June 2021: Issue #2

THE LEAD

UNSW SCHOOL OF CHEMICAL ENGINEERING NEWSLETTER

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UNSW SYDNEY

Message from the Head of School

Dear Friends and Supporters of UNSW School of Chemical Engineering,

Welcome to the School's 2021 mid-year newsletter. As vaccines offer hope for an end to the pandemic, we still live in uncertain times with many of our current and future students stuck outside Australia. I find myself becoming more patient and appreciative of the basics of an academic life. After a year of seemingly never-ending online meetings, our academic staff got together to talk about the future of chemical engineering and food science in the School's Annual Planning Day in May this year, next to a beautiful golf course.

On the first day of teaching the chemical engineering lab course, I was delighted to be with our third year undergraduate students in the distillation lab, supervising them taking apart a distillation setup and reassembling the parts. Am I imagining it, or did the students also become more patient and appreciative of in-person, hands on learning? There was joy all around when after patiently adjusting the flow rate, liquid finally trickled down the column.

I am proud to share stories from UNSW School of Chemical Engineering. We particularly want to hear from our alumni about their professional achievements. Alumni, please send your news stories to: chemeng.external@unsw.edu.au.

Best wishes,
Professor Guangzhao Mao

UNSW Chemical Engineering rankings:

#50	**QS World by Subject**
#51-75	**2021 ARWU by Shanghai Rankings (Chemical Engineering)**

UNSW SYDNEY

Associate Professor Rita Henderson: making a splash in the water industry

The impact of Associate Professor Rita Henderson's work is far more than just a drop in the ocean. She does many things well: she has gained international recognition for her work in the design, optimisation and monitoring of solid-liquid separation processes for microalgae, cyanobacteria and organic matter; she has received almost seven million dollars in research funding and published dozens of journal articles; and she plays a crucial role in many projects, committees and Boards. And while juggling all this, Rita has graduated a number of PhD students who have won revered industry prizes and scholarships.

Dr Naras Rao completed his PhD in 2018 under Rita's supervision and remained with her as a post-doc before he was awarded a Marie Curie Individual Fellowship this year. He played a key role in ARC linkage projects related to algae, cyanobacteria and water treatment and, with Rita, contributes to the Nuisance and Harmful Algae Science-Practice Partnership, a multi-party initiative seeking to more effectively manage algal blooms by introducing smart surveillance and evidence-based, cost-effective policy and asset design for the benefit of the Melbourne region. Under a prestigious Marie Curie Fellowship, he now has the opportunity to embark on a new research project in Belgium next year.

2019 was another great year for one of Rita's students. Dr Florence Choo won the Australian Water Association (AWA) National Student Water Prize for her research on real-time monitoring cyanobacteria in real-time for drinking water processes—and has since gone on to work as a scientist at SA Water.

Unsurprisingly, Rita's supervision and mentorship has not gone unnoticed. The recipient of the AWA NSW Kamal Fernando Mentoring Award in 2016 is in hot demand, especially from those who see themselves working in the water industry in future.

Rita says, "With my own PhD students the focus is not about positioning them for a postdoctoral career, rather it is looking at all options—including industry-related roles if that is their preference. Alumni from my research group have had, or currently have, roles at SUEZ, AECOM, Sydney Water, SA Water, WaterRA, WaterNSW and other notable water companies."

So what is the key to Rita's success—and that of her students? Her continued involvement in the water sector helps her to stay on top of water industry needs, developments and challenges—a concept that was central to her Masters and PhD research at Cranfield University in the United Kingdom. Her PhD in water pollution was industry driven and supported, with sponsors including Yorkshire Water, Thames Water, Northumbrian Water and Anglian Water. This introduced Rita to the concept of research that has direct impact in the water industry and it's something that has been a priority for her ever since.

Rita's PhD supervisor Professor Bruce Jefferson and postdoctoral supervisors at UNSW, Professor Stuart Khan and Professor Richard Stuetz, provided valuable mentorship and sponsorship; showing her how to work with industry to ensure her own research had impact beyond publications. Her first postdoctoral role was Postdoctoral Research Associate on an ARC Linkage grant with multiple industry partners. She subsequently won her own Linkage grant with several industry partners and received an associated ARC Australian Postdoctoral Industry Fellowship that kept her working closely with industry.

"With my own PhD students the focus is not about positioning them for a postdoctoral career, rather it is looking at all options—including industry-related roles if that is their preference."

Rita's work at UNSW remains highly industry focused. She established the Algae and Organic Matter Lab (originally the bioMASS lab) in 2014, aiming to combine fundamental scientific and mechanistic understanding with novel developments in process engineering to provide enduring, innovative solutions related to algae and organic matter in water and biotechnology industry applications. Until 2019, she was Chair of the Water Research Australia Education Committee, She is currently a Member of both the Australian Water Association and International Water Association (IWA) and is an Editor-in-Chief of the new IWA H2Open Journal. This year, she is Chair of the organising committee for the 13th International Water Association Specialist Conference on Wastewater Ponds and Algal Technologies (WPAT22), which will be held in Melbourne and online on 3-6 July 2022.

Rita enjoys working with industry in undergraduate teaching too. She teaches a first-year course that tackles a real challenge set by industry: designing a compact, energy-efficient water treatment system that can provide safe and reliable water supply for dialysis in remote communities. This is currently in partnership with Purple House, an Indigenous run and owned organisation that operates permanent clinics in 18 remote communities and a mobile dialysis service that supports patients requiring treatment for end-stage renal failure. The project aims to help Purple House minimise any disruptions in treatment caused by poor groundwater quality or high water temperatures that disable equipment.

The UNSW Global Water Institute (UNSW-GWI) is involved with many of Rita's projects and collaborative efforts, and Director Professor Greg Leslie says that her multi-disciplinary approach aligns perfectly with what UNSW-GWI's vision and mission.

