Simple method for great enhancement of impact strength and heat resistance of poly(lactic acid) and poly(butylene succinate) blends

Poly(lactic acid) (PLLA) has attracted much interest in many applications such as medical and healthcare product, textiles, and single-use packaging. Recently, the application of PLLA has expanded to three-dimensional (3D) printing where individually customized products are produced. A critical lack of medical supplies and personal protective equipment has occurred during the COVID-19. Fortunately, 3D printing technology can be an effective solution to overcome this problem. Although having high stiffness, PLLA has a relatively low heat resistance and is considered brittle for some applications. Therefore, simultaneous improvements of impact toughness and heat resistance of PLLA need to be made while preserving its biodegradability and sustainability.

In this work, we present an economical and effective method for obtaining high toughness PLLA of balanced stiffness and heat resistance by manipulating the crystallization morphology through simple blending and heat-treatment of the molded parts under appropriate conditions within a short period. A short period of thermal annealing (10 min) is efficient for concurrently enhancing the impact strength and heat stability of the PLLA-based materials, without sacrificing a significant loss in stiffness and strength. The production of fully biodegradable parts with comparable properties to ABS for FDM 3D printing is highly possible.

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