Nanofiltration membrane materials and processes for energy-efficient separations

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Abstract:

The development of sustainable membrane materials is crucial for advancing organic solvent nanofiltration (OSN), an energy-efficient separation technology widely used in the pharmaceutical and fine chemical industries. Conventional membranes rely on fossil-based materials, prompting a shift toward bio-based alternatives. We explore the fabrication of solvent-resistant nanofiltration membranes using biomass and green monomers via phase inversion and interfacial polymerization, ensuring high selectivity and stability, while minimizing environmental impact. Complementing these material innovations, data-driven approaches are transforming OSN process optimization. The OSN Database, an open-access platform, enables the development of machine learning (ML) models that integrate molecular structure data for solute rejection predictions. These models, achieving high accuracy, offer valuable insights into membrane performance and process efficiency. By combining sustainable membrane design with predictive modeling, we aim to drive greener, more efficient separations. Case studies will illustrate how explainable ML models and next-generation materials together enhance OSN technology.

Keywords: nanofiltration, solvent, sustainability, separation, polymer, biomass

Speakers bio with photo

Gyorgy received his MEng from the Technical University of Budapest, and his PhD in Chemistry under Marie Curie Actions from the Technical University of Dortmund. He worked in Hovione PharmaScience Ltd, and an IAESTE Fellow at the University of Tokyo. He was a Research Associate in Imperial College London, then appointed a Lecturer in Chemical Engineering at The University of Manchester. He was the recipient of the Distinguished Visiting Fellowship of the Royal Academy of Engineering. He is an Associate Professor in Chemical Engineering at the Advanced Membranes & Porous Materials Center at KAUST. The research interests of Gyorgy focus on sustainable separations through a combination of materials science and process engineering. He serves on the editorial boards of several journals including the Journal of Membrane Science. Gyorgy is a Fellow of the Royal Society of Chemistry (FRSC), Fellow of the Higher Education Academy (FHEA), and a council member of the European Membrane Society. He received the I&ECR Class of Influential Researchers Award, and the ACS-SCE Lectureship Awards from the American Chemical Society.