"UNSW-GWI is a multi-disciplinary venture that connects diverse water expertise from across seven faculties and aims to help solve real-world issues related to water," says Greg. "We have been working with Rita for years and have always been impressed by her ability to connect people across disciplines and her capacity to conduct and translate fundamental research into practical insights and solutions for our industry partners."

Sharpening UNSW's expertise in carbon catalyst technologies

Professor Liming Dai is relatively new to UNSW but is certainly no stranger to the world of Chemical Engineering. When he joined UNSW full-time in early 2020, Dai was already well-known among colleagues as a world-leading expert in carbon, nanomaterials and nanotechnology.

Prof Dai joined UNSW full-time in early 2020 as an Australian Laureate Fellow, Scientia Professor, and SHARP (Strategic Hires and Retention Pathways) Professor. His expertise covers the synthesis, functionalisation and device fabrication of conjugated polymers and carbon nanomaterials for energy-related and biomedical applications—and he is widely credited for his contribution to developing new pathways for clean renewable energy generation and storage.

When asked about his career highlights, Prof Dai uses the Apollo Lunar Mission of the 1960s to provide context and perspective for his landmark research, saying, "At the heart of the moon-landing project was the novel use of fuel cells using platinum as an electrocatalyst to power the aerospace vehicles. But despite this milestone achievement, the large-scale practical application of fuel cells has not yet been realised due to limited resources and the high cost of platinum."

Dai says that for more than half a century, experts worldwide have dedicated considerable effort to reducing or replacing the expensive platinum-based catalysts for Oxygen Reduction Reaction (ORR) in fuel cells by using nonprecious metal alloyed catalysts with or without platinum. But across the board, these nonprecious metal catalysts have been found to be either too low in efficiency or too poor in stability when compared to platinum. They are also too expensive to be a feasible choice for mass production.

That's why Prof Dai's 2009 breakthrough discovery of a durable, affordable and earth-abundant alternative was so significant.

"In 2009, my group discovered that using nitrogen-doped carbon nanotubes as metal-free catalysts for ORR could dramatically reduce the cost and increase the efficiency of alkaline fuel cells. This ground-breaking work spurred worldwide studies that demonstrated the over-whelming potential of carbon-based, metal-free electrocatalysts (C-MFECs) for energy con-version and storage," says Dai.

"This ground-breaking work spurred worldwide studies that demonstrated the overwhelming potential of C-MFECs for energy conversion and storage."

While at UNSW, Prof Dai is advancing his knowledge of C-MFECs, exploring their electrocatalytic mechanism and structural diversity with a specific focus on the structures of active centres and their functions. He plans to develop world-class research programs in the field of C-MFECs at UNSW which will place the University at the global forefront of carbon catalyst technologies and further strengthen its commitment to solving Earth's critical energy and environmental problems.

After having been previously associated with institutions, such as the Australian National University, University of Cambridge, University of Illinois at Urbana-Chamgaign, CSIRO, University of Akron, University of Dayton and Case Western Reserve University, Prof Dai is confident to further develop his research into its next phase at UNSW.

"Even before joining UNSW, my visits to the UNSW School of Chemical Engineering had already convinced me that it had state-of-the-art facilities, world class researchers, and outstanding students. And my recent, more extensive visits to some labs within the UNSW School of Chemical Engineering have clearly revealed that the facilities I had seen before were only a small tip of a very big iceberg."

He also has nothing but admiration for his colleagues, saying, "My experience as a full-time academic staff in the UNSW School of Chemical Engineering has demonstrated that I am lucky to not only be surrounded by advanced facilities but also to be in the presence of outstanding colleagues who are very knowledgeable, collegial, helpful, and supportive. I am deeply impressed by the top quality of all the academic and technical staff here at UNSW."

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This is high praise from an expert with such a long and impressive list of accolades. Prof Dai has published more than 500 referred papers with 93,666 citations and has an h-index of 153 (Google Scholar). He has been a 'Highly Cited Researcher' in both Materials Science and Chemistry every year since 2015 and he recently received the 2019 IUMRS-Somiya Award from the International Union of Materials Research Societies, and the 2019 Australian Laureate Fellowship. Prof Dai also serves as an Associate Editor of Nano Energy, Fellow of the Royal Society of Chemistry, Fellow of the US National Academy of Inventors, Fellow of the American Institute for Medical and Biological Engineering, Fellow of the European Academy of Sciences, and Fellow of the International Association of Advanced Materials.

Under Prof Dai's leadership and with his extensive experience, skills and international connections as well as the strong support from his colleagues in the School and University, the UNSW School of Chemical Engineering is well placed to fast become a world leader in the field of C-MFECs.

Patrick Spicer: complex fluids and nanomaterials expert and 2021 ARC Linkage Grant recipient

Patrick Spicer is known as UNSW's resident expert in all things soft, squishy and runny. As Associate Professor in UNSW's School of Chemical Engineering and leader of the Complex Fluids group, Patrick focuses on understanding the flow and rheology of fluid coatings, films and other complex products that have the potential to improve human health, protect precious ecosystems and benefit a range of critical industries.

Patrick studied Chemical Engineering at the University of Delaware before completing his PhD in Chemical Engineering with the Particle Technology Group at the University of Cincinnati. He then spent 15 years of his career in Cincinnati running a research department for consumer goods juggernaut Procter and Gamble. While in this role, he achieved a remarkable and rewarding career highlight; co-inventing Procter and Gamble's $30 million cubosome patent portfolio that was used by Children's Hospital Cincinnati to develop the first skin product to prevent life-threatening infections in premature infants.

