

DEPARTMENT OF  
CHEMICAL ENGINEERING  
MONASH UNIVERSITY

# *focus*

TEACHING AND RESEARCH NEWS FROM THE  
DEPARTMENT OF CHEMICAL ENGINEERING

*Proudly Announcing our New Look  
Chemical Engineering Focus Newsletter*

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**MONASH** University  
Engineering

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DEPARTMENT OF CHEMICAL ENGINEERING

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# YOUR BLOOD TYPE IN WRITING: THE GLIF PAPER SENSOR

“The GLIF card sensor is a paradigm shift in blood group diagnostics. GLIF requires no external elements to perform a safe, reliable and fast ABO test.”

Award winning research from Monash's Australian Pulp and Paper Institute (now BioPRIA) has taken another important step toward commercialisation.

The GLIF card, developed by Professors Wei Shen and Gil Garnier, together with Haemakinesis, their collaborating company, is a low-cost, paper-based sensor for use in developing countries and remote areas where advanced medical facilities are limited, and developed countries for rapid and mobile diagnosis. The GLIF card (named Group Legible Immunohaematology Format) is a low-cost bioactive paper device to test ABO and rhesus (RhD) blood types. The results literally appear in writing. It is the world's first whole blood, self-interpreting blood grouping test. It requires no water, no electricity and no laboratory.

consisting of the bioactive and nonbioactive sections are used to form the letters and symbols for the final display of the testing report. This paper-based device rapidly reports a patient's blood type in unambiguous written text.

The team, led by Professors Shen and Garnier, began their paper-based microfluidic research in 2008, when they developed techniques of printing biological reagents (proteins and enzymes) on paper and making microfluidic systems using paper. By 2009 the team was collaborating with researchers in biomedical, nano fabrication, analytical chemistry and materials engineering to explore immunological sensing on paper. In 2011 Professor Shen had a breakthrough with the text-reporting method to report assay results with another critical invention patented in 2015.

This research began in 2008 and was awarded the 2012 Eureka Prize for Innovative Use of Technology. It has since captured the world's media attention for its Harry Potter inspired self-reporting paper.

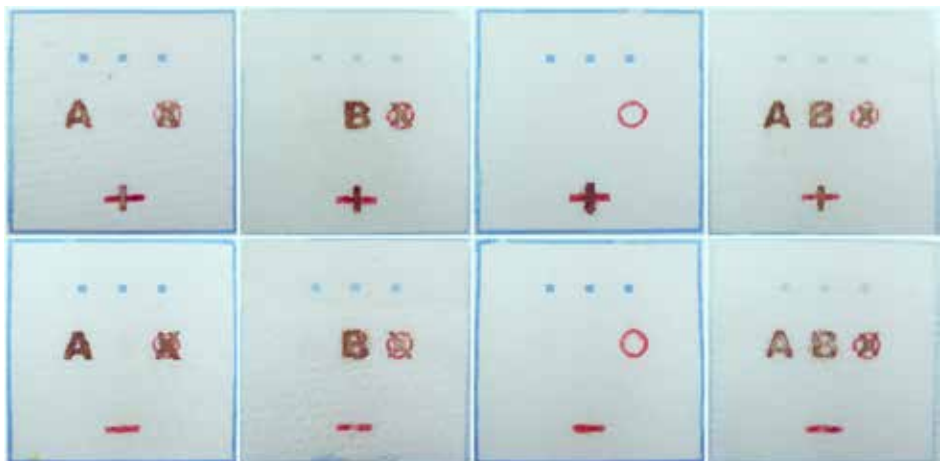
In this technology, paper text patterns are printed within the paper to interact with antibodies and red blood cells. Composite text patterns

The major advantage of using paper to develop sensors is that it is an ubiquitous and cheap material. Paper can also be printed upon, facilitating the use of printing technology to manufacture sensors, in this case printing with biomolecules instead of ink.

*[continues over page]*



[Watch the GLIF video](#)



*ABO results appear within minutes*

# GLIF PAPER SENSOR

The GLIF technology addresses key issues of producing medical and environmental sensors for developing regions with limited medical facilities. GLIF requires no equipment or specialised training to perform a safe, reliable and fast ABO test. The World Health Organization has recognised these difficulties and set an 'ASSURED' guideline for designing sensors for developing countries: Affordable, Sensitive,

Specific, User Friendly, Rapid and Robust, Equipment Free, Deliver to users who need them. The GLIF card superbly overcomes the challenges represented by 'UED'.

Professor Shen emphasises, "User friendly means that users can easily operate the sensors to perform a test, as well as easily interpret the results. Our sensor design has all the ASSURED capability; we also have a

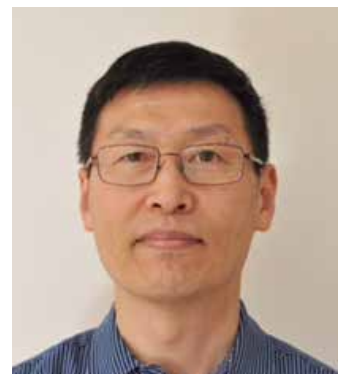
unique U capability to enable users to perform the test, and be informed unambiguously with the test results via text-reporting."

