



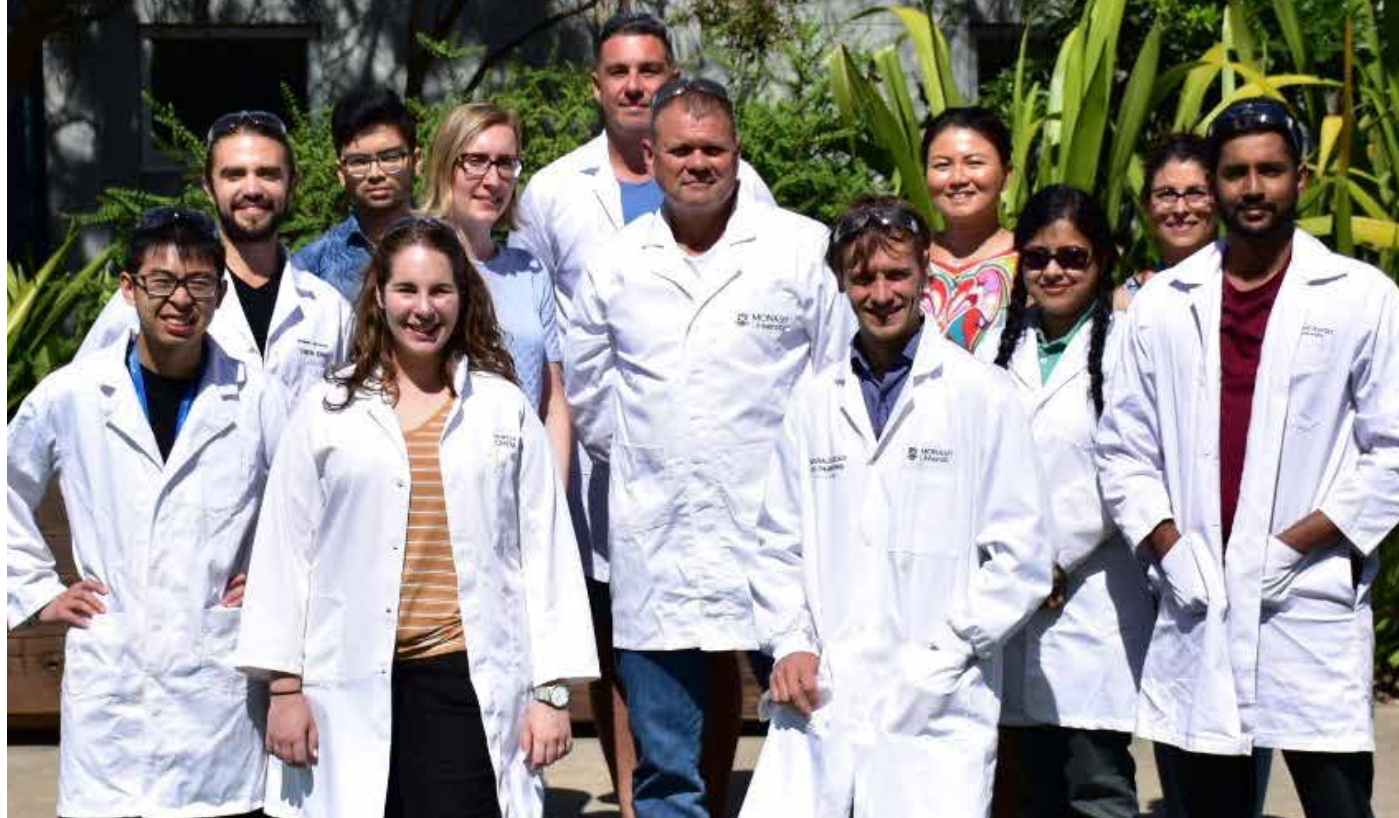
MONASH  
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MONASH  
CHEMICAL  
ENGINEERING

March 2019 Vol 12, Issue 1

# FOCUS

TEACHING AND RESEARCH NEWS FROM THE  
DEPARTMENT OF CHEMICAL ENGINEERING



*Chemical Engineering Focus Newsletter*



# *focus*

TEACHING AND RESEARCH NEWS FROM THE  
DEPARTMENT OF CHEMICAL ENGINEERING

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# WELCOME FROM THE HEAD OF DEPARTMENT



We are starting 2019 with lots of exciting changes at Monash Chemical Engineering. A new student team has been founded: Monash BrewLab – a wonderful example of an ancient chemical engineering process and the advancement of the field. The team is backed by the department and the faculty and is a wonderful part of our overall efforts in Food Engineering including our food grade pilot lab/kitchen in the Green Chemical Futures building. Our efforts in Food Engineering are also greatly bolstered by two recent hires – Lecturer Leonie van't Hag and Senior Lecturer Sushil Dhital. We are very excited about the new dimensions they will bring to our efforts in the critically important food space. We have also added new strength by jointly hiring for the first time with the Civil Engineering and Materials Science & Engineering departments. Associate Professor Laura-lee Innes will join us to greatly bolster the Program in Environmental Engineering that we run with Civil. Associate Professor Tim Scott provides new strength in additive manufacturing and exciting new strategies for polymer design and processing. Full details on BrewLab and more information on the research and teaching

interest of our four new hires are in this issue of Focus.

Industry, government and/or NGO interaction as part of the undergraduate academic experience remains a key goal department. Last year our successful Industry Based Learning Project (CHE4164) again integrated interested students into interesting projects for a semester with an industry partner as described in a Focus article. In addition, we also have student teams interacting with industry as part of Research Project (CHE4180), on Monash Industry Team Initiative (MITI) projects, and the Faculty of Engineering's new Co-op program. Co-op is a flexible new approach that can provide significant engagement for 3 – 12 months. The four programs offer a variety of approaches to external engagement for our students. If you are a student looking to connect with these opportunities, or one of our fantastic alumni looking to engage, and/or an industry, government, or NGO partner looking for new opportunity – please get in touch with us and we will be happy to provide more information.

Our students, research fellows, and academics continue to garner recognition for the excellence of their achievements. The incoming President of SMUCE, Shivank Vijayakumar received the Victorian Chemical Engineering Student Achievement Award. SMUCE received the Most Outstanding Publication award for their excellent Career Guide. Nathan Eden has received the Russell and Jenny Tait Ph.D. scholarship for his research on Metal-Organic Frameworks. Sepideh Afshar was awarded a Victorian Fellowship for her research on powdered dairy products. Akshat Tanksale received the IChemE Caltex award for exceptional course development and Cordelia Selomulya won the IChemE global award for Food & Drink and the BHERT award for outstanding collaboration in research and development. Andrew Hoadley was recognized by the Faculty for his exceptional service as part of our successful Engineers Australia and IChemE accreditation efforts. The professional staff of chemical engineering contributes to all of our teaching and research – and I am delighted that Ross Ellingham was recognized by the Faculty for his exceptional efforts on behalf of the department and entire engineering faculty.

Finally, at the beginning of this year, I passed my one-year anniversary point with the department. It has been an exciting and fulfilling journey over the past year with a wonderful set of colleagues – students, professional staff, and academics. I look forward to working with all of you in 2019!

Best Regards,

*Professor Banaszak Holl*







# MONASH LAUNCHES FIRST BREW LAB

**The Department is pleased to announce the establishment of its first Brew Lab. The nano/micro brewery is an analytical laboratory for beer products and will give students a unique opportunity to explore the art of craft brewing in a full analytical laboratory, where they can innovate and experiment with the brewing process.**

The Monash BrewLab is a student-run team who design, produce and compete with their very own amateur brews in Australia. The team is comprised of students from a range of faculties, including engineering, commerce, science, design, and law. The students work collaboratively on the technical, business and management aspects.

BrewLab team members not only develop their hands-on engineering and business acumen, but they also gain interpersonal skills and create networks that carry far beyond their university education and into the Chemical Engineering/ Food Manufacturing industry.

The initiative is supported by the Department, providing the teams with access to various laboratories across the Monash Clayton campus, including the Green Chemical Futures Building with its food grade laboratories.

The Monash BrewLab is the first of its kind at Monash and will focus on building an inclusive community for students who are interested in the craft of brewing. Both safety and sustainability are key elements of the BrewLab.

A management team will oversee the running of the BrewLab and guide the initiative as it grows and develops, maintain effective communication, deliver continuous brand improvement and develop appropriate marketing strategies, as well as manage sponsorship.

Once the BrewLab is established, the brew teams hope to increase their brew volume to several thousand litres per year. There is also scope to engage the broader community university, with weekly brew nights for Monash students



The BrewLab teams are mentored by a supportive cohort of Engineering staff, including Dr Scott Wordley, Dr Parama Banerjee, Dr Andrew Rodda, Prof. Cordelia Selomulya, Prof. Murray Rudman, Ms Lilyanne Price, and Ms Veronica Halupka.

**For more information on the Brew Lab**

**Email: [brewlab@monash.edu](mailto:brewlab@monash.edu)**

**Web: [monashbrewlab.com](http://monashbrewlab.com)**

**Facebook: [MonashBrewLab](https://www.facebook.com/MonashBrewLab)**



We provide an opportunity for students to learn, design, and operate brewing systems in a safe environment! Our focus lies on gaining experience and developing a passionate community around beer, by inspiring other student communities for craft brewing.

We might not make the best beer (yet), but we love doing it!

## WHAT ARE WE DOING?

- Developing a student-operated nano-scale brewery on campus
- Creating unique beers for the Monash community
- Enhancing the brewing skills of our team
- Entering into competitions and festivals to make ourselves known

## WHY SHOULD YOU GET INVOLVED?

- Access to the best engineering students in Australia
- Opportunity for collaboration in research and innovation
- VIP invitations to our events
- Publicity through sponsorship

## HOW CAN YOU HELP US?

- Mentoring
- Expertise and knowledge
- Donations (equipment and ingredients)
- Experience for students (tours, courses, training)
- Sponsorship



Join us for a cold one

## JOIN US FOR A COLD ONE @



MonashBrewLab



brewlab@monash.edu

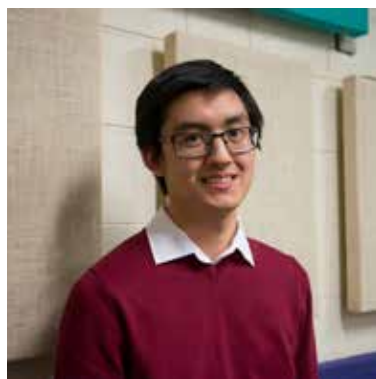


Faculty of Chemical Engineering  
Monash University  
Tel: +61 3 9905 3555

[www.monashbrewlab.com](http://www.monashbrewlab.com)



# RUSSELL AND JENNY TAIT POSTGRADUATE RESEARCH SCHOLARSHIP



**Congratulations to new PhD student, Mr Nathan Eden, who has been awarded the Russell and Jenny Tait Scholarship for 2019.**

Nathan comes to Monash from South Australia, where he completed a Bachelor of Science (Advanced, Hons I) with a double major in chemistry and experimental physics at the University of Adelaide. His honours thesis examined a sol-gel derived Manganese Metal-Organic Framework (MOF), and it was his interest in MOFs that brought Nathan to Monash. While an undergraduate — as well as being an active musician (cornet player) in the Marion City Band — Nathan also received the 'Adelaide Graduate Award' that recognises extracurricular activities completed that promote work-relevant skillsets for his work with the Vice Chancellor's Host Program, Peer Mentor for Faculty of Sciences, AUScA (Adelaide University Sciences Association) member, volunteer for the IAC held in Adelaide in 2017, and general volunteer for 'Science Alive!'.

Nathan says, "When choosing a university to complete a PhD, I recognised that Monash would be the place where I could develop my interest in nanomaterials to include combinations of metal-organic frameworks (MOFs) with polymers."

"Monash is Australia's number one chemical engineering faculty with close ties to CSIRO research and in the top 1% of world universities. I am also very interested in my supervisor Matthew Hill's development of CO2Gen and the opportunity to develop my laboratory work into real-world applications that can make a difference".

Nathan's PhD research focuses on the development of porous membranes for small molecule storage, separation and purification. He will investigate the interaction between crystalline metal-organic frameworks and amorphous polymers into porous membranes, with the objective of achieving hydrogen separation and purification under real-world conditions.

In the future Nathan hopes to play a part in the development of hydrogen infrastructure as a form of energy storage in transition away from reliance on fossil fuels.

The Russell and Jenny Tait Scholarship is for eligible outstanding PhD students to pursue research in the Faculty of Science or Engineering at Monash in the areas of environmental conservation, environmental protection/prevention, energy generation and transition to renewable energy, sustainable renewable energy, and climate modelling or research using UAV technology.

The Department of Chemical Engineering would like to thank the Mr and Mrs Tait for their generous support of Nathan's PhD project with this scholarship.

## ABOUT RUSSEL TAIT

Russell completed his Bachelor of Science (Honours) at Monash University in 1976.

Upon graduating he moved to Adelaide to begin his first job as a water pollution biologist with the state water regulator, working on environmental monitoring and water treatment.

Following assignments in the Northern Territory, Queensland and New South Wales, he moved to the east coast of the USA in 1989. His next major challenge was in Alaska, where he managed the Environmental and Natural Resources Damage Assessment field studies for the Valdez oil spill. Moving back to Australia in 1992 he undertook environmental management and research studies on Bass Strait and Westernport. Returning to the United States in 1996, he commenced a series of environmental and socio-economic assignments through increasingly senior positions. He has worked on projects in more than 80 countries during his career. These assignments led to him becoming Chief Environmental Scientist of Exxon Mobil Corporation in 2012, a position from which he retired in 2017.

Russell has contributed to numerous government and international environmental assessments, most recently focusing on the Arctic. He has been an industry scientific advisor on research, some of which included the impact of sound on marine life, decommissioning of offshore structures and climate change. Russell is a Certified Environmental Professional (Impact Assessment) and has published over 50 scientific papers, and received the Brodie Medal in Chemical Engineering for research on waste water treatment. During his time working in the former Soviet Union, he was awarded a Fellowship of the Azerbaijan Eco-Energy Academy for his leadership and contributions to the science of the Caspian Sea. He is a technical expert advisor to the U.N. for the 2nd World Ocean Assessment, and has been a director of the Victorian Institute of Marine Science and the Marine Science Laboratories of Victoria.

