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Lattice Boltzmann Simulations of Slip Flow in Microchannels at High Knudsen Numbers RAMESH AGARWAL, Washington University in St. Louis — In this paper, we consider the application of Lattice Boltzmann Method (LBM) to flow in micro-fluidic devices, which requires special consideration because of the variation in Knudsen number as the fluid moves along these devices driven by pressure or acceleration. We consider the pressure driven gaseous slip flow with small to moderate rarefaction through a long micro-channel and formulate the problem in LB framework. The accuracy of the LB solution is checked by comparing it with analytical solution with slip boundary condition and the numerical solutions of Navier-Stokes and augmented Burnett equations without and with slip boundary condition. It is shown that the treatment of slip boundary condition has a significant influence on the solution at moderate to high Knudsen numbers. We also consider the influence of magnetic field on the same flow assuming that the gas is conducting. The numerical solution of magnetohydrodynamic (MHD) flows using the LBM, in particular Lattice BGK (LBGK) method, requires the construction of an appropriate particle distribution function which recovers both the continuum MHD flow equations and magnetic induction equations in low Mach number limit. For the test cases considered, the LBGK results agree well with the analytical solutions for velocity and pressure field. As physically expected, the higher value of the magnetic field (higher Hartmann number) flattens the velocity profile in the channel.

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