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Rheology of a dilute suspension of cubic nanoparticles RAJESH KUMAR MALLAVAJULA, DONALD KOCH, LYNDEN ARCHER, School of Chemical and Biomolecular Engineering, Cornell University — 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. As a first step toward understanding suspensions of these particles, we present theoretical (multipole and finite element) solutions of simple shear flow around an isolated cube and use this solution to obtain the intrinsic viscosity. The stress stress-strain-rate relationship is anisotropic with different particle stresslets when the extensional axis is parallel to an axis or a diagonal of the cube. The suspension viscosity, μ_{eff}, in the limit of zero shear rate can be obtained as an isotropic orientational average, yielding a prediction $\mu_{eff} = \mu(1{+}5.45\phi)$ where ϕ is the particle volume fraction and the coefficient 5.45 is the intrinsic viscosity, $[\ \eta\ ]$ of the cube. The calculated $[\ \eta\ ]$ for cubes is therefore more than twice that computed by Einstein, $[\ \eta\ ] = 2.5$, for spheres. To evaluate our prediction, we have synthesized cube-shaped Fe_3O_4 particles and characterized their rheological properties in dilute suspensions.

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