MEMBRANE SOCIETY OF AUSTRALASIA

October 2023 Newsletter

What is covered in this issue:

- *ICOM 2023 highlights and MSA Travel Awardees*
- *Interview with Prof. Mikel Duke (Victoria University)*
- *Interview with John Warner (Chairman of JordProxa)*
- *Latest membrane science and industry news*

... and many more!

Building a membrane community in Australasia.

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ICOM2023 Highlights

The 13th International Congress on Membranes and Membrane Processes, ICOM 2023 conference, was successfully held from 9th to 14th of July 2023 at Makuhari Messe, Chiba, Japan. The conference was hosted by the Membrane Society of Japan, and organised by WA-MS, AMS, EMS, and NAMS, and chaired by Prof. Takeo Yamaguchi, Prof. Hideto Matsuyama, Prof. Toshinori Tsuru, and Emeritus Prof. Shin-ichi Nakao.

Plenary speakers

Professor Rong Wang

Nanyang Technological University (Singapore)

Bioprogrammable reverse osmosis membranes for energy-efficient water reuse and seawater desalination: from lab-scale development to commercial-scale translation

Professor João Crespo

FCT Universidade Nova de Lisboa Portugal (Portugal)

Monitoring and modelling of membrane bioprocesses

Professor Benny Freeman

The University of Texas at Austin (USA)

Emerging Basic Science Questions Regarding Water and Ion Transport in Polymers for Water Purificationand Resource Recovery

ICOM2023 Highlights

World Association of Membrane Societies (WA-MS) Award

Student Oral Presentation

Tianmu Yuan
(The University of Manchester)

Hoseong Han
(The University of Melbourne)

David Kitto (University of Michigan)

Nico Marioni
(The University of Texas at Austin)

Hiroki Fukuda
(The University of British Columbia)

Student Poster Presentation

Kana Moriguchi	Jia Zheng Oor
Qiming Zhang	Ward Wakileh
Haya Nassrullah	Johanne Pirkin-Benameur
Nico Marioni	Gede Herry Arum Wijaya
Irmariza Shafitri Caralin	Shiyu Zhang
Dan Li	Ayano Yamamoto
Yi Hsin Lin	Fanmengjing Wang
Byung Kwan Lee	

ICOM 2023 Award

Student Oral Presentation

Mizuki Kamata
(University of California, Santa Barbara)

Everett Zofchak
(The University of Texas at Austin)

Kosuke Taketsuna
(Kyushu University)

Da Xiao
(The University of Tokyo)

Agathe Uzee
(University of Rennes)

Antonio Condello
(National Research Council of Italy, Institute on Membrane Technology)

Student Poster Presentation

Chaimaa Gomri	Wan-Ni Wu
Xueli Yuan	Sumanta Sahu
Bao Tran Duy Nguyen	Yong Xuan Shi
Tsung Han Huang	Juyeon Choi
Shweta Negi	Hoan Minh Tran
Yongfan Zhu	Utkarsh Misra
Wei Rong Jian	Wenyu Liu

Next ICOM will be held in San Antonio, July 19-25 2026!

ICOM2023 Highlights

Prof. Xiwang Zhang represented MSA in attending the AMS Session at ICOM. This session saw the participation of membrane society leaders from different countries to provide an update on membrane related R&D activities. Prof. Zhang presented an overview of the recent membrane research activities in Australasia, including various events and conferences organised by MSA such as IMSTEC, ECR symposiums/events and the upcoming MSA-ISPT 2023 conference.

MSA Travel Awardees

MSA has sponsored 2 PhD students to attend ICOM 2023 by covering the cost of conference registration fees. Congratulations to the MSA travel awardees!

Javad Farahbakhsh

I pursued my master's degree in civil and environmental engineering at Kharazmi University in Tehran, Iran, in 2014. During master's program, I worked on membrane separation technology, particularly in reverse osmosis and nanofiltration membranes for water desalination. After completing my master's degree in 2017, I became a research assistant at the Kharazmi Center of Membrane Technology for nearly three years, focusing on photocatalytic membranes to degrade dyes from textile wastewater and fabricating bio trickling filters for removing formaldehyde from air. In 2021, I was offered a PhD position at Edith Cowan University, where my research revolves around the vital area of microplastics and PFAS substances' removal from water and wastewater using advanced membrane technology and innovative strategies with hydrophilic materials such as zwitterions, metal organic frameworks, and covalent organic frameworks.

My commitment to the membrane field goes beyond my academic research. As an active member of the Membrane Society of Australasia (MSA), I am honoured to be a part of the editorial board for their esteemed MSA Newsletter. In this role, I contribute by reporting on the latest membrane news worldwide and conducting scientific interviews with prominent figures in the membrane community, enriching the knowledge of our membrane family in Australia. During our initial project in PhD, we achieved significant progress using zwitterions modified membranes, introducing a specific surface patterning structure that greatly reduced microplastic fouling in forward osmosis membranes. Additionally, we explored the combined effects of microplastics and other organic foulants, such as bovine serum albumin, which yielded promising results. Our work was orally presented at the ICOM 2023 conference during the surface patterning section, where we showcased how our modified membranes successfully transformed the membrane structure into a honeycomb lattice pattern and improved their performances. Currently, our research projects are dedicated to exploring various metal organic frameworks, covalent organic frameworks, and their novel structures, aiming to address the challenges related to PFAS and Microplastic removal and fouling with membranes. I am deeply committed to contributing to the advancement of membrane technology and its applications for a sustainable and cleaner future.

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Hashim Jalil Khan

I hold a B.Eng. (Hons) degree in Chemical and Biomolecular Engineering from the prestigious University of Sydney, where I graduated with First Class Honors in 2020. My educational background has provided me with a strong foundation in advanced engineering principles and cutting-edge research methodologies.

Currently pursuing my PhD at the University of Sydney, my research focuses on wastewater treatment. Specifically, I am working on the synthesis of cobalt-based bimetallic catalysts for the degradation of antibiotics using advanced oxidation processes. Additionally, I am exploring the coating of catalysts onto inorganic membranes to assess their efficacy in rejecting/degrading antibiotics while measuring water flux.

