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How Nanoparticles Impact Phase Evolution in Polymer Blend Films[1]

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Polymer films containing nanoparticles (NP) are of technological interest because their unique mechanical, electrical and optical properties. Here, we present a systematic study of phase separation dynamics in polymer blend films containing mobile NP. Films (650nm) of PMMA:SAN (50:50) containing methyl-terminated silica NP provide a model system to investigate wetting and phase separation dynamics. Concurrent with PMMA wetting, NP segregate to the air and substrate interfaces. The NP also preferentially partition into the PMMA rich domains. During the intermediate stage, the correlation length between domains, ξ, scales as $t^{1/3}$ for neat blends as well as those with 2 and 5 wt.% NP. As NP concentration increases, ξ increases more slowly, consistent with a coalescence model that reflects the increase in PMMA viscosity due to the NP. The effect of PMMA-grafted silica NP on phase separation and wetting depends on the length of the grafted chain. In some cases, the early stage morphology is preserved for long-times and film rupture is prevented. Selected studies of Ag-nanoparticle formation in homopolymer films will also be presented.

[1]NSF-Polymer Program