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Electroosmotic Flow in Rigid and Soft Nanochannels: Effects of Solvent Polarization LUCAS MYERS, SHAYANDEV SINHA, SIDDHARTHA DAS, Univ of Maryland-College Park — Electroosmotic (EOS) flow, triggered by the interaction of an applied electric field and the charge density gradient generated at the interface of a solid-liquid interface, has evolved as an extremely popular technique of driving liquid in micro-nanochannels. Unlike the Poisson-Boltzmann (PB) approach based analysis of the EOS transport, there is relatively little work on studying EOS flows in a framework beyond the PB approach. Here we provide a theory for the EOS transport using a Langevin-Bikerman (LB) model that simultaneously accounts for two important non-PB elements, namely solvent polarization and finite ion sizes. Our analysis reveals new non-dimensional parameters that influence the EOS flow. More importantly, we identify an effective electric double layer (EDL) thickness that dictates the flow characteristics. The central finding of our calculations is that for the realistic set of parameters, non-PB influences always enhances the electroosmotic flow. In the next part of the study, we highlight the non-trivialities associated with the case where the nanochannels become "soft," i.e., the nanochannel walls are grafted with polyelectrolyte layers that affect both the electrostatic potential distribution as well as the drag force associated with the electroosmotic flow.

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