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Rheology, Microstructure and Migration in Brownian Colloidal Suspensions WENXIAO PAN, BRUCE CASWELL, GEORGE KARNIADAKIS, Brown University — We demonstrate that suspended spherical colloidal particles can be effectively modelled as single dissipative particle dynamics (DPD) particles provided that the conservative repulsive force is appropriately chosen. The suspension model is further improved with a new formulation, which augments standard DPD with non-central dissipative shear forces between particles while preserving angular momentum. Using the new DPD formulation we investigate the rheology, microstructure and shear-induced migration of a monodisperse suspension of colloidal particles in plane shear flows (Couette and Poiseuille). Our simulations yield relative viscosity versus volume fraction predictions in good agreement with both experimental data and empirical correlations. We also compute the shear-dependent viscosity and the first and second normal- stress differences and coefficients in both Couette and Poiseuille flow. Simulations near the close packing volume- fraction (64%) at low shear rates demonstrate a transition to flow-induced string-like structures of colloidal particles simultaneously with a transition to a non-linear Couette velocity profile. Migration effects simulated in Poiseuille flow compare well with experiments and model predictions. Overall, the new method agrees very well with the Stokesian Dynamics method but it seems to have lower computational complexity and is applicable to general complex fluids systems.

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