



## DIRECTOR'S WELCOME



Our hub has been very busy over the last six months, with our focus on research resulting in numerous publications. We also continued to engage with our global networks in materials science, with a number of our researchers travelling to China last November to attend the China-Australia Energy-Efficient Separation Workshop, also taking the opportunity to visit a facilities and research institutes.

Last July we had the pleasure of officially launching the hub, with several activities including a workshop, facilities tour and working lunch.

Our hub has also benefited from a number of high calibre seminars, with senior researchers sharing their valuable experience to our early career researchers.

I hope you enjoy reading our latest newsletter to learn more about our research and engagement activities.

Professor Xiwang Zhang

## RECENT CENTRE PUBLICATIONS

Research into salt adsorption materials, led by Professor Huanting Wang and colleagues, was selected as the cover article in *Advanced Materials*. This work provides a novel, effective strategy for synthesising new-generation, environmental-friendly, and responsive salt adsorption materials for efficient water desalination and purification.



### Other recent publications:

- » D.T. Myat, F. Roddick, P. Puspita, L. Skillman, J. Charrois, I. Kristiana, W. Uhl, E. Vasyukova, G. Roeszler, A. Chan, B. Zhu, S. Muthukumaran, S. Gray, M. Duke, Effect of oxidation with coagulation and ceramic microfiltration pre-treatment on reverse osmosis for desalination of recycled wastewater, *Desalination*, Volume 431, 2018, Pages 106-118.
- » Lavern T. Nyamutswa, Bo Zhu, Dimuth Navaratna, Stephen Collins and Mikel C. Duke, Proof of Concept for Light Conducting Membrane Substrate for UV-Activated Photocatalysis as an Alternative to Chemical Cleaning, *Membranes* 2018, 8(4), 122
- » Bo Zhu, Mikel Duke, Ludovic F. Dumée, Andrea Merenda, Elise Des Ligneris, Lingxue Kong, Peter D. Hodgson and Stephen Gray, Short Review on Porous Metal Membranes—Fabrication, Commercial Products, and Applications, *Membranes* 2018, 8(3), 83.
- » Bo Zhu, Gayle Morris, Il-Shik Moon, Stephen Gray, Mikel Duke, Diffusion behaviour of multivalent ions at low pH through a MFI-type zeolite membrane, *Desalination*, Volume 440, 2018, Pages 88-98.
- » Lili Song, Bo Zhu, Veeriah Jegatheesan, Stephen Gray, Mikel Duke, Shobha Muthukumaran, Treatment of secondary effluent by sequential combination of photocatalytic oxidation with ceramic membrane filtration, *Environmental Science and Pollution Research*, Volume 25, Issue 6, pp 5191-5202.
- » Kejun Lin, Ruoyang Chen, Liyuan Zhang, Duyang Zang, Xingguo Geng, and Wei Shen, Transparent bioreactor based on nanoparticle-coated liquid marble for in-situ observation of suspending embryonic body formation and differentiation, *ACS Applied Materials & Interfaces*, Just Accepted Manuscript, DOI: 10.1021/acsami.8b20169
- » Ruoyang Chen, Liyuan Zhang and Wei Shen, Controlling the contact angle of biological sessile drops for study of their desiccated cracking patterns, *Journal of Materials Chemistry B*, 2018, 6, 5867-5875
- » Bhuvana K. Shanbhag, Chang Liu, Victoria S. Haritos, and Lizhong He, Understanding the Interplay between Self-Assembling Peptides and Solution Ions for Tunable Protein Nanoparticle Formation, *ACS Nano* 2018, 12, 7, 6956-6967

## JOE DA COSTA SEMINAR

Last September we were delighted to have the opportunity to hear from Node Director Emeritus Professor Joe da Costa, who shared his 27 years of experience in research and teaching.

Professor da Costa inspired our earlier career researchers to stay focussed, even when it can feel like a challenge. Furthermore, he discussed skills and techniques in project management and how to apply this to bottle necks in studies and later careers.

He also shared his valuable knowledge on how to best maintain motivation, and the typical 'mood' cycles to expect when pursuing a PhD, which can often feel like three long years. Additionally, he shared his insights into technology maturity versus industry and academic research.

We are very grateful to Professor da Costa for his inspirational seminar and wish him the very best for his next exciting adventure.



