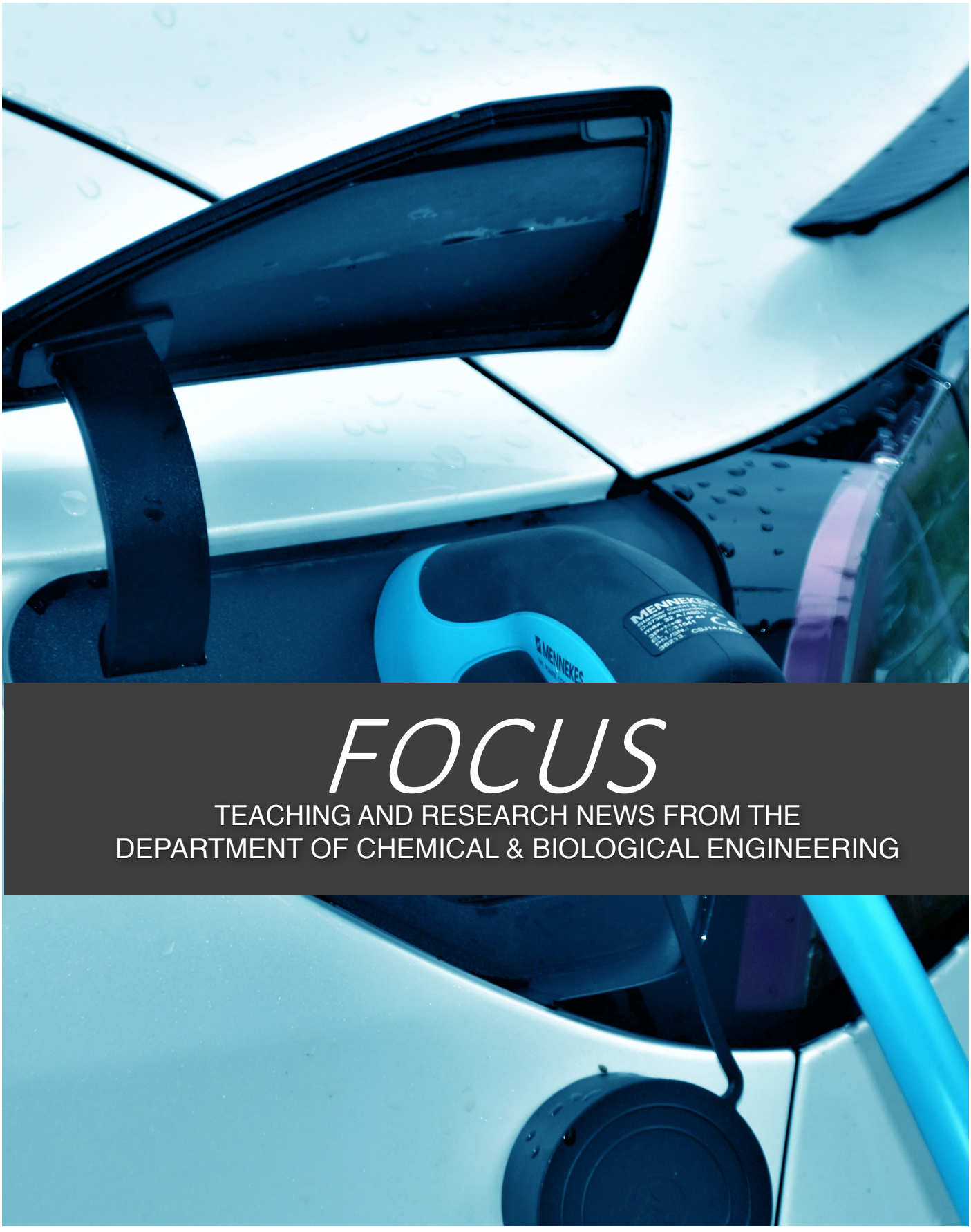
MONASH University

MONASH
CHEMICAL &
BIOLOGICAL
ENGINEERING

September 2022



FOCUS

TEACHING AND RESEARCH NEWS FROM THE
DEPARTMENT OF CHEMICAL & BIOLOGICAL ENGINEERING

CONTENT HIGHLIGHTS

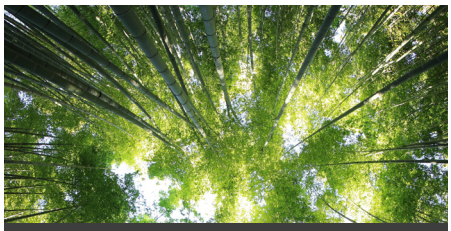
MEPPS Alumni Evening 4

Monash Carbon Capture and Conversion 6

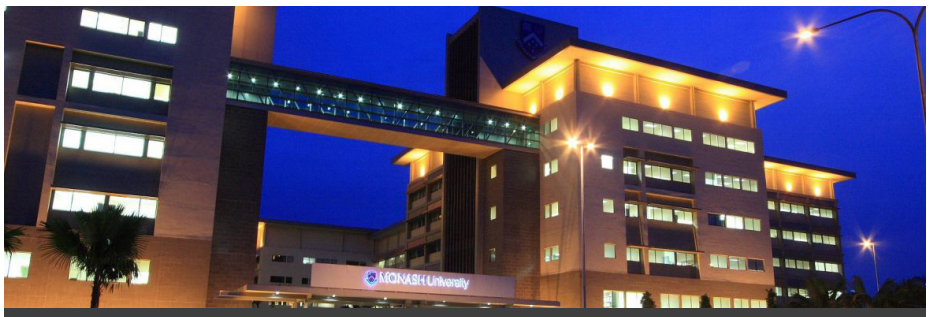
Introducing the Student Pilot Process Team 8

BrewLab Update 12

Lithium Battery Breakthrough 14



BioPRIA Update 16



Monash Malaysia Highlights 20

Edward Attenborough addresses the NZ PM 23

FROM THE HEAD OF DEPARTMENT

As the department completes its 60th year, we can look back on our accomplishments with pride and look forward to the future with optimism. Back then, the department started with mineral processing, fluidization and fuels research, and training of chemical engineers. As the profession evolved, the department diversified into a number of areas of industry relevance – functional nanomaterials, membrane technology, food technology, modelling of particle flow, rheology and soft matter, solar and photovoltaics development, industrial biotechnology, bioprocessing and platform chemicals, flow chemistry, lithium-sulfur batteries and supercapacitors, and waste processing to name a few – by recruiting appropriate staff. We use this diverse expertise to train chemical and biological engineers who take up employment in a range of industries here and overseas. Despite being a small department in terms of the number of academics across campuses, our academics are internationally recognised for their expertise. We are very research intensive – as aptly demonstrated by our number of publications, patents, start-up companies and industry-funded research projects, including five ARC Industry Transformation Research Hubs led by the Department in the last ten years.

To all our undergraduate students, I encourage you to question everything that you are taught. It is through questioning and the discussions in and outside the classroom with academics and your fellow students that enhance understanding and the uptake of knowledge, preparing you for employment following graduation. We are proud of our final-year students who won the Pratt prize last year for the best design project among all chemical engineering departments in Victoria; the team now goes into the national competition. We are also very pleased with the success of our students-led Monash Carbon Capture and Conversion club at multiple international competitions.

Another team, Monash Future Fuels, has progressed to the finals of the CHEMECA Future Fuels Hackathon. The department is a significant sponsor of this year's CHEMECA conference, including its student team at the hackathon.

