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Toward a model for pattern formation in thin film polymer blends

NIGEL CLARKE, University of Durham — We outline a dynamic theory for simultaneous phase separation and dewetting in thin film polymer blends with free surfaces. Although an understanding of the processes of both dewetting and phase separation is well advanced, the coupling between the two has received little attention theoretically. We consider the coupling between surface driven instabilities and compositional instabilities in a thin film on a flat solid substrate with a free upper surface. We utilise a simple model, in which only fluctuations of composition within the plane parallel to the substrate are allowed, and neglect the possibility of fluctuations normal to the substrate. Such a model yields quantitative relationships for the stability in terms of the height of the film and the various thermodynamic parameters. From a dynamic viewpoint, the attraction of such a model is that it permits an analytical description of the early dynamic stages of an instability. Reduction of the problem from 3D to 2D is important when undertaking numerical studies on films that are nanometers thick, in which the typical lengthscales of dewetting and phase separation in the plane of the film are of the order of microns. As an example, the consequences of phase separation within a system which has already undergone considerable dewetting is highlighted by comparing with the process of phase separation when no dewetting occurs. With simultaneous dewetting, the phase separation becomes retarded and the co-continuous nature of the phases are absent.

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