This year, I was honoured to receive the MSA travel award, which enabled me to attend ICOM 2023 in Chiba, Japan. This invaluable experience allowed me to network with researchers worldwide and gain insights that can have a significant contribution to my research work. Moreover, as a student member of MSA, I am able to stay updated on various events and scholarship opportunities tailored for students like myself.

Scientific Interview

In this edition of the academic engagement section, we interview Prof. Mikel Duke from Victoria University. He is the Professorial Research Fellow, Membrane Science and the Editorial Board member of the "Desalination" journal. Prof. Duke was the founding President of the MSA and has recently completed his three year term as President of the World Association of Membrane Societies (WA-MS). He is also a former panel member of the Australian Research Council College of Experts.

Interview between Dr. Amir Razmjou and Prof. Mikel Duke

Left: **Dr Amir Razmjou** Right: **Prof. Mikel Duke**

Amir: Thank you very much for accepting our invitation for interview with MSA Newsletter, we are honoured to have you here. Could you kindly provide us with a brief introduction of yourself, your background and the journey that led you to the field of membranes?

Mikel: Thank you very much, Amir. It's a pleasure to talk to you. I completed my Bachelor of Engineering at the University of Queensland in 2000. Following that, I pursued my PhD in chemical engineering at the University of Queensland (UQ), which I successfully completed in 2004. My PhD was sponsored by Johnson Matthey Technology Centre in the UK.

I began my journey into membrane research during my final year of engineering when I met Professors Joe da Costa and Max Lu. They were working on inorganic membranes for gas separation, particularly hydrogen. This then became the focus of my PhD. I did my PhD in ceramic membranes for separating hydrogen and carbon monoxide for fuel cell pretreatment. My industry engagement began through sponsorship from the Johnson Matthey Technology Centre in the UK, offering an exciting opportunity to apply our research to clean energy solutions.

Amir: So, what happened after your PhD? Did you return back from England to Australia?

Well, my PhD was still based at UQ and I visited JMTC twice to translate the research in their laboratory and explore the commercial practical opportunities. I continued to expand my research into hydrogen separation from carbon dioxide with Profs. da Costa and Lu. Initially, the focus was on coal gasification to produce syngas for pre-combustion carbon capture. Over time, this project expanded significantly, and I remained engaged as a postdoctoral researcher at UQ for an extended period.

Amir: So, you finished your PhD at 2004 and you were there for several years as a post doctoral researcher. Please tell us about your journey as a research fellow and lecturer at UQ?

After completing my PhD, I started as a Research Fellow at the ARC Centre of Excellence for Functional Nanomaterials at UQ. Subsequently, I transitioned to a lecturer role and then applied for an ARC Linkage International Fellowship. During our research in gas separation, we naturally brought new ideas and opportunities, as is typical for researchers. Consequently, we began to direct our research for potential applications in water treatment. This involved adapting ceramic or inorganic molecular sieving membranes for water treatment over the years while I held the positions of Research Fellow then Lecturer at UQ.

Amir: Interesting. And then, for how long were you in UQ as a Research Fellow and Lecturer?

Mikel: Well, that was from 2004 to about 2007. After that, I moved over to the US with Professor Jerry Lin at Arizona State University, and that was a really exciting opportunity also for me personally because since then, I got married and had my first child. My child was born in Australia and then we moved to USA and then we had his first birthday over there as I stayed in USA for around nine months. I was working on desalination within that short period. During that time, I applied for a job that was advertised at Victoria University to work on water treatment and membranes with Prof. Steven Gray. It was so exciting to move back to Australia with this new opportunity.

Amir: Right, so this was the time that you met Stephen Gray, and since then, you stayed in Victoria, am I right?

Mikel: That's right. I moved back to Australia from the USA, but this time to Melbourne.

Mikel: However, I had previously met Professor Stephen Gray during my time as a Research Fellow at UQ. It was during this period that I got to know his research in membranes, which significantly contributed to my interest in the opportunity at Victoria University.

Amir: Fantastic. Are you originally a Queenslander or are you from Victoria?

Mikel: I am originally a Queenslander, but I moved to Melbourne in 2008 and I have been here in Victoria for 15 years. So, I have spent more time in Victoria as a researcher.

Amir: Alright, so let's get to the second question. I'd like to hear about the history and development of MSA since you played a role as one of its founders.

Yes, certainly with pleasure. I was very excited to work with a team of people to found the MSA in 2008. An association for membranes in Australia has been a dream of some people, particularly Prof. Tony Fane, but that sort of association was not there at that time. During my PhD, I recognised that UNSW was actively involved in membrane research, and we would occasionally cross paths at conferences like IMSTEC. However, beyond these occasional encounters, there was no structured way for us to establish stronger connections. I was aware that there were so many membrane researchers out there, and I believed that there was a need for something to bring us together and allow us to get to know one another better. The idea happened exactly after ICOM 2008 in Hawaii and we started the MSA after that. I should mention that Dr. Anita Hill was one of the key people who introduced me to the idea. We started to work together and then we established the first board registered as a company.

Amir: So, it's initiated in Hawaii with Anita Hill in 2008?

Mikel: Yes, It was just shortly after I arrived back from Hawaii. Apart from me and Anita, other people also came together to found the MSA including Dr. Ludovic Dumee, Prof. Bradley Ladewig, Prof. Joe da Costa, A/Prof. Pierre Le-Clech, Prof. Stephen Gray, Prof. Sandra Kentish and Prof. Vicki Chen as the board of MSA directors and Prof. Tony Fane as the honorary Patron.

Amir: It's truly fascinating to learn about the founders of MSA. Mikel, how do you feel when you see how MSA has changed over the years, and ultimately arriving at its current status of increasing recognition and popularity?

Mikel: It is really exciting and great to see that it is getting so much better. It was because of people like yourselves and all the other current board members that made it happen. It brings it to life and we are now onto the fifth president to continue this journey. In the early days, it had virtually no revenue, just a minimal amount, certainly nothing like what we see today. It is really amazing and impressive to see this transformation. I believe it is a testament to all of you and the incredible efforts you've put in to maintain it in such a constructive manner.

