Thousand-fold acceleration of phase decomposition in polymer / liquid crystal blends

Natalia Ziębacz, Stefan A. Wieczorek, Tomasz Szymborski, Piotr Garstecki and Robert Hołyst

Small-angle light scattering measurements were carried out on 5CB/PS (4-cyano-4'-n-pentyl-biphenyl/polystyrene) and 8CB/PS (4-cyano-4'-n-octyl-biphenyl/polystyrene) mixtures during phase separation in the AC electric field. The size of polymer domains in LC matrix was determined as a function of time, film composition, amplitude and frequency of applied external electric field. For 5CB/PS and 8CB/PS, in the absence of electric field or in a high frequency (>30 Hz) electric field, we found diffusion growth of domains, $L(t) \sim t^{\alpha}$, in time t with exponent $\alpha = 0.3 \pm 0.04$. In the low frequency electric field (<30 Hz) the phase separation process in the isotropic phase was accelerated more than one order of magnitude for moderate fields of amplitude 3V/µm. For 5CB/PS and 8CB/PS mixtures in the AC field of frequency 2 Hz and amplitude 3.3 V/µm we found exponential growth of the domain's size $L(t) \sim exp(bt)$. We gave a set of experimental evidence that ion impurities in liquid crystals are responsible for the acceleration of the phase separation process in liquid crystal/polymer mixtures.

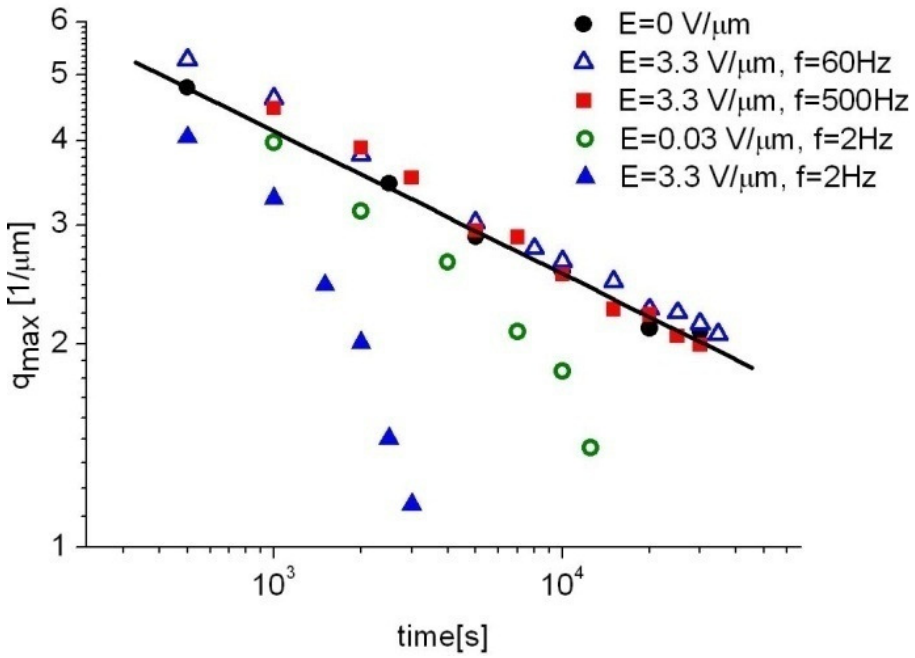

Figure 1. Double logarithmic plot of the evolution of q_{max} in the 5CB/PS 72/28 wt% cooled to 35.5°C in the I+I region. Measurements without EF are represented by solid circles. Measurements taken for the blend separating under the influence of OEF is given for various amplitudes and frequencies of the OEF. Please see the legend for explanation of the symbols.

