Potentials of 2D Nanomaterials in Membrane Technology for Solving Water-Energy Nexus

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Recent advances in two-dimensional (2D) nanomaterials offer unprecedented opportunities to fabricate a new class of materials that can potentially revolutionize membrane technology and play an important role in solving water-energy nexus. In this talk, I will first discuss the promise of using 2D nanomaterials (e.g., graphene oxide/GO and MoS2) as building blocks to make new nanostructured membranes with unique separation capabilities to remove organics. Our recent efforts in the characterization and control of membrane interlayer spacing and understanding of water structure and transport in the 2D nanochannels will be presented. Some 2D nanomaterials also have unique photothermal and adsorption properties that can be promisingly utilized to address water-energy problems. For example, MoS2 demonstrates high selectivity and high adsorption capacity for heavy metal removal. As a broadband solar light absorber, GO can be used to efficiently absorb solar light and localize the heat to enable fast water evaporation. Using this property, a synthetic GO leaf and solar-powered artificial tree are developed for the desalination of high salinity water and concentrated brine.