Amir: Great, thank you very much. I appreciate all of your support and everything that you had done and have been doing for MSA. Now, if you don't mind, could you briefly mention your involvement with the World Association of Membrane Societies for the benefit of our audience?

Mikel: Certainly. I had the honour of serving as the President of the World Association of Membrane Societies (WA-MS) in its second term. WA-MS was initiated by Prof. Bart Van der Bruggen from KU Leuven, Belgium. He led a team, including an initial committee comprised of representatives from the three key founding societies.

Mikel: The Aseanian Membrane Society, the European Membrane Society, and the North American Membrane Society. Together, they established a constitution for WA-MS and launched it during the ICOM conference in San Francisco in 2017. Under Prof. Bart Van der Bruggen's leadership, the organisation established working groups focused on education, website development, and event calendars, which gave WA-MS a strong foundation. The tradition within WA-MS is that it moves to the next founding society to host it, and in this case, it transitioned to the Aseanian Membrane Society, where I took on the role of President. My term just finished two months ago before the ICOM conference in Japan this year. It has now been handed to the North American Membrane Society.

Amir: Great, I hope that in the future, MSA can become a part of the World Association of Membrane Societies and actively contribute to finding solutions for global challenges, particularly in addressing issues related to environmental sustainability and membrane technology. As you are aware that obtaining research funding, whether from government sources or industry, requires a substantial amount of knowledge and experience. What guidance or suggestions would you provide to early and mid-career researchers navigating this process?

Mikel: That's an excellent question. The global challenges I faced when I began my career were just as crucial as the ones today with just a different context. My suggestion is to maintain a sense of curiosity and to consistently question your findings, your focus, and your motivations. You always have to make sure your work remains interesting. Collaboration with others is equally important. It's challenging to approach funding solely on your own. Ideas and motivations vary, but when you share your motivation with someone else who brings a different perspective or motivation to the table, it can greatly enhance the significance of your work.

Mikel: This collaborative approach can result in more compelling and exciting funding proposals, especially for projects related to discovery or fundamental research. Obviously, establishing strong relationships with the key individuals you work with or collaborate within your scientific community is essential. However, when it comes to industry partnerships, engaging with industry colleagues is extremely important. They have a deep understanding of the challenges their specific industry encounters, and often, they have insights into problem-solving approaches that may not even be documented in scientific literature.

Amir: Correct. One of the challenges for the younger generation is establishing connections with industry. As you mentioned, finding like-minded individuals is crucial. How can we kickstart this process? It's not as simple as just knocking on the door and saying, 'Hey, I want to talk.' How do we go about initiating these collaborations effectively?

Mikel: That's a good question, and it does take some time, especially as an early career researcher. At that stage, I was more research-focused, with some experience from my PhD. But engaging with the industry was a new challenge. So, where do you find these industry connections? In my case, transitioning into water treatment, partnering with colleagues or mentors who already had these connections was incredibly helpful. They could make introductions on my behalf.

Another effective approach is through organisations like MSA, which provide a solid foundation for industry networking. Like-minded industry professionals are often part of such organisations and can facilitate valuable connections. It is all about building and expanding your network and increasing your visibility.

Amir: One of the primary challenges faced by early and mid-career researchers today, in addition to securing research grants, is finding the right balance between teaching and research responsibilities.

Amir: What advice or recommendations do you have for maintaining this balance effectively for early and mid-career researchers?

Mikel: Well, Amir, I'm not sure if I'm the most qualified person to answer this question. While I did some teaching during my time at UQ, I have held research-only positions for most of my career.

Amir: What advice would you give to your younger self, the version of you from 20 years ago when you began your PhD in 2002?

Mikel: My advice is to be more patient. It is important to build a network and always take risks, and never shy away from opportunities. Looking back, I've found that the most challenging and intimidating experiences often resulted in the most valuable outcomes.

Amir: Lovely answer. Let's go to rapid fire questions. If you had to pick a different career, what would it be?

Mikel: Well, I would really like to learn to fly a plane.

Amir: Amazing. If you had to choose one city to live in for the rest of your life, which city would it be?

Mikel: That's an interesting question. I always like European cities, so I might choose to reside in one of them. Montpellier, which I found to be exceptionally beautiful during my visit, could be on my top list.

Amir: If you had the chance to select one individual, whether from history or the contemporary world, for a dinner meeting, who would you choose?

Mikel: I have had a dinner with Dick Smith many years ago which was very inspiring. Maybe I would like to have dinner with Steve Jobs.

Amir: Great, thank you very much, Mikel. I really appreciate it. It's fantastic to have you always in our community.