To all our postgraduate students, over 150 across four campuses - we provide one of the best multicultural research environments among Australian universities, with students coming from all continents of the world. Therefore, make every effort to enrich your cultural experience during your stay at Monash. This is an important experience for your career in a rapidly globalising world.

Also, the nature of the research work that you do is very diverse, reflecting the wide experience of our academics and research staff and the support that we receive from a wide range of industries. Therefore, I encourage you to attend as many milestone presentations as possible; these take place every week. Listen carefully and ask questions. Your questions will broaden your knowledge beyond your own area of research work. This experience will help you as most of you will work outside of academia after receiving your PhD. As with the undergraduate students, I am always available if you have any issues to discuss.

Our academics are collaborating more than ever before with colleagues on three campuses in Clayton, Malaysia and Suzhou through co-teaching, cross-campus research nodes and co-supervision of PhD students. The co-supervision of PhD students also extends to our IITB-Monash Academy where we currently have 14 collaborative projects with 27 others completed in the last ten years. The extent of this multi-campus collaboration will continue to increase in the future years

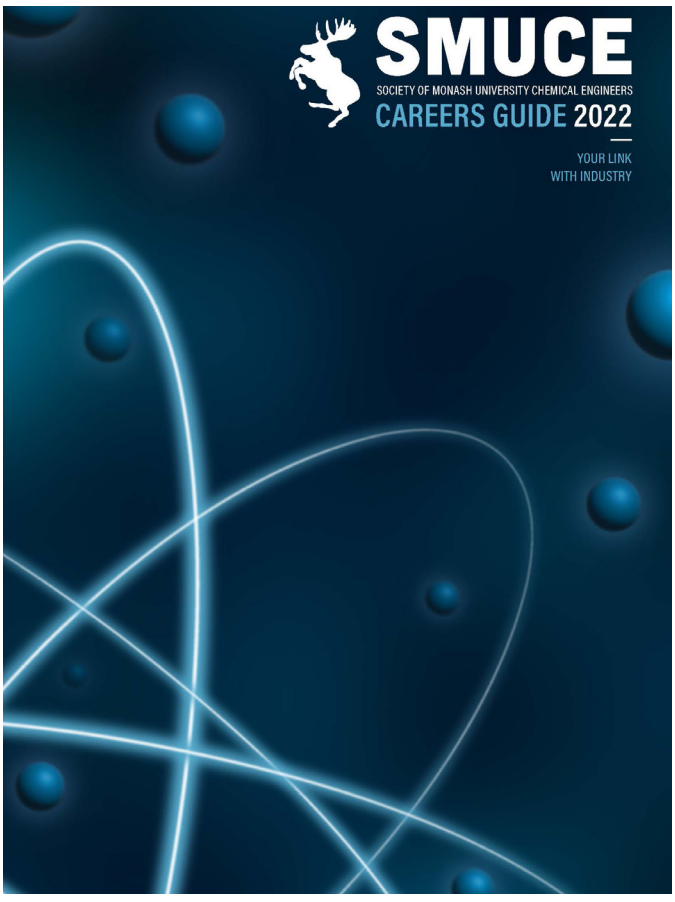
Finally, I thank all our project sponsors and in particular our Alumni for their support of our current students. The Class of 72 has been sponsoring two entrepreneurship awards this year apart from providing philanthropic support.

Sankar Bhattacharya
Professor and Interim Head
Department of Chemical and Biological Engineering

SOCIETY OF MONASH UNIVERSITY CHEMICAL ENGINEERS

Linking students with industry

The Society of Monash University Chemical Engineers is a student club dedicated to Chemical Engineering undergraduate students. Our goal is to act as the bridge between chemical engineering undergraduates, academics and the industry. As a part of our work, we organise events, both social and industry based, including the SMUCE Cocktail Night and the SMUCE Industry Seminar. Our industry arm also aims to bring industrial expertise and advice right to the students through inserts in the annual SMUCE Careers Guide and seminars. Our academic arm focuses on giving feedback to academics through our SSLM sessions and organising GroupUp sessions for revision on current Chemical Engineering units at Monash University.



SMUCE career guide out now

We are pleased to announce the SMUCE Careers Guide 2022 is available to download!

With over 30 company and researcher profiles, we hope to provide you a complete insight into chemical engineering.

Download the career guide at www.smuce.org/career

facebook.com/SocietyOfMonashUniversityChemicalEngineers/

smuce@monashclubs.org

Monash Engineering and Pharmaceutical Science Society annual Alumni Night

The Monash Engineering and Pharmaceutical Science Society held their annual Alumni Night in August, in person for the first time since 2019, where attendees could share in some great food and discussions.

Although the Virtual Alumni Nights of 2020 and 2021 were great successes, being able to move around and talk to new faces was a welcome change. Alumni could hear of the achievements of those that have graduated, which was a great opportunity for students still looking for inspiration of what they can do after university. We had alumni that have only just graduated as well as some who were already several years into their professional careers.

We are grateful to all the alumni who made the effort to share the night with us. A huge thank you goes to our Parkville committee for doing an enormous amount of organising to get this night running again.

About MEPSS

MEPSS
MONASH ENGINEERING & PHARMACEUTICAL SCIENCE SOCIETY

MEPSS is a society primarily for students of the Chemical Engineering / Pharmaceutical Science double degree. Our role is to provide academic, industry and social support to students at both the Clayton and Parkville campuses to enable students to thrive in their studies. We do this through regular pizza mentoring lunches, social events, industry and alumni engagement nights and other academic initiatives, with the aim of fostering professional relationships between students, alumni, Faculty and industry.

facebook.com/groups/monashEPSS/

mepss.monaash

@MEPSS1

mepss@monashclubs.org

Monash Carbon Capture and Conversions Continuing Success

MC_3 aims to successfully develop innovative, sustainable, scalable and economically viable solutions to capture and store carbon to improve the outlook for the future of the planet.

Since being founded in 2021, Monash Carbon Capture and Conversion (MC_3) have established themselves as an international, interdisciplinary team of Monash students passionate about bettering the wellbeing of the planet and establishing long lasting change.

Since the last edition of the FOCUS newsletter was released, MC_3 has have been hard at work with a focus on the XPRIZE competition and expanding their team.

In October of 2021, three proposals were submitted by MC_3 for the Student Awards component of the XPRIZE carbon removal challenge, in the areas of microalgae, artificial forestry and direct air capture. As a result, in November, MC_3 became one of eighteen teams to be globally recognised for their carbon dioxide removal technologies receiving a student prize of $250,000USD to go towards their continuing work.

In February of this year, MC_3 entered the Phase 1 Milestone stage in which the team submitted two proposals involving a cost and sustainability model for the solutions. Both the Biotech and Direct Air Capture-PolySynth (DAC-PS) proposals were within the 287 'qualified competitors' from the original 1133 submissions, making the top 25% of Phase 1 submissions.

June has seen the successful submission of the biotechnology six month milestone progress report resulting in the full prize money being made available, allowing the scale up the microalgae species to 30L (a scale up of 120 times what they started with) and perform a continuous Biochar run.

Currently, the team are busy culturing, growing, and testing our algae, as well as setting up further facilities across Monash University to scale up the microalgae. They hope to achieve this through rooftop rigs and a microalgae nursery. Further, the team has successfully

produced biochar at an O:C ratio that demonstrates carbon stability, whereby the carbon can be sequestered for 100 or more years. The DAC-PS team have been preparing the mass-energy balance for the chosen concept in the air draft process with further parameters modelling and CAD. The PolySynth team is ready to test the bench scale prototype of the CO_2 reduction flow cell aiming to synthesise ethylene for polyethylene fabrication.

