Temperature induced ordering in colloidal suspensions confined in thin films

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Oscillatory (or structural) forces occur in thin films of colloidal dispersions and are due to the ordering of molecules, aggregates or particles which are expelled layerwise from the thin film. In the present contribution forces across thin films of Silica suspensions are presented. Characteristic lengths of the structuring of silica nanoparticle suspensions confined between two silica surfaces were extracted from the oscillatory force profile of colloidal-probe atomic force microscopy (CP-AFM) measurements and are compared with the bulk counterparts as obtained from structural peak of small angle X-ray scattering (SAXS). The wavelength λ extracted from CP-AFM correlates well with the mean particle distance 2π/qmax as obtained from SAXS structural peak [1,2]. This observation suggests that there is no confinement effect on characteristic lengths themselves that represent the structuring, even though the confinement indeed induces a layered structure of the particles.
The only confinement effect is observed when the last layer of nanoparticles is expelled from the film. We will present a new model to fit the forse curves at short distances (< 10 nm). A more quantitative study shows a relation of oscillatory wavelength of silica nanoparticle suspensions with the particle number density as $\lambda=\rho^{-1/3}$, irrespective of particle size, surface charge of the particles and ionic strength of the solution. CP-AFM measurements on modified and deformable confining surfaces show an increase in amplitude with increasing surface potential and decreasing surface roughness and deformability. However, the corresponding wavelength remains unaffected [3,4].
Current studies address the ordering of soft particles like thermosensitive PNIPAM nanogels in the confinement of thin films, where the inter particle interactions can be switched on and off by changing the temperature. Only beyond the LCST of the PNIPAM nanogels structural forces can be observed.

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