Self-assembly of colloidal dumbbell particles at the oil-water interface

Fuqiang Chang and Willem K. Kegel

Utrecht University, Debye institute for nanomaterials science, Van 't Hoff Laboratory for Physical and Colloid Chemistry, The Netherlands

Capillary interactions between particles adsorbed at fluid interfaces arise when interface distortions by neighbouring particles overlap. Recently, capillary interactions have been investigated to direct anisotropic colloidal particles at interface with precise control over the orientation and spatial arrangement [1]. While equilibrium orientations and capillary interactions of dumbbell particles at fluid interfaces have been investigated in theory, the experiments remain largely unexplored [2].

In this work, we present an experimental study of the self-assembly of dumbbell particles at the oil-water interface. Well-designed, surfactant free, and charge-stabilized dumbbells with tuneable aspect ratios were synthesized. Most importantly, our approach allows facile further asymmetric modification of the surface properties, which could in principle be utilized to direct two-dimensional self-assembly into well-defined structures. We systematically examined the effects of the particle geometry and wetting property on the structure of the colloidal monolayer at the interface, which is monitored by optical microscopy combined with quantitative image analysis and particle tracking. These self-assembled structures, formed by capillary effects and tailored by the contact angles, could provide means of controlling the magnitude and directionality of interface-mediated capillary interactions.

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