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Electroosmosis through a Bottleneck: Formation of Eddies and Theory for Arbitrary Debye Lengths STELLA PARK, Harvard University, CHRISTOPHER RUSSO, Harvard University, HOWARD STONE, Harvard University, DANIEL BRANTON, Harvard University — Although using an applied electrical field to drive flows becomes desirable as channels become smaller, most discussions of electroosmosis treat the case of thin Debye layers. Here electroosmotic flow (EOF) through a constricted cylinder is presented for arbitrary Debye lengths κ^{-1} using a perturbation approach. The varying diameter of the cylinder produces radially and axially varying effective electric fields, as well as an induced pressure gradient. We predict the existence of eddies for certain constricted geometries and propose the possibility of electrokinetic trapping in these regions. Eddies can be found both in the center of the channel and along the perimeter, and the presence of the eddies is a consequence of the induced pressure gradient that accompanies electrically driven flow into a narrow constriction. An experimental system is also presented in which we observe regions of recirculation in EOF eddies in the small Debye length limit.

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