Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Electroosmotic flow through a cylindrical nanopore in a charged membrane of finite thickness[1] MAO MAO, SANDIP GHOSAL, Northwestern University, JOHN D. SHERWOOD, University of Cambridge — We present numerical solutions to the coupled Nernst-Planck-Poisson-Stokes equation for electroosmotic flow through a cylindrical nanopore. The pore traverses a dielectric membrane with uniform surface charge. A multi-physics solver that incorporates electrostatics, ionic transport and electroosmotic flow is developed using the OpenFOAM CFD library. In the limit of small surface charge and weak applied electric field, the numerical results of fluid flux agree with theory when the thickness of the pore h is either very small or very large compared to the pore radius a. For intermediate h/a, our simulation agrees with the composite model of electroosmotic conductance [Sherwood et al. Langmuir (in press)]. When the finite permittivity of the dieletric membrane is taken into account, pairs of toroidal counter rotating eddies appear at the corner of the nanopore that expand to fill the entire pore as the pore radius is decreased. We discuss how the topology of the eddies/stagnation points varies as the aspect ratio of the pore increases.

[1]Supported by the NIH under grant 4R01HG004842.

Mao Mao
Northwestern University

Date submitted: 27 Jul 2014 Electronic form version 1.4