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Control of dynamical self-assembly of strongly Brownian nanoparticles through convective forces induced by ultrafast laser. SERIM ILDAY, GURSOY B. AKGUC, ONUR TOKEL, GHAITH MAKEY, OZGUN YAVUZ, KORAY YAVUZ, IHOR PAVLOV, F. OMER ILDAY, OGUZ GULSEREN, Bilkent Univ — We report a new dynamical self-assembly mechanism, where judicious use of convective and strong Brownian forces enables effective patterning of colloidal nanoparticles that are almost two orders of magnitude smaller than the laser beam. Optical trapping or tweezing effects are not involved, but the laser is used to create steep thermal gradients through multi-photon absorption, and thereby guide the colloids through convective forces. Convective forces can be thought as a positive feedback mechanism that helps to form and reinforce pattern, while Brownian motion act as a competing negative feedback mechanism to limit the growth of the pattern, as well as to increase the possibilities of bifurcation into different patterns, analogous to the competition observed in reaction-diffusion systems. By steering stochastic processes through these forces, we are able to gain control over the emergent pattern such as to form-deform-reform of a pattern, to change its shape and transport it spatially within seconds. This enables us to dynamically initiate and control large patterns comprised of hundreds of colloids. Further, by not relying on any specific chemical, optical or magnetic interaction, this new method is, in principle, completely independent of the material type being assembled.

Serim Ilday
Bilkent Univ

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