Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Development of macroscopic nanoporous graphene membranes for gas separation. MICHAEL BOUTILIER, NICOLAS HADJICONSTANTINOU, ROHIT KARNIK, Massachusetts Institute of Technology — Nanoporous graphene membranes have the potential to exceed permeance and selectivity limits of existing gas separation membranes due to their atomic thickness and ability to support sub-nanometer pores for molecular sieving, while offering low resistance to flow. Gas separation by graphene nanopores has been demonstrated experimentally on micron-scale membranes, but scaling-up to larger sizes is challenging due to graphene imperfections and control of the selective nanopore size distribution. Using a model we developed for the inherent permeance of graphene, we designed a macroscopic graphene membrane predicted to be selectively permeable despite material imperfections. Micrometer-scale defects are sealed by interfacial polymerization and nanometer-scale defects are sealed by atomic layer deposition. The underlying support structure is tuned to further reduce the effects of leakage. Finally, ion bombardment followed by oxidative etching is used to create a high density of selective nanopores. SEM and TEM imaging are used to characterize the resulting membrane structure, and its performance is assessed by gas permeance and selectivity measurements. This work provides insight into gas flow through nanoporous graphene membranes and guides their future development.

Rohit Karnik
Massachusetts Institute of Technology

Date submitted: 29 Jul 2015 Electronic form version 1.4