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Quasi-two-dimensional equilibrium and non-equilibrium thermodynamics of thin liquid films stabilized by colloidal particles[1] JERZY BLAWZDZIEWICZ, Yale University, ELIGIUSZ WAJNRYB, IPPT, Warsaw, Poland — Due to the presence of oscillatory structural forces, static and dynamic properties of thin liquid films stabilized by colloidal particles, micelles, or macromolecules differ from the properties of particle-free films. During drainage process, particle-stabilized films often form a stepwise structure with coexisting regions (phases) of uniform but different thickness. We describe film phase equilibria using a quasi-two dimensional thermodynamic formalism. The key quantity in our approach is the film tension. We show that the particle contribution to this quantity results from the anisotropy of the particle osmotic-pressure tensor in the film. The quasi-2d description is also developed for non-equilibrium film states. We show that the motion of particle-stabilized films is analogous to the dynamics of a two-dimensional compressible fluid - the film thickness plays the role of mass density per unit area and film tension the role of pressure. In the linear-response regime, the film dynamics is characterized by the shear and extension viscosity coefficients. There are also two independent kinetic coefficients relating the particle flux to the gradients of the normal osmotic pressure and particle chemical potential. For a film stabilized by a suspension of hard spheres we have calculated these coefficients using a multipolar-expansion methods combined with a flow reflection technique.

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Jerzy Blawzdziewicz
Yale University

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