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Ductility improvements of PLA-based binary and ternary blends with controlled morphology using PBAT, PBSA, and nanoclay

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Abstract

In this study, binary and ternary immiscible blends of polylactide (PLA) with poly[(butylene adipate)-co-terephthalate] (PBAT) and poly[(butylene succinate)-co-adipate] (PBSA) were prepared through an injectionmolding (IM) process. Blend nanocomposites of PLA/PBAT/nanoclay were also prepared using a twin-screw extruder (TSE) followed by IM. An amorphous PLA (A-PLA), a semicrystalline PLA (SC-PLA), and their mixture were used as the matrix to investigate the matrix crystallization effect on blend morphology evolution and ductility enhancements. The results showed that in PLA/PBAT blends with 75/25 wt ratio, the increase in PLA crystallization capability caused finer and more homogenous blend morphology and hence the ductility increased significantly from around 5% to ~205%. In contrast, the ductility enhancements of co-continuous PLA/PBAT blends with 50/50 wt ratio became more profound when the PLA matrix was more amorphous. In PLA/PBSA blends, however, no ductility improvement was observed as the vitrification of PLA could hinder the PBSA crystallization which resulted in a non-uniform blend structure. In ternary blends, a matrix-core shell morphology was obtained and led to the improvements of the flexural strength and modulus. The use of nanoclay also significantly promoted the ductility of PLA/PBAT blends with 75/25 wt ratio, specifically in blends with APLA.