Last time: Spinodal decomposition—I.

Background

- Pair interaction model with conserved and nonconserved variables

- Diffusion within the spinodal

- Free energy of an inhomogeneous system

Today: Spinodal decomposition—II.

Gradient energy
Elastic energy
Improved diffusion equation

- Modification to Fick's laws
- Solution to diffusion equation
- Spinodal microstructures
- Later stages of spinodal decomposition

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Spinodal decomposition—II.

Gradient energy

The "uphill" diffusion that results within the spinodal leads to the evolution of a high density of material in which there are significant *gradients* of composition. These gradients have an associated excess energy that diminishes the available driving force for diffusion. Thus, there must be a gradient energy modification to the diffusion potential and consequent modifications to Fick's laws for diffusion.

Elastic energy

If there is a change of molar volume with composition, solid-state diffusion will be accompanied by changes of elastic energy. The elastic energy contribution for compositional inhomogeneities enters the expressions for the F_T, as well as the diffusion potential and Fick's laws.

When the material is elastically anisotropic, the elastic energy will depend on the *orientation* of the developing composition wave. The wavevector will tend to align along elastically soft directions in the material.

When elastic energy is significant, the region of compositional instability in the phase diagram is reduced, and the smaller unstable region is known as the *coherent spinodal*.

Improved diffusion equation

Solution to modified diffusion equation

Spinodal microstructures

Later stages of spinodal decomposition: nonlinear effects