Hierarchical Structure of Polymer Spherulites Detected by Synchrotron X-ray Microbeam and 2D FTIR Spectral Techniques

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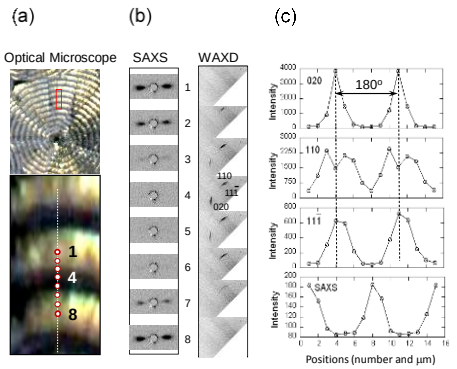
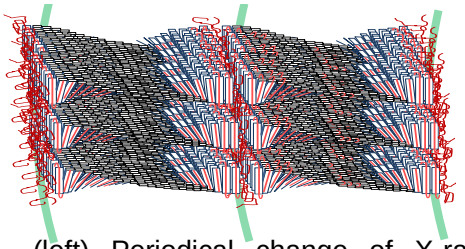
(1) Twisting phenomenon and Discontinuity of Stacked Lamellae

Poly(ethylene adipate) shows the round-shape spherulite with ring pattern. Interpretation of WAXD/SAXS data collected using a synchrotron microbeam X-ray scattering method revealed the twisitng phenomenon of lamellae along the radial direction. However, as found out by Woo *et al*. [*Euro Polym J*., 71, 27 (2015)], these lamellar blocks are not connected continuously but the discontinuous gaps are existent between them. So far we might have believed that the lamellae in the ring-pattern spherulite are twisted *always continuously*. However, the present case gives the serious warning for this common sense *[Polym. J.*, in press].

(2) Flat-on and Edge-on Structure of Lamellae

isotactic Polybutene-1 exhibits the square spherulite (hedrite) when crystallized at 103°C, while the round-shape spherulite at 98°C. Only 5°C temperature difference causes such a remarkable morphological change. X-ray microbeam experiment combined with polarized 2D FTIR spectral data revealed that the polymer chains stand on the substrate vertically in the hedrite grown at 103°C (falt-on), but the chains lie in parallel to the spherulite surface at 98°C (edge-on). The discussion is made by taking the phase transition and structure difference between the crystal forms I and II [*Macromolecules*, 49, 1392 (2016)].





(left) Periodical change of X-ray peak intensity with the position on the spherulite (right) Discontinuous aggregation of twisted lamellae

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Research Interest: Relationship between structure and physical properties of polymer substances viewed from microscopic and hierarchical structural points.