MEMBRANE SOCIETY OF AUSTRALASIA

March 2023 Newsletter

What is covered in this issue:

- *IMSTEC and MSA Events Highlights*
- *Interviews with academic and industry membranenologists*
- *Emerging membrane science news*
- *World's Largest MBR Facility Under Construction*

... and many more!

Building a membrane community in Australasia.

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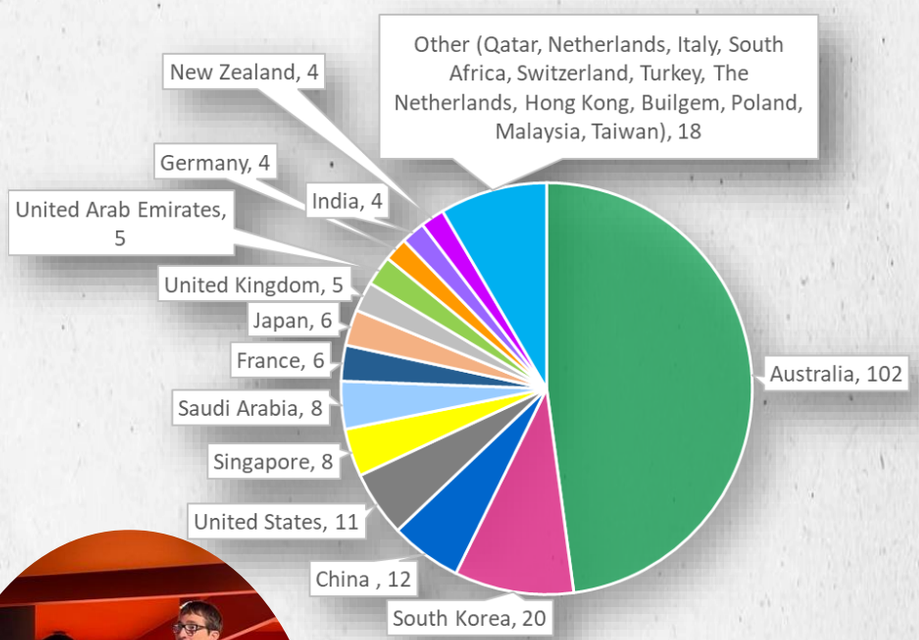
IMSTEC2022 Highlights

The International Membrane Science & Technology Conference (IMSTEC) organised by MSA is one of the most important conferences that brings our members together from around the world to share professional experiences, expand our professional networks, and receive updates on the latest advances in the field of membrane sciences and technology. IMSTEC2022 was attended by both industry and academic leaders.

The 11th conference, IMSTEC2022, was successfully held from 4 to 8 December 2022 at Monash University, Melbourne. The conference was chaired by Prof. Xiwang Zhang and Prof. Mikel Duke, focusing on thematic areas of circular design and engineering membranes, crossing the gap with the new normal, and vision 2030. A total of 219 people from Australia, South Korea, China, United States, etc. participated and 81% of them participated in person. Check out more pictures of the conference here!



Organising Committee

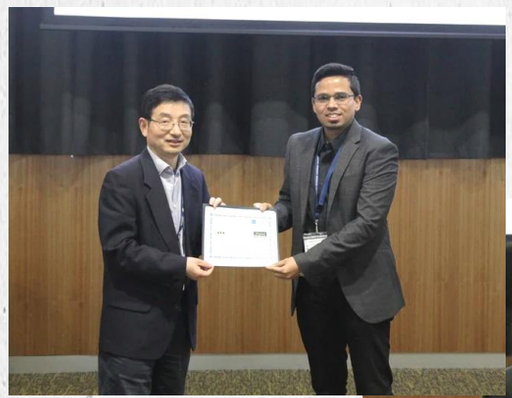
Student Committee

IMSTEC2022 Highlights

IMSTEC 2022 Awards

ECRs	
1st Presentation	Muhammad Baig, University of Twente
2nd Presentation	Zhan Li, Kobe University

Students	
1st Presentation	Moataz El Okazy, University of Melbourne
2nd Presentation	Zhuyuan Wang, Monash University
1st Poster Presentation	Xinyue Wen, University of New South Wales
2nd Poster Presentation	Sin Sieng (Gianna) Sim, University of Melbourne
2nd Poster Presentation	So Youn Lee, Yonsei University



IMSTEC2022 Highlights

Plenary speakers

Prof. Jerry Lin, Arizona State University, USA
"**CO2-Permselective Membrane Reactors for Hydrogen Production with Carbon Capture**"

Prof. Amy Childress, University of Southern California, USA
"**Membrane Systems for Integrated Desalination and Potable Reuse**"

Prof. Kazuo Yamamoto, University of Tokyo, Japan
"**Integrated validation plant: An energy-efficient approach**"

Dr. Lidietta Giorno, University of Calabria, Italy
"**"Bio" for membranes: perspectives and challenges**"

Prof. Tongwen Xu, University of Science and Technology of China, China
"**Roll-to-roll production of alkaline stable anion-exchange membrane**"

Dr. Tina Arrowood, DuPont Water Solutions
"**Innovative Brine Concentration Membranes Enable Lower Cost MLD/ZLD Treatment**"

Conference Dinner

Emeritus Professor,
Anthony Gordon Fane

The conference dinner was held at Park Royal Hotel in Clayton, Melbourne. A special highlight of the night was the seminar by the guest speaker Emeritus Professor Anthony Gordon Fane, "Membranes Past, Present and Future".

Next IMSTEC will be held in Brisbane, 2025!

Further information of the conference can be found at https://www.imstec2022.org/ .