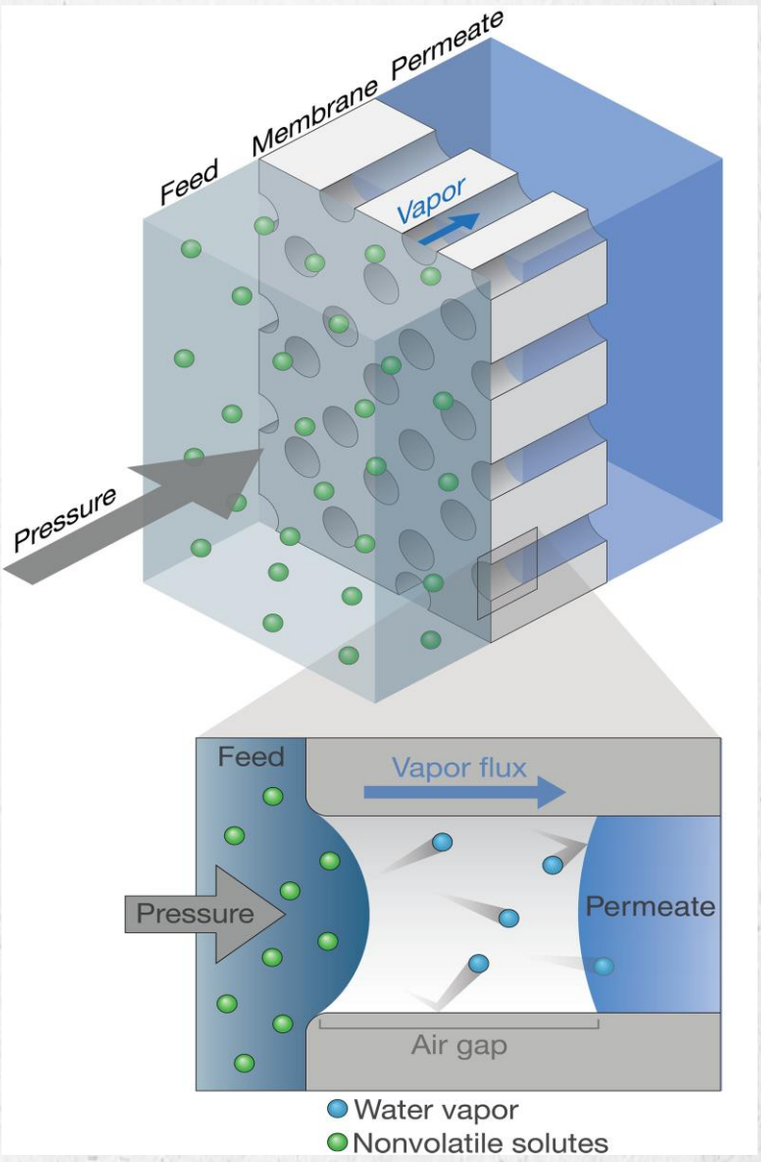
Mikel: Thank you so much Amir, it's been a great pleasure and a great honour to talk to you.

Pressure-driven Membrane Distillation for Fast and Selective Water Purification

BY Mitra Golgoli

Pressure-driven distillation (PD) is a relatively new concept in desalination, offering the advantages of reverse osmosis (RO), while efficiently removing nonvolatile substances. The PD technique can also accommodate difficult feeds without the need for the heat energy used in membrane distillation. In PD, pressure, rather than heat, is applied to the feed side to induce a gas-liquid phase transition through a membrane. This process allows for evaporation on the feed side, gas-phase diffusion through the membrane pores, and subsequent condensation on the permeate side. While the theory of desalination through PD is feasible, practical implementation has been hindered by the lack of suitable membranes. Recently, a proof-of-concept study was conducted by Nguyen et al. using air-trapping hydrophobic membranes. The membranes were fabricated by anodic aluminum oxide substrates with a controlled hydrophobic coating, featuring uniform pore diameters. Due to decreasing the air layer thickness, the membranes could achieve normalized permeabilities of up to 8.9 kg/m^2hbar without sacrificing salt rejection. Moreover, due to the small length scale and conduction through the nanopores, the nanopores remain isothermal, and the energy required for evaporation is immediately recovered by condensation. Additionally, the performance of air-trapping membranes remains unaffected even when exposed to sustained high concentrations of chlorine and ozone. Using small monodisperse pore sizes and thin air layers enables operation at high applied pressure without wetting (read more).

While this work has elucidated the fundamental principles of PD technology, the authors noted that there are still significant knowledge gaps pertaining to the interfacial and evaporation phenomena that underlie the process. That signifies the need for further research and development in this area, given the high potential of the PD technology for advanced water treatment.



Source: Nguyen, D., et al. "Pressure-driven distillation using air-trapping membranes for fast and selective water purification." Sci. Adv. (2023)

MSA-ISPT 2023

Plenary Speakers:

Prof. Lei Jiang
Chinese Academy of Science

Prof. Suzana Nunes
King Abdullah Univeristy
of Science and Technology

Prof. Huanting Wang
Monash University

Keynote Speakers:

Prof. Zhi Wang
Tianjin University

A.Prof. Ludovic Dumee
Khalifa University

Prof. Gyorgy Szekely
KAUST

Prof. Hokyong Shon
University Technology, Sydney

Prof. Benny Freeman
Monash Univeristy

Prof. Xiwang Zhang
Queensland University

A/Prof. Rakesh Joshi
UNSW

Prof. Jin Jian
Soochow University

A.Prof. Dan Zhao
National University of Singapore

and more...

MSA welcomes you to join our 2023 Annual Conference, co-hosted by The International Congress on Separation and Purification Technology in the beautiful city of Perth, Western Australia on 3-7 December 2023. Our plenary and keynote speakers will discuss the latest advancements and cutting-edge developments in membrane technology during their presentations. For more information, please visit MSA- ISPT 2023 | MSA (membrane-australasia.org).

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Dr. Shouliang Yi

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Dr. Milton Chai

Advancing Membrane Technology: Ultrathin Inorganic Membranes for a Sustainable Future

BY Mohadeseh Najafi

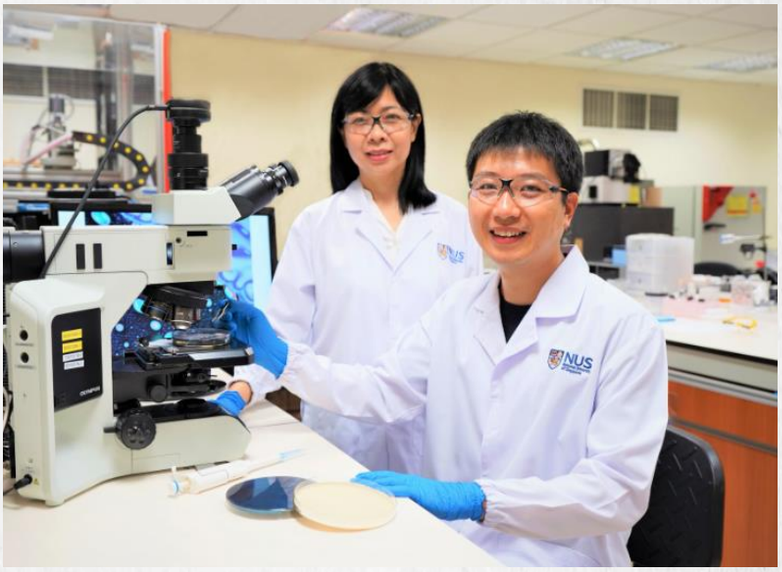
In a ground-breaking study published in Nature on March 29, 2023, researchers from the National University of Singapore (NUS) have introduced a game-changing innovation in membrane technology. They have developed a novel strategy for creating ultrathin inorganic membranes that can function without any supporting substrate. This breakthrough promises to revolutionize multiple industries by offering exceptional versatility, energy efficiency, and sustainability.

