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Effect of nanofillers characteristics and their selective localization on morphology development and rheological properties of melt-processed polylactide/poly(butyleneadipate-co-terephthalate) blend composites

Reza Salehiyan[1], Mohammadreza Nofar[2], Kuruma Malkappa[1], Suprakas Sinha Ray[1,3]

[1] Centre for Nanostructures and Advanced Materials, DSI-CSIR Nanotechnology Innovation Centre, Council for Scientific and Industrial Research, Pretoria, South Africa
[2] Metallurgical and Materials Engineering Department, Faculty of Chemical and Metallurgical Engineering, Istanbul Technical University, Maslak, Turkey
[3] Department of Chemical Sciences, University of Johannesburg, Johannesburg, South Africa

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Abstract

This article reports the effects of the characteristics and selective localization of nanofillers on the morphology development and rheological properties of melt-processed polylactide/poly(butylene adipate-co-terephthalate) (PLA/PBAT) blend composites. Four types of nanofillers (1 wt%) are used: nanoclay (Cloisite30B [C30B]), carbon nanotubes (CNTs), nanosilica, and graphene oxide (GO). Transmission electron microscopy studies reveal that C30B is localized mainly at the PLA/PBAT interface, whereas silica, GO, and CNT are localized in PBAT droplets, although some CNTs also appear toward the interface inside the PBAT. Despite their selective localization inside the PBAT, CNTs are found to be the most effective particles for droplet size reduction, whereas silica nanoparticles are ineffective. The CNT bundles recoil during melt blending, and eventually, their breakage facilitates droplet breakup. The effects of nanofiller localization and annealing under dynamic shear on the blend morphologies are also explored through rheological analysis. The results show an anomalous relationship with the morphologies of the composites. It is also found that both coalescence and thermal degradation are involved in the annealing process of the blends. Interestingly, the CNT-filled composites may have been transformed into co-continuous-like structures during annealing, unlike the other blends studied here.