

MAR09-2008-020185

Abstract for an Invited Paper
for the MAR09 Meeting of
the American Physical Society

Carbon Nanotube Membranes for Water Purification¹

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Carbon nanotubes are an excellent platform for the fundamental studies of transport through channels commensurate with molecular size. Water transport through carbon nanotubes is also believed to be similar to transport in biological channels such as aquaporins. I will discuss the transport of gas, water and ions through microfabricated membranes with sub-2 nanometer aligned carbon nanotubes as ideal atomically-smooth pores. The measured gas flow through carbon nanotubes exceeded predictions of the Knudsen diffusion model by more than an order of magnitude. The measured water flow exceeded values calculated from continuum hydrodynamics models by more than three orders of magnitude and is comparable to flow rates extrapolated from molecular dynamics simulations and measured for aquaporins. More recent reverse osmosis experiments reveal ion rejection by our membranes. Based on our experimental findings, the current understanding of the fundamentals of water and gas transport and of ion rejection will be discussed. The potential application space that exploits these unique nanofluidic phenomena will be explored. The extremely high permeabilities of these membranes, combined with their small pore size will enable energy efficient filtration and eventually decrease the cost of water purification.

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¹Prepared by LLNL under Contract DE-AC52-07NA27344, with funding from LLNL's LDRD program, DARPA, & NSF.