Russell and his wife live in Melbourne, and are continuing to engage on environmental and social issues. Russell is actively engaged with the Environment Institute and Monash University assisting students and early career scientists and engineers through mentoring, academic and career development activities.

# DEVELOPING AND UNDERSTANDING FUNCTIONAL FOODS

**As the understanding of food evolves from sustaining life and supplying energy, to foods that have a role in preventing disease and enhancing physical and mental health, interest in 'Functional Foods' has increased.**

**Professor Cordelia Selomulya and PhD researcher Ms Qianyu Ye, with colleagues Nicolas Georges and Meng Wai Woo, have undertaken leading work in the development and understanding of functional foods and their application for the manufacturing sector. Together they have recently published two articles in leading scientific journals.**

PhD researcher Qianyu Ye obtained her Bachelor in Chemistry at Lanzhou University in 2011 and her double Master in Advanced Chemical Engineering at University of Birmingham (2012) and in Chemistry with distinction at The University of Melbourne (2016). She commenced her PhD at Monash University in 2017, under the supervision of Prof Cordelia Selomulya. Her work focuses on the microencapsulation of functional dairy ingredients.



PhD Student Ms Qianyu Ye

In the paper *Microencapsulation of active ingredients in functional foods: From research stage to commercial food products* published in *Trends in Food Science and Technology* (doi:10.1016/j.tifs.2018.05.025), twelve categories of active ingredients or functional foods have been deemed 'Foods with Health Claims' and have been identified for their promotion of human health. These 12 ingredients include: dietary fibre; oligosaccharides; sugar alcohols; amino acids; peptides and proteins; glucosides; alcohols; isoprenes and vitamins; cholines; lactic acid bacteria; minerals; unsaturated fatty acids.

Already manufacturers are supplementing these active ingredients into food and dairy products to improve nutritional value.

The researchers are examining different encapsulation techniques and tailored shell materials, with their research investigating ways to optimise the functional properties of microcapsules. Through encapsulation some of these active ingredients will extend their ability to withstand process conditions such as heat and shear stresses, prolonging their shelf stability.

Key challenges to this work include the incorporation of bioactive ingredients into functional foods to keep the constituents stable and to release them into the target site within the human body. Certain microcapsules have been incorporated into commercial food products, however, most remain at the research stage where the functional properties of microcapsules like encapsulation efficiency and storage stability have been optimised, but the evaluation of controlled release and bioavailability has rarely been studied. At present, there are two possible trends: (1) reducing the size of capsules from microscale to nanoscale; and (2) employing shell materials with specific functionality. Both options have benefits, these being benefits that provide opportunities for functional food manufacturers.

The second paper released by the research duo examined 'Modification of molecular conformation of spray-dried whey protein microparticles improving digestibility and release characteristics' published in *Food Chemistry* (doi:10.1016/j.foodchem.2018.12.074). This paper continues the researchers work on the design and production of nutraceuticals and functional foods to provide health benefits including enhanced cognitive performance, gut immune function and improved anti-oxidant capabilities.

Through the preparation of riboflavin-loaded whey protein isolate (WPI) microparticles, using desolvation and then spray drying. The results showed the coupling between desolvation and spray drying displays a great potential for applications in the food industry as a versatile and low-cost approach to microencapsulation with proteins for targeted release.

## READ MORE

Qianyu Ye, Meng Wai Woo, Cordelia Selomulya  
*Modification of molecular conformation of spray-dried whey protein microparticles improving digestibility and release characteristics*. *Food Chemistry* 280 (2019) 255–261

Qianyu Ye, Nicolas Georges, Cordelia Selomulya  
*Microencapsulation of active ingredients in functional foods: From research stage to commercial food products*. *Trends in Food Science & Technology* 78 (2018) 167–179



# POSTGRADUATE OPPORTUNITIES

## PhD

Monash Engineering operates at the forefront of engineering research. All specialised fields of research are at world standard or above and the most recent Excellence in Research for Australia assessment has rated our research results well above world standard. With access to world-class laboratories, workshops and facilities and with highly specialised equipment and software, a PhD in Engineering offers you a stimulating, supportive and professional environment in which to explore engineering challenges and develop solutions for the future.

A PhD in Engineering takes the form of the Monash Doctoral Program – a PhD for the 21st century. The program consists of extensive, independent research of a topic formulated in consultation with academic staff. A minimum of two academic supervisors will support you throughout your study. As part of the program you will also complete a series of professional development activities or coursework units that provide you with the skills required to make an impact in academia, industry, government or the wider community. Your study will result in a research thesis or alternative approved output, which makes a valuable contribution to the current body of knowledge on your chosen topic.

Our research explores a wide range of chemical engineering disciplines, including chemical reactor engineering, coal conversion processes and particle technology. And our researchers are leading the way. Not only are we the number one chemical engineering faculty in Australia – we're among the very best in the world.

### Our expertise

Our research here at the Department of Chemical Engineering at Monash is organised into six key areas.  
<http://www.monash.edu/engineering/departments/chemical/research/departments-research-expertise>

### Why join Monash?

Monash University is ranked as the best university in Australia for engineering and technology by the Times Higher Education, 2016-2017.

What's more, Monash itself is in the top 1 per cent of world universities according to the Times Higher Education World University Rankings 2016-2017, and a member of the prestigious Group of Eight Universities here in Australia.

A full-time funded scholarship is available for outstanding candidates for PhD study in Chemical Engineering.

Chemical Engineering Higher Degree by Research enquiries.

Email us at: [chemeng-hdr.enquiries@monash.edu](mailto:chemeng-hdr.enquiries@monash.edu)

## Masters

Master of Advanced Engineering Coursework (Chemical Engineering) enquiries

<https://www.monash.edu/engineering/masters>

Email us at: [chemeng-pgcoursework.enquiries@monash.edu](mailto:chemeng-pgcoursework.enquiries@monash.edu)



# SMUCE UPDATE

The Society of Monash University Chemical Engineers (SMUCE) aims to bridge the gap between the classrooms and the world outside university. It serves as a link between students, academics and industry.

SMUCE is a student run society aiming to help and engage with the chemical engineering student community. Through our hugely popular Industry Seminar Series we strive to expose our fellow students to the chemical engineering world by regularly inviting industry members to visit.

These visits involve a presentation to students regarding what it is like to be an engineer in industry and to learn about graduate and vacation opportunities. SMUCE also work closely with the Department of Chemical Engineering and Monash Employment and Careers Development to increase student awareness of the professional opportunities and to build upon the skills necessary to aid them in their professional undertakings.

Socially, SMUCE organises a number of events to facilitate networking opportunities between students, different year levels and academic staff. Such events include barbecues, game competition nights and our annual SMUCE Academic Dinner.

In 2018 the SMUCE Careers Guide was nominated for the **Most Outstanding Publication by Monash Clubs & Societies**



The SMUCE Committee for 2019 has been announced. Congratulations to all new committed members and year level representatives. We look forward to another outstanding year of engagement.

| SMUCE Committee 2019                            |   |                |
|---|---|----------------|
| <b>President</b><br>Shivank Vijayakumar         | <b>Academic VP</b><br>Hassan Al-Jawati      |                |
| <b>Industry VP (co-op)</b><br>Nicholas Farrugia | <b>Social VP</b><br>Anthea Martin           |                |
| <b>Treasurer</b><br>Adam Hayes                  | <b>Secretary</b><br>Garv Bhardwaj           |                |
| <b>Industry Liaison Officer</b><br>Liam Giezen  | <b>Social Media Officer</b><br>Leeay Henzel |                |
| <b>Fourth Year Representatives</b>              |   |                |
| Carson Yuan                                     | Dilini Eriyagama                            |                |
| <b>Third Year Representatives</b>               |   |                |
| Katelyn Evans                                   | Khalid Al-Subhi                             | Sabrina Bassal |
| <b>Second Year Representatives</b>              |   |                |
| Nithiya Pathmasiri                              | Callum Porritt                              | VACANT         |



## SOCIETY OF MONASH UNIVERSITY CHEMICAL ENGINEERS

### Linking students with industry

CONTACT [smuce@monashclubs.org](mailto:smuce@monashclubs.org)  
to organise your opportunity to connect with the  
Chemical Engineering students at  
Monash University

Like us in Facebook [www.facebook.com/SocietyOf-MonashUniversityChemicalEngineers/](https://www.facebook.com/SocietyOf-MonashUniversityChemicalEngineers/)

# CHE4164 INTEGRATED INDUSTRIAL PROJECT

**The Department of Chemical Engineering runs a scheme offering students the opportunity of spending a period working on an industry-based project integrated within the undergraduate program. This scheme has been running successfully since 2008.**

**The aim of the integrated industrial project scheme is to engage, stimulate and challenge our brightest students, by providing a unique environment that broadens their learning and allows for intellectual stimulation, innovation and creativity.**

During the industrial placement, students work in-depth on a significant project, allowing them to apply their chemical engineering knowledge in an industrial context. This can be challenging in an industrial situation and thus will develop an informed and reflective approach to theories and concepts presented as part of their course. At the conclusion of the project, the students will write a major report describing the organisation and activities of the host company and a detailed report on the project undertaken.

The scheme is accredited by EA and IChemE as part of the Chemical Engineering Degree.

## **Unit Integration:**

The students will enrol in an 18 credit point subject (CHE4164), which integrates and aligns the learning objectives of two subjects -- CHE4180 Chemical Engineering Project and CHE4161 Engineer in Society -- that the student would normally take during the first semester of their final year. Students will study the topics included in these subjects simultaneously in context as part of their placement, making this a flexible, integrated learning environment. To achieve this, the project or projects undertaken will be carefully defined by the industry partner in collaboration with academic supervisor, and will be scoped to include the learning objectives of the subjects. Independent study will also be required in order to achieve some subject objectives. Some students will also do an additional 6 cp unit on Data Analysis, running by distance education.

## **Timing and Duration:**

The students will work full time in industry, starting at the end of February at the latest and running to the third week of June, at the premises of the sponsor company, on a project selected by, and under the control of, the company. The end time is fixed, while the start time is subject to negotiation between the student and the company.

## **Academic Supervisor:**

An Academic Supervisor will be appointed to each student. The role of the Academic Supervisor will be to liaise with the industry partner to ensure that the project undertaken by the students is appropriate and to assist in the pastoral care of the student. The Academic Supervisor will visit the student at least once at the start of the placement to review the project with student. The student will also make a presentation, which the Academic Supervisor will visit to assess, at the end of the project on the final outcomes of the project.

## **Student Selection:**

Students will be selected by the department based on academic and personal qualities demonstrated during the first three years of their University studies and after interview. The Department will endeavour to match student preferences and qualities to the requirements of industry partners.

## **Independent Study:**

Students on the scheme will be required to engage in some independent study in the areas of Process Safety and Process Economics in order to complete the full scope of the project. To assist them with this, students will be provided with the study material (which may include lecture notes, Powerpoint presentations, reading recommendations, exercises). Also, students will be able to liaise with the lecturers coordinating the other units.

## **Assessment:**

The main piece of assessment is a major report on the placement. This report is worth 50% of the final mark for the subject. Interim assignments are required to be submitted throughout the semester, with the exact timing depending on the specific project. One interim assignment will be a project plan to be submitted one month into the placement. The project plan, prepared by the student in consultation with the industry partner and academic supervisor, will outline the plan for their specific project or projects and will demonstrate how the learning objectives of the unit will be achieved. At the conclusion of the project, each student will make an oral presentation (10% of final mark) on their project activities to their industry supervisor and visiting academic supervisor and also receive a mark for their performance in the project.

## **Confidentiality and Intellectual Property:**

The Sponsor Company retains all Intellectual Property generated as part of the placement. All information from the placement must be kept confidential by the student and the academic supervisor. These provisions are included in an agreement covering each placement, which is completed between the Sponsor Company and Monash, with separate acknowledgement by the student.

## **Scholarship Value: \$12,500 Tax free to the student**

### **Cost to Company:**

**Scholarship value, plus \$5,000 Departmental overheads fee, for a total of \$17,500 excluding GST.**

## **Companies interested in participating in the CHE4164 unit can contact:**

**Associate Professor Warren Batchelor**

**T: +61 3 99053452**

**E: [warren.batchelor@monash.edu](mailto:warren.batchelor@monash.edu)**



# INDUSTRIAL PLACEMENT AT SUN PHARMA PORT FAIRY

Three of our students took the opportunity to complete an industrial placement (Industry Based Learning Project (CHE4164)) in Port Fairy, Victoria with Sun Pharma in 2018. The students, Imogen Mollross, Audrey Kottek and Chau Cat Tuong Vo enjoyed some time away from Melbourne renting a house together (along with Imogen's dog Leo), immersing themselves in the local community.



Last year Imogen Mollross completed her sixth and final year of a Bachelor of Chemical Engineering/ Bachelor of Pharmaceutical Sciences dual degree. During her industrial placement at Sun Pharma she developed and designed a recovery process for tartaric acid.

Tartaric acid is used at Sun Pharma during the manufacture of morphine and thebaine, and is currently lost in its entirety to the waste effluent from the site. If the tartaric acid could be recovered and recycled through the processes, both costs and wastage would be reduced. Imogen's job was to develop a chemical process to recover the tartaric acid, and design the implementation of the process on site.

"I thoroughly enjoyed the experience and I am very glad I applied for the IBL program. The project allowed me to put into practice a lot of knowledge that I gained throughout all aspects of my studies, and allowed me to get into a 'process design' headspace, which was extremely useful going into my final year design unit in the following semester."

"The projects at Sun are very student friendly, and the staff allow full ownership of the projects with the required support. Living in a small country town (Port Fairy) was also a very valuable experience.

Imogen is currently working at the Australian Energy Market Operator (AEMO) as a graduate engineer in the Gas Operations team.

Audrey completed her Bachelor of Engineering in Chemical Engineering degree last year and is now working in a milk processing facility. During her time at Sun Pharma, Audrey examined the clean-in-place process of a distillation column.