MSA Awards 2022

Student Award

Ms Chen Wang, UTS

- Research topic: Development of novel organic solvent nanofiltration membranes using inkjet printing
- Published 7 journal articles as first author, 4 journal articles as co-author
- Co-authored 1 book chapter

ECR Award

Dr Myoung Jun Park, UTS

- Expertise in the development of FO, PRO, NF and RO membranes.
- Published 47 high-impact journal articles in top-rated journals like Nature Communications, CEJ, Desalination and JMS (total citations: 1956, h-index: 23)
- Holds 8 patents

Mentor Award

Prof Stephen Gray, VU

- Active membrane researcher for over 30 years
- Initiated and led the CSIRO Membrane Cluster project involving 9 Australian universities and CSIRO
- First national membrane program in Australia leading to the formation of MSA
- First Australian President of the AMS
- Supervised 14 PhD students and 4 Masters students to completion

Service Award

Dr Filicia Wicaksana, University of Auckland

- Part of the MSA Board of Directors since 2019
- Organized Water and Wastewater Treatment Symposium on “Advanced Processing and Membrane Technology” (2019)
- Led the transition of the new MSA website
- Involved in IMSTEC 2022 organizing committee

Membrane Science Award

Dr Huacheng Zhang, RMIT

- Contributed to bioinspired ion channel membranes for efficient ion separation and water purification
- Recipient of ARC DECRA, ARC Future Fellowship, two ARC Discovery Projects and RMIT VC research fellowship
- Published in Nature Materials, Science Advances and Nature Communications (ESI top 1% highly cited papers)

Applied Research Award

Dr George Chen, UniMelb

- Collaborated with Australian dairy processors like Bega and Saputo
- Demonstrated technical feasibility and financial viability of membrane technologies in dairy processing
- Recipient of ICM Agrifood Award 2022 and the CBE Outstanding Industry Engagement Award 2019
- Generated over $4 M in funding from industry partners and competitive research grants

MSA Awards 2022

Anita Hill Leadership Award

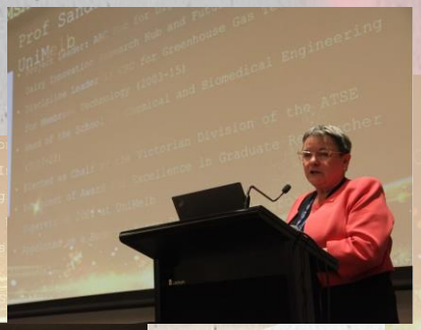
Prof Sandra Kentish, UniMelb

- Project Leader: ARC Hub for Digital Bioprocess Development, Dairy Innovation Research Hub and Future Fuels CRC
- Discipline Leader in CRC for Greenhouse Gas Technologies for Membrane Technology (2003-15)
- Head of the School of Chemical and Biomedical Engineering (2017-22)
- Elected as Chair of the Victorian Division of the ATSE
- Recipient of Award for Excellence in Graduate Researcher Supervision 2022 at UniMelb
- Appointed as a Redmond Barry Distinguished Professor in 2019

Tony Fane Award

Prof Hokyong Shon, UTS

- Director of the ARC Research Hub for Nutrients in a Circular Economy
- Head of Discipline, Environmental and Water Engineering, Deputy Director of the CTWW at UTS, ARC College of Experts Member and Editor-in-Chief of the Desalination journal
- His publications received 20,010 citations (h-index: 72)
- ARC Future Fellowship (2015-20), 2 ARC Industrial Transformation Research Hubs, 4 ARC DP grants, 4 ARC Linkage Project grants and 2 ARC LIEF grants, 4 NCEDA grants, 3 CRC CARE grants, several international industry and national research grants
- MSA President (2018-21) and chair of IMSTEC 2020



Further information of the conference can be found at https://www.membrane-australasia.org/awards .

Scientific interview

In this new academic engagement section, we are eager to know more about novel membranes and membrane structures using electrospinning. This edition features an interview with Prof. Sandra Kentish from The University of Melbourne, who is a project leader within the ARC Hub for Digital Bioprocess Development, the Dairy Innovation Research Hub and within the Future Fuels CRC. She was the discipline leader in the CRC for Greenhouse Gas Technologies (CO2CRC) for Membrane Technology from 2003-2015.

Interview between Dr. Amir Razmjou and Prof. Sandra Kentish

Left: **Prof. Sandra Kentish** Right: **Dr. Amir Razmjou**

Amir: I really appreciate your time and the opportunity that you gave us for MSA Newsletter. Well, I think it is probably better to first start with what inspired you to pursue a career in academia? Tell us about your academic journey?

Sandra: I graduated as an engineer from the University of Melbourne. After that, I decided to work in industry for six years. So, two years with what's now known as Qenos and then four years with Kodak. I was a production supervisor and supervised eighteen men to make liquid emulsions that were the precursors for Kodacolor films.

Amir: Where did you get your PhD?

Sandra: I did my PhD at the Department of Chemical Engineering, the University of Melbourne while I was having babies. I had two children and did my PhD part-time. In the midst of that, my husband got a promotion to Mount Gambier, South Australia, which meant that I had to complete my PhD remotely from there in 1996. After that, I worked at Kimberly-Clark nearby in Millicent for three years before returning to Melbourne. Following this, I joined the University of Melbourne where I have been working for the past twenty-two years.

Amir: How did you end up with membranes? Please tell us about your membrane background.

Sandra: Well, my PhD was in solvent extraction with Geoff Stevens but then I began working with Prof. Ashokkumar on ultrasonics. I actually spent probably the first five or six years of my academic career working with him on ultrasonics and supplying ultrasonics to industry. I later got involved in membrane technology in a couple of ways.

Firstly, with Ashok, we did some work with the dairy industry on cleaning membranes with ultrasonics. At the same time, I started looking at membranes for carbon capture and storage. I had been looking at solvents for this application as early as 2001 with Geoff Stevens.

Amir: So, the first point that you just touched the membrane was, I guess, the time that you had with Ashok on cleaning the membrane with ultrasonic technology. That was the first time that membrane came into your career?

Sandra: Well, yes, it was probably about the same time as I was starting to look at carbon capture and storage.

Amir: Since then, you've been on the membrane and working on different aspects of the membranes. I know that is interesting.

Sandra: Yes, exactly.

Amir: In 2001, you were a lecturer, and then you kept promoting. How was your promotion year-wise?

Sandra: I worked part-time until 2007 and began full-time work when my eldest child started high school. Working part-time slowed down progress; but finally, I became a professor in 2012.

Amir: In terms of your research interests in membrane, you mentioned that you were always on carbon capture. So how is there any sort of involvement in the way you thought about membranes back twenty years ago and then to 2023?

Sandra: There has been a shift towards materials research in the field of membrane technology over the past twenty years, with a majority of papers now focused on developing new materials rather process development, particularly in high rank journals like JMS. However, this may not be beneficial for the industry as few materials make it into production. Additionally, there has been a shift away from classical processes such as reverse osmosis and ultrafiltration towards forward osmosis and electrical separation processes like electrodialysis and capacitive deionisation - I also now do a lot of work in electrical separations. These didn't really exist twenty years ago, so I think that will continue to be a trend given the huge interest in electrically driven processes. The field of electrolysis, particularly in relation to the hydrogen economy, has driven progress towards more economical solutions. This trend is also evident in water treatment applications, where the mass production of ion exchange membranes has made such approaches more cost-effective.

Amir: So, you are saying that the membrane has already been pretty much mature in water and wastewater treatment, and then it is now a transition towards hydrogen or ion separation membranes?.

