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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



Ancora Imparo! As a learning community dedicated to the pursuit of knowledge it is critical that we spend time on how and what we teach. We continued that process last year as part of our three professional accreditations, reflected on the recommendations, and initiated actions on them during our day-long Education Retreat. The drive to further develop our teaching and learning community continued this year with a search for a new academic with a research specialty in chemical engineering education. The students and the professional and academic staff searched internationally for an expert in this area of critical importance to the department. We are delighted to be welcoming A/Professor Nicoleta Maynard to the department starting October of 2019. Nicoleta will bring her extensive experience to the department, described in this issue of Focus, as we launch multiple new education initiatives.

We have been very active in developing new Master degrees beginning 3 years ago with the new Masters of Advanced Engineering program, which has already reached ~40 students per year. Last year, we launched a bold new online offering of a Master of Bioproduct Manufacturing Engineering spearheaded by BioPria and the ARC-funded PALS Hub. In this way, we are making available the expertise of Monash's highly successful and oldest industry-focused institute to student's world-wide. You can also read about exciting new recent developments from BioPria and industrial partners Varden and Australian Paper in this issue.

Chemical Engineering is also part of a faculty-wide effort to introduce a new Professional Master program. This degree provides the opportunity for engineers who hold a non-accredited engineering degree to obtain a Washington Accord accredited degree that allows them to work as a professional engineer world-wide. This is an exciting new opportunity that also serves to substantially increase our Master level unit offerings. Finally, we have just accepted our first cohort in our new Master of Industrial Chemical Engineering at the Monash-Suzhou campus. We are excited to have 39 new students matriculating at the campus located just west of Shanghai. The initiation of this last program firmly ensconces the department in three of the world's major cities – Kuala Lumpur, Melbourne, and the Shanghai-Suzhou metro area.

Our Sunway campus is also in the midst of important educational innovations including the initiation of a new stream to emphasise the importance of Industry 4.0 for the field of chemical engineering. This stream includes a set of units in the areas of artificial intelligence and machine learning and is wonderful opportunity for our Sunway-based students and Clayton students taking a semester exchange to our Malaysian campus. In addition, the Sunway campus has initiated a bioprocessing pilot plant unit where students will solve real industrial problems at scale.



Finally, we are working to upgrade our core teaching space and to substantially improve our undergraduate laboratories and to create the new spaces we need for our Master courses. The new Woodside Building for Technology and Design (<https://www.monash.edu/it/woodside-building>) is well underway and will provide extensive new space for active learning instruction. Plans are well underway to completely renovate our space in Building 37 and will include new undergraduate pilot plant and creator spaces, instrumentation facilities, as well as modern biological and materials laboratories.

Best Regards,

Professor Banaszak Holl



BREWING SUSTAINABLE PROCESSES AND INDUSTRY PARTNERSHIPS

Chemical engineers play a vital role in food and beverage production by turning raw materials into commercial products - like a pint of the latest craft beer or a can of VB. Brand new Chemical Engineering student team Monash BrewLab is taking on the challenge of creating a sustainable nanoscale brewery right here on campus, giving students the chance to learn hands-on processing skills while putting Monash on the map as makers of well-crafted beers.

Director of BrewLab and PhD student Daniel Rojas Sanchez is leading a team of 30 students currently working hard to get production up and running, with the aim of producing up to 200 litres of beer over the next 12 months. Starting with a pale ale variety, the team is planning to produce a range of different beers, with spirits and kombucha on the menu further down the track.

"One of the benefits of setting up a brewery in a university is having access to great equipment and expertise," said Daniel. "We'll be working in established labs that will help us to work on the yeasts and hops in fine detail, and our headquarters are right next door to Monash Food Innovation, who work closely with industry on developing new food products."

Chief Operating Officer of Monash Food Innovation Dr Angeline Achariya believes that BrewLab is a great initiative that will help students and industry address the global challenges currently facing the future of food. "BrewLab could be an exemplar for the beverage industry to adopt more sustainable practices in the future, offering them the chance to leverage our new expertise," she said. "I'm also looking forward to sampling a few of the brews."

BrewLab will also create new opportunities for multidisciplinary student collaboration as the team progresses. "There are so many Final Year Projects made possible through our set-up, particularly for students interested in sustainable waste management," said BrewLab External Operations Manager Eddie Attenborough.

"We've also been in discussion with Biotech students, plus the Monash Permaculture Society, about finding alternative uses for our waste. We'll be looking at adopting sustainable brewing practices that minimise water wastage, such as the 'no-chill brewing' method that was developed in Australia during the drought."

Already on the radar of the wider brewing industry, BrewLab aims to open up a new talent pipeline of work-ready chemical engineers with direct food industry experience. "The whole point of the team is to give students practical opportunities to learn, whether it's recipe formulation or finding customers for a new product," said Eddie. "The beer is the added extra." The team have already made a solid start in establishing mutually-beneficial industry relationships, including sourcing second-hand equipment and receiving processing advice. "We've begun partnering up with breweries and equipment suppliers who are already showing a lot of interest in the BrewLab team," said Daniel. "They're looking to hire young people with process control experience, while we're helping to prepare students to be readily employable. It's a win-win situation."

Head of Chemical Engineering Professor Mark Banaszak Holl is already a keen BrewLab enthusiast. "I'm really looking forward to enjoying an excellent ale brewed using the latest sustainability practices and the very best of hops!" he said. "This is a great team that will give our students a wonderful new set of opportunities to learn and show off their engineering skills."

For now, BrewLab is working hard to establish their lab, with a broader plan in mind to showcase their new range at the Good Beer Week festival in 2020. "We've even got our first customers already - MESS and CEPA!," said Eddie. "Now all we have to do is make some beer!"

If you're a brewing industry professional interested in supporting Monash BrewLab through equipment donations, financial support or mentoring, get in touch via their website - <https://www.monashbrewlab.com>.





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 @



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THE MONASH DIFFERENCE

Monash Engineering qualifications are professionally accredited and internationally recognised. We provide a total experience for our students. We want to teach highly skilled engineers, while developing well-rounded individuals, who are ready for professional life, leadership and success. That's the Monash difference.

Engineering – your way

At Monash, you can complete your engineering qualification in just four years, or study for five years and graduate with a double degree or a masters. Our engineering students complete a common first year to gain a broad understanding of engineering and the different specialisations. And there are plenty of options for you to branch out in your subsequent years of study.

Studying a double degree with Monash is a great choice for students who have a passion for two disciplines and would like to further their career options. Monash Engineering is aligned with nine degrees from other Monash faculties. More and more organisations seek engineering graduates with expertise in multiple areas and Monash Engineering caters for this with the opportunity to complete two degrees, in just five years.

A total learning experience

Great engineers are so much more than just their skills – they're planners, leaders, team players and communicators. At Monash, our engineering courses aim to produce highly skilled engineers who are ready for life, ready for work, ready for the world.

The Monash Engineering Leadership Program, the Work Ready Program, and the Monash Industry Team Initiative, are all designed to help our students become well-rounded engineers, and better develop their strengths and their passions as people. Monash Engineering students are able

to branch out by way of activities such as – studying abroad or joining a club such as the Monash Unmanned Aerial Systems Club (UAS Club).

Learn and do in world-class facilities

Engineering is a hands-on discipline. At Monash, you get the chance to develop your skills in some of the world's best engineering facilities, like the Cave2 immersive visualisation platform, the largest wind tunnel in the Southern Hemisphere, one of the world's most powerful electron microscopes, and the New Horizons Centre – a collaboration between Monash and the CSIRO.

Professionally accredited, globally recognised

Monash Engineering degrees are recognised by a range of professional engineering bodies (depending on the specific degree), including Engineers Australia, The Institution of Chemical Engineers, Engineering Accreditation Council Malaysia, and the Australian Computer Society.

Reading online?

Find out more about the student experience at Monash

Find out more about our facilities

STUDENT & INDUSTRY ENGAGEMENT



We believe there's more to great engineers than excellent technical skills alone. And that's why Monash Engineering provides a range of programs designed to give you the knowledge and skills you'll need to be confident and articulate professionals, and to be well and truly ready to take your excellent engineering skills to your chosen industry.

Reading online?

Find out more about student & industry engagement



CREATING A BETTER WATER FUTURE

In a world-first breakthrough, researchers at Monash University, CSIRO, The University of Melbourne and The University of Texas at Austin have established an unprecedented new method to filter contaminants from groundwater and industrial wastewater, opening up new options to provide safe, clean drinking water in the developing world, and to protect the natural environment from industrial water pollution.

In their study published in *Nature Communications*, the international research team outline their unprecedented control method through which to separate particular negatively-charged ions, termed anions, from water using Metal-Organic Frameworks (MOFs).

MOFs are an advanced nanostructural material comprised of porous crystals with metal ions joined together by organic linkers. MOFs contain molecular-sized pores that can store, separate, release or protect many substances, and can be scaled up to suit a variety of industrial purposes.

An extremely flexible and customisable technology, there are now over 60,000 types of MOFs synthesised, with unlimited potential for researchers to identify further MOFs customisations to suit particular industry needs.

Led by Professor Huanting Wang and Dr Huacheng Zhang from the Department of Chemical Engineering at Monash University, in collaboration with Dr Anita Hill of CSIRO and Associate Professor Matthew Hill of CSIRO and Monash University, Professor Benny Freeman of the McKetta Department of Chemical Engineering at The University of Texas at Austin, and Associate Professor Jefferson Zhe Liu of The University of Melbourne, the team developed a MOF with precisely tuned pores of a size and chemistry to be compatible with the selected anion.

When passing over the filter material, the selected anion was attracted to the pore, and easily passed through with little force or resistance, while other anions were largely unable to pass through the pores.

This is an unprecedented breakthrough, as in other water filtering methods, all forms of anions need to be removed and filtered to extract the unwanted substance from the water, a costly and energy-intensive process that often requires some of the filtered anions to be added back into the water once the unwanted anions are removed.

In this instance, as outlined in the research paper entitled *Fast and selective fluoride ion conduction in sub-1-nanometer metal-organic framework channels*, the team demonstrated the success of this technique by identifying a MOF that showed high selectivity for fluoride anions over other anions.

Although World Health Organisation guidelines determine fluoride to be safe for human consumption in levels up to 1.5 mg/litre, many developing countries have higher natural fluoridation levels in their groundwater, yet lack energy and cost-efficient methods to filter the water effectively. Also, the agriculture industry is increasingly searching for ways to clean up water pollution caused by fertiliser and pesticides, particularly in areas where contaminated run-off is at risk of entering rivers and the ocean.

"Based on our research, we now have the capability to produce simple and affordable water filters that can be used safely and effectively anywhere in the world," said Professor Wang. "This is a significant outcome for people in developing countries who lack access to safe, clean drinking water, and for industries who are increasingly seeking ways to reduce the cost of their environmental impact. Our findings also prove we have the capability to determine the most effective filtering material and method to suit a specific material, or a particular industry need."

"The ability to selectively remove targeted ions from water with such high levels of specificity provides new pathways to address fundamental challenges in energy-efficient production of fit-for-purpose water for a variety of water and energy applications," said Professor Freeman.

"This research work also demonstrates the essential value of collaboration between experiments and simulations, which helps us gain molecular-level insights into the ion transport process," said Associate Professor Liu. "It has also helped to identify the critical role of the fluoride binding sites in the MOF nanochannels on the high ion selectivity and conductance."

Associate Professor Matthew Hill added, "This research outcome is a great example of using high-tech, next-generation technologies to assist in the transition to a circular economy, where long-term management of wastes can generate new industries, while also protecting the environment."

First published: <https://www.monash.edu/engineering/about-us/news-events/latest-news/articles/2019/creating-a-better-water-future>



PhD Scholarship in Chemical Engineering

The Opportunity

Expressions of interest are sought from outstanding candidates for PhD study in Chemical Engineering.

PhD Project – Implantable biosensors for real-time and continuous monitoring of disease

A full scholarship is available for a PhD student to conduct research on development of a new class of biochemical sensors to detect and quantify disease-related protein biomarkers in animal models of disease. The research will be conducted in Dr Simon Corrie's group (Nanosensor Engineering Lab) in the Department of Chemical Engineering, in collaboration with research groups at Monash and overseas.

This project will combine nanoparticles and engineered antibodies which can be injected into the skin to bind target proteins and produce signals detectable using a range of common biomedical imaging modalities. Using nanoparticles sourced either from the NEL or from commercial sources, the student will design and express engineered antibodies that, when bound to the nanoparticle surface, can transduce protein binding events for detection outside the body. A strong background in Analytical Chemistry and/or Molecular Biology (or Protein Engineering) is essential. Additional experience in animal studies is desirable.

Applicants must show excellent communication and inter-personal skills, and the ability to conduct self-motivated research. They should have research-based Honours or Masters Degree (or equivalent) in the relevant research areas and have a record of publishing their research in mainstream scientific journals.

Note: applicants who already hold a PhD will not be considered.

Faculty / Portfolio: Department of Chemical Engineering, Faculty of Engineering

Location: Clayton campus, Monash University

Main Supervisor: Dr Simon Corrie

Remuneration: \$28,900 p.a. full-time rate (pro-rata) 2019 rate.

