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Tentative topic of the invited talk

Atomically-Thin Membranes and Other Nanostructured Materials for Water Purification and Chemical Separations

Abstract of the invited talk

Separation processes are integral to human civilization, playing a critical role in clean water, energy, manufacturing, health, and circularity. Membrane-based separations are attractive due to their modularity, simplicity, and energy efficiency; and improving their selectivity, efficiency, and chemical resistance, or reducing their costs is important to create a more sustainable future. In this talk, we will discuss our work on advancing three unconventional nanostructured membrane concepts. First, we present the development of the thinnest possible membranes from a continuous layer of one atom-thick graphene. Nanopores in graphene provide pathways for rapid and selective fluidic transport, which has potential for improving the efficiency, selectivity, and chemical resistance for a variety of membrane separations. Next, we describe 'vapor-gap' membranes that desalinate water by nearly isothermal evaporation and condensation across short hydrophobic nanopores, which can improve rejection of many contaminants and allow for more versatile fouling control. Third, we show that the sapwood of conifers can be used as natural, biodegradable, low-cost, and easily manufactured filters to remove microbes and turbidity from drinking water. These filters exploit the naturally-occurring membranes in the xylem tissue to remove microbes and present opportunities to create affordable and sustainable filters for household use or for agile distribution in emergencies. These nanostructured membrane concepts illustrate the interplay between material structure and transport and demonstrate potential to realize next-generation membranes for water purification and chemical separations to provide clean water and unlock industrial efficiency and materials circularity for a sustainable future.