Sandra: Yes, I can see that. There will be a bit of a transition that way.

Amir: So, do you predict it will go back again to the process of using membranes for hydrogen? You mentioned that the transition was from process to material, and then do you think it is now well established as we are moving towards new applications, such as hydrogen or ion separation?

Sandra: I think more work on process development is needed, but unfortunately, I don't think it will happen. I think our academic workforce is now very much in the materials field, and training will be difficult. I think people have lost some skills in that process area. A lot of the work also was very heavy mathematical modeling originally, and I don't know whether we still have that skill set. So now I can't see that it would necessarily tend to go back that way.

Amir: What other sort of challenges do you think the membrane community will face in the next few years?

Sandra: The main challenge nowadays seems to be how to come up with innovative ideas. Although there are still some areas where improvements can be made, it has become increasingly difficult to find groundbreaking solutions. It's challenging to make significant breakthroughs and create something that can change the world when certain fields, like chemical engineering, have already reached a high level of sophistication. Reverse osmosis is a prime example of this, as it is already highly advanced, and finding new innovations in this area has become more challenging. So, how can we create something new and game-changing?

Amir: What advice do you have for those who want to pursue an academic journey considering the fact that currently, the industry market is very good? When I discuss with people, I see that students or fresh graduates, or even mid-career researchers are now thinking: "do I need to stay in academia as I can go to the industry and get promoted quickly?"

Sandra: There are certainly some advantages in industry, and I would also say that we are going to see people shifting to industry increasingly. I think moving between academia and industry has advantages, and it would be beneficial to have more people shifting seamlessly between the two as I experienced it myself. Having industry experience provides a grounded understanding that informs both research and teaching. While academia offers more freedom, industry can offer opportunities for advancement and higher pay. I have much more freedom in academia to do what I want than in industry. I personally prefer academia to industry, but I think there would be just as many people who would do well in industry and get promoted and certainly get paid more.

Amir: I guess that's very important because you started your profession by going to industry and then to academia. But as I said, there is also a back-and-forth between academia and industry, and that would be very helpful to create a network in both areas.

Sandra: I definitely agree. It also means that we would begin to teach chemical engineering and other disciplines in a much better way. I think we've lost a lot of that understanding of where the industry is at the moment.

Amir: You were very successful in securing grants and funds. So, for membrane people like me and our community, what would be your advice or suggestion to be more successful in industry and ARC grants? It's very hard these days to get a DP, for example. What was your strategy, and what sort of advice do you have for us?

Sandra: I would certainly recommend that you start small, from an industry point of view. I think building relationships with companies is important for success in industry. You build the relationship, and as you probably know, companies like people they know and trust. And if they know and trust you, they'll keep coming back to you even if your science is no good, which can sometimes be frustrating. It is also good to understand the companies' mindset and delivering results quickly, even if it means sacrificing some accuracy. You have to create networks and find a mentor who can introduce you well and writing budgets with extra cash can also be helpful. In my case, I was well mentored, so it helped a lot that I had a mentor who had introduced me to people to build the connections.

Amir: In DECRA, sometimes they choose a fresh PhD or future fellows to give them DECRA, what is your opinion about this?

Sandra: It's tough out there. Just don't rely on getting your DECRA, I think that's honest advice. I've seen some very good candidates miss out on DECRA, and then I've also sometimes seen people with DECRA, and I think, "how did they possibly get that?" So, I think it is very much the luck of the draw. I think it is better when you are writing a DECRA proposal, to get at least three other people out there who are independent of you to read it because the grant application goes to a panel who will not be in your field. So before submitting your proposal, you have some good feedback. I think that would be helpful to receive a grant.

Amir: The DECRA is like a catalyst for obtaining a tenure position, especially at a prestigious academic institution. While research records are considered, it is more important to have the ability to attract industry income. Starting with a DECRA and progressing through the ranks is a common pathway to obtaining a tenure position. However, it is not necessarily required to have a DECRA or future fellowship to be hired for a position, even at a senior level, and it ultimately depends on the hiring institutions' specific requirements and priorities. Do you think it is true?

Sandra: Not from my perspective. We look at research records, but it certainly doesn't have to be DECRA. We would be looking at the ability to draw from a broader funding pool. The strategy of relying solely on ARC funding is not a viable long-term plan for researchers. A good track record of publications and awards is important, and the DECRA and future fellowship adds to that. However, our recent recruitments for academic tenure did not require a DECRA, as it is more important to have a well-rounded individual with a strong research record.

Amir: What do you hope your legacy will be in your field of study, in chemical engineering and also in, specifically, membrane?

Sandra: well, I think the most important thing is the success of my PhD graduates and postdocs in their careers. Probably my focus has always been on making people understand the systems and be successful in their studies. In gas separation, I work hard to get people to understand that systems are not made up of single components. For instance, a membrane that works well in a dry CO_2 and nitrogen stream may not work well when impurities such as water are present. Therefore, it is crucial to consider more realistic systems and take into account factors such as mechanical properties when scaling up the process.

Amir: Is there anything that you want to tell the community, particularly young researchers, about the membrane area?

Sandra: Nothing special, not especially at this time of the year.

Amir: If you could live anywhere in the world, where would it be?

Sandra: Well, I would choose Melbourne again as I really like Melbourne.

Amir: If you had the option to go back and choose another profession from industry and now academia. Suppose you had the option to go another way or another profession; what would it be?

Sandra: Electrical engineering.

Amir: Thank you very much Sandra. I really appreciate your time, and I'm pretty sure our audience and I will enjoy and benefit from this interview and the details of the interview and the tips and advice that you gave us. Thank you very much, and I really appreciate your time.

Sandra: Thank you Amir. Good to see you. Thank you for putting in for the membrane society.

MSA Travel Awardees

MSA has sponsored 4 PhDs and 2 ECRs to attend the IMSTEC2022 conference and to present their research work by covering the cost of conference registration fees. Congratulations to the MSA travel awardees!

Weonjung Sohn is currently pursuing her PhD in the Faculty of Engineering and IT at University of Technology Sydney. Her research topic is nutrients recovery from source-separated urine by the nitrification in a membrane bioreactor, which is highly focused on the application of membrane technology. As the global fertiliser market price soared in recent years, recovering valuable nutrients in a circular economy has gained increasing attention globally. As such, her presentation at IMSTEC2022 was a good opportunity to share the ideas of nutrient recovery from urine as well as step forward to a circular economy. In addition, she is actively engaging in collaborative works in membrane community as a member and a volunteer of Membrane Society of Australasia. She has been actively engaged with MSA as an assistant editor of MSA Newsletter Taskforce since the beginning of her PhD.

