Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Particle cage dynamics in flowing colloidal dispersions STEPHANIE MARENNE, JEFFREY F. MORRIS, Levich Institute / Chemical Engineering Department, City College of New York — The idea of the particle in a suspension at rest being trapped in a cage formed by its neighbors, widely used to understand glassy suspensions, has been applied to freely flowing suspensions. Stokesian Dynamics, a discrete particle simulation, is used to simulate the flow of monodisperse colloidal hard sphere suspensions. The cage analogy is useful to study the nonlinear stress in the material during start-up of shear flow, where the neighbor cage deforms and breaks, and during oscillatory shear flow where, depending on the amplitude of oscillation, the particle is trapped inside the cage or escapes during the oscillation cycle. A precise statistical definition of the cage in terms of the nearest neighbor ring in the pair distribution function is developed. We examine the dependence of the cage dynamics on the volume fraction of particles and the Peclet number Pe, the ratio between shear and Brownian forces. Under flow, the cage is found to break at quite definite positions, and the structural distortion is found to be clearly related to the shear and normal stress response. The shear strain needed to break the neighbor cage depends on Pe as Brownian motion enhances the total deformation. A simple model captures the strain at the stress overshoot for start-up of steady shear.

Stephanie Marenne
Levich Institute / Chemical Engineering Department, City College of New York

Date submitted: 28 Jul 2016 Electronic form version 1.4