As well as the hard work put towards the XPRIZE Carbon removal challenge, the team has also seen remarkable growth in team numbers, spirit and culture. During 2021 a physical presence at the Monash University Clayton campus has been established, as well as in-person full team meetings with over sixty members. On site lab work, an excursion to CO2CRC and social events such as the celebration of MC3s first birthday have all helped to establish a sense of community within the team.

MC_3 not only provides amazing opportunities for students looking for technical experience, but also in the corporate experience (operations, communications and partnership areas), where students are working to increase team support and reputation among the community public, partners, sponsors and fellow Monash students. MC_3 is now taking rolling applications. If you are a Monash student interested in improving your technical or business skills and are passionate about the environment, then consider joining MC_3s team of passionate and like-minded Monash students focusing on developing climate change solutions.

Membership forms are available here:
https://forms.gle/NGTvJERX6yoxyA2B7.

Chief Executive Officer Emily Qiao reflected on her experience

Growing up, throughout primary and high school, I have learnt that the release of carbon is one of the factors that facilitate climate change, a key cause of global warming, and harmful to our future. Therefore, when the opportunity arose to contribute to developing carbon capture technology, spreading awareness, and making an impact, I joined this team with confidence.

One of my main highlights over the past year has been watching the growth and development of Monash Carbon Capture and Conversion. From our humble beginnings as 8 team members, with little knowledge of the scope of the industry that comprises CCUS, to winning the Student Awards for the $100 Million XPRIZE for Carbon Removal, I was almost in disbelief that our dream became a reality. And now, we've scaled into an international multidisciplinary student team, spanning across both the Australian and Malaysian campuses of Monash University, of 57 team members who all hold the same passion to contribute toward the sustainable development of Earth.

Continuing the growth we've experienced this past year, Monash Carbon Capture and Conversion aims to strengthen and grow our Student Experience, Operational Excellence, and Technical innovation. This brand new year, I will pass on the Chief Executive Officer role to Angie Watts, a sixth year Mechanical Engineering and Industrial Design student, and look forward to what the future holds for us. While it's been a steep learning curve over the past year, I'm sure Angie will build upon the work we've begun and encourage the community to think differently about how talented students can be the future leaders of tomorrow.

Monash Carbon Capture and Conversion was founded to analyse and produce lasting technical solutions to facilitate carbon capture and conversion to reduce the expected catastrophic outcomes of climate change in the future. Our solutions aim to achieve this for at least 100 years.

MONASH CARBON CAPTURE CONVERSION

Introducing the Monash Student Pilot Process Team

The Monash Student Pilot Process Team (MSPPT) was formed in early 2022 to work on a range of projects related to the Monash Student Pilot Plant. Nine undergraduate and postgraduate students from a range of disciplines, skill sets and backgrounds were chosen via a competitive selection process to represent the diversity of the Monash Engineering student body.

MSPPT aims to advance research and education at Monash using the Student Pilot Plant. To help us achieve this vision, we have been working hard to build our understanding of the Monash Student Pilot Plant and have been involved in commissioning the pilot plant equipment, developing operating procedures, and ensuring that the proper safety protocols, logs and documentation are in place. Other initial activities include setting up our student office and the pilot plant control room, and establishing remote operation of the pilot plant to improve access to the pilot plant for offshore students and those at the Monash Malaysia and Monash Suzhou campuses.

MSPPT are working on our education goals by developing practical, hands-on activities for several undergraduate units, including CHE2163 – Heat and Mass Transfer and CHE3162 – Process Control. Related projects that the student team will work on include dynamic process modelling and developing digitalisation technologies for the pilot plant such as an augmented reality experience for training and pilot plant interaction, and a dashboard and digital twin for data visualisation and online real-time process optimisation. Our future focus includes establishing industry funding and partnerships and working on industry research projects, as well as collaborating on student projects and with other student teams.

We have also been busy building our visibility at Monash. We have an active presence on social media and our booth was very popular at the recent Monash Open Day 2022 (August 7). Please get in touch via the links to find out more!

MSPPT at Open Day

Meet the Monash Student Pilot Process Team:

- Romalya Ranasinghe – PhD student, Chemical and Biological Engineering
- Gloria Diaz Arenas – PhD student, Chemical and Biological Engineering
- William Bucknall – 4th year undergrad, Chemical and Biological Engineering and Pharmaceutical Science
- Abishek Kumar Arya – PhD student, Mechanical Engineering
- Joshua Dillon – 3rd year undergrad, Materials Engineering and Biomedical Science
- Kavindya Liyanage – 2nd year undergrad, Chemical and Biological Engineering
- Lokukankanange Isuru Abhaya Peiris, 4th year undergrad, Electrical and Computer Systems Engineering
- Imaya Kehelkaduwa – 4th year undergrad, Chemical and Biological Engineering
- Kavindi Jayasekara – 3rd year undergrad, Chemical and Biological Engineering

facebook.com/MSPPTwastewater

instagram.com/mspptwastewater

linkedin.com/company/86350484

c-msppt@monash.edu

monash.edu/engineering/student-pi-lot-plant

MSPPT with Director, Joanne Tanner, next to the commissioned pilot plant

The Monash Student Pilot Plant - Ready for learning and open for business!

Above: Unboxing the pilot plant skids in the Undergrad Labs at Monash, Clayton

Top left: The Monash Student Pilot Plant at Monash, Clayton for resource recovery and water and wastewater treatment using industrial membrane technology

Top right: Orientation session for CHE1010 - Grand Challenges in Chemical Engineering, where students learn about water and wastewater treatment

The Monash Student Pilot Plant provides engineering students at Monash with an opportunity to get authentic, hands-on, industry-relevant experience. The design is a membrane-based product recovery and water treatment process at semi-industrial scale, demonstrating ultrafiltration and reverse osmosis technology. Students at all levels of the undergraduate and postgraduate curricula will use the pilot plant to explore engineering concepts and tackle real world problems.

The pilot plant skids were delivered in late March, and construction was completed in April. We've been working hard with the inaugural Monash Student Pilot Process Team (MSPPT) over the past few months, and commissioning and validation of the pilot plant are now complete. We are also working on further enhancing the student experience with a dedicated industrial-style control room, as well as augmented reality and digital twin technologies, which will be linked via real-time data to the physical plant. These features ensure that our students will graduate with industry-relevant experience.

This semester, we are excited to be running hands-on pilot plant activities for the first time. We have already

run several orientation-type activities for students in the first year unit CHE1010 - Grand Challenges in Chemical Engineering unit, as well as the Masters unit CHE5889 - Food Engineering and Processing. We are also developing activities for several second and third year units across multiple disciplines, including Civil and Electrical Engineering, to be rolled out in 2023.

As well as coursework activities, students will have the chance to interact with the pilot plant by taking on industry-sponsored projects, including final year and summer research projects. We are working closely with a number of industry partners in wastewater, pulp and paper, membrane technology, and bio-engineering fields on ideas for student-led projects using the pilot plant. We will offer these opportunities as interdisciplinary projects, where students from several engineering disciplines work together and pool their complementary knowledge to develop products and solutions for industry.

Joanne Tanner, Director, Monash Student Pilot Plant

Scan here to visit us at www.monash.edu/engineering/student-pilot-plant and find out more about the pilot plant, including past and current projects, collaborators, and all the latest updates!

Chemeca Future Fuels CRC Student Hackathon 2022

For all chemical engineering students thinking about joining in the Chemeca Future Fuels CRC Student Hackathon 2022, we are holding a virtual information evening on Wednesday 29 June 2022, 18:00 AEST, 16:00 AWST/MYT, 20:00 NZST.

