253b Effects of Particle Shape on Colloid Rheology and Shear Thickening

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The effects of particle shape on colloid rheology are studied, with emphasis on understanding the shear thickening transition. Model systems of anisometric colloidal particles studied include multiple dispersions of rod-like mineral particles of varying aspect ratio and varying size, and clay dispersions of plate like particles. Electron microscopy, light and neutron scattering measurements are performed to characterize the particles. Stable dispersions are formulated studied as a function of particle loading. Rheological measurements demonstrate that reversible shear thickening in anisometric particle dispersions has many similarities to that for spherical particle dispersions. Shear thickening evolves from continuous to discontinuous shear thickening with increasing volume fraction. However, the volume fraction required for discontinuous shear thickening decreases with increasing aspect ratio. Rheo-SANS (small angle neutron scattering) measurements demonstrate that particles flow align in the shear thinning regime and that the flow alignment is largely maintained in the shear thickened state. Comparison to established results for colloidal dispersions of spherical particles suggests that shear thickening in anisometric particles is a consequence of hydrocluster formation driven by short-range hydrodynamic interactions. Predictions for the onset of shear thickening (critical stress) are possible from a micromechanical model including interparticle and hydrodynamic interactions.