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Transient yield in reversible colloidal gels: a micro-mechanical perspective LILIAN JOHNSON, BENJAMIN LANDRUM, ROSEANNA ZIA, School of Chemical and Biomolecular Engineering, Cornell Univeristy — We study the nonlinear rheology of colloidal gels via large-scale dynamic simulation, with a view toward understanding the micro-mechanical origins of the transition from solid-like to liquid-like behavior during flow startup, and post-cessation relaxation, and its connection to energy storage and viscous dissipation. Such materials often exhibit an overshoot in the stress during startup, but the underlying microstructural origins of this behavior remain unclear. To understand this behavior, a fixed strain rate is imposed on a reversible colloidal gel, where thermal fluctuations enable quiescent gel aging. It has been suggested flow occurs only after clusters first break free from the network and then disintegrate, leading to two stress peaks that vary with age, flow strength, volume fraction, bond strength, and pre-strain history. However, our detailed studies of the microstructural evolution during startup challenge this view. We present a new model of stress development, relaxation, and microstructural evolution in reversible colloidal gels in which the ongoing age-coarsening process plays a central role.

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