian arid and semi-arid landscapes. It develops a methodology on DC or GEE, which integrates the two data sources as input into a deep learning fusion model for deriving AET by taking the advantages of the high spatial resolution of Landsat imagery and the high temporal resolution of MODIS imagery. The 25m-resolution monthly AET output (1987-2018) will be calibrated using ground observed meteorological and hydrological data. The project provides a rigorous AET dataset for supporting informed decisions about hydro-meteorological disasters forecasting in arid and semi-arid Australia.
Skills required from candidate	Scholars or PhD students will have more than two of the following skills: <ul style="list-style-type: none"> • Optical remote sensing technology; • AI (artificial intelligence) techniques; • Python scripting; • Understanding of meteorology and surface water hydrology.
Developmental outcomes for candidate	They will gain an enriching experience by conducting cutting-edge research in a highly-productive team environment. They will develop high-level skills in geoinformatics by applying the most advanced RS, GIS technologies and AI modelling approaches to Big Data on DC and GEE. They will be able to publish high-impact journal articles.
Additional comments	Supervisor's homepage: https://people.csiro.au/C/Y/Yun-Chen

5.3 Towards a national identification and enumeration of farm dams

CSIRO Supervisor	Dr Yun Chen
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CSIRO Business Unit	Land and Water
Project Location	Australia, Australian Capital Territory - Black Mountain
Project suitable for type of candidate	Either PhD Student or Scholar
Project title	Towards a national identification and enumeration of farm dams
Research area	Remote sensing (RS), Big Data, Data Cube (DC), Google Earth Engine (GEE), GIS and artificial intelligence (AI)
Project description	The collective effect of individual farm dams (about 10 millions in Australia) raises important hydrological, ecological, and biogeochemical questions. Because of their local and unregulated nature, the number, location, and water retaining capacity of nation's farm dams is very poorly known. This objective of this project is to catalogue national farm dams using the new high-resolution sentinel-2 and sentinel-1 satellite data available via the DC and GEE. The integration of both optical and SAR images has the potential to develop tools and digital techniques based on automatic pattern recognition of both pond shape and spectral characteristics of the stored water.
Skills required from candidate	Scholars or PhD students will have more than two of the following skills: <ul style="list-style-type: none"> • Remote sensing (skills in SAR data processing is preferable); • AI (artificial intelligence) techniques; • Python scripting; • GIS.
Developmental outcomes for candidate	They will gain an enriching experience by conducting cutting-edge research in a highly-productive team environment. They will develop high-level skills in geoinformatics by applying the most advanced RS, GIS technologies and AI modelling approaches to Big Data on DC and GEE. They will be able to publish high-impact journal articles.
Additional comments	Supervisor's homepage: https://people.csiro.au/C/Y/Yun-Chen

6 Manufacturing

6.1 New biodegradable elastomer and soft polymer for biomedical applications

CSIRO Supervisor	Dr Johan Basuki
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CSIRO Business Unit	Manufacturing
Project Location	Australia, Victoria - Clayton
Project suitable for type of candidate	Either PhD Student or Scholar
Project title	New biodegradable elastomer and soft polymer for biomedical applications
Research area	Design and development of new biodegradable elastomer with specific functional linkers for tissue engineering applications
Project description	Elastomers were first introduced in tissue engineering applications to improve the interaction between implant materials and the soft tissue. While materials based on poly(lactic acid) and poly(glycolic acid) were used heavily in the academia and industry, their mechanical properties and degradation rates of these materials were not optimal for engineering soft tissues. There is also a need to functionalize the elastomer with functional groups for better tissue interactions, i.e. with peptide. In this project we will design new biodegradable soft polymer with tuneable mechanical criteria, biodegradation, and chemical functionalities for conjugation of biomolecules for potential tissue engineering applications.
Skills required from candidate	<ul style="list-style-type: none"> • Essential: Synthetic organic or polymer chemistry; • Essential: Chemical analysis (NMR, FTIR, UV-Vis etc); • Essential: English communication; • Supplementary: Surfactant and colloidal science; • Supplementary: Physico-Mechanical test of polymer; • Supplementary: Cell culture.
Developmental outcomes for candidate	The learning outcome would be the development of new technology to address the unmet needs in the industry (applied science). The student will be exposed to polymer and biomedical science community in Australia, which often involves training to talk in conferences and publication in peer-reviewed journals.
Additional comments	The supervisor has industrial and academic research backgrounds that could be beneficial for a student to direct the research for industrial applications. In addition, CSIRO has a large Chinese community (both staff and visitors) that the visitor can interact with.

