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Lattice Boltzmann simulations of liquid crystal particulate flow in a channel with finite anchoring boundary conditions RUI ZHANG, TYLER ROBERTS, JUAN DE PABLO, University of Chicago, DEPABLO TEAM — Liquid crystals (LC) posses anisotropic viscoelastic properties, and, as such, LC flow can be incredibly complicated. Here we employ a hybrid lattice Boltzmann method (pioneered by Deniston, Yeomans and Cates) to systematically study the hydrodynamics of nematic liquid crystals (LCs) with and without solid particles. This method evolves the velocity field through lattice Boltzmann and the LC-order parameter via a finite-difference solver of the Beris-Edwards equation. The evolution equation of the boundary points with finite anchoring is obtained through Poisson bracket formulation. Our method has been validated by matching the Ericksen-Leslie theory. We demonstrate two applications in the flow alignment regime. We first investigate a hybrid channel flow in which the top and bottom walls have different anchoring directions. By measuring the apparent shear viscosity in terms of Couette flow, we achieve a viscosity inhomogeneous system which may be applicable to nano particle processing. In the other example, we introduce a homeotropic spherical particle to the channel, and focus on the deformations of the defect ring due to anchorings and flow. The results are then compared to the molecular dynamics simulations of a colloid particle in an LC modeled by a Gay-Berne potential.

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