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Time Periodic Electroosmotic Flow in Cylindrical Microchannel with Heterogeneous Surface Charge AMINUL KHAN, PRASHANTA DUTTA, Washington State University — Mixing of species is very slow in microfluidic device due to creeping flow. Time periodic electroosmotic flow (EOF) has been used for faster mixing in microdevice by rapid stretching and folding of fluid streams. Furthermore, surface inhomogeneities are also explored to expedite the mixing process. Although several analytical models exist for each individual case, there is no analytical solution for time-periodic EOF in a heterogeneously charged microchannel. In this work, a general analytical model has been developed for time-periodic EOF through cylindrical microchannel by solving Navier-Stokes equation with slip velocity conditions at the channel wall. Results show that the axial variation of surface charge yields diverse flow patterns containing counter-rotating vortices. The extent and strength of vortices are characterized by channel size, charge distribution and the period of electric field. As the electric field frequency or channel diameter increases, vortices are shifted towards the channel surface and the perturbed flow region confined near the channel wall. Also, the number of vorticities depends on the periodicity of the surface charge. Our analytical model can be used for effective micromixer design by manipulating the surface charge pattern.

Prashanta Dutta
Washington State University

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