In 2012, Patrick arrived at UNSW Sydney ready to dive into a career in academia. He currently teaches three courses and is involved in a range of different research projects that involve the understanding, design, development and application of fluid products and soft matter.

New technology takes shape

Patrick was awarded an ARC Discovery Project grant in November 2018 to develop, engineer and test novel, high-performance sprays with unique 'cling' to coat leaves, protecting them from encroaching weeds and insects. He and his team discovered that small cellulose fibers allow sprayed droplets to stick to plant leaves much better than conventional additives, and they wanted to use the technology to reduce chemical run-off that can harm local ecosystems—and also to enable more efficient spray delivery, allowing smaller volumes to be used in the first place.

This work caught the eye of local company JoyHarvest who were eager to support Patrick and his team in a TechVoucher proposal. In 2019-2020, the successful proposal allowed Patrick's team to collaborate with JoyHarvest for six months to test the new material in their commercial herbicide formulations. They found that the new formulation was far superior and could feasibly replace typical harmful additives.

And Patrick's work on films for plants is set to accelerate further this year. Still collaborating with JoyHarvest, he was awarded an ARC Linkage Grant in early 2021 to study the films that dry onto the plant leaves. These films are surprisingly strong and could protect active ingredients against degradation or waste, so different methods of application are being explored to determine variations in strength and efficacy.

Working on less-invasive allergy diagnosis with Sydney Children's Hospital

Food allergies are common, life-threatening, and on the rise across Australia. The high demand for testing means that vulnerable children must often wait months to be seen by specialists to have allergies diagnosed and life-saving management plans put in place.

Associate Professor Alice Lee from the UNSW School of Chemical Engineering has recently joined forces with Dr Mahila Namasivayam, Dr Brynn Wainstein and staff of the Department of Immunology and Infectious Diseases at Sydney Children's Hospital in Randwick to overcome these challenges. They are working together to develop better diagnostic tools, treatment and management strategies for food allergies to help at-risk children and their families.

Dr Wainstein and Dr Namasivayam first met with Alice last year where they expressed the urgent need for molecular analysis to improve allergy diagnostics. After an initial meeting with the Head of the Department of Immunology and Infectious Diseases, Dr Paul Gary, and the team at the Children's Hospital at Randwick; a concept and protocol was developed for the first cohort study which now has full human ethics approval to proceed.

Alice says that current tests used to diagnose allergies have significant limitations which must be overcome.

"Unfortunately, the basic skin prick test has more than 50 per cent false positive," says Alice. "The gold standard for diagnosing food allergy is the oral food challenge, but this is a costly and labour-intensive test that can cause a life-threatening allergic reaction."

Alice and her colleagues say that the need to perform an oral food challenge can be significantly reduced by using minimally-invasive in vitro testing, which can differentiate between sensitised children with and without clinical food allergy almost as accurately as an oral food challenge.

"In our first study, we are working to determine IgE binding epitope signatures in children with cashew and pistachio allergies using peptide microarray assays," says Alice. "This data will then be correlated with clinical information using bioinformatics and machine learning to identify key epitope biomarkers for cashew and pistachio allergy diagnosis."

With 2.7 per cent of Australian children under the age of six suffering from a cashew allergy, this is an area of significant concern. It is also a one of the most severe of all tree nut allergies and exhibits high cross-reactivity with pistachio.

When the initial research is complete, the team have an array of further studies to explore on common and emerging food allergies. One study that is earmarked for priority, complementing the current diagnostic research, explores cashew oral immunotherapy as a novel approach to allergy treatment.

"Unfortunately, the skin-prick test has more than 50 per cent false positive… The gold standard for diagnosing food allergy is the oral food challenge, but this is a costly and labour intensive test that can cause a life-threatening allergic reaction."

4th year Chemical Engineering students work to improve sustainability of abattoirs

With water scarcity increasing in many parts of Australia, modern abattoirs need to find new engineering solutions and technical recommendations to reduce their water and energy consumption. These abattoirs use large quantities of water and energy to meet stringent food safety requirements, and the Australian Meat Processors Corporation (AMPC) has been tasked with conducting a technical and economic feasibility study to identify technologies capable of water recycling and recovering energy from meat processing waste.

This real-life scenario formed the basis of the capstone course CEIC4001 - Process Design Project. For 10 weeks in Term 1, chemical engineering undergraduates in their final year worked in teams to evaluate the technical feasibility, financial viability and environmental impact of a series of processes designed to recover useful resources such as water, heat and nutrients from the liquid or solid waste streams of an abattoir in Victoria. The students considered a range of products (and their expected purity) to recycle from the waste streams, and were asked to justify the most appropriate options for the design of the plant.

We spoke to Project Design Project students Ummi Nuraihan Mohamad Rizal and Stephanie Damelian halfway through the course to talk about their experiences; from getting the ball rolling through to challenges and lessons and the impacts of COVID-19 on collaboration.

How did you get started on this project and can you describe the learning curve so far?

Stephanie: Our team touched base in week zero for preliminary teamwork housekeeping. We agreed upon programs and processes for typesetting (Latex), reference management (Mendeley), meetings (in person and on Teams when necessary) and file sharing (Sharepoint). We additionally created a shared google calendar to block out any unavailabilities, thus facilitating meeting arrangements and creating understanding of each other's external commitments. Quick discussions were had regarding individual expectations, and highlighting our strengths and weaknesses to assess how we'll balance each other out. Lengthier discussions were had regarding the pronunciation of 'potable' - consensus has still not been reached. Some of our 'early-starters' hit the ground running with research into innovative solutions to our design problem. Otherwise, the starting point and learning curve was mostly concerned with developing insight into the red meat processing industry; understanding the characteristics of the waste, current industry norms, needs, and likely trajectory for the future.

