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Lattice-Boltzmann Simulations of Bubble Suspensions in Vertical and Inclined Channels XIAOLONG YIN, DONALD L. KOCH, Chemical and Biomolecular Engineering, Cornell University — We have developed a lattice-Boltzmann boundary method to recover the slip boundary condition at the gas-liquid interface. This rule enables one to use a single-component lattice-Boltzmann solver to simulate gas-liquid flows. The method is applied to suspensions of spherical, non-coalescing bubbles with Re=O(10). We first studied the hindered rising velocity and microstructures of bubble suspensions in periodic domains. We observed that the bubbles form a distinctive structure with strong correlations in the horizontal positions of neighboring bubbles at all bubble volume fractions. We then simulated the rise of bubbles in vertical and slightly inclined channels bounded by solid walls in the horizontal direction. In vertical channels, the bubbles are pushed away from the walls. A strong backflow is observed near the wall. In inclined channels, the gravity component normal to the walls breaks the symmetry and creates a bubble-rich layer next to the upper wall. A weak shear flow then develops. The shear rate is just sufficient so that the lift force on the bubbles balances the cross-channel buoyancy, thus keeping most of the bubbles suspended.

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