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Understanding the relationship between plasticity and material microstructure in disordered systems LARRY GALLOWAY, Department of Mechanical Engineering and Applied Mechanics, University of Pennsylvania, XIAOGUANG MA, Department of Physics and Astronomy, University of Pennsylvania, NATHAN KEIM, Department of Physics, Pennsylvania State University, DOUGLAS JEROLMACK, Department of Earth and Environmental Science, University of Pennsylvania, ARJUN YODH, Department of Physics and Astronomy, University of Pennsylvania, PAULO ARRATIA, Department of Mechanical Engineering and Applied Mechanics, University of Pennsylvania — How soft, disordered materials yield is a question of fundamental interest to material engineers and physicists alike. In this talk, we explore the relationship between the plastic flow-induced dynamics and microscopic structure of disordered colloidal solids. Our experimental setup consists of a custom-built interfacial stress rheometer, in which a dense monolayer of repulsive colloidal particles is placed and undergoes cyclic shear. This apparatus permits simultaneous measurement of the material bulk rheology (G', G'') and dynamic structure factor from particle trajectories, as well as characterization of the suspension microstructure. We quantify system-wide structure using the concept of (structural) excess entropy, the difference between system entropy and that of an ideal gas. The experiments reveal that structural relaxation induced by plastic flow depends on and scales with the strain-rate and microscopic order measured at earlier and later times, respectively. Thus, measurement of sample *static* structure (excess entropy) provides insight about both strain-rate and constituent rearrangement *dynamics* in the sample at earlier times. Moreover, the relaxation times scale with shear rate according to a classic shear thinning relation.

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