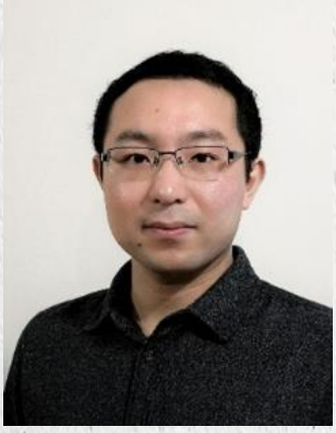
Mitra Golgoli is a PhD candidate at Edith Cowan University (ECU), working under the guidance of Dr. Masoumeh Zargar. Her research is focused on the development of innovative polymeric membranes using advanced materials, with a particular emphasis on enhancing their performance and fouling resistance against microplastics. Mitra presented her work on modified membranes using metal organic frameworks to enhance their performance and fouling resistance at IMSTEC 2022. Mitra has been working with MSA since 2021 and has taken on the role of assistant editor in the MSA newsletters team in 2022. In this role, she is responsible for producing high-quality content on the latest developments in the field.

Shiyang Huang is a PhD candidate in Chemical Engineering at UNSW. Before PhD, he obtained his master's degree in environmental engineering at the University of Southern California (USC) and his bachelor's degree in civil engineering at Chongqing Jiaotong University. His PhD research focuses on the fabrication and surface modification of polyamide-based thin film composite (PA-TFC) membranes for desalination and wastewater reuse. This includes the use of surface modification approaches to improve the removal of trace organics by PA-TFC membranes and the use of the electrospray technique to print PA-TFC membranes. At IMSTEC2022, Shiyang presented his work using the electrospray technique to achieve 3D printing of PA-TFC membranes. He has published 6 peer-reviewed papers, and he was the recipient of the master's Student Research Award at USC in 2018. Shiyang is now a member of the MSA Newsletter Team, working on the update of membrane industrial news. In the meantime, he is a graduate water engineer at Jacobs Solutions based in Sydney.

MSA Travel Awardees

Yi-Chen Lin received his bachelor's and master's degrees from Chung Shan Medical University in Taiwan, where he focused on protein purification through ultrafiltration membrane modification. Currently, he is a second-year PhD student at the University of Sydney, where he is developing nanocomposite membranes in the gas separation field. His research aims to achieve high gas selectivity through the nanoconfinement effect between polymer membranes and inorganic substrates. He has successfully synthesised a polyetherimide membrane coated on alumina tubes using a vacuum-assisted dip-coating method. The membrane demonstrated excellent low nitrogen permeability (>0.001 Barrer) over 72 hours of pure gas permeation and achieved over 5000 CO_2/N_2 permselectivity. The interfacial nanoconfinement between polymer-polymer interface can form gas selectivity layer to improve the gas separation performance. This high selectivity gas separation membrane can be used for high purity gas synthesis, which extends the membrane technology application into a novel field. He is actively joining the meeting and conferences arranged by MSA and helping to attract other students working in membrane science to join MSA.

Dr. Milton Chai is a postdoctoral research fellow at the University of Queensland working under the supervision of Dr. Jingwei Hou, and he previously completed his PhD under the supervision of Prof. Vicki Chen. He is currently working on metal-organic framework (MOF) membranes for critical minerals recovery and energy applications. The MSA Travel Award sponsorship provided him the opportunity to attend IMSTEC 2022 to present a recent work on hierarchically structured MOF membranes for lithium recovery. The construction of MOF-on-MOF membrane with asymmetric sub-nanometer pores and implanted energy barriers enabled selective recovery of lithium from other monovalent alkali metal ions, which is very challenging to achieve in membrane separation. Apart from IMSTEC, he also had the privilege to be part of the organising committee for MSA ECR Social Networking event last year, and currently also serves as the associate newsletter editor for MSA.



Dr. Xing Wu is a Research Scientist at Commonwealth Scientific and Industrial Research Organisation (CSIRO) since 2022. Dr. Wu graduated with a Ph.D. in Engineering from the Chinese Academy of Sciences (CAS) in 2018 and worked as Postdoctoral Fellow at CSIRO between 2019 to 2022. His research interests focus on membrane fabrication and modification for energy and environmental applications. He has published 24 journal papers about membrane fabrication and application. He participated in IMSTEC2022 and presented his work associated with the fabrication and application of MXene interlayered forward osmosis membranes for desalination, wastewater treatment and the CO2 capture system. He actively makes contributions to MSA including working as a volunteer for IBMM2018 and MSA Annual Meeting 2021. He was also on the organising committee of the 8th MSA ECR membrane symposium (2021).

New Membrane-based Seawater Electrolyser Effectively Extracts Hydrogen and Lithium

BY Mohadeseh Najafi

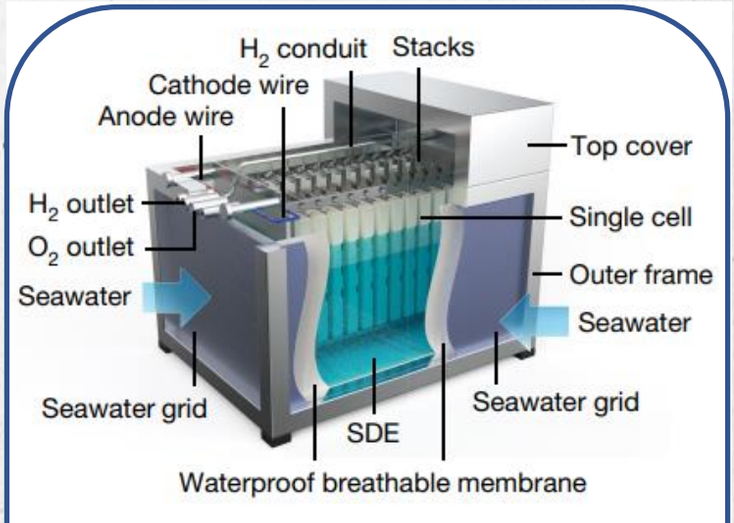
Source: www.intelligentliving.co

A crucial development has taken place in Western Australia regarding the Bristol Springs Green Hydrogen Project, which is hailed as one of the initial low-cost renewable hydrogen initiatives in the region. Located in the Waroona Shire, approximately 120 km south of Perth, the project will consist of a massive 114 MW solar farm, which will power an electrolyser to generate over 4 million kilograms of green hydrogen annually in its initial stage. The freshwater supply is a crucial challenge for this project. Without access to fresh water, the project would have had to rely on a costly desalination plant to avoid side-reaction and corrosion problems (read more).

