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Characterization of the Velocity and Power Consumption of Electroosmotic Flow in Nanochannels Using Numerical Simulations JOSHUA D. SHAWALA, FRANCISCO J. DIEZ, Rutgers University — A numerical simulation of the electroosmotic flow in a nanochannel is performed. The study focuses on characterizing the velocity behavior when changes are applied to the zeta potential in the electrical double layer and the electric field. Similarly, the characteristics of power consumption are indentified by the ratio of convection to conduction current, which changes with flow velocity and ion concentration. In the 2D numerical simulations the electrostatic potential is obtained by the Poisson Boltzmann dilute solution theory which is solved in its nonlinear form and is validated from published work. Aqueous solutions of 1:1 electrolytes at bulk ion concentrations from 1-100 mM are considered. The viscous-driven nature of the flow outside the electric double layer causes an adverse pressure gradient along the center of the channel which is examined in detail. Pressure effects at the inlet and outlet are also considered. The need for higher inlet pressure increases with velocity, which is proportional to the applied electric field. Increasing the bulk ion concentration causes minimal change in average velocity under conditions of zero slip at the channel walls. In the case when a slip length is imposed at the walls, the flow velocity increases significantly with ion concentration. The increase in slip length also increases the ratio of convection to conduction current.

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