(**Key Note Talk**) Fibers and Films

Structural and Mechanical Behaviors under Tensile Stress of Poly(trimethylene terephthalate) Fibers Prepared in High-Speed Melt Spinning Process

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Abstract:
Poly(trimethylene terephthalate) (PTT) is one of the aromatic polyesters with odd-numbered methylene units in its main chain. In this study, high-speed melt spinning of PTT was performed and structure and properties of the as-spun fibers were investigated. Orientation-induced crystallization of PTT started to occur when the take-up velocity exceeded 3 km/min. Crystalline and amorphous birefringences of crystallized fibers were analyzed from the measured birefringence, crystalline orientation factor and crystallinity using the intrinsic birefringence (=0.0206) estimated from the atomic co-ordinates and the unit cell parameters of the PTT crystal. It was found that the amorphous birefringence is significantly larger than the crystalline birefringence. Considering the extremely low crystalline modulus of PTT, which was reported to be 2.59GPa, variation of the birefringence of fibers with increasing tensile stress was analyzed. Obtained photo elastic constants for the crystalline and amorphous phases were comparable. This result also suggests the easy deformability of PTT molecules in the crystalline phase. Effect of the structure of crystalline phase on the mechanical behavior of the PTT fibers was investigated through the wide-angle X-ray measurement of crystalline strain while imposing the tensile stress to the fiber. It was revealed that the tilting of the c-axis of PTT crystal against the fiber axis has a certain effect on the tensile modulus of fibers.