Microfluidic study on electrokinetic streaming potential induced by microflows of electrolyte solution

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We develop the theoretical model of the electrokinetic streaming potential considering the Navier-Stokes equation coupled with the Poisson-Boltzmann equation in order to elaborate the possible applicability of the microfluidic power from conceptualization to system validation. The ion transport in the microchannel is described on the basis of the Nernst-Planck equation. In this study, symmetric electrolytes are considered, and the profile of fluid conductivity is derived in terms of both the concentration profile and the mobilities of anion and cation. The present simulations provide that the flow-induced streaming potential increases with increasing surface potential of microchannel wall, whereas increasing the surface conductivity reduces the streaming potential. We also present the results on the change of streaming potential with variations of the electric double layer thickness normalized by channel radius. It is of interest to find the behavior that lower value of ion mobility leads to the enhancement of streaming potential, which tends to develop with either increasing the bulk electrolyte concentration or decreasing the surface conductivity.