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Localized Plastic Deformation in Colloidal Micropillars DANIEL STRICKLAND, JYO LYN HOR, CARLOS ORTIZ, DAEYEON LEE, DANIEL GIANOLA, University of Pennsylvania — When driven beyond yield, many amorphous solids exhibit concentrated regions of large plastic strain referred to as shear bands. Shear bands are the result of localized, cooperative rearrangements of particles known as shear transformations (STs). STs are dilatory: their operation results in an increase of free volume and local softening that leads to spatially concentrated plasticity. However, the evolution of STs into a macroscopic shear band remains poorly understood. To study the process, we perform compression experiments on amorphous colloidal micropillars. The micropillars, which are composed of fluorescent 3 μm PMMA particles, are made freestanding so that shear banding instabilities are not suppressed by confining boundaries. During compression, we observe strong localization of strain in a band of the pillar. As deformation proceeds, the sheared region continues to dilate until it reaches the colloidal glass transition, at which point dilation terminates. We quantify a length scale by measuring the extent of spatial correlations in strain. This length scale decreases gradually with increasing dilation and becomes static beyond the glass transition. Our results reinforce the idea of yield as a stress-induced glass transition in amorphous solids.

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