Recent progress in studying the phase behavior of deformable colloids at fluid interfaces: Why in situ techniques are needed.

Déborah Feller[a], Julian Ringling[b], Vahan Abgarjan[b], Matthias Karg[a]

[a]Martin Luther University Halle-Wittenberg, Physical Chemistry of Functional Polymers, Halle (Saale), Germany
[b]Heinrich Heine University Düsseldorf, Physical Chemistry I, Düsseldorf, Germany

matthias.karg@chemie.uni-halle.de

The stabilization of fluid interfaces by colloidal particles is crucial for applications (e.g. stabilization of foams and emulsions, nanolithography) and fundamental science (e.g. crystallization, role of defects, collective behavior). While monodisperse rigid spheres tend to arrange in hexagonal lattices when adsorbed at fluid interfaces at sufficiently high packing fraction, their spacing is typically limited to close-packing. In contrast, deformable colloids like microgels[1] can assemble into dense monolayers with a spectrum of interparticle distance that is controlled by the available area. Many studies in the last two decades attempted to understand the phase behavior of soft, deformable microgels at such liquid interfaces. Typically, the microstructures in dependence of the applied surface pressure are studied *ex situ* using transfer of microgel monolayers from the liquid to a solid interface followed by investigation with different types of microscopies. Recent works have shown that microstructures obtained from *ex situ* analysis can differ significantly from the phase behavior observed *in situ* at the fluid interface [2-4]. In this contribution we will reflect on different methods that can be applied for *in situ* investigations of colloidal monolayers at fluid interfaces. We will discuss limitations of these techniques and with respect to the requirements for the colloids under investigation. In particular, we will focus on two approaches that are compatible with Langmuir trough experiments: 1) Small-angle light scattering (SALS) as a tool to study structure factors under equilibrium as well as non-equilibrium conditions [2, 5]. 2) Extinction spectroscopy that can be applied to labelled microgels as for example core-shell microgels with plasmonic cores [6]. Finally, we will shine light on the complex interplay of different forces that act on a soft colloidal monolayer during transfer to a solid substrate and the subsequent drying of the thin film (figure 1) [3].

Keywords:
deformable colloids, microgels, self-assembly, Langmuir trough, uniaxial compression, small-angle light scattering

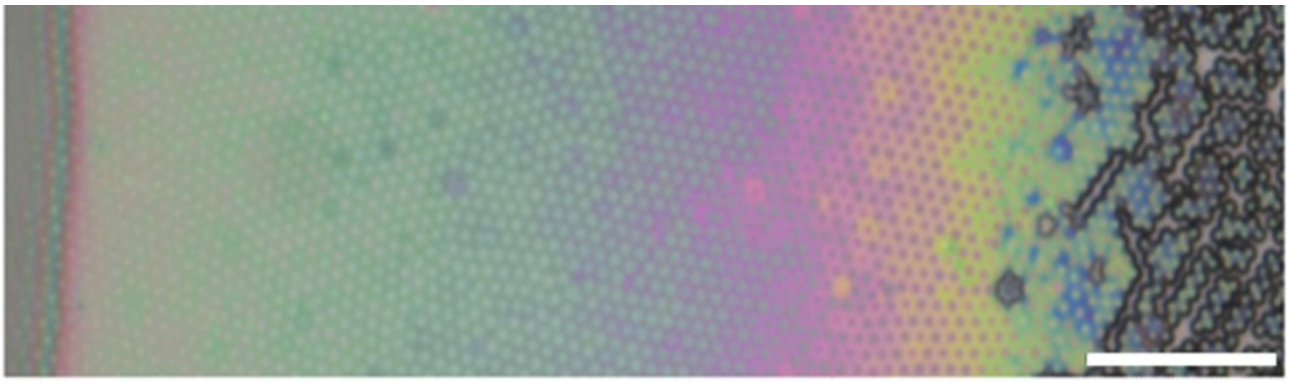

Figure 1: Microgel monolayer during different states of drying (from right to left) on a hydrophobic substrate. Scale bar = 10 µm.

References:

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