The column was a bottleneck of the system and was typically cleaned every 20hrs. Cleaning took about 4-6hrs. As part of her project, Audrey's initial aim was to reduce cleaning downtime, while maintaining or improving performance/uptime. However, while at Sun Pharma, the column developed a new problem – namely a blockage which would form after 10-12hrs thus forcing the column feed to slow down and require cleaning after a much shorter time.

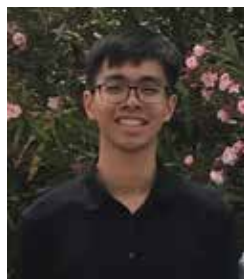
Audrey's project therefore morphed into an investigation of the blockage (location, composition, potential causes, etc.)

"I managed to identify the rough location and general composition of the blockage, and proposed a solution which helped to reduce the severity and frequency (although not remove altogether) of the blockage. I also proposed a change to the CIP sequence which saw a reduction in downtime while maintaining performance".

Audrey found the experience very enjoyable and would recommend it to everyone.

"I learnt about a lot of things that I wouldn't have ever heard about at university. I learnt things like what CIP (clean-in-place) is to broader aspects like how change management process can work and other workplace practises and exposure to a production environment, which I greatly enjoyed!"

Audrey also was able to learn and improve her own communication skills, and gained an understanding into the many kinds of coworkers using different methods and levels of knowledge about a process (other engineers, process owners and operators).



Bachelor of Chemical Engineering (Honours) student Chau Cat Tuong Vo also participated in the course and was part of the Environmental Health and Safety department.

At Sun Pharma, organic solvents are widely used to extract opiates from poppy straws. Following extraction, the organic solvents are recovered. However, not all solvent can be recovered and is discharged to the Trade Waste system. It is important to keep the solvent content in the Trade Waste system as low as possible, due to both economic and environmental concerns. One way to measure the solvent content in the Trade Waste is through its COD reading. COD, or Chemical Oxygen Demand, is a measurement of the amount of oxygen required to completely oxidise the organic content in the solution. Sun Pharma has installed a COD analyser (around June 2017) to measure the COD and control the solvent content in the Trade Waste system. However, at the time of Chau's placement, Sun Pharma had not yet identified the control limit for the COD reading. The control limit can be used to warn the operators that the solvent content in Trade Waste is too high, which may be a result of a significant leakage. Chau's project aim was to identify that control limit and hence develop an alarm system for the COD analyser.

"To a chemical engineering student, it is difficult to choose which chemical industry to start their career path. However, after finishing this placement, I found myself to be very interested in the water treatment industry".

"I also enjoyed the chance to put most of theory I gained from lectures to practical work, which is a valuable experience. This is definitely the most enjoyable and practical unit I have ever had."

Chau plans to find a position in a water treatment plant and also hopes eventually to complete a PhD that relates to water treatment.

# SHIVANK VIJAYAKUMAR RECEIVES THE VICTORIAN CHEMICAL ENGINEERING STUDENT ACHIEVEMENT AWARD



Photo (left to right): Mike Connell, Principal Process Safety Analyst, WorkSafe Victoria, Shivank Vijayakumar, Andrea Hosey, GM Victoria, Thyssenkrupp and IChemE representative

**Monash Chemical Engineering student Mr Shivank Vijayakumar was awarded the Victorian Chemical Engineering Student Achievement Award for Monash for 2018 at the JVCEC award ceremony, part of the AGM and annual members dinner.**

To be eligible for the JVCEC (Joint Victorian Chemical Engineering Committee) Award, entries must prepare a 400 word essay on the role of chemical engineering in society, demonstrate a commitment to the profession and the community and belong to either Engineers Australia (EA) or Institution of Chemical Engineers (IChemE). All entries received for this award were assessed by three experienced chemical engineers from a range of industries.

The award recognises and encourages chemical engineering students to fully participate in professional and public life. The winner receives \$500 and a framed certificate on behalf of the Joint Victorian Chemical Engineering Committee (JVCEC).

Shivank Vijayakumar is the President Society of Monash University Chemical Engineers (SMUCE) for 2018 and 2019.

## DR SEPIDEH AFSHAR AWARDED A 2018 VICTORIA FELLOWSHIP

**Monash University chemical engineering research fellow Dr Sepideh Afshar was awarded a 2018 Victoria Fellowship, announced at an awards ceremony hosted by Veski. Veski is an organisation dedicated to fostering an innovative economy, engaged by the Victorian Government since 2013 to administer and host the annual awards designed to drive science and innovation in Victoria.**

Dr Afshar is a researcher working to improve dry powdered products for the Victorian dairy industry, one of the largest agricultural industry sectors in Victoria. Dry powdered products such as milk powder, infant formula and whey proteins are produced through spray drying, an energy-intensive manufacturing process where product can be lost or wasted when optimal drying techniques can't be determined.

The 2018 Victoria Fellowship travel grant will be used by Dr Afshar to visit the French National Institute for Agricultural Research (INRA). There she will conduct experimental studies into optimal industrial spray drying techniques in one of the world's premier sites for drying research, using her existing research strengths in Computational Fluid Dynamics (CFD).

"The 2018 Victoria Fellowship will allow me to obtain comprehensive skills in multi-stage spray drying systems, while also using my CFD skills to better predict drying behaviours in large-scale industrial systems," said Dr Afshar. "The outcome of the Fellowship will contribute to potential energy savings in spray drying operations, help to reduce wastage and offer better quality Victorian milk products to the domestic and international market."

"I am very thankful to Veski and the Victorian Government for awarding me the 2018 Fellowship, and I look forward to the contribution my research will make to the Victorian dairy industry and wider economy."





# DEPARTMENT SUCCESS AT IChemE



The IChemE Australasian Design Prize has been awarded to Monash engineering students for their well-researched project, the Darwin MEG Plant.

It was a big night for the Department at this year's Chemeca2018 conference awards in NZ with Associate Professor Akshat Tankale receiving Caltex Award for exceptional course development and teaching of chemical engineering and Professor Cordelia Selomulya recognised with the Global award in the Food and Drink category.

Congratulations everyone!



## CORDELIA SELOMULYA WINS IChEME GLOBAL AWARD

**We congratulate Professor Cordelia Selomulya for winning the IChemE Global Awards 2018 - Food and Drink category last night.**

Cordelia Selomulya received the award at The IChemE Global Awards ceremony and dinner, which took place in Manchester, UK.

The IChemE Global Awards, in association with Johnson Matthey, celebrate excellence and achievement in chemical, biochemical and process engineering. Finalists demonstrate their professional engineering expertise across a range of industry sectors and projects. Successful finalists this year included: ExxonMobil, Green Lizard Technologies, the Hong Kong Productivity Council, Imperial College London, InterEngineering, Monash University, Recycling Technologies and Universiti Teknologi Malaysia.

IChemE Chief Executive Jon Prichard said "Once again, we've had a wonderful variety of entries to this year's awards, showcasing innovation, technical progression, and a dedication to advancing the profession to make the world a better place."



# DEGREASING THE CAMPUS

## SUNWAY STUDENTS CONVERT USED COOKING OIL TO BIODIESEL USING A GREEN PROCESS

**Every month, the cafeteria in Sunway campus generates about 100kg of used cooking oil that is considered as a waste product. The used cooking oil is harmful to health if it is recycled for cooking, and it causes serious environmental pollution if disposed into the drains and landfills.**

Since January 2018, a team of chemical engineering students from Monash IChemE Student Chapter (MISC) Sunway Campus has embarked on a year-long pilot project to convert the used cooking oil generated on-campus to biodiesel. The project is being undertaken under the guidance of Professor Chan Eng Seng from Chemical Engineering and Monash-Industry Palm Oil Research Platform (MIPO).

Conventionally, biodiesel is produced via a one-step reaction process using an alkaline catalyst. However, used cooking oil is a low-quality feedstock, which contains a varying amount of free fatty acids and water content. These impurities create problems during biodiesel production as they generate a large amount of by-product (i.e., soap) in the presence of alkaline catalyst during reaction, thus lowering the process yield and at the same time, producing a large volume of wastewater during purification.

In order to overcome these problems, a cost-effective lipase enzyme has been chosen as the catalyst. The enzymatic reaction can also be carried out at a near-ambient temperature, thus substantially reducing the amount of energy required to drive the reaction. The reaction and purification processes have been performed using a 50-L integrated enzymatic reactor designed and developed by Professor Chan and his team.

During the course of the project, the students have been tasked to manage a variety of activities. The activities include material sourcing and procurement, logistical arrangement, inventory management, plant operation and process optimisation, safety review, waste management and valorisation, production costing, and product application.

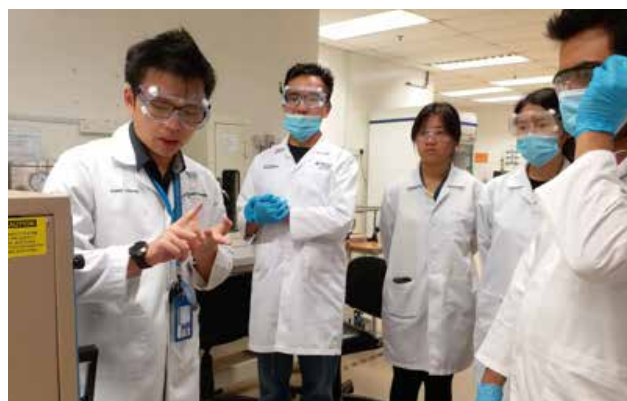
"We are very excited to have this opportunity to work on a project that addresses a real-world problem and mimics the operation of a real chemical plant. We have not only gained hands-on experience operating a mini chemical plant, but also learned to manage a chemical business".

"This project definitely complements our learning experience and prepares us to become better engineers. I hope the project can be expanded to benefit more chemical engineering students." said Mr. Lee Chin Loong, the President of Monash IChemE Student Chapter and a second-year Chemical Engineering student at the Sunway Campus.

The biodiesel produced by the team is currently being tested for its performance in generating electricity for a designated area in the Sunway campus. More student volunteers will be needed to share the expanding workload and to ensure the continuity of the project.

This project is an initiative supported by Chemical Engineering and MIPO at Sunway Campus with the goals to improve student experience via experiential learning based on a real-life problem and to support campus sustainability initiatives to reduce, reuse and recycle wastes generated on-campus.

**For more information Professor Chan Eng Seng**  
[chan.eng.seng@monash.edu](mailto:chan.eng.seng@monash.edu)





# 2+2 GRADUATES CELEBRATE MONASH-CHINA PARTNERSHIP



**Monash Engineering recently congratulated 44 students from partner university Central South University (CSU) in China on completing their 2+2 Bachelor of Engineering degrees at Monash University.**

The program provides students with an opportunity to complete their final two years of their undergraduate engineering course at Monash after undertaking the first two at CSU, graduating with two degrees awarded by both their home university and Monash University.

"On behalf of the Faculty of Engineering at Monash, I congratulate you on this momentous occasion." Professor Elizabeth Croft, Dean of Engineering said.

Central South University (CSU) is a highly regarded university located in southern China, ranking within the top 20 universities in China. CSU and Monash have fostered a longstanding relationship since 2008 through partner programs such as the 2+2 and other research collaborations.

The program has allowed students to explore the range of engineering disciplines including chemical, civil, mechanical and materials engineering through access to Monash' unique learning experiences and world-class facilities.

"This is a wonderful achievement and the students should all be extremely proud on the successful completion of their Bachelor of Engineering degree. We have developed a strong relationship with CSU with over 420 students who have graduated or are currently enrolled in the program. This is a testament to the high calibre of students at CSU," Professor Croft said. "We look forward to continuing our graduates' engagement with Monash University as a member of our valued alumni community."

Honourable delegates from CSU, lead by Professor Yuehua Hu, Executive Vice President of the CSU University, attended the graduation ceremony and expressed their gratitude for the strong relationship this program has helped establish.

CSU delegates also met with Professor Abid Khan, Monash's Deputy Vice-Chancellor and Vice President (Global Engagement) to celebrate the ongoing success of the collaboration.

## STUDY ABROAD



### Study in Malaysia

Spend 1 or 2 Semesters at the tropical Monash Malaysia campus and earn full credit towards your Engineering degree, all while exploring South-East Asia!

#### Global Intercampus Program

- Unlimited places – study the same units as Clayton campus
- Guaranteed acceptance when eligibility requirements are met:
  - 48 credit points completed | Good academic standing
- No minimum WAM/GPA
- Guaranteed \$2500 to all students in 2019.
- Streamlined application process
- **Australian Citizens & PR:** Free visa, free on-campus accommodation, free travel insurance

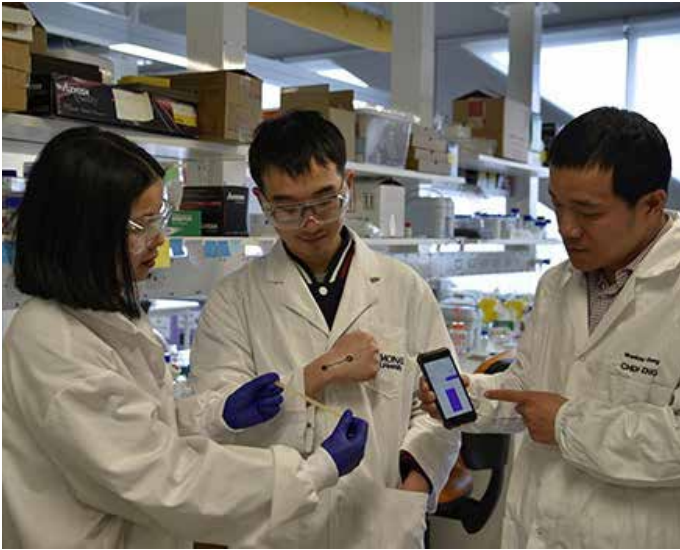
#### Engineering – Tropical Exchange Challenge (E-TEC)

- Complete core units overseas
- Includes 10-day enrichment module.
- Funded by New Colombo Plan (up to \$5750) for eligible students
- Limited places
- Internship opportunities
- **Australian Citizen & PR:** Free visa, free travel insurance

**Apply for Semester 2 via the Monash Abroad Portal**  
Applications close end of March

More information here <https://www.monash.edu/study-abroad>

# 'WEARABLE SKIN' TO MONITOR HEALTH CONDITIONS



**Professor Wenlong Chen's team of chemical and materials science engineers have made highly stretchable gold electronic 'skin' that can monitor cholesterol, blood pressure, glucose, foetal movements and help people with autism disorder and dementia.**

The electronic skin contains sensors that send signals to smartphones and can be used to monitor a wide variety of medical conditions.