6.2 Anti-wetting nanocomposite membranes with enhanced flux for membrane distillation

CSIRO Supervisor	Dr Zongli Xie
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CSIRO Business Unit	Manufacturing
Project Location	Australia, Victoria - Clayton
Project suitable for type of candidate	PhD Student
Project title	Anti-wetting nanocomposite membranes with enhanced flux for membrane distillation
Research area	Membrane fabrication and evaluation, membrane distillation, desalination and water purification
Project description	Membrane distillation (MD) is a promising technology for treating saline wastewater. Despite its many advantages, there exist some drawbacks such as relatively low flux, lack of appropriate membranes, membrane wetting and fouling problems, which hinders MD from full-scale commercializing. Research in recent years indicated that nanomaterials can potentially solve these problems and thus to promote the commercialization of MD process. The project aims to develop omniphobic MD membranes with enhanced anti-wetting/fouling properties by exploring different fabrications methods (e.g. phase inversion and electrospinning) and employing novel nanomaterials such as metal organic frameworks (MOFs) and 2D nanosheets as additives.
Skills required from candidate	<ul style="list-style-type: none"> • Knowledge on polymer chemistry, membrane material and membrane processes; • Knowledge and experience on membrane fabrication and materials characterisation; • Good communication skills and team-work ability.
Developmental outcomes for candidate	The expected outcome includes: - the capability development, conference presentation and high-quality journal publication; - increase the networking and strengthen the collaboration relationship in the membrane society; - the student will have the opportunity to develop research skills about nanocomposite membrane fabrication, characterisation and testing for desalination and water treatment.
Additional comments	Supervisor's homepage: https://people.csiro.au/X/Z/Zongli-Xie

6.3 Full Circle Polymer Recycling

CSIRO Supervisor	Dr Graeme Moad
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CSIRO Business Unit	Manufacturing
Project Location	Australia, Victoria - Clayton
Project suitable for type of candidate	Either PhD Student or Scholar
Project title	Full Circle Polymer Recycling
Research area	Recycling polypropylene and polypropylene copolymers/blends by reactive extrusion
Project description	Reactive extrusion of polypropylene is well-established and is used for chain scissioning, chain extension/branching, grafting and other processes, e.g., forming polymer nanocomposites. CSIRO have a strong background in here. Reactive extrusion has also been used in recycling mixed polyolefin post-consumer waste typically to low value added products. A challenge is to take mixed polypropylene waste stream and transform it into a higher value added product. We will use reactive extrusion or another forms of continuous processing. This product may be a grade of polypropylene, a reagent or a compatibilizer. Another challenge is to understand and, preferably, eliminate any prospects for microplastics.
Skills required from candidate	Some or all of the following skills: polymer chemistry (polymerization reaction mechanisms, polymer modification mechanisms, polymer degradation mechanisms), polymer synthesis, polymer processing, characterization of polymer structure (NMR, FTIR, SEC), mechanical properties (tensile, impact properties), polymer morphology (WAXS, SAXS, SEM, TEM).
Developmental outcomes for candidate	The student will gain expertise in polymer processing and recycling and in a wide range of characterization techniques.
Additional comments	Supervisor's homepage: https://people.csiro.au/M/G/Graeme-Moad

