# Faculty of Science

## Dayong Jin Student Fellowship

### IBMD Research Projects Available – 2026 Winter Round

- **Polyphenol-based coatings for magnetic particle integration and actuation** – Dr Franco Centurion
  How can we make tiny devices move using a magnet and why does it matter? Controllable microdevices are emerging as powerful tools for applications ranging from soft robotics and micro-actuation to advanced biomedical systems and biointerfaces. In this project, we explore the use of polyphenol-based coatings (inspired by natural compounds like tannic acid) to attach magnetic particles onto micro-scale devices. These coatings provide a simple and versatile strategy to create magnetically responsive microdevices that can be remotely controlled with precision. During this project, the student will gain hands-on experience in surface coatings, nanomaterials, and microdevice fabrication. You will work on designing and optimising coatings to achieve uniform particle distribution and strong magnetic response, contributing to the development of next-generation remotely controlled microdevices with potential applications in complex biological environments.

- **Asynchronous Rotational Bead Magnetometry for Viscosity and Extracellular Vesicle Sensing** – Dr GunGun Lin Zelyu Chen
  This project aims to develop a microfluidic bead-rotation sensing platform for viscosity measurement and extracellular vesicle (EV) detection. The student will contribute to the design and fabrication of a microfluidic chip containing an array of trapping sites, where each site is intended to capture a single magnetic bead. A rotating magnetic field generated by Helmholtz coils will be used to actuate the beads, and their rotational dynamics will be measured through optical imaging and quantitative image analysis. Because bead rotation is sensitive to the local fluid environment, this platform can be used to probe viscosity changes and explore their relationship with EV concentration. The project combines microfluidic chip development, magnetic actuation, imaging integration, signal readout, data analysis, and fluid-dynamics modelling in an interdisciplinary sensing platform.

- **Mitochondiral Mechanobiology in Lipid Membrane Toxicity** – Dr Le (Leo) Zhang
  Explores how toxic alterations in cellular lipid membranes influence mitochondrial structure, mechanics, and function. This project investigates how changes in membrane composition or lipid stress affect mitochondrial dynamics, membrane tension, bioenergetics, and stress signalling pathways that contribute to cell injury and disease. Students will gain hands-on experience with a range of experimental techniques, which may include mammalian cell culture, fluorescence and confocal microscopy, live-cell imaging, mitochondrial membrane potential and respiration assays, lipid treatment models, molecular biology methods (such as PCR and protein analysis), and quantitative image/data analysis. Participants can expect training in experimental design, data interpretation, and scientific communication within an interdisciplinary research environment.

- **Develop Nanothermometers to Unlock Secrets in Living Cells** - Professor Jiajia Zhou and Yitong Zhao
  How do temperature dynamics inside a single cell drive disease or signal health? Join our project to build and apply the next generation of nanoscale thermometers to answer these fundamental questions. You will get hands-on experience synthesising and functionalizing upconversion nanoparticles (UCNPs), using these novel nanoprobes to perform live cell imaging, and visualising temperature gradients in real-time within physiological environments. This interdisciplinary project offers you the chance to be involved in every step: from nanoparticle synthesis and surface chemistry to cell culture and advanced optical microscopy. You will be directly involved in developing new biomedical applications, from mapping metabolic activity in cells to pioneering new thermo-diagnostic strategies. Let's turn light into temperature and knowledge.

- **Tracking SARS-CoV-2 virus spike within lung cells** - Dr Martin (Mohammad) Sadraeian
  This project aims to investigate the intracellular trafficking and dynamics of SARS-CoV-2 spike protein in lung cell models using advanced fluorescence imaging. By combining nanoparticle labelling and live-cell microscopy, students will visualise how viral spikes interact with host cellular machinery, including endocytosis and intracellular transport pathways. The project provides hands-on experience in cell culture, fluorescence microscopy, and image analysis, while offering insight into viral infection mechanisms relevant to respiratory diseases.

- **Oligo-based biosensors for quantification of cancer-associated microRNAs** - Dr Martin (Mohammad) Sadraeian
  This project focuses on the design and development of oligonucleotide-based biosensors for sensitive detection of cancer-associated microRNAs. Using fluorescence-based assays and nanomaterial conjugation strategies, students will explore how synthetic DNA/RNA probes can be engineered for selective and quantitative detection. The project introduces key concepts in molecular diagnostics, nucleic acid chemistry, and biosensing technologies, with applications in early cancer detection and precision medicine.

- **Enhancing upconversion nanoparticle through synergetic absorption and emission sensitisations** - Dr Guochen Bao
  Upconversion nanoparticles (UCNPs) are promising for biomedical applications due to their ability to convert near-infrared light into visible emission, enabling deep tissue penetration with low background. However, their practical use is limited by low brightness, particularly in ultrasmall particles (<20 nm) where surface quenching reduces luminescence efficiency. Here, we propose a hybrid nanoplatform that combines a high-performance NIR dye sensitizer (e.g. IR806) with surface-bound acceptor dyes such as sulforhodamine B (SRB) to enhance brightness. IR806 offers improved absorption capacity, while SRB efficiently extracts excitation energy to suppress non-radiative losses. The synergistic integration of these components is expected to significantly amplify upconversion emission under continuous excitation. Ultrasmall UCNPs will be synthesized and functionalized, followed by spectroscopic evaluation. This work aims to develop a compact, highly luminescent nanohybrid system for advanced bioimaging and diagnostic applications.

