Numerical study on the slip effect of the non-Newtonian electroosmotic flow in microchannels

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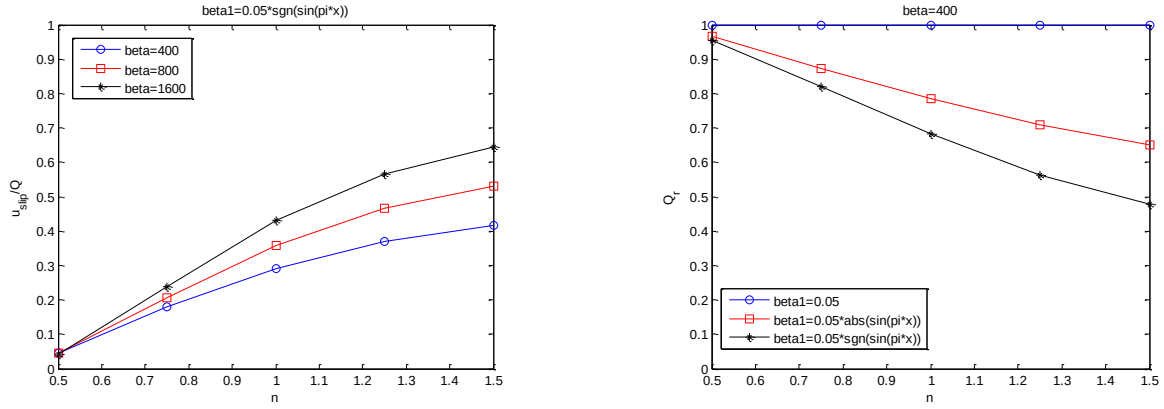
The last few decades have witnessed the increasing interest in the electroosmotic flow due to its widely applications (H.C. Chang, L.Y. Yeo (2010)). Most existing works are limited to the problems with constant slip boundaries or Newtonian fluid flow. No works have been done to the combined effect of variable hydrodynamic slip and fluid rheological behaviour on the electrokinetic flow. In the paper, the power-law electroosmotic flow in microchannels with variable boundary slip conditions is numerical simulated by the lattice Boltzmann method (Z.H. Chai, T.S. Zhao (2012)), how the Debye length, the power law index, the slip distributions on the channel boundaries affect the fluid flow involved is studied. The following conclusions can be obtained: (1) The slip contributes more to the flow flux when the power law index increases or the Debye length decreases in the variable boundaries slip cases (Fig. 1(a)); (2) The larger boundary slip area on the boundaries means larger flow flux, the larger power law index leads to the smaller flow flux compared with the constant boundary slip cases (Fig.1(b)); In the meantime, the flow flux difference between cases with different boundary slip areas seems larger when the index increases; (3) the larger boundary slip oscillation frequency leads to the smaller the flow flux. The effect of the frequency is more apparent when the power law index increases.



(a) (b)

Figure 1. (a) The slip contribution to the flow flux under different power-law index and Debye length. (b) The flow flux ratio between cases with variable slip distributions and the cases with constant slip one.

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