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Rheology of cube shaped particles in a suspension RAJESH MALLAVAJULA, DONALD KOCH, LYNDEN ARCHER, Cornell Univesity —
The rheological properties of suspensions of Brownian cube-shaped particles are interesting because of the greater increase in the translational freedom caused by layering relative to suspensions of Brownian spheres. Theoretical solutions for a simple shear flow around an isolated cube were obtained using the geometric properties of cubes. Since stress-strain relationship is anisotropic, the suspension viscosity in the limit of zero shear rate can be obtained from the orientational average of the stresslet acting on the cube. The value of intrinsic viscosity was found to be 3.1. Brownian dynamics simulations were carried out with the obtained anisotropic stress relationship to understand hydrodynamic interactions between cubes at low to moderate volume fractions and lubrication hydrodynamic interactions at higher volume fractions. Interesting transitions are observed in rheological properties as the volume fraction of particles in suspension rises above a critical value substantially lower than the minimum close-packing. We have also synthesized model cube-shaped particles with two different chemistries and sizes: Iron oxide, Fe_3O_4, nanocubes (20nm and 100nm) and hollow Manganese Carbonate ($MnCO_3$) microcubes (1-2microns). $MnCO_3$ microspheres were also synthesized to compare their properties with the cubic particle suspensions. At low particle volume fractions, the experimentally determined intrinsic viscosity for the suspension of cubic particles is in excellent accord with expectations from theory. The talk will also compare results of rheological properties of spheres and cubes for both high and low volume fractions over a range of Peclet numbers.

Rajesh Mallavajula
Cornell Univesity

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