Microstructure in Concentrated Sheared Dispersions  
JEFF MERRIS, EHSSAN NAZOCKDAST, City College of New York — This work describes a theory for predicting microstructure of concentrated colloidal hard spheres as a function of Péclet number \(Pe = 6\pi\eta\dot{\gamma}a^3/kT\) and particle volume fraction, \(\phi\); \(\dot{\gamma}\) is the shear rate, \(a\) is the particle radius, \(\eta\) is fluid viscosity and \(kT\) is the thermal energy. We study the pair distribution using the pair Smoluchowski equation. Many-body effects in the conservation equation were then formulated self-consistently through probabilistic third-particle integrals, with emphasis on capturing the interaction of flow and excluded volume effects. The resulting integro-differential equation was solved iteratively. Comparison between theory predictions and simulation results show that the theory is able to predict known near-equilibrium \((Pe \ll 1)\) and dilute-suspension large-\(Pe\) results. The approach accurately predicts the major features of microstructure at concentrated \(\phi\) under strong shear, which differentiates it from previous theoretical work. Rheological quantities of shear stress, normal stress differences, and particle pressure are computed from the structure.