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Predicting out-of-Equilibrium Phase Behavior in the Dynamic Self-Assembly of Colloidal Crystals JAMES SWAN, ZACHARY SHERMAN, Massachusetts Inst of Tech-MIT — Crystals self-assembled from colloidal particles are useful in an array of well demonstrated applications. During fabrication however, gelation and glassification often leave these materials arrested in defective or disordered metastable states. We show how time-dependent, pulsed interparticle interactions can avoid kinetic barriers and yield well-ordered crystalline domains for a suspension of hard, spherical colloidal particles interacting through short-range attractions. This dynamic self-assembly process is analogous to the flashing Brownian rachet. Although this is an inherently unsteady, out-of-equilibrium process, we can predict its outcome using appropriate time averages of equilibrium equations of state. The predicted phase behavior is tested and validated by examining the fluid/crystal coexistence of such dynamically self-assembling dispersions in Brownian dynamics simulations of sedimentation equilibrium and homogeneous nucleation. We also show that our dynamic self-assembly scheme offers control and tunability over the crystal growth kinetics and can even stabilize nonequilibrium structures.

James Swan
Massachusetts Inst of Tech-MIT

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