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A continuum model of particle-stabilized interfaces

Colloid particles that are partially wetted by two immiscible fluids can become confined to fluid-fluid interfaces. At sufficiently high volume fractions, the colloids may jam and the interface may crystallize. The fluids together with the interfacial colloids compose an emulsion with interesting new properties and offer an important route to new soft materials. Based on the principles of mass conservation and thermodynamic consistency, we develop a continuum model for such systems which combines a Cahn-Hilliard-Navier-Stokes model for the macroscopic two-phase fluid system with a surface Phase-Field-Crystal model for the microscopic colloidal particles along the interface. We demonstrate the feasibility of this approach and present numerical simulations that confirm the ability of the colloids to make the interface sufficiently rigid to resist external forces and to stabilize interfaces for long times.