Interactions across thin liquid films

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The (de)stability and functionality of thin liquid films plays an important role in processes and technical applications like foaming, emulsification and flotation. Within this work the stability of single films is tuned by the addition of different (poly)electrolytes. The films are either free-standing (foam films) or supported by a solid substrate (wetting films) and they are formed from aqueous surfactant solutions. The interactions between film surfaces are determined in a thin film pressure balance (TFPB). By this method equilibrium measurements of a disjoining pressure isotherm (disjoining pressure vs. film thickness) are determined. The disjoining pressure is a quantitative measure for the interactions between the two opposing film interfaces, including repulsive electrostatic, attractive van der Waals (both together known as DLVO forces) and steric contributions [1].

Usually the addition of low molecular salt like NaCl leads to a thinning of the aqueous film due to screening of the electrostatic interactions. But not only the ionic strength, also the type of added ion has a pronounced effect on the film thickness and stability. For instance a “simple” water wetting film or a foam film with negatively charged surfaces becomes thicker and more stable by adding NaI instead of NaF at a fixed ionic strength [2-4]. It is explained by a stronger adsorption of I\(^-\) ions at the film surface in comparison to F\(^-\) ions due to differences in the hydration shell.

The addition of polyanions to foam films stabilized by cationic surfactants leads to a strong destabilisation close to the isoelectric point [5].

If there is enough time, I will address also the topic of thin liquid films as confining tool for the ordering of colloidal suspensions. In order to measure the forces across a thin liquid film formed between two solid surfaces, a Colloidal Probe AFM is used. Oscillatory forces (non-DLVO forces) will dominate the interaction due to layerwise expulsion of the colloidal particles. The period of oscillation and the correlation length of ordering under confinement shows excellent agreement with the interparticle distance and the correlation length in the bulk phase. The results for ordering of particles in both geometries (in bulk and under confinement in thin films) coincides very well with the results of Monte Carlo simulations [6].