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Mechanical Engineering Lecture in Micro/Nano Engineering

Engineering Flows in Nanostructured Materials: From Graphene Membranes to Xylem Filters

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on Friday, November 7th at 4:00pm in 3-370

Our ability to understand and control fluid flow at the nanometer scale is critical for advancing membrane-based technologies for water purification, biochemical separations, dialysis, controlled drug delivery, and many other applications. The performance of these membranes is dictated by the nanoscale structure and properties of the membrane material, which in turn can be engineered to tailor their selectivity, permeance, and other characteristics. In this talk, we first present the development of monolayer nanoporous graphene as an ideal ultrathin membrane material with the potential for high flux, tunable properties, and chemical resistance. We show that a high density of sub-nanometer pores can be created by nucleation and oxidation of defects, and fabricate leakage-tolerant membranes to quantify the effect of porosity on selective mass transport and nanofiltration. In contrast to sub-nanometer pores in graphene, we then present the concept of using larger nanostructures that trap vapor nanobubbles as a selective medium for water desalination. This approach combines the advantages of thermal desalination and reverse osmosis while providing fundamental insights into the behavior of water at the nanoscale. Finally, I will discuss our work on using naturally occurring nanoporous plant xylem – the tissue that conducts sap in plants – as a selective material for low-cost water disinfection. These studies illustrate the interplay between material structure and nanofluidic flows and demonstrate the potential for the realization of next-generation membranes for water desalination, filtration, and gas separations.

Refreshments will be served before the seminar.
Please contact Tony Pulsone at pulsone@mit.edu with any questions.

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