Electroosmotic flow driven by oscillating zeta potentials : comparison of the Poisson-Boltzmann model, the Debye-Hückel model and the Nernst-Planck model

신광섭, 김훈태, 박흥목*
서강대학교 화공생명공학과
(hmpark@sogang.ac.kr*)

We consider electroosmotic flows (EOF) generated by temporally varying zeta potential which is usually adopted for pumping or mixing of fluids. In this case the dynamics of ions in the electric double layer (EDL) influences the induced electric eld and consequently the EOF significantly. Therefore, the appropriate model should be the Nernst-Planck (NP) model for all zeta potentials or the Debye-Hückel(DH) model for low zeta potentials rather than the Poisson-Boltzmann(PB) model which is based on the equilibrium distribution of ions in the EDL. In the present investigation we compare the predictions from the DH model and the PB model with the exact ones from the NP model for a range of frequency of zeta potential oscillation. It is found that one may adopt the PB model when the frequency is low and the DH model when the zeta potential is low. However, for either high frequency of zeta potential oscillation or large value of zeta potential, one must adopt the NP model to get accurate predictions of EOF.