A Novel Synthesis Approach

Conventional membrane technologies often rely on energy-intensive processes. They also require complex regeneration and further treatment of filtered components. **Dr. Zhang Chen**, a postdoctoral research fellow at NUS, led a pioneering synthesis strategy by manipulating free-floating inorganic building blocks in a liquid environment to self-assemble into a desired membrane structure. This tuneable process allows precise control over membrane thickness and pore characteristics, optimizing energy efficiency. “Our study has also allowed us to take a fresh approach to rethink how inorganic membranes are traditionally developed,” added **Dr Zhang**. (read more)

Reshaping Membrane Development

This research has not only improved energy efficiency but also transformed the way inorganic membranes are developed. The team presented a synthesis template that other researchers can adopt, potentially leading to the discovery of novel membranes with a broader compositional range, all in a scalable and cost-effective manner. "Our new technique has the potential to transform industries that heavily rely on membranes for their operation, particularly those related to energy or the environment,” said **Prof Ho**. (read more)



Dr. Zhang Chen (seated), part of Professor Ho’s (standing) team, developed a novel synthesis strategy for highly efficient inorganic membranes. (Source: NUSnews)

Expanding Membrane Functionality

The study also explores an exciting dimension of membrane functionality. By incorporating highly selective 2D barriers, the energy flow across the membrane can be precisely controlled. This opens up a world of possibilities, including selective ion filtration based on charge, harnessing various forms of energy (thermal, electrical, or light), and concentrating specific molecules selectively. This adaptability is particularly valuable in energy-related applications, such as fuel cells and solar energy conversion.

Looking Ahead

The team has strategic plans for the future, aiming to lead interdisciplinary research and advancing the technology even further. “By exploring the vast range of membrane compositions and coupling them with various forms of energy, we hope to unlock new applications and make further strides towards a more sustainable future,” shared **Prof Ho**. (read more)

Industry Engagement

In this edition of the industry engagement series, we interview John Warner who is the Chairman of JordProxa formed from a joint venture between Jord (process company) and Proxa (membrane company). He has an incredibly rich experience encompassing engineering, sales and management. We are very grateful to him for sharing his journey in this interview.

If you would like to nominate a person to be featured in this section, please contact our Newsletter Coordinator and Editor or Associate Editor at amir.razmjou@ecu.edu.au / milton.chai@uq.edu.au.

Interview between Dr. Amir Razmjou and John Warner

Amir: We are honoured to have John Warner here today with a very rich industry background and academic portfolio. Can you please tell us about your background? It's a long span to cover (about 30-40 years)!

John: After I graduated from Melbourne Uni (Chemical Engineering) in the 1970s, I had the opportunity to get some practical experience working at Exxon for 2 years. An opportunity later came up at CSIRO and I took up a research job working on effluents which I thoroughly enjoyed. Later, I was able to go back to Melbourne Uni to do my PhD project on dual solvent extraction, since CSIRO agreed to fund it if I could find a topic that complements the effluent work that I was doing with them. In 1987, I set up a company (wool scouring) with two other guys and we had three brilliant years. The company turnover in the first year was $300k, and $4 million around 3-4 years later. The wool industry imploded after that, and suddenly the whole game changed. We were left with 2 choices, either sell the company and make a loss, or keep going which would have been a disaster. That was when Jord, a chemical engineering company in Sydney, came along. They were interested in buying the technology rather than the company, as their business model is to design and subcontract. A condition that they put on the sale was that I was basically constrained to work for Jord. That could have been awkward, but one day, I received a fax from the owner of Jord that said "John, here's the deal… What do you think?". I saw it and remember exactly what I wrote back: "I should negotiate, but how about I say yes?" and that was it.

Amir: Can you briefly tell us about Jord International and your time working there?

John: Jord had mainly been involved in oil and gas doing heat exchangers and some solid-liquid separation, so those were the two sides of the business when I joined. I was one of a pool of about 11 people. I was a salesman for equipment in the wool industry, so this shows how a career can go in all sorts of directions. Strangely, the very first sale we made was to Smith & Nephew for a bandage plant. The reason we made that sale was because along my career, I'd always been conscious that the control of process systems was where the action was. The control of process plants had changed enormously from when I started in the 70s to where it was in the 90s when we made this sale. In the 70s, everything was pneumatic, but it shifted to electronics during the 80s. Meanwhile, PLCs were developed in the late 80s, and I thought I should learn how to program these things. I used to do process design with PLCs as an interest on the side, so when I joined Jord, I was able to design a control system to cut bandages accurately for Smith & Nephew. This was in my first year at Jord. It wasn't big but it was enough to make sure they didn't feel like they needed to sack me. Then two years later, we sold a large evaporation plant for wool effluent. At the time, it was the largest sale Jord had made.

Amir: That's interesting. That was the time when you moved to evaporation?

John: That was when my career in Jord took off. A contact of mine in Western Australia phoned and told me that a company in France (Evatex) could evaporate effluent using one-tenth of what we think the energy input should be. I did some research and found out that the principle was mechanical vapor recompression (MVR), which made sense and it was neat that they've done it with wool scouring effluent. I got into contact with Evatex, and we were able to licence their technology to build a plant in Rockingham, Perth in 1997. I believe this was the first plant done at scale in Australia with electrically driven MVR.

Amir: In the interest of time, let's flash forward to the 2000s around the time when Jord International expanded.

