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Melting of Colloidal Crystals[1] YI PENG, ZIREN WANG, Department of Physics, Hong Kong University of Science and Technology, Clear Water Bay, Hong Kong, China, AHMED ALSAYED, Complex Assemblies of Soft Matter, CNRS/UPENN/Rhodia UMI 3254, Bristol, Pennslyvania 19007, USA, ARJUN YODH, Department of Physics and Astronomy, University of Pennsylvania, 209 South 33rd Street, Philadelphia, Pennsylvania 19104, USA, YILONG HAN, Department of Physics, Hong Kong University of Science and Technology, Clear Water Bay, Hong Kong, China — We experimentally studied the melting and freezing behaviors of colloidal crystals composed of diameter tunable poly-N-isopropylacrylamide (NIPA or pNIPAM) microgel spheres by bright-field and confocal video microscopies. The melting behaviors of three-dimensional (3D), two-dimensional (2D) and multilayer thin films of both single crystals and polycrystals were systematically studied with single-particle dynamics. Thick films (>4 layers) melt heterogeneously, while thin films (<5 layers) melt homogeneously even in polycrystals. A novel heterogeneous melting at dislocation is discovered in 5- to 12-layer films. The equilibrium phase behaviors are different in three thickness regimes: thick films have a liquid-solid coexistence regime which decreases with the film thickness and vanishes at 4 layers, thin films melt into the liquid phase in one step, while monolayers melt in two steps with an intermediate hexatic phase. These results provide new challenges in theory.

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