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Electro-osmotic flow in a non-uniformly charged cavity DAVID HALPERN, Unviersity of Alabama, HSIEN-HUNG WEI, National Cheng Kung University — Electro-osmotic flow (EOF) has recently received growing attention in view of its potential means to manipulate flows within microfluidic devices. In this work, the EOF in an open, rectangular cavity is investigated theoretically. In the limit of a thin Debye screening layer adjacent a charged surface, the EOF is characterized by the Smoluchowski-slip velocity at the walls with prescribed zeta potentials because of an electric field. It is well known that an EOF with a uniform zeta potential does not give rise to flow separation due to its irrotational nature, as opposed to the classical problem of shear flow past a cavity. This study explores how a non-uniform charge distribution along the cavity surface affects the EOF therein. Assuming Stokes flow, a boundary element method is employed to determine the fluid motion and electric field in the cavity. The results show that the system can be susceptible to flow separation, and exhibit various flow patterns, depending on the distributions of zeta potentials and the aspect ratio of the cavity. This work might provide guidance for developing optimal strategies on achieving effective mixing using microdevices without appealing to complicated designs. This research is supported by Grant NSC 94-2214-E-006-008 of the National Science Council of Taiwan.

David Halpern
Unviersity of Alabama

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