Professor Wenlong Cheng from Monash University said the thin bandaid-like 'wearable skin' is made from gold and is surprisingly resilient.

"We can make gold highly stretchable so when you stretch it, it doesn't break, it doesn't tear, it doesn't come off," he said.

The wearability of the electronic skin means it can be used to track a range of health issues, including blood pressure, cholesterol and glucose levels.

Professor Wenlong Cheng said it works by applying the wearable skin to the face and then using bluetooth compatible sensors.

"These wireless signals basically detect skin muscle movement, which relate to the facial expression, facial expressions relate to the autism disorder," he said.

Another form of the skin can be used to monitor hand movements, allowing for better monitoring of elderly people with conditions like dementia or assist in monitoring other conditions that affect motor control.

Professor Cheng said pregnant women could use the electronic skin to observe their baby's movements in the womb.

"They can simply put it on, wear it as often as they like and monitor foetal movement."

Chemical Engineer William Yap said that function could come in handy in detecting irregular movement that could prompt a visit to the hospital.

"This thing actually tells you that the baby is actually kicking and will alert you when there's something wrong with the baby's movement," he said. "So it will ask you to go to the hospital to get it checked immediately."

Medical trials have been conducted and the search is on for commercial backing.

Trial results have found the skin can still deliver 93 per cent data accuracy even after the gold nanowire material, which makes up the electronic skin, is stretched and released 2000 times.

Researchers say some forms of the skin could be on the market within one or two years.

The Australian Medical Association said smart technologies will enhance rather than replace medical treatment.

*By Greg Dyett, FEATURED ON SBS (<https://www.monash.edu/engineering/about-us/news-events/latest-news/articles/2018/australians-develop-new-wearable-skin-to-monitor-health-conditions>)*



# EXCHANGE OPPORTUNITY TO GEORGIA INSTITUTE OF TECHNOLOGY

The International Network of Excellence in Photovoltaics is providing funding for an international PhD student exchange between Monash University and Georgia Tech. This grant will fund two PhD students from each university to participate in the exchange. The generous funding will provide the students a living supplement of \$4,800 AUD for the 3-month program. It will also cover up to \$1,600 AUD for round-trip flights, and \$250 AUD for the Visa application fee.

Currently, the research performed under the Exchange Program must be related to back-contact solar cells, semi-transparent solar cells, perovskite solar cells, or perovskite-silicon tandem solar cells.

The exchange has a number of benefits for the university.

- » Initiates collaboration between researchers at Monash University and Georgia Tech;
- » Develops capabilities in renewable energy currently not available at Monash University;
- » Gives students first-hand research experience in the United States, orientation to US culture, and an introduction to the research and policy infrastructure of the US;
- » Increases Monash University's international visibility and reputation.

All interested students are asked to, please send an email to Giovanni L. DeLuca on Giovanni.DeLuca@Monash.edu with a description (one to three paragraphs) of their current research and capabilities. This information will go onto a webpage to help researchers and students decide on potential collaborations. The dates are flexible, but ideally the Monash PhD Students should be in the US during June and for the Georgia Tech PhD Students to be in Australia during September each year. This will give the students the opportunity to participate in PV workshops and conferences taking place in the US and AU during that time of the year. However, some flexibility is possible.

We have over 16 confirmed hosts between Georgia Tech, Monash University, and CSIRO; spanning chemistry, physics, chemical engineering, materials science and engineering, mechanical engineering, and more. Monash University has completed the website detailing current research interests and capabilities. Additionally, the website contains application instructions for the PhD students whose research aligns well with the program.

More information here <https://www.monash.edu/engineering/photovoltaic-exchange-program>

## RESEARCH

# SALT ADSORPTION MATERIALS OF WATER TREATMENT FEATURED ON COVER OF ADVANCED MATERIALS



**Research into salt adsorption materials, led by, Professor Huanting Wang and colleagues was selected as the cover article in Advanced Materials.**

Regenerable, high-efficiency salt sorption materials are highly desirable in water treatment processes. In the paper, the researchers reported on a thermoresponsive, amphoteric metal-organic framework (MOF) material that can adsorb multiple salts from saline water at room temperature and effectively release the adsorbed salts into water at elevated temperature (for example 80 °C).

The amphoteric MOF, integrated with both cation-binding carboxylic groups and anion-binding tertiary amine groups, is synthesized by introducing a polymer with tertiary amine groups into the cavities of a water-stable MOF such as MIL-121 with carboxylic groups inside its frameworks.

The amphoterized MIL-121 exhibits excellent salt adsorption properties, showing stable adsorption-desorption cycling performances and high LiCl, NaCl, MgCl<sub>2</sub>, and CaCl<sub>2</sub> adsorption capacities of 0.56, 0.92, 0.25, and 0.39 mmol g<sup>-1</sup>, respectively.

This work provides a novel, effective strategy for synthesizing new-generation, environmental-friendly, and responsive salt adsorption materials for efficient water desalination and purification.

# ASSOCIATE PROFESSOR ANDREW HOADLEY WINS THE EXCEPTIONAL ACHIEVEMENT AWARD (ACADEMIC)



**Department academic Associate Professor Andrew Hoadley has been recognised for his tireless efforts in ensuring that the Chemical Engineering program at Monash University meets Australian accreditation and global benchmarks.**

An accredited program in engineering is one that meets Australian and global benchmarks. Graduates of accredited programs are guaranteed membership with Engineers Australia. Engineering bodies in other countries that have agreements with Engineers Australia are also more easily accessed when a degree is from an accredited program.

IChemE has four different accreditation activities. For university accreditation, an IChemE degree accreditation provides benchmarking of academic programmes against high, internationally recognised standards. EA and IChemE accreditation is reviewed every five years.

The accreditation process can be a gruelling task including many levels of administration within the university, as well as cooperation among engineering colleagues.

At the end of 2017, A/Prof Andrew Hoadley accepted the rather thankless task of leading the effort for the Chemical Engineering department for both the Engineer's Australia (EA) and IChemE accreditations. A successful accreditation from EA and the IChemE is a team effort and A/Prof Hoadley did have a great team working with him. During the yearlong accreditation process, Andrew worked closely with Ms Chloe Priebee, the Faculty's Accreditation and Policy Officer in ADE Lamborn's office and with Ms Trina Olcorn, our own Undergraduate Programs Administrator in the Department of Chemical Engineering for both of the EA and the IChemE accreditations. Both Chloe and Trina were invaluable during this time ensuring everything came together for Andrew's critical deadlines.

Andrew also had to coordinate the Chemical Engineering efforts with Chemical Engineering at Monash Malaysia for both the EA and IChemE accreditations of the Malaysian degree.

Throughout the whole process, Andrew offered critical leadership at a time of transition for our Department. At the beginning of 2018, we also had a change in the Head of Department between an interim head and a new head of Department; Professor Mark Banaszak Holl had just re-located from the USA. One of Mark's first tasks as the new HOD was the EA and IChemE accreditation. With no experience in the Australian tertiary system, Mark quickly learnt that Andrew's years of experience in Monash was invaluable. Andrew worked effectively with professional staff, academic staff, and students to pull together the accreditation reports and participated in all the key meetings with the reviewers.

The outcomes from Andrew's yearlong efforts were excellent. The degrees offered by the Department of Chemical Engineering were fully accredited by EA and received a number of key complements from the assessing committee. The IChemE provide Masters level accreditation to our single degree and three of our double degrees for the Clayton campus.

Andrew's willingness to invest an enormous amount of his time on this common good for the department came at a time of critical need for the department. This award is a testament to Andrew's hard work and diligence.

The following degrees are offered at Monash with full IChemE and EA accreditation:

- » Bachelor of Chemical Engineering (Honours) E3001 BChemEng(Hons)
- » Bachelor of Chemical Engineering (Honours) and Bachelor of Arts E3002 BChemEng(Hons)/BA
- » Bachelor of Chemical Engineering (Honours) and Bachelor of Biomedical Science E3004 BChemEng(Hons)/BBiomedSc
- » Bachelor of Chemical Engineering (Honours) and Bachelor of Commerce E3005 BChemEng(Hons)/BCom
- » Bachelor of Chemical Engineering (Honours) and Bachelor of Commerce Specialist E3003 BChemEng(Hons)/BComSpec
- » Bachelor of Laws (Honours) and Bachelor of Chemical Engineering (Honours) L3002 LLB(Hons)/ BChemEng(Hons)
- » Bachelor of Chemical Engineering (Honours) and Bachelor of Pharmaceutical Science E3008 BChemEng(Hons)/BPharmSc
- » Bachelor of Chemical Engineering (Honours) and Bachelor of Science E3007 BChemEng(Hons)/BSc



# MONASH FOOD AND DAIRY WINS **BHERT AWARD**



*Professor Cordelia Selomulya, photo by Elke Meitzel*

**Our Food and Dairy Program continues to impress, this time recognised with the 2018 BHERT Award for Outstanding Collaboration in Research & Development: Industry Partnership.**

The Food and Dairy Program aims to develop new processing and technologies, and provide Australia's dairy companies with innovative powders that can be sold at a premium, and novel ingredients like milk protein concentrates, specialty proteins, and whey products.

In 1998 BHERT (Business and Education Round Table) initiated a series of Awards to reinforce the importance of business-university partnerships in innovation, R&D and teaching. These are prestigious annual awards which recognise outstanding achievement in collaboration between the sectors of business and higher education.

Award Applications were assessed by a panel of independent judges against a number of criteria. The submissions needed to be highly innovative and reflect a strong relationship between partners. The winning Projects are also those deemed to have measurable outcomes, and high impact for Australia.

Now in their 21st year, the BHERT Awards are presented at a Gala Event in November in Melbourne. The Awards are sponsored by university and business members of BHERT.

**More information here (<https://www.bhert.com/awards.html>)**



**WATCH: VIDEO ABOUT THE FOOD AND DAIRY GRIP**

## MR **ROSS ELLINGHAM** WINS **EXCEPTIONAL ACHIEVEMENT AWARD** (PROFESSIONAL)



**On a daily basis, Ross Ellingham consistently provides a high standard of care and support to the students of the Department of Chemical Engineering (HDR and Undergraduate) to ensure that their safety and their technical/maintenance requests are actioned promptly. These requests assist the students in their PhD research and provide laboratory safety for the undergraduate students. His contribution has recently been recognised with an Exception Achievement Award.**

Ross consistently goes beyond his job description to help the staff and students to deliver their objectives in their roles and he is happy to assist to bring change in processes in the Department as needed, which benefits the whole department.

During his career at Monash University, Ross has made an exceptional contribution to the Department of Chemical Engineering, now spanning over twenty years. Ross has always undertaken on any job with a can do attitude and a smile on his face. It goes without saying that Ross is very passionate about Monash University. In everything he does Ross strives to deliver the strategic plan of the Faculty and University. Ross has made a lasting impact on those around him especially the number of students that he has supported over the years, which has ultimately benefited the lives and educational outcomes of many students and staff that have had the pleasure of working with him.

Ross being someone who cannot sit around idle during the quiet times often requests additional tasks to keep himself busy. If you ask anyone who works in the Faculty of Engineering, Ross has excellent work ethics; no task too small or too big for Ross.

# MONASH ALUMNUS WINS WHITELY AWARD FOR SPIDER APP



When asked to join Minibeast Wildlife as lead developer of the Spidentify app, Dr Cameron Hunt (BChemEng(Hons) 2012, BBiomedSc 2012, PhD 2018) leapt at the opportunity. As part of a team of four, he has helped create Australia's most comprehensive spider identification assistant and field guide for mobile devices. Whether you're just curious about a huntsman's habits or desperate to know how bad a redback's bite might be, Spidentify is your go-to source.

"As you can imagine, Chemical Engineering didn't offer any app development lectures. Nor was my thesis related to spider apps," says Cameron. "With help, I learned to design the interfaces and algorithms for producing suggested spider species. I then put that together with all the information on the spiders. And now I'm responsible for ongoing maintenance and app upgrades."

At this year's Whitley Awards, the Royal Zoological Society of New South Wales acknowledged the significance of the Minibeast Wildlife team's work: Spidentify

won a Certificate of Commendation for the digital field guide category. "It's a great feeling that they considered our app to have made an outstanding contribution to publications highlighting Australian wildlife," Cameron shares.

A passion for learning new programming languages lies behind Cameron's success with Spidentify. "This started way back as an undergraduate student, while doing simulation work with MATLAB, and then followed me to my PhD where I used a lot of different programming languages in my thesis," he explains. "So writing an app was just another step, another language to learn, and one where I could see exactly what I'd created on my phone."

Struck by the growing accessibility of programming information, Cameron remarks, "When I was quite young, I watched my dad, a mechanical engineer, writing some software for his work. He had this pile of large reference books and special software. It took days of his time. Now you can log into an online platform that can teach you the basics of the programming language Python in a matter of hours." Cameron hopes machine learning tools will become even more accessible.

In grappling with personal adversity, Cameron has been bolstered by friends and family. And he encourages students to seek professional help in times of need. "There are amazing people out there who can and do want to help, without judgement," he relays. Cameron also offers this broader advice: "Stop worrying about grades so much and get involved with groups and clubs. Take advantage of startup and entrepreneur resources – look for opportunities to apply the things you're learning to the real world."

A self-confessed nerd, Cameron reveals, "I play a lot of board games and computer games. I collect miniatures and paint them, I own a 3D printer with googly eyes, and I love to read fantasy and science fiction books. I used to do a lot of hiking and running and I'm trying to get back into that now that I've completed my PhD." And, of course, Cameron maintains his fascination with Australia's eight-legged wildlife (a weird and wonderful way to combine work with pleasure).

