

Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Hydrodynamic flow in the vicinity of a nanopore in response to an applied voltage¹ MAO MAO, Department of Mechanical Engineering, Northwestern University, SANDIP GHOSAL, Department of Mechanical Engineering and (by courtesy) Engineering Science & Applied Mathematics, Northwestern University, GUOHUI HU, Shanghai Institute of Applied Mathematics and Mechanics — Continuum simulation and analytical modeling is employed to study ion transport and fluid flow through a nanopore in a solid-state membrane under an applied voltage. The ion distribution near the surface of the membrane arises due to the combined effect of the intrinsic surface charge as well as concentration polarization due to the applied field. It gives rise to an electric pressure that drives hydrodynamic flow in the vicinity of the pore. There is a net hydrodynamic flow through the nanopore due to the asymmetry in the Debye layer induced by the membrane surface charge. The qualitative behavior is similar to that observed in a previous study using molecular dynamic simulations. The flow strength is a strongly nonlinear function of the applied field. Combination of electrophoretic and hydrodynamic effects can lead to ion selectivity in terms of valences and this could have some practical applications in separations.

¹This work was supported by grant number R01HG004842 from the National Human Genome Research Institute, National Institutes of Health. One of us (SG) acknowledges support from the Leverhulme Trust (UK).

Mao Mao
Department of Mechanical Engineering, Northwestern University

Date submitted: 23 Jul 2013

Electronic form version 1.4