Indeed with GLIF, as in J. K. Rowling's, *Harry Potter and the Chamber of Secrets*, a user can interrogate a piece of paper for information and get unambiguous answers from the paper in writing.

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## About Professor Wei Shen

Professor Wei Shen leads a number of research projects at BioPRIA within the Department of Chemical Engineering at Monash University. Since 2008, he has led research in bioactive paper- and thread-based microfluidic sensors. His group has applied their skills in paper surface modification and printing to fabricate microfluidic systems on paper, thread and polymer films. More recently Wei has begun new research into powder-liquid interfaces, constructing soft reactors using liquid drops and liquid marbles for stem cell research. He has also applied surface engineering to modify powdery materials for oil spill control. Professor Shen invented the text-reporting paper sensors; this invention has led the commercial development of the GLIF Technology. In 2012, Wei led his group to win the Australian Museum Eureka Prize and the IChemE Award (UK) for their innovation in bioactive paper diagnostics. In 2013, he was selected as a finalist in the Australian Innovation Challenge.



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## About Professor Gil Garnier

Professor Gil Garnier works in the Department of Chemical Engineering at Monash University and is the Director of the Bio Resource Processing Institute of Australia (BioPRIA). His current research interests are focused on the application of colloids and polymers to surfaces, adhesion, composites, and the process of paper making. At BioPRIA he heads of a multidisciplinary team, which uses nanotechnology for surface engineering, bioprinting and the development of novel specialty papers. The success of the group lies in multidisciplinary collaborations with experts in the fields of surface and material science, printing, biochemistry and biomaterials. Professor Garnier works closely with his colleague Dr Wei Shen, and Dr George Thouas (Biological Engineering) and Dr John Forsythe (Department of Materials Engineering and the Cooperative Research Centre for Polymers).





# MONASH CHEM ENG CLOSE UP: PhD STUDENT JOEL SAMSU

Monash Chemical Engineering welcomes students from all over the world, and in August this year we welcomed Joel Samsu to our ranks. Joel comes to us from Alpine Austria. For the moment he has hung up his skis to pursue a PhD at the Laboratory for Simulation and Modeling of Particulate Systems (SIMPAS). Joel's project, titled *Discrete Particle Simulation of Granular Flow in an Ironmaking Blast Furnace* focusses on creating and validating a 3D sector model to investigate imposed stresses on walls/staves under various conditions as well as formulate fundamental understanding of stave failure mechanisms for a longer stave lifespan. The obtained model will be combined with BlueScope Steel's RaBIT and SHAFT models for operation control.

Find out more about Joel and his motivations in this Q&A:

## ***What inspired you to become a chemical engineer?***

The reason why I chose to study chemical engineering is that I wanted to be able to make a difference in the world. Which I know sounds very idealistic. However chemical engineering can help to make the world safer and more sustainable, leading to increased quality of life. In the end I chose research because I wanted to go deeper into a specific subject and become a specialist. Also I believe that working for one's own research project can be a very rewarding (but possibly not always easy) experience.

## ***Austria is a stunning country, with a strong industry and a tradition in innovation. What motivated you to move to the other side of the world and join Monash?***

For my development as an engineer/researcher I believe that it is important and helpful to surround myself with a new environment. Going to a different country to undertake a PhD was the obvious decision to make. Also I wanted to live in an English speaking country for several years, as English is the global language. Australia, and especially Melbourne, has a good reputation as being a very liveable place, which was an important aspect in my decision making. Finally, Monash University, and especially the SIMPAS group have an excellent reputation and are one of the finest places I could imagine undertaking a PhD.

## ***Tell us about your current research interests?***

What I can say so far (as I just started) is that my research will use discrete particle simulation to study multiphase flow in the blast furnace. The blast furnace is a reactor used to extract iron from iron ore as part of the steel making process. Discrete particle simulation has been developed in the last 20 years, to a great part by Professor Aibing Yu and his team at SIMPAS, and enables understanding of industrial processes on a microscale level. Each particle in a system is tracked individually, so that it is possible to make a prediction about the trajectories of each particle and the contact forces between the particles and between the reactor walls and the particles. The project is part of the 'Sustainable steel manufacturing' program of the steel research hub.

## ***Where do you think this area of research is heading? Can you imagine or list some of the potential applications?***

This area of research has been able to develop so fast because of the great improvement of computational power that we were able to witness during the last few decades. As computers get better/faster, the variety of applications will be able to increase and it will be possible to get a better understanding of the industrial processes where multiphase flow phenomena occur.

## ***Which profession would you choose if you were not a scientist? How do you spend your spare time?***

I actually don't know. Five, or even two years ago I would have never imagined to be where I am now/to do what I do now. Maybe I would have become a sports and maths/physics teacher. Somehow I like the idea of getting someone enthusiastic about science and encouraging students.



