

Transient response of concentrated colloidal dispersions to shear

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The time-dependent macroscopic rheological response of concentrated colloidal dispersions is related to changes in their microscopic structure and dynamics. In the transient regime preceding the onset of steady-state flow a stress overshoot is observed at strains where shear-induced structural anisotropy is maximal and the dynamics present a super-diffusive regime in the transition from in-cage to out-of-cage dynamics. The Peclet number and the available free volume control the ability of caged particles to relax deformation through Brownian motion and therefore the magnitude of the overshoot and the degree of anisotropy. In the steady state of shear structural anisotropy is still present. When shear is removed, a deformed cage leads to an incomplete stress relaxation and to a localization length in the dynamics different from that before application of shear. These change with Peclet number revealing a pronounced effect of shear history on the quiescent state of the system.