Abstract Submitted
for the MAR05 Meeting of
The American Physical Society

Simulations of induced-charge electro-osmosis in microfluidic devices YUXING BEN[1,3], KEVIN T. CHU[1,3], JEREMY LEVITAN[2,3], MARTIN Z. BAZANT[1,3], 1. Department of Mathematics, MIT 2. Department of Mechanical Engineering, MIT 3. Institute for Soldier Nanotechnologies — Theories of nonlinear electrokinetic phenomena generally assume a uniform, neutral bulk electroylte in contact with a polarizable thin double layer near a metal or dielectric surface, which acts as a "capacitor skin". Induced-charge electro-osmosis (ICEO) is the general effect of nonlinear electro-osmotic slip, when an applied electric field acts on its own induced (diffuse) double-layer charge. In most theoretical and experimental work, ICEO has been studied in very simple geometries, such as colloidal spheres and planar, periodic micro-electrode arrays. Here we use finite-element simulations to predict how more complicated geometries of polarizable surfaces and/or electrodes yield flow profiles with subtle dependence on the amplitude and frequency of the applied voltage. We also consider how the simple model equations break down, due to surface conduction, bulk diffusion, and concentration polarization, for large applied voltages (as in most experiments).

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Date submitted: 01 Dec 2004 Electronic form version 1.4