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Thesis Abstract (English)

Approaches to the thermally stable poly(lactide)s with stereocomplex as a unique crystalline components

Blends of poly(L-lactic acid) (PLLA) and poly(D-lactic acid) (PDLA) forms stereocomplex crystal (sc) which shows a melting point around 230°C, about 50°C higher than that of PLLA and PDLA homo crystal (hc). The degree of sc is affected by the method and condition of mixing, the optical purity and the molecular weight of parent poly(lactide)s, and by the mixing ratio. Among these factors, the effects of the molecular weight of parent polymers and the mixing condition on the stereocomplexation of the equal blends of PLLA and PDLA are determined in this study. Further the effect of the processing condition on the physical property and the higher-order structure of the biaxially oriented PLLA/PDLA blend films were studied.

The effect of the molecular weight on the hc crystallization of PLLAs is those known for various semi-crystalline polymers. However there are both lower and higher threshold of the molecular weight exist for sc crystallization. Lower threshold of the molecular weight for the sc crystallization of PLLA/PDLA blend is about 1,000, while that for hc crystallization of PLLA is about 2,500. When the molecular weight is higher than 25,000, both hc and sc tended to form in the blend

The effect of the mixing condition on the sc formation of the PLLA/PDLA blends was investigated. The blends melt-mixed at 200°C and 210°C under application of a high shear flow tend to show a single melting peak of the sc. Further kneading of the blends at an elevated temperature caused the transesterification between the same enantiomeric chains forming block copolymers of L- and D-chains. This block copolymer acts as a nucleating agent of sc and the compatibilizing agent between PLLA and PDLA and promotes the formation of SC.

PLLA/PDLA blend was prepared at an optimum condition. The blend was compression molded into films and biaxially drawn and annealed. The biaxially drawn films showed a broad crystalline WAXD reflection and the application of annealing completely changed the reflections into those of sc. The mechanical property was improved by the biaxial drawing and the annealing for short period of time.