*Joel Samsu at the APCCChE conference in September 2015*

# SMUCE CONNECTING STUDENTS WITH INDUSTRY

The Society of Monash University Chemical Engineers (SMUCE) is a student-run organisation, which aims to bridge the gap between the classroom and the world outside the university. We are responsible for linking together industry, the Monash Department of Chemical Engineering and Monash University students, ultimately providing students with opportunities they would otherwise not receive.

SMUCE started off the year with the annual publication of the Chemical Engineering Careers Guide which contains profiles of a number of companies in various industries, information about applying for jobs and experience-sharing articles written by students and members of industry. The committee worked throughout the summer holidays to compile the SMUCE guide and 350 copies were ready for distribution to Chemical Engineering students in Week 1 of first semester.

SMUCE's Industry Seminar Series has become synonymous with SMUCE itself; every week, a different

company delivers a presentation to students spanning all year levels, giving students real insight into the opportunities available to them during and after university.

This year, SMUCE expanded its scope and organised the first student-run site visit to the Visy Paper Mill in Coolaroo. The visit was a great success and all students found the day eye-opening, and the perfect way to see applications of their academic work in real processes.

SMUCE has been a very active student society this year. There have been Meet&Greet Breakfasts as a means for young and old students to connect, regular GroupUp sessions whereby SMUCE facilitate collaborative study sessions prior to tests, and of course the biannual Student Feedback Week where SMUCE representatives gather feedback from the student cohort, which is then relayed back to the Department of Chemical Engineering so changes to the units can be made in a timely manner.

SMUCE organised various social events including a Trivia Night and the annual SMUCE Ball, where both students and staff attended to enjoy a fancy three course meal at the Brighton Savoy. In addition to delicious food, drink and dancing, a raffle was also held where over \$275 was raised and donated to Robogals Monash, a not-for-profit organisation which aims to increase interest in STEM-related courses, particularly among high-school girls.

SMUCE have had a very successful year and are in the process of handing over the committee to the 2016 student group, who are excited to continue the work to ensure that the Chemical Engineering student cohort receive the multitude of benefits of being SMUCE Student Members!

Laura De Rango  
President – 2015

 [facebook.com/smucemoose](https://facebook.com/smucemoose)



*2015 SMUCE Committee at the Annual SMUCE Ball held in September 2015*



*Shell Industry Seminar organised by SMUCE*

# SPE MONASH CHAPTER LAUNCHED

In February this year, students at Monash University established Victoria's first and only student Chapter of the Society of Petroleum Engineers (SPE). The society aims to build relationships between students, Monash University, SPE and the Victorian Oil and Gas industry.

Monash student Alexander Grufas founded the chapter after realising that Monash students were missing opportunities. "Students in QLD and WA had opportunities from their involvement in SPE and university links with industry that Monash students were missing, despite having on par résumés and skillsets. Our students were unaware of the number of petroleum companies operating oil and gas facilities in Victoria despite a strong industry presence in the Bass Strait. I wanted to do something about this."

Alexander researched SPE, contacted the SPE Victoria/Tasmania section in Melbourne and attended their monthly industry meetings (from October last year). Attendees included professionals with up to 30 years plus experience from companies such as ExxonMobil, Origin Energy, WorleyParsons and

many others. Impressed with the society, Alexander realised how valuable this could be for students and created a team to form a chapter.

With strong support from SPE Vic/Tas and Monash Faculty members, and the hard work and dedication from the executive committee members, Alexander Grufas, Ilia Lyamin, Stephanie Wong and Victoria Seesaha, the student society has grown to 200 members and already held eight events since February.

The Chapter was launched with an Industry Dinner at the Kelvin Club with excellent representation from industry and Monash Faculty staff including the Associate Dean of Engineering A/Professor Victoria Haritos and Head of Chemical Engineering Professor Karen Hapgood. Senior oil and gas professionals gave presentations, discussing current opportunities and key skills needed to address industry challenges.

The executive committee also represented Monash at the 2015 APPEA Melbourne conference, networking with senior business professionals to build key

connections for the chapter. Other events in 2015 included site tours to CSIRO's Oil and Gas research facility and Origin Energy's Lang Lang gas plant, providing real world exposure to classroom theory. The chapter also held seminars where students were mentored by oil and gas professionals in developing skills required for industry.

"We look forward to building upon this year's success and strengthening the connection between SPE, industry, university and its students, growing the club long into the future."

"We hope to attract further industry support, whether through sponsorship, mentoring, site tours, providing speakers, attending our events or any other means."