John: There was a mining boom and wool scouring went quiet in Western Australia, so we as a company started to look for different things and I became heavily involved with small modular plants. Jord had sold maybe four or five small modules (~$1 million) over 10 years before this, which was not much, but we saw this as an opportunity when things were going quiet. So, I was given this area to develop. By 2010, we built this up to $60 million and it was the biggest division in Jord.

During this time of expansion, I went from a solo operator to head of the division/technology in Jord. As a reward, Jord freed me up from the responsibility to sell and gave me a blue-sky portfolio to develop new technology. For a few years, we were mainly developing solid-liquid separation ideas generated by one of my colleagues. We set up joint research projects and secured government funding with the University of Newcastle. Today, selling Viper filter is now one of Jord's booming business streams (~$30-40 million/year).

We struggled for a while in what one of the researchers called the valley of death. That is the phase where you go from a pilot plant that works to a demo plant that can produce stuff. If you can traverse that then you can be successful, and the Americans have been brilliant at getting across that bridge.

I think unfortunately in Australia, we fall into the British tradition. We're pretty good at

getting the ideas and building the pilot plants, but we're still not able to get across the valley of death. There's a variety of schemes like from the government that gets you $1 million for your project, but who is going to give you the $5 million from that point to traverse that valley?

Amir: Thank you for sharing your very interesting journey! Given that our audience are mainly membranenologists, can you share with us about your exposure to membranes?

John: I first became aware of membranes for desalination applications, but we were more involved in industrial evaporation and crystallisation. There was a nickel boom in the late 90s in Western Australia that needed large amounts of clean water inland. The miners wanted to treat brackish water, which was a little trickier for membranes located inland compared to the usual plants on the coast. They needed to harvest most of the water to end up with a small concentrated reject stream that they could evaporate in solar ponds rather than having to pump large volumes of dilute reject back to the coast.

There were only a handful of companies that could do this. One was an Israeli company (IDE Technologies). At that time, my colleagues were stubborn. They saw low cost MVR evaporation coupled with membranes as competition to what we offered. In reality, they were complimentary.

You can call this one of the foundation lessons in my career. Nowadays, a lot of simple jobs with brackish water that need be cleaned up are certainly solvable with membranes. And if membranes alone cannot do it, then low cost evaporation from IDE and various other MVR companies coupled with membranes can do it. That portion of the market was chopped away for us.

Things became interesting when the battery chemical boom came up in 2017 and we started to get inquiries in the lithium battery chemical space. The one of interest to membranes is probably the feed water supply. Battery plants need ultrapure feed water. Ideally, they would produce it with membranes, but there was a point where they had a reject stream and that's where Jord became involved to solve the overall water balance. We were lucky in the sense that to tackle the market for the battery chemical space, we were encouraged to form a joint venture with Proxa, which is a membrane company.

Amir: Ah, I see! So that was the time when Jord formed a joint venture with Proxa?

John: Yes, we came together and the rivalries between membranes and thermal evaporation continued even though we now had membrane technology. For example, a problem would come in and some would say we ccan do this with evaporation alone. We can take a feed of a few thousand TDS and bring it to 100,000-200,000 TDS. The membrane people meanwhile were saying they could concentrate to 20,000 TDS. Although it sounds like only one-eight, if you think about it, a lot of water is removed to concentrate by a factor of almost 10. If you do the economics, it's just a no-brainer to use membranes before you evaporate. They have much lower capital and energy cost. It's funny that even to this day within our company, people will still say "we should use evaporation alone, it's safer".

Amir: Very interesting that Jord joined forces with Proxa rather than compete.

John: Proxa acquired some crystallisation skills in South Africa and they saw a huge opportunity in battery chemicals, but they weren't able to sell particularly in Australia.

We could sell but needed their crystallisation expertise, so we joined forces as there were two other big players including Veolia that each took up about 40% of the market. We formed the partnership with the ambition to get to 30% of the market and we hit that in the first year and stayed there roughly. I would say it worked out well.

Amir: Can you give some advice to the ECRs and fresh graduates who are looking to pursue their engineering career in academia or industry?

John: The key thing for a researcher in a technology driven field like engineering is that you need industrial experience. It's one thing to be a theoretician in chemistry or physics, but for engineering it doesn't quite cut it. It's certainly been the basis in the US if you look at why MIT or Stanford is what it is, it's because people move to-and-fro academia and industry relatively easily. I don't deny that it can be difficult to do that in Australia now. Aside from that, you also need to have a mindset that enables it. I was always very interested in doing things from first principles. I love fluid dynamics and solving problems from the very basics. I understood these things were fundamental to good thinking. When I was in Jord, the reason they allowed me to be head of technology was because I always had ideas and I wasn't afraid to take them forward.

Amir: We know that industry engagement is important (from academic perspective), so what would be your advice on how academics can approach the industry?

John: It's very important for universities to approach industry. I think the interesting nexus is between universities and small-to-medium enterprises (SMEs), but I may be biased.

Let's say SMEs with less than 200 employees and turnover of around $100-200 million. I think a lot of those are very interested in how to get to $500 million, and the way to do that successfully is to find an emerging technology to back. That's where there's definitely a role for universities.

Amir: We have a tradition of asking some rapid-fire questions to finish off our interview. The first question is: If you could choose another profession, what would it be?

John: I think it would have been architecture.

Amir: If you could pick any city to settle in permanently, which would it be?

John: I guess I'll say Perth. I'm not really a city person in many ways. I live in Margaret River 80% of my time and 20% in Perth, and I feel like that I've stumbled on paradise with that balance.

Amir: If you could choose one person (present or past) to have dinner with, who would it be?

John: It would be Bill Clinton. I'm not sure if I agree with him on everything, but I reckon it would be a very interesting dinner. He might even play the saxophone.

