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Material properties of the shear-thickened state in concentrated near hard-sphere colloidal dispersions NORMAN WAGNER, COLIN CWALINA, Chemical and Biomolecular Engineering, University of Delaware — Reversible shear thickening is common in concentrated dispersions of Brownian hard-spheres at high shear rates. We confirm the existence of a well-defined colloidal shear-thickened state through experimental measurements of the shear stress and the first and second normal stress differences in the shear-thickened state as a function of the particle volume fraction for a model dispersion of near hard-spheres. The shear stress and normal stress differences are observed to grow linearly with the shear rate in the shear-thickened state and both normal stress differences are observed to be negative. Our experimental results show the shear-thickened state of colloidal dispersions can be described by three material properties—the shear viscosity and first and second normal stress difference coefficients—that are a function of the volume fraction. All three material properties are found to diverge with a power law scaling with the approach to maximum packing,which is found to be 0.54 ± 0.01. We find the magnitude of the relative shear viscosity is greater than the magnitude of the dimensionless second normal stress difference, which is greater than the magnitude of the dimensionless first normal stress difference. These results are consistent with theoretical predictions for shear thickening by hydrocluster formation and quantitatively comparable to Stokesian Dynamics simulations. We further postulate and show that these material properties are consistent with those measured for non-Brownian suspensions.

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