Ummi: We initially started the project with a little too much excitement. We went straight into the selection of our process lines as indicated in the criteria for our first interview. However we soon discovered that we had very little knowledge on the actual product that we have intended to produce, and the processes involved in red meat abattoir. We decided to take a step back and start again from the beginning. As a starting point, we have established the base for our project by looking into the processes involved in the abattoir, the limitations in selecting the product (standards, rules, current climate issues, client demands) the design criteria of the process lines (product quality, economics, safety, regulations) and the divergences between the process lines to fully comprehend the requirements of our project.

How did you make your decision on the process design and how confident in that decision?

Stephanie: There's always a level of doubt in decisions, where ideally we would love to have more data and industry experience behind our selections. A benefit of having a team of five with different experiences is the pooling of knowledge and breadth of ideas. As a team we decided safety was not to be compromised on, and we prioritised technical feasibility for obvious reasons. Apart from that we made the collective decision to prioritise environmental impacts above several economic factors on the premise that we believe this is 'designing for the future' and will have a J-curve effect. One of our biggest challenges was comparing processes that felt incomparable, whereby we settled on making production of a 'primary product' the factor for distinguishing designs. We are reasonably confident in our decisions, knowing that there is no right answer and that the design is going to develop with the project as we delve deeper.

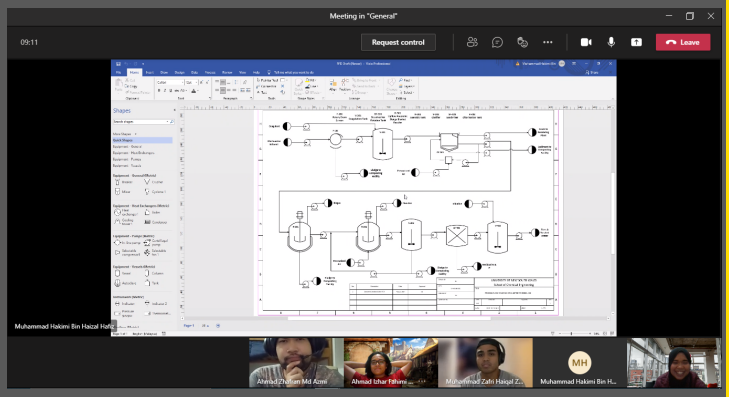
Ummi: Indeed, we did face some difficulties at the beginning especially in terms of the best possible way to approach the problem. However, after looking through all the notes and reflecting on all the guidance from our lecturers, we managed to start with something and it all when went well from there. There were some disagreements throughout the discussions but nevertheless, we have tried our best to come up with the best solution possible.

What are the main challenges you expect for the rest of the term?

Stephanie: Avoiding and managing burn-out is always part of managing a heavy workload. Across our team members we are juggling thesis commitments, paid employment, chronic illness, and most likely other personal factors too. We have a positive team environment for honesty and communication, so we feel we will be able to manage the challenges relating to team dynamics.

Ummi: The main challenge we anticipate is determining how to tackle issues arising from the design project. As we proceed with the report, we have encountered new problems and questioned our decision as our understanding grows. Other than that, time management has also became a concern since all the group members currently enrolled in Thesis B as well. To avoid conflicts in the future, we all have scheduled our lab session to be on the same day.

"We made the collective decision to prioritise environmental factors above several economic factors on the premise that we believe this is 'designing for the future' and will have a J-curve of effect."



What lessons do you expect to learn from this course?

Stephanie: It's a wonderful opportunity to consolidate the coursework from the entire chemical engineering degree. Some of the major learning outcomes we expect to derive from the course are the stitching together of the whole design process, research-driven decision making that encompasses a value hierarchy, and bringing technical knowledge together with external influences such as legislation.

Ummi: We are hoping that through the Design Project, we can gain a better understanding of a real-world working experience. Being able to engage directly with industry panellists may really help us to understand what will be expected from us as fresh graduates.

How well do you think the last three years of your degree prepared you for this project?

Stephanie: Exceptionally well.

Ummi: The transition from previous courses to Design Project was quite bumpy. This project requires us not to only apply the concepts that we have learnt in the classroom, but also to incorporate other skills and learnings such as how to deal with incomplete data, set up project boundaries, make justified assumptions, and correlate individual work into group work.

How has COVID-19 affected your project?

Stephanie: We consider ourselves very privileged to be in Australia where COVID-19 has been relatively well managed. In week 1 we tried to book a private room for our group meeting only to find that the booking was limited to 1 person. It was annoying but also slightly comical, and we've managed to find a space where we can do our work in person at an appropriate distance, as we feel this keeps us on the same page and facilitates the design process.

Ummi: The experience could have been better with more face-to-face learning; we could have engaged more within our groups and with our mentors to foster more fruitful discussion. But with the technology available around us, adaptation to the situation could not have been any easier. All the learning resources we need are within reach.

7 Chem Eng academics attend Course Design Institute

During the Term One student break, 7 academics from Chemical Engineering participated in UNSW's Course Design Institute (CDI) —a five-day intensive workshop teaching the fundamental concepts of course design, student motivation and assessment. UNSW's flagship professional development program delves into novel methodologies and approaches participants can go on to implement in their own courses.

In the latest round, more than half the 13 Course Design participants were from the School of Chemical Engineering. This unprecedented representation from the school resulted in great collaboration and high morale throughout the five days.

When asked why she thinks so many people from Chemical Engineering signed up to do the CDI this term, Head of School Prof Guangzhao Mao said, "Educating is an important and fun part of being an academic. Reimagining how to deliver a course with the assistance of the facilitators at the CDI is an excellent way to improve a course and rekindle the fun. As universal engineers, chemical engineers have long had a culture of continually learning new skills to tackle problems in new domains — this principle applies to education too and we encourage professional development to learn new approaches and polish our skills."