## Digital Field Guide

**Spidentify by Caitlin Henderson, Alan Henderson, Cameron Hunt & Deanna Henderson, Published by Minibeast Wildlife**



Source: <https://www.monash.edu/engineering/alumni/meet-our-alumni/chemical/cameron-hunt>

## RESEARCH

# PAPER ON EDITOR'S CHOICE LIST

Professor Ravi Jagadeeshan's journal article entitled Rheological consequences of wet and dry friction in a dumbbell model with hydrodynamic interactions and internal viscosity, recently published in The Journal of Chemical Physics has been selected to be part of The 2018 JCP Editors' Choice collection.

The collection contains 72 articles selected by the editors as the most innovative and influential articles of 2018. The articles are freely available to download through to the end of 2019.

**THE COLLECTION IS AVAILABLE ONLINE AND YOU CAN DOWNLOAD A PDF.**



# CHINA–MONASH LINKS STRENGTHENED WITH NEW RESEARCH COLLABORATIONS

**A delegation from Jiangsu Province in China visited Monash recently to establish research collaborations between the University and Jiangsu Industrial Technology Research Institute (JITRI).**

The delegation, led by Professor Liu Qing, President of JITRI, included 20 research and development (R&D) leaders from JITRI specialised research institutes in Jiangsu. Monash President and Vice-Chancellor Professor Margaret Gardner AO, Provost and Senior Vice-President Professor Marc Parlange, Pro Vice-Chancellor and President (Suzhou) Professor Aibing Yu and other Monash leaders met the delegation last Wednesday.

The two parties discussed Monash–JITRI collaboration on the eve of the inaugural Monash–JITRI joint symposium on 16–17 August to explore opportunities and research areas of mutual interest for future collaboration.

Of the 34 presentations at the symposium, 23 were delivered by Monash senior representatives, including deans or associate deans, HoDs, directors of ARC research hubs/centres and project leaders.

The delegation also visited some of the University's leading research platforms, including the CAVE2 facility, Monash Centre for Electron Microscopy and the Woodside Innovation Centre.

JITRI was established in December 2013 in Jiangsu Province, a sister region with Victoria. Its aim is to close the gap between science and technology, and assist industries, small or large, in utilising the latest technology to enhance their competitiveness.

Monash and JITRI signed an initial CNY20 million (A\$4 million) agreement in 2015 that resulted in the development and implementation of nine collaborative projects.

A second agreement with the same value was last year signed to support further projects. Monash–JITRI joint PhD training has now become part of the collaboration.

The JITRI funds are available to Monash researchers in collaboration with JITRI researchers, with detailed information provided on the [website \(http://jri.eng.monash.edu/industry.html\)](http://jri.eng.monash.edu/industry.html)



## MONASH ENGINEERING GIRLS (MEG)

**Be part of an innovative new program for high school girls and explore engineering.**

Monash Engineering Girls (MEG) is an engagement program designed for young women who want to

know about the possibilities of a career in engineering. If you like maths and science, are creative, a problem solver, enjoy working in a team and designing things, engineering might be the perfect career choice for you.

MEG will enable you to learn about the Faculty of Engineering. We want you to join the program in year 9 and stay through to year 12. During that time you will have the opportunity to participate in a range of special activities and VIP events that will help you gain an understanding of all the different types of engineering and which one could suit you. You will form connections with other girls like you, have lots of fun experiences, and interact with our current Engineering students to learn what it's really like to study at Monash. You will also get to meet the talented academic staff who teach here, as well as many female graduates who are doing amazing things in their lives and careers.

We hope to be part of your journey. We want to help you make a confident decision about your future.

**MEG invites girls in Years 9 and 10 to participate in free engineering workshops, special activities and VIP events held on campus. Be part of a community that supports you to explore your skills, talents and potential as a future engineer, and experience being part of Monash University while still at high school. [LEARN MORE](#)**



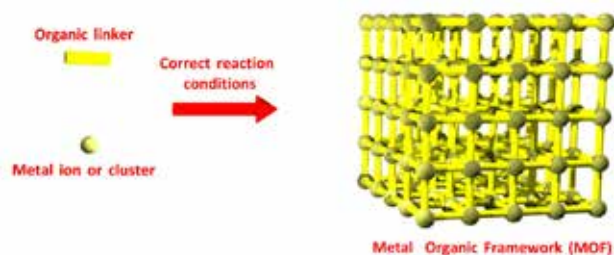
## RESEARCH

# METAL-ORGANIC FRAMEWORKS: A BREATH OF FRESH AIR FOR GAS MASKS

**When Australian soldiers based in Mosul were exposed to a low-grade chemical attack by Islamic State in April 2017, the Department of Defence realised a 21st-century solution was needed. Searching for someone with the capability to develop an improved canister, it approached Associate Professor Matthew Hill, the incumbent of an 'experimental' joint appointment between Monash University's chemical engineering department and CSIRO.**

In April 2017, a suspected chemical attack on the Syrian town of Douma was reported to have killed at least 40 people and injured up to 500, including women and children. Syria had made its chemical weapons capability known to the world six years earlier, with a public declaration of its intention to use them against any foreign assault. Under Saddam Hussein, Iraq waged chemical warfare against Iran and its own civilian Kurdish population, including the notorious 1988 attack on Halabja that killed 5000 Kurds. Not even a common gas mask would have spared these victims a ghastly death.

Associate Professor Matthew Hill – an ARC Future Fellow, 2011 Victorian Young Tall Poppy of the Year, 2012 Eureka Prize winner and 2014 Prime Minister's Prize for Science winner – works 50-50 between Monash University and the CSIRO and can thus take full advantage of the research capacity of the University's chemical engineering department and the industrial muscle of the nation's science and technology lab.



*In the right conditions, MOFs form by linking metal atoms with organic molecules. Their unprecedented structure offers many potential applications.*

"The current canisters in gas masks have been used by soldiers since World War I, and haven't been improved since," says Associate Professor Hill.

"They offer virtually no protection from common chemicals like chlorine and ammonia, so we've been commissioned to make a new canister that can. We've already found an improvement up to a factor of 40 using metal-organic frameworks. CSIRO would never have delivered this technology without the involvement of Monash, so we know this relationship is working.

"Once they're on the market, they'll be useful to anyone needing a safer gas mask, including our soldiers, but also firefighters, miners

and construction workers."

Metal-organic frameworks (MOFs) is the research linchpin in this innovative relationship. Highly porous materials that make it possible to store, separate, release or protect gases or liquids, MOFs have the largest internal surface area of any known material, and offer a real-world impact as vital as filtering toxic chemicals through a protective mask.

Associate Professor Hill is leveraging the know-how of engineers to make the science of MOFs applicable to useable products, and the 20-year-old MOFs technology is now being scaled up to produce up to 15kg of the material in pellet form – a global first.

"No one else around the world is doing this sort of fundamental science combined with process engineering at scale on MOFs," says Monash's head of chemical engineering, Professor Mark Banaszak Holl. "Applying engineering processes to the chemistry of MOFs while using the facilities of CSIRO, the Australian Synchrotron and the Melbourne Centre for Nanofabrication, all located within a short walk of each other, is something not available anywhere else in the world. This joint appointment, in this specific location, allows Matthew the opportunity to uniquely pursue MOF applications, like the improved gas mask canister, very successfully."



In the right conditions, MOFs form by linking metal atoms with organic molecules. Their unprecedented structure offers many potential applications.

### Too small to not coordinate

The joint appointment allows for the pooling of resources within a limited local ecosystem. “Australia is such a small innovation system that we can’t have organisations undercutting each other,” says Associate Professor Hill. “Compared to who we’re competing against globally, we’re a very small country, and it’s much better to simply combine our limited resources.”

“Matthew couldn’t have done his incredible research on MOFs sitting isolated in a chemical engineering department somewhere,” says Professor Banaszak Holl.

“And it would also have been impossible to do it sitting purely in CSIRO, because of their industry focus. That’s the power of this type of joint arrangement offered in this particular engineering faculty. It’s very uniquely placed.” From CSIRO’s perspective, collaborating closely with Monash gives it direct access to high-quality PhD students and Postdoctoral Researchers, allowing it to better deliver commercial solutions.

“For CSIRO, this partnership is ideal, as it allows both the in-depth study and commercial exploration of these exciting materials,” says Dr John Tsanaksidis, the research director of CSIRO Manufacturing’s Advanced Fibre and Chemical Industries (AFCI) program.

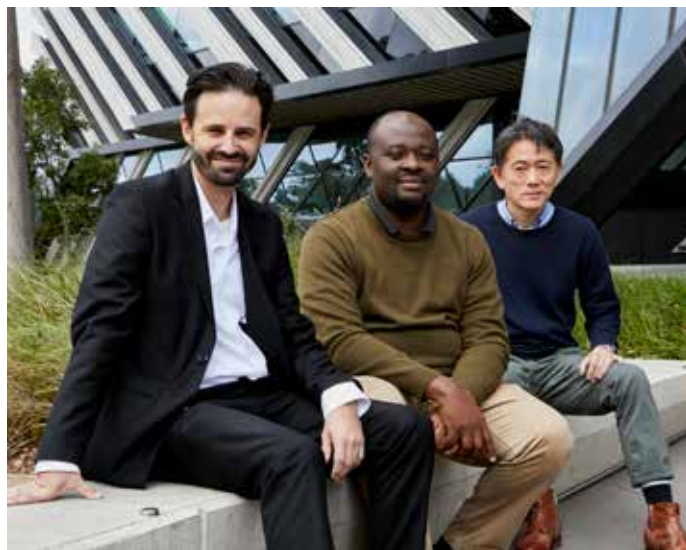
### Educating and creating a future industry

Another project with clear significance, capturing carbon dioxide out of the air using MOFs, is also working its way into the marketplace.

Dr Munir Sadiq, who’s completing a PhD project under the joint supervision of Associate Professor Hill and Professor Kiyonori Suzuki from Monash’s Department of Materials Science and Engineering, combined magnetic nanoparticles with MOFs to demonstrate the capture and release of CO<sub>2</sub> at half the current costs. He’s now working in a team developing a prototype that’s attracting plenty of interest.

“I’m currently still using CSIRO’s facilities to complete the lab experiments needed to prove the technology is 100 per cent commercially viable,” says Dr Sadiq.

As an international student from Nigeria, he speaks highly of his experience within the collaborative and supportive network. “Without the joint appointment, it’s highly unlikely these two research areas would have come together to allow a project like this,” he says.



*Collaborators: Associate Professor Matthew Hill, Dr Munir Sadiq and Professor Kiyonori Suzuki.*

### Technological entrepreneurship

Despite the progress, Associate Professor Hill believes Australia is still slowly building its capacity to foster this type of technological entrepreneurship. The country has the right people to make it happen, including Chief Scientist Alan Finkel (also a highly successful business innovator), CSIRO CEO Larry Marshall (described as a “serial entrepreneur”), even Prime Minister Malcolm Turnbull, who spent many years as a technology entrepreneur before entering federal politics.

In the research and development space, Associate Professor Hill has one key recommendation. “Universities are pushing for people to engage with industry. So I’d say to anyone who’d listen, don’t do it in a way that undercuts CSIRO, because that’s a zero-sum game for the country. We don’t need two people knocking on the same door asking for the same thing. While it might help one organisation’s bottom line temporarily, it takes it straight off the other one – who’s probably down the corridor in the same building anyway.”

Source: <https://lens.monash.edu/2018/06/08/1351931/breath-of-fresh-air-for-gas-masks>

Matthew leads an interdisciplinary team of researchers actively involved with industry partners to bring laboratory discoveries to market. He holds a joint position between CSIRO and Monash. His research areas include development and application of porous materials: storage, separation and triggered release of small molecules with adsorbents and membranes, flow chemistry, lithium-sulfur batteries and supercapacitors.

# UPDATE FROM THE ARC RESEARCH HUB FOR ENERGY-EFFICIENT SEPARATION (EESep)



*Delegates attending the China-Australia Energy Efficient Separation Workshop, Nanjing China*

The China-Australia Energy-Efficient Separation Workshop was held in Nanjing (China) recently. This workshop provided the opportunity for researchers from Monash's Chemical Engineering and the ARC Research Hub for Energy-Efficient Separation (EESep) to share ideas and further foster the strong relations between China and Australian researchers involved in energy-efficient separation technology.

The workshop, which was jointly organised between Monash University and Jiangsu Industry Technology Research Institute (JITRI), attracted 50 research and industry representatives from China, Australia and Malaysia. Australian researchers delivered 22 technical presentations.

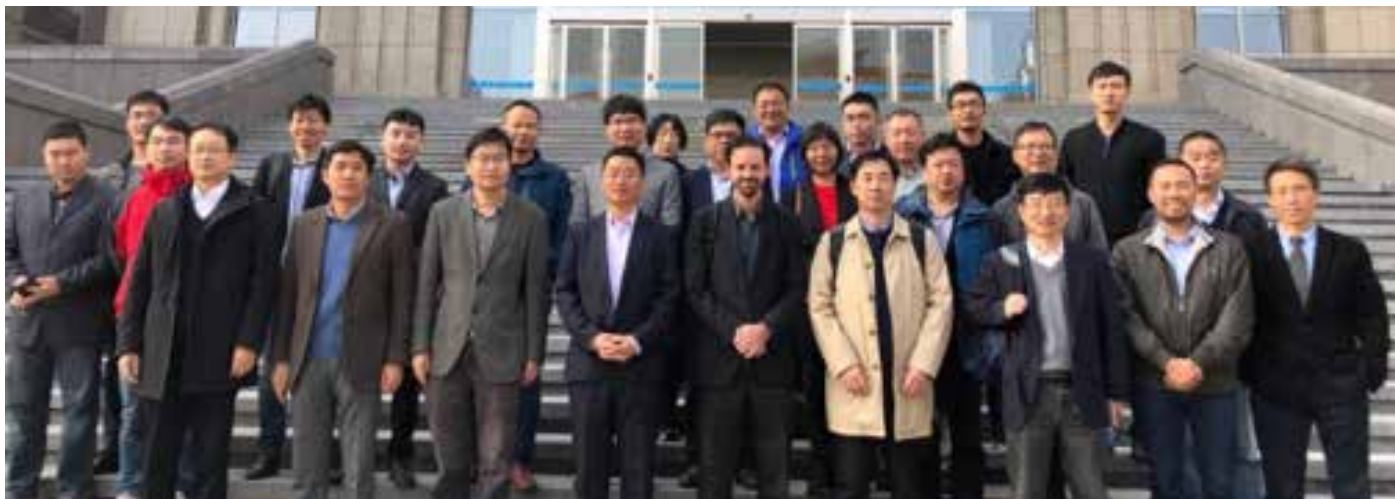
Eight Monash Chemical Engineering researchers attended the three-day event including EESep's Director Prof Xiwang Zhang and Deputy Director Prof Huanting Wang. Other Monash delegates included A/Prof Lian Zhang, A/Prof Xuchuan Jiang, A/Prof Matthew Hill, Prof Siang Piao Chai, Prof Beng Ti Tey, and Dr Soo Leong. Australian representatives from UNSW, University of Technology Sydney, Deakin University, Curtin University, and The University of Sydney also attended.

