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Characterization of surface-solute interactions by diffusioosmosis

JESSE AULT, Brown University, SANGWOO SHIN, University of Hawaii at Manoa, HOWARD STONE, Princeton University — The measurement of wall zeta potentials and solute-surface interaction length scales for electrolyte and non-electrolyte solutes, respectively, is critical to the design of biomedical and microfluidic applications. We present a microfluidic approach using diffusioosmosis for measuring either the zeta potentials or characteristic interaction length scales for surfaces exposed to, respectively, electrolyte or non-electrolyte solutes. When flows containing different solute concentrations merge in a junction, local solute concentration gradients can drive diffusioosmosis due to interactions between the solute molecules and solid surfaces. We demonstrate a microfluidic system in which solute concentration gradients drive diffusioosmosis within a pore, resulting in predictable fluid and solute profiles. Furthermore, we present analytical results and a methodology to determine the zeta potential or interaction length scale for the pore surfaces in the system. We apply this method to the experimental data of Lee et al., and we use 3D numerical simulations to validate the theory. To the best of our knowledge this is the first flow-based approach to characterize surface/solute interactions with non-electrolyte solutes.

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