Thermal Patterning of a Critical Polymer Blend

W. Kohler,[C,S] A. Voit, A. Krekhov, W. Enge, and L. Kramer (deceased)
Physics Department, University of Bayreuth, Bayreuth, Germany
werner.koehler@uni-bayreuth.de

The influence of inhomogeneous temperature fields on the demixing of a critical binary polymer blend has been investigated with the aim of controling the spinodal demixing morphology. We have employed a moderately focused laser beam to write spatial composition patterns into layers of a critical PDMS/PEMS polymer blend both in the one- and in the two-phase region a few degrees above and below the critical temperature. Due to the critical divergence of the Soret coefficient, moderate temperature gradients are sufficient to induce composition modulations of large amplitude. In the two-phase regime the spinodal demixing pattern can be locally manipulated in a controlled way. 2D-simulations based on a modified Cahn-Hilliard equation are able to reproduce the essential spatial and temporal features observed in the experiments. Ising-like critical scaling of the diffusion coefficient is observed close to Tc, and mean field behavior is observed for larger distances. The thermal diffusion coefficient shows Arrhenius-like thermal activation but no critical behavior. The temperature dependence of the collective diffusion coefficient in the mean field regime is explained by the mean field critical exponent $\gamma = 1.0$ and a thermal activation of the background contribution. The Soret coefficient diverges with Ising-like critical scaling close to Tc. In the mean field regime it scales like the structure factor S(0). Thermally activated friction effects cancel, similar to the situation in binary glass formers.