6.4 RAFT for sequence-defined oligomers

CSIRO Supervisor	Dr Graeme Moad
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CSIRO Business Unit	Manufacturing
Project Location	Australia, Victoria - Clayton
Project suitable for type of candidate	Either PhD Student or Scholar
Project title	RAFT for sequence-defined oligomers
Research area	RAFT polymerization for the synthesis of discrete sequence-defined oligomers by continuous processing
Project description	We have recently described the application of photo-RAFT to form discrete sequence defined oligomers with high yield and selectivity. These materials have potential application as novel functional RAFT agents for use in biomedicine and electronics and nanotechnology. They can also be a precursor to precise periodic polymers. A challenge to scale up this or a related process and develop a viable continuous flow process. The project will involve optimization of polymerization conditions, design of the oligomers (and polymers), production and screening of polymer libraries, end-group removal transformation, and making use of high-throughput equipment and a prelude to scale-up.
Skills required from candidate	Some or all of the following skills are required: organic chemistry, flow chemistry, polymer chemistry (oligo/polymerization reaction mechanisms), polymer synthesis, characterization of chemical/polymer structure (NMR, FTIR, mass spectra)
Developmental outcomes for candidate	The student will gain through involvement in a interdisciplinary research program. They will undertake a fundamental study using state-of-the-art technology platforms that has the potential for industrial application. The research is expected to lead to high impact publications.
Additional comments	Supervisor's homepage: https://people.csiro.au/M/G/Graeme-Moad

6.5 Advanced metal-nano material composites for Additive Manufacturing

CSIRO Supervisor	Dr Adrian Trinchi
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CSIRO Business Unit	Manufacturing
Project Location	Australia, Victoria - Clayton
Project suitable for type of candidate	Either PhD Student or Scholar
Project title	Advanced metal-nano material composites for Additive Manufacturing
Research area	Metals Powders Nanomaterials Advanced Manufacturing Composites Grain refining Material characterisation Functional materials Materials Science
Project description	In this project, metal and ceramic nanomaterials having a variety of crystal structures and morphologies will be synthesised, and then incorporated and mixed into bulk metal powders to determine if the grain structure can be modified. These mixed systems will be sintered at high temperatures, and subsequently characterised to understand the structural phases occurring at the grain boundary/nanoparticle interfaces. A combinatorial approach to varying the nanoparticle size, shape, loading, as well as sintering temperature and time will be investigated. Detailed material and surface characterisation will be conducted.
Skills required from candidate	<ul style="list-style-type: none"> • A background in Chemistry, Chemical Engineering, or Materials Science; • Materials and optical characterization (particularly, x-ray diffraction, electron microscopy, and electrochemistry); • Nanomaterials and powders; • wet chemical methods.
Developmental outcomes for candidate	<ul style="list-style-type: none"> • Gain research experience in Australia's national science agency; • Advanced skills in nano-technology and sensor technology; • Enhanced English language skills; • Networking with researchers in CSIRO and in the Australia; • Ability to work in multi-disciplinary research teams in CSIRO; • Opportunity to publish work in leading journals.
Additional comments	The research will be undertaken at CSIRO in Melbourne, Australia, working within the Functional Powders team and will have the team's support.

