Improving Crystallization Properties, Thermal Stability, and Mechanical Properties of Poly(L-Lactide)-*b*-Poly(Ethylene Glycol)-*b*-Poly(L-Lactide) Bioplastic by Incorporating Cerium Lactate

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Abstract:

The more flexible and faster biodegradation rate of poly(L-lactide)-b-poly(ethylene glycol)-b-poly(L-lactide) (PLLA-PEG-PLLA) triblock copolymer makes it a promising bioplastic compared to PLLA. However, finding effective additives for this triblock copolymer remains a research challenge for their wider applications. This work involved the melt-blending of a cerium lactate (Ce-LA) antibacterial agent with a triblock copolymer. The thermal properties, crystalline structures, mechanical properties, and phase morphology of the PLLA-PEG-PLLA/Ce-LA composites were examined. With 0.5 wt% Ce-LA, the composite exhibited the best crystallization properties. The crystallinity of the composite contained 0.5 wt% Ce-LA increased from 11.8 to 15.9%. The incorporation of Ce-LA did not result in any changes to the crystalline structure of the triblock copolymer matrix. The best improvement in thermal stability and tensile properties of the composites was achieved with the addition of 1.5 wt% Ce-LA. When compared to the pure triblock copolymer, the temperature at the maximum decomposition rate of PLLA blocks shifted from 310 °C to 327 °C, the tensile strength increased from 14.3 MPa to 19.5 MPa, and the Young's modulus increased from 204 MPa to 312 MPa. This study concludes that the incorporation of Ce-LA enhanced the crystallizability, thermal stability, and mechanical properties of PLLA-PEG-PLLA.