



Special Issue: Early career membrane scientists

The latest decade will be remembered as a memorable one in the membrane field. Despite a pandemic that has hardly hit research laboratories across the world for almost two years, membrane science has experienced impressive growth. New membranes exhibiting promising ion-ion or dye/salt selectivity were discovered, fabrication and characterization tools exhibiting enhanced accuracy and control over the final membrane properties were introduced and, remarkably, membranes fabricated using green solvents and exhibiting promising performance were reported. In the meantime, membrane manufacturing became a scholarly field of research, while 3D printing enabled us to achieve better control over microstructure and separation performance. Many of these discoveries came from young scientists, who are on the trajectory of becoming leaders in the field. This Special Issue, which includes all the topics mentioned above, is intended to recognize and celebrate these individuals.

The reader will learn about recent advances in nanofiltration (NF) from Zhu and co-workers, who fabricated membranes exhibiting enhanced fouling resistance and sulfate ions rejection, and from Li and co-workers, who fabricated bio-inspired, highly scalable polypeptide membranes. Polyamide NF membranes exhibiting unique nesting-doll microstructure for PFAS removal and water purification were reported by Xu and co-workers, while polyelectrolyte modified NF membranes exhibiting enhanced selectivity for similarly sized nutrient ions, such as NH_4^+ and K^+ , were fabricated by Sanyal and co-workers using a desolvation-based mechanism. Yang and co-workers used a promising approach to developing NF poly(homopiperazine-amide) membranes for sustainable water treatment, while Wu and co-workers presented UV-interfacially polymerized NF membranes exhibiting enhanced permeance and anti-fouling performance.

Advances in ion exchange membranes are the subject of the papers from Kamcev and He. Specifically, Kamcev and co-workers fabricated highly charged ion exchange membranes showing that structural, thermal, and mechanical properties exhibited critical transitions in these conditions. He and co-workers used high-throughput framework to identify and design anion exchange membranes exhibiting enhanced performance.

Niu and co-workers proposed membranes incorporating 2D graphene oxide nanosheets for dye/salt separation, while advances in ion-ion selectivity were reported by Jiang and co-workers. Bui and co-workers fabricated new membrane systems for trace lead and rare earth element remediation from water, while Malmali and co-workers discussed reverse osmosis as an opportunity for desalination of partially desalinated produced water.

Quist-Jensen and co-workers discussed 3D printing, a fabrication approach that rapidly became a popular *leitmotif* in membrane science.

Rabbani Esfahani and co-workers fabricated upcycled PVC membranes using green solvents and exhibiting performance comparable to commercial membranes, while next generation bipolar membranes were the topic of the paper from Sun and co-workers.

Advances in membrane gas separation are also part of this special issue. Helium/methane separation, an emerging strategic application, is the topic of the paper from Liu and co-workers, who reported highly α -oriented ultrathin FER zeolite membranes for helium harvesting fabricated through nanosheet-seeded epitaxial growth. Wei and co-workers discussed about novel mixed matrix membranes exhibiting enhanced N_2/SF_6 selectivity relative to polymer membranes. A new approach to tailor pore flexibility in mixed-ligand ZIF-8 membranes for exceptional propylene/propane selectivity was reported by Eum and co-workers, while Moon and co-workers used click chemistry to fabricate new generation facilitated transport membranes for CO_2 separation. Finally, Zhang and co-workers showed that high-temperature pyrolysis of Torlon® leads to carbon molecular sieves membranes exhibiting ultra-high and stable H_2/CO_2 mixed gas selectivity under high-temperature operation, with an overall performance among the best ever reported.

Finally, membrane fabrication and characterization also remain important topics. Duval and co-workers reported that low UV-intensity and high monomer concentration could impede UV-grafting from PES membranes, showing that NMR is a valuable tool to detect and avoid pitfalls in these fabrications. Loianno used a new approach to study mixed gas transport in glassy polymer membranes, while Zhu and co-workers critically discussed methodologies to measure mixed gas permeability through thin film composite membranes.

The international membrane community is proud of the progress made by this cohort of emerging leaders who received their PhD within the last decade. This JMS special issue is a tribute to them, for their service to the community and for seeding new ideas that will inspire and shape the field in the years to come.

CRedit authorship contribution statement

Michele Galizia: Conceptualization, Project administration, Writing – original draft. **Dae Woo Kim:** Conceptualization, Writing – review & editing. **Xing Yang:** Conceptualization, Writing – review & editing. **Yi Liu:** Conceptualization, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence

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the work reported in this paper.

Data availability

No data was used for the research described in the article.

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