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A Generalized Frictional and Hydrodynamic Model of the Dynamics and Structure of Dense Colloidal Suspensions JOAO MAIA, ARMAN BOROMAND, BRANDY GROVE, Case Western Reserve University, SAFA JAMALI, Massachusetts Institute of Technology — We perform mesoscopic DPD simulations incorporating both hydrodynamic and frictional interparticle interactions to study the effect of interaction potential on the rheology and structure of dense frictional colloidal suspensions. In particular, we performed a series of viscosity and normal stress measurements in suspensions with different volume fractions and obtained, for the first time, a complete picture of the dynamic state and of the microstructure. We confirmed that N_1 for semi-dense suspensions stays negative and grows with shear rate, which is consistent with hydrocluster-induced shear-thickening. We show that CST in colloidal suspensions can be explained solely via hydrodynamics, frictional bonds being transient and negligible to the rheological response. In dense suspensions and close to the jamming transition however, friction is required to obtain DST and replicate the recently experimental findings of a transition from negative to positive N_1. We prove that hydroclusters form first at low stresses; this brings the particles together, thus allowing frictional contacts to develop, eventually leading to DST. In addition, when each particle is subject to an average of one frictional contact, N_1 reverses its increase but remains negative; at approximately two frictional contacts, a percolating network forms and N_1 becomes positive.

Joao Maia
Case Western Reserve University

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