Fluctuations and Instabilities at Interfaces and Confining Substrates

A. Robledo and C. Varea
Instituto de Fisica
Universidad Nacional Autonoma de Mexico
Apartado Postal 20-364
Mexico City, D.F. 01000, Mexico

We analyze the stability of planar, cylindrical and spherical interfaces with respect to shape and width fluctuations for a model free energy density functional with square-gradient and square-laplacian terms [1]. We also study the fluctuations and correlations of similar systems when confined by parallel planar substrates [2]. In all cases we determine the stability matrix of the inhomogeneous stationary state, and from its spectrum and related eigenfunctions we identify the fluctuations that grow or decay in a process where the equilibrium state is reached. For a model amphiphile interface we establish where lamellar and micellar domain-structured phases occur, and contrast our results with those for a simple square-gradient fluid model for which these phases are always unstable. We also characterize some instability properties such as buckling of lamella and nucleation of micelles. For simple fluid interfaces our results agree with the stability criteria obtained from the Laplace equation, that is, the nucleation of critical droplets, and in the case of cylinders also the Rayleigh instability. For confined fluids we identify the fluctuations close to the walls and in the middle of the slab and discuss their effect when the wall separation diverges. We analyze both cases of identical and competing walls and study the behavior above and below the wetting transition temperature. We also calculate the pair correlation function for the inhomogeneous states.

[1] C. Varea and A. Robledo, *Physica A* **255**, 269 (1998), C. Varea and A. Robledo, preprint.
[2] C. Varea and A. Robledo, *Physica A* **268**, 391 (1999).