Shortlisted candidates will be interviewed, over Skype if necessary. The interviews will be conducted in English.

Candidate Requirements

Applicants will be considered provided that they fulfil the criteria for PhD admission at Monash University and demonstrate excellent research capability. Details of the relevant requirements are available at <http://www.monash.edu/graduate-research/future-students/apply>

Submit an Expression of Interest

EOIs shall comprise:

- A cover letter that includes a brief statement of the applicant's suitability
- A curriculum vitae, including a list of published works
- A full statement of academic record, supported by scanned copies of relevant certified documentation
- Contact details of two academic referees
- Evidence of English-language proficiency (international applicants only)

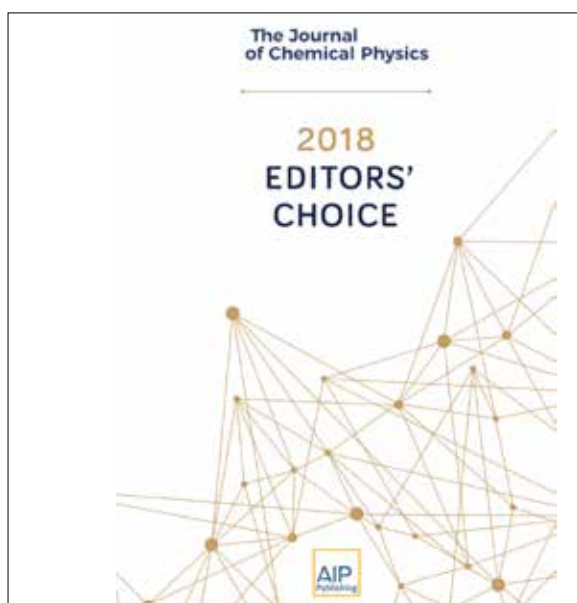
Enquiries and EOIs shall be sent, preferably in the form of a single PDF attachment to an e-mail, to:

Dr Simon Corrie

Email: simon.corrie@monash.edu

Closing date, August 30, 2019

PAPER MAKES JCP EDITOR'S CHOICE COLLECTION



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.

Professor Jagadeeshan was supported by postgraduate student Ramalingam Kailasham who is enrolled in IITB-Monash Research Academy Joint Program. Ramalingam conducted sophisticated calculations required for the paper.

The collection is available [online](#) or you can download the [PDF](#).

CSC AWARDS FOR TWO DEPARTMENT STUDENTS

Two of our students have received the prestigious award from the Chinese Scholarship Council for their outstanding work. Students Wenxin Mao and Yan Wang received their prize at a ceremony at the Consulate-General of the People's Republic of China in Toorak, Melbourne.

The Chinese Government award for outstanding self-financed students abroad was established by the China Scholarship Council in 2003. The worldwide recipients are chosen annually based on a record of outstanding accomplishments in any discipline. This award is considered the highest award given by Chinese government to graduate students studying outside China, who do not receive financial support from Chinese government. To date, the recipients include students from 33 countries, including United States, United Kingdom, Germany, Japan, Australia and Canada.



Students Menxin Wang (left, with supervisor Professor Udo Bach) and Yan Wang

MONASH DAIRY RESEARCH PART OF A FOOD TECHNOLOGY REVOLUTION

There is a quiet but momentous revolution happening on the farms, in the processing plants, and in the marketing groups of Australia's premium food companies – and it is being guided and supported by two of Australia's major universities. While United States–China tensions continue to grow, Australia is positioning itself as a preferred supplier to Asia, not on the basis of cost, but of taste and quality.

Behind the trade behemoths of wheat and wool, it is often missed that the Australian dairy industry is the nation's third-largest rural industry, with an annual sales value of A\$13.5 billion. For the last few decades, it has been export-oriented, with Australia punching well above its weight in representing six per cent of the world's dairy trade. Further, the industry has significant room to grow as the tastes of consumers continue to expand. Dairy and associated foods are rightly becoming one of Australia's most exciting economic stories. What is less known is that it is also one of our most accomplished collaboration stories.

Monash University's Australia–China Joint Research Centre in Future Dairy Manufacturing (ACJRC), in which the University of Queensland is a major participant, and Food and Dairy Graduate Research Industry Partnerships (GRIP), are at the forefront of advancing Australian food and dairy products into new markets.

The opportunity: China

Australian food and dairy products are well recognised for their superior taste and quality. The demand for premium dairy and food products is growing rapidly in Asia, specifically among the Chinese middle class. As disposable income increases, so does a taste for Western food, and a greater focus on food safety standards, making Australian dairy products the cream of the crop. The Australian dairy industry is thus faced with the challenge of responding to this demand in a scalable and sustainable way.

At present, dairy powders comprise more than 40 per cent of the Australian products on the market, with these mostly being for export to Asia. There is growing demand for 'added value' products, such as infant formula and protein powders – over the last few years, there has been a 614 per cent growth in infant formula production, a 208 per cent increase in skim milk powder production, and an 88 per cent increase in cheese production. Australian exports of infant formula alone to greater China are valued at more than US\$325 million, with increased demand stemming from the 2008 Chinese milk scandal in which melamine was found in infant formulas.

As Chinese demand for Australian food and dairy continues to grow, the industry must also evolve.

Monash University programs – partnerships with producers and innovators

Monash University has been at the forefront of food and dairy innovation, with the ACJRC and GRIP allowing for innovative new practices and products to be developed. The ACJRC works in collaboration with Soochow University, and the China National Cereals, Oils and Foodstuffs

Corporation (COFCO) – the largest cereal and grain company in China. The parties are undertaking specific research projects together, with Dr Xiaoming Hao, director of the Nutrition and Health Research Institute (a research arm of the COFCO), stating that its decision to collaborate with Monash Food & Dairy was based on 'the international reputation of Monash University's chemical engineering research' and its 'strong relationships with many Australian food companies, especially in the R&D area'.

Monash University's GRIP is focused on supporting the value chain of the dairy and food industry by way of novel material usage; product manufacturing; big data optimisation; sustainable practices in water, energy and waste management; and intensive collaboration with food producers like Lion and Bega.

Successful partnership with Bega

Monash University's partnership with Bega has been a component of the Australian company's innovation strategy. Bega's innovation group worked closely with the university to use new drying technologies to extend the life and improve the quality of powdered dairy products, and process improvements in cheese manufacturing.

Monash has created a 'smart drying program', in which a manufacturer can test how a product would dry and how long it would last under various conditions at a small scale, prior to investing in, and rolling out, the new product or process at a commercial level. Spray-drying has been commonly used by the sector for decades to make popular products, such as powdered infant formula, but Monash's use of a small-scale drying machine, X-ray diffraction and infra-red technology allows it to not only significantly cut the cost of trialling the spray-drying of new products, but also to monitor fundamental changes in the properties of the powdered products during storage that are caused by heat or moisture. Monash has also developed modelling algorithms to let it test how the materials in a powder will react in different conditions.

Professor Cordelia Selomulya, who has led the project at Monash, said that a more targeted approach to spray-drying helped manufacturers to produce higher-quality powders, as well as leading to energy savings. In Bega's case, the partnership has led to several important improvements in the drying process to improve energy use and product quality. Monash also conducted research on cheese to modify formulations and technology, in order to optimise production and reduce salt.

Karren Bathurst, Group Research and Innovation Manager at Bega, credited Selomulya's drive and determination with making the collaborative program, which provided students and industry benefits, so successful. 'At Bega, we promote collaborative research with academic organisations,' Bathurst says. 'We have now worked with the Monash University teams, led by Cordelia, for five years. Working with the students is mutually beneficial – their research has provided us with real benefits in improving our processes and identifying new product opportunities, and the students

receive practical experience in Australian dairy and manufacturing businesses. We hope that by supporting this program, students will decide on careers in food and dairy manufacturing.'

The future: innovation in product, safety, and energy cost

The university–industry partnership has played a major role in the development of the Australian dairy industry over the last decade, transforming it from a minor player on the world export stage, focused primarily on one product – milk powder – into a diverse, innovative, and rapidly growing sector with a portfolio of high-quality nutritional products. There is more to come: Australian food and dairy products can continue to improve in myriad ways. Opportunities include sophisticated new packaging, which exploits barrier protection to increase shelf life; disposable sensors for tracking and quality control; and process improvements, such as sustainable wastewater management and energy-use minimisation. The industry also envisages the potential re-use of waste streams to expand the product range, such as acid whey, permeate, milk minerals and lactose derivatives, providing both nutritional and consumer taste benefits for new market segments.

As importantly, the university– industry partnerships that underpin this growth and diversification are robust and fruitful, while also developing a new generation of food technologists for Australia. They are focused on export markets, as well as domestic consumers, and have built outstanding partnerships in the region – particularly with China.

The partnership between Monash University, the University of Queensland, and a host of Australian dairy and food operators has achieved substantial national recognition, including as the winner of a prestigious BHERT Award for collaboration between business and universities in 2018. It is rightly regarded as one of Australia's most important collaborations, and also serves as an exciting model for all export oriented industries.

*Article first published in Forge Magazine, Vol 5, No 2.
Written by Peter Binks and Hania Syed*

GRIP WORKSHOPS

The Dairy GRIP program continues to add value to Education and Research pillars of MFI by training Food and Dairy Grip PhD students in a three part series of workshops on research translation to commercialisation.

Working with Professor Cordelia Selomulya, these workshops provide the graduate students with hands-on practical tools and leadership skills they can apply back to their PhD research and future careers.

They also learn about innovation culture, best practice and business models and the pathways and pitfalls of research to commercialisation through a design led research approach which culminates in a Shark Tank style pitch at the end.

The last of the series finished on 12 June in collaboration with MADA D-LAB (a great outcome from the initial engagement session with MADA in April). A full hype reel will soon be shared widely across Monash network.

The three workshops included:

- 11 April Young Food Intrapreneurs
- 16 May Strategy Innovation Workshop - long video including Shark Tank Pitches in email trail below
- 12 June Project Management Workshop

Click on the link below to see graduates in action from workshops 1 and 2.





DEPARTMENT NEWS

MONASH PHD GRADUATE HEADING TO THE ALPS

Recent PhD graduate Dr Kye Robinson will swap the lights of Melbourne for the Alpine slopes of Europe as he heads to Switzerland to take up a postdoctoral position in Geneva.

Kye has been awarded a prestigious Swiss Government Excellence Scholarship, which has given him an outstanding opportunity to work with the renowned Bakker Group at the University of Geneva.

Kye's research in optical sensors focuses on the selective monitoring of important molecules (ions, metabolites, proteins, etc) in complex solutions (blood, sea water and other environmental samples), a topic that remains a significant challenge in the field of analytical chemistry.

While electrode sensors are commonly employed in industrial settings, optical sensors ("optodes") are also in development as they can be scattered throughout a sample to provide 3D information in a real-time and continuous manner.

Key challenges in using these optodes in complex solutions include poor selectivity and stability over time. During his time in Geneva, Kye will investigate a range of polymeric coatings designed specifically to improve the stability of these sensors and provide the mechanical strength necessary for grafting of these sensors onto other surfaces such as implants or optical fibres as sensor arrays enabling a wide range of new applications.

Kye is looking forward to seeing Europe for the first time and the chance to explore both Switzerland and its neighbouring countries during his weekends.

"I'm also looking forward to getting in some skiing in those alps and brushing up on my French with native speakers.", Kye said

Kye notes that Monash has given him many great opportunities that have propelled his career forward including being part of the Monash/Melbourne Node of the ARC Centre of Excellence in Convergent Bio-Nano Science and Technology (CBNS) in addition to participation in several outreach initiatives and workshops.

"Special thanks to my PhD supervisor Simon Corrie for his tremendous help in both getting me through my PhD and introducing me to the leaders in the field of optical ion sensing", Kye said.

Each year the Swiss Confederation awards Government Excellence Scholarships to promote international exchange and research cooperation between Switzerland and over 180 other countries.

DO NOT BE PUSHED BY YOUR PROBLEMS, **BE LED BY YOUR DREAMS**



The year was 2014. Fully enrolled and 2 years into my Chemical Engineering degree at Monash Malaysia, I was blessed with the opportunity to finish the remainder of my studies here at Monash Clayton. For as long as I can remember, I was always interested in engineering. Having just arrived in Melbourne, I remembered being young and hopeful. Equal parts excited and equal parts naive. I studied hard. I made wonderful friends and fostered many life-long relationships.

At the end of my penultimate year in 2014, I had the opportunity to undertake vacation work for Australian Paper. Australian Paper has a long treasured history of being Australia's only manufacturer of office and printing papers, as well as bag, sack, and lightweight packaging, and is a major supplier of kraft liner board for the cardboard packaging industry. Through my role as a project engineer, I was involved in investigating alternative uses for spent pulping chemicals at their Maryvale plant. I collaborated with an international team and was focused on developing simple cost-effective solutions to some of the industry's most pressing problems. This great experience taught me that hard work and effective communication is necessary to drive team outcomes.