Contact SPE Monash  
[spemonash@gmail.com](mailto:spemonash@gmail.com)

 [facebook.com/monashspe](https://facebook.com/monashspe)

[Credit: Alex Grufas, Society of Petroleum Engineers - Monash University Chapter President and Founder  
[agrufas@gmail.com](mailto:agrufas@gmail.com) +61 412 497 434]



Site tour



Founding committee from left to right in the photo are Victoria Seesaha (Secretary), Ilia Lyamin (Vice President), Alex Grufas (President) and Stephanie Wong (Treasurer)



Networking with industry



# SHAHROUZ TARANEJOO JOINS PRESTIGIOUS HARVARD/MIT RESEARCH GROUP

Monash Chemical Engineering PhD student Shahrouz Taranejoo came to Australia following studies and research in medical nanotechnology and tissue engineering in Iran. Now, with the support of a competitive travel award from the Monash Institute of Medical Engineering (MIME), Shahrouz has the opportunity to join one of the most prestigious biomedical engineering research groups in the world. He has been admitted for a placement at a joint research centre between Harvard University and The Massachusetts Institute of Technology in Cambridge, Massachusetts, USA. During this visit, Shahrouz will work with new technologies developed to advance the understanding and treatment of diseases of the organs (e.g. kidney) using nanofabrication methods.

Find out more about Shahrouz and his research in this Q&A:

## *What inspires you about Monash academic life?*

Monash is a highly regarded university globally. Before starting my PhD at Monash, I received several admissions from universities in both the USA and Australia. I chose Monash Chemical Engineering because of its reputation and quality of research in my field of interest, drug delivery. Monash University is ranked amongst the top universities in both pharmaceutical sciences and chemical engineering, with high quality facilities and laboratory equipment. I have also received wonderful mentorship and guidance from my supervisor during my time here.

## *Tell us about your current research interests?*

Currently I am developing multi-stimuli responsive carriers that can be employed for internal and external induced prolonged release of their encapsulated therapeutic agents, mainly for cancer therapy. Also, I am investigating the cellular cytoskeleton of cancer cells, before and after application of drug-carrier conjugates. As part of my PhD, under the supervision of Professor Kerry Hourigan, I have been researching the development of new advanced stimuli-responsive drug delivery systems. To improve the quality of my PhD research, I have been enthusiastically involved in research activities with some globally recognised scientific groups at Georgia Tech University, the University of California at Los Angeles (UCLA), USA and EPFL, Switzerland. As the major output of my collaboration, an article has been recently accepted in *Advanced Materials* for which I am first author. Moreover, we developed novel microfluidic based procedure for fabricating fine-tuned engineered drug carriers with a core/shell structure.

## *Where do you think this area of research is heading? Can you imagine or list some of the potential applications?*

Gene/drug delivery is a promising interface of chemical engineering and medicine; I believe, it will be the backbone of several scientific fields in the future. Drug delivery systems, or in its general form, therapeutic agent delivery platforms, benefit from one of the fastest growing areas of interest in scientific research. For example, in USA, National Institutes of Health (NIH) and its components of participating organisations (National Cancer Institute (NCI)

and National Institute of Biomedical Imaging and Bioengineering (NIBIB)) are spending billions of dollars to support innovative research projects that are focused on drug delivery technologies such as selective and targeting drug delivery, real-time monitoring, quantitative in vivo characterisations and validation of drug delivery and response.

Moreover, pharmaceutical companies are looking for new technologies and methods that may be considered as potential solutions to effectively target patient concerns about safety, side effects and effectiveness of normal routes of drug administration.

Future research in drug delivery will be highly focused on novel methods, such as transdermal technologies, multi-stimuli, on-demand and intelligent delivery systems capable of modulated delivery and nasal delivery through nanoparticulate based delivery technologies. These technologies would be great candidates for tissue engineering, cancer therapy and organ(s) on a chip.



Shahrouz Taranejoo



# WOOD PULP WASTE PROJECT WINS MACNAB LACEY PRIZE

“By aligning our taught programmes with industry’s needs, our students will be more work-place ready on completion of their engineering studies”



*This year's winning team comprises: Richard Arthur, Jimmy Nguyen, Trang Truong, Kirilly Wagstaff, Daniel Wielechowski and Makarios Wong*

For the second year running, undergraduate students from Monash Department of Chemical Engineering have been awarded IChemE's Macnab Lacey prize for their design project work on the development of sustainable process solutions for wood pulp waste. This award is open to students worldwide studying an IChemE accredited course.

One of the aims of the Macnab Lacey prize aims to encourage students to think of sustainable development as a key element of their design and provide a showcase for student talent.

Monash's director of BioPRIA, Gil Garnier, said that the sustainability challenge and a transformation of the industry landscape was shifting the focus of chemical engineering education at the university.

The winning entry was a conceptual design to determine the feasibility of using black liquor (a lignin rich co-product of wood pulping produced in paper production) as a renewable feedstock for producing ammonia.

Winner Daniel Wielechowski told IChemE Deputy President Andrew Jamieson that even when the team thought it had reached a more sustainable solution, they had found themselves re-designing the process as new ideas for industrial symbiosis emerged. He said, "Our ultimate goal was to implement a highly efficient process that would benefit the community and perform symbiotically with existing industries."

