Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Electrochemical surface properties of bare- and silane-coated silica nanochannels MATHIAS B. ANDERSEN, HENRIK BRUUS, Dept. Micro- and Nanotechnology, Technical University of Denmark, 2800 Kgs. Lyngby, Denmark, JARED FREY, SUMITA PENNATHUR, Dept. Mech. Eng., University of California, Santa Barbara, CA 93106, USA — We present a combined theoretical and experimental analysis of the solid-liquid interface of fused-silica nanofabricated channels with and without a hydrophilic cyanosilane coating. Our theoretical model consists of three parts: (1) a chemical equilibrium model of the wall, (2) a chemical equilibrium model of the bulk electrolyte, and (3) a self-consistent Gouy–Chapman–Stern triple-layer model of the electrochemical double layer coupling (1) and (2). To validate our model, we used both pH-sensitive dye based capillary filling experiments and electro-osmotic current-monitoring measurements. Our model shows that the important fitting parameters are the inner Stern capacitance C_1 and the surface reaction constant $\mathrm{p}K_+$. We also find that changing the outer Stern capacitance C_2 with surface composition results in more accurate fits of experimentally determined ζ potentials. This model is of value to predict experimentally observed phenomena in nanofluidic systems.

Mathias B. Andersen
Technical University of Denmark

Date submitted: 29 Jul 2010 Electronic form version 1.4