At the start of my final year in 2015, I successfully interviewed with Visy Industries and had the opportunity to undertake an IBL (Industry-Based-Learning) project with them. Through my role as a process engineer, I was involved in the fluidised bed boiler sand recycling system project at their co-generation clean energy plant. The day-to-day operations of this plant involved sorting and combusting waste in a high temperature sand boiler to produce steam and generate electricity. I was tasked with conducting a comprehensive life cycle analysis on the spent sand. As a key project highlight, I successfully tracked the changes in sand size distribution which led to potential savings of \$500,000 a year from boiler tube repair costs. This experience taught me that being flexible (working across multiple processing sites, technical centres and engineering offices) and playing to the strengths of your multi-disciplinary team (engineers, managers, technicians, chemists and accountants) is crucial to develop synergies in any working environment.

Thankfully, an opportunity opened up at the start of 2016 to pursue my Ph.D. here at Monash BioPRIA with an industry partner. Because I had once conducted work for them, Australian Paper were happy to structure an industry-based Ph.D. specifically for me. Today, I work closely with them to investigate high-value nanocellulose packaging applications produced from commodity wood fibres. Our goal is to create sustainable packaging materials of the future which can rival the performance of fossil-fuel based plastics. I am also very blessed to have 2 excellent supervisors who care not only for the project but also for my wellbeing and success here at Monash. Interestingly, the Ph.D. also opened up an opportunity for me to conduct teaching. Throughout all 3 years of my Ph.D., I was the lead tutor for CHE4173 Sustainable Processing II in the areas of heat integration, water integration and gaseous emissions. Under the tutelage of an excellent unit coordinator and mentor, we were blessed to continuously receive excellent student feedback (SETU). Award letters such as the "Top 10% of Units in Monash Letter by the Vice Provost" were not uncommon, a testament to the high quality of teaching here at the Department of Chemical Engineering. In my final year of Ph.D., I was also given the opportunity to do some work for Varden Process. We are currently investigating sustainable packaging solutions with renewable materials using high technology machinery and chemistry.

I am so grateful to have had the opportunity to do volunteer work for an orphanage and breast cancer welfare association. These experiences have shaped my perspective of life to be more grateful, humble and thankful for my family and the people around me. In my spare time, I love venturing out for new foods and playing electric guitar. My dream is to one day build my own electric guitar; complete with electronics, pickups and the finest wood selection. Certainly not the primary reason for pursuing this Ph.D., but I do hope my background with products made from trees would assist this wood selection process.

To say this journey was always smooth-sailing and only sometimes difficult would be a gross understatement. I will never forget finishing my undergraduate studies well; but because I was an international student at the time, I was encumbered with so many limitations imposed upon me with Australian job applications. But thankfully through the amazing Ph.D. program at Monash, I never stopped pursuing my passions and always kept in touch with the industry-side of engineering. Because of that, today I am an Australian Permanent Resident. Last week, I received my dream job offer to work as an engineering management consultant at one of the biggest consulting companies in the world, Accenture. I am overjoyed and humbled. Overjoyed by the fact that someone decided to take a chance on me; and humbled because I will never forget the great sacrifice and choice I had to make based on those limitations to get me here.

Everyone comes from different backgrounds, with different life-changing stories and from sometimes unforgiving circumstances. But I believe the true measure of a person is not one that lets life dictate their paths, but rather one that shamelessly and unceasingly chases after their deepest hopes and dreams. Problems and challenges will always come and go. Such is the brevity of life. But always remember that all our dreams can come true if we have the courage to pursue them. As R. W. Emerson once said, "Do not be pushed by your problems, be led by your dreams."

Submitted by Sean Ang, Final Year Ph.D. Candidate (Coursework and Industry Project), First Class Honours in Chemical Engineering, 4 Time Dean's Honours List Recipient



RESEARCH

DEPARTMENT RESEARCH EXAMINES **THE UPTAKE AND RETENTION** OF NANOPLASTICS IN AQUATIC ECOSYSTEMS

Head of Department Professor Mark Banaszak Holl and colleagues have recently published their research into aquatic nanoplastics in the *Global Challenges* journal.

Their experiments demonstrated the potential use for mussels, specifically their siphons, to monitor environmental accumulation of aquatic nanoplastics.

In their paper they report on a set of experiments to assess the feasibility of using an invasive and widespread freshwater mussel (*Dreissena rostriformis bugensis*) as a sentinel species for nanoplastic detection .

Under laboratory experimental conditions, mussels ingested and retained fluorescent polystyrene (PS) beads with carboxylic acid (–COOH) termination over a size range of 200–2000 nm. The number of beads the mussels ingested was quantified using fluorescence spectroscopy and the location of the beads in the mussels was imaged using fluorescence microscopy.

PS beads of similar size (1000–2000 nm) to mussels' preferred food were trafficked in the ciliated food grooves of the gills. Beads of all sizes were observed in the mussels' digestive tracts, indicating that the mussels do not efficiently reject the beads as unwanted foreign material, regardless of size.

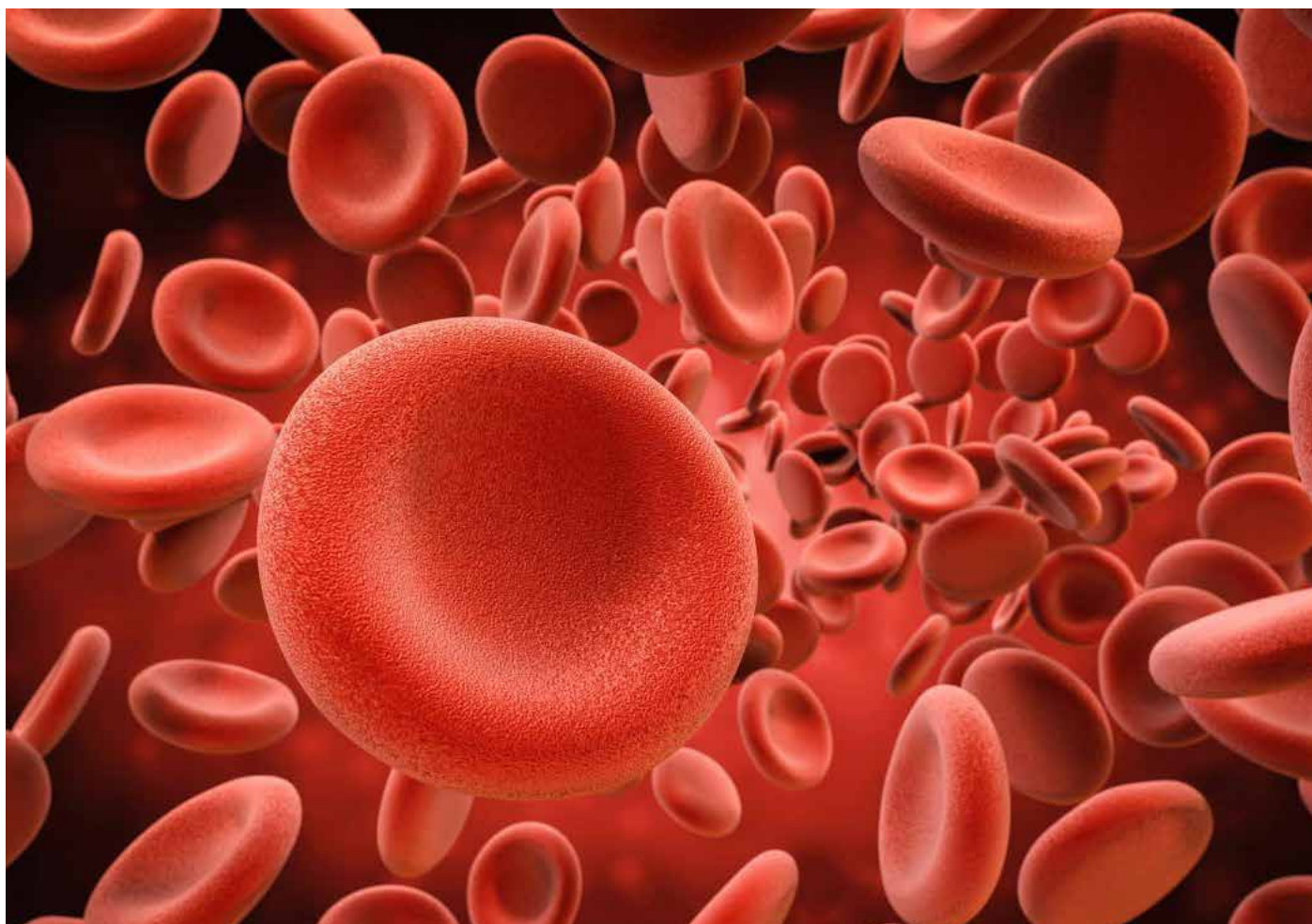
Fluorescence microscopy showed that all sizes of beads were concentrated in the siphons and were retained there for longer than one month post-exposure. Combined atomic force microscopy, infrared spectroscopy and photothermal infrared spectroscopy were used to locate, image, and chemically identify the beads in the mussel siphons.

Uptake and Retention of Nanoplastics in Quagga Mussels

Rachel L. Merzel, Lauren Purser, Taylor L. Soucy, Monica Olszewski, Isabel Colón-Bernal, Melissa Duhaime,* Ashley K. Elgin,* and Mark M. Banaszak Holl*

DOI: 10.1002/gch2.201800104

Global Challenges 2019, 1800104



RESEARCH

NEW RESEARCH AIMS TO IMPROVE THE EFFICACY OF BLOOD TYPE TESTING

In research published recently by the American Chemical Society, a group from Monash have demonstrated an effective way to improve the reliability and sustainability of blood type testing.

Currently, the gel test is the most prevalent method for the forward and reverse blood typing tests. This test relies on the controlled centrifugation of red blood cells (RBCs) and antibodies through a gel column.

This noncontinuous matrix is based on microbeads that often lack sensitivity.

For the first time, nanocellulose hydrogel is demonstrated as a sustainable and reliable medium for gel-based blood typing diagnostics. Gels with a minimum of 0.3 wt % TEMPO-oxidized cellulose nanofibers (0.92 mmol/g of carboxyl content) separate agglutinated and individual RBCs in the forward test.

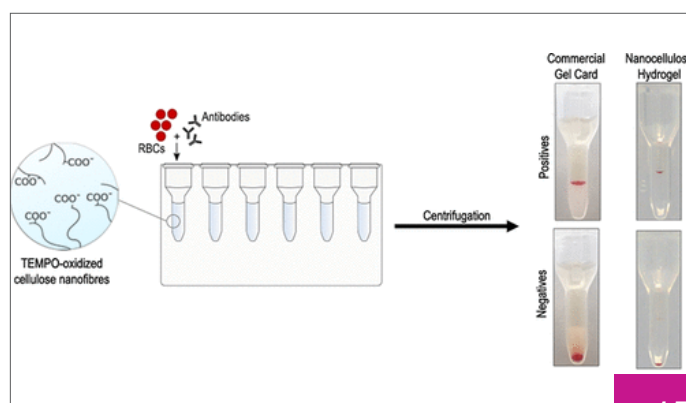
The addition of glycine is able to balance the osmotic pressure and reduce hemolysis to 5%, while retaining the electrostatic repulsion responsible for the gel network structure and its rheological properties.

For the reverse typing, cellulose nanofibers are chemically cross-linked with hexamethylenediamine (HMDA), increasing the gel yield point 8-fold. Sodium chloride is added to achieve the osmolality found in the human plasma and limit cell lysis to 15%, without affecting the gel colloidal stability.

Nanocellulose hydrogel constitutes a performant, low cost, and green soft material, providing clear and well-defined results for both blood grouping tests.

Nanocellulose Hydrogel for Blood Typing Tests

Rodrigo Curvello Llyza Mendoza, Heather McLiesh, Jim Manolios, Rico F. Tabor, Gil Garnier*
ACS Appl. Bio Mater.2019262355-2364



MONASH ACHIEVES WORLD GOLD STANDARD FOR RESEARCH EXCELLENCE & IMPACT

Monash University's research performance has been ranked above international standard in the latest round of the Excellence in Research for Australia (ERA) rankings.

Every three years, the ERA evaluates the research strengths of Australian universities by discipline, following a rigorous assessment process by internationally respected experts.

Of the 22 broadfields of research rated, Monash was eligible for assessment in 21. The University achieved world standard status across all disciplines and the highest possible ranking of five in 10 research disciplines, placing Monash well above world standard in:

- Physical Sciences
- Chemical Sciences
- Biological Sciences
- Engineering
- Technology
- Medical and Health Sciences
- Economics
- Psychology & Cognitive Sciences
- History & Archaeology
- Philosophy & Religious Studies

Over 90 per cent of the University's sub-fields of research were ranked above or well above world standard, with the number of disciplines achieving the highest ranking of five increasing to 45 in 2018 - up from 38 in the 2015 round.

Among the sub-fields that attained the highest score for the quality of their research, 12 achieved a rating of five for the first time, including Artificial Intelligence and Image Processing, Criminology, Applied Ethics, Electrical and Electronic Engineering, Applied Mathematics and Pure Mathematics.