# CENTRE LAUNCH



In July 2018 the Hon Craig Laundy MP (The Minister for Small and Family Business, the Workplace and Deregulation) officially launched our hub. Also in attendance were Ms Leanne Harvey (Executive General Manager of the Australian Research Council), Professor Ian Smith (Vice-Provost, Research and Research Infrastructure, Monash), Professor Elizabeth Croft (Dean of the Faculty of Engineering, Monash), Professor Marc Parlange (Provost and Senior Vice-President, Monash) and Professor Xiwang Zhang (Director, ARC Research Hub for Energy-Efficient Separation) and about 110 guests from the universities and industry companies.

As part of our launch we invited our special guests on a tour of the Hub's laboratories in Green Chemical Futures building.

Thanks to our volunteer team, Mr Meipeng Jian, Ms Wang Zhao and Mr Xingya Li to demonstrate the research area themes of the hub to the visitors.



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## ARC-EESEP HUB WORKSHOP

To celebrate the launch, we gathered our CIs, PIs and researchers together for a workshop at Monash. Professor Long Nghiem (UTS), Dr Stephen Holt (ANSTO), Professor Mikel Duke (Victoria University), Dr Nicholas Low (2D Water) and Associate Professor Simon Smart (UQ) presented talks about their experience in the research of energy-efficient separation and their roles in the University Industry Collaboration (UIC) model. At end of the workshop, the CIs and PIs joined the round table discussion to brainstorm the topics of the activities which will be beneficial to UIC and the expectation outcome from UIC.



## Advisory Committee

At our Hub's first **Scientific Advisory Committee Meeting** (July 2018 at Monash University) discussion centred around general research management and opportunities for the training hub. The rich experience of the SAC members in research and business provided invaluable guidance to achieve greater success.

In December a more detailed plan for 2019 was discussed by our **Industry Advisory Committee**. Our group of senior industry experts identified key action themes for the hub, including promoting collaboration among industry partners, highlighting and promoting the economic & social impact of EESep Hub, and leading a new era of membrane technology in biotechnology industry.



# CHINA VISIT

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

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

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

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

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

Two further technical visits were undertaken in the Kunshan region by Prof Xiwang Zhang, Prof Huanting Wang, A/Prof Matthew Hill and Dr Soo Leong. The Kunshan RNAi Institute (KSRI) is a non-profit research institute jointly founded by Kunshan Industrial Research Institute and Tsinghu Science Park.

KSRI is seen as an innovative driver for bioscience, and it focuses on the transformation of bio-medicine research, in particularly in the application of RNAi technologies and drug discovery. KSRI also has the role of promoting bio-medicine companies in China and initiate incubator projects, and to explore biotechnological research in the region.

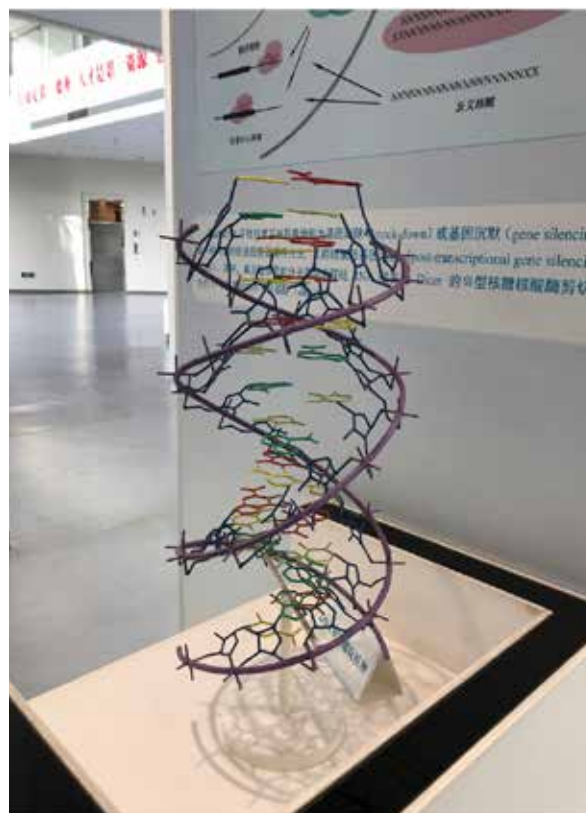
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## VISIT TO THE KSITRI

Kunshan RNAi Institute (KSRI) is an innovative driver for bioscience. It is a non-profitable research Institute jointly found by Kunshan Industrial Research Institute and Tsinghua Science Park. The institute focuses on transformation of the bio-medicine research in particularly in application of RNAi technologies and drug discovery. Another role of the institute is to promote the bio-medicine companies in China and initiate the incubator projects and explore the bio-technologies research in the region.

Our Hub Director (Prof Xiwang Zhang) and 2 chief investigators (Prof Huang Wang, A/Prof Matthew Hill) are pleased to have the opportunity to present their research outcomes with Kunshan Industrial Technology Research Institute (KSITRI). KSITRI showed great interest in the product and further collaboration will be negotiated in near future.