In this regard, researchers at Nanjing Tech University have developed a new direct seawater electrolyser that can extract hydrogen and a small amount of lithium from seawater with the same efficiency as commercial freshwater electrolysers. That radically addresses the associated side-reaction and corrosion problems. This strategy realizes efficient, size-flexible, and scalable direct seawater electrolysis in a way similar to freshwater splitting without a notable increase in operation costs, and has a high potential for practical application.

They say that the device with an H_2 generation capability of 386 l h^{-1} is stably operated at 250 mA cm^{-2} for over 3,200 h with an attractively low energy consumption of 5.0 kWh Nm^{-3} H_2, and no obvious electrocatalyst corrosion or membrane wetting is observed.

The team is positive that their device can also recover lithium from seawater, providing a sustainable platform for resource recovery. Further, the device can be used for cleaning industrial freshwater, offering a potential solution to the problem of water pollution.



A schematic of the scaled-up system. This study was published in the scientific journal "Nature", 612, 673-678 (December 2022).

MSA ECR Social Networking Event

Building professional networks in a fun social event

In December last year, the MSA ECR social networking event was successfully held with the aim of creating an opportunity for ECRs from different parts of the world to extend their professional network with peers of similar interests and experiences. The event started off with a panel of distinguished professors and industry experts sharing their career experiences and advice, followed by a lively discussion between ECRs and the panel members, and ending with a dinner party for social networking.

Thanks to all the participants for making this event a blast! This event was organised by the following committee members:

Dr Chi Cheng – Chair
Dr Andrea Merenda – MSA Representative
Dr Soo Leong – PR and ECR/IMSTEC Liaison
Dr Milton Chai – Social Media Coordinator
Dr Nawshad Akther – Website Coordinator
Fanmengjing Wang – Treasurer
Moataz El Okazy – Secretary
Maedeh Nadimi – Program Coordinator/MC
Mahdi Shahrooz – Program Coordinator

Panel discussion with audience. From left: Prof. Xiwang Zhang, Elvis Saric, Prof. Sandra Kentish, Mark Mullett, Prof. Mikel Duke, Prof. Jerry Lin

Microporous Organic Nanotubes to Develop High Performance Nanofiltration Membranes

BY Mitra Golgoli

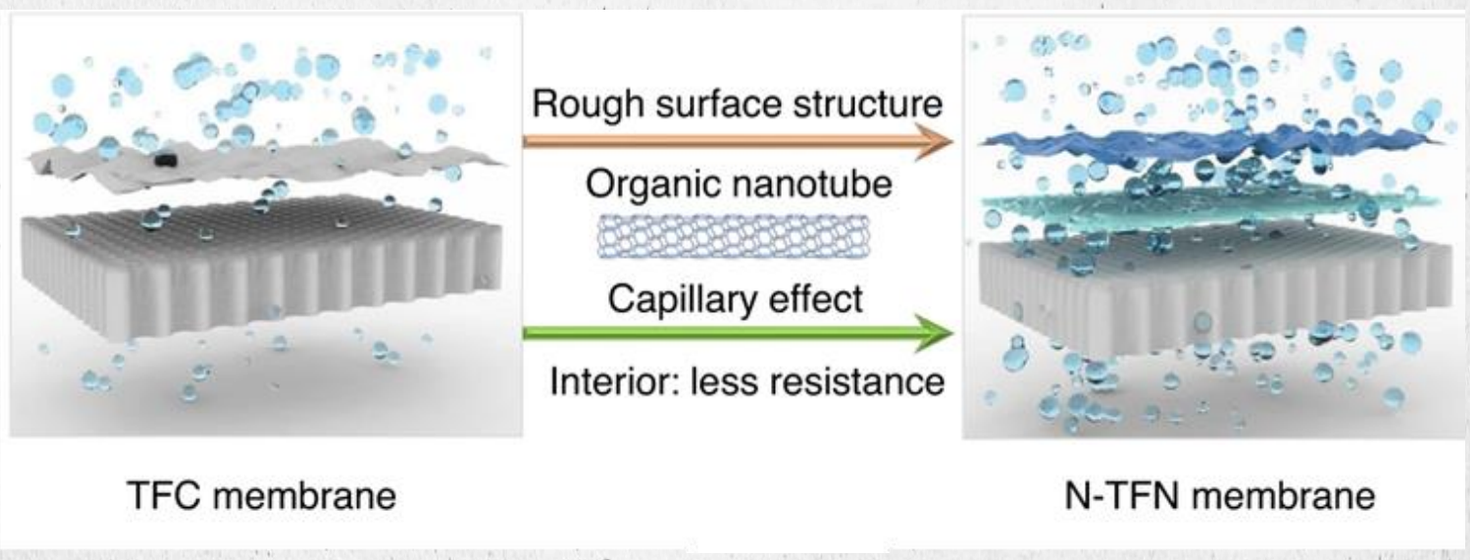
Water scarcity

"Half of the world's population could be living in areas facing water scarcity by as early as 2025." UNICEF

Water scarcity is a growing global concern, and traditional sources are insufficient to meet the increasing demand for freshwater. Non-traditional water sources like seawater, wastewater, and brackish water are being explored for treatment, but they are challenging to treat due to high levels of inorganic salts and trace ions. Nanofiltration membranes are commonly used for liquid separations, but they have limitations in pore control and charge uniformity, hindering advancements in membrane technology for high-precision separation of ions and solutes. To address this challenge, ongoing research are exploring the use of functional nanomaterials to enhance pore control and improve charge uniformity to develop new membranes which can offer exciting potential for water treatment.

A tailored advanced membrane

Microporous organic nanotubes (MONs) are a new class of porous materials with high microporosities and tunable chemical functionalities. MONs offer superior stability and polymer affinity compared to other inorganic nanotubes making them promising nanomaterials for improving the performance of nanofiltration membranes, ultimately leading to sustainable freshwater treatment solutions. A recent study published in "Nature communications" has successfully incorporated MONs in the interlayer of nanofiltration membranes achieving remarkable water permeability of 41.7 $L\,m^{-2}\,h^{-1}\,bar^{-1}$ and high removal of boron (78%) and phosphorus (96.8%), surpassing the capabilities of reported nanofiltration membranes. This MON-regulated interfacial polymerization strategy offers promising opportunities to develop next-generation membranes that can revolutionize water treatment and pave the way for a sustainable future (read more).