Everyone is welcome to come along and hear more about the competition, what it involves and what prizes are up for grabs!

We also have two panel sessions with industry experts from Hydrolytics, Australian Gas Infrastructure Group, Viva Energy, Jemena, government departments and more.

Get involved with your chance to pitch your ideas to solve a real-world problem to industry leaders.

STUDENT NEWS

Monash BrewLab

Monash BrewLab has had a busy start to the semester, ramping up our brewing schedule, organising events, and welcoming some new members.

We were greatly humbled to have Andre Krogh and Jamie Fox, who were both executives of Carlton United Brewery, vitis the BrewLab. Andre Krogh is now working at Hort Innovation Australia and Jamie Fox is co-running his own brewery 'Brewmanity' with David Nietz, a former Melbourne Football club Captain! The night involved a tour of our brewing facilities, which left the CUB alumni in awe and helped facilitate future collaboration and opportunities.

On Sunday 7th August, we had the opportunity to talk to some of Monash's potential future students at the Monash Open Day. We were able to showcase some of our equipment and chat about our team in Monash Makerspace, amongst the other amazing Engineering Teams. Our BrewTeam demonstrated the process for making kombucha, a fermented tea beverage with sweet and fruity flavour, whilst answering questions about BrewLab and Monash Engineering.

In week 5 we welcomed six new members to the team, joining our Social Media, Research and Development, Microbiology and Events sub-teams. These new members will be bringing new skills, experiences and ideas to our team, and we're very excited to see what they can contribute to our growing community.

What's been brewing?

This semester we have already completed four different brews, a pilsner, a citronium pale ale, a lemon myrtle blonde ale and just recently, a NEIPA. The microbiology team has been undertaking a yeast analysis procedure involving the investigation of multiple variables including the inclusion of yeast nutrient, pitching rates and the investigation of the effects of top cropping vs bottom harvesting of yeast strains. In collaboration with the analytical team, these experiments can be analysed for the detection of phenol and ester compounds, and conclusions can be drawn about the quality and efficiency of our production methods.

facebook.com/MonashBrewLab

linkedin.com/company/monash-brewlab/

brewlab@monash.edu

Faster, cleaner, longer: Lithium battery breakthrough to improve lifetime performance

Just imagine for a moment that you could buy an electric vehicle that only needed to be charged once a week. Now imagine that this battery was also clean to produce and made right here in Australia.

Monash University researchers have taken a giant leap towards claiming this holy grail of renewable energy by creating a new lithium-sulfur battery; redesigning the heart of the battery to promote exceptionally fast lithium transfer and improved lifetime performance.

“It’s world-leading,” says Professor Matthew Hill, Deputy Head of the Department of Chemical and Biological Engineering at Monash University.

“A lot of our research has been about making the battery more stable and lasting longer, so this particular discovery is really exciting.”

As the world charges towards cleaner and greener energy, swapping dirty fossil fuels for emissions-free electrification, lithium batteries are playing an increasingly vital role as storage tools to facilitate energy transition.

They’re the go-to choice to power everything from household devices such as mobile phones, laptops and electric vehicles to major industries such as aviation and marine technology, but until now, long-duration storage has been somewhat elusive.

The new frontier of renewable energy

In addition to their environmental benefits, they offer higher energy density and reduced costs compared to the previous generation of lithium-ion batteries, and they can store two to five times as much energy by weight.

Previously, the electrodes in lithium-sulfur batteries deteriorated rapidly and the batteries broke down, but the new interlayer developed by Professor Hill, Dr Mahdokht Shaibani, Professor Mainak Majumder and PhD candidate Ehsan GhasemiEstahbanati from the Faculty of Engineering solves that problem, delivering high capacity and long-life.

“The interlayer stops polysulfides, a chemical that forms inside this type of battery, from moving across the battery; polysulfides interfere with the anode and shorten the battery life,” Professor Hill says.

“It means the battery can be charged and discharged hundreds of times without failing.”

While the world has embraced the development of lithium batteries as a game-changer on the path to reducing global emissions, there is a dark side to the clean, green image.

Lithium-ion batteries rely on metals such as cobalt, nickel and manganese, which have finite reserves and are often mined in countries known for poor mining practices and reliance on child labour. The horrific price of green energy has been well-documented.

Currently, about 60% of the world's cobalt supply comes from the Democratic Republic of Congo, where large numbers of mines are unregulated, and the use of child labour is common.

In some cases, children as young as seven have been used to mine unstable tunnels, breathing in cobalt-laden dust.

By contrast, the mineral sulfur is in abundant supply in Australia and almost considered a waste or by-product, and Australian mining practices are among the world's best.

"We needed to find a better way," says Professor Hill, "and these batteries are not dependent on minerals that are going to lack supply as the electrification revolution proceeds.

"A good supply of minerals combined with reducing the footprint from mining to manufacturing means this battery is far more environmentally sound and ultimately cheaper to produce."

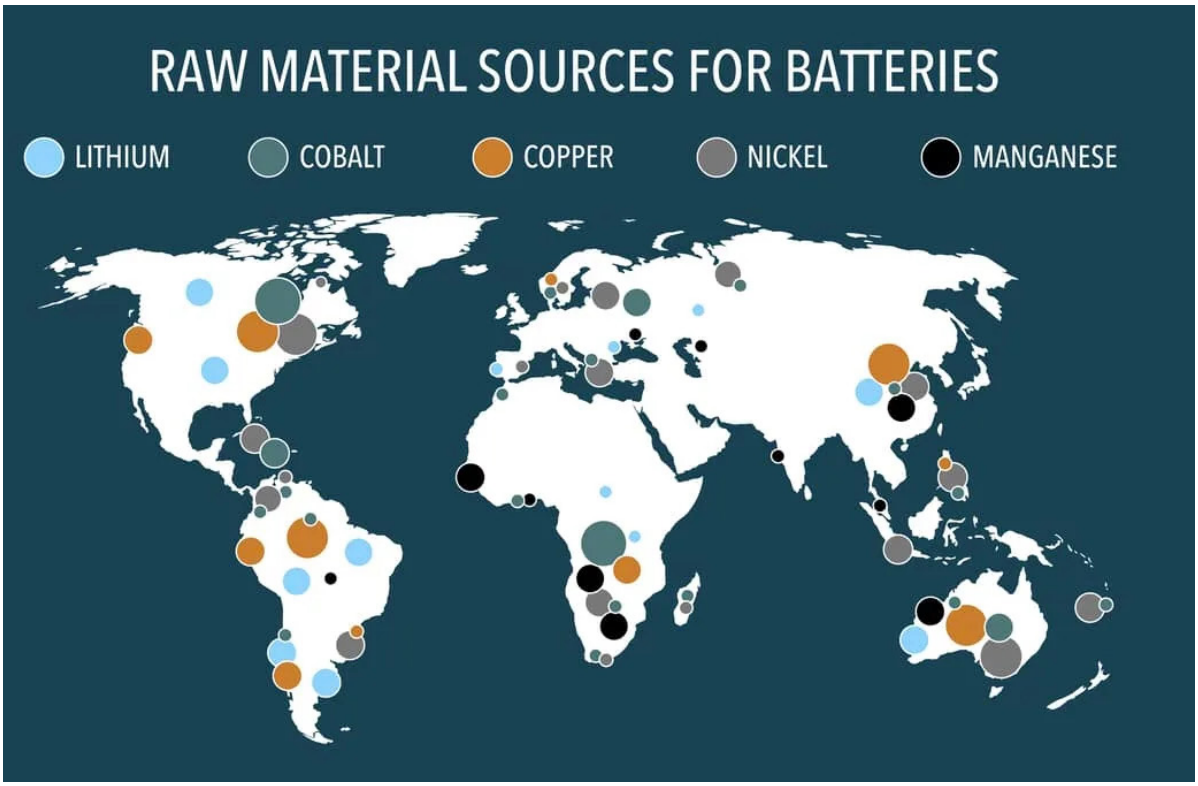
The key to this latest discovery was going against the accepted norms and conventions of lithium battery construction.

