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Transient Currents, Capacitance and an Electrical Analogy of a Finite Length Microchannel ALI MANSOURI, SUBIR BHATTACHARJEE, LARRY KOSTIUK, U of Alberta, UNIVERSITY OF ALBERTA TEAM — Numerical simulations with the fluid mechanics based on the unsteady Navier-Stokes equations, and the Poisson-Nernst-Planck formulation of electrostatics and ion transport, were used to explore the transient transport of charge through a finite length cylindrical microchannel that is driven by a pressure difference. The evolution of the trans-capillary potential from a no-flow equilibrium to the steady-state-steady-flow streaming potential was analyzed by following the convection, migration and net currents. Observations of the unsteady characteristics of the streaming current, electrical resistance, and capacitance lead to an electrical analogy. This electrical analogy was made from a current source which was placed in parallel with a capacitor and a resistor. A parametric study involving a range of geometries, fluid mechanics, electrostatics, and mass transfer states allowed predictive sub-models for the current source, capacitor and resistor to be developed based on a dimensional analysis.

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