Monash President and Vice-Chancellor Professor Margaret Gardner AO said the results highlight the University's strengths across a diverse range of disciplines and a commitment to high-quality research.

"Monash has demonstrated not only a very high level of research excellence but further significant improvements in research quality," Professor Gardner said.

"Only through the highest quality research can we address and solve the complex challenges of today's world."

Monash Provost and Senior Vice-President, Professor Marc Parlange, said the University set new benchmarks for research excellence in Humanities, Arts and Social Science (HASS) and STEM.

"We are delighted to see strong performances across STEM and HASS which confirms the University's research strengths in these fields," Professor Parlange said.

"These results reflect our investment in the expertise, infrastructure and collaborations to drive leading research discoveries."



INAUGURAL ENGAGEMENT AND IMPACT ASSESSMENT

Monash has excelled in research excellence, impact and engagement in a series of rankings. The Australian Government's inaugural Engagement and Impact Assessment (EI) of its research found Monash was deeply engaged with the community and industry, and excelled in translating research into economic, social, environmental and cultural change.

Monash President and Vice-Chancellor Professor Margaret Gardner AO said the results reflected the University's endeavour to advance research that changes lives and has a positive impact for communities locally, nationally and internationally.

"Monash research is geared towards making lasting, positive changes in the world and taking on big challenges. These results demonstrate that we are having real impact, and engaging with the community about how research translates into real-world benefits," Professor Gardner said.

"We are rapidly advancing our ability to solve the great human challenges of our time through our commitment to the translation of quality research, commercialisation and building global alliances and partnerships with industry, government and beyond".

The EI is a companion report to the Excellence in Research for Australia report, released earlier this week, in which Monash research also ranked well above world standard for the quality of research across a broad range of fields.

Every three years, the ERA evaluates the research strengths of Australian universities by discipline, following a rigorous assessment process by internationally respected experts.

The University achieved world-standard status across all disciplines, and the highest possible ranking of five in 10 research disciplines.

More than 90 per cent of the University's sub-fields of research were ranked above or well above world standard, with the number of disciplines achieving the highest ranking of five increasing to 45 in 2018 – up from 38 in the 2015 round.

Among the sub-fields that attained the highest score for the quality of their research, 12 achieved a rating of five for the first time, including Artificial Intelligence and Image Processing, Criminology, Applied Ethics, Electrical and Electronic Engineering, Applied Mathematics and Pure Mathematics.



EXPERIENCING MONASH - YEAR 10 STUDENTS COME TO WORK

During May and June the university hosted year 10 work experience students for a week. Working in the Department, the students were given a taste of university life and the potential careers that await them once they finish school. Below are some perspectives from two of our students.



Haireya Abudureheman

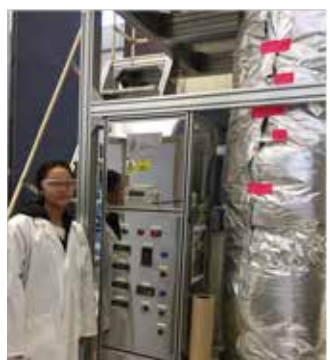
In May I had the pleasure of completing one week's work experience in the Department of Chemical Engineering at Monash University.

During the work experience week, we did various fun activities and experiments, including *the fabrication and characterisation of gold nanoparticles* and *coffee ring effect of gold nanoparticle sessile drops*.

On the first day we synthesised the gold nanoparticles in the laboratory by mixing chlorauric acid and different concentrations of sodium citrate.

On the second day we used a microscope to observe the process of gold nanoparticles drying and forming a coffee ring. After I did the experiments I did a work experience presentation based on my research project.

In general I liked my work experience at Monash University. It was a great opportunity for me to gain a deeper understanding and increase my passion for science. Through this work experience I gained a better understanding of chemical engineering. Also it helped improve my social skills and build up my confidence. Most importantly it helped me improve my knowledge.



Soo Yan

In June I spent five days at Monash and experienced many groups and labs throughout the week. I discovered the many different aspects of Chemical Engineering. I learnt about food engineering, environmental engineering, modelling and simulation, bioengineering and electrical chemistry all within chemical engineering.

I also discovered that chemical engineering is not about chemistry, but the optimisation of processes to achieve the desired form of a material and that many students move from other fields into Chemical Engineering as it is often related to other fields.

I noticed that each of the groups are like small communities, which made it a very welcoming environment.

It was a pleasure to meet so many people and learn about what each of them do and it's great to see people love what they do.

MONASH CHEMICAL ENGINEERING STILL NUMBER ONE IN GLOBAL RANKINGS

Monash has ranked in the top ten per cent of universities globally for subject-specific performance, in the QS World University Rankings by Subject.

The QS (Quacquarelli Symonds) analysis lists the world's best universities in 48 different subject areas across five broad fields. Monash featured prominently among the world's elite institutions, placing in the top 100 in 40 of the subjects tabled, and in the top 50 in 25 subjects.

The University retained a number one ranking across four subject areas in the Australia - Theology, Divinity & Religious Studies, Chemical Engineering, Chemistry, and Pharmacy & Pharmacology. Ranked third in the world, Pharmacy & Pharmacology remains the University's highest-ranking subject.

Monash significantly improved in the global rankings for Performing Arts (16), Philosophy (30) geography (33), Sociology (33) and Materials Sciences (42).

Monash President and Vice-Chancellor Professor Margaret Gardner AO said the results reflected the University's growing international reputation for excellence and collaboration.

FROM MIMOZAX TO ACACIA-NO-KI



Some twenty years ago, in Monash's Department of Chemical Engineering three "retired" persons, a wood chemist, a former Acting Director of the Australian Pulp and Paper Institute and an amateur botanist were looking at the possibility of using tannin from the bark of pine trees to produce tannin formaldehyde adhesives that could be used instead of the currently used phenol formaldehyde adhesives in the manufacture of plywood sheets.

This situation was unusual because the chemist had retired from CSIRO and the

other two members of the group were academic chemical engineers retired from the Monash Department and the problem in which they were interested was of importance to a Japanese company headquartered in Hiroshima with pine plantations and production facilities in New Zealand.

Progress on the adhesive development has been good with a number of patents being taken out and technical papers published. However that is another story. As part of the adhesives study, the properties of tannins (polyphenols) from a variety of tree species were determined since the actual organic compounds present differ from species to species and hence their chemical reactivity differs. One of the properties measured was the antioxidant capacity. All tannins have some antioxidant capacity and it was found that wattle tannin (Acacia bark extract) had extremely high activity.

This discovery led in March 2007 to the establishment of the mimozax Company to sell a product of wattle tannin: "ACAPOLIA" as a health food. Clinical and other trials were undertaken in Japan on the safety of the product. In 2010, ACAPOLIA was certified by the Japan Health Foods and Supplements Information Centre Inc. as the first "High Quality" product in the safety and the effectiveness for health foods and supplements. In 2014, wattle tannin was listed on the National Institute of Health and Nutrition database under "Information system on safety and effectiveness for health foods" (ChemEngFocus 4 (2) May 2011). Much has occurred since then.

In April 2015, a new category "Foods with Function Claims" in the "Foods with Health Claim" was introduced in Japan in order to clearly label for the general public claims based on scientific evidence and to enable consumers to make more informed choices when purchasing health food supplements. Development work continued and in 2016, an improved version of "ACAPOLIA" "ACAPOLIA PLUS" was awarded a Silver Award by Mondo Selection (International Institute for Quality Selection). In 2017, "ACAPOLIA PLUS" was approved by the Japan Consumer Affairs Agency and was registered as a "Foods with Function Claims". The label describes "ACAPOLIA PLUS" as containing 163 mg of proanthocyanidins derived from Acacia bark as the functional substance in each daily dose, and the supplement aids in the reduction in the absorption of carbohydrates and so limits the postprandial rise in blood glucose in humans. This is very important for a person who has a high blood glucose level or an easily increased blood glucose level.

Seven years after mimozax was established, the large expenditure which covered the numerous clinical trials and the development of potentially new formulations, had been recovered. Since then, the business at mimozax has progressed very rapidly and Monash has received an annual modest royalty payment which has gone to support University activities and graduate students of the Department.

After careful consideration of the future of mimozax, its branding and its present and future products, on 1 April 2019, the Company name was changed from mimozax to "Acacia-No-Ki" (Acacia Tree) and from "ACAPOLIA PLUS" to "ACAPOLIA SUGAR CARE". Currently, the Acacia-No-Ki is focusing on developing new products that help to maintain human health both physically and mentally.

The Monash team consists of Drs Yoshi Yazaki, Frank Lawson and Peter Uhlherr. The Monash team has been collaborating with Mr Takeshi Kataoka, Dr Sosuke Ogawa and Mr Tomoki Kobayashi from the Acacia-No-Ki Company, Prof. Takashi Tanaka and Dr Yosuke Matsuo from Nagasaki University, Prof. Kiyoshi Sugiyama and Dr Nobutomo Ikarashi from Hoshi University and Dr Kuniyoshi Shimizu from Kyusyu University. Mr Takeshi Kataoka, President of the Acacia-No-Ki Company said that the remarkable development in his company business was due to the great collaborations between the Japanese academic institutions and the Monash Group, which will be strengthened even more in the future as further developments in the Company occur.



Dr Yoshi Yazaki



JOIN US AT THE ANNUAL CHEMICAL ENGINEERING POST GRADUATE ASSOCIATION CONFERENCE THIS OCTOBER

The 9th Annual Chemical Engineering Postgraduate Association (CEPA) Conference 2019 at the Monash University Clayton Campus in Melbourne, Australia, is an opportunity to meet, greet and interact with fellow members of the scientific community of the Faculty of Engineering.

Since 2011, the CEPA conference has been run by students as an opportunity to showcase the wide range of research within the department. Students from around Australia are invited to present their work to their peers, academics and industry, receive helpful feedback, and open avenues for collaboration.

Chemical Engineering at Monash encompasses a wide range of topics, from nanomaterials and computational modelling to biotechnology and food engineering. The CEPA conference provides a unique opportunity to learn about research in a range of fields, which encourages cross-disciplinary work. Following very positive feedback from the previous years, we will again be designing the 2019 program around abstract submissions. Presentations will be aligned with the following exciting engineering fields related to work performed at Monash University: membranes, biotechnology, food engineering, fuels and energy, modelling, nanomaterials, and renewable and sustainable engineering

Please visit the conference website for more information, including sponsorship opportunities, on the conference, speakers, topics and organisers. Registration is open and abstracts can be submitted via the website:

<https://www.monashcepa.org/conference>

We look forward to welcoming you to our 2019 conference in Melbourne.

KEY DATES

Call for abstracts opens

13 February 2019

Sponsorship & Exhibition opportunities opens

22 February 2019

Registration opens

17 June 2019

Call for abstracts closes

23 August 2019

Authors Notified

13 September 2019

Registration closes

20 September 2019

Conference

31 October 2019

Networking Dinner

31 October 2019

CONFERENCE EVENTS

**Post-Conference Alumni and Industry
Networking Event**
October 31, 6pm - 8pm
Level 4 New Horizons Building,
Monash University Clayton Campus

The CEPA conference committee invites students, staff, alumni and industry partners to share canapé and a few drinks while trying out our new beer brews made by our very own MonashBrewLab Team and exchange stories of how engineering contributes to industry in our communities and organisations around the world.

Conference awards will be presented during the evening.

REGISTER AT <https://www.monashcepa.org/registration>



BECOME A CEPA CONFERENCE SPONSOR AND GET INVOLVED

The annual CEPA conference is an unmissable opportunity to connect with Australia's future research leaders!

The conference - an important professional development event for research scholars - brings together postgraduate students and their mentors to exchange and share their experience and research on all aspects of Chemical Engineering. Presentations and other events provide a unique opportunity to network. If your organisation is invested in engineering and development, then the Chemical Engineering Postgraduate Association (CEPA) would be delighted to welcome you to the 9th Annual CEPA conference.

WHY SPONSOR THE CONFERENCE:

- Meet and recruit amazing and innovative talent
- Attend and engage with students and academics
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- Brand product promotions and feedback

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DEPARTMENT ALUMNUS HONoured IN QUEENS' BIRTHDAY LIST



Dr Mark Toner AM - Member (AM) in the General Division of the Order of Australia

Dr Toner obtained his PhD from the Department of Chemical Engineering, Monash University 1975/6. He has been recognised in the annual Queen's Birthday honours list for significant service to engineering and the technological sciences.

Mark's CV spans a range of roles in engineering and IT, and he is an Engineers Australia Fellow. More recently, though, he has turned his focus to closing the profession's gender gap and now works to help engineering organisations increase gender diversity in their workplaces. We congratulate him on the wonderful contributions he has made to our society.

View the full list of Queen's Birthday Honours 2019 here. <https://www.gg.gov.au/queens-birthday-2019-honours-list>

INTERNSHIP ABROAD AT UNIVERSITÉ DE SHERBROOKE (UDES)

PALS researcher, Debjani Ghosh had a four-month internship at the Laboratory of Bio-mass Technologies (LTB), in UdeS Canada as part of her PhD project. LTB was founded and directed by Prof Jean-Michel Lavoie, and it provided technological solutions for the recovery and utilisation of residual carbon process to many industrial partners (lumber, fuel, pulp and paper industries).

