Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Toward predicting the electrokinetic zeta potential in slit micro/nanochannels with nanoscale surface features: Continuum and molecular dynamics analysis.[1] TROY SINGLETARY, AMIR RAHMANI, SIJIA HUANG, GERARD MILES, CARLOS COLOSQUI, State Univ of NY - Stony Brook — We present a recently developed continuum description of electrokinetic flows for predicting the zeta potential in the case of slit channels with nanoscale surface features of dimensions comparable to the Debye length. The proposed analytical model considers the average effects that such nanoscopic features commonly found on macroscopically smooth surfaces have on the streamwise-averaged fluid velocity and ion density by solving a unidirectional Navier-Stokes and Poisson-Boltzmann equation for such variables. The proposed analytical model is simple and compact and quantitatively accounts for results from molecular dynamics simulations that consider the finite size of ionic species as well as the presence of ion solvation shells and hydration layers on the channel surface. Our theoretical and computational analysis indicates that under conditions for which the Onsager symmetry holds, a simultaneous knowledge of the electroosmotic flow rate and the pressure-driven flow rate or streaming current is instrumental to unambiguously determine the zeta potential and the effective height of the nanoscale surface features.

[1]This work was supported by the Office of Naval Research under award N00014-16-1-3178 and the National Science Foundation under award CBET-1605809

Carlos Colosqui
State Univ of NY - Stony Brook

Date submitted: 14 Aug 2020 Electronic form version 1.4