Separation and assembly of colloidal particles by capillary, magnetic and electrostatic forces

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ABSTRACT

Colloidal particles are known to be very efficient stabilizers for fluid interfaces with applications in the food and cosmetics industry, enhanced oil recovery, drug delivery or waste water management. Capillary interactions between particles with different shape, contact angle on the particle surface, or particle-particle interactions are also promising candidates to self-assemble complex structures for the production of new soft materials or applications in the printing and coating industries. We present computer simulations based on a hybrid lattice Boltzmann and molecular dynamics method [1] and demonstrate new ways to self-assemble complex structures by means of capillary interactions and external magnetic fields to steer the movement of ellipsoidal particles [2]. We then introduce spherical magnetic Janus particles with a hydrophobic and a hydrophilic side and demonstrate that their capillary interactions can be tuned by a well-controlled external magnetic field [3,4,5]. At last, we introduce a new algorithm to simulate electrokinetic effects in multiphase flows and colloidal suspensions and demonstrate its ability with several benchmark examples ranging from floating droplets deforming in electric fields to electrowetting [6,7].

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