During her internship, Debjani worked on the development and optimisation of the processing parameters for isolation of hemicellulose as oligomeric sugars from different biomass. She undertook a wide range of task and activities including: learning and adopting the lignocellulose characterisation techniques. She also had an opportunity to visit a start-up company "Resolve Energy Inc", which aimed to transform lignocellulosic residue (bark, tree canopy, sawdust, woodchips) into second generation ethanol and pallets.

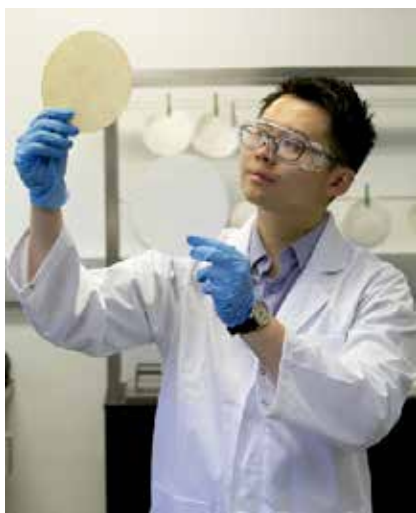
Debjani mentioned, "the internship was a worthwhile experience. It helped me to gain professional knowledge and make contacts with people who are leading in this field. Working here, I have improved my skills and awareness related to biofuels, bio-mass pre-treatment and valorisation. Having an access to the state-of-art analytical facility at LTB was definitely an advantage. A very big special thanks to my supervisors at LTB (Prof Jean-Michel Lavoie) and Monash University (Prof Gil Garnier and Prof Tony Patti) for this opportunity, and also new colleagues at UdeS who made my time so enjoyable at Canada."



Prof Gil Garnier, Prof Jean-Michel Lavoie and Debjani Ghosh

First published in the BioPRIA Newsletter, June 2019

RESEARCH ON NANOCELLULOSE: SUSTAINABLE PACKAGING MATERIALS OF THE FUTURE



BioPRIA PhD student, Shaun Ang

The global consumer packaging industry is valued at approximately \$500 billion USD according to recent estimates. So great is the drive in this modern day and time for renewable, sustainable and recyclable packaging materials with excellent strength and barrier properties, as in the case of nanocellulose.

My PhD project here at BioPRIA focuses on engineering these nanocellulose materials with remarkable performance which can rival that of fossil-fuel based plastics. I work closely with my industry partner, Australian Paper who provide guidance and support throughout this project. Australian Paper is Australia's only manufacturer of lightweight packaging and office printing papers. Our goal is to one day spur the widespread manufacture and adaptation of these nanocellulose based materials on an industrial scale for recyclable packaging applications.

A great emphasis is placed on the concept of sustainability and sustainable production throughout this PhD project. My work focuses on the production of nanocellulose from inexpensive, everyday commodity wood fibres as opposed to more specialty, low-volume and unsustainable feed-stocks. The production process of nanocellulose is often known to be very energy intensive which makes it unattractive from an industrial production standpoint. In my work, I have very recently published a paper on this topic addressing the issue of energy consumption for high strength applications. This paper highlights a way to produce very high strength

nanocellulose sheets at lower energy. I have also investigated the production of nanocellulose from recycled wood fibres as a potential alternative to virgin wood fibres. I'm currently evaluating the recyclability of these high strength nanocellulose sheets with the goal of encouraging the use of these extraordinary recyclable materials over unrecyclable packaging plastics. Recently, I have also uncovered a way to produce high barrier nanocellulose films to serve as excellent packaging materials for food and coating applications.

This PhD has provided me an amazing platform to develop both strong technical skills and build life-long relationships with the people around me. I feel so blessed and humbled to be able to pursue this PhD and play a part in solving one of the most pressing issues of our time. It is my hope and dream that the production and application of these nanocellulose materials will one day be economically feasible, socially beneficial and most importantly, environmentally sustainable.

Further Reading:

Ang, S., Haritos, V. and Batchelor, W., 2019. Effect of refining and homogenization on nanocellulose fiber development, sheet strength and energy consumption. *Cellulose*, 26(8), pp.4767-4786. <https://doi.org/10.1007/s10570-019-02400-5>

First published in the BioPRIA Newsletter, June 2019

FIRST RUNNER UP AT THE CLEAR WATER CLEAN ENERGY CONFERENCE



Department student Shalini Kandasamy has won the first runner up prize for the presentation of her paper *Energy efficient synthesis of methanol from biodiesel waste glycerol: Introducing a new sustainable research process.*

Shalini received the award due to the high quality of the work in the manuscript and her superior presentation at the conference.

The award acknowledges the many excellent papers given by students and gives the winners some well-deserved recognition.



ERASMUS+ STAFF MOBILITY PROGRAM WITH JUSTUS-LIEBIG UNIVERSITY IN GIESSEN, GERMANY

Academic Programs Manager Lilyanne Price has long envied the academic staff and HDR students of the Department of Chemical Engineering when they have told her over the years about their planned overseas business travels to international destinations. However, during 2019 the Monash Global Engagement office announce the Professional development category of Erasmus Staff Mobility Program with Justus Liebig University in Giessen in Germany. Upon reviewing the Erasmus+ program, she knew that it was her time to apply for an overseas study program. It was a perfect fit for her!

This program offered the opportunity to attend the JLU International Networking Week with a second week of job shadowing within JLU. The Justus Liebig University Giessen invites its partner institutions from International offices, Faculties and Departments from around the world to JLU's annual International Networking Week. This year's program was organised and hosted by JLU's International Office and is embedded in the Erasmus+ Staff Exchange Programme. The Networking meetings allowed participants to exchange ideas about fostering student and staff mobility, to present their home universities, structures and working practices, and to explore and discuss topics of interest within the field of internationalisation. This year's main focus was on the internationalisation of administrative staff with individual meetings with colleagues of JLU's departments or other university facilities.

On the 14th March 2019, Lilyanne received an email from the Office of Deputy Vice-Chancellor and Vice-President (Global Engagement) at Monash University informing her that her application to attend the JLU program had been successful. Little did she realise at the time of being awarded this opportunity that JLU had received 70+ applications from applications all over the world and they had only accepted 26 people to attend the networking week.

Lilyanne said the "International Networking Week attendees came from a host of Universities from all over the world such as Belarus, China, Colombia, Czech Republic, France, Georgia, Namibia, Netherlands, Serbia, South Africa, Spain, Sri Lanka, Uganda and the Ukraine and of course Australia".

The Networking week opened with an address by the President of JLU Prof. Dr. Joybrato Mukherjee who was particularly welcoming to the Networking group. After this address the attendees had a group session learning about JLU and its Internationalisation Strategy.

Tuesday events included one of two German language courses during the program. The day's activities also included Internationalisation of administrative staff: German perspective – strategy and implementation; funding possibilities Partners' perspective and group work discussions. The day was finished off with a site visit to the main JLU University library.

Lilyanne said a particular fun activity for her was the International lunch on Wednesday. "Before we left our home country we received the final program from Julia-Sophie and Annika. In that email we were each asked to bring small food item which is typical of your country. Julia-Sophie and Annika said "this way, we can have lunch with food from almost all around the world." On the day of the International lunch we were each asked by Julia-Sophie to describe the food we had brought. Lilyanne said "there was a large array of food to try but her particular favourite was the green bananas and cracked peanut sauce made and brought by our Ugandan friend on the program." Lilyanne said she was surprised to learn that, in the green state, the banana has a similar texture to sweet potato or pumpkin and are not sweet at all. With the added crushed peanut sauce to the cooked green bananas, the dish was absolutely lovely.

On the Thursday the group was treated to an all-day trip to Hessenpark and Frankfurt which including the bus ride and a delicious lunch buffet. "When we arrived at Frankfurt we were free to dispersed into separate smaller groups to look at the city sights like museums and walked around the

city. A small group of us decided to take a river cruise on the Main River which was the perfect way to end the day.” Lilyanne said.

Friday was dedicated to the closing session, presentation of results of the groups work from the Wednesday session and the Networking week evaluation. Then the group was presented with their attendance certificates and lastly the Farewell Lunch which was another wonderful bonding experience for the group. Everyone said this week’s experiences, the friendships that were made and the things learnt during the weeklong program will remain close to our hearts for ever. The whole group attending the International Networking Week were so welcoming and friendly and everyone agreed at the end of the first week that they had a lot of fun during the JLU Networking program.

Week two was the second part of the Staff Mobility Program with Justus Liebig University. Lilyanne was hosted by the Center for Materials Research (LaMa), Justus Liebig University Giessen under the wonderful supervision of Dr. Thomas Leichtweiß and Dr. Martin Guengerich. The week started with a session at the LaMa-Office following by a meeting with the Prof. Dr. Jürgen Janek Dean of the Faculty of Biology and Chemistry who is also the Scientific Director of the Centre for Materials Research. During the afternoon Lilyanne was taken on a tour of the Labs at Science Campus. During her second week Lilyanne also had meetings with Dr. Eric Gutz who is the Quality Manager of the Department of Physics and then on Wednesday she visited with Ms Regina Gaitsch (Study program coordinator of the Faculty of Biology and Chemistry), attended and gave a short presentation to the Executive Board meeting of LaMa and was invited to attend the “Meet, Eat and Find out “ which is an information event for new postdocs at JLU Giessen.

During her exchange program with LaMa, Lilyanne learnt that there was an opportunity for Monash University PhD students to apply for a JLU Research Fellowship for Postdoctoral Researcher in Energy Materials from Monash University which has been sent to all HDR students studying in Science and Engineering of the relevant research areas being sort by JLU.

Lilyanne said that she highly recommends Professional staff at Monash University to consider applying for next year’s Erasmus+ Staff Mobility Program with Justus-Liebig University. The EU Erasmus+ worldwide staff training programme funds training periods of international university staff (especially administrative and technical staff) at JLU Giessen. The Professional staff program supports the professional development of non-teaching staff in the form of training events abroad (excluding conferences) and job shadowing/observation period.

Lilyanne said “a big thank you goes out to Julia-Sophie Rothmann and Annika Weiser for their organisation of such a wonderful program. Every detail was meticulously planned. I cannot thank them enough for everything that they did for all of the people attending the Erasmus+ Staff Mobility Program with Justus Liebig University.”

Dr. Thomas Leichtweiß is particularly interested in PhD students from the Department of Chemical Engineering and Materials Engineering taking advantage of Monash’s exiting Exchange Programs between Monash and JLU. Dr Leichtweiß suggested academic or HDR student at Monash should consider reviewing the areas of research of LaMa’s core research areas here to open up discussion

of a collaborative research project and/or a joint visit. Dr. Thomas Leichtweiß himself plans to visit Monash University in the near future. As Monash’s PhD Student Exchange Programs are built upon the collaborations, complementary capabilities and strategic objectives of partnering institutions, students will benefit from shared supervision from across the universities and scholar visit(s) to the collaborating university.

Other programs available to undergraduate, postgraduate, professional staff and Academic staff via the Monash University mobility program with Justus-Liebig University are as follows:

- Justus Liebig University of Giessen - Study Abroad (undergraduate students)
- Erasmus+ Staff Mobility (Academic and Professional Staff)
Outgoings (JLU → Monash) and incomings (Monash → JLU) to support visits for staff (teaching and training (admin and technical))
- Joint PhD Programs Monash-Justus Liebig University, Giessen, Germany (JLU) focusing principally on research into men’s reproductive health.
- Erasmus Student Mobility - Monash University (Postgraduate / Master)
Subject: Biology, chemistry, agronomy, environmental management, nutritional sciences, ecotrophology
Number of exchange places: 1 (during 2019/20)
Duration total: (2019/20)

Monash Contacts:

RACHEL TAYLOR

International Education Coordinator, Europe and Monash South Africa

Monash Abroad

Office of the Deputy Vice-Chancellor (Global Engagement)
Monash University

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At Justus-Liebig University (JLU): Student mobility

Anne Landsiedel, Julia-Sophie Rothmann
mobility@admin.uni-giessen.de

Staff mobility

Annika Weiser, Julia-Sophie Rothmann
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JLU Incoming Students information and Application WEBSITE



JLU Research Fellowship for Postdoctoral Researcher in Energy Materials from Monash University



Center for Materials Research (LaMa) Justus Liebig University Gießen

The Center for Materials research is a core-facility of JLU and supported by the departments of chemistry and physics. It serves for running joint research projects, for the coordination of study programs in materials science and for promoting the qualification of doctoral candidates. It also offers central experimental resources to its member research groups.

If you are a researcher with an interest in energy materials and/or battery materials, at the beginning of your academic career and only **completed your doctorate in the last four years from Monash University**, a Research Fellowship at the Center for Materials Research (LaMa) allows you to carry out long-term research in Germany within one of the Research groups at LaMa.