Industry representatives from Poten Environmental Group, Scinor Membrane Technology, Yantai Jinzheng Eco-Technology, Rinland Environment tech, Shenzhenshi Huawei Green Building Material and Dajiang Environment Corporation also attend the workshop.

Following the workshop, the Monash delegation were invited to visit several research and industry sites within the region. This included a visit to the National Engineering Research Centre for Special Separation Membrane in Nanjing at the invitation of that Centre's Prof Zhaoxiang Zhong and his team. A second technical visit to PEIRE Membrane in Yixing, which specialises in membrane biological reactors (MBR), allowed the Monash delegation to tour the company's manufacturing plant. Discussions while at PEIRE membrane were undertaken with the company's technical adviser examining potential collaboration opportunities.

Two further technical visits were undertaken in the Kunshan region by Prof Xiwang Zhang, Prof Huanting Wang, A/Prof Matthew Hill and Dr Soo Leong. The Kunshan RNAi Institute (KSRI) is a non-profit research institute jointly founded by Kunshan Industrial Research Institute and Tsinghu Science Park. KSRI is seen as an innovative driver for bioscience, and it focuses on the transformation of bio-medicine research, in particularly in the application of RNAi technologies and drug discovery. KSRI also has the role of promoting bio-medicine companies in China and initiate incubator projects, and to explore biotechnological research in the region.

The second meeting in the Kunshan region was with Kunshan Industrial Technology Research Institute (KSITRI). At this meeting Monash delegates Professor's Xiwang Zhang and Huanting Wang and A/Prof Matthew Hill, were invited to present their research and discussions on potential collaboration were undertaken.



*Technical visit to National Engineering Research Centre for Special Separation Membrane, Nanjing, China*



# DEPARTMENT ADMIN UPDATE



**What's going on in Chem Eng? Why is Ross moving all these desks/furniture around? Why do we need to look at Laura now through her fish bowl office. Well, as many of you would know, most/all universities or departments have a space issues. We have been actively reviewing our current office space to come up with ideas to create or use the office space more effectively. Better use of our space is critical for supporting our growing numbers of students, post-docs, and visitors to the Department.**

I do have to say that we could not have completed the changes without the support of all the staff during this office space transition. Everyone that has been approached to move has been very positive and understanding of the request. We have always been mindful to create improvement in their new work location/environment. As Mark has advised, we have 3 academic staff that have accepted employment offers within the Department and their offices are ready and eagerly awaiting their arrival in July/August. Within the general office, we now have 4 hot desks that can be booked through [chemeng.hod.pa@monash.edu](mailto:chemeng.hod.pa@monash.edu) on a short term basis. With all the movement that has occurred over the last 5 months, we have managed to

create an additional 30 desks, which is fantastic for the current growth of our Department.

A huge thank you to our 'SWAG' committee (Mark, Trina, Laura, Lilyanne, Lian, Kye, Ed, Bhishm, Shavink and Monica) for all the effort and support for making the merchandise dream come to life. Staff, students and friends of the Department can now order through [shop.monash](http://shop.monash) and collect the merchandise from the Department's General Office. We have clothing items (jacket, vest & polo) which you can come and try on before you place the order. We also have express cups, lanyards, satchels and beanies available. Please think about placing an order if you need visitor and or seminar speaker/presenter gifts. The polos are the perfect clothing choice for your next poster presentation at a major international meeting.

The Department is also actively transitioning from paper-based activities to online process for the administrative and laboratory processes. These changes are designed to improve the services for both staff and students and to improve our record keeping or data management of each activity. You can now request keys and security access via google form. All forms are located on the OHS - Chemical Engineering intranet website <https://www.monash.edu/engineering/departments/chemical/ohs> under forms. *Ms Tracy Groves*



## SWAG MERCHANDISE AVAILABLE NOW

The Department has ordered Department jackets, beanies, express cups, lanyards and drawstring backpacks. These can also be ordered for your convenience via [shop.monash](http://shop.monash). Collection will be from the general office. If you are thinking about buying some of the Department merchandise, but unsure of the sizing, contact the office.

**Below is the pricing and link to [shop.monash](http://shop.monash):**

Vest - \$37.00

<https://shop.monash.edu/chemical-engineering-apex-vest.html>

Polo - \$25.00

<https://shop.monash.edu/chemical-engineering-polo.html>

Jacket - \$45.00

<https://shop.monash.edu/chemical-engineering-jacket.html>

Beanies, express cups, lanyards and drawstring backpacks

<https://shop.monash.edu/shop-by-area/engineering/department/department-of-chemical-engineering.html>

**If you have any questions, please do not hesitate to contact Laura or Tracy.**

**+61 (3) 9905 3555 | [chemeng.hod.pa@monash.edu](mailto:chemeng.hod.pa@monash.edu)**



*Left to right: Mr Tim Woods, Managing Director, IndustryEdge Professor Gil Garnier Director of BioPRIA and PALS, Prof Therese Jefferson from ARC Executive Director, Professor George Simons Deputy Dean, Engineering*

## RESEARCH

# AUSTRALIAN PAPER INDUSTRY GETS BIO-OVERHAUL THANKS TO NEW RESEARCH HUB

**Australia's pulp and paper industries are set to be the beneficiaries of a new research hub that will look at transforming wood and other organic waste into everything from medicinal gels to food packaging.**

Last October Monash University launched the Australian Research Council (ARC) Hub for Processing Advance Lignocellulosics into Advance Materials - a game-changer for pulp and paper companies that will effectively become bio-refineries.

A total of \$6.8 million over five years will be invested to convert materials, such as wood, plant-based matter and cellulose-based hydrogels for personal medicine (blood

typing), nanocellulose films to replace plastic food packaging, and nanogels to help farmers maintain crops in the ever-changing climate.

An industry consortium of Amcor, Circa, Leaf, Orora, Norske Skog and Visy will join Monash, the University of Tasmania, the University of South Australia, the Government of Tasmania and AgroParis Tech as part of this ARC Hub.

Professor Gil Garnier, Director of the Bioresource Processing Research Institute of Australia (BioPRIA), said this ground breaking research will greatly help the Australian pulp, paper and forest industry transform their production waste into high-grade goods for the global marketplace.

"This Hub will leverage world-leading Australian and international research capabilities in chemistry, materials science and engineering with the express aim of creating new materials, companies for our growing bioeconomy," Professor Garnier said.

"With ongoing support and vision from our government, industry and university partners, we will identify new applications and products derived from biowaste to transform the pharmaceutical, chemicals, plastics and food packaging industries in Australia and across the world."

"In fact, one of the goals is for our industry partners to generate, within four to 10 years, 25-50% of their profits from products that don't exist today," Professor Garnier said.

"This is an exciting time for Australia's paper and pulp industry as we develop new products for existing markets and further grow our knowledge in bioresources. We're pleased to be able to contribute to the nation-wide goal of reducing biowaste in our communities."

Professor Marc Parlange, Provost & Senior Vice President of Monash University, said: "Monash actively invests in research and new technologies that have the potential to make an impact both here and Australia and globally. PALS will leverage world-leading Australian and international research capabilities in chemistry, materials science, and engineering to create new materials, chemicals and jobs in the emerging Australian bio-economy."

This industry transformation will be achieved through three specific objectives:

- » Derive 'green' chemicals from Australian wood and lignocellulosic streams: Following examples in Europe and North America where high-grade chemicals, including gels and thermoplastics, are developed from wood extractives;
- » Engineer new nanocellulose applications: Using Australian agricultural and wood residue to create nanocellulose and better nanofibers; and
- » Develop ultralight paper and novel packaging: Creating cellulosic-based packing products with significantly improved physical properties and new attributes, including radio-frequency identification technology to integrate with transport / retail information systems

*Published previously in Mirage News @miragenewscom*

# NEW STAFF JOIN THE DEPARTMENT

## LEONIE VAN 'T HAG



**In October we will welcome Dr Leonie van 't Hag to the Department as one of our new Lecturers. Dr van 't Hag brings strong fundamental research expertise in self-assembly, food engineering, high-throughput methods and X-ray and neutron scattering techniques.**

Dr van 't Hag brings strong fundamental research expertise in self-assembly, food engineering, high-throughput methods and X-ray and neutron scattering techniques. Dr van 't Hag is interested in soft material – property relationships and uses an interdisciplinary approach employing physical chemistry, chemical engineering and biochemistry approaches. She published well received papers in journals such as Chemical Society Reviews, The Journal of Physical Chemistry Letters, Crystal Growth & Design and Langmuir. Dr van 't Hag received a number of awards including the ANSTO, Australian Synchrotron Stephen Wilkins medal. In the last two years she also gained extensive experience with working with the industry in Switzerland during her Postdoctoral

Researcher position at ETH Zurich. Before that, Leonie received her PhD from the University of Melbourne and CSIRO after her MSc degree at Wageningen University & Research (the Netherlands).

One part of her research focuses on how the physicochemical properties of lipid self-assembly materials affect membrane protein and peptide encapsulation, structure and function. This lead to a significantly enhanced understanding of the *in meso* crystallisation technique which can lead to increased success rates and more 3D-structures of membrane proteins being solved; these structures are important for rational drug design. In her research at Monash Dr van 't Hag will develop new nano-materials capable of enhancing therapeutic peptide treatment of multi-drug resistant bacterial infections. Therapeutic peptides have shown great potential but face unsolved hurdles of oral drug delivery due to their limited solubility in water. Dr van 't Hag will focus on understanding the role of the nanostructure of lipid self-assembly materials in the delivery of *de novo* designed antimicrobial peptides.

In the last two years, Dr van 't Hag developed a method for the effective preservation of African leafy vegetables by drying, based on changes in micro- and nanostructure. This will significantly increase food safety as well as food supply during droughts in sub-Saharan Africa. At Monash she will continue to develop energy efficient drying processes for the effective preservation of fruits and vegetables, with a focus on investigating structural and nutritional changes. Dr van 't Hag is additionally interested in the development of new (sustainable) food products using her knowledge on crystallisation, as well as protein-lipid interactions and their self-assembly.

Dr van 't Hag will contribute to the development of the new Food Science & Agricultural Technology MSc degree and contribute with a Food Technology and Food Materials Engineering subject. In addition to food engineering, Leonie's teaching interests included Separation Processes and Nanotechnology and Materials. She will also contribute to the Design and Chemical engineering projects.

## DR SUSHIL DHITAL



**We are pleased to welcome Sushil Dhital to our Department as Senior Lecturer from July 2019. Dr Dhital brings fundamental research on elucidating the structure-property-function-health relationships of food and food ingredients. His research interests focus on relating plant molecular structures to macroscopic properties with relevance to food, health, and product development. He uses cross-disciplinary approaches drawing from physics, chemistry, biology, and engineering and uses various *in-vitro* and *in-vivo* models to elucidate the fundamental mechanisms beyond the nutritional and processing functionality of food and food ingredients.**

Dr Dhital graduated with Food Technology Degree (B.Tech) in 1998 and has 6 years of experience working as Technical Manager in the Food Industry. He also has more than 7 years of post-doctoral research experience and is currently working as a Research Fellow/Lecturer at the University of Queensland, Australia. He has published more than 55 papers in the top-most journals in the area of polymer sciences and food technology as well as presented research findings at more than 60 national and international forums. He is currently a member of the Australian Institute of Food Science and Technology (AIFST), the American Association of Cereal Chemist (AACCi), and also serves as a council member of Australasian Grain Science Association (AGSA). He is the recipient of 2014 Jack Kefford Award (AIFST) and inaugural AB Blakeney Development Scholarship (2017, AGSA).

On joining the department in July, Dr Dhital will work closely with Cordelia Selomulya, Victoria Haritos, Lian Zhang, and Leonie van't Hag to further develop our teaching program in Food Engineering as well to strengthen our research efforts within the department. Sushil is interested in the supervision of undergrads and PhD projects pertaining to new food product development using intact plant cells, modification of starch, enzyme-fibre interactions, and phytochemicals-fibre interactions.



## TIMOTHY SCOTT



At Monash University, Professor Scott will examine research and teaching themes in reaction kinetics and thermodynamics. In particular, the Scott group will focus on the areas of ultra-rapid additive manufacturing of soft and hybrid materials, the processing and utilization of crystalline porous materials for catalyst supports and gas separations, the assembly of biomimetic macromolecules, and biomaterial/tissue interfaces that strengthen upon chemical and mechanical insult.

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## LAURA-LEE INNES



We will welcome Associate Professor Laura-lee Innes to the Department later in March this year. A/Prof Innes will be jointly appointed to the Departments of Chemical and Civil Engineering with a focus in Environmental Engineering. She obtained her BEng and PhD in Chemical and Materials Engineering from the Royal Military College of Canada, where her research focussed on the performance of polymeric containers used for the storage of radioactive waste. She also completed her MSc in Chemical and Materials Engineering at the University of Alberta. Dr. Innes also served as a Commissioned Officer in the Canadian Air Force, where she trained as an Air Navigator and had responsibility for development and implementation of the ISO14001 Environmental Management System at one of the first Canadian Air Force Bases to adopt this system.

She will join us after 12 years at the Environment Protection Authority (EPA) Victoria where she has held the role of Senior Applied Scientist – Waste and Chemicals since 2014 as well as the appointment as EPA Victoria's Principal Expert for Waste since 2013. While at EPA Victoria, she developed and delivered research programs that provided the evidence base to inform regulatory and policy development and implementation in the areas of waste and chemicals. In 2017

she was the technical lead for the development of the Per- and poly-fluoroalkyl substances (PFAS) National Environmental Management Plan.

