Aggregation dynamics of colloidal particles at interfaces

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Colloidal particles are considered ideal building blocks to produce materials with enhanced physical properties. The state-of-the-art techniques for synthesizing these particles provide control over shape, size, and directionality of the interactions. In spite of these advances, there is still a huge gap between the synthesis of individual components and the management of their spontaneous organization towards the desired structures. The main challenge is the control over the dynamics of self-organization. In their kinetic route towards thermodynamically stable structures, colloidal particles self-organize into intermediate structures that are much larger than the individual particles and become the relevant units for the dynamics. To follow the dynamics and identify kinetically trapped structures, one needs to develop new theoretical and numerical tools. Here, we will discuss the dynamics of colloidal particles at interfaces.

Experiments with suspensions of ellipsoidal colloidal particles suggest a transition in the statistical properties of the stain left by an evaporating drop, depending on the eccentricity of the particles [1]. We proposed a stochastic model to show that the very-strong anisotropic capillary attraction between particles stemming from the deformation of the interface can be responsible for such transition [2,3]. We will discuss the main mechanisms involved and compare the quantitative results with experiments.

With the experimental groups of Erika Eiser (Univ. Cambridge) and Jasna Bruijc (New York University), we have shown that the long-range capillary attraction and consequent formation of kinetically trapped structures of colloidal particles at interfaces can be avoided using DNA-coated colloids on complementary functionalized interfaces (oil droplet) [4], where we keep the irreversible interfacial binding but suppress the strong attraction, resulting in a fully ergodic colloidal dynamics. We will discuss how the coverage of the oil droplet by colloidal particles and the self-assembled structures depend on different system parameters, such as, temperature and bulk concentration of colloidal particles.

1) P. J. Yunker et al. *Physical Review Letters*, **2013**, 110, 035501.
2) C. S. Dias et al. *in preparation*.
3) C. S. Dias, N. A. M. Araújo, M. M. Telo da Gama, *EPL*, **2014**, 107, 56002.
4) D. Joshi et al. *Science Advances*, **2016**, 2, e1600881.