He added, "The sustainability thinking developed during the design project is now being applied in my work as a process engineer for recovery and power generation at Melbourne based paper and board manufacturer, Visy Industries."

Entries were received from Australia, Malaysia, Singapore and the UK, with the University of Manchester, UK and Imperial College London, UK being highly commended.

The competition is judged by experts from the Institution's Sustainability Special Interest Group and IChemE Deputy President Andrew Jamieson presented the prize.

*Credit: This story was adapted from a media release from IChemE*

## ENGINEERING SEED FUNDING SCHEME

Five applicants from Chemical Engineering were successful in obtaining grants from the Monash Engineering Seed Funding Scheme.

- **A/Prof Victoria Haritos** - Development of biofactories for the sustainable production of fatty acid oils for conversion into biofuels and chemicals
- **Dr Lizhong He** - Low-cost bioprocess for production of mussel adhesive proteins as biomedical adhesives
- **Dr Bin Su** - Mimosa leaves inspired design of flexible pressures sensor with gentle touchable sensitivity
- **Dr Akshat Tanksale** - Circulating catalytic bed pyrolysis of woody biomass into synthesis gas
- **Dr Meng Wai Woo** - Development of a spray drying agglomeration modelling platform for food powders

# MSA SYMPOSIUM BEST POSTER AWARD

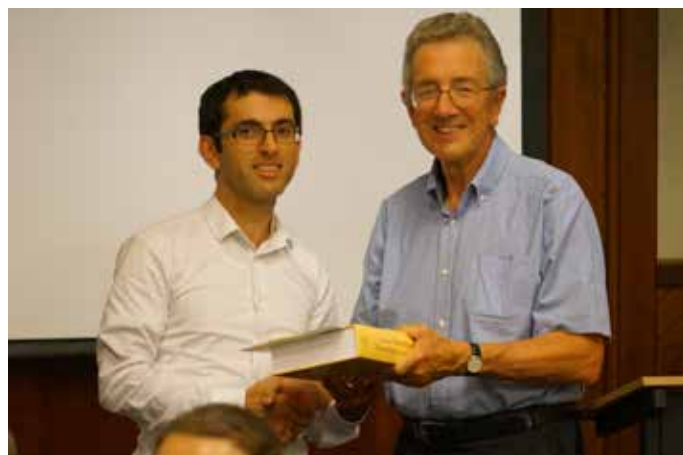
We congratulate postgraduate student Mr Ezzatollah Shamsaei who won the 'best poster award' at the 4th Membrane Society Australasia (MSA) Early Career Research Membrane Symposium held at Deakin University.

The poster, *Enhanced Water Permeation through Nanoporous Polymer Membranes*, was selected because of 'the scientific content and relevance as well as the clarity of the presentation during the session' among 67 posters presented in the symposium.

The co-authors were Ezzatollah Shamsaei, Kun Wang, Ze-Xian Low, Xiaocheng Lin, Huanting Wang.

Poster abstract:

We report a new methodology for tailoring the chemistry and porous structure of polymer ultrafiltration (UF) membranes, to dramatically enhance water flux without sacrificing rejection properties, by blending a charged polymer that is more hydrophobic than the main polymer component in the immersion precipitation technique.



Ezzatollah is receiving the award from Prof. Anthony Fane, MSA Patron

## HEAD OF DEPARTMENT KAREN HAPGOOD REPRESENTS MONASH AT SAGE PILOT LAUNCH



Head of Department Professor Karen Hapgood represented Monash University at the launch of the new Science in Australia Gender Equity (SAGE) pilot of the Athena SWAN Charter. The launch of the program was at Parliament house in Canberra in September. The Charter aims to advance women in the science, technology, engineering, mathematics and medicine (STEMM) disciplines and to improve gender equity practices, representation and retention in these fields.

The Athena SWAN program, which has been active in the UK since 2005, provides access to a standardised, methodological framework for collecting data and identifying gaps and opportunities in gender equity processes, along with workshops to support successful accreditation, constructive feedback and support from gender equity experts. This approach uses research to identify and change practices that unfairly exclude, marginalise or disadvantage people, supporting institutions to remove barriers to progression and success for staff and students.

Read more about this program on the website of the Australian Academy of Science (<https://www.science.org.au/SAGE/Pilot>)

# INAUGURAL POSTGRADUATE INDUSTRY LINKAGE PROGRAM A RESOUNDING SUCCESS

The Postgraduate Industry Linkage Program (PILP) is a two part program designed and run by the Chemical Engineering Postgraduate Association (CEPA) to help chemical engineering postgraduates improve their networking skills and connect them with industry. It received a \$2,000 grant from the Office of the Vice-Provost (Learning and Teaching) as part of the Better Teaching, Better Learning Student Bursaries Scheme. It has also received a \$200 grant from the Monash Postgraduate Association (MPA), as well as funding from the Department of Chemical Engineering.

