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Embedding memories in colloidal gels though oscillatory shear[1]
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While gels are ubiquitous in applications from food products to filtration, their mechanical properties are usually determined by self-assembly. We use oscillatory shear to train colloidal gels, embedding memories of the training protocol in rheological responses such as the yield strain and the gel network structures. When our gels undergo shear, the particles are forced to rearrange until they organize into structures that can locally undergo reversible shear cycles. We utilize a high-speed confocal microscope and a shear cell to image a colloidal gel while simultaneously straining the gel and measuring its shear stresses. By comparing stroboscopic images of the gel, we quantify the decrease in particle rearrangement as the gel develops reversible structures. We analyze and construct a model for the rates at which different regions in the gel approach reversible configurations. Through characterizing the gel network, we determine the structural origins of these shear training memories in gels. These results may allow us to use shear training protocols to produce gels with controllable yield strains and to better understand changes in the microstructure and rheology of gels that undergo repeated shear through mixing or flowing.

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