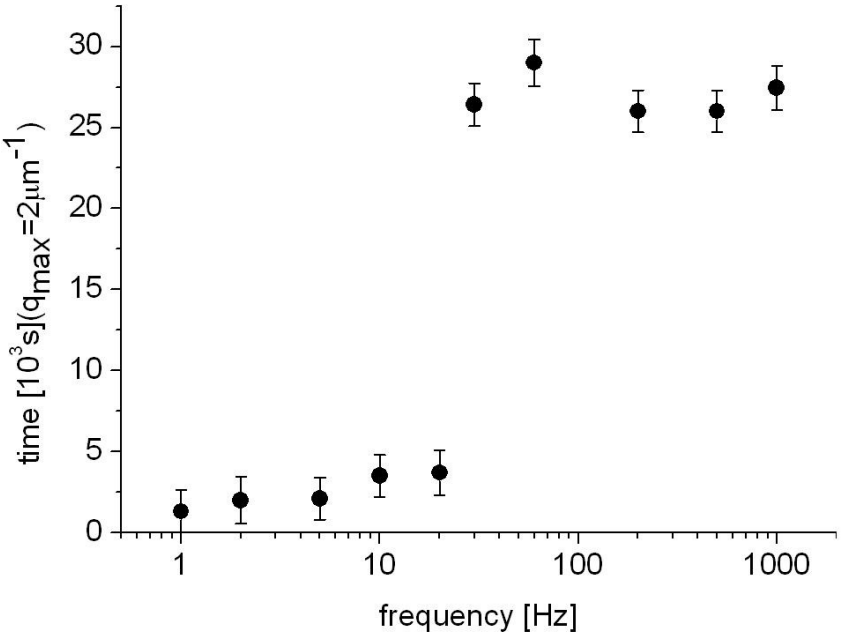

Figure 2. The plot demonstrates the threshold frequency below which we observe acceleration of the phase separation process. On the graph we plotted the the time for which wave vector attains a value of 2 μm^{-1} obtained for 5CB/PS 72/28 wt%. cooled to 35.5°C in the I+I region versus the frequency of the electric field. Threshold frequency depends on the concentration of PS, because PS can affect strongly the ion mobility. All measurements were done in alternating current electric field of intensity 3.3 V/μm.

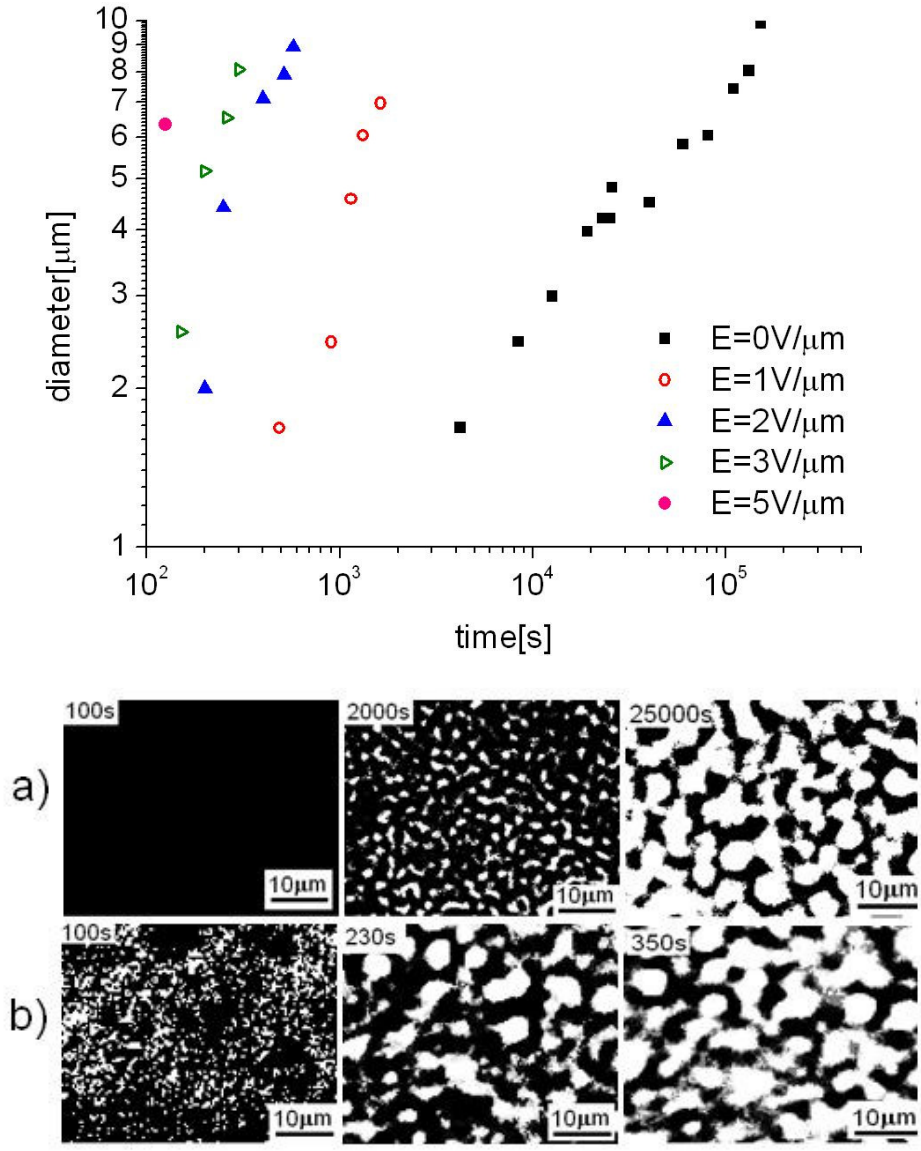

Figure 3. Average size of the domains versus time obtained for 5CB/PS 72/28 wt%. cooled to 35.5°C in the I+I region. Frequency for all measurements was set to 2 Hz. **a)** domains without an external electric field, last micrographs recorded at t = 25 000 s. **b)** domains in an external electric field E = 2V/μm, f = 2 Hz, last micrographs recordered at t = 350 s.

N. Ziębacz, S. A. Wieczorek, T. Szymborski, P. Garstecki, R. Hołyst, *Thousand-fold acceleration of phase decomposition in polymer / liquid crystal blends* ChemPhysChem **2009**, *10,* XXX