In March 2015, two interactive networking seminars were delivered by Naanki Pasricha, a Communications Coach and trained speech pathologist. Her seminar covered:

- What is networking?
- Identifying who is in your current network (activity)

- How do we build our professional network?
- The power of effective conversation skills – the role of the listener and the speaker, body language, eye contact, being aware of your listener's needs, and asking relevant questions.
- Constructing your 1-minute 'elevator-pitch' (individual and small group activity)
- Online networking - LinkedIn, Facebook, Twitter

Participants then visited the production facilities of Yakult and Nufarm, where there was ample opportunity to learn about their operations and network with engineers. It was also a great chance to develop key industry contacts, giving students a competitive advantage when applying for graduate employment.

With about 40 participants attending each part of the program, the interest in PILP exceeded expectations.

CEPAs feedback survey revealed that 92% of the participants were 'extremely satisfied' or 'satisfied' with the site visit and networking seminar experience. Two thirds of the participants found the output of the networking seminar helpful in interacting with company representatives or peer students during subsequent site visits.

This feedback highlights the strong latent demand for soft skill development and industry engagement. Based on the positive endorsement from the student body, CEPA intends to integrate PILP in its annual event calendar. This project has the potential to serve as a flagship program for other departments to follow.



*Monash University chemical engineering post-graduates tour Nufarm's production plant in Laverton North.*

# CORDELIA SELOMULYA AWARDED FOR RESEARCH AND SUPERVISION

A/Professor Selomulya leads the Biotechnology and Food Engineering group and is a co-founder of the Monash Advanced Particle Engineering Laboratory. She is a current ARC Future Fellow (2014-2018) and is involved in several projects as a project leader. These include major industry grants, for example ARC Linkage projects with Dairy Innovation Australia Ltd and Dairy Research Institute (US), as well as ARC Discovery projects with collaborators in Fudan, Xiamen, and Soochow Universities. She also collaborates with CSIRO, the Departments of Microbiology, Immunology, Materials Engineering, Physics (Monash University), UNSW, South Dakota State University, Chinese Academy of Sciences, INRA, and Agrocampus Ouest (France).

Cordelia's contributions to research and teaching have been recently recognised with awards from Monash and the international research community.

[Read more about A/Professor Selomulya's research.](#)

## Dean's Award for Excellence in Postgraduate Supervision 2015

Cordelia recently received the Dean's award for Excellence in Postgraduate Supervision. Since joining Monash in 2006, she has supervised 15 students (11 PhDs, 4 Master by Research) at Monash and 1 PhD at UNSW to completion, the majority of which as the main supervisor. She has demonstrated several innovative approaches to supervising graduate research candidates at Monash such as organising a monthly group meeting where students take turns to present their work, sponsoring regular social events for her students, and encouraging students to join different technical societies. Cordelia also encourages her students to seek counselling or take extended breaks if necessary. Her gentle approach, which recognises the complexities of life for a young person, often living far away from family and friends, has led also to her nomination for the 2015 Vice Chancellor's Award for Excellence in Postgraduate Supervision.

## International Food Engineering Award

In recognition of her outstanding achievements in research, Cordelia received the Young Food Engineer Award at the 12th International Conference on Engineering and Food (ICEF) at Québec City in Canada. This prestigious award is presented only every four years for an individual who has demonstrated high quality scientific and/or industrial productivity, evidence of leadership, and acting as an inspirational role model.

This award recognises her achievements and contributions to the Food Engineering discipline.

*Cordelia Selomulya receiving her award at the ICEF*





# ALUMINA QUALITY WORKSHOP CONFERENCE SCHOLARSHIP RECIPIENT

The Alumina Quality Workshop (AQW) is an international conference held once every three years by the industry. Monash Chemical Engineering Student Ms Negin Amini was awarded a student scholarship. Here Negin reports on the conference and her highlights.

This year The Alumina Quality Workshop (AQW) was hosted by Alcoa in Perth and chaired by their Principal Research Scientist, Dr Sharon Eyer, who did an excellent job managing the event.

I was fortunate enough to have been awarded a student scholarship for this conference. I would like to thank BASF and the AQW committee for funding the student scholarships which included the flights, conference registration, social events and tours to the BASF laboratories as well as the Alcoa refinery sites. I would also like to extend my gratitude to the student coordinator, Dr Wayne Tichbon, for his warm welcome and support for all the students throughout the conference. The 12 other students who attended the conference were from various Universities ranging from University of Queensland to University of Szeged in Hungary; amongst them I was the only student representing Victoria.

The AQW conference is focused on the alumina industry which revolves around the Bayer Process. To summarize, this process converts bauxite into alumina, which can then undergo the Hall-Héroult process to produce aluminium.

The structure of the conference consisted of concurrent sessions held by industry experts as well as students, predominantly on the Bayer Process. The topics of the papers presented ranged

from Energy in Alumina Refining, optimising the process to cut down on energy use, to the Floating Alumina Refinery, a concept similar to the floating facility for LNG processing but for Alumina refining where the facility can be relocated close to the bauxite supply.

