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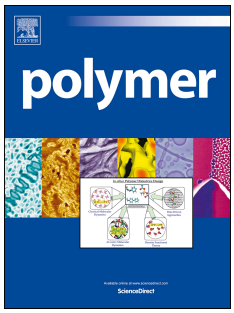

Nucleation barrier, growth kinetics in ternary polymer blend filled with preferentially distributed carbon nanotubes

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Nucleation barrier, growth kinetics in ternary polymer blend filled with preferentially distributed carbon nanotubes

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Abstract

Structural properties, evolution of morphology and crystallization kinetics in immiscible polymer blends filled with multiwall carbon nanotubes (MWNTs) in the droplet phase were systematically investigated in this study. By grafting suitable macromolecules (here SAN, styrene acrylonitrile), that can drive the MWNTs to the droplet phase, allowed the understanding of the rate of nucleation and growth of the semicrystalline matrix in droplet-filled blends in contrast to matrix-filled blends. By blending 90 wt% of PVDF with 10 wt% ABS, matrix-droplet morphologies were generated and by grafting SAN onto MWNTs, the localization of the nanotubes was tuned to fill the droplet phase which otherwise prefers the matrix phase (here PVDF); driven by thermodynamics. The evolution of morphology under quiescent annealing conditions was assessed by SEM. The blends with SAN-*g*-MWNTs also coarsened as a function of time similar to neat blends however, to a lesser extent. Although, droplet laden MWNTs did not suppress coarsening in the blends but it still improved the tensile properties when compared with the neat blends. The fold surface free energy (as evaluated from isothermal crystallization kinetics) was estimated to be less in case of blends with only MWNTs in contrast to blends with SAN-*g*-MWNTs. This was attributed to the fact that matrix (here PVDF) filled with MWNTs experiences faster crystallization rate due to heterogeneous dispersion of nucleating agents (here MWNTs) in the matrix. However, when the SAN-*g*-MWNTs were mostly localized in the amorphous droplet phase (here ABS), PVDF experienced similar crystallization behavior like the neat PVDF/ABS blends. Taken together, our study demonstrates that lower amount of energy is required for the arrangement of PVDF chains into the crystal lattice upon cooling from the melt state and accelerate the crystallization process when the heteronucleating agents are localized in the matrix phase than when they are localized in the amorphous droplet phase.

Keywords: PVDF/ABS, MWNTs, SAN, ternary blends, fold surface free energy