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Experimental study of structure and rheology of concentrated colloidal suspensions XIANG CHENG, Dept. of Physics, Cornell University, JONATHAN MCCOY, Dept. of Physics, Colby College, JACOB ISRAELACHVILI, Dept. of Chemical Engineering, Univ. of California, Santa Barbara, ITAI COHEN, Dept. of Physics, Cornell University — We investigate the three-dimensional flow structure and rheology of concentrated colloidal suspensions in a newly designed plane shear cell. Using fast confocal microscopy, we optically probe the dynamics of colloidal suspension under shear with single particle resolutions. The rheological properties of the suspensions are also measured simultaneously. Hence, a direct correlation between the microstructure and the rheology of the suspensions is obtained in our experiments. Three regimes are observed with increasing shear rate. At low shear rates where the Brownian motion of particles dominates, the structure of the suspensions is indistinguishable from that at equilibrium. At intermediate shear rates, colloidal particles form sliding layers normal to the shear gradient direction, but keep a disordered structure within the layers. Along with this transition, the suspensions shear thins dramatically. At even higher shear rates, particles in the layers organize into a novel structure – strings of particles perpendicular to the shear direction. We speculate that this structure may be a precursor to the hydroclusters observed in shear thickening suspensions.

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