Despite the fact that the participants had a wide range of teaching experience, from none at all to over 15 years, all felt they took something valuable away from participating in the CDI. Dr Peter Neal, who co-facilitated the CDI, observed, "My colleagues began the week with quite diverse levels of experience – some have been teaching for years while others are new to course coordination. Regardless of their level of experience, they all threw themselves into the process and learning new things. It was great to see them engaging with all facets of course design – particularly those which challenge our disciplinary defaults around teaching, assessment and expectations. I was really excited by what they learned and what they achieved – I'm looking forward to seeing these new course designs implemented."

Peter also had some thoughts on why anyone would devote an entire week to 'just' course design: "First, because it takes time. Time to wrestle with concepts, time to analyse about your past learning and teaching experiences, and time to creatively design a new approach to learning for your students. It's like a retreat, and the week gives you the space to rethink your past approaches and construct new ones. And second, because we they want to be good teachers, and the University expects us to provide good learning opportunities for our students. Regardless of whether education is your primary or tertiary focus, good teaching takes time to develop, and good learning begins with good course design. The CDI will help you create better course designs and become a better teacher. Think about it this way - if you have 40 students, in one term they will spend 6,000 hours completing your course. The 30-40 hours of the CDI represent less than 1% of the time your students will spend on your course in a single term. Then think about the number of students you teach over the years. Considering the impact of the CDI I see on improving people's teaching and on students learning, it is an amazing return on investment."

Of course, doing the Course Design Institute isn't in itself enough to entirely transform a course. There is work to do afterwards, and the School of Chemical Engineering recognises that and supports staff to take their work the rest of the way.

Assoc. Prof. Stuart Prescott, the School's Deputy Head (Education) came along to the CDI showcase at the end of the week to see what his colleagues had achieved. He said, "There were so many wonderful ideas coming from our colleagues at the CDI. The School wants to back these efforts and help our staff turn their ideas into real changes in our courses. Keeping the momentum post-CDI is important and so we're running a round of Teaching Microgrants to provide funding that will help our staff deliver their plans. We're looking forward to seeing the results of all this work in future terms."

Dean’s awardees

Sihao Xu and Tao Yang from the UNSW School of Chemical Engineering have been recognised for their research through the prestigious Dean’s Award. The Dean’s Award for Outstanding PhD Theses recognises PhD graduates who produce a thesis that requires only minimal corrections, receives outstanding and/or excellent levels of achievement for all examination criteria, and in the opinion of both examiners is in the top 10% of PhD theses examined.

Tao Yang, Dean’s Award Recipient

Tao Yang - Enzyme Mimics for Nitric Oxide Delivery

“My PhD aims to develop technologies that can generate nitric oxide in the body.

Nitric oxide, a simple gas molecule, possesses a wide range of therapeutic functions. It can promote wound healing, widen blood vessels, and kill bacteria and cancerous tumours. The delivery of nitric oxide is extremely challenging as this molecule is short-lived. Nitric oxide disappears in seconds once it is delivered inside our body, meaning it can be effective only within a limited area, that is, the source of the delivery.

My research overcomes these challenges by coating implantable devices with an inorganic material that acts as a catalyst to convert a natural prodrug in the blood and tissue into nitric oxide. The coatings are expected to be as stable as possible to generate nitric oxide that is sufficient for long-term clinical applications. Despite the fact that these implants are under initial development, my design has attracted attention from INNOVYZ, a well-known international company dedicated to commercialising innovations.

I am thrilled and humbled to receive the UNSW Dean's Award. I would like to take this opportunity to give thanks to my extraordinary supervisor, A/Prof Rona Chandrawati. It has been a fantastic journey to work with her and all these achievements would not be possible without her constant support and excellent supervision.

After my PhD, I decided to expand my expertise and skills as preparation for achieving my career goal – to secure an academic position. I am very lucky to have the opportunity to work as a post-doc in Prof Molly Stevens’ lab at Imperial College London. At Imperial, I will focus on developing scaffolds for tissue regeneration using advanced technologies and designing drug delivery systems for cancer treatment. "

Sihao (Henry) Xu - Photo-intiated Polymerization Induced Self-Assembly: A tool for simplified polymeric nanoparticle synthesis

“My thesis explores the synthesis of polymeric nanoparticles through a more convenient polymerization technique.

When synthesised, polymeric nanoparticles can be potentially used as drug carriers for cancer treatment or for imaging purposes. Stimuli-responsive polymeric nanoparticles can diffuse under certain designed external stimuli (such as light, pH or temperature). And if used as drug carriers, these nanoparticles could allow the drug to release only at designated areas.

Conventionally, the synthesis of nanoparticles through the polymerization-induced self-assembly (PISA) process need to be performed under a high temperature and without oxygen. With the help of photoinduced electron/energy transfer combined with reversible addition-fragmentation chain transfer (PET-RAFT), we developed a system where the PISA process can be carried out in an ambient temperature and with the presence of oxygen. We then developed a technique to further simplify the PISA process into a single step through the gradual injection of monomers. This gives it greater potential for further industrial application.

In the future, we are looking to further develop the PET-RAFT PISA process into a fully automated flow-reactor system to further simplify the process for future industrial scale production.

I would like to take this opportunity to show my appreciation to my supervisor Cyrille Boyer for his guidance and supervision over my PhD career. I am now exploring other options to apply my research background within an industry setting to develop and solve real-life problems.”

Sihao Xu, Dean’s Award Recipient

“We developed a system where the PISA process can be carried out in an ambient temperature and with the presence of oxygen. We then developed a technique to further simplify the PISA process into a single step through the gradual injection of monomers. This gives it greater potential for further industrial application.”

