Theoretical study of instability control for AC electroosmotic flow in non-uniformly charged microchannel

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In this work we study the AC electroosmotic flow in 2-dimensional microchannel when the non-uniform zeta potential distribution varies periodically as a function of time. The utility of time-varying zeta potential distribution for fluid mixing in DC electroosmotic microchannel has been reported. We determine the flow field analytically by solving the time dependent Stokes equation with an electrostatic body force term.

As for the time-periodic zeta potential distributions assigned at the top and the bottom surfaces, we use two different types of zeta potential distributions alternately. We assume that the first (second) type of zeta potential distribution is maintained over the first (second) half period of time. Using the corresponding velocity field at each half period of time several particle pathlines are numerically computed.

The frequencies of both AC electric field and time-periodic zeta potential distribution are the most important parameters. The effects of these two frequencies on the instability characteristic will be discussed.