Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Water and Molecular Transport across Nanopores in Monolayer Graphene Membranes DOOJOON JANG, SEAN O'HERN, PIRAN KIDAMBI, MICHAEL BOUTILIER, YI SONG, Massachusetts Institute of Technology, JUAN-CARLOS IDROBO, Oak Ridge National Laboratory, JING KONG, Massachusetts Institute of Technology, TAHAR LAOUI, King Fahd University of Petroleum and Minerals, ROHIT KARNIK, Massachusetts Institute of Technology — Graphene's atomic thickness and high tensile strength allow it to outstand as backbone material for next-generation high flux separation membrane. Molecular dynamics simulations predicted that a single-layer graphene membrane could exhibit high permeability and selectivity for water over ions/molecules, qualifying as novel water desalination membranes. However, experimental investigation of water and molecular transport across graphene nanopores had remained barely explored due to the presence of intrinsic defects and tears in graphene. We introduce two-step methods to seal leakage across centimeter scale single-layer graphene membranes create sub-nanometer pores using ion irradiation and oxidative etching. Pore creation parameters were varied to explore the effects of created pore structures on water and molecular transport driven by forward osmosis. The results demonstrate the potential of nanoporous graphene as a reliable platform for high flux nanofiltration membranes.

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Date submitted: 30 Jul 2015 Electronic form version 1.4