Study with us at UNSW Chemical Engineering

Message from our Head of School

You will learn from dedicated educators in world class facilities. Your UNSW degree will enable you to pursue a variety of professional careers in academia, industry, government and community organisations. Our School has a long and proud history of teaching, research and service for the advancement of chemical engineering and food science to solve real-world problems both in Australia and around the globe.

Professor Guangzhao Mao

Our Programs

Bachelor of Engineering (Honours)	
Chemical Product Engineering	Chemical Engineering

Bachelor of Science (Honours)	
Food Science and Nutrition	Food Science and Technology

Join our network of world-changing alumni working across a range of key industries. A degree in Chemical Engineering provides a gateway into a wide range of careers, with graduates earning an average of over $68,000 (Association of Professional Engineers Australia, 2019).

- A wide range of scholarships are available from the University and Faculty.
- Trimester system offers increased flexibility in study, offering opportunities to study abroad and gain industrial training.
- Our degrees offer experience in hands-on learning, including thesis projects and lab courses.
- All of our undergraduate programs are professionally accredited by industry associations.

Our school in numbers

#1
Ranked Engineering Faculty in Australia

#1
Most employable students (AFR Future Leaders Awards 2020)

#1
University for research and impact in Australia

46%
Female undergraduate students in the School

Want to find out more? Find us at....

chemeng.FutureStudents@unsw.edu.au
UNSW School of Chemical Engineering
@UNSWChemEng
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unsw.edu.au/engineering/chemical-engineering

Student societies

UNSW Chemical Engineering students have the opportunity to be part of student-led groups at all stages of their studies. The Chemical Engineering Undergraduate Society, Food Science Association and the new Chemical Engineering Research Society offer a variety of social and professional opportunities and are open to new members.

Chemical Engineering Undergraduate Society

The UNSW Chemical Engineering Undergraduate Society is the oldest and largest student society within the UNSW School of Chemical Engineering. Known affectionately among staff and students as CEUS, the society is set to mark its 60th anniversary in 2021 and its student leaders have a big celebration in mind to mark the special milestone.

"CEUS students are here to support each other through their degrees and all the trials and tribulations that come with navigating student life."

So what is it about CEUS that has seen it stand the test of time? President Annie Tu says that one of the great things about CEUS is its huge emphasis on work-life balance. The Society runs a series of popular social events throughout the year and these are interspersed by industry events, networking nights and other activities designed to help students consider and prepare for a range of exciting career opportunities.

"The main benefits for students involved with our society are the opportunities to meet new people, have fun and achieve a healthy work-life balance," says Annie.

"CEUS students are here to support each other through their degrees and all the trials and tribulations that come with navigating student life."

Every student who enrols in an undergraduate course with the School of Chemical Engineering automatically becomes part of the society, and new students are given extra encouragement to participate by gaining 5% of their ENGG1000 Project Eevee course mark by attending the CEUS welcome camp in term one.

Unfortunately this year's camp coincided with the major flooding event near Hawkesbury River which saw it conclude a day earlier than planned, but the enthusiastic CEUS Executive Team has ensured that 2021 is flush with events to make up for a quiet 2020 due to strict restrictions on gatherings. During term three there will be a speed networking event, the 60th anniversary party and the annual ball—always the highlight on the CEUS social calendar.

For more information on the UNSW Chemical Engineering Undergraduate Society, contact Annie Tu on ceus@unsw.edu.au

Facebook facebook.com/ceus.unsw/ | Linkedin linkedin.com/company/ceusunsw

Food Science Association

UNSW Food Science Association (FSA) co-presidents Celeste Clayton and Ciara Pighin say that their chosen discipline of Food Science remains a bit of a niche industry, but that's all the more reason for eligible people to become involved in the student-led group.

FSA was established in the early 2000s to offer support and connection both inside and outside of the University for all food science students. They focus on nurturing career pathways, running regular events that introduce students to industry representatives and take tours through some of the impressive manufacturing sites where they could find themselves working in future.

And one look at the FSA Instagram page demonstrates just how much the students have to offer. They have found a way to effectively use social media to share snippets of food knowledge, forge connections and demonstrate just exactly why UNSW food science graduates are in such high demand by potential employers.

"We have so many very talented and passionate students within the FSA that have very promising careers ahead," says Celeste. Our social media presence helps us demonstrate why UNSW is one of Australia's top universities for food science."

Ciara says that their Instagram account has also been a useful way to connect with others that aren't necessarily involved in the sector, saying, "Being active on social media allows us to easily engage with the public to learn more about knowledge gaps and how our skills can be applied to make a difference."

This year, the 15-strong FSA executive team has already organised a successful welcome mixer, cocktail night, professionals night, peer mentoring program, study tools workshop and a cruise with CEUS and the UNSW Materials Science Society. The remainder of the year includes multiple site visits, an annual ball and a speed networking event where students will have the opportunity to have a series of short conversations with industry representatives.

Instagram: @fsa.unsw
Facebook: https://www.facebook.com/FSAUNSW/
LinkedIn: www.linkedin.com/in/fsaunsw

FSA students collaborate on truffle research

Ciara Pighin and Caitlyn Richardson have more in common than being members of the UNSW Food Science Association. They're also working together on their Masters and Honours theses; operating as a picture perfect example of how societies can foster meaningful collaboration between students with similar interests.

Both Ciara and Caitlyn have chosen truffles as the focus of their research. Caitlyn, a second-year Masters student, is looking at the molecular composition difference between Australian and European truffles; while Ciara, in her honours year, is exploring the sensory assessment and characterisation of European and Australian truffles.

By working together, they will be able to identify the flavour compounds of specific truffles clearly and precisely and create a more holistic sensory and analytical analysis of Australian truffles.

Both Ciara and Caitlyn have thoroughly enjoyed working together so far, with each complimenting the other emphatically on their work ethic.

