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Microstructure and rheology of a thermoreversible gel under large amplitude oscillatory shear (LAOS) deformation using time-resolved oscillatory rheo-small-angle neutron scattering (tOr-SANS)
JUNG MIN KIM, A. KATE GURNON, NORMAN WAGNER, University of Delaware, AARON EBERLE, NCNR NIST — Large amplitude oscillatory shear (LAOS) rheology is an effective way of studying the nonlinear dynamics of complex fluids. Here, we present a new method for a direct, quantitative study of the microstructure under LAOS deformation in the framework of the alignment factor, Af. We use a model thermoreversible adhesive hard-sphere system composed of octadecyl-coated silica particles suspended in n-tetradecane. With temperature the particle potential is controlled and the system is shifted from behaving as a near hard-sphere to an adhesive hard-sphere system leading to aggregation and ultimately a dynamical arrest transition to macroscopic gelation. Time-resolved oscillatory rheo-small-angle neutron scattering (tOr-SANS) measurements in the 1-3 plane are performed by stroboscopically probing the structural evolution as a function of time during LAOS. Under strong shear, the 2D scattering pattern of the system in the gelled state exhibits a strong anisotropy commonly known as a "butterfly" pattern, which corresponds to the stretching of the microstructure along the flow direction. The first structure-Lissajous plots of this model system are presented in terms of an order parameter and Af as a function of instantaneous strain and strain rate. This new analysis demonstrates a novel method for simultaneously measuring the rheology and microstructure during a time-dependent deformation (LAOS).

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