Application and selection procedure - Expressions of Interest (Eoi)

Interested individuals are required to submit an EOI application in the first instance addressed to:

Dr. Thomas Leichtweiß
Center for Materials Research (LaMa) - Justus Liebig University Gießen
Thomas.Lleichtweiss@lama.uni-giessen.de

The desired Research area of the successful Research Fellow would have a research background in energy materials, and/or battery materials, however other areas of research which complement the LaMa's core research areas of JLU will also be considered. Please view full list of the LaMa's research topics [here](#).

EOIs shall comprise of:

- Eoi cover letter that includes a brief statement of the applicant's suitability
- A curriculum vitae, including a list of published works
- A full statement of academic record, supported by scanned copies of relevant certified documentation
- Contact details of two academic referees
-

Other selection criteria

1. **Doctorate** or comparable academic degree (Ph.D. or equivalent) from Monash University, completed less than four years prior to the date of application. Candidates who have nearly completed their doctoral degrees are eligible to apply provided that they submit the manuscript of their dissertation or publications containing the results of their dissertation.
2. **Academic publications** reviewed according to international standards and printed in journals and/or by publishing houses.
3. **Language skills:** a good knowledge of English and/or German.

Support during Research Fellowship stay

One of our hallmarks is the degree of support we offer to our guest researchers. This is why we offer you extra benefits in addition to the monthly research fellowship from invitations to JLU events, conference travel assistance during your stay at JLU, travel to and from Germany to take up the Research Fellowship, health insurance and social insurance coverage for the period of the Fellowship. JLU also has a dedicated University team devoted to Postdoc career and mentoring: [Postdoc Career and Mentoring Office \(PCMO\)](#)

Duration of Research Fellowship: 2 years

Application closing date: Applications shall remain open until the position has been filled.

www.uni-giessen.de/lama



MONASH-GEORGIA TECH PV WORKSHOP

The 1st Monash-Georgia Tech Photovoltaic Workshop took place in Atlanta, Georgia on June 13 & 14, 2019. This was a workshop for novices and experts covering current research in photovoltaics. Invited guests included researchers from CSIRO, Monash University, and Georgia Tech. This was a highly successful event with 24 poster presentations and 10 plenary talks. A follow-up workshop is scheduled to be held at Monash University on Dec. 11 & 12, 2019.

This workshop brought together researchers working on organic, silicon, and perovskite solar cells for poster presentations, plenary talks, and round-table discussions. Guest speakers included: Udo Bach, Elsa Reichmanis, Seth Marder, Mei Gao, Jean-Luc Bredas, Juanita Hidalgo from Juan-Pablo Correa-Baena's Group, Alexandr Simonov, Noel Duffy, and Wenchao Huang from Chris McNeill's Group.

The objectives of the workshops are to:

- Initiate collaboration and communication between national and international academic institutions, federal and provincial agencies, non-governmental organizations and private sector participants working with closely related photovoltaic technologies.
- Discuss ways to develop capabilities in renewable energy by optimization of resources through the sharing of equipment and research facilities, databases and personnel.

This event was co-sponsored by Monash University's International Network of Excellence in Photovoltaics and Georgia Tech's Center for Organic Photonics and Electronics.

The Georgia Tech Center for the Science and Technology of Advanced Materials and Interfaces (STAMI) and its constituent Center for Organic Electronics (COPE) have a long and distinguished track record in working on organic and hybrid haloplumbate/organic materials and devices for solar energy conversions. Georgia Tech has supported this work through STAMI and COPE, but several faculty including, but not limited to, Jean-Luc Bredas, David Collard, Samuel Graham, Bernard Kippelen, Zhiquan Lin, Seth Marder, Elsa Reichmanis, and John Reynolds, have received funding from various US agencies including the Air Force Office of Scientific Research (AFOSR), the Office of Naval Research (ONR), the Department of Energy (DOE) and the National Science Foundation (NSF) for their work in this area. Of particular note are the center-level efforts funded by DOE and ONR. This work has led to a number of high profile and highly cited papers in journals such as Science, Nature Materials, Nature Energy and JACS that have received literally thousands of citations.

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) is home to the Flexible Electronics Laboratory (FEL), a facility dedicated to the development and commercialisation of next generation photovoltaic technologies. Comprising of approximately 40 staff and affiliates, over the past decade the FEL has worked with consortia, such as the Victorian Organic Solar Cell Consortium (VICOSC) and multi-party Australian Renewable Energy Agency (ARENA) projects, to translate the research from academic partners to large scale prototypes. The FEL specialises on solution processable deposition techniques to dramatically reduce the cost and increase the rate of solar cell fabrication.





RESEARCH

WOODSIDE AND MONASH JOIN FORCES IN INNOVATION AND RESEARCH PARTNERSHIP

Woodside Energy and Monash University have joined forces to develop a state-of-the-art 'living laboratory' and long-term research partnership to support Australia's low-carbon energy transition.

Woodside will contribute \$16.5 million to the construction of the Woodside Building for Technology and Design, located in the Monash Technology Precinct. The Precinct houses Australia's largest concentration of research institutions and leading engineering companies.

The building is due for completion in early 2020. It will be one of the world's most efficient and innovative teaching facilities, and through the partnership, Monash and Woodside will explore the possibilities of hydrogen and carbon abatement, with a focus on materials, electro-chemical and thermal chemical research.

Woodside and Monash will also jointly invest more than \$40 million into the ongoing research partnership over the next seven years.

The Woodside Building for Technology and Design and Woodside Monash Energy Partnership will build on the foundation FutureLab collaboration, established by Woodside at Monash in 2015.

Monash University President and Vice-Chancellor Professor Margaret Gardner AO said the new building and the growth of the Woodside-Monash Energy Partnership would greatly improve Australia's capacity to find new solutions in sustainable energy technology, and that it would quickly build a reputation as a leading centre for innovation.

"With generous support from Woodside, we are excited to see the next iteration of FutureLab take shape. This will be a place where industry interacts with students, researchers

and academics to produce job-ready graduates and provide solutions to some of the biggest challenges in our future. In partnership, we are committed to leading the world with our research and study programs to achieve sustainable, positive change," Professor Gardner said.

Woodside CEO Peter Coleman said the new research partnership would deepen a proven relationship.

"Woodside and Monash share a commitment to developing innovative responses to real-world challenges and we recognise that finding a sustainable path to a lower-carbon economy is one of the biggest we face. This challenge can only be solved by companies like Woodside, which is applying disruptive data-driven technologies to our operations, working with the best and brightest minds at universities such as Monash.

"Our goal through the Woodside Monash Energy Partnership is ambitious but is grounded in reality. It is not simply about shifting to a low-carbon future, but about ensuring that future is achievable and sustainable for industry and for a resource-rich nation like Australia by maintaining a strong economy and the employment that goes with it. We think natural gas, renewables and ultimately hydrogen are all part of the answer to this challenge and we look forward to working with Monash on multiple prongs of the energy transition," he said.

Woodside's investment meets a key aim under Monash's Change it. For Good. philanthropy campaign to accelerate the scale and success of the university's international research to tackle the world's biggest challenges.

This article first published 4 July 2019. <https://www.monash.edu/engineering/about-us/news-events/latest-news/articles/2019/woodside-and-monash-join-forces-in-innovation-and-research-partnership>

Above image: A/Professor Matthew Hill with Woodside chief scientist Neil Kavanagh.

**Society of Monash University
Chemical Engineers**

MONASH OPEN DAY

**IF YOU ARE INTERESTED IN KNOWING MORE ABOUT
CHEMICAL ENGINEERING, COME AND FIND THE SMUCE
STALL AT OPEN DAY!**

**AUG 4TH (SUNDAY)
9:30AM TO 3:30PM**



INTERNSHIP AT ARUP RESEARCH



Postgraduate student Pamrod Sripada took advantage of a great opportunity to complete a part time internship with Arup research over the summer.

Arup is an independent firm of designers, consultants, engineers, architects, planners and technical specialists that work in all aspects of the modern-day built environment. Arup Research, a part of the Arup Foresight, Research and Innovation team, is involved in funding and supporting research projects aimed at working on challenging problems expected over the next decade.

Recently, Arup Research developed a value assessment framework that aims to capture the overall value from research projects encompassing both tangible and intangible value to the company.

Pamrod's internship looked to test this framework for the projects that were funded in 2016-17. This involved interviewing 40+ project managers who delivered the research projects catering to four different markets, namely, cities, transport, water and energy to get information on all of the nine metrics (both direct and indirect impacts) in the framework.

The data compiles the net value the research portfolio achieved in the given financial year. Further, through additional analysis, insights linking the type of the project to the nature of the value help optimise the funding strategies and developing the research portfolio to suit the business vision and needs. The outcomes of the project involve a series of value analysis through data analytics and visualization for presentation to the regional board and staff members across the region. Further, additional recommendations have been provided for improving the framework to capture value attained through social media outreach

"The internship helped me understand the skills are that typically sought after in a technical consulting firm, in particular the soft skills, Pamrod said.

"The extensive interactions within the firm helped me to develop extensive professional networks with the various project managers and relationships with my mentors which will be useful for professional advice and career guidance."

Coming from a pure research environment, Pamrod said that his greatest challenge was understanding the business needs and developing analytical solutions for effective high-level communication tools.

"The internship was an exciting opportunity for me as my previous experiences have mainly been in a university setup. The exposure to an industry environment helped me understand the importance of gaining soft skills particularly work place communication and administration, and the dynamics of team work", Pamrod said

BREAKTHROUGH IN DEVELOPING GRAPHENE-COATING FOR DURABLE CORROSION RESISTANCE OF MILD STEEL

Corrosion of engineering alloys and its mitigation measures continue to cost dearly (~4% of GDP of any developed economy which translates to an annual loss of ~\$250b to USA). Traditional approaches, such as use of corrosion resistance alloys and coatings have brought about significant mitigation of the age-old problem of corrosion.

Corrosion resistant alloys such as stainless steels perform on the principle of their inherent ability to develop a corrosion resistant surface film of oxide of chromium. However, chloride ions (i.e., abundantly present in sea-water) can disrupt this protective oxide film not only in lesser alloys, but even in the case of the alloys with the highest resistance when the corrosive environment is very aggressive.

Hence, the traditional mitigation strategies have not always succeeded in providing durable mitigations. However, a durable corrosion resistance is still a non-trivial challenge in some critical applications, such as where highly corrosive solutions are handled (e.g., concentrated chloride solutions in desalination plants or highly acidic solutions in Proton Exchange Membrane Fuel Cell), or where corrosion resistance is required for very long durations (e.g., nuclear waste containers) or where corrosion can cause serious health problems (such as by degradation of human implants). It is true that circumventing corrosion in such critical applications is technologically challenging, socially fulfilling as well as commercially attractive, but it is equally true that a durable solution calls for a disruptive approach, which in itself is a non-trivial challenge (given the age-old nature of the discipline). On the other hand, given huge economic losses caused by corrosion, the emergence of a new materials often triggers an interest in its applicability for corrosion resistance. Most recent examples include ultrathin coatings of graphene.

Graphene, the thinnest of engineering materials (i.e., just an atomic layer thick) has triggered unprecedented research interest in recent years because of its unique and technologically appealing properties. Graphene also possesses a few unique properties that are specifically required for an effective ultra-thin barrier layer for resistance to aggressive environment. Raman's group demonstrated for the first time that a monolayer or a few atomic layer thick graphene coatings on metals has been shown to improve corrosion resistance of copper by up to two orders of magnitude^[1]. There were considerable variability in the literature on the degree of improvement. However, the recent studies of Raman's group have systematically identified the reasons for such variability, and have addressed them by optimizing the parameters for developing graphene coatings by the chemical vapour deposition (CVD) technique. The graphene coatings developed on nickel surface with the optimized CVD provided durable corrosion resistance^[2].

The success in developing CVD graphene for corrosion resistance of metals have generally been limited to copper^[1], nickel^[2] or their alloys, whereas the most extensively used engineering metallic materials are mild steels. It is a non-trivial challenge to develop CVD graphene on mild steel. Raman's group (through a PhD project of A Sanjid, co-supervised by Dr Parama Banerjee) has recently succeeded in devising a suitable surface modification of mild steel that enabled CVD graphene deposition. They also have also demonstrated that the CVD graphene coating thus developed on mild steel provided remarkable and durable corrosion resistance to mild steel in aggressive chloride solution (similar to seawater), as shown in the figures below. This work was patented in April 2019 [3], and was also selected for one of the TechConnect awards in Boston in June 2019.

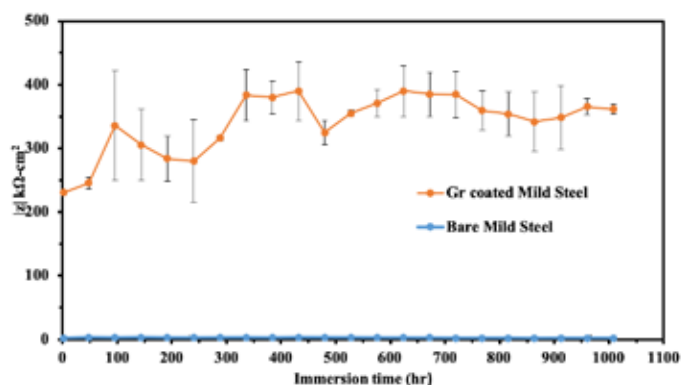


Fig. 1: Impedance ($|Z|$) vs immersion time plots showing the CVD graphene developed on mild steel to provided durable corrosion resistance during exposure to 0.1 N NaCl for >1000 h. Note: the magnitude of $|Z|$ on the y-axis) is a measure of corrosion resistance.

