Confinement and Surface Effects in the Decomposition of a Binary Mixture

C. Varea and A. Robledo
Instituto de Física
Universidad Nacional Autónoma de México
Apartado Postal 20-364
México D.F. 01000, México

We investigate, via numerical analysis of Model B, the phase separation of a binary mixture confined by two parallel walls that compete with short-ranged surface interactions with the two chemical species. In this model, with conserved order parameter, the rate of change of concentration is proportional to the Laplacian of a generalized chemical potential difference μ, and its stationary solutions include, besides the equilibrium states, those states with non-uniform μ, and but with vanishing Laplacian. We consider initial states with both critical and non-critical concentrations. In the first case the typical labyrinthine regions of the two phases in spinodal decomposition align rapidly along the walls of the container, independently of whether at the working temperature capillary condensation takes place or not. The fast growth of a microscopic layer of the preferred phases at the walls and subsequent depletion of this phase in its vicinity inhibits the formation of the equilibrium state. For off-critical quenches small droplets of the majority phase grow, coarsen and arrange themselves along the walls, but in our numerical studies they do not develop quasi-wetting layers along the walls. In the terminal states μ, varies linearly with distance from the walls when close to them and becomes constant inside the container; in both regions the driving force for time evolution vanishes while it is very small in the region that joins them.