6.6 Green and sustainable 3D printing with re-processable and self-healing photopolymers

CSIRO Supervisor	Ke Du
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CSIRO Business Unit	Manufacturing
Project Location	Australia, Victoria - Clayton
Project suitable for type of candidate	Either PhD Student or Scholar
Project title	Green and sustainable 3D printing with re-processable and self-healing photopolymers
Research area	Develop 3D printing resins that offer a higher level of environmental sustainability, which could be recycled and/or have self-healing properties
Project description	Additive manufacturing (3D printing) is an increasingly important part of global manufacturing (expected to be valued at \$44B by 2025). Typically, thermosetting photopolymers represent the largest market segment in the additive manufacturing materials market. In the meantime, with the growing attention to global energy and environmental problems, a great deal of effort has been devoted to fabricating self-healable and/or recyclable thermosetting photopolymers that can potentially replace parts of traditional polymers. This project focuses on the development of a platform technology for reprocessable thermosetting photopolymer resins for a sustainable and green 3D printing industry.
Skills required from candidate	<ul style="list-style-type: none"> • Essential: Synthetic organic chemistry; • Essential: Chemical analysis (NMR, FTIR, UV-Vis etc); • Essential: English communication; • Supplementary: 3D printing; • Supplementary: Polymer design and characterization (i.e. mechanical test, rheology, self-healing characterization).
Developmental outcomes for candidate	The learning outcome will involve the design, synthesis and characterization of novel recyclable thermoset polymers, 3D printing of resin formulations and the characterization of the resulting printed parts. The student will be exposed to polymer and biomedical science community in Australia, which may involve regional as well international conferences.
Additional comments	The supervisor is native Mandarin speaker and has both industrial and academic research backgrounds that could be beneficial for a student to direct the research for industrial applications. In addition, CSIRO has a large Chinese community (both staff and visitors) that the visitor can interact with.

6.7 Converting small molecule anti-cancer drugs into nanomedicines

CSIRO Supervisor	Dr Xiaojuan Hao
CSIRO Supervisor contact details	Xiaojuan.hao@csiro.au +61 3 9545 2614
CSIRO Business Unit	Manufacturing
Project Location	Australia, Victoria - Clayton
Project suitable for type of candidate	Either PhD Student or Scholar
Project title	Converting small molecule anti-cancer drugs into nanomedicines
Research area	RAFT polymerisation, drug-polymer conjugation chemistry, nanotechnology, targetting drugs, theranostics, carbon materials, nanomaterials, biomaterials, drug/gene delivery systems
Project description	<p>Current anticancer drugs on market are usually toxic to both cancer cells and normal cells, causing severe adverse effects for patients receiving chemotherapy. One new direction of cancer treatment is the development of efficient drug delivery vehicles (nanomaterials) that aim to increase effective levels of chemotherapy for tumor cells while reducing side effects. Different strategies can be used to convert small molecule drugs into nanomaterials:</p> <ul style="list-style-type: none"> • physical encapsulation of small drug molecules in biocompatible polymer micelles; • covalent attachment of small drug molecules to polymer chains. Both strategies can be applied to increase solubility and bioavailability of hydrophobic small drugs.
Skills required from candidate	<ul style="list-style-type: none"> • Demonstrated capability to carry out research work independently including literature search, concept development, experimental work planning and implementation; • Good knowledge in chemistry or biomedical materials, a degree in chemistry or material science will be desirable; • Good knowledge and skills on composite fabrication and characterization methods; • Good communication and writing skills and capable to prepare oral presentation and written report, articles; • Good interpersonal skills and a team player, hardworking and willing to strive for excellence.
Developmental outcomes for candidate	Development and full characterization of novel biomaterials; biological and biocompatible testing towards their potential bio-applications; publications of results in peer reviewed journal and presentations of outcomes at national/international conferences.
Additional comments	The student will gain experience in multidiscipline R&D environment and will increase knowledge in synthesis and characterisation of materials both chemically and biologically. In addition, He/she will improve skills of writing reports, publications, and presentations. Moreover, he/she will get to experience a foreign culture and gain valuable English language experience.