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## IBMD Project Supervisors

**Dr Franco Centurion**

Dr Franco Centurion Rodriguez is a postdoctoral researcher at the Institute for Biomedical Materials and Devices (IBMD), University of Technology Sydney. He completed his PhD in Chemical Engineering at UNSW, specialising in advanced functional materials, nanomedicine, and interfacial engineering. His research focuses on the development of dynamic biointerfaces that integrate materials science, microfabrication, and bioelectronics. His current work explores programmable microdevices and self-folding systems for controlled interaction with complex environments. This includes the integration of magnetic actuation, microfabricated structures, and functional coatings to enable remotely controlled systems with applications in biomedical technologies and advanced materials. The overall goal of his research is to engineer active and responsive biointerfaces capable of interacting with biological systems, with potential applications in neuroengineering, mechanobiology, and next-generation biomedical devices.

**Dr Gungun Lin**

Dr Gungun Lin is an ARC DECRA Fellow and Senior Lecturer at the University of Technology Sydney, and a core member of the Institute for Biomedical Materials and Devices. His research focuses on functional micro- and nanomaterials and MEMS technologies for biomedical applications, with particular interest in magnetic sensing, actuation, and microscale device development. His work combines materials science, microfabrication, and analytical technologies to develop new sensors, actuators, and robotic systems for biomedical analysis.

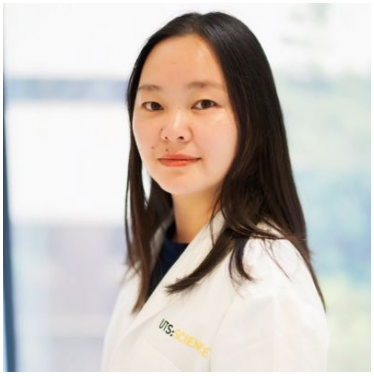
**Zulyu Chen**

Mr Zelyu Chen is a PhD candidate and Research Assistant at the University of Technology Sydney. His work focuses on magnetic microrobotics, microfluidics, interfacial transport, and quantitative experimental systems. He has experience in microfabrication, magnetic actuation, imaging, computational modelling, and data analysis for microscale sensing and transport.

**Dr Le (Leo) Zhang**

Dr Zhang serves as a Postdoctoral Research Fellow at UTS and plays a pivotal role as a core member of the UTS Institute for Biomedical Materials and Devices (IBMD). He completed his PhD in Biomedical and Microbiology at UTS in 2021, under the guidance of Distinguished Professor Dayong Jin. Emerging as an international leader in antimicrobial resistance (AMR), his primary focus lies in exploring the mechanisms behind bacterial evolution of antibiotic resistance through a variety of interdisciplinary approaches. These methods include single-molecule microscopy, whole-genome sequencing, and global transcription analysis. Dr Zhang's groundbreaking work involves the integration of photonics and advanced materials into molecular biology, significantly contributing to the understanding of AMR. His research has yielded 19 journal publications, featuring in prestigious outlets such as Nature Methods, eLife, and Analytical Chemistry.

**Professor Jiajia Zhou**



Prof. Jiajia Zhou is an internationally recognised leader in single particle spectroscopy at the University of Technology Sydney, where her work focuses on nanoparticles while preserving their optical properties for applications in biomedical sensing, imaging, display technology, and security inks. As a recipient of major awards and grants such as the prestigious David Syme Research Prize, ARC Future Fellowship and NHMIC Investigator Grant, Prof. Zhou has driven innovations in rapid COVID-19 testing and protein detection, publishing extensively in high-impact journals including Nature and Nature Photonics.

**Yitong Zhao**

Ms Yitong Zhao is a postdoctoral research associate at the University of Technology Sydney (UTS), specialising in nanoscale thermometry for biological systems. Her research focuses on developing advanced temperature sensing methods to study heat generation and transfer at the cellular level, with potential applications in biomedicine, diagnostics, and treatment.

**Dr Martin (Mohammad) Sadraeian**

Dr Martin Sadraeian is a Postdoctoral Researcher working across biomolecular physics, nanobiotechnology, and advanced imaging. His research focuses on developing nanoparticle-based platforms for studying virus–host interactions and designing RNA/DNA-based biosensors for diagnostics and therapeutics. He has contributed to projects in antiviral immunotherapy, photo-diagnostics, and molecular imaging, with applications in cancer and infectious diseases. His current work integrates upconversion nanoparticles (UCNPs), molecular assays, and live-cell imaging to investigate viral mechanisms and develop translational diagnostic tools.

**Dr Guochen Bao**

Dr Guochen Bao is an Emerging Leadership Fellow of the Australia National Health and Medical Research Council (NHMRC EL1), a Chancellor's Research Fellow (CRF) and a group leader at University of Technology Sydney (UTS), and a member of IBMD, with expertise in organic synthesis, analytical chemistry, spectroscopy, hybrid nanomaterials, nanophotonics characterisations, and biomedical engineering. Currently, Dr Bao leads research focusing on developing hybrid materials, with desired functions, and optical properties for ultrasensitive bioassay, biomedical imaging, and precise therapy.