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Delayed yield in reversible colloidal gels: a micro-mechanical perspective ROSEANNA N. ZIA, Cornell University, BENJAMIN J. LANDRUM, Cornell University and Princeton University, WILLIAM B. RUSSEL, Princeton University — We study via dynamic simulation the nonlinear response of a reversible colloidal gel undergoing deformation under applied stress, with a view toward elucidating mechanisms of macroscopic yield at the level of particle dynamics. Under shear, such gels may flow then regain solidlike behavior upon removal of the stress. The transition from solidlike to liquidlike behavior is a yielding process that is not instantaneous but rather occurs after a finite delay. The delay length decreases as stress increases, but the underlying microstructural origin is not clear. Recent experiments reveal two regimes, suggesting multiple yield mechanisms. Theories advanced to link gel structure to rheology aim to predict the ultimate state of a gel under an applied load. While these hypothesize a competition between bond breakage and reconnection rates, no such particle-scale dynamics have been directly observed, and it is not clear these theories reconcile with ongoing structural evolution. To study these behaviors, we conduct large-scale dynamic simulation to model structural evolution and particle transport in colloidal gels subjected to a step stress. A range of volume fraction, attraction strength, and stress is studied, with detailed connection between macroscopic response, microstructure, and particle dynamics.

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