Colloidal particles at liquid interfaces: self-assembly due to capillary, magnetic and electrokinetic interactions

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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 [1,2] and demonstrate the impact of the particle shape and contact angle on the formation, rheology and stability of particle stabilized emulsions such as Pickering emulsions and bijels [3,4]. We then demonstrate new ways to self-assemble complex structures by means of capillary interactions and external magnetic fields to steer the movement of ellipsoidal particles [5,6] or magnetic Janus particles with a hydrophobic and a hydrophilic side [7,8]. At last, we present simulations of charged colloids immersed in binary electrolyte solutions based on a new combination of the Shan-Chen multicomponent lattice Boltzmann method and the link-flux method to resolve the ions' kinetics [9,10]. Here, we focus on details of the newly implemented computational method as well as benchmark simulations of fluid droplets deforming under an electric field and charged massive particles driven by an electric field.

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