

Mandal, Shubhadeep; Ghosh, Uddipta; Bandopadhyay, Aditya; Chakraborty, Suman
Electro-osmosis of superimposed fluids in the presence of modulated charged surfaces in narrow confinements. (English) Zbl 1382.76292
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Summary: In the present study, we attempt to analyse the electro-osmotic flow of two superimposed fluids through narrow confinements in the presence of axially modulated surface charges. We attempt to solve for the flow structure as well as the interface deformation by both analytical and numerical techniques. Approximate analytical solutions are obtained through asymptotic analysis for low deformations, whereas numerical solutions are obtained by applying the phase field formalism; the numerical solutions are obtained for small as well as large interfacial deformations. The analytical solutions are derived only for the transient deformation of the interface, neglecting the transience in the flow, i.e. the flow is assumed to be quasisteady. The numerical solutions, however, are derived including the effects of inertia and transients in the flow. We attempt to compare our analytical and numerical results and explore the effects of several physico-chemical parameters on the deformation of the interface as well as the nature of the flow. Our analysis reveals that parameters such as the modulation wavelength, surface tension (described through the capillary number), viscosity ratio, permittivity ratio and extent of asymmetry in the potential on the two walls are the major contributors to the deformation and the resulting flow features.

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76W05 Magnetohydrodynamics and electrohydrodynamics

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