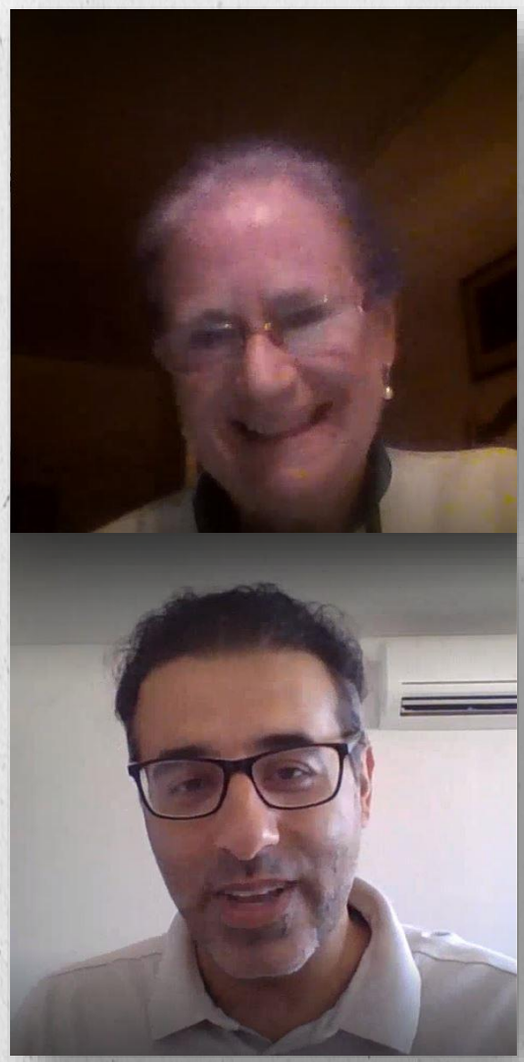
Source: Nature Communications volume 13, Article number: 7954 (2022)

Industry Engagement

In this edition of the industry engagement series, we interview Dr. Anita Hill from CSIRO. She is an Honorary Fellow in the Active Materials Team in CSIRO Manufacturing. Previously, she was the Executive Director of CSIRO, Office of the Chief Executive Science Leader and Chief of CSIRO Process Science and Engineering. Dr. Anita Hill is a highly renowned expert in membranes, and we are very grateful for her time for 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 Dr. Anita Hill from CSIRO



Top: **Dr Anita Hill**
Bottom: **Dr Amir Razmjou**

Amir: Hi Anita, thanks for giving us your time today. I am sure that many people know you and there is even an award in honour of you (Anita Hill Leadership Award). The purpose of this interview is to allow young professionals and ECRs to get to know you better. Could you please tell us a little bit about your journey and perhaps some advice for young researchers going into membranes?

Anita: Thanks Amir. I did mechanical engineering for my undergraduate and graduate work. I got my PhD in the US in 1989 and my first job after my PhD was at Monash University. Back then, I was working on barrier polymers, or materials that would stop the motion of any small molecule or ion. At some point, I got very interested to see if I can understand how to stop their motion, how to control their motion, and that's what membranes do! I talked to my bosses and collaborators and told them that controlling the transport, rather than just stopping it could be very interesting. I had to have a lot of people support me to shift from barrier to membrane. When I looked back, I think those are the people that led me to a new path

because they listened, supported and were very instrumental in me getting into membranes. That was about 1996 when I was working with Eastman Chemical Company. Even though they weren't selling any products, they supported me to look at membranes, which was pretty impressive.

I think our journey all goes back to those who helped, and who knows someone might just open a door for you. When I wanted to go into membranes, there was a guy at CSIRO named Terry Turney and he said, we need to desalinate water in Australia as we didn't have any desalination plants at that time. And Tom Hatton, he was the head of energy at CSIRO, and directed national water and marine research programs. He backed this project going into membranes that kind of got everybody looking at how we can reduce the energy needed to purify water (water-energy nexus), so how we can get security of energy and security of water.

Amir: Very inspiring! I saw that your research revolved around the transport of ions, atoms and small molecules in condensed matter, and one ion that I am particularly interested in is Li^+. Could you please tell us more about these methods that you have developed?

Anita: I'm glad you picked up on that! I did my PhD using positrons, which are just antimatter electrons. So they're the same size as the electron, but they're positive. You send them into materials and they give you a picture of what's inside the material, so they tell you about all the empty space, about the atoms and the packing. And then I thought: they're also telling you about the flow, for example "is there a channel?", or "if you're an atom stuck somewhere can you move?". It's like you have the smallest little camera in there telling you if someone can move. That someone could be an ion, or an atom, or a gas molecule. I just loved it, and really started thinking about what it would look like if we were inside that material and what it means to be able to move somewhere. So that's how I got into it, just kind of mapping space. I had so much data and after a while of creating these maps, I was just thinking that we ought to be able to make materials better than what I measured. We should not stop trying to make better membranes for example.

Amir: That's very cool. I think we might need a day to talk about your background! If I could ask something more broad, what do you think we have to do to make that bridge between academia, industry and government for a sustainable energy future, given your vast experience?

Anita: I would say one word and that is collaborate. Instead of thinking of any project as yours, you need to think about it as "I'm doing this for the community where my parents or children live". Once you think about it that way, it becomes more inclusive and you will start going: "I need to get my university involved", or "I need to get the state government involved" rather than it just being your project. Everything should be collaborative and everybody wins. For everyone to win, it's not about you. It's about, we're going to rise the tide for everyone. The second one would be coordinate. Let's say that you're looking to have distributed production of fuel sources, it could be hydrogen from water or it could be aviation fuel from CO_2 and green hydrogen. You can start having the conversations with your vice-chancellor for example and bring everybody on board, the other universities, and the different councils. Don't stand up and just say the government should be doing this. Honestly, we should be doing this.

Amir: Very interesting point, that's quite a shift in attitude! Now moving to something I know a

lot of ECRs and MCRs are struggling with, and they are industry engagement and grants. Could you please give us any tips on how we can become more efficient on this?

Anita: For industry engagement, find out your local industry association (e.g. via Innovation Connections) and join it. Go to the meetings and offer to speak and when you speak, don't give a presentation on what works in a lab. Give a presentation that says: “we've made this work at this scale and we're looking for partners to scale up the pilot reactor”, for example. Whatever your talk is, make it relevant to the industry because there will be somebody from the industry that says: “it's risky, but I bet I can get my board to invest”. They're going to want some idea of success within two years, so rather than saying “we will know in 10 years”, say “we'll have milestones and we will have a go/no-go gate within 48 months”. So join an industry association, give a talk that's relevant to them that has some time bound aspiration.