"It's ground-breaking technology, because in a regular lithium battery there's about half a dozen components that make up the battery. Most people research those, but hardly anyone has looked at changing the interlayer or separator in the middle. They tend to be fairly standardised, and until now we've assumed it didn't matter too much if you changed them.

"Now we're saying it actually does; we're going against the accepted convention."

This latest breakthrough, published by the Royal Society of Chemistry, continues the world-leading work into lithium battery development by the Monash team.

This article is republsihed from Monash Lens: https://lens.monash.edu/@technology/2022/03/04/1384501/faster-cleaner-longer-lithium-battery-breakthrough-to-improve-lifetime-performance



Update from BioPRIA

Distinguished Seminar by Prof. Florent Allais

In June, BioPRIA hosted a distinguished seminar titled *Combining green chemistry, biotechnologies and downstream process to upscale biomass and by-products*, by Professor Florent Allais from the URD ABI-AgroParis Tech in France. The seminar ran in a hybrid mode, with in-person meetings and live-streamed online. There were approximately 54 attendees from Monash students and staff, as well as from the industry representatives.

At this seminar, Professor Allais showed some examples on how lignocellulosic biomass can be efficiently transformed into the production of high value-added products such as: flavors, antioxidants, UV filters, monomers and polymers, by combining biotechnology, green chemistry and process engineering.

Visiting Researcher - Sheila Bhatt (University of Cambridge, UK)

Sheila Bhatt refelcts on her time at BioPRIA.

“As part of an ongoing collaboration between the BP Institute colloidal research group led by Professor Alex Routh’s group at the University of Cambridge and the BioPRIA research group at Monash University, an invitation was extended to me by Professor Gil Garnier for an initial visit to work in their blood-research lab. I am investigating the drying of blood droplets, looking at the time evolution of structure driven by evaporation.

I was welcomed by a wonderful, enthusiastic young group for my 2-months visit, who went out of their way to help me. My programme of work was a little ambitious for such a short visit, so I am doubly grateful to Professor Garnier who helped expedite my lab access and training. Professor Garnier personally encouraged me to take advantage of access to the advanced laser-profilometer for my measurements of blood droplet residue shapes resulting from evaporation. Together with my own equipment, this allowed me to collect a large body of data, which it will take me some time to process and analyse!

I was delighted to be able to host the group for a meal before I left, and surprised by the lovely gifts they bought me! I shall treasure them, along with the many friendships I made at BioPRIA. We in Cambridge are hugely excited to be working with BioPRIA, and I hope to see you all again soon!”

Congratulations to our PhD Graduates

We were delighted to celebrate the achievement of Dr Ruth Barajas Ledesma who had completed her PhD in 2021 and is now able to attend the graduation ceremony in person. Ruth's thesis was entitled *Engineered nanocellulose superabsorbents for application in agricultural soils*. Her supervisors were Prof. Gil Garnier and Prof. Antonio Patti and A/Prof. Vanessa Wong.

We also extend our congratulations to the following who have recently completed their PhDs:

- Dr Mostafa Dehghani, *Photocatalytic degradation of persistent organic pollutants in water using ZnO/CNF catalyst*. Supervisors: A/Professor Warren Batchelor and Professor Mark M Banaszak Holl.
- Dr Simin Miri, *Development of modified cellulose nanofiber wastewater treatment membranes for combined ultrafiltration*. Supervisors: A/Professor Warren Batchelor, Professor Philip Andrews.
- Dr David Mendoza, *Engineering nanocellulose chemical functionalization for applications.* Supervisors: Professor Gil Garnier and Professor George Simon.
- Dr Mahdi Naseri, *Point-of-test biosensor for the detection of waterborne bacteria.* Supervisors: A/Professor Warren Batchelor and Professor George Simon.
- Dr Maisha Maliha, *Applications of organobismuth-nanocellulose composites as antimicrobial materials.* Supervisors: A/Professor Warren Batchelor, Professor Phil Andrews and Melissa Werrett.
- Dr Laila Hossain, *Engineering sustainable nanocellulose superabsorbent: characterization and applications*. Supervisors: Professor Gil Garnier and Dr Joanne Tanner.
- Dr Wriju Kargupta, *Energy efficient production of nanocellulose*. Supervisors: Professor Gil Garnier and Dr Joane Tanner.
- Dr Humayun Nadeem, *Advances in spray deposited nanocellulose films*. Supervisors: A/Professor Warren Batchelor and Professor Gil Garnier.

RESEARCH

Rapid Detection of Gram-Positive and -Negative Bacteria in Water Samples Using Mannan-Binding Lectin-Based Visual Biosensor

BioPRIA research on visual biosensor for the detection of Gram-positive and –negative bacteria in water samples has been chosen as the cover feature in *ACS Sensor* journal.

The work by Naseri et al. demonstrates that the biosensor generates a blue signal when the water is contaminated and becomes colourless in the absence of bacteria.

