High-performance Membranes: From Conceptual Design to Membrane Preparation and Applications

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ABSTRACT

Separation typically accounts for 40-60% energy consumption and 60-80% of capital cost in many chemical processes. Hence, reducing the separation energy is probably the most efficient and meaningful approach to reaching carbon neutrality. The membrane process is one of the most energy-efficient separation technologies that can save up to 90% of separation energy compared to conventional distillation methods, as demonstrated in seawater desalination. However, most membrane applications suffer from low performance and need innovative ideas from material design to fabrication methods.

In this talk, I will start to elucidate the importance of membrane performance from the conceptual design approach. Then, I will share our work in preparing high-performance membranes from ordered porous materials and ideas on creating ordered porous structures in amorphous materials such as polymers. Lastly, I will share a couple of industrially important applications of membranes in separating olefin/paraffin, seawater desalination, wastewater treatment, and lithium extraction from seawater.

Biography

Dr. Zhiping Lai is a full professor in the Chemistry and Chemical Engineering program and Co-Chair of the Center of Excellence for Renewable Energy and Storage Technologies at King Abdullah University of Science and Technology (KAUST), with a B.E. and M.S. from Tsinghua University and a Ph.D. from the University of Massachusetts Amherst. He then conducted postdoctoral research at the University of Minnesota Twin Cities and served as an Assistant Professor at Nanyang Technological University before joining KAUST as a founding faculty member.

Prof. Lai's research focuses on developing high-performance membranes with precisely controlled microstructures to address challenging gas and liquid separation problems from both fundamental and industrial perspectives. He is recognized for his work on zeolite membranes and pioneering contributions to metal-organic framework (MOF) membranes.