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ABSTRACT

Experimental Investigation of Cold and Melt Crystallization of PLA and Its Critical Influence on Mechanical Properties

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Polylactic acid (PLA) is a widely used biodegradable polymer with applications in packaging, biomedical, and automotive industries. Understanding its crystallization behavior and mechanical properties is crucial for optimizing its performance. This study investigates the cold and melt crystallization of PLA and their influence on mechanical properties through a combination of experimental techniques.

To analyze crystallization, Differential Scanning Calorimetry (DSC) is used to examine crystallization kinetics and thermal transitions. Uniaxial tension tests assess the mechanical performance, including tensile strength, elastic modulus, and elongation at break. Additionally, rheological measurements with a rotational rheometer characterize the viscoelastic properties and flow behavior of PLA, which are essential for processing and end-use applications. A key focus of this research is the transformation of melt crystallization into cold crystallization when PLA is cooled to a specific temperature.

The findings provide deeper insights into the relationship between thermal history, crystallization behavior, and mechanical properties of PLA. Understanding the interplay between cold and melt crystallization can aid in developing optimized processing strategies for additive manufacturing and other applications involving PLA-based materials.