6.8 Polymeric Cryoprotectants for Cell Banking

CSIRO Supervisor	Dr Timothy Hughes
CSIRO Supervisor contact details	tim.hughes@csiro.au +61 3 9545 2503
CSIRO Business Unit	Manufacturing
Project Location	Australia, Victoria - Clayton
Project suitable for type of candidate	Either PhD Student or Scholar
Project title	Polymeric Cryoprotectants for Cell Banking
Research area	Design and fabrication of new polymeric cryo-protectants which can avoid the cytotoxicity effects of DMSO and maintain high cell viability.
Project description	Cell banking, the proliferation and subsequent freezing of cells, is critical process in many cell-based endeavours. The process requires the use of cyro-protectants (eg DMSO) so that the cell survive the process and are still capable to being used for their intended purpose once thawed. In this project we aim develop new cyro-protectants that offer a higher level of protection and maintain a higher level of cell viability than currently available agents. The project will use high through-put methodologies to prepare and assess novel cyro-protectants.
Skills required from candidate	<ul style="list-style-type: none"> • Essential: Synthetic organic chemistry; • Essential: Chemical analysis (NMR, FTIR, UV-Vis etc); • Essential: English communication; • Supplementary: Polymer science; • Supplementary: Cell culture and animal study.
Developmental outcomes for candidate	The learning outcome would be the design, synthesis and characterization of novel polymers cryo-preservatives for cell banking involving both chemistry and cell biology techniques (multidisciplinary science). The student will be exposed to polymer and biomedical science community in Australia, which may involve regional as well international conferences.
Additional comments	The supervisor has supervised more than five CSC scholars and engagements with various industries as well as Chinese universities. In addition, CSIRO has a large Chinese community (both staff and visitors) that the visitor can interact with.

6.9 Fabrication of nanomaterials incorporated thin-film composite membranes for water purification

CSIRO Supervisor	Dr Zongli Xie
CSIRO Supervisor contact details	zongli.xie@csiro.au +61 3 9545 2938
CSIRO Business Unit	Manufacturing
Project Location	Australia, Victoria - Clayton
Project suitable for type of candidate	PhD Student
Project title	Fabrication of nanomaterials incorporated thin-film composite membranes for water purification
Research area	Polymeric membrane, solvent resistant nanofiltration, forward osmosis, pervaporation
Project description	Membrane technology has the potential to be used in many industries including desalination, wastewater treatment and food industry. However, there are some challenges in current membranes including the trade-off between rejection property and permeability, and related-poor organic solvent resistant. Research in recent years indicated that nanomaterials can potentially solve these problems in membranes. The project aims to design and fabricate high-performance thin film composite membranes modified by novel nanomaterials. The student will have the opportunity to learn skills about membrane fabrication/characterisation and investigate how to improve properties and performance of membranes by using nanomaterials as modifiers.
Skills required from candidate	<ul style="list-style-type: none"> • Sound knowledge on membrane materials and polymer chemistry; • Knowledge on the interfacial polymerization process and phase inversion; • The fundamental experience about membrane fabrication; • Good communication skills and team-work ability.
Developmental outcomes for candidate	The expected outcome includes a comprehensive investigation of membrane fabrication methods, presentation in the workshop and conference, and high-quality scientific papers associated with thin-film nanocomposite membranes. It is also expected to increase the networking and develop/strengthen the collaboration.
Additional comments	Supervisor's homepage: https://people.csiro.au/X/Z/Zongli-Xie

6.10 Injectable hydrogel for controlled release of proteins to the brain

CSIRO Supervisor	Dr Tuan Nguyen
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CSIRO Business Unit	Manufacturing
Project Location	Australia, Victoria - Clayton
Project suitable for type of candidate	Either PhD Student or Scholar
Project title	Injectable hydrogel for controlled release of proteins to the brain
Research area	Design and development of novel polymers that act as pharmaceutical excipient to protect and encapsulate protein therapeutics for brain-injury treatment.
Project description	Protein therapeutics are increasingly being used in many therapies including the treatment of brain injury. Nevertheless, due to the poor stability of these therapeutics, there is a need for localised drug delivery systems that serves as a reservoir to enable effective and prolonged release into the brain. In this project, we will design a hydrogel-based depot using biocompatible polymers with specific criteria such as ease of implant, tuneable degradation and controllable protein release kinetic. The hydrogels will be assessed for in-vitro cytotoxicity, in-vivo biocompatibility, and drug encapsulation/release efficacy, and targeted for applications in brain injury treatment.
Skills required from candidate	<ul style="list-style-type: none"> • Essential: Synthetic organic chemistry; • Essential: Chemical analysis (NMR, FTIR, UV-Vis etc); • Essential: English communication; • Supplementary: Polymer science; • Supplementary: Drug formulation and delivery; • Supplementary: Cell culture and animal study.
Developmental outcomes for candidate	The project will be a great opportunity for the Student/Scholar to gain experience and knowledge in a novel drug delivery technology that can be translated to commercialization. The Student/Scholar will be exposed to polymer and biomedical science network in Australia, which may involves regional as well as international conferences.
Additional comments	As Australia's national science agency and innovation catalyst, CSIRO is solving the greatest challenges through innovative science and technology. The outcome of this project would lead to publications in high impact-factor journals. In addition, CSIRO has a large international community of experts/scientists that the visitor can interact with.

