Heterogeneous pattern formation of small colloids grafted to large oil droplets using DNA

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Fluid-fluid interfaces are omnipresent in biological, everyday life, and industrial processes. Understanding the dynamics, aggregation and pattern formation of solid particles at these interfaces is important for enabling the design of novel approaches and materials for future applications. We report a study of controlled and reversible assembly of colloidal particles on oil droplets. For this, we functionalize surfactant stabilized large oil-droplets with single-stranded (ss) DNA and mix them with small colloids grafted with the complementary ssDNA. Differently from Pickering emulsions [1], the reversibility of the assembly of the particles at the interface is enabled by the selective binding via DNA hybridization [2, 3]. We show that it is possible to control the surface coverage by colloidal particles since compositional arrest takes place before structural arrest during slow adsorption, due to the mobility of the DNA anchors attached to the oil-water interface. Moreover, we illustrate the equilibrium behavior of the adsorbed colloidal particles by exploring the aggregation phase diagram under the influence of depletion interactions, triggered by the excess concentration of the added surfactant micelles [4]. The conclusions on compositional arrest and equilibrium behavior of colloidal aggregation are supported by simulation studies.

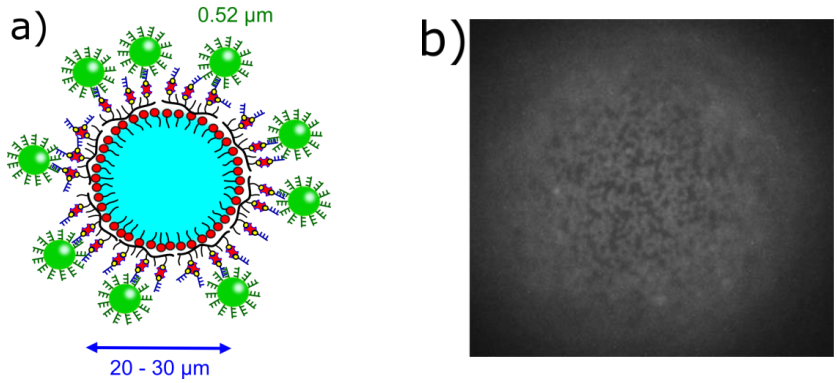

Figure 1: (a) Cartoon representing the oil droplet-colloids system. (b) Typical microscopy image showing the fluorescent colloids hybridized to the oil droplet surfaces

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