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Shear Thickening, Gel Elasticity and Internal Stresses in a Colloidal System with Attractive Interactions CHINEDUM OSUJI, Yale University, DAVID WEITZ, Harvard University — Dilute dispersions of carbon particles in hydrocarbon fluids flocculate, forming colloidal gels with typical fractal scaling of shear modulus with particle volume fraction. Surprisingly, these systems exhibit shear thickening in two regimes. At low shear rates, shear thickening is concurrent with the formation of vorticity-aligned structures, a general phenomenon in attractively-interacting complex fluids, but not previously implicated in shear thickening. At high Péclet numbers, thickening involves degradation of particle clusters and an increase in effective volume fraction. This contrasts with the hard-sphere case where thickening is due to pseudo-jamming events that occur with the growth of hydro-clusters with persistent contacts. On cessation of high shear rate flow, these shear thickened gels display a power-law dependence of elasticity on pre-shear stress and the data can be re-scaled simply to provide a universal response for different particle volume fractions. We propose a mechanism and scaling argument that accounts for this behavior in terms of the stress dependence of the cluster number density during pre-shear. We characterize the internal stresses that result from a shear rate quench from the fluid to the gel state and find that the modulus is directly proportional to the internal stress in the system. At short times, t$\approx 10^3$s, the internal stress decays with a weak power law dependence on time.

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