SELF-ASSEMBLY OF PARTICLES VIA CONTROLLED EVAPORATION

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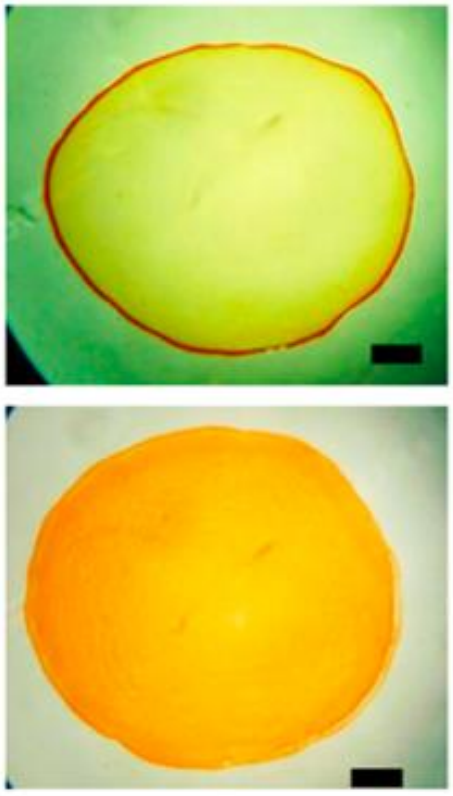
Evaporation of solvent from a dispersion is a simple and effective method to direct the self-assembly of colloidal scale materials. In particular, the drying of particle laden sessile drops has received considerable attention since pioneering work in the late 1990's. Upon evaporation, suspension drops leave a distinct ring-like deposit of particles at the periphery of the drop. It is widely accepted that physics of pattern formation in drying of drops containing in-soluble material is identical to that observed in drying of a coffee drop. Both the formation and suppression of coffee-stains are fundamentally and technologically important. There is need for the design of strategies to prevent coffee stains, which are unwanted in several applications. However, there are several reports where the desirable consequences of coffee-stain formation are exploited – especially in the field of separation technology and in the detection and diagnosis of diseases.



We discuss an experimental study of sessile drop evaporation of aqueous dispersions containing well-characterized monodisperse particles at a temperature of 25 °C and relative humidity of 60%. The objective of this talk is to elucidate the role of particle shape, surface charge and particle softness on the intriguing morphology of final deposit. The emphasis will be on the self-assembly of particles in these patterns. We show that coffee-rings (Figure 1 (top), uniform particle deposition (Figure 2 (bottom)) as well as coffee stains containing particles arranged either in close packed or in loosely packed configuration can be achieved by appropriate choice of particles, solution or external environmental conditions.

Figure 1 –Patterns formed upon evaporation of drops containing ellipsoids: coffee-stains (top) and uniform deposit (bottom). The scale bar is 0.5 mm