Decomposition in and dewetting of films of binary mixtures

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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 therefore potential usage is mostly determined by the wettability properties of the substrate and is rather well understood for single component liquids.

However, in various 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 [1,2]. We derive an extended Model-H [3,4] coupling transport equations for momentum and concentration fields for the non-isothermal case. We complete the description by introducing boundary conditions at the free surface and the solid substrate.

Focusing on an isothermal setting we analyse the spinodal decomposition of a film of a binary mixture of polymers. The internal composition gradients give rise to a solutal Marangoni effect that modifies deeply the dynamics of the system. Linear results obtained with the full transport equations for (a) purely diffusive transport described by the Cahn-Hilliard equation and (b) diffusive and convective transport described by model-H between parallel plates are compared to the case of a free surface.

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