First Full-scale Implementation of Biomimetic Membranes in Europe

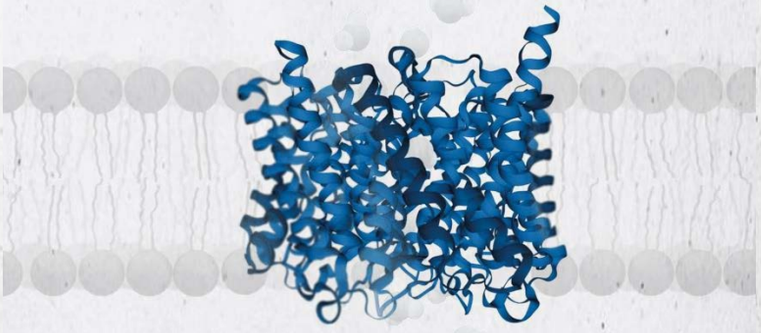
After a decade of development, the aquaporin-based biomimetic membrane is now marching its way to real applications.

Aqualia, the fourth largest Water management company in Europe is in collaboration with Danish water technology company Aquaporin to use its biomimetic membrane elements at municipal water treatment plants. The Aquaporin membranes were successfully tested in several new full-scale municipal drinking water treatment plants.

“We are experiencing an increased interest and preference for biomimetic solutions from the municipalities where we are present, and Aquaporin will help to meet these expectations. The scope of the collaboration is for Aqualia to primarily use Aquaporin membranes in certain applications when they help achieve the best water quality for our customers in a sustainable manner” says Victor Monsalvo, Aqualia Head of Eco-efficiency Area.

Before this long-term partnership between Aquaporin and Aqualia, four pilot projects were commissioned in different locations in Spain. One project has demonstrated a 20% performance increase when using Aquaporin’s biomimetic membrane elements to remove nitrate compared to conventional membranes. Similar performance improvements were observed for removing sulphates and fluorides during brackish water desalination.

“We are pleased to help Aqualia deliver clean drinking water to municipalities all over the world with our biomimetic membranes. After working together for over a year, we are very glad to see our efforts turn to commercial success. We expect to see the demand for biomimetic membranes rise, as municipalities become increasingly aware of the technology and its merits in terms of efficiency and sustainability. Our collaboration with Aqualia prepares us for that,” says Matt Boczkowski, Aquaporin CEO. (Source: Filtration + Separation)



Aquaporin water channels provide fast water transport to cell membranes and are embedded into polymeric membranes to make biomimetic membranes.

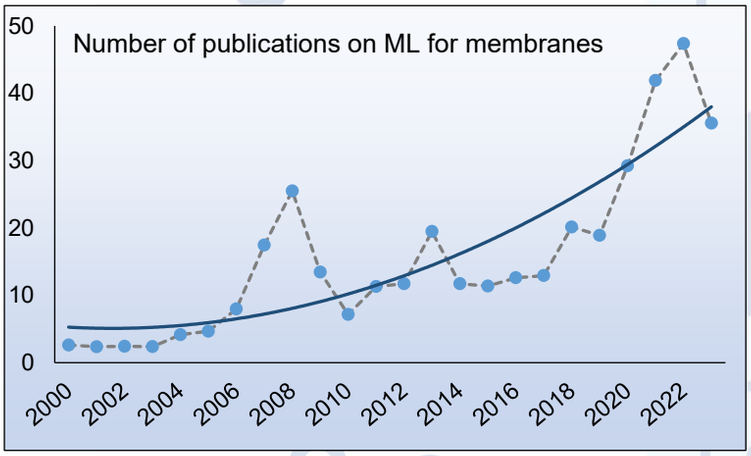
Machine Learning for Membranes!

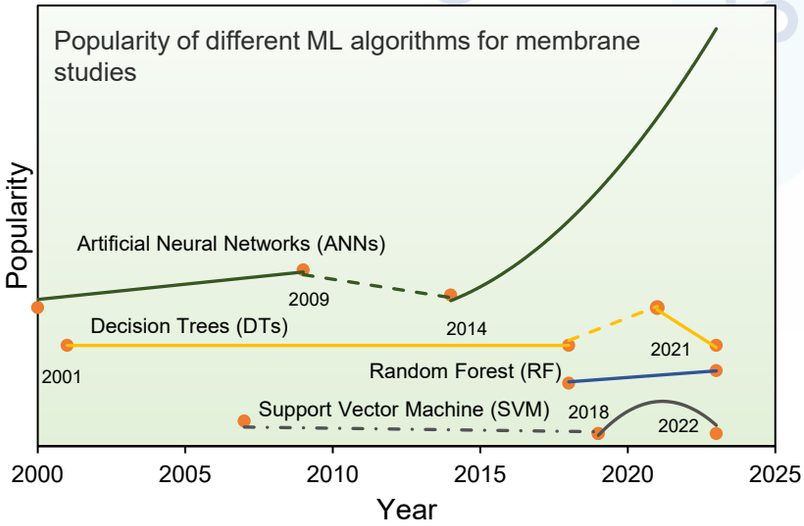
By Hoda Khoshvaght & Milton Chai

What is machine learning?

Machine learning (ML) is a subfield of artificial intelligence (AI). It focuses on developing algorithms and models that enable computers to learn and make predictions or decisions without being explicitly programmed. It involves using data to train these algorithms, allowing them to recognise patterns, make inferences, and improve their performance over time.

The number of publications on ML for membranes has risen steadily over the years, with artificial neural networks (ANN) being the most popular ML algorithm applied.

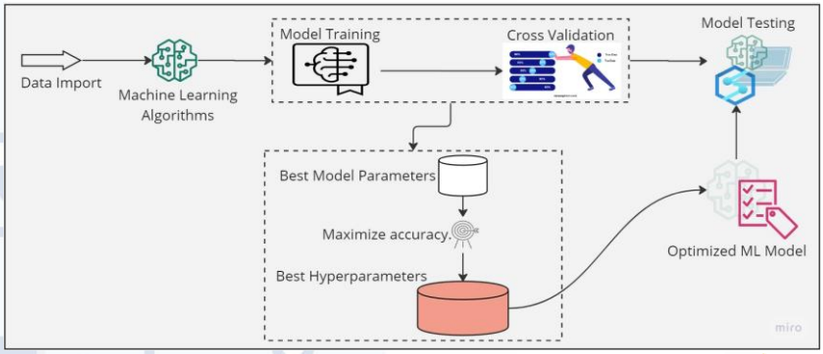




* The publication data in the two graphs above were extracted from Scopus database.

