Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

Characterization of Nanostructured Silicon Membranes for Control of Molecular Transport BERNADETA SRIJANTO, SCOTT RETTERER, JASON FOWLKES , MITCHEL DOKTYCZ, Oak Ridge National Laboratory — Fabrication of nanoporous membranes for selective transport of molecular species requires precise engineering at the nanoscale. The membrane permeability can be tuned by controlling the physical structure and the surface chemistry of the pores. We use a combination of electron-beam and optical lithography, along with cryogenic deep reactive ion etching, to fabricate silicon membranes that are physically robust and have uniform pore sizes. Pore sizes are further reduced using plasma enhanced chemical vapor deposition and atomic layer deposition of silicon dioxide onto the membrane surfaces. Integrating nanoporous membranes within a microfluidic network provides a platform for tailoring molecular exchange between microchannels, independent of hydrodynamic effects. In enzymatic reactions, for example, tuning the pores size will allow smaller enzymatic substrates to traverse the membrane at controlled rates while larger enzymes remain spatially separated. Our results from membrane cross-sectioning using focused ion beam milling show that pore sizes can be controlled at dimensions below 10nm. Functional characterization was performed by quantitative fluorescence microscopy to observe the selective transport of molecular species of different sizes.

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Date submitted: 19 Nov 2010 Electronic form version 1.4