Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Scaling Laws for liquid and ion transport in nanochannels grafted with polyelectrolyte brushes GUANG CHEN, SHAYANDEV SINHA, SIDDHARTHA DAS, Univ of Maryland-College Park, SOFT MATTER, INTERFACES, AND ENERGY LABORATORY (SMIEL) TEAM — Grafting nanochannels with polyelectrolyte (PE) brushes renders tremendous functionality to the nanochannels, making them capable of applications such as ion manipulation, ion sensing, current rectification, nanofluidic diode fabrication, and flow control. PE brush is a special case of polymers at interfaces; such brush-like structure is possible only when the grafting density (σ) is beyond a critical value. In this study, we shall propose scaling laws that identify σ-**N** (N is the size of the PE molecule) combination that simultaneously ensure that the grafted PE molecules adopt "brush"-like configuration and the height of the PE brushes are smaller than the nanochannel half height. Secondly, we pinpoint the scaling conditions where the electrostatic effects associated with the PE brushes can be decoupled from the corresponding PE excluded volume and elastic effects; such de-coupling has tremendous connotation in context of modeling of electrostatics and transport at PE-brush-covered interfaces. Thirdly, we provide scaling arguments to quantify the dependence of the flow penetration depth into the PE brush as a function of the σ-**N** combination. Finally, our scaling estimates pinpoint the conditions where the flow or electric field induced deformation of the grafted nanochannel PE brushes can be neglected while modeling the pressure-driven or electroosmotic transport or ionic current in such nanochannels.

Guang Chen
Univ of Maryland-College Park

Date submitted: 06 Nov 2015 Electronic form version 1.4