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## Activated Water Technologies and Consolidated Potash Corporation – Joint Venture Update

The significant progress being made by a R&D project led by Centre CI Mike Dike (Professor at Victoria University), together with industrial partner PI Mr Bahay Ozcakmak (Director of Activated Water Technologies) featured in a recent ASX media release from Verdant Minerals on 7 February 2018. The media release outlines the key role of the R&D in developing and demonstrating an improved flow sheet for Consolidated Potash Corporation (CPC) to make valuable products from the Karinga Lakes Potash Project (KLPP) as part of a Joint Venture with Verdant Minerals (ASX: VRM) that commenced in August 2017.

This project applies the innovative aMES™ technology to recover high-purity minerals, reagents and water from a range of different feedstocks. In the case of the KLPP, the aMES™ technology has been shown to be effective in recovering a number of key precursors required for the production of sulphate of potash (SOP). This water and energy efficient technology offers potential for economic advantage as well as improved environmental outcomes.

As part of the collaboration between Victoria University and Activated Water Technologies, a series of experimental studies were performed by Dr Xing Yang, Dr Peter Sanciolo, Dr Jianhua Zhang and Johnson Luo (PhD student) on a range of brines and salts sourced from the KLPP. The series of experiments was based on the core aMES™ technology platform and designed to investigate key brine processing parameters including dissolution, crystallisation and kinetic factors in the process flow sheet.

In order to optimise and validate the performance of the aMES™ flow sheet, and generate important process design and performance data, the research was scaled-up to a pilot plant which was constructed in late 2018 by AWT/CPC and Victoria University.

Development of the pilot plant is a critical step in the commercialisation pathway for the aMES™ technology, as the pilot plant provided important engineering data required to further scale-up the technology towards commercial deployment.

The research and subsequent containerised scale-up has led to the successful development of an effective aMES™ flow sheet for producing a number of high-grade mineral products.

Following the development of an efficient process, SOP was produced from intermediary salts made through the preferred aMES™ flow sheet. Importantly, the SOP was produced at room temperature, without the use of any reagents or external reactants. This is a major advantage over conventional flow sheets. Although the process flow sheet is not yet fully optimised, the SOP produced to date was of an ultra-pure grade (>K<sub>2</sub>O-52). This is a similar purity to the soluble SOP products which typically trade at a premium price compared to lower grade SOP products.

The team also identified several important strategies to simplify the development of the KLPP through the integration of the aMES™ technology by potentially eliminating the requirement for flotation, process steam, gas pipeline and a freshwater bore field, which collectively represent major costs in traditional potash production. As the aMES™ mediated process for producing SOP from the KLPP does not require reagents or external reactants, the process is not only efficient, but significantly more sustainable than conventional technologies.

## Seminar series welcomes internationally renowned Professors

**Prof Benny D. Freeman** (Richard B. Curran Centennial Chair in Engineering at The University of Texas in Austin) delivered an insightful talk, *Advanced Separation Membranes: Historical Development and Future Trends* in our hub scientific seminar/webinar. The seminar / webinar was attended by 82 guests either physically attending the seminar in Monash or through a Zoom Conference Meeting. If you missed the seminar, you can listen to it online [HERE](#).

**We also welcomed Prof Wojciech Kujawski** (Faculty of Chemistry, and Head of the Chair of Physical Chemistry and Physical Chemistry of Polymers in Nicolaus Copernicus University, Torun, Poland) for his seminar *Physicochemical Properties of Hydrophobized Ceramic Materials (Powders and Membranes)*. He has over 30 years of experience in education, research, and cooperation with diverse external companies.

**PhD student Mr Ted Ahn** has presented his research in a seminar titled *NanoIR3 and mIRage: A New Generation of Photothermal Infrared Spectroscopy for a Nanoscale Material Characterization*.

In his talk, Ted explained the physical principles and basic operation of the AFM-IR and mIRage, presenting examples of polymeric and biological materials to showcase the capabilities of both instruments.



Professor Benny D Freeman



Professor Wojciech Kujawski

## UPCOMING EVENTS

Scientific Seminar / Webinar: Prof Robert Field, University of Oxford  
4 March 2019. More info [HERE](#)

iEESep2019, 27 - 30 November 2019 (more info [HERE](#))

### Key Dates:

- » Abstract Submission Deadline  
1 June 2019
- » Notification of Abstract Acceptance  
1 July 2019
- » Early Bird Registration Deadline  
1 August 2019

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