

Abstract

Atomically thin membranes for molecular separations in organic liquid systems

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Selective solvent and solute transport across nanopores is fundamental to membrane separations, yet it remains poorly understood, especially for organic liquid systems. In this presentation, I will show our recent progress on the 1) design of a chemically robust nanoporous graphene membrane, 2) study of molecular transport in various organic liquids under subnanometer confinement, and 3) defect-management strategies to achieve high selectivity. I will present the discovery that the nature of the solvent can modulate solute diffusion across graphene nanopores, and that breakdown of continuum flow occurs when pore size approaches the solvent's smallest molecular cross-section. Importantly, I will discuss that by holistically engineering membrane support, modelling pore creation and defect management, high rejection and ultrafast organic solvent nanofiltration of dye molecules and separation of hexane isomers can be achieved. The engineered membranes exhibit stable fluxes across a wide range of solvents, consistent with flow across rigid pores whose size is independent of the solvent. These results show that nanoporous graphene is a rich materials system for controlling subcontinuum flow that could enable new membranes for a range of challenging separation needs.