Preferred Lamellar Orientation of Linear Polyesters in Melt-crystallized Thin Films on Substrates

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Chain-folded lamellar crystals of linear polymers show preferred orientation in their melt-crystallized thin films with thicknesses below 1μm. However, influential factors on lamellar orientation in the films haven't completely been understood on the molecular scale. In this study, lamellar orientation of linear polyester thin films was quantitatively evaluated by microbeam grazing-incidence wide-angle X-ray diffraction (GIWAXD) measurements using synchrotron radiation in SPring-8 (RIKEN, Hyogo, Japan). Relationship between the preferred lamellar orientation in the films and the orientation of crystal nuclei was discussed on the basis of the classical nucleation theory applied to polymer crystals.

Samples used were biobased poly(3-hydroxybutyrate) and poly(3-hydroxybutyrate-*co*-3-hydroxyhexanoate) (PHBH) having 3.2-10 mol% of the uncrystallizable 3-hydroxyhexanoate (3HH) (Kaneka Corp.). Their thin films with the average thickness of 360 nm were prepared on Si substrates by a spin-coating method. GIWAXD and contact angle measurements were performed for the films crystallized isothermally from the melt. The dominant lamellar orientation found for the films was inconsistent with the probable orientation of crystal nuclei generated near the substrate surface by thermodynamic driving force.

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