

## Effects of Annealing and Drawing on Crystal Structure and Supermolecular Structure of Poly (L-Lactide)

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### Abstract

Recently, attention has been paid to biodegradable polymers in relation to the global environment. Poly-lactide (PLA) is one of such polymers and has studied by some investigators. In this study, the changes of crystal structure, crystal orientation and supermolecular structure of Poly(L-lactide) (PLLA) during drawing or annealing have been investigated.

proceed extremely by annealing at the high temperature of 160°C near the melting point.

On comparing the films drawn by 13 times before and after annealing at 160°C, the width of the central diffuse scattering in SAXS patterns decreased after annealing. This indicates that the film as drawn has some amount of voids but this amount diminishes accompanied by the fibril growth by annealing.

### Experimental

PLLA (Mitsui Chemical Co., Mw of ca. 140,000) was kindly supplied. The pellet of PLLA was melt and pressed at 220°C and 80 kgf/cm<sup>2</sup>. Then non-crystallized film and crystallized film with the thickness of 0.3 mm were prepared by quenched into ice-water, and gradually cooled at room temperature, respectively. The crystallized films were cut into strip specimens, which were drawn by 3, 7, 13 times using a hand-operated drawing machine in hot-water at 70°C. The drawn films were annealed at a series of temperatures (from 80°C to 160°C) for 2.5 or 5 hours in a vacuum oven. DSC measurements, WAXD and SAXD experiments were employed to characterize the thermal properties and the structures of the samples.

### Results and Discussion

DSC thermograms for the annealed films (from 80°C to 150°C) drawn by 7 times showed two endothermic peaks. The higher melting temperature may correspond to the large and stable crystals occupying most part in the sample and the lower one to the small crystals with instability, which are expected to form during the cooling process after heat treatment. A lot of reflections were observed in a WAXD photograph for the film annealed at 160°C after drawn by 13 times. This might suggest that the crystallite should remarkably grow and besides the oriented-induced crystallization should