Frontiers in Membrane Science and Technology

TYPE Editorial
PUBLISHED 04 April 2025
DOI 10.3389/frmst.2025.1591950

Check for updates

OPEN ACCESS

EDITED AND REVIEWED BY
Hale Özgün,
Istanbul Technical University, Türkiye

*CORRESPONDENCE
Michael D. Guiver,
michael.guiver@outlook.com
Nalan Kabay,
nalan.kabay@ege.edu.tr

RECEIVED 11 March 2025
ACCEPTED 21 March 2025
PUBLISHED 04 April 2025

CITATION
Guiver MD and Kabay N (2025) Editorial: Celebrating 1 year of Frontiers in membrane science and technology.
Front. Membr. Sci. Technol. 4:1591950.
doi: 10.3389/frmst.2025.1591950

Editorial: Celebrating 1 year of Frontiers in membrane science and technology

Michael D. Guiver[1]* and Nalan Kabay[2]*

[1]State Key Laboratory of Engines, School of Mechanical Engineering, Tianjin University, Tianjin, China, [2]Ege University, Chemical Engineering Department, Faculty of Engineering, Izmir, Türkiye

KEYWORDS

reverse osmosis (RO), anion exchange membrane (AEM), direct contact membrane distillation (DCMD), oily wastewater, deep eutectic green solvents, membrane gas separation, forward osmosis (FO), membrane fouling and cleaning

Editorial on the Research Topic
Celebrating 1 year of Frontiers in membrane science and technology

Frontiers in Membrane Science and Technology was launched in March 2022, and this Research Topic was established in March 2023 to celebrate the 1-year anniversary. The goal of the Journal is to be an inclusive open-access publishing venue for high quality research, perspectives and reviews. This Research Topic reflects on the Journal in the inaugural year by showcasing cutting-edge research, novel developments, new insights and on the outlook of the future directions of membrane science and technology. This Research Topic has nine papers in different disciplines.

Paper 1 "Evaluation of fouling and chemical cleaning of reverse osmosis membrane after treatment of geothermal water" by Zaid et al. explores membrane fouling and mineral scaling, which are major problems for desalination processes using reverse osmosis (RO) membranes. Membrane characteristics, water quality, operational conditions, biofouling, organic fouling, and inorganic scaling were considered to limit the overall performance of RO systems by increasing energy cost, decreasing membrane lifespan, and increasing chemical cleaning frequency. This paper focused on periodic chemical cleaning of RO membrane used for the cycle treatment of geothermal water having high mineral scaling characteristics during a mini-pilot-scale field test. Water permeability tests were applied before and after chemical cleaning to monitor flux decline after each cycle and flux recovery after chemical cleaning with citric acid solution. The anti-scalant employed in this study was not found to be effective for the prevention of membrane scaling; instead, pretreatment was needed to remove scalants from geothermal water prior to RO treatment.

Paper 2 "Microstructural orientation of anion exchange membrane through mechanical stretching for improved ion transport" by Zheng et al. demonstrates the fabrication of highly conductive anion exchange membrane (AEMs) driven by the external force of mechanical stretching. Insights into macromolecular orientation at the atomic level were gained by investigating the effect of elongation at different water contents on polymer structures and OH^- conductivities, using molecular dynamics simulation combined with experimental studies. Macromolecular chain orientation at the atomic level results in continuous and oriented ion-conduction pathways for hydroxide transport, providing substantial increases in hydroxide conductivity.

Paper 3 "Modeling pore wetting in direct contact membrane distillation—effect of interfacial capillary pressure" by Ahmad et al. presents a model developed for computing direct contact membrane distillation (DCMD) performance, by taking into consideration capillary pressure effects at the liquid–gas interface within membrane pores. The simulation model investigates the effects of pore radius, feed/permeate temperature, pressure, and contact angle on the distance of liquid intrusion into the pore, the weight flow rate in a single pore, and the temperature at the liquid–gas interface. The model predicts increases in the weight flow rate with increases in the pore radius, feed temperature and contact angle, but decreases with an increase in permeate temperature. At constant permeate pressure, the model predicts a decrease in the permeation rate as feed pressure increases. The partial pore wetting is enhanced with increasing feed pressure when the pore size is larger (1 μm) and an opposite trend when the pore size is smaller (0.1 μm), which is a significant finding for DCMD.