To correspond with the conference theme of Innovation – Refining the Future, a number of keynote speakers from various industries presented, explaining how their work has been innovative and contributes to our everyday lives.

The opening keynote speaker was Professor Fiona Wood from the School of Surgery at University of Western Australia, whose remarkable career journey was truly inspirational. As a young female medical student in the 1970's who, upon fascination of the human forearm during an autopsy of the human body, aspired to one day become a surgeon. Never discouraged by the negativity and lack of support of many people in her industry, she became a surgeon and went on to patent a unique spray for burns victims. The spray allowed for a faster healing time and reduced scarring on the human skin. I thought that her presentation was an excellent introduction into the conference.

One of the highlights for me was definitely visiting the world's leading chemical company, the BASF laboratories. On the day of our visit we were shown a lab demonstration of the solid liquid separation technology that they currently provide to the alumina mining industry. We were shown a proprietary polymer additive that was added to a mixture containing bauxite residue and the liquor. Once this was added to the mixture, it was visible to see the solids continuously forming polymers at a very fast rate and sinking to the bottom of the test

tube, separating from the liquor. The tricky part of this technology is that the additive needs to be tailored for bauxite mined from different regions, as the bauxite composition varies from one location to the next. It is a cost effective way for companies to separate the waste from liquor, saving them money.

What impressed me the most about BASF was that they are the only chemical company who have six integrated process facilities in the world. Their largest facility is in Germany which incorporates more than 200 processes, where the by-product of one process is the feed for the next. As their facility is located next to a harbour, they have state of the art technology for the prevention of environmental contamination. In case of a chemical spill, air jets are activated around the bay which changes the direction of water just enough to allow for the chemicals to be captured and not pollute the water.

I feel very lucky to have had this opportunity; I gained a lot of knowledge and was able to network with many people in the field of chemical engineering. In 2018 the conference will be held in Queensland and hosted by Rio Tinto. I highly recommend for students to consider this opportunity and apply.



Ms Negin Amini

# MONASH CHEM ENG CLOSE UP: ASSOC PROF VICTORIA HARITOS

Victoria Haritos is the Associate Dean (Student Engagement) at Monash University and A/Professor in the Department of Chemical Engineering. Her research combines biology and engineering to address future energy and chemical needs. A/Professor Haritos joined the department in 2014 after a distinguished career at CSIRO.

Fascinated by the natural world growing up in Darwin, and inspired by a high school chemistry teacher, A/Professor Haritos has since pioneered the application of enzymes (biological catalysts) to capture CO<sub>2</sub> from coal-fired flue gas streams. Her approach has attracted international collaborators and extensive funding. Other highlights of her career include the discoveries of novel and special silk materials, adhesives and unusual fats from insects, how they are produced and their potential applications.

A/Professor Haritos was at CSIRO for 17 years in a broad range of roles. During that time she was awarded the organisation's One CSIRO Award for teamwork in successfully negotiating a cross-disciplinary 12 year multi-million dollar strategic partnership between CSIRO and Grains Research and Development Corporation (for R&D into Crop Biofactories). She also received a Service Award for industry collaboration with BOC Australia Ltd to develop the first new grain fumigant registered in Australia in 50 years.

Also during her time at CSIRO, A/Professor Haritos led the Biofuels R&D program, which, together with key industry partners, aspired to build an Australian advanced aviation biofuels industry using sustainably grown, non-food feedstocks including forestry,



agricultural residues and algae. This was a large enterprise involving a multidisciplinary team from CSIRO collaborating with the aviation industry, biofuels companies, airlines and R&D providers in an umbrella body called the Australian Initiative for Sustainable Aviation Fuels. Unfortunately, changes in federal government climate and research policy in 2013 meant that funding for this initiative was discontinued.

Now at Monash, her research is focused on developing biotechnological approaches, for example using whole microorganisms or enzymes to convert feedstocks into useful and valuable products. The feedstocks can be renewable materials like cellulose or fossil sources, but the challenge lies in improving efficiency and demonstrating scalability of the processes. Although the current drop in the crude oil price and the abundance of unconventional oil has placed greater economic pressure on competing processes, biotechnology offers advanced transformations under mild conditions with lower energy requirements.

In her role at Monash, A/Professor Haritos now has greater opportunity to interact with and mentor students. Her advice for young engineers hoping to forge a career in research: "Take on challenges, move out of your comfort zone and test your boundaries as you could find your passion there."

"For women in technological fields in particular, have confidence in your abilities and knowledge as that helps you to take on challenges and will lead to others having confidence in you as well. Build networks and keep connected, and give back to others who have helped you."

[Read more about A/Professor Haritos and her research.](#)

# CHEMICAL ATTRACTION

## SCIENCE AND INDUSTRY BOTH STAND TO GAIN FROM AN INNOVATIVE PROGRAM THAT BRINGS THEIR INTERESTS TOGETHER

“We are bringing together the interests of academic and industry leaders to identify challenges, topics and ideas that need to be addressed”

How can green chemistry reduce environmental impact caused by industrial and domestic waste? What is the potential for helping society through developing self-healing polymers? The answers to these challenges may be found by students who are working towards their PhD as part of GRIP, an innovative program that links academia with industry and government.