7 Oceans and Atmosphere

7.1 Tracing the uncertainties of global carbon cycle

CSIRO Supervisor	Dr Yingping Wang
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CSIRO Business Unit	Oceans and Atmosphere
Project Location	Australia, Victoria - Aspendale
Project suitable for type of candidate	Scholar
Project title	Tracing the uncertainties of global carbon cycle
Research area	global carbon cycle, land surface modeling
Project description	<p>Considerable uncertainties remain in projecting future climate change, and a key source of those uncertainties is terrestrial carbon cycle. This project will use the traceability framework to quantify the contributions of model input, model structure and model parameters to the uncertainties in the simulated carbon cycle of tropical forests and semiarid grasslands using the Australian community land model (CABLE). The expected deliverables are:</p> <ul style="list-style-type: none"> • complete the CABLE simulations; • complete the traceability analysis and; • submit 1 to 2 papers to major international journals.
Skills required from candidate	<p>Key skills required for this project:</p> <ul style="list-style-type: none"> • a good understanding of traceability framework; • good skills in R or python; • ability in setting up, and executing CABLE simulation on CSIRO supercomputer; • good communication and writing skills.
Developmental outcomes for candidate	<p>This project will provide an excellent opportunity for the visiting scholar to work a world-leading group on land surface modeling and carbon cycle. The scholar will learn about one of leading global land surface models, CABLE and land surface modeling in general. The scholar will improve his/her writing skills.</p>
Additional comments	Supervisor's homepage: https://people.csiro.au/W/Y/Yingping-Wang

7.2 Ocean heat uptake and sea level studies

CSIRO Supervisor	Dr Xuebin Zhang
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CSIRO Business Unit	Oceans and Atmosphere
Project Location	Australia, Tasmania - Hobart
Project suitable for type of candidate	Either PhD Student or Scholar
Project title	Ocean heat uptake and sea level studies
Research area	Climate change; sea-level rise; ocean heat content; ocean and climate dynamics; ocean and climate modelling; Southern Ocean; climate projection
Project description	Ocean warming and sea level rise are two closely related topics in climate change, with ocean thermal expansion being a dominant contributor to sea level rise. Ocean heat uptake and its redistribution within the ocean is a cutting-edge research topic and “regional sea level change and coastal impacts” is one of seven WCRP Grand Challenges. For this visiting opportunity, the student/scholar would explore topics in ocean heat uptake and regional sea level change and variability using observations, reanalysis datasets, CMIP5/6 climate models, high-resolution ocean models, or running & analysing ocean or climate model. Findings will be reported in international peer-reviewed journals.
Skills required from candidate	<ul style="list-style-type: none"> • Outstanding background in physical oceanography or climate science; • Sound skills in data processing, especially on time-series analysis, such as Fourier analysis, harmonic analysis, filtering; • Good knowledge of basic statistical methods, such as linear regression, correlation and covariance, and principal component analysis; • Good computer programming skills for data processing, handling and analysing, with either Matlab or Fortran (or other comparable languages), preferably under Unix-based environment.
Developmental outcomes for candidate	<ul style="list-style-type: none"> • Good exposure to climate variability and change field, especially a world leading sea level research team; • Capacity to carry out further independent research in ocean heat and sea level related fields; • Enhanced skills in data processing and analysing; • Good scientific writing skill for journal publication.
Additional comments	Since 2013, we have been supervising four visiting students sponsored by the CSC: Kewei Lyu and Quran Wu for two years from Xiamen University, Jinping Wang and Yi Jin for two years from Ocean University of China (OUC). We also hosted a CSC visiting scholar – Prof. Xian Yao Chen from OUC.