"Having the opportunity to collaborate with Caitlyn has been amazing," says Ciara. "She has so much knowledge and is extremely motivated, making her such a great person to work alongside. I feel as though we make a great team!"

Caitlyn says that it' terrific to work alongside a fellow student on the same food product, and that they're often able to help each other out.

"If we have any questions about truffles, we can often just ask each other—and the collaboration aspect helps to motivate me even further as we're working together as a team towards a common goal," says Caitlyn. "It has been wonderful to work with Ciara; she is so hard working with the number of subjects she is juggling and her FSA presidency. Her work ethic inspires me to work even harder on the project."

Their advice for those considering studying in food science at UNSW has a common thread: jump in head first and soak up every opportunity.

"Get involved in your classes and make the most of your time at university—because it will go VERY fast!" said Ciara. "Make sure to talk to your lecturers and find out more about their area of expertise, because it will come in handy one day! And get involved in different events, societies, and groups throughout your degree. Your university experience is only as good as you choose to make it!

NEW—Chemical Engineering Research Society

The UNSW Chemical Engineering Research Society (CERS) is only in its infancy, but the inaugural CERS executive team lead by co-presidents Zainab Mustafa, Ernest Tse and Bijil Subhash has been working hard to put the foundations in place to build a society with both credibility and longevity.

Established in September 2020, CERS aims to connect all of UNSW's chemical engineering research students through a platform where they can collaborate, share resources and request assistance when they need it. It also seeks to promote student wellbeing and assist new students with their daunting onboarding experience. Ernest says that with over 200 people currently undertaking Masters and PhD research in the School of Chemical Engineering, CERS has the potential to assist hundreds.

"CERS was set up to build linkages between these researchers—but also to act as the bridge for communication between our school's academic staff and research students."

"Currently our researchers are spread across different parts of the school; they work on different floors and within different buildings which means they often don't have the opportunity to connect and build relationships with others," says Ernest.

"CERS was set up to build linkages between these researchers—but also to act as the bridge for communication between our school's academic and professional staff and research students."

While Ernest, Zainab and Bijil have been focusing on building a constitution, succession planning and getting CERS registered with Arc–UNSW's official organisation for student experiences—they also organised a fun-filled trivia night on the 18th of June that coincided with their Inaugural General Meeting. The trivia event gathered huge interest with numbers capped to allow for social distancing.

It was an evening of networking, collaboration and friendly competition between research groups and academics from numerous fields across the School of Chemical Engineering. The event also inaugurated the new members of the CERS executive team that will carry the society forward for the next 12 months.

"It was wonderful to see everyone coming together and participating, with so many expressing that they wanted many more of these events. With the incredible support that we have from the School of Chemical Engineering, I am excited to see CERS grow in the years to come," said Zainab.

CERS plans to work closely with the Chemical Engineering Undergraduate Society (CEUS), Food Science Association (FSA) and Material Science and Engineering (PGSOC) to engage more effectively with undergraduates and demonstrate the many benefits of pursuing postgraduate research.

For more information on the Chemical Engineering Research Society, contact their team at cers.unsw@gmail.com.

Instagram: @cersunsw | Twitter: @CersUnsw

Congratulations to our latest grant and award recipients

Australian Research Council Discovery Early Career Researcher Awards

Dr Chuangang Hu: Carbon-based catalysts for value-added chemicals from CO2 and sunlight
Dr Priyank Kumar: A predictive, ab initio design of enhanced plasmonic photocatalysts
Dr Ruopian Fang: Unlocking carbon nano-tectonics for next-generation lithium batteries
Dr Md Arifur Rahim: Nanomanipulation of Liquid Metal Interfaces via Polyphenol Assembly

Australian Research Council Discovery Projects

Jie Bao: A system behavioural approach to big data-driven nonlinear process control
Cyrille Boyer, et al: Programming the microstructure of 3D printed objects
Jason Scott, et al: Designing a photo-electro-catalysis system for selective organic oxidation
Jiangtao Xu, et al: Chiral synthetic macromolecules – control of sequence and stereochemistry
Kang Liang, et al: Highly efficient nanomotors for autonomous cell recognition and isolation

Australian Research Council Linkage Projects

Yansong Shen**:** Data-driven monitoring of raceway dynamics in ironmaking blast furnaces
Patrick Spicer: Plant plasters: Efficient spray micro-coatings for plant delivery

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Other news

Chief Scientist Cathy Foley presents at UNSW

UNSW School of Chemical Engineering hosted a virtual presentation by Australia's Chief Scientist Dr Cathy Foley on 7 April 2021. The presentation was titled *How we do science is changing - The impact of A.I, automation, quantum and COVID,* and covered the many ways that research has evolved from the
traditional approach of building a lab with all the necessary equipment and resources contained therein. New ways to collaborate and access major research have emerged over recent years–and Dr Foley said that the with artificial intelligence,
machine learning and automation—research approaches are changing once again. Her talk discussed what researchers can do to be leaders in this transition rather than followers.

Dr Cathy Foley, Australia's Chief Scientist

IWD2021

Choose to Challenge

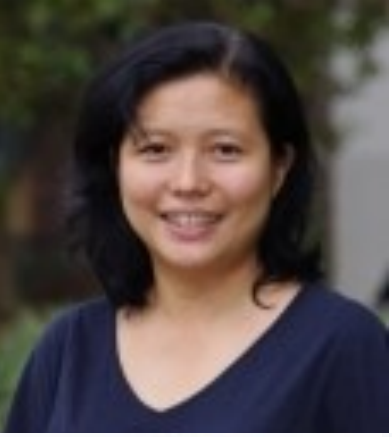
Happy International Women's Day from the UNSW School of Chemical Engineering

A challenged world is an alert world and from challenge comes change. So let's all choose to challenge.