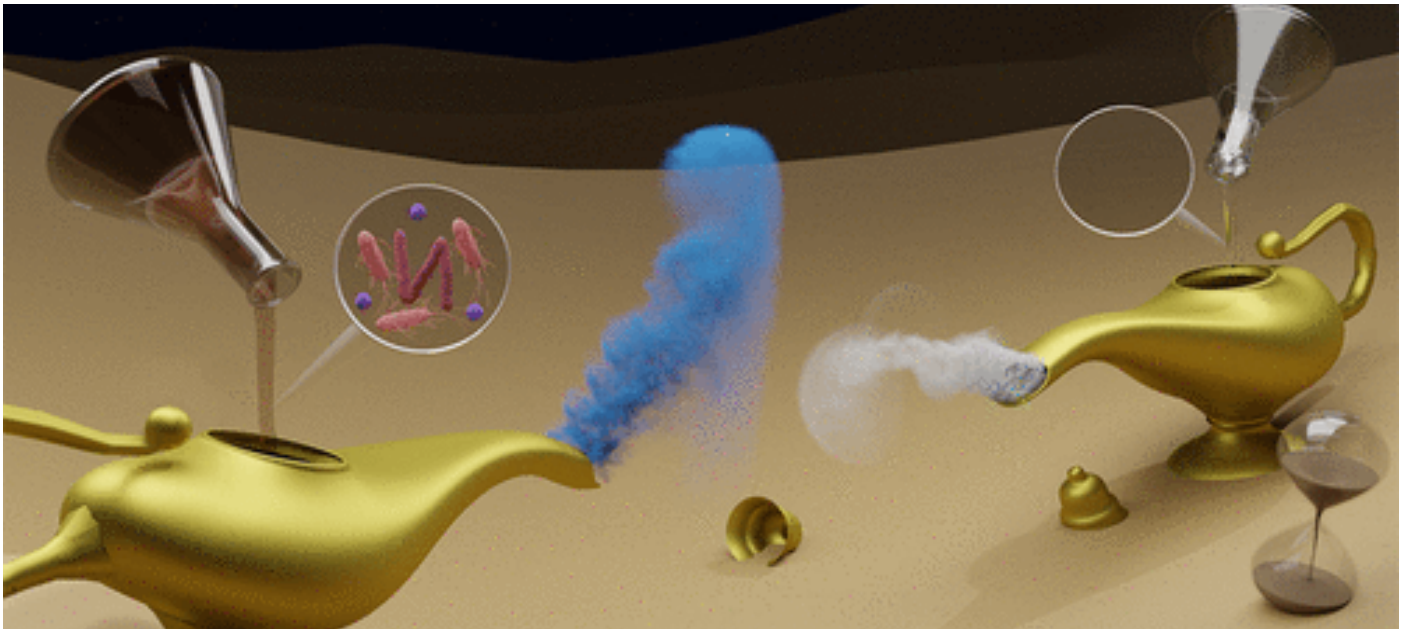
ABSTRACT

Waterborne bacterial infection is a health threat worldwide, making accurate and timely bacteria detection crucial to prevent waterborne disease outbreaks. Inspired by the intrinsic capability of mannan-binding lectin (MBL) in recognizing the pathogen-associated molecular patterns (PAMPs), a visual biosensor is developed here for the on-site detection of both Gram-positive and -negative bacteria. The biosensor was synthesized by immobilization of the MBL protein onto the blue carboxyl-functionalized polystyrene microparticles (PSM), which is then used in a two-step assay to detect bacterial cells in water samples. The first step involved a 20 min incubation following the MBL-PSM and calcium chloride solution addition to the samples. The second step was to add ethanol to the resultant blue mixture and observe the color change with the naked eye after 15 min. The biosensor had a binary (all-or-none) response, which in the presence of bacterial cells kept its blue color, while in their absence the color changed from blue to colorless. Testing the water samples spiked with four Gram-negative bacteria including Acinetobacter baumannii, Escherichia coli, Klebsiella pneumoniae, and Pseudomonas aeruginosa and two Gram-positive bacteria of Enterococcus faecalis and Staphylococcus aureus showed that the biosensor could detect all tested bacteria with a concentration as low as 101.5 CFU/ml. The performance of biosensor using the water samples from a water treatment plant also confirmed its capability to detect the pathogens in real-life water samples without the need for instrumentation.

Mahdi Naseri, Maisha Maliha, Mostafa Dehghani, George P Simon, and Warren Batchelor

ACS Sens. 2022, 7, 4, 951–959, https://doi.org/10.1021/acssensors.1c01748

Read article here



RESEARCH

Phenolic Ester-Decorated Cellulose Nanocrystals as UV-Absorbing Nanoreinforcements in Polyvinyl Alcohol Films

Research by BioPRIA researchers Mendoza et al. has been featured on the cover journal of *ACS Sustainable Chemistry and Engineering*. The study highlights the incorporation of nature-inspired phenolic ester-grafted cellulose nanocrystals in polyvinyl alcohol to engineer performant UV-blocking polymer films.

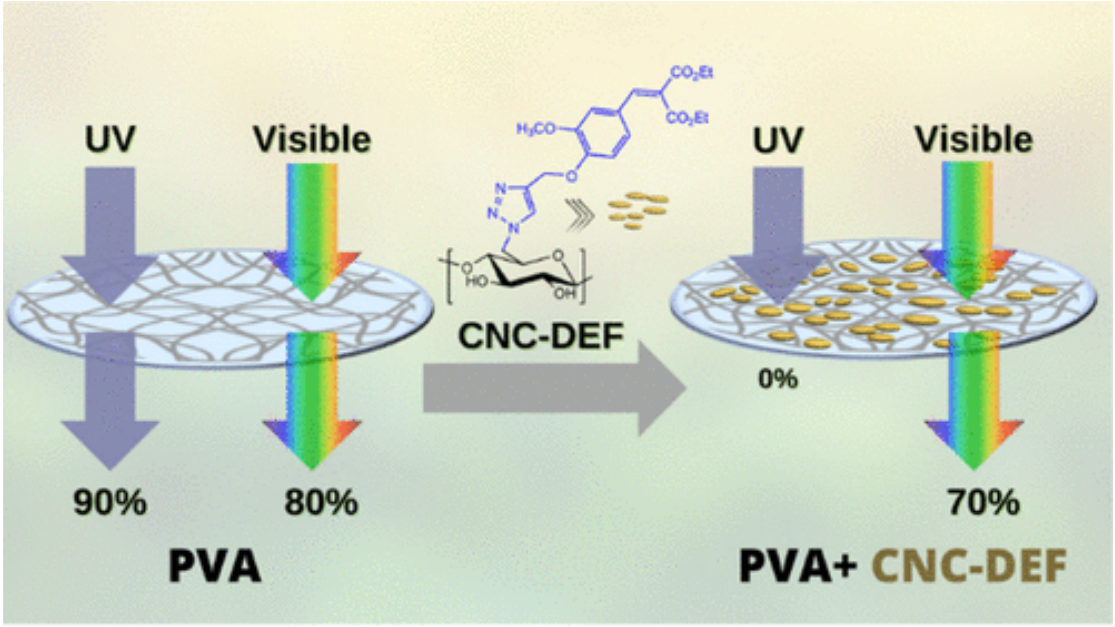
ABSTRACT

Grafting novel and nature-inspired phenolic esters onto cellulose nanocrystals (CNCs) provides nanofibers with excellent protection against UV radiation when incorporated into a polymer matrix. In this work, CNCs decorated with a novel UV-absorbing phenolic diester (CNC-diethyl ferulate or CNC-DEF) obtained via a click-type copper-catalyzed azide/alkyne cycloaddition reaction were incorporated into a polyvinyl alcohol (PVA) matrix to produce transparent films with excellent photostability and UV-absorbing properties. PVA films filled with 20 wt % CNC-DEF exhibited complete UV protection (0% transmittance) and high transparency in the visible region (70–90% transmittance). In contrast, PVA films loaded with the pristine CNCs do not show any UV-shielding properties. Importantly, the grafting of DEF moieties on CNCs significantly aids the dispersion of the phenolic diester in the aqueous PVA matrix, which was not achieved with DEF blended with PVA. Mechanical tests also show that the addition of 20 wt % CNC-DEF in PVA increases the tensile strength and modulus by 91 and 150%, respectively, relative to neat PVA. The oxygen barrier properties of the composite film also improve with CNC-DEF addition. This study shows the great potential of the phenolic-ester-decorated CNCs as dispersible, multifunctional UV-absorbing nanoreinforcements in PVA films for industrial and packaging applications.

David Joram Mendoza, Christine Browne, Vikram Singh Raghuwanshi, Louis M. M. Mouterde, George P. Simon, Florent Allais*, and Gil Garnier*

ACS Sustainable Chem. Eng. 2021, 9, 18, 6427–6437

Read article here



Monash University Malaysia Update

Monash Malaysia undergraduate chemical engineering students won prizes in Regional Chemical Engineering Undergraduate Conference (RCEUC) 2022.

The Regional Chemical Engineering Undergraduate Conference (RCEUC) serves as an avenue for chemical engineering undergraduates to present their research or design projects on an international platform. Participating in RCEUC is a great opportunity to nurture various soft skills, particularly effective communication, innovation and entrepreneurship qualities. This year, this event was held by Department of Chemical Engineering, University of Malaya (UM) in August. Highlights included a paper writing competition, online presentation competition, prototype competition, plenary forum and keynote speeches.

Monash Malaysia final year chemical engineering students participated in the competition with great success.