7.3 Climate drivers of harmful algal blooms in the 21st century

CSIRO Supervisor	Dr Chaojiao Sun
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CSIRO Business Unit	Oceans and Atmosphere
Project Location	Australia, Western Australia - Crawley
Project suitable for type of candidate	Either PhD Student or Scholar
Project title	Climate drivers of harmful algal blooms in the 21st century
Research area	Numerical modelling, climate variability, harmful algal bloom mechanism
Project description	This project will investigate the climate drivers responsible for the sudden shift in harmful algal blooms (from diatom to dinoflagellate blooms) around the year 2000 in the East China Sea. We will investigate the relationship between climate regime shift and changes in algal blooms around 2000, and specifically, how the Kuroshio Current Intrusion is affected by the climate. Future ocean projections will be analysed to provide foresights. This project will complement a current joint CAS-CSIRO project to develop a forecasting system for HABs. The expected deliverables are new insights into the bloom shift phenomenon and publications.
Skills required from candidate	Strong numerical analysis and modelling capabilities, with good knowledge of harmful algal bloom mechanisms. Good programming skills such as Matlab, FERRET or Python.
Developmental outcomes for candidate	The CSC student or scholar will gain experience working with high-resolution global ocean model hindcast and future projections for the next 100 years, and connecting physical drivers with ecological impact, and develop new insights into shift in harmful algal blooms in the East China Sea.
Additional comments	This project is a good opportunity for a student or researcher who is interested in the interdisciplinary study of oceanography and ecology.

7.4 Impact of extreme river discharges on coastal suspended sediments

CSIRO Supervisor	Dr Nagur Cherukuru
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CSIRO Business Unit	Oceans and Atmosphere
Project Location	Australia, Australian Capital Territory - Black Mountain
Project suitable for type of candidate	Scholar
Project title	Impact of extreme river discharges on coastal suspended sediments.
Research area	Sediment properties; extreme river discharges; biogeophysical properties; numerical ocean modelling; optical remote sensing; impact on ecosystem
Project description	River discharges influences coastal waters. They transport and transform suspended sediment populations in estuarine and coastal waters. Consequently, variability in sediment properties impacts the light availability and productivity of the aquatic ecosystems. There is limited knowledge on the understanding of sediment dynamics in river discharges and in extreme events. To overcome this limitation this study will focus on investigating, sediment characterises in multiple hydrodynamic regimes, factors controlling sediment distribution and biogeophysical relationships in different water types. New understanding of changes in sediment characteristics and its influence on underwater light climate will help improve the predictive capability of coastal ecosystem models.
Skills required from candidate	<ul style="list-style-type: none"> • Scientific computing skills; • Numerical ocean modelling; • Sediment dynamics in coastal waters; • Experience with oceanographic equipment data analysis and optical remote sensing datasets; • PhD in physical oceanography/marine science.
Developmental outcomes for candidate	<p>Benefits and learning outcomes:</p> <ul style="list-style-type: none"> • New research on extreme river discharges; • Work experience with unique data sets: both in situ and remote sensing; • Opportunity to work with a multidisciplinary team on a complex topic; • Collaborative experience in research, development and publications.
Additional comments	<ul style="list-style-type: none"> • Visiting scholar should have required proficiency in English; • Scholar should be willing to publish the research conducted at CSIRO.

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agency and innovation catalyst,
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challenges through innovative
science and technology.**

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