On the grants, the ARC is in place to make sure that we do fundamental basic research that delivers what the nation needs in the next 10 to 20 years. So with ARC, you're not doing what I just said. With the ARC, you're saying: “I have an idea. If it works, it could be really fantastic. I have thought about where I am going to fall over. I’ve done these tests and haven’t fallen over yet, so I think you need to support me for 3 to 5 years to get it the point where I can talk to the industry”.

Amir: That’s good advice. Looking ahead, what do you think will be the most important trend in membrane research in the next 5-10 years? This is particularly for fresh PhDs and ECRs who are looking for a new research area that they want to get into, and not just follow their supervisor’s background.

Anita: I think it will be membrane as a sensor. Not only are you separating, but you're. counting. You're sending that data somewhere You're telling someone that you've got nitrates and they might be able to turn them into ammonia. You're telling someone that you've got boron and they might be able to turn it into MBenes. You've got resources. So not only are you separating them, you're counting them and you're telling someone that you've got them.

Amir: There are some discussions about using AI, or machine learning for materials discovery, that sort of things. What are your thoughts about this?

Anita: I am sure that it's a good thing to be doing. For example, I might learn something from an AI that I could then use to develop a membrane. I think it's going to be useful and human directed.

Amir: Thank you. I really enjoyed talking to you. In the interest of time, we usually have a tradition of some rapid fire questions near the end of the interview. The first question is: If you could choose any career other than engineering, what would it be?

Anita: I guess if I'm not an engineer, I'm going to be a scientist.

Amir: What is your favourite city where you could spend the rest of your life in?

Anita: Probably have to say Melbourne.

Amir: If you had the chance to have dinner with anyone in the world, who would it be?

Anita: My mom.

Singapore's Tuas Water Reclamation Plant to Become the World's Largest MBR Facility

The Tuas Water Reclamation Plant (WRP) is currently under construction and is planned to start initial operations in 2026. As part of the "Deep Tunnel Sewerage System (DTSS) Phase 2" by Singapore's Public Utilities Board (PUB), Tuas WRP will have the capacity to treat an average flow of 650,000 m^3/day of domestic wastewater and 150,000 m^3/day of industrial wastewater. Both the domestic and industrial streams use MBR and RO processes to treat the wastewater. This means that Tuas WRP will be the world's largest MBR facility once fully commissioned.

The DTSS Phase 2 is a key component to help Singapore achieve its goal of becoming self-sufficient in water by 2060. It comprises deep tunnels to convey used water entirely by gravity and the centralised Tuas WRP that highly purifies the used water to Singapore's NEWater. While Phase 1 works on the eastern half of Singapore, Phase 2 will cover the western area of the island. With the establishment of Phase 2, Singapore is looking to use NEWater to meet more than half of the future water demand by 2060.

According to PUB, Tuas WRP uses MBR, RO, and UV disinfection to purify the domestic wastewater and produce high-quality NEWater. As reported by Filtration+Separation in March 2023, this stream has selected DuPont to implement its MemPulse MBR and FilmTec RO technologies. On the other hand, the industrial wastewater stream will house the world's largest ceramic MBR, and the final RO permeate will be sent back for industrial reuse. The plant is also coupled with the Integrated Waste Management Facility, collectively known as Tuas Nexus, to achieve a more sustainable operation by optimising land use and maximizing energy/resource recovery.

"Over the last 20 years, Singapore has been an international trendsetter in water reclamation. NEWater, its third National Tap, has helped to educate people about the benefits of recycled water and how reuse is proving critical to helping the country strengthen its water resilience in the face of climate change," said Alan Chan, Global Vice President and General Manager at DuPont Water Solutions.
(Source: Filtration+Separation, the Straits Times. Edit: Shiyang Huang)

A 3D demonstration of Tuas Nexus which shows the co-location of the Integrated Waste Management Facility *(left)* and the Tuas Water Reclamation Plant *(right)*. Photo credit: PUB, Singapore's National Water Agency.

IMSTEC Industry Workshop

Visions of the future for membranes

This IMSTEC industry workshop provided a glimpse into a future where membrane technologies and infrastructure can play an integral role in the advancement of society, and our climate, public health, and environmental goals. The workshop started with a series of short 'Visions of the Future" talks from leading industry professionals and academics, followed by a lively panel discussion with the attendees. Questions were posed around finding solutions to the challenges and barriers to the use of membrane technologies in our post 2030 future.

The key themes that were covered in this workshop are:

- The Role of Membranes in Decarbonising the World – carbon capture and storage, low energy technologies in industry.
- When Every Drop Counts – beyond just zero liquid discharge, towards achieving zero waste discharge, brine valorisation and/or resource recovery.
- Membranes and Public Health – the ongoing risk of pathogens, microbial resistant organisms, heavy metals and persistent organic pollutants to public health. The role that membranes can play to protect us now and into the future.

Industry workshop plenary speakers

Jian Guan
OriginWater Technology

David Leinster
Water and Carbon Group

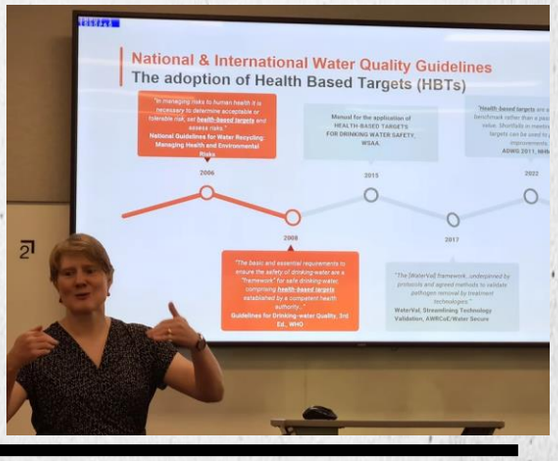
Kathy Northcott
Veolia Environmental Services

Cliff Duckworth
Enviropacific

Geoffrey Johnston-Hall
DuPont

Will McLean
Clean TeQ Water

Garrick Lai
Veolia Water Australia



Vitens and NX Filtration Start Pilot for Testing IJssel River Water as Potential Source for Drinking Water

Vitens, which is the largest drinking water utility in the Netherlands, is on the verge of starting a pilot program with NX Filtration, the global provider of breakthrough direct nanofiltration (dNF) technology for pure and affordable water. In the pilot program, Vitens will use NX Filtration's dNF membrane technology to produce drinking or industrial process water from the Dutch IJssel river. The pilot program of Vitens is expected to run from October 2022 to Fall 2024.

