Oscillatory Microrheology of Colloidal Suspensions

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Abstract: We investigate active linear microrheology of colloidal suspensions. Suspensions are studied because a large theoretical framework has been developed to study their *macro*-rheological as well as microrheological properties. Recently, it has been realized that several factors contribute to the measured suspension microviscosity. Direct probe-bath interactions contribute to the microstructure of the suspension, whereas indirect bath-bath interactions indicate the true bulk behavior of the suspension. Therefore, by studying these interactions, one may develop more accurate comparisons between microrheology and bulk rheology. Furthermore, one may tune measurements to study specific aspects of suspension behavior. We use small amplitude active oscillatory microrheology experiments to study these interactions in colloidal suspensions. The experimental system is an aqueous suspension of index matched fluorinated ethylene propylene (FEP) particles embedded with either 2 um diameter silica or 3 diameter um polystyrene probe particles. Probes are trapped and oscillated using laser tweezers at frequencies of between 5-1000 Hz and at amplitudes of 28-440 nm. The oscillation amplitude and phase of the probe are measured using a photo diode and lock-in amplifier, and these values are used to compute the frequency dependent microviscosity of the suspension. Frequency thinning is observed at all concentrations and is most significant for volume fractions above 0.3. The results are in quantitative agreement with both previous measurements of the suspension microviscosity [1] and recently developed theory.

[1] Meyer, A., et al., Journal of Rheology. 50(1), 77-92, (2006).