At Monash her research will focus on sustainable engineering in the areas of: waste characteristics including the intrinsic physical and chemical characteristics of waste and the changes to these characteristics after environmental or other exposures; waste technologies with consideration of engineering processes and associated chemical/material transformations; and the identification of pathways to environment and human health impact within the waste management cycle, including the identification of critical control points.

A/Prof Innes, her husband and two children spend most of their free time enjoying the Mornington Peninsula where they explore the amazing outdoors, kayak and sail with the dolphins in Western Port Bay, and admire their resident koalas.

## JENNY CHEN



**We are pleased to welcome Jenny Chen to the team. Jenny joins us from the University of Melbourne, where she was the Acting Executive Assistant to the Executive Director and Deputy Dean (Melbourne Business School), Faculty of Business and Economics.**

Prior to working at the Faculty, Jenny worked at the University of Melbourne in a variety of roles, where she was the Executive Officer (Projects) to the Director of the Melbourne Institute: Applied Economic and Social Research.

Jenny is self-motivated, and enjoys being part of, as well as motivating a successful team and thrives in highly pressurised and challenging environments. She possesses the skills, confidence and maturity to manage conflicting time-frames. Her ability to lead by example coupled with a proactive and positive attitude have added value to the roles Jenny has held during her career.

Working as the Project Officer for the ARC Centre of Excellence in Exciton Science, Jenny's responsibilities include: providing executive support to the Chief Investigators at Monash Node; working collaboratively with other Nodes to support Centre outreach activities, functions and marketing projects; ensuring monthly financial reports are coded correctly and promptly reported to the Adminstrating Node; and working closely with Node Professional Service team.

**Contact details**

Ms Jenny Chen  
Project Officer, ARC Centre of Excellence in Exciton Science  
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Clayton, VIC 3800, Australia  
T: +61 (3) 9905 6496 | E: Jenny.Chen2@monash.edu



## MONASH CENTRE FOR MEMBRANE INNOVATION

We are pleased to introduce the Monash Centre for Membrane Innovation (MCMI), a multidisciplinary research centre focused on membrane science, technology and innovation. MCMI brings 10 researchers from Engineering and Science together with 30 industry partners to produce/drive breakthroughs in membrane science and technology. Entrepreneurial in nature, this collaboration will produce the high quality publications, patents and licences to underpin new membrane manufacturing start ups.

The academics located in Chemical Engineering are:

- Prof Huanting Wang, Director
- Prof Xiwang Zhang, Deputy Director
- A/Prof Matthew Hill, Deputy Director
- Prof Mark Banaszak Holl
- Dr Huacheng Zhang, DECRA Fellow
- Dr Parama Chakraborty Banerjee

## FOCUS ON STAFF

# LAURA MCMANUS



**Current Role:** Executive Assistant to Head of Department, Professor Mark Banaszak Holl

**Brief overview of role:** The Executive Assistant provides a range of effective secretarial, administrative and office management services to support the operations of the office of Head of Department, other senior managers and colleagues.

The Executive Assistant undertakes key support functions to ensure the smooth and professional operation of the general office which includes general administrative support for projects and events and has a focus on excellence in process and judgement to provide sound and timely advice and executive support

**Worst job and why?** I would not say that I've had bad jobs but I would say I've had a bad boss previously which ended up making me leave that organisation.

**What projects are you currently working on and what does it involve?**

Currently working on coordinating six streams of the current academic recruitment drive with the Head of Department. This involves a lot of logistics and

operational support to incoming prospective candidates to the Department.

**What is your favourite place in the world and why?** Home, because it is with my family and Nala (my puppy)

**Name the person you'd most like to sit next to on a long-haul flight and why?** Someone who doesn't exist so I can have two seats.... Hahahahaha....

**Tell us something about yourself that your colleagues wouldn't know?** I really like to build stuff like furniture (tables/planter boxes) if I'm getting my hands dirty, I'm happy.

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## FOCUS ON STAFF

# ROSS ELLINGHAM



**Current Role:** Technical Officer

**Brief overview of role:** The technical officer provides a highly skilled technical and chemical workshop/laboratory service to ensure that the needs of the teaching, research and consulting programs of the department and its associates research centres are met.

**Worst job and why?** my worst job was working with the bio-waste with Prof Hoadley - I was getting 1000 ltrs of waste in a bulk container and de-filtering the waste product - YUK!

**What projects are you currently working on and what does it involve?**

There are a mixture of things at moment. Currently, preparing offices for new academics and student and assisting the Department Manager in better usage of our office space.

**What is your favourite place in the world and why?** Lake Elidon or the Bogan High Plains and Tasmania - I really love the fishing and wildness - Camping/Hiking

**Name the person you'd most like to sit next to on a long-haul**

**flight and why?** Lecturer - John Andrews because he was always cracking jokes and was really funny - He added a bit of colour to the place.

**Tell us something about yourself that your colleagues wouldn't know?** I love collecting old things and love to go around second-hand stores looking for small antiques.



# LONDON'S IMPERIAL COLLEGE NEXT STEP FOR RECENT GRADUATE



**Dr Huadong Peng who recently completed his PhD under the supervision of Associate Professor Victoria Haritos and Dr Lizhong He, has moved to London to take up a new position in a research group led by Dr Rodrigo Ledesma Amaro in the Department of Bioengineering, Imperial College London, UK. This group also belongs to the Imperial College Centre for Synthetic Biology.**

This postdoctoral position (academic and research level B) will give Huadong around three years to learn and challenge the hard questions in the field of the synthetic microbial communities/consortia. To be specific, he will employ the latest synthetic biology tools and metabolic engineering strategies to engineering a group of microorganisms to enhance bioproduction, either from different species or the same species but different strains.

As part of his research, he aims to develop new synthetic biology tools and functional synthetic microbial communities. These could be used for extending the potential of microorganisms to service the industry of medicines, biofuels and biomaterials, etc. in the future. At the moment, Huadong uses the yeast *S. cerevisiae* amino acid pathway as a model to develop the synthetic microbial community.

Huadong has always been driven to pursue an academic career and enjoys the university environment. However, such a big move so soon after graduation has not been without its challenges.

"It has taken me a while to get used to life in London. I very much missed the sunshine in Melbourne because it rained almost every day in the first two weeks and the days were shorter. Also, life in London is much faster than that in Melbourne, especially as Imperial is located in the centre of London", Huadong said. "Everything in London is new. Both Imperial and the postdoc project are new and it has been a big step outside my Monash comfort zone. But such an opportunity is worth the risk"

In addition to the challenges of a new city, Huadong also has to learn a whole set of new skills. As his scientific background is in bioprocesses and metabolic engineering, he lacked the hands-on experiences of the popular synthetic biology tools such as gene editing tools of CRISPR, golden gate gene assembly kit, etc. Thus, he needs to learn a batch of new molecular biology skills and tools to move forward in his project. He also assists the group leader to supervise Master students and manage the laboratory including the consumables purchasing, etc.

"With so much going on, it can be a struggle to find a work/life balance. However, I have just resumed swimming and jogging and can relax by cooking during my spare time."

"Now that I have found my feet I am learning to enjoy all that London has to offer, including the natural science and history museums. Everything here is convenient and there are so many places to visit. I've also been able to extend my network by making new friends here and catching up with several old friends who are living in the UK and Europe."

# MONASH ALUMNUS SELECTED FOR YOUNG PIONEERS PROGRAM

**Dr Nicholas Low, PhD in Chemical Engineering and CEO of Monash start-up company 2D Water, has been selected to participate in the 2018 Young Social Pioneers program run by the Foundation For Young Australians.**

An initiative that supports young people leading responses to the most pressing social and environmental challenges of our time, Dr Low will connect with 45 other young entrepreneurs and leaders at a week-long intensive workshop in the environment stream, a recognition of his work in developing a revolutionary technology that will help deliver clean water to the world.

Along with Professor Huanting Wang and other research colleagues in the Department of Chemical Engineering, Dr Low has worked on developing a chlorine-resistant membrane, a technology that helps to desalinate seawater at a lower cost than other methods. 2D Water is currently working on commercialising the membrane, which has the potential to be more efficient and robust than any other membrane product currently available in the market.

"We're revolutionising desalination with this membrane," said Dr Low. "We're passionate about solving the problem of water scarcity, as there's currently 1.2 billion people in the world without access to clean drinking water. If we successfully bring the membrane to market, we'll make clean water accessible to more people around the world, at a reduced cost in a more environmentally sustainable way."

Dean of Engineering Professor Elizabeth Croft said, "Engineers develop the creative technical solutions we need to solve the world's greatest challenges, including water scarcity. The technology developed by Nicholas and his supervisor have the potential to make a profound difference in the availability of potable water in many places where clean drinking water is often unavailable. We're proud to see a Monash engineer chosen to take part in the Young Social Pioneers program, and are confident in his ability to continue to solve important technical problems for the benefit of humanity."

The Young Social Pioneers program will help Dr Low and his fellow participants further develop the networks, support and mentors required to develop a successful and sustainable business. "I'm really looking forward to connecting with like-minded entrepreneurs who are committed to making a difference," he said. "It will be great to share ideas and experiences, as we work to compete against established technologies through our newer, more innovative products, processes and business models."

## PROFESSOR AIBING YU CONTINUES AS PRO VICE-CHANCELLOR AND PRESIDENT MONASH SUZHOU

Monash President and Vice-Chancellor Professor Margaret Gardner AO made the announcement in March, stating that Professor Yu has achieved a number of important strategic and operational outcomes in his role, including:

- Rationalising settings for the SEU-Monash partnership, and developing and implementing strategies to develop Monash Suzhou and the joint venture with Southeast University (SEU)
- Establishing the Monash Suzhou Research Institute
- Developing and maintaining excellent relationships with SEU, governments, industry and the community to generate opportunities to attract funds for Monash research and development activities in Suzhou
- Establishing an ARC Research Hub for Computational Particle Technology with an arm in Suzhou as well as in Clayton
- Building a strong linkage with Jiangsu Industrial Technology Research Institute, a prominent organisation bridging the gap between pure and applied research.

In 2017, Professor Yu was elected a Foreign Academician of the Chinese Academy of Engineering.

Monash University is pleased that Professor Yu has accepted the invitation to continue in his role and looks forward to ongoing work in building the University's relationships and presence in China, and increasing the influence and impact of our joint research and innovation projects.

# STUDY YOUR PhD IN AUSTRALIA



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## FOCUS ON ALUMNI

## THE ASPIRATIONS OF A SELF-PROFESSED HUMANITARIAN ENGINEER

## ALI RAHIMI

**As a Works Planner at Aqua Metro, Ali Rahimi (BE(Chemical) 2013) manages \$2.5 million annual turnover delivering service connections, sewer and water extensions, and commercial plumbing for water authorities. In doing so, he aims to develop sustainable partnerships and to create a cooperative environment in the water sector.**

"I manage several teams in the South East Water, Yarra Valley Water and City West Water service areas – this involves new asset installation, and renewal and maintenance of existing assets," explains Ali. "I am also a project engineer on a number of Capital Delivery Projects for Melbourne Water; these projects are very diverse. They could be anything between working on picturesque retarding basins (for storm water management) to working in complex environments such as Eastern Treatment Plant and Western Treatment Plant.

In furthering his career, Ali says he is open to new experiences. "I'm in the trial-and-error stage of my life where I'm trying a lot of different things to learn and test my strengths and weaknesses while preparing for the next stage which is consolidating this learning into a specific field of expertise," he shares. Ali is currently working towards building his expertise in sustainability and risk management, undertaking postgraduate studies to earn a Master of Sustainable Practice.

Five or so years ago, when Ali first entered the water industry, he noticed a dearth of young people coming up through the ranks. "Since then, the water authorities and associated businesses have experienced an increased intake of young people," he reports. "They're the future of the industry – we need young people to keep our waterways healthy and our water supply network robust."

Ali serves as President of the Victorian chapter of Engineers Without Borders, where he works with other young engineers to support their activities to alleviate poverty worldwide through humanitarian engineering and human-centered design. "What I love most about the organisation is the passion," he says. "Everyone is so galvanized and committed to making a positive social impact through engineering, in Australia and overseas."

To engineers just starting out, Ali offers this perspective: "Choose an industry you're passionate about and stay the course. Don't let your area of study dictate your career path – instead let it enrich your career choice. I chose to stick with the water industry and to let my chemical engineering background enhance my work. This was the best decision I've ever made."



Source: Monash University Engineering, <https://www.monash.edu/engineering/alumni/meet-our-alumni/chemical/ali-rahimi>

# FOCUS ON ALUMNI

## ENERGY EXECUTIVE REVEALS HIS PATH TO SUCCESS

### MARK BROWNLEY

**Some people find it hard to describe what they do for a living. Mark Brownley (BE(Chemical) 1987, MBA 1992) has no trouble at all. He deftly reels off his responsibilities as General Manager Field Services at SA Power Networks, the sole electricity distributor in South Australia.**

"I handle the detailed design, construction, commissioning and maintenance of the high- and low-voltage electricity distribution network," Mark says. "This includes all the supervisory control and data acquisition (SCADA) and telecommunications infrastructure that sits on top of the network, enabling us to operate it safely and efficiently."

Mark's background has informed his executive roles at SA Power Networks and previously at Jetstar Airways. "Deeply technical organisations have lots of moving parts comprising complex automation and information systems, plant and equipment, and processes," he explains. "My training in chemical engineering and my operational experience allow me to readily process all the inputs and make safer, more informed decisions more quickly."

So how exactly did Mark make his way to the top?

"I have a natural curiosity about how the world works and have changed industries a number of times. Each time, I've had to learn from scratch. That's hard. The key is to be humble and ask lots of questions. That's what got me through."

He then adds, "When I graduated, I didn't understand the importance of relationships – I don't mean superficial networks, but deep, meaningful relationships within and outside the profession. It sounds obvious, but things that matter only get done through people. Relationships are more important than any other single factor in your career. Start building them the day you start studying!"

Mark also stresses how mentors have contributed to his success. "There are so many roads you can go down. Mentors have helped me narrow down the choices and make smart decisions about the direction of my life. Wherever it is I've wanted to go, mentoring has gotten me there faster."