Fundamental principles and procedures of ML methodology

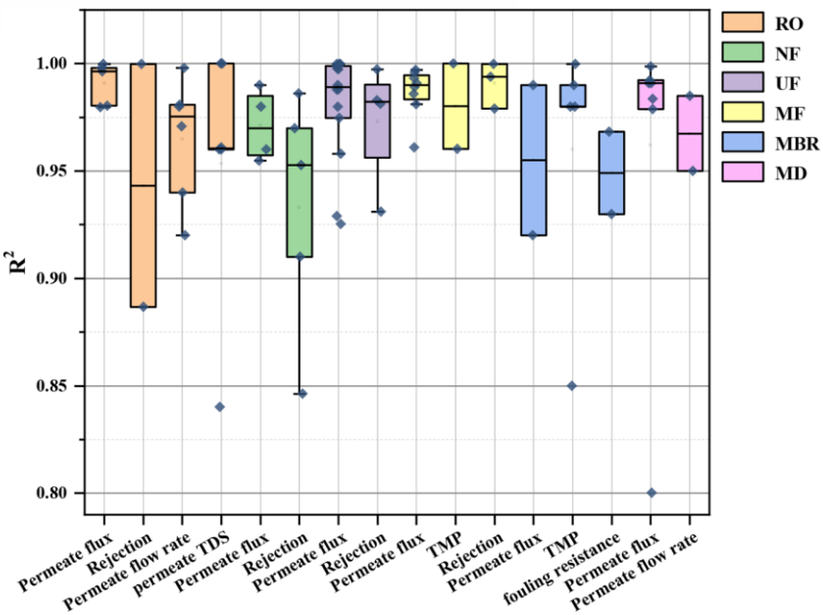
ML involves three key steps: training, cross-validation, and testing. The basic procedure is to fine-tune model parameters with training data, optimise using validation data and assess for efficient, accurate predictions.



Key applications of ML for membranes

Examples of Key Applications
Membrane design and discovery
Prediction of membrane filtration performance of drug molecules
Assessing membrane lifetime
Designing and optimising thin-film nanocomposite membranes
Forecasting plasticisation pressure
Discrimination of membrane proteins
Prediction of membrane fouling

One of the most common applications of ML for membranes is related to membrane fouling prediction. The prediction accuracy of ANN algorithms for different membrane filtration systems' fouling is shown below.[1]



One of the World's Largest Energy-Efficient Desalination Plants to be Delivered in Abu Dabhi

Veolia, the world leader in water technologies, will lead, via its subsidiary SIDEM, a consortium in charge of the engineering, procurement and construction (EPC) on the Mirfa 2 desalination project commissioned by Abu Dhabi National Energy Company PJSC (TAQA) and ENGIE. Located in Abu Dhabi, this state of the art Reverse Osmosis Desalination (M2 RO) will be the third-largest desalination plant in the United Arab Emirates (UAE). With a production capacity of 550,000 cubic meters per day of potable water, it will provide clean drinking water to approximately 210,000 households while offering increased efficiency and a reduced environmental footprint. The contract represents revenue of approximately 300 million euros for Veolia. Project construction will begin in Q2 2023 so the plant can be commissioned by 2025.

Most of the drinking water used in the UAE comes from the sea. To manage the growth in water consumption and to compensate for the aging of existing facilities, mainly thermal desalination plants, the country has decided to use the latest advanced technologies and engineering processes to increase its desalination capacity while reducing its energy consumption. A strategy that strongly supports the country's 2050 carbon neutrality ambition.

Relying on Veolia's worldwide expertise in water desalination, the Mirfa 2 plant will follow the latest developments in environmental and efficiency standards for desalination, featuring advanced technological processes such as reverse osmosis, which represents strong efficiency gains compared to traditional thermal desalination, to lower energy consumption and improve productivity. These technological advancements allow to slash energy use by 80% compared to the 1980s, when thermal desalination was predominant.

Source: Veolia Water Technologies

Upcoming Membrane Events

CURRENT EVENTS	DATE OF EVENT	ABSTRACT SUBMISSION
16th International Conference on Catalysis in Membrane Reactors Donostia-San Sebastian, Spain www.iccmr16.org	16 – 18 Oct 2023	**Closed**
6th International Conference On Desalination Using Membrane Technology (MEMDES 2023) Sitges, Spain www.elsevier.com/MEMDES	19 – 22 Nov 2023	**Poster abstract submission open until 1 November!**
2023 Annual Conference of the Membrane Society Australasia (MSA-ISPT 2023) Perth WA, Australia www.membrane-australasia.org/msa-ispt	3 – 6 Dec 2023	**Closed. Registration open until 15 November!**
The International Conference on Desalination, Environment And Sustainability (IDEAS 2024) Abu Dhabi, UAE wp.nyu.edu/abudhabi-ideas2024	22 – 23 Jan 2024	**Closed. Early Bird Registration by 23 Oct 2023!**
9th International Conference on Organic Solvent Nanofiltration Thuwal, Saudi Arabia osn2024.kaust.edu.sa	3 – 7 March 2024	**Submit abstract by 1 December 2023!**
19th IWA Leading Edge Conference on Water and Wastewater Technologies Essen, Germany iwa-let.org	24 – 28 June 2024	**Call for outline papers open until 15 December 2023!**

MSA Newsletter Taskforce

Meet our newsletter team for this October edition!

From left to right:
Vedant A. Joshi, Shiyang Huang, **Dr. Milton Chai (Associate Editor),** **Dr. Amir Razmjou (Newsletter Coordinator and Editor)**, Mitra Golgoli, **Dr. Masoumeh Zargar (Associate Editor)**, Weonjung Sohn, Mohadeseh Najafi, Javad Farahbakhsh

Our Newsletter team is expanding! Please welcome our new assistant editors to the team!

Dr. Wafa Ali

Hoda Khoshvaght

Shokat Akbarnezhad