GRIP – Monash University's Graduate Research Interdisciplinary Program – is an incubator of industry-relevant research, explains the vice-provost (graduate education), Professor Zlatko Skrbis. He sees it as creating a catalyst for innovation that benefits students and industry.

“We are bringing together the interests of academic and industry leaders to identify challenges, topics and ideas that need to be addressed,” he says.

This year, Monash has launched a GRIP underpinned by the Australian chemistry industry. In partnership with the Plastics and Chemicals Industry Association (PACIA) and the Victorian Government's Department of Economic Development, Jobs, Transport and Resources, the GRIP puts PhD students together with more than 20 participating companies and organisations including BASF, Procter & Gamble,

3M, Agilent Technologies, Nufarm, PPG, PerkinElmer, Dulux, Axieo and KPMG. The program also involves Victoria's Environment Protection Authority and CSIRO. It links to Monash University's Green Chemical Futures initiative, which has already attracted more than \$100 million in investment.

The researchers coming out of the program will have a firm understanding of industry needs, says PACIA chief executive (and Monash alumna) Samantha Read.

“We have seen a tremendous response from industry to this initiative,” she says. “This is recognition of the vital importance of strong collaboration between academia, the research community and industry in helping to drive innovation. The role of innovation in helping to create competitive advantage for the Australian chemistry industry cannot be overstated.”

### Industrial experience

Professor Karen Hapgood, a chemical engineer, and Associate Professor Tony Patti, a chemist, oversee the GRIP program, working with a team of academics from the science and engineering faculties who supervise the students in collaborative partnerships. Students will gain industrial experience through mentorship by an industry R&D expert, and





*"The role of innovation in helping to create competitive advantage for the Australian chemistry industry cannot be overstated." – Samantha Read*

by working as interns. "The PhD projects will be industry focused, and the industry partners will be looking to commercialise the research outputs," says Joseph Lawrence, director of industry partnerships at Monash.

Mr Lawrence says students will gain from the joint influence of research scientists and industry engineers. The program also gives industry a role in fostering the next generation of chemical scientists and engineers, and the opportunity to develop relationships with Monash and its extensive research capabilities.

Many of the participating companies intend to build a deeper partnership with the university; PerkinElmer, for example, has set up an industrial flagship facility at Monash in the new Green Chemical Futures building. Another GRIP that focuses on

sustainable water management in developing Asian cities is also under way at Monash (see page 13), and other programs are being developed.

Professor Skrbis says the GRIP model was inspired by the Centres for Doctoral Training in the UK and other international best-practice models in graduate research education.

"These allow universities to productively engage with industry partners – but those partnerships also serve as embedding mechanisms for PhD students who are future captains of industry and future research leaders."

[Credit  
Article first published in Monash  
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Photo: Steve Diffey  
Words Bianca Nogrady]



# ALUMNI EVENT

Monash University Chemical Engineering Alumni Networking Night 2015  
Melbourne Convention and Exhibition Centre





# ALUMNI EVENT



# MONASH CHEM ENG HIGHLIGHTS IN BRIEF

## Monash team shortlisted for Sustainable Technology Award

A Monash team were shortlisted for the 2015 Institute of Chemical Engineering Singapore Sustainable Technology Award for their work – *Immobilizing lactobacilli proteinases for improved performance*. In their entry for the Award, Drs Lizhong He and Dominic Agyei developed a process of immobilising protein-degrading enzymes from lactic acid bacteria. This approach is not only simple, cost-effective and scalable but also produces recyclable enzymes with improved stability.

### Entry summary

Protein-degrading enzymes have broad applications in the food processing industry. Typically, manufacturers use them in soluble form to improve the functional, sensory, and nutritional qualities of food. However, traditional methods of using soluble enzymes are inefficient and expensive because these enzymes have very short shelf lives, can't be reused and rapidly break down when heated. This entry developed and analysed a process of immobilising enzymes from lactic acid bacteria, and also demonstrated that the resulting immobilized enzymes can break down several food proteins. This approach is not only simple, cost-effective and scalable but also produces recyclable enzymes with improved stability.

## Coffee stain research featured in 'The Age'

Monash Department of Chemical Engineering researchers Azadeh Nilghaz, Liyuan Zhang and Wei Shen have recently published the first mechanistic study to clarify the coffee ring phenomenon on paper. This research provides some insight into controlling coffee stain shapes for paper-based sensors.

The research examined why spilt coffee sometimes fails to produce a ring or a stain. They concluded that the coffee ring phenomenon could be altered or prevented by the absorbent properties of the surface on which the coffee is spilt.

The research featured in the Sunday Age (5 July 2015), providing an insight into Monash Chemical Engineering to a diverse and broad audience.

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