Self-similarity breakdown induced by viscosity contrast during the coarsenning of a two phase fluid

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In many multiphase solid materials, the spacial organisation of the multiple phases (the microstructure), has dramatic effects on their properties (mechanical, electrical. . .). The formation of the microstructure can occurr during the solidification processes or during thermal treatment as in metals. It can also take place before the solidification itself. For instance in glasses spontaneous phase separation can take place at a temperature above the glass transition[1]. In this case the spontaneous phase separation induces the formation of a multiphase fluid that consists of twoo entangled phases with a very small characteristic lengthscale (and a very large surface area)[2]. The evolution of the microstructure is then, after some time giverned by the flow of the two phases that is induced by surface tension.

We have studied numerically how the transport properties (i.e. their viscosities here) of the two phases affect the micortructure. It appears that for moderate departure from the perfectly symmetric regime (i.e. same viscosity and same volume fraction of the two phases) the self-similar bicontinuous regime is robust[3]. However, the connectivity of one phase decreases when its volume fraction decreases or when it is becoming less viscous than the complementary phase. Eventually we observe the transition from a state where the two phases are entangled to a state where the mattrix of one phases contains inclusions of the other phase[4].

From the study of different patterns close to the transition and from the elementary mechanism that leads to the coarsenning we give a rationale to this *transition*

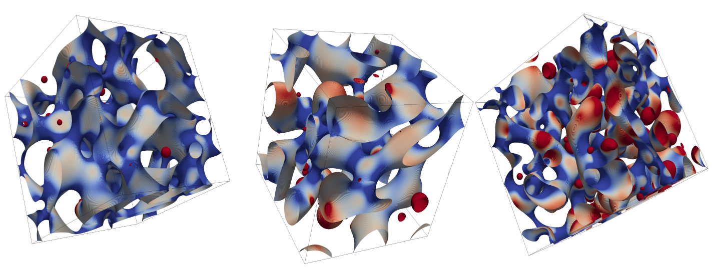

Figure 1. Typical images of the interface between the phases for diffreent parameters. Color corresponds to Gaussian curvature.

Références

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