Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Enhanced Electrokinetic Energy Conversion & Ion-Selective Transport in Macroscopic Vertically Aligned BNNT Membranes[1] SEMIH CETINDAG, Rutgers University, AADITYA PENDSE, University of Illinois, Chicago, ROBERT F. PRAINO, Chasm Advanced Materials, SANGIL KIM, University of Illinois, Chicago, JERRY W. SHAN, Rutgers University — Recent nanofluidic experiments with single or few nanopores in graphene, MoS_2 and h-BN have shown unique fluidic transport properties and the potential for electrokinetic energy conversion with unprecedented power densities. In such nanopores, the high-surface charge makes possible a diffusio-osmotic mechanism for ion-selective transport, distinct from the Donnan exclusion in the conventional membranes. Here, we describe the fabrication of the first-ever macroscopic vertically aligned boron-nitride nanotube (VA-BNNT) membranes, and our study of their ion-selectivity mechanisms and osmotic-power-generation performance. We show that the VA-BNNT membranes are highly cation-selective even when the Debye length is smaller than the inner-pore radius of the nanotubes. Moreover, the membranes exhibit osmotic-energy-conversion efficiencies of 30%, and have osmotic power densities (based on open pore area) comparable to and even exceeding that of single BNNTs, up to 7,500 W/m^2 at pH 11 for a 1M:1mM KCl molarity difference. This osmotic power density increase with increasing surface-charge density at higher pH, but remain substantial even at pH 7. To further elucidate the mechanism(s) for the ion selectivity, we compare the power generation and transport rates of the VA-BNNT membranes for salts having different cation and anion diffusivities and thus diffusio-osmotic parameters.

[1]NSF GOALI-1762913

Semih Cetindag
Rutgers University

Date submitted: 31 Jul 2019 Electronic form version 1.4