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Growth and Deformation of Colloidal Crystals and Glasses PETER SCHALL, ITAI COHEN, DAVID A. WEITZ, FRANS SPAEPEN, Harvard University — Plastic deformation in atomic crystals is governed by dislocations line defects in the crystalline lattice. Understanding how these dislocations propagate, multiply, and interact is central for understanding the plastic response of a crystalline material to an applied stress. Unlike for crystals, not much is known about the deformation mechanism of glasses, and the microscopic processes leading to macroscopic deformation are still highly speculative. We use colloidal crystals and glasses as models to study the behavior of their atomic counterparts under applied stress. We use confocal microscopy to determine the position of the individual particles and to study defect propagation on the particle scale. The colloidal crystals exhibit dislocations that show remarkable similarities to dislocations in atomic crystals. The slow time scale of the colloidal suspension allows us to directly observe the nucleation of dislocations as the crystal is deformed. We have built a laser diffraction microscope, which is inspired by a transmission electron microscope used to study dislocations in hard materials, to image the strain field of the dislocation defects. This technique enables us to study dislocation motion and dislocation interaction on a much larger length scale. In the amorphous suspension, we are able to follow the motion of the individual particles and identify local shear events that give rise to the macroscopic deformation. Recent results indicate a correlation between the location of shear events and regions of low local particle density or high free volume.

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