Structure and stability of decomposing films of binary mixtures with free evolving surfaces

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Thin polymer films are often used in advanced technological applications either as homogeneous coatings or as structured functional layers. Their stability and potential use is mostly determined by the wettability properties of the substrate and is well understood for single component liquids. However, in many relevant applications the film consists of a binary mixture such as a polymer blend. For such systems the dynamics of the decomposition within the film and of the dewetting of the film itself may couple. This allows for new pathways of structuring like decomposition induced dewetting[1].

We propose a model for films of binary mixtures with free surfaces that allow to study the coupling between profile evolution and decomposition. The model is based on model-H[2] describing the coupled transport of concentration (convective Cahn-Hilliard equation) and momentum (Navier-Stokes-Korteweg equations) fields supplemented by boundary conditions at the substrate and the free surface.

After determining homogeneous and vertically stratified base states we analyse their lateral stability and show that depending on the energetical bias at the surface and the mean concentration the convective transport (i) promotes the instability and (ii) induces surface deflections for the stratified base states[3]. In addition, we derive the longwave limit of our generalized model-H and show the structuring of droplets of binary mixtures on solid substrates.

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