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Bulk Rheology of Noncolloidal Deformable Fiber Suspension[1]
MUBASHAR KHAN, MINH DO-QUANG, GUSTAV AMBERG, KTH Royal Institute of Technology, JINGSHU WU, CYRUS AIDUN, Georgia Tech — The effect of fiber flexibility and shear rate on microstructure and rheology of fibers suspended in Newtonian fluid is investigated with direct numerical simulation based on the external boundary force lattice-Boltzmann method (Wu and Aidun, *Int. J. Multiphase Flow*, 36 (3) March 2009). It is shown that the fiber bending ratio (BR), which is proportional to the fiber elastic modulus divided by dynamic viscosity and shear rate, has significant influence on rheology. For fiber suspension under shear, the relative viscosity decreases significantly as BR increases. The primary normal stress difference undergoes a minimum at a critical BR value and increases rapidly as BR decreases further (Wu and Aidun. *J. Fluid Mech.*, to appear 2010). In previous studies, the effect of shear rate on bulk rheology at a constant BR and volume fraction has remained unclear. In this study, we show that the ratio of viscosity for deformable (BR=0.25) to rigid fibers for volume fraction 0.05 may reach a maximum at a critical shear rate. We explain this behavior in terms of fiber orientation distribution and fiber-fiber interaction.

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