Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Microstructure and rheology of colloidal suspension in simple shear and dynamic oscillatory flows: theory and simulation EHSSAN NAZOCKDAST, Courant Institute, New York University, STEPHANIE MARENNE, JEFFREY MORRIS, Levich Institute and Department of Chemical Engineering at CUNY — A Smoluchowski theory is developed for analytical prediction of structure and rheology of concentrated colloidal dispersions. Pair distribution function, $g(\mathbf{r})$, is computed as a solution to pair Smoluchowski convection-diffusion equation at a given volume fraction, ϕ, and Pe which is the ratio of hydrodynamic to Brownian forces. Pair distribution function is then used to evaluate rheology. Many body interactions are modeled self-consistently through third particle integrals which allows for predictions of structure and rheology at $\phi < 0.50$ and the entire range of Pe. The predictions of structure and rheology of steady state simple shear flow are in good agreement with Accelerated Stokesian Dynamics simulations (ASD). In this work the theory is extended to study time-dependent pair structure, $g(\mathbf{r}\ \mathrm{t})$, and rheology of colloidal dispersions, considering both startup of steady shear and oscillatory shear flows. The predictions of startup flow are compared against ASD simulations over a wide range of Pe and ϕ. The predictions of stress and microstructure in oscillatory shear flow are also presented over a wide range of strain amplitudes and frequencies.

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Date submitted: 02 Aug 2013 Electronic form version 1.4