Considering the current scenario, groundwater is Vitens' primary source for high quality and reliable drinking water production. Due to growing demand for water in combination with increasing periods of droughts because of increased climate change, Vitens is looking for alternatives for its traditional groundwater sources and to alternatives to supply
.

industries. This led Vitens to start testing new technologies for additional surface water sources to safeguard its water supplies to households and industries for the future.

Doek Schippers, strategic advisor at Vitens commented that they have already worked with NX Filtration's direct nanofiltration membranes in small scale testing environments. Based on these results they are now ramping-up to a multi-year testing program for the treatment of surface water from the IJssel river. This will provide valuable inputs to develop alternative sources for drinking water supply that will enable their customers to continue to benefit from healthy, safe, and affordable drinking water in the future

Source: Dreams Time

Upcoming Membrane Events

CURRENT EVENTS	DATE OF EVENT	ABSTRACT SUBMISSION
32nd North American Membrane Society Annual Meeting Tuscaloosa, AL, United States https://membranes.org/	13 – 17 May 2023	**Registration opening soon!** (Abstract deadline past)
13th International Congress on Membranes and Membrane Processes Makuhari Messe, Chiba, Japan www.icom2023.jp	09 – 14 Jul 2023	**Registration open Jan 2023!** (Abstract deadline past)
The 10th International Water Association (IWA) Membrane Technology Conference & Exhibition for Water and Wastewater Treatment and Reuse Washington University in St. Louis, USA www.sites.wustl.edu/mtc2023	23 – 26 Jul 2023	**Registration open Jan 2023!** (Abstract deadline past)
15th International Conference on Membrane Science and Technology 2023 (MST2023) Duangjitt Resort & Spa in Patong beach, Phuket island, Thailand www.mst2023.com	7 – 8 Sept 2023	**Early Bird Registration by 30 June 2023!** (Submit abstract by 30 April 2023)
16th International Conference on Catalysis in Membrane Reactors Donostia-San Sebastian, Spain www.iccmr16.org	16 – 18 Oct 2023	**Registration open Jan 2023!** (Submit abstract by 31 May 2023)
6th International Conference On Desalination Using Membrane Technology (MEMDES 2023) Sitges, Spain www.elsevier.com/MEMDES	19 – 22 Nov 2023	Submit abstract by 19 May 2023
The International Conference on Desalination, Environment And Sustainability (IDEAS 2024) Abu Dhabi, UAE https://wp.nyu.edu/abudhabi-ideas2024/	22-23 Jan 2024	**Early Bird Registration by 23 Oct 2023!** (Submit abstract by 1 Sept 2023)

MEMBRANE DESALINATION 2023

6TH INTERNATIONAL CONFERENCE ON DESALINATION USING MEMBRANE TECHNOLOGY

Join us at **Membrane Desalination 2023** to discuss the latest research findings and perspectives on desalination, water reuse and treatment and related techniques.

TOPICS INCLUDE:

- Membrane-based pre-treatments
- Advanced chemical pre-treatment and post-treatment processes
- Membrane desalination
- Thermal desalination processes
- Electrochemical systems for selective desalination and polishing
- Membrane fouling, scaling and mitigation
- Advanced materials
- Emerging desalination and non-conventional water production technologies
- Novel hybrid systems and intensification efforts
- Spacers and modules design and hydrodynamics control
- Brine/concentrate management and valorisation
- Resources recovery from brine
- Energy and sustainability, life cycle and economic evaluation
- Membrane materials recycling and upcycling
- Pandemic impact on desalination processes
- R&D in desalination and commercial operation of membranes for desalination

A special issue will be published post-conference in *Desalination*.

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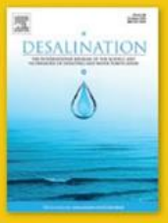

#MEMDES2023

SUBMIT ABSTRACTS BY 19 MAY

FOR FURTHER INFORMATION VISIT:
www.elsevier.com/MEMDES

Special Issue in DESALINATION

THE INTERNATIONAL JOURNAL OF THE SCIENCE AND TECHNOLOGY OF DESALTING AND WATER PURIFICATION

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Membrane distillation (MD) and crystallization (MCr)

SPECIAL ISSUE

Guest Editor:
Prof. Andrew Matin

Manuscript submission now open

Deadline: 31 December 2023

The scope includes, but not limited to, the following topics:

- Novel modules.
- MD/MCr (bio)fouling and scaling.
- Membrane pore wetting.
- Enhancements in mass transfer.
- MD/MCr scale-up.
- MD/MCr energetics.
- Temperature polarization and thermal efficiency improvements.
- MD/MCr hybrids.
- Materials development for MD/MCr, e.g., novel membranes, materials for localized heating (photothermal, ceramics, carbon based, etc.).
- Renewable energy-driven MD/MCr, e.g. solar, geothermal, waste heat etc.
- System optimization and eco-design.
- Modeling and simulation.
- Process economics, Life Cycle Analysis and Life Cycle Cost Analysis.

For more information:
http://www.journals.elsevier.com/desalination/call-for-papers/

Special Issue in DESALINATION

THE INTERNATIONAL JOURNAL OF THE SCIENCE AND TECHNOLOGY OF DESALTING AND WATER PURIFICATION

ELSEVIER

Role of desalination in the circular economy

SPECIAL ISSUE

Guest Editor:
Prof. Qilin Wang

Manuscript submission now open

Deadline: 31 December 2023

The scope includes, but not limited to, the following topics:

- *Advancements in recycled water production from various sources such as wastewater, brine, and seawater through desalination processes*
- *Recovery of minerals and valuable elements, particularly the energy-critical element such as Lithium through desalination processes*
- *Resource recovery from wastewater*
- *Hybrid desalination systems; energy recovery from geothermal brine*
- *Life-cycle analysis (LCA) and life cycle sustainability assessment (LCSA) of desalination systems on resource/energy recovery; sustainable treatment incorporated into the desalination system*
- *Membrane filtration and separation process*
- *Renewable/green technology advancements in desalination*
- *Theoretical and computational analysis*
- *Technological readiness of emerging processes in desalination for energy or resource recovery.*

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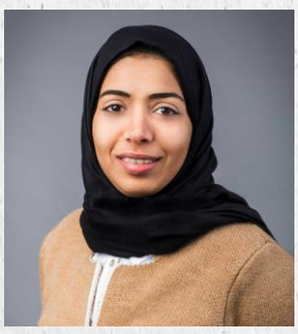
Our Newsletter team is expanding! Please welcome our new assistant editors to the team!



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