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Sculpting Pickering Emulsion Droplets by Arrest and Jamming[1]
CHRISTOPHER BURKE, Tufts Univ, ZENGYI WEI, University of New South Wales, MARCO CAGGIONI, Proctor Gamble, PATRICK SPICER, University of New South Wales, TIM ATHERTON, Tufts Univ — Pickering emulsion droplets can be arrested into non-spherical shapes—useful for applications such as active delivery—through a general mechanism of deformation followed by absorption of additional colloidal particles onto the interface, relaxation of the droplet caused by surface tension and arrest at some point due to crowding of the particles. We perform simulations of the arrest process to clarify the relative importance of diffusive rearrangement of particles and collective forcing due to surface evolution. Experiment and theory are compared, giving insight into the stability of the resulting capsules and the robustness of the production process for higher-throughput production in, for example, microfluidic systems. We adapt theoretical tools from the jamming literature to better understand the arrested configurations and long timescale evolution of the system: using linear programming and a penalty function approach, we identify unjamming motions in kinetically arrested states. We propose a paradigm of metric jamming to describe the limiting behavior of this class of system: a structure is metric-jammed if it is stable with respect to collective motion of the particles as well as evolution of the hypersurface on which the packing is embedded.

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