Paper 4 "*In-situ* ionized construction of PVDF/sodium polyacrylate-grafted-PVDF blend ultrafiltration membrane with stable anti-oil-fouling ability for efficient oil-in-water emulsion separation" by Gao et al. reports the fabrication of an ultrafiltration membrane based on sodium polyacrylate (PAAS) blended polyvinylidene fluoride (PVDF) with hydrophilicity. Its characteristics are underwater low-oil-adhesive superoleophobicity and outstanding anti-oil-fouling ability even for viscous crude oil. The emphasis is on a practical route for fabricating stable anti-oil-fouling membranes for the challenging separation of emulsified oily water. The blend membrane exhibited long-term stability because of the strong interaction between the PAAS-*g*-PVDF additive and the PVDF matrix, suggesting good potential for real emulsified oily wastewater in large-scale operation.

Review 5 "A perspective on cellulose dissolution with deep eutectic solvents" by Altinkaya explores the use of deep eutectic solvents (DES) as green alternatives to dissolve cellulose, which is a sustainable and natural membrane material. Few conventional solvents are capable of dissolving cellulose because of its strong intermolecular and intramolecular hydrogen bonds and semicrystalline nature. Low cost and low toxicity DESs, containing both hydrogen bond donor and acceptor groups, are promising as alternatives to less environmentally-friendly conventional solvents, allowing the wider use of cellulose membranes. Key findings from experimental and theoretical studies are summarized.

Review 6 "Advanced and sustainable manufacturing methods of polymer-based membranes for gas separation: a review" by Alkandari et al. summarizes the wide array of membrane manufacturing techniques, and notes the shift towards more sustainable practices, such as more environmentally-friendly processes and membrane casting solvents, which is also a focus of the preceding review. The authors acknowledge the increasing proportion of scientific literature on sustainable processes relative to advanced and other membranes, and examine how conventional fabrication techniques can be more sustainable, and discuss emerging processes like 3D-printed membrane, as well as end-of-life recycling and re-use.

Paper 7 "Surface-modified PVDF membranes for separation of dye by forward osmosis" by Muratow et al. addresses the recovery of dyes from wastewater for reuse and to prevent environmental contamination by the Forward Osmosis (FO) membrane process. FO requires less operating pressure and exhibits less fouling than conventional RO, thereby being potentially less energy-intensive. PVDF nanofiber mats were modified by deposition of polyamide layers, synthesized by reaction between *m*-phenylenediamine, piperazine, and trimesoylchloride. FO performance was dependant on the type of aromatic amine and the reaction time. Over 90% dye rejection of bromocresol green dye was achieved, with the best membrane having 3.3 LMH water flux.

Review 8 "Opportunities for membrane technology in controlled environment agriculture" by Safari et al. discusses the wide array of membrane processes that can benefit controlled environment agriculture, which is becoming increasingly important to reduce energy expenditure and enhance agriculture sustainability and local-grown produce in the face of stressed food supply chains. Energy-efficient membrane processes such as RO, nanofiltration and electrodialysis can be harnessed to improve supply water, as well as recover and treat wastewater streams, by recovering water for reuse and removal and recovery of contaminants such as nitrates. Membranes also have a role in air management, such as controlling humidity, thermal management and carbon dioxide control.

Paper 9 "Investigation of multi-stage forward osmosis membrane process for concentrating high-osmotic acrylamide solution" by Hao et al. reports the development of a multi-stage FO process to concentrate acrylamide solution. For this, a thin-film composite polyamide membrane was fabricated and used for the multi-stage FO process, which was shown to allow concentration of high-osmotic acrylamide solution at room temperature. They concluded that this work provided practical insights into the viability and optimization of multi-stage FO process for concentrating high-osmotic chemicals. The authors emphasized the need for further work on regenerating draw solution to achieve a sustainable scale-up operation, and an integrated FO-MD system could help in energy savings for the production of highly concentrated acrylamide and purified water.

Author contributions

MDG: Writing – original draft, Writing – review and editing. NK: Writing – original draft, Writing – review and editing.

Funding

The author(s) declare that no financial support was received for the research and/or publication of this article.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declare that no Generative AI was used in the creation of this manuscript.

Publisher's note