

Insights: Publications

The effect of light penetration depth on the LCST phase behavior of a thermo- and photoresponsive statistical copolymer in an ionic liquid

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A reflection cloud point technique allows for rapid screening of light-dependent phase separation temperatures of thermo- and photoresponsive polymer/ionic liquid solutions as a function of sample thickness, molecular weight, and copolymer composition. We systematically investigate the lower critical solution temperature (LCST) phase behavior of poly(benzyl methacrylate-stat-(4-phenylazophenyl methacrylate)). Under UV light, the photoresponsive azobenzene-based repeat unit becomes more polar as the cis form dominates, increasing its solubility in the ionic liquids 1-ethyl-3-methyl imidazolium and 1-butyl-3-methyl imidazolium bis(trifluoromethanesulfonyl)imide. This light-dependent polarity change leads to two phase separation temperatures, depending on the illumination wavelength. Under visible light, which drives the azobenzene moiety into the trans ground state, the LCST shows no sample thickness dependence. Under UV light, however, sample thickness plays a significant role. Samples of around 1 mm thickness show no apparent difference under UV and visible light, whereas thinner samples show an increasing difference between the phase separation temperatures with decreasing sample thickness. Neither phase separation temperature exhibits a significant dependence on molecular weight. Increasing the photoresponsive monomer content did not lead to an increase in the difference between the phase separation temperatures at fixed thickness, due to a concomitant increase in UV light absorbed at the sample surface.