How will you help forge a gender equal world?

Celebrate women's achievement. Raise awareness against bias. Take action for equality.

https://www.internationalwomensday.com














Postgraduate study at UNSW Chemical Engineering

Message from our Head of School

You will learn from dedicated educators in world class facilities. Your UNSW degree will enable you to pursue a variety of professional careers in academia, industry, government and community organisations. Our School has a long and proud history of teaching, research and service for the advancement of chemical engineering and food science to solve real-world problems both in Australia and around the globe.

Professor Guangzhao Mao

Our Programs

Master of Food Science

Master of Engineering Science

Chemical Process Engineering	Food Process Engineering

What's hot?

Graduate Certificates

Study something bite-sized to whet your appetite for our postgraduate programs.

Key Benefits

Whether you have just completed your undergraduate studies or are a few years into your career, a Masters degree from UNSW School of Chemical Engineering, will provide you with the opportunity to advance your professional skills and deepen your knowledge and expertise. Study with us in Sydney, Australia! According to the Association of Professional Engineers Australia (2019), holding a Masters Degree delivered a wage premium of 15.4%, compared with a Bachelors degree.

- Join our network of world-changing alumni working across a range of key industries.
- Trimester system offers increased flexibility in study, offering opportunities to study abroad and accelerate learning.
- Our degrees offer experience in hands-on learning included thesis projects and lab courses.

Our school in numbers

#1

Ranked Engineering Faculty in Australia

#1

Most employable students (AFR Future Leaders Awards 2020)

#1

University for research and impact in Australia

Want to find out more? Find us at...

chemeng.FutureStudents@unsw.edu.au

UNSW School of Chemical Engineering

@UNSWChemEng

@UNSWChemEng

unsw.edu.au/engineering/chemical-engineering

Inspiring alumni

Dr Kirsty Germaine was the guest speaker for the Inspiring Alumni series in Term 1. Kirsty is now the Technical Director at MAURI, a division of George Weston Foods. Her presentation described her journey from graduation as a Food Scientist from UNSW (class of 1999) to a strategic technical business leader in the food industry. Kirsty started as a Baking Technologist at BRI Research and moved on to secure leadership positions at George Western Technologies before securing her current role.

Kirsty shared her personal and professional experiences and how she reached her ambitions and goals. An inspirational leader with a passion for people, Kirsty has over 20 years of experience in the grains, milling and baking industries. Future graduate engineers, higher degree research students and fellow UNSW alumni all tuned in to gain insights into Kirsty's career journey.

Dr Kirsty Germaine, UNSW Chemical Engineering Alumni

Vesna Olles, UNSW Chemical Engineering Alumni

Vesna Olles is the Director of Strategy and Business Development for BOC South Pacific. She is responsible for strategic innovation, planning and business development, which includes identifying and analysing opportunities that contribute to BOC's strategic direction for LNG, hydrogen and alternative fuels.

Vesna has extensive experience in Australian and global blue-chip companies where she worked across major sectors including industrial, building and construction and gas sectors, in senior and general management positions spanning P&L management, marketing and engineering. Since beginning her career with BOC, she has held multiple positions including General Manager, Sales & Marketing Transformation and General Manager, Channels Strategic Marketing. This role saw her implement a cohesive channel interaction program alongside digital to deliver a seamless and effective cross channel customer experience. She is passionate about leading her teams with integrity and authenticity to deliver outcome.

Vesna has a degree in Chemical engineering, and a Masters in Commerce, Marketing and Finance from the University of NSW.

Are you alumni of the UNSW School of Chemical Engineering? We'd love to hear from you! We're always looking for inspiring alumni members to feature in our communication material.

If you are happy to share your story, please email us at chemeng.external@unsw.edu.au

Executive Team

Guangzhao Mao
Head of School

Cyrille Boyer
Deputy Head of Research

Stuart Prescott
Deputy Head of Education

John Starling
Technical Manager

Rahul Bajoria
School Manager

Academic Team

Ali Jalili

Alice Lee

Alison Jones

Cordelia Selomulya

Da-Wei Wang

Dipan Kundu

Emma Lovell

Francisco Trujillo

Graeme Bushell

Greg Leslie

Jason Scott

Jayashree Arcott

Jian Zhao

Jiangtao Xu

Jie Bao

Johannes Le Coutre

Kang Liang

Kondo-Francois Aguey Zinsou

Kourosh Kalantar-Zadeh

Liming Dai

May Lim

Nicholas Bedford

Patrick Spicer

Per Zetterlund

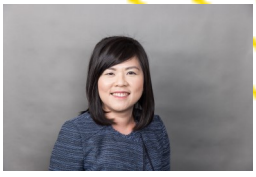
Peter Neal

Peter Wich

Pierre Le Clech

Priyank Kumar

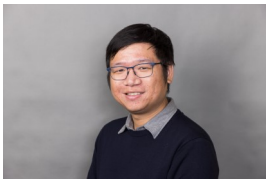
Rita Henderson



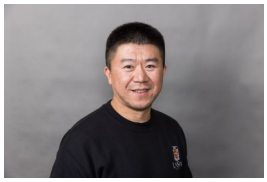
Rona Chandrawati

Rose Amal

Sarah Grundy



Xunyu Lu



Yansong Sheng

Zhaojun Han

Zi Gu

www.unsw.edu.au

UNSW School of Chemical Engineering in numbers

Total number of academic staff: 41
Total number of technical and professional staff: 19
Total number of PhD students: ~220
Total number of postdocs: 65

Research funding: USD 236k/academic staff/year
Publications: ~10 papers/academic staff/year
Clarivate 2021 HCR: 4 academic staff

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https://www.unsw.edu.au/engineering/chemical-engineering