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Structure and Symmetry of Ground States of Colloidal Clusters[1]

ELLEN D KLEIN, W. BENJAMIN ROGERS, VINOTHAN N. MANOHARAN, Harvard Univ — We experimentally study colloidal clusters consisting of 6 to 100 spherical particles bound together with short range, DNA-mediated attractions. These clusters are a model system for understanding colloidal self-assembly and dynamics, since the positions and motion of all particles can be observed in real space. For 10 particles and fewer, the ground states are degenerate, and, as shown in previous work [1], the probabilities of observing specific clusters depend primarily on their rotational entropy, which is determined by symmetry. Thus less symmetric structures are more frequently observed. However, for larger numbers of particles the ground states appear to be subsets of close-packed lattices, which tend to have higher symmetry. To understand how this transition occurs as a function of the number of particles, we coat colloidal particles with complementary DNA strands that induce a short-range, temperature-dependent interparticle attraction. We then assemble and anneal an ensemble of clusters with 10 or more particles. We characterize the number of apparent ground states, their symmetries, and their probabilities as a function of the size of the cluster using confocal microscopy. 1. The Free-Energy Landscape of Clusters of Attractive Hard Spheres, G. Meng, et. al. Science

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