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SEMINAR SERIES

HIGHLIGHTS IN ENERGY RESEARCH

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Towards the next-generation membranes for energy-efficient molecular separation

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Improving the energy-efficiency of the molecular separation is key to reduce the carbon footprint of the chemical and the petrochemical industries. Membranes operating with high separation selectivities can cut down the cost of the thermally driven separation processes such as distillation by up to 10-fold.[1,2] Moreover, chemically and thermally stable, high-throughput membranes are expected to open new avenues for the process intensification and a wide-scale decentralized operation. Inspired by this, we have been driven to develop synthetic and engineering routes to design chemically and thermally stable membranes that outperform the state-of-the-art-membranes in separation selectivity as well as productivity (membrane permeance). With this perspective, I will present our recent endeavors to develop the nanoporous two-dimensional membranes which are the ultimate membranes for the gas separation. I will discuss our recent advances in the top-down and the bottom-up synthetic approaches, solvothermal crystallization, the novel designs of high-throughput porous support, and the key challenges that still need to be overcome to develop the next-generation membranes.[3,4,5,6]

References:

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4. Agrawal et al., Adv. Mater., 2015, 27, 3243–3249.
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Bio: Prof. Kumar Agrawal

Prof. Agrawal is an assistant professor in ISIC at EPFL. His research group, laboratory of advanced separations (LAS), is developing synthetic routes for the high-performance two-dimensional nanoporous membranes with a precise control of nanopore size and functionality. He received his undergraduate degree in Chemical Engineering from IIT Bombay (2005). Following this, he joined the global R&D division of Procter & Gamble, Japan, working on the product design (2005-2008). Kumar pursued the PhD degree in chemical engineering at the University of Minnesota (2008-2013). His thesis on development of zeolite nanosheets led to several high-impact publications (2 in Science, Advanced Materials, 3 in Angewandte Chemie International Edition, Nature Communication, etc.) He joined Strano group at the Massachusetts Institute of Technology (MIT) as a postdoctoral researcher (2014) where he studied the effect of nanoconfinement on the phase transition of fluids leading to a publication in Nature Nanotechnology, and several others. Kumar is the recipient of several awards including IIT Bombay Institute Silver Medal (2005), Manudhane Best Undergraduate Student award (2005), University of Minnesota Doctoral Degree Fellowship (2012), Sigma Xi Award (2013), the AIChE Separations Division Graduate Student Research Award (2013), etc.