Abstract Submitted for the DFD09 Meeting of The American Physical Society

Induced Charge Electrokinetics Over "Controllably Contaminated" Surfaces: The Effects of Dielectric Thin Films and Surface Chemistry on Slip Velocity ANDREW PASCALL, TODD SQUIRES, University of California, Santa Barbara — Microfluidics has renewed interest in utilizing electrokinetics (EK) for transporting fluids on small scales, and has subjected EK theories and understanding to new challenges. For example, induced-charge electro-osmosis (ICEO), a non-linear EK effect in which an externally applied AC electric field both induces and drives a layer of charged fluid near an electrically conductive surface, could provide an on-chip means to drive high pressures with low voltage [1]. Experimental data on ICEO and related phenomena have shown that the standard theory consistently overpredicts slip velocities by up to a factor of 1000[2]. Here we present experiments in which we controllably "contaminate" the metallic surface with a thin dielectric film or Au-thiol self assembled monolayer, and derive a theory for ICEO that incorporates both dielectric effects and surface chemistry, which both act to decrease the slip velocity relative to a 'clean' metal. Data for over a thousand combinations of electric field strength and frequency, electrolyte composition, dielectric thickness and surface chemistry show essentially unprecedented quantitative agreement with our theory. [1] Squires & Bazant. J. Fluid Mech. 2004 [2] Bazant, et al. arXiv. 0903.4790

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Date submitted: 10 Aug 2009

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