Perhaps this partly explains his joining the Advisory Board of the School of Engineering at the University of South Australia. "Early on I didn't know how to go about establishing relationships with industry or navigating a career as a professional engineer," reveals Mark. "I had to make it up as I went along. I want as few engineers as possible to face that and I'd like to help show them the way."

Over the years, Mark has witnessed many developments, but one in particular stands out: "Mobility. The ability to connect, communicate, transact and simplify work and life through the use of handheld devices and apps. In the future, I'd like to see more seamless integration of all the systems in our lives to give everyone more power and control over their destiny."

When not caught up with work, Mark pursues his passion for military history. "I've travelled to a number of significant sites around the world, including the Western Front in France and Belgium, Kokoda in Papua New Guinea and Nui Dat and Long Tan in Vietnam," he reports. When you're forging the future, sometimes it helps to look back.



Source: Monash University Engineering, <https://www.monash.edu/engineering/alumni/meet-our-alumni/chemical/mark-brownley>

# FOCUS ON ALUMNI

## BACK TO BROKEN HILL



**DAVID BRENNAN** - How did each of us choose to study Chemical Engineering at University?

**Monash Chemical Engineering Alumnus and Adjunct Professor David Brennan reflects on his senior years as a student at Broken Hill High School and how he came to be a chemical engineer.**

David Brennan was fascinated by chemistry, excelled in science and maths, and was planning to study Science at University, majoring in Chemistry.

At the time of finishing school, he had the opportunity to participate in a program run by BHP at Port Kembla Steelworks. This program was designed for some thirty school leavers, and ran for approximately two months.

"We were provided with catered accommodation,

transported daily to the steelworks, and given an overview of various sections of the works such as the Coke Ovens and the Open Hearth Furnace. In the final two weeks we were each given a role in one of the steelworks divisions – I replaced a clerk at the Open Hearth Furnace who had taken holidays"

While at the steelworks David met some chemical engineering university students on vacation work who suggested that chemical engineering was rather more focussed than science, and would open up more career opportunities.

"I thought about this and decided to change my direction and study chemical engineering at the University of New South Wales. I was fortunate to be supported by a scholarship granted by Broken Hill South Ltd. on the merits of my leaving certificate results."

Almost sixty years down the track, David was back in Broken Hill last September for a school reunion with his classmates.

Although David only attended Broken Hill High School for his final two years, following three years at Sydney Boys High School, the change proved beneficial, despite concerns his parents had about the quality of education available to him.

"My journey from home to school took ten minutes on a bicycle compared with an hour and a quarter on bus, train and tram in Sydney. There was also the bonus of smaller classes - there were 30 students in my year compared to 160 boys at Sydney High and co-education was a very beneficial experience, for example opening up appreciation of many different sporting activities and regular participation in school dances."

"The teachers at Broken Hill High School were very competent and dedicated and we had ready access to sporting facilities both at school and outside of school. It was a marked change from life in a big city, including meeting school community members outside of school hours, exposure to kangaroos and emus, attending chop picnics in creek beds, and camping at Menindee on the banks of the Darling river (free from dead fish)".

At his recent school reunion David took the opportunity to talk to students about the chemical engineering profession and had sessions with Year 10 and Year 11 Chemistry students and their teacher.

"It was great to meet up with the young students. I emphasised that chemical engineering involved transforming raw materials into more valuable products by a series of physical and chemical changes. I pointed out that raw materials such as natural gas extracted from a wellhead, minerals like lead and zinc sulphides mined in Broken Hill, and even salt from seawater, while valuable resources, all had impurities and needed a process to refine and transform them into more valuable products. I emphasised the economic, environmental and safety challenges as well as the technical challenges involved. The students responded with some good questions, often about related environmental impacts".

"Whether we see any of those Broken Hill students in our future enrolments at Monash is one thing, but I'm glad to have had the opportunity to briefly outline my perception of the role of our profession. Perhaps a number of them will need to consult with chemical engineers in the future, and it is valuable to have a basic understanding of other professions, and their skills and roles."

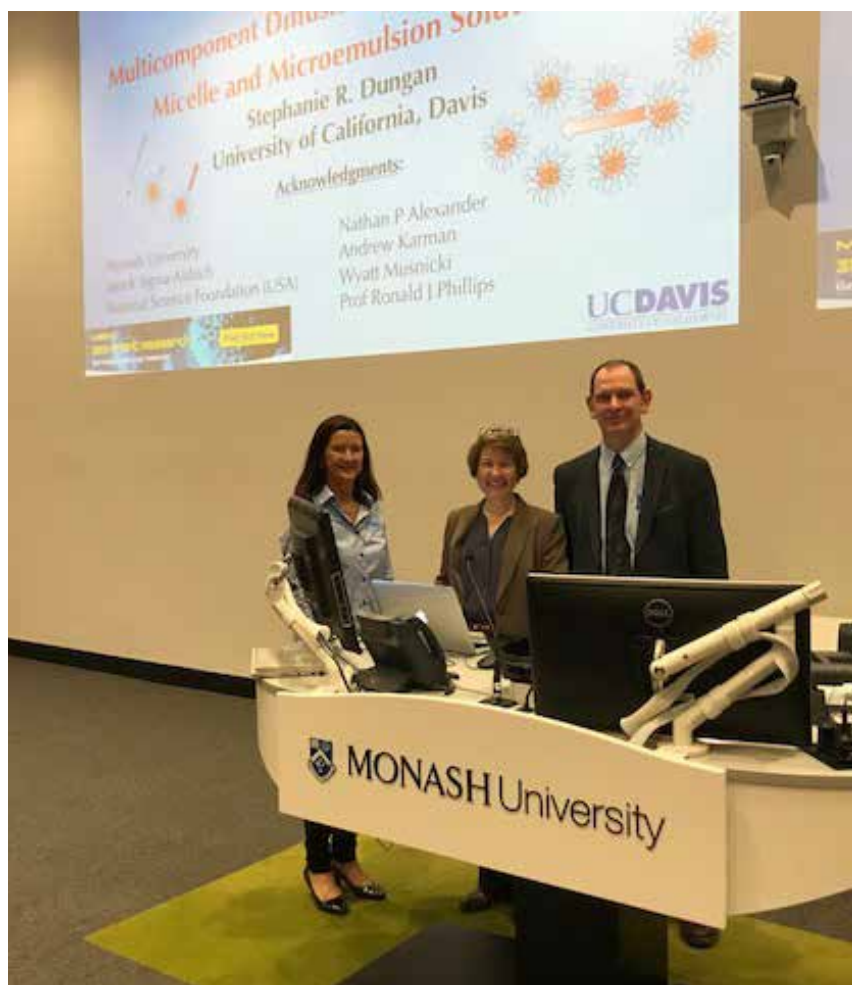


# MERCK SPONSORED SEMINAR SERIES

**It was with great please that we welcomed Professor Stephanie Dungan from the University of California, who presented a platinum seminar as part of our Aldrich Series Lecture sponsored by Sigma-Aldrich.**

Professor Dungan's seminar, in which she presented her research on multicomponent diffusion processes using Taylor tube diffusimetry and holographic interferometry, for alcohols and alkanes of various chain lengths, in anionic and nonionic surfactant mixtures, was open to all staff and students in the Department.

Professor Dungan received her undergraduate degree in chemical engineering from Princeton University. She attended the Massachusetts Institute of Technology for her masters and doctoral degrees in chemical engineering, working with Howard Brenner and T. Alan Hatton on colloidal transport, proteins and microemulsions. She joined the University of California, Davis as an assistant professor in 1993, with a joint appointment in two departments: Food Science and Technology and Chemical Engineering. There her research focuses on complex transport and equilibrium behaviour of surfactant self-assemblies or dispersions, such as micelles, vesicles, emulsions and microemulsions, when used to solubilize and deliver hydrophobic molecules such as flavours or pharmaceuticals.



## Multicomponent Diffusion in Solute-Containing Micelle and Microemulsion Solutions

When a hydrophobic solute, such as a drug, flavor or nutrient, diffuses in the presence of micelles or other surfactant aggregates, the partitioning of solute into the oily interior of the aggregates strongly affects the rate of diffusion of both the solute and the surfactant.

We explore such multicomponent diffusion processes using Taylor tube diffusimetry and holographic interferometry, for alcohols and alkanes of various chain lengths, in anionic and nonionic surfactant mixtures. The diffusion of more hydrophilic solutes is an average of aggregate and molecular diffusivities, weighted by the extent of partitioning between micelle and water. As the compounds become more hydrophobic, they partition almost completely into the micelle, and thus might be expected to diffuse at the same rate as their micelle carrier. Surprisingly, however, their diffusivity is found to be more than four times smaller than that of the micelle. In addition, we observe strong coupling between the diffusion of hydrophobic solutes and surfactant. In particular, the presence of a gradient in the concentration of the solute can induce a surprisingly large flux of surfactant either up or down the solute gradient. These effects mean that delivery of hydrophobic ingredients will occur at rates far different than that expected based on intuition or models based on binary Fickian diffusion.

To explore the origin of these effects, we analyze the transport process from the perspective of irreversible thermodynamics, to connect the rate of diffusive transport to gradients in chemical potentials. Dynamic light scattering is used to characterize the size, shape and interparticle interactions between micelles containing different levels of solute. Solid phase microextraction (SPME) is also developed as a tool to quantify solute partitioning between micelle and water. By using SPME to determine solute concentrations in the vapor that is in equilibrium with the sample solution below, the chemical potential of the solute in micelles can be determined, allowing us to probe how the chemical potential landscape changes with gradients in solute or surfactant.

# NEVER TOO EARLY TO PLAN CHRISTMAS - MARK THESE DATES IN YOUR DIARY!

XMAS IN JULY - FRIDAY  
26TH JULY 2019

2019 XMAS PARTY -  
MELBOURNE ZOO



The Chemical Engineering Professional staff will be hosting a traditional Christmas lunch on 25th July from 12:00pm until 2:00pm in the Lawson Room. The cost of attending this event will be \$27.50 per person which includes drinks:

#### Lunch Menu

- » Cracked pork shoulders cooked on a charcoal spit with extra crackle
- » Whole marinated charcoal chickens
- » Vegetarian option (tbc)
- » Gourmet garden salad with mixed lettuce, tomato, cucumber, olives, artichokes, red capsicum
- » Bulgarian sheep's cheese feta dressed with a red wine vinaigrette
- » Apple and fennel coleslaw with house made mayonnaise
- » Potato and chive salad with house made mayonnaise
- » Fresh French sticks, butter and gravy, mustard, and apple sauce to complement your meal.
- » Dessert Buffet - To be confirmed

**To book your place for this event, please register and pay your \$27.50 via Eventbrite.**

**<https://www.eventbrite.com.au/e/christmas-in-july-2019-tickets-55013524934>**

**BOOKINGS WILL CLOSE ON MONDAY 1ST JULY AT 5.00PM FOR CATERING PURPOSES**

The 2019 Xmas Party has been booked and will take place at the Melbourne Zoo on the 6 December 2019.

#### Lunch includes

- » 100% Australian beef burgers
- » Chicken kebabs - chargrilled served with a yoghurt & mint dressing
- » Thin BBQ snags (Halal)
- » Zoo Bakery breads/buns/wraps will be served to complement your choice of hot items
- » Option of a vegetarian substitute on request
- » Seasonal Salad Selection
- » Mixed garden salad with tomato, cucumber & red onion (V LG HC)
- » Classic house made coleslaw bound with mayo & fresh herbs (V)
- » Potato salad with freshly chopped chives (V)
- » Ice cream
- » Soft drinks, juice & water which is served throughout the lunch.

#### Schedule

- » 9:15 am - Arrive at bus departure spot - do not be late the bus will leave with out you!
- » 9:30 am SHARP - Bus departs from 20 Research Way (outside Sapore cafe)
- » 10:15 am approx. - Bus arrives at Melbourne Zoo
- » 10:30 am - 11.45 pm - Wander the Zoo
- » 12:00 pm - Lunch 2:30 pm - 3:15 pm Wander the Zoo
- » 3:30 pm approx. - For staff wanting to return to Clayton the bus will depart Melbourne Zoo.

**To book your place for this event, please register and pay your \$30.00 via - <https://www.eventbrite.com.au/e/2019-christmas-party-melbourne-zoo-tickets-53845903547>**

**BOOKINGS WILL CLOSE ON FRIDAY 15TH NOVEMBER AT 5.00PM FOR CATERING PURPOSES**



# RIP TO THE RESIDENT GOOSE AT JOCK MARSHALL RESERVE AT MONASH UNIVERSITY, CLAYTON CAMPUS.



If you are a staff member or you have been a student of Monash Clayton Campus, you may have enjoyed a lunch time walk around the lake at Jock Marshall Reserve. If you did, you would have seen the resident goose. Sadly the old man has passed away this month. Staff and students have begun a memorial at the lake to remember the grand old bird. The goose has been a fixture at Monash Clayton for many, many years. I remember taking my two youngest children who are now 16 and 14 years old down to see him during their school holidays to entertain them for an hour. Even before that, when they were attending the Monash childcare centres on campus we would regularly walk down to visit him. The goose and the other Monash wildlife were their favourite thing to see when they came to work with either me or their Dad. He will be sadly missed in our family's lives and I'm sure many other of Monash staff and students as well. *Ms Lilyanne Price*

Dear Goosey,

Thank you for making our lunch time walks full of joy as you guarded your family of birds on the J.M. lake.

## A Bridge Called Love

It takes us back to brighter years,  
to happier sunlit days  
and to precious moments  
that will be with us always.  
And these fond recollections  
are treasured in the heart  
to bring us always close to those  
from whom we had to part.  
There is a bridge of memories  
from earth to Heaven above...  
It keeps our dear ones near us  
It's the bridge that we call love"

The Jock Marshall Reserve ([jockmarshallreserve.com.au/about](http://jockmarshallreserve.com.au/about)) was established in 1961 to provide a teaching and research resource for environmental studies on campus. The reserve was established by and named after the Foundation Chair of Zoology and Comparative Physiology Professor AJ 'Jock' Marshall.



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- Graduate Positions (Undergraduate and Postgraduate)
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