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Glassy dislocation dynamics in colloidal dimer crystals

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Dislocation mobility is central to both the mechanical response and the relaxation mechanisms of crystalline materials. Recent experiments have explored the role of novel particle anisotropies in affecting the rules of defect motion in crystals. “Peanut-shaped” colloidal dimer particles consisting of two connected spherical lobes form densely packed crystals in 2D. In these “degenerate crystals,” the particle lobes occupy triangular lattice sites while the particle axes are randomly oriented among the three crystalline directions. One consequence of the random orientations of the dimers is that dislocation glide is severely limited by certain particle arrangements in the degenerate crystals. Using optical tweezers to manipulate single lobe-sized spherical intruder particles, we locally deform the crystal, creating defects. During subsequent relaxation, the dislocations formed during the deformation leave the crystal grain, either via annihilation with other dislocations or by moving to a grain boundary. Interestingly, in large crystalline grains this dislocation relaxation occurs through a two-stage process reminiscent of slow relaxations in glassy systems, suggesting the novel concept that glassy phenomena may be introduced to certain kinds of colloidal crystals via simple anisotropic constituents.