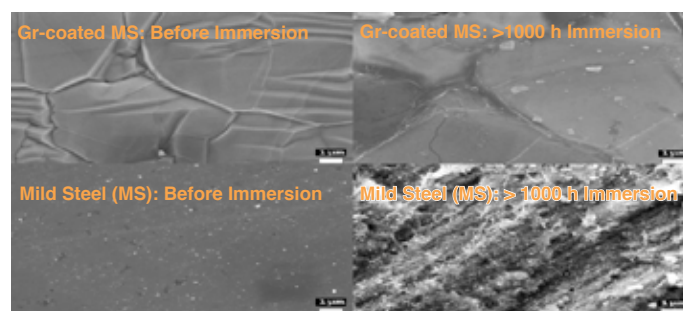
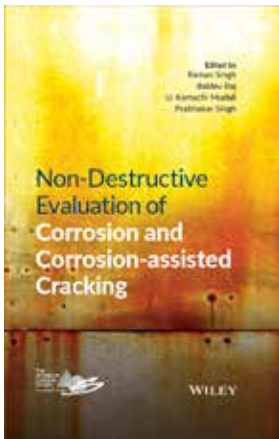


Fig. 2 Unlike uncoated mild steel (that suffered pitting and corrosion), the graphene coated mild steel suffered little (invisible) pitting and corrosion during exposure to 0.1 N NaCl for >1000 h.

References:

1. R. K. Singh Raman, P. Chakraborty Banerjee, D. E. Lobo, H. Gullapalli, M. Sumandasa, A. Kumar, L. Choudhary, R. Tkacz, P. M. Ajayan and M. Majumder, *Carbon* 50, 4040-4045 (2012).
2. M.R. Anisur, P. Chakraborty Banerjee, Christopher D. Easton, R.K. Singh Raman, *Controlling Hydrogen Environment and Cooling during CVD Graphene Growth on Nickel for Improved Corrosion Resistance*, *Carbon*, 127 (2018) 131-140.
3. R.K. Singh Raman, A. Sanjid, Parama C Banerjee, Patent, 2019.

NEW BOOK PUBLISHED WITH A FOCUS ON CORROSION



Congratulations to Professor Raman Singh on the publication of his new book, *Non-destructive Evaluation of Corrosion and Assisted Cracking*, which has just been published by Wiley and American Ceramic Society.

Surprisingly, this seems to be the first book on Non-destructive Evaluation (NDE) of Corrosion and he feels privileged to be the lead editor of the book.

NDE is commonly employed to detect corrosion, a problem that comes at great expense to national economies; it is estimated that a country can lose up to 4% of its GDP due to corrosion - the annual loss is estimated to be ~\$300billion in USA and ~\$8billion in Australia).

This unique book was conceived when Dr. Baldev Raj - a world renowned expertise in NDE - visited Australia several years ago.

Dr Raj was responsible for establishing world's one of the best NDE facilities and expertise at Indian Atomic Energy. Professor Singh had worked at this research centre in the initial part of his career. Dr. Kamachi Mudali (Indian Atomic Energy) and Professor Prabhakar Singh (U Connecticut) later joined the editorial team.

Dr Raj had a great appreciation for the need of such a book, and very actively contributed to various chapters, in spite of his extremely busy professional life.

Sadly, Dr. Baldev Raj passed away in January 2018. He is honoured with an obituary page in the book.

The foreword has been written by world renowned corrosion/electrochemistry expert, Professor Macdonald (UC Berkeley).

Link: <https://www.wiley.com/en-us/Non+Destructive+Evaluation+of+Corrosion+and+Corrosion+assisted+Cracking-p-9781118350058>.

STAFF

THE DEPARTMENT WELCOMES ASSOCIATE PROFESSOR NICOLETA MAYNARD



In October we will welcome Associate Professor Nicoleta Maynard, who will soon join us and will work with academic staff across the Faculties of Engineering, Business and Education to establish communities of practice aimed to further develop our teaching program and create a strong education research team. She will continue to further develop her national and international collaborations in engineering education research while also contributing to the teaching in the department and faculty.

Nicoleta Maynard has an undergraduate degree in Chemical Engineering, a PhD in Particle Technology from The University of Queensland and a Postgraduate Degree in Education from Curtin University. She has 5 years of industrial experience, working as a design engineer.

At Curtin University, she has been a valuable academic staff member in the Chemical Engineering Department and the Faculty's Director of Engineering Education Development. In her role, Nicoleta worked with the engineering staff to enhance industry engagement in the engineering curriculum, scholarship of teaching and learning, and research in the development of Engineering Professional Skills, Communities of Practice and STEM Education. Associate Professor Nicoleta Maynard's work and contributions in educational leadership and teaching innovation have been recognised by a number of national and international awards.

She is the recipient of the 2016 Caltex Award for Excellence in Teaching, a 2013 Australian Government's Office for Learning and Teaching Citation for Outstanding Contributions to Student Learning and a 2009 Australasian Association for Engineering Education Awards and Engineers Australia Citation Award. Nicoleta's work and research has been recognised nationally and internationally with peer review publications, presentations and invitations for participation in technical panels. She is also the Conceive Design Implement and Operate (CDIO) Chair for Australia and New Zealand.



DISCOVER MORE TO CHANGE MORE

OPEN DAY

ACTIVITY TITLE	TIME	LOCATION	CATEGORY	DESCRIPTION
Chemical Engineering	10:40AM-11:10AM	21 College Walk, lecture theatre E2	Information session	Hear about our Chemical Engineering
Chemical Engineering	1:20PM-1:50PM	21 College Walk, lecture theatre E2	Information session	Hear about our Chemical Engineering
Pharmaceutical Science and Engineering	2:45PM - 3:15PM	Lecture Theatre E3, 21 College Walk	Information session	Hear about our Pharmaceutical
Chemical Engineering Course Information	All Day	G33 14 Alliance Lane	Course information	Chat to academic staff and students
Reactor Demonstration	All Day	G09 19 Alliance Lane	Tour	On the chemical engineering to the food and waste processing industry
Chemical Engineering Lab Tour	All Day	G09 19 Alliance Lane	Tour	See the Undergraduate labs, led by a student of Chemical Engineering
Biomedical sensors and electronic tattoos	1pm-4pm	G33 14 Alliance Lane	Interactive display	Want to find out how to get an electronic tattoo?
Water filtration	10am-1pm	G33 14 Alliance Lane	Interactive display	Find out how you can drink much cleaner water
Solar Power	10am-1pm	G33 14 Alliance Lane	Interactive display	Find out how we can use chemical engineering to harness solar power
Food that doesn't taste like it looks	1pm-4pm	G33 14 Alliance Lane	Interactive display	Learn about the process of food production
Lava Lamp in a cup	All Day	G33 14 Alliance Lane	Interactive display	Explore molecular polarity and intermolecular forces
Paper technology to find out your blood type	10am-1pm	G33 14 Alliance Lane	Interactive display	Can you find out your blood type using paper technology?
Solid to Liquid demonstration	All Day	G33 14 Alliance Lane	Interactive display	Can a solid become a liquid with a little heat?
The Society of Monash University Chemical Engineer (SMUCE)	All Day	Monash Maker Space 23 College Walk	Leadership	The Society for Monash University Chemical Engineers is a community between the classroom and the workplace
Monash BrewLab	All Day	Monash Maker Space 23 College Walk	Leadership	We are a student-led team of engineers who design, build, and operate a nano-scale brewery. We are a passionate community around the world of brewing. We might not make the best beer, but we make the best of it.

MONASH CLAYTON OPEN DAY

SUNDAY 4 AUGUST 2019

Sunday 4 August 2019 marks Monash University's Open Day. Do you have a child who will be attending? If so, we encourage you to visit our Alumni Lounge. Open from 10am to 4pm at the Monash Club, Clayton Campus, the lounge is a great place for you and your family to take a break, and enjoy complimentary tea, coffee and light bites. Our Open Day eplanner will help you organise your day.

LEARN MORE ABOUT OPEN DAY AND CREATE YOUR PLAN
<https://www.monash.edu/open-day#/campus/clayton>

neering course and career opportunities.

neering course and career opportunities.

Science and Engineering double degree and career opportunities.

dents about Chemical Engineering.

ur see an operating reactor, and learn about reactors used in the petrochemical, biomass, coal
for power, chemicals and fuel production.

earn how membrane films are formed and ask questions about what is involved when you are a
ng.

electronic tattoo?

d and not get sick.

ical engineering to get us off the grid.

d extrusion and how to make food that doesn't taste like how it looks.

liquid density

be with a piece of paper?

hout heating?

sity Chemical Engineers (SMUCE) is a student run society that aims to bridge the gap be-
world outside university. Drop by for some food. <http://www.monashclubs.org/Clubs/SMUCE>

nthusiastic brewers at Monash University, providing an opportunity for students to learn, de-
brewery on campus. Our focus lies on giving the students a hands-on experience and building
d beer.
er (yet), but we love doing it!



POSITION OF POWER: AUSTRALIA'S PATH TO A SUSTAINABLE ENERGY FUTURE

A new feature on Monash Lens takes a closer look at how we will achieve a sustainable energy future, and the wonderful and diverse array of research undertaken at Monash to achieve this. Professor Sankar Bhattacharya from the Department contributed to this important feature.

Despite the absence of clear climate or energy policy over the past 10 years, the Australian energy market has experienced a series of transformational disruptions that have fundamentally changed its nature.

The centralised 'base load' coal-dominated business model of the past 50 years is defunct, and an incredible opportunity now lies ahead to reimagine how we generate, purchase, store and share clean energy within an affordable system powered by businesses, communities and individuals.

A decade ago, the sector was relatively stable. Large coal and hydro generators, mostly built and paid for by government many years earlier, dominated the market, with gas generators burning cheap gas supporting the summer peak periods. Wind and solar power were just emerging in Australia and considered a relatively expensive novelty.

But the state of play was about to change.

The first disruption came in the form of slowing demand driven by a global economy reeling from the global financial crisis (GFC), global manufacturing migration, and advances in energy efficiency technology.

By 2014, demand had bottomed out and the wholesale market was operating close to the marginal cost of generation. For large ageing power plants with looming refurbishment requirements, this period of operation tested their long-term viability, and consequently, in 2015, we saw the closure of the first major coal station, in South Australia.

This tipping point irreversibly changed the South Australian

market, and with strong state government leadership (now bipartisan), the state was set on a course to become a global leader in renewable energy transformation.

The next disruption came shortly after, with the start of natural gas export from the eastern seaboard heralding a rapid rise in energy prices. With exporters buying up gas to meet international contracts, prices for large gas users – including Monash University – tripled. Electricity prices quickly followed as the cost to run gas generators to meet peak demands shot up in an increasingly undersupplied market. The effects of this are still being felt today.

During this time, wind and solar power were penetrating the market at scale, helped by falling technology costs and state government support.

The combination of new variable generation coupled with a large uptake in air-conditioning resulted in a significant change to the shape of our energy demand – a more dynamic profile with higher peaks and lower troughs.

Unlike fuel-based generators, the cost of renewables is primarily driven by the financing costs of building the plant, as operating costs are very low (near zero). This means that once established, it still makes financial sense for a renewable facility to continue generating energy even if the wholesale market is very low.

Also, for generators eligible to generate renewable energy certificates, it can be worth generating even if the wholesale market goes negative (for example, in situations where generators pay to put power into the grid), as they can sell the certificate on the secondary market and still make a net profit.

For coal generators already struggling and unable to easily ramp up and down generation, this change further undermined their viability. Consequently, Hazelwood Power Station closed, and a 'pro-free market' federal government scramble ensued in an attempt to prop up the very industry with the greatest contribution to climate change.

Despite their best efforts, the writing was on the wall, and a series of closures is confirmed for the coming years, with all of the major generators and lending institutions in agreement that a business case for coal generation no longer exists.

So, after a series of disruptions, we find ourselves in a market where: Large coal power stations are exiting the market (predominantly those built and paid for by government before being privatised) high internationally driven gas prices are pushing up the top of the market, and new low-cost capacity in wind and solar power is pushing down the base of the market, creating dynamic wholesale prices contingent on weather conditions.

Rather than federal government providing a steady hand through clear and consistent energy policy, we've seen the disruption exacerbated by investment uncertainty created by partisan-factional politics.

As a result, we're experiencing periods of abundant, cheap wholesale electricity mixed with periods of extremely expensive power, destabilising the traditional retail business model and increasing prices for consumers.

In South Australia, where renewable energy generation is rapidly approaching 75 per cent of the state's energy mix, new market opportunities are emerging for large companies with dynamic load, generation assets and storage capacity.

By using and storing power when it's cheap, and generating down when prices are high, these companies are effectively neutralising their multimillion-dollar energy bills through active market participation.