Online presentation category:

1st Prize - Shobita Sree Gunasegaran

Paper writing category

1st prize - Jeffrey Ruzain Md Yazid

3rd prize - Khoo Jun Wei

4th prize - Shobita Sree Gunasegaran

6th prize - Chan Xuan Tong

7th prize - Lee Jiun Hong

8th prize - Yong Jing Ru

Prototype demonstration category

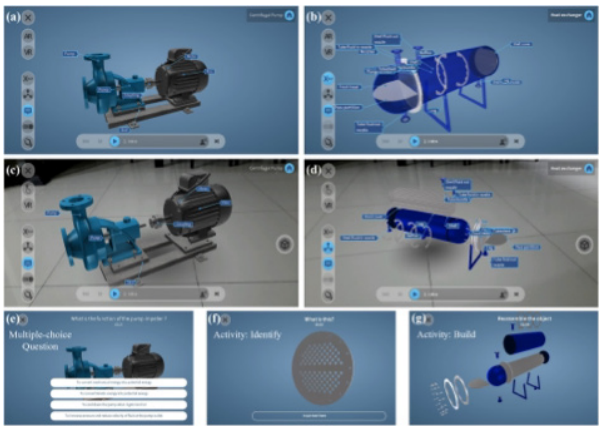
Winner - Tunku Intan Nadia Tunku Noorzaman

Kahoot Challenge category

1st prize - Wong Wei Han

Congratulations to all students and supervisors. They have made us really proud.

Dr Patrick Tang Siah Ying received multiple awards for development and application of augmented reality (AR).



Dr Patrick Tang Siah Ying received multiple awards for his educational innovative project on development and application of augmented reality (AR) to promote students' learning experience. His excellent work with his PhD student (Darren Low) has been awarded with Silver Prize from the IChemE in *Digital Classroom Learning Innovation Competition*. Additionally, he was awarded with the Faculty of Engineering Special Commendation for COVID teaching and innovation, as well as the School of Engineering for Excellence in Teaching.

In the project, he and his team developed two interactive AR lessons on centrifugal pump and shell-tube heat exchanger on the EON-XR platform. To apply the AR, the students were required to download the application on their personal mobile device before beginning the lesson. The application is downloadable without additional costs and is widely compatible with computer and mobile device operating systems, such as Windows OS, iOS, and Android OS The effectiveness was assessed by observing students' learning motivation and performance using a 16-item questionnaire based on the Instructional Materials Motivation Survey (IMMS) from Keller's ARCS model, and qualitative questions related to the future of AR technology in chemical engineering.

His work has further been published in Education for Chemical Engineers 39, 31-43. The quantitative analysis indicated that AR had brought positive impacts on students learning motivation. This further highlights the importance of AR in chemical engineering education.

Congratulations Professor Chong Meng Nan

We are pleased to announce that the promotion of Dr Chong Meng Nan to Professor has now been approved. Congratulations Professor Chong Meng Nan.

Professor Nan is a well-established researcher in sustainable water systems and catalysis for energy and environment. He has secured more than RM 20 million in research funding as both PI and CI from his research career to date. He has further been accoladed by highly respected awards such as Royal Society of UK Newton Advanced Fellowship, Green Talents Award, Top Research Scientist Malaysia and others.

According to a recent study by Stanford University, he is ranked among the World's Top 2% Scientists in his fields of research for 2020 and 2021 (i.e., both for the single year and career-wise categories).

His research group is actively designing novel nanostructured photoelectrodes using semiconductors, carbon materials, and polymers with further modifications using metal and non-metal doping, photosensitizers, and co-catalysts that could alleviate these technical bottlenecks.

Congratulations to Nurul Hidayah and Sharon Wong Weng Yan

Technical Officers play a tremendous role to ensure the smooth and safe operation of the research and teaching laboratory. Their roles are even more critical during the pandemic to ensure the continuity of the laboratory by implementing stringent COVID-19 protocols. Congratulations to Nurul and Sharon, who have been promoted as Principal Technical Officers.

They have contributed greatly to the discipline not only in heath and safety, but also to administrative tasks including IChemE and EAC accreditations. Another testimony of their contribution is the prize of Lab Continuity Plans during the COVID-19 pandemic.

Promotions

Congratulations to Dr John Quinn on his promotion to Associate Professor.

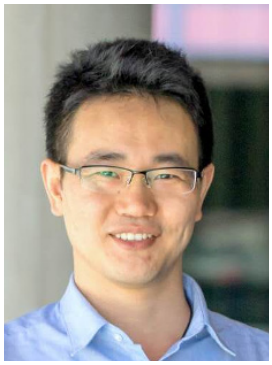
Dr Quinn joined the Monash Institute of Pharmaceutical Sciences as a Senior Research Fellow in the ARC Centre of Excellence in Convergent Bio-Nano Science and Technology in 2014 after a number of years working in non-research roles, including in intellectual property law.

He was subsequently jointly appointed to the Department of Chemical Engineering in 2019. Dr Quinn's research group focuses on understanding and characterising new polymericmaterials for drug delivery applications.

He has published >100 papers in leading materials science and polymer science journals including Chemistry of Materials, Biomacromolecules, and ACS Macro Letters, and in general chemistry journals such as JACS and Chemical Communications. Collectively, his work has been cited >8000 times.

Since joining MIPS, Dr Quinn's work has been funded by two ARC Discovery Projects, an ARC Linkage Project, an NHMRC project grant, and an ARC Future Fellowship, totalling >$3M.

In addition to his research, Dr Quinn serves as Deputy Course Director for the BPharmSci degree and Course Leader for the BE(Chem)/BPharmSci double degree, and serves on the Chemical Engineering Education Committee and Graduate Engineering Education Sub-committee.



Congratulations to Dr Zhikao Li on his promotion to Senior Research Fellow.

Dr Li is a Senior Research Fellow, Monash Suzhou Research Institute of Science and Technology and

Senior Lecturer, Chemical and Biological Engineering, Monash University

After obtaining a PhD from the University of Western Australia, Dr Li worked as a research associate at UWA before joining Monash University in 2019.

Dr Li has a strong track record for engineering research and HDR student supervision.

His research interests include membrane science and technology, adsorption science and technology, and physics informed machine learning (ML).

Congratulations to the position of Associate Professor Simon Corrie, a well deserved recognition of your hard work.

Simon Corrie completed his undergraduate degree in Chemical Engineering and PhD in Physical Chemistry at the University of Queensland, before undertaking postdoctoral studies at the HPV Research Laboratory at the University of Washington, Seattle.

After further postdoctoral studies in Australia developing microneedle arrays for wearable immunoassays, he joined the Chemical and Biological Engineering Department at Monash University in mid-2016 to establish the Nanosensor Engineering Lab (www.nanosensor-eng.net). He is a recipient of the Australian Research Council's DECRA Award and the 2018 Churchill Fellowship.

His research interests lie in developing nano-particles and proteins for applications in bio-sensing, bio-assays and medical devices.

Awards and Honours

Pratt Prize

The Monash CHE4170 team of 2021 have won the Pratt prize The Pratt Prize is awarded annually to the best Chemical Engineering Design Project submission in Victoria. The team designed a wastewater treatment plant along with safety and hazard analysis and techno-economics of the plant. They will now participate at the national competition and depending on the national results they may go into the international competition.

