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Plastic crystal to crystal transition in mesoscopic colloidal plates

BINBIN LUO, ZIXUAN WU, AHYOUNG KIM, ZIHAO OU, JUYEONG KIM, QIAN CHEN, Department of Materials Science and Engineering, University of Illinois at Urbana-Champaign — We introduce mesoscopic colloidal plates as a new type of building blocks that integrate micron-sized plate edge length to facilitate optical microscopy imaging and nano-sized thickness to allow fast diffusion and fluctuation dynamics comparable to nanoscale objects. The mesoscopic nature of plate and interaction length scales together complicate the free energy landscape for the self-assembly of plates. We observe experimentally the formation of a three-dimensional closely-packed honeycomb lattice, and more notably, the relaxation of that lattice upon expansion into a positionally ordered and orientationally disordered plastic crystal. Direct optical microscopy imaging and single-particle tracking allow us to elucidate the entropy origin of the plastic crystal as well as the lattice relaxation.

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