Across the country, we're seeing large energy users insulating themselves against a dynamic market by proactively building or using their purchasing power to underwrite solar and wind farms to take advantage of predictable low-cost energy.

With the market irreversibly changed, we now have the opportunity to imagine something new.

Contrasting with the traditional model of centralised one-way flow of power from generator to user, with generation following relatively smooth and predictable consumer demand, we're moving towards a decentralised model where the grid and market is made up of interconnected energy precincts dynamically generating, storing and using energy.

A market-driven collective of self-managed energy hubs is emerging to solve local requirements and trade between precincts to create a national network where generation and demand follow each other.

A series of closures is confirmed for the coming years, with all of the major generators and lending institutions in agreement that a business case for coal generation no longer exists.

These precincts would likely include community organisations comprising residences with roof-top solar, domestic energy storage batteries, smart devices and community-funded wind or solar farms, working together as a virtual power plant to support the local and broader network while providing power and market opportunity for residence and investors.

Such precincts would be balanced at a state or national level by complementary precincts such as renewable generation hubs made up of wind and solar generation,

balanced by large-scale storage or embedded microgrids such as Monash, with a private network of high-energy buildings, solar generation and storage.

Each precinct would optimise for local stability and energy requirements while collectively solving national balance through an interconnected dynamic market of diverse participants.

Moving from a vertically integrated oligopoly to a distributed system thriving off the bespoke efficiencies and opportunities of individual communities, organisations and businesses can collectively create a resilient, competitive and sustainable national energy market.

Originally published on <https://lens.monash.edu/@a-different-lens/2019/06/14/1375453/australias-sustainable-energy-future>



Watch 'The business of energy'

About Professor Sankar Bhattacharya



Professor Bhattacharya came to academia in 2009 after having worked for twenty-one years in industry

In his current position, he has supervised 17 students to PhD completion and currently leads a group of 16 PhD students and researchers working on gasification of coal and biomass, petroleum coke and wastes, advanced combustion for CO₂ capture at lower energy penalty, biofuels production and platform chemicals from biomass.

Professor Bhattacharya believes in the near to intermediate term application of engineering research. Most of his research projects are, therefore, affiliated with industries in Australia and overseas. Professor Bhattacharya has presented extensively at academic and industry conferences in Australia, China, Germany, India, Poland, Thailand, and the USA.

Recent press interest in his work relating to Australia's energy policy includes features on the ABC and the local newspaper the *Latrobe Valley Express*.

- <https://www.abc.net.au/news/science/2019-04-01/coal-fired-power-emissions-mercury/10958128>
- <http://www.latrobevalleyexpress.com.au/story/5994105/mercury-emissions-reported/>

DAVID HAWKINS

CREATING CHEMISTRY FOR A SUSTAINABLE FUTURE



The way David Hawkins (BSc 1989, BE (Chem)(Hons) 1991) sees it, “The more senior you get, the bigger the impact you can have on people.” Now Chairman and Managing Director of BASF Australia and New Zealand, he plays a lead role in realising the company’s vision of environmental protection and social responsibility.

“We operate 13 production sites with over 500 people working across a range of industries, including agriculture, manufacturing, automotive refinishing, mining and construction,” explains David. “Our purpose is to create chemistry for a sustainable future. This is a responsibility we take very seriously – and a space where BASF is a key driver of innovation and change.”

In his 15 years with BASF, David has performed various functions. “This gave me important exposure to broad-based challenges,” he remarks. “I had the opportunity to explore different contexts which taught me a lot and, in hindsight, helped prepare me for my current role. For me, the broader the better – you have to empower your people as experts in their areas and, as a leader, guide them through challenges along the way.”

David adds, “All of the experiences – good and bad – and knowledge you collect over your career really help when you get into a senior role. Having studied Chemical Engineering, and now having spent time in the

business of chemistry, means that I often need less background when discussing technical subjects with my team.”

Good preparation notwithstanding, taking on a senior role presents significant hurdles. “You start moving away from being valued for what you know to being valued for who you are as a leader,” shares David. “This requires a lot of vulnerability and self-acceptance. You need to rethink how you see yourself and what you bring to an organisation.”

At BASF, David also advocates for a diverse and empowered workforce. “I want to develop the growth mindset of our people and support a culture that makes BASF a great place to work,” he says. In that spirit, he has become involved with *Male Champions for Change*, a group dedicated to improving gender equity in Australian workplaces. David recognises that a workforce that’s gender diverse is more engaged and more successful than one that’s not.

“Research shows that, to make change, key leaders in organisations need to be the driver of gender equity and, by the very nature of the issue, it is mostly males in this position,” David asserts. “*Male Champions for Change* come together to discuss barriers and challenges, and encourage consistent action by identifying and implementing common initiatives that can increase diversity across all levels. We don’t just say ‘I believe in this’ – we go in there and say ‘hold me accountable’ and live what we say.”

David serves on the board of Chemistry Australia, the body representing Australia’s chemistry industry. “Companies working collectively is important for our social license – that is, the acceptance of standard business practices and operating procedures by employees, stakeholders and the general public,” he maintains. “Two of our major focusses right now are plastic waste reduction and the impact of gas pricing on business profitability.”

Additionally, David sits on the Dean’s Advisory Council of the Faculty of Engineering. “I joined the Council because I was really impressed with Monash’s work in the Innovation Precinct, as well as with the 50/50 gender balance of University staff,” he states. “I had a great time at university and do not think I’d be where I am today without Monash. I’m excited to continue that connection with the students coming through by putting myself in their shoes.”

What does David say to young engineers? “Don’t get too caught up in measuring yourself by your marks, or comparing yourself to others. Make the most of your time at Monash through the many opportunities on offer,” he advises. “When it comes to success, it’s just as important to bring your whole self to a job and not just rely on intellectual ability. The people who are most successful have worked just as hard to grow themselves personally as they have intellectually.”

EMBRACING TWO CONTRASTING CAREERS: A WONDERFUL BALANCING ACT



Call it good luck, but Alexandra Gummer (BE(Chemical) (Hons) 2016, BSc 2016) has worked hard to juggle two successful careers: one as a chemical engineer/biochemist and the other as an elite athlete. Let's unpack the amazing life of this superwoman...

As a graduate in CSL Behring's quality stream, Alexandra has spent the past two years ensuring the safe release of healthcare products to market. In this role, she has had the opportunity to rotate through different departments, helping to meet the needs of patients and fulfil pharmaceutical regulatory requirements.

"Currently, I'm in Quality Assurance Release, where I complete deviation investigations – when a product or process falls short of a standard, I identify the root cause and

suggest a corrective and preventive action so that the issue won't recur," explains Alexandra. "I've also had a rotation in Process and Cleaning Validation, which involved confirming that manufacturing and cleaning processes are capable of consistently delivering quality products."

All the while, Alexandra has also been playing professional soccer with the Melbourne Victory Football Club. The team competes in the W-League, Australia's top-division women's soccer league. Previously, Alexandra played for Adelaide United, as well as Doncaster Rovers Belles Ladies in the Women's Super League 1, the highest tier of women's football in England. She credits Monash with having strongly supported her athletic pursuits, by making scheduling allowances for her laboratory sessions and exams.

"I'm now incredibly fortunate to also have a supportive employer and a flexible work arrangement!" says Alexandra. "I try to be as efficient as possible during business hours to ensure that I complete all my work, but sometimes I need to miss a training session or work later at night. There are some sacrifices, but I know how blessed I am to have two careers that I'm extremely passionate about."

Being crazy about sport is one thing, but what attracted Alexandra to chemical engineering? "I always loved processes and working out ways to innovatively complete tasks and activities – smarter and faster – so chemical engineering was a no brainer for me!" she shares. While completing her double degree, Alexandra squeezed in an exchange in Chemical Engineering at the University of Leeds.

"When I was just about to come back from my exchange, CSL opened up its graduate applications in Australia. I knew it was a great company where I could have a future," she relays. "After the initial screening, online testing, video interview, assessment centre and final interview, I was so happy and relieved to get a position there! And I'd love to have a stint with them in Germany or Switzerland."

Alexandra has also found time for volunteer work. While at uni, she mentored children in science classes in low socioeconomic areas. She also served as Vice President of the Society of Monash University Chemical Engineers. And, last year, she joined CSIRO's STEM Professionals in Schools to help bring science, technology, engineering and maths into Australian classrooms.

So what does Alexandra say to engineers just starting out? "Just keep your head down and work hard," she advises. "Grab opportunities with both hands, and never say no to something that offers you a learning experience."

FOCUS ON STAFF

ANTHONY DE GIROLAMO



Current Role: Senior Technical Officer

Brief overview of role: The Senior Technical Officer provides a variety of professional and high-quality technical services to support the operations of the Department of Chemical Engineering. This includes applying theoretical and technical knowledge to manage the delivery of a range of technical services to support undergraduate, postgraduate and research program outcomes. I also oversee (and undertake) staff and student training on a number of instruments/equipment, maintain such equipment, as well as data analysis, planning and scheduling while ensuring a compliant and safe operating environment. The Senior Technical Officer works closely with postgraduate students, staff (academic and research), to understand the research/service requirements and operates with excellence in process and judgement to provide sound and timely advice and technical services support.

Worst job and why? I haven't really had a job that I didn't like

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

I am currently transitioning the Department of Chemical Engineering to iLab for equipment management. This includes creating the content that will be on

our iLab core, attending weekly training sessions on how to administrator the core for the Department and meeting with equipment owners/users.

What is your favourite place in the world and why? Queensland, because it's much warmer than Melbourne.

Name the person you'd most like to sit next to on a long-haul flight and why? Elon Musk. I'm sure he would have a lot of interesting ideas to share.

Tell us something about yourself that your colleagues wouldn't know? Last weekend I completed the Tough Mudder obstacle course. I had to submit an old photo to this profile because someone kicked me in the face during the event. I hope some of my colleagues can join me next year.

FOCUS ON STAFF

KIM PHU



Current Role: Laboratory Manager/Safety Officer

Brief overview of role: The Laboratory Manager/Safety Officer is responsible for the management, training, operations and maintenance of undergraduate teaching laboratories which includes overseeing purchasing, storage allocation and compliant disposal of chemicals.

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

Currently, I am reviewing all paper-based forms within the department for labs and implementing an online Google forms to replace the paper-based documentation.

What is your favourite place in the world and why?

Australia; it's nice and peaceful and there is plenty of food – I have a fabulous working environment and enjoy coming to work.

Name the person you'd most like to sit next to on a long-haul flight and why?

My husband because I always get travel sickness and I always lean on him

Tell us something about yourself that your colleagues wouldn't know?

I love dancing – Latin kind of dancing.

DEPARTMENT ADMIN UPDATE



What a year! I've recently reached my first milestone and had my one year anniversary within the Department. The year has flown by and I can't really believe how it happened so quickly. On reflection of this year, I can honestly say that I have totally enjoyed every minute (even the not so issues) of my job and especially working with you all. I would also like to acknowledge the hard work and dedication of the professional teams (including our HUB/Centre colleagues) within the Department because this year would have not been so enjoyable without their support and hard work. Thumbs up to the professional team!

On 1st July, we physically welcomed our new academic staff members Timothy Scott and Sushil Dhital. They are both slowly settling into their new offices and working their way around the numerous Monash systems and processes. Please pop your head into their offices and welcome them to the Department. We will be having a Welcome Reception (Afternoon Tea) for Laura-Lee (who commenced in May), Tim and Sushil on 13th August at 2.30pm in the Common Room. Everyone is very welcome to join.

The Department was very pleased and excited to hear that Lilyanne Price's application to participate in the 2019 Erasmus+ Staff Exchange Program was successful. Lilyanne had an amazing opportunity to represent the Department of Chemical Engineering/Faculty of Engineering and travelled to Justus-Liebig University. She participated in a one week program during the International Networking Week program from 17 - 21 June at the University. During the following week, she also had the opportunity for individual meetings with colleagues of Justus-Liebig University departments or other university facilities in the area.

Just a reminder that the International Staff Mobility Grants for 2019 are still available for both the Research and Teaching and Learning streams. If you have any questions, please feel free to contact the Acting Director of Teaching Akshat Tanksale akshat.tanksale@monash.edu or Joesph Ho ho.yongkuen@monash.edu. For the International Research Mobility Grants, please feel free to contact the Director of Research, Wenlong Cheng wenlong.cheng@monash.edu. Recently, I received one of the grants and will be travelling to Sunway campus in the first week of October to meet and network with key staff within the School of Engineering.

Open Day will be upon us before we know and we have been facilitating some changes with what will be showcasing in the Department on the day. A huge thank you to Matthew Hill and Trina Olcorn who have been leading this change and their dedication to make the day such a success for all the potential student and families looking at studying Chemical Engineering at Monash University.

The CEPA conference will be held on 31st October and this year we are looking at offering sponsorship packages. If you are (or know of any) industry partners that would interest in this opportunity to become a sponsor, please contact the CEPA committee via eng.cepa@monash.edu who will assist you with further information on the sponsorship packages on offer.

Tracey Groves

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