Big congratulations to the team, Ailsa Malinda Azizah, Yirong Fang, Reynaldi Roman, Asoka Sudwigunawan, Naweed Waghu, Harrison James Wearing-Smith, and the entire team of mentors Mark Banaszak Holl, Matthew Hill, Benny Freeman, Leonie van't Hag, Murali Sastry, Nicoleta Maynard and Sankar Bhattacharya, the lecturers, John Westover, A/Prof David Brennan and the industry advisors Imtenan Sayeed and Abbas Eghimi for their sincere and selfless assistance to the entire cohort. Professor Benny Freeman, in particular, deserves a lot of credit for mentoring this team members who were scattered in three countries.

Edward Attenborough addresses NZ Prime minister

Well, yesterday seemed a bit like a fever dream... I was lucky enough to join the team at Monash Food Innovation to present the 2022 New Frontiers Innovation Program to New Zealand Prime Minister Jacinda Ardern at Monash University. This program is a 10 week intensive, with teams of students from faculties across Monash partnering with SMEs and spending 9 weeks learning the food innovation methodology. This fantastic program then culminates in a one week design sprint to develop products for the fast moving Australian consumer market and present them to industry. In the second half of 2022, five New Zealand businesses will be undertaking the program and working with Monash students to innovate on new products in the Australian market.

As an alumni from the 2019 New Frontiers Innovation program, where I got to work alongside Singaporean SME Life3 Biotech to develop healthy beverages for life, I was lucky enough to share my experience with Prime Minister Ardern, the Hon Stuart Nash and Professor Rebekah Brown. Presenting alongside Rodney Heath and Abhishek Banerjee from MFI, I had the amazing opportunity to discuss what MFI does and how this links into the research and innovation strengths at Monash University. I was also lucky enough to speak to the delegation about my experience in the New Frontiers Innovation Program, how this has developed me as a graduate and what I work on currently as a student and researcher in the Department of Chemical and Biological Engineering, working alongside Dr Leonie van 't Hag and Australian SME Great Wrap to develop compostable and biodegradable packaging from food waste.

What an amazing opportunity and thank you again to everyone who worked so hard to plan, organise and put on this event. Monash Food Innovation is one of many feathers in the cap at Monash University and continues to drive innovation in the food and beverage sectors. With our research capabilities at Monash and in the Department of Chemical and Biological Engineering, we are able to support industry research into food science and engineering thanks to our food safe facilities and equipment. This is an extremely exciting sector to be a part of as we start rethinking our consumption for a more sustainable future

IMSTEC 2022

THE 11TH INTERNATIONAL MEMBRANE SCIENCE & TECHNOLOGY CONFERENCE
4-8 DECEMBER 2022
MELBOURNE, AUSTRALIA

ARC RESEARCH HUB
ENERGY-EFFICIENT SEPARATION

MEMBRANE SOCIETY OF AUSTRALASIA

11TH INTERNATIONAL MEMBRANE SCIENCE AND TECHNOLOGY CONFERENCE

IMSTEC 2022

4-8 DECEMBER 2022

Monash University Clayton Campus
Learning And Teaching Building
19 Ancora Imparo Way, Clayton VIC 3800 AUSTRALIA

KEY THEMES

- ✓ Circular Design & Engineering Membranes
- ✓ Crossing the Gap with the New Normal
- ✓ Vision 2030

All membrane topics supported, including: Application of membranes, Membrane Processes, Membrane operations and module designs, Membrane materials, Advanced membrane characterisation techniques, Separation modelling and simulation, Democratization of separation science

Early Bird Registration will be closed on 31 AUGUST 2022

OUR PLENARY SPEAKERS


Prof Amy **Childress**


Prof Jerry **Lin**


Prof Kazuo **Yamamoto**


Dr Lidietta **Giorno**


Prof Tongwen **Xu**

CONFERENCE CO-CHAIRS
Prof Xiwang Zhang
Prof Mikel Duke

https://www.imstec2022.org/
info@imstec2022.org

Travel awards available for students and ECRs who join MSA or are existing MSA members

MASTER OF ENGINEERING
BIOLOGICAL ENGINEERING

MASTER OF ENGINEERING BIOLOGICAL ENGINEERING

Biological engineering is at the interface of biomedical engineering, biomaterials science, pharmacy and pharmaceutical sciences, and biology. It is central to the growing biotechnology industry within pharmaceutical, food and beverage, wastewater and other materials, fermentation, bioenergy and bioplastics sectors.

This course offers students the opportunity to explore sustainable process engineering for pharmaceuticals, proteins, food, beverages, lignocellulosics, fermented products and a variety of other biologically-related areas of great importance to both local and international industry.

WHAT WILL IT GIVE STUDENTS?

The specialisation is designed to provide students with a thorough understanding of engineering which draws on biology to undertake transformations of materials including:

- bioprocessing in biopharmaceutical production
- microbial water treatment
- biocatalysis
- fermentation and advanced biotechnology
- transformation of primarily biological materials, e.g., food and wood processing

Course details

Location:	Clayton (on campus)
Course code:	E6014
Duration:	1 year full time 2 years part time
Start dates:	First Semester (February Second Semester (July)

Biological engineering benefits emerging industries to improve economic, social and environmental outcomes

For more information

https://www.monash.edu/study/courses/find-a-course/2021/engineering-e6014

MONASH University

MONASH
CHEMICAL &
BIOLOGICAL
ENGINEERING

New equipment

In 2021 and 2022, the Department of Chemical and Biological Engineering expanded their equipment catalogue by adding 12 new items for shared research and teaching. The new range of equipment has been added to the analytical, rheology, food and teaching labs. The equipment is accessible to all Monash University staff and students and the wider community. It can be booked through the Department of Chemical and Biological Engineering iLab core. See below for a brief description of the equipment:

- TA Instruments DSC 2500 - Differential scanning calorimeter (DSC) for measuring glass transition, melting temperature and enthalpy, heat capacity and reaction kinetics.
- TA Instruments SDT 650 - Thermal gravimetric analyser (TGA) coupled with DSC for analysis of thermal stability and decomposition, oxidation and reduction.
- Micromeritics AutoChem II chemisorption analyser - Temperature programmed reduction (TPR), oxidation (TPO), desorption (TPD) and pulse chemisorption studies.
- Pfeiffer ThermoStar mass spectrometer (MS) gas analyser for coupling with either TA SDT 650 or Micromeritics AutoChem II chemisorption analyser.
- Thermo Fisher ICS-6000 Ion chromatography - Simultaneous cation and anion analysis.
- Thermo Fisher TQe triple quadrupole ICP-MS - Elemental analysis of solutions down to ppt level.
- Surface Measurement Systems DVS Adventure - Dynamic vapour sorption (DVS) measurements.
- Agilent 1260 Infinity II SEC/GPC RI System - Size exclusion chromatography.
- ColorFlex EZ Colorimeter - Colour measurement.
- Liquid/headspace/SPME autosampler for GC-FID in the ChemBio makerspace
- Student pilot plant Membrane filtration wastewater treatment

CONTACT MONASH CHEMICAL & BIOLOGICAL ENGINEERING

Department of Chemical & Biological Engineering

Monash University
Clayton Victoria 3800
Telephone: +61 3 9905 3555
Facsimile: +61 3 9905 5686
eng.monash.edu.au/chemical

LinkedIn
Twitter @MonashChemEng

WOULD YOUR COMPANY LIKE TO OFFER ANY OF THE FOLLOWING?

- **Vacation Work Experience to our undergraduate students**
- **Graduate Positions (Undergraduate and Postgraduate)**
- **Speak to undergraduate students at a lunch time seminar about your company**
- **Become a corporate sponsor or donate a student prize**

Would you like to receive future issues of ChemEng Focus? If so, please join up here to be added to our newsletter mailing list.

monash.edu/engineering/departments/chemical