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High Performance Poly(vinyl Alcohol) Microfibrillar Fiber Prepared by High-Temperature Point Stretching

- Effect of Stretching Conditions on the Orientation of the Fiber -

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High strength microfibrillar poly(vinyl alcohol) (PVA) fiber (PVA fibril) having number-average degree of polymerization (P_n) of 4,500-20,000, degree of saponification (D.S.) of 85.0-99.9%, and syndiotactic diad (S-diad) content of 57-64% could be prepared by different five fibrillation methods. To effectively orient the molecular chains of syndiotacticity-rich high molecualr weight PVA fibril, a high-temperature point stretching technique was applied. Draw ratio up to seven was achieved by stretching the PVA fibril having P_n of 15,100, S-diad content of 63.1%, D.S. of over 99.0%, and crystal orientation index of 0.81 (PVA 1) at around 260°C close to its crystal melting temperature (Figure 1). The draw ratio of the PVA fibril increased with a decrease in the orientation index, D.S., and S-diad content and with an increase in the molecular weight. The crystal orientation index of the PVA fibril calculated from the azimuthal X-ray diffractogram could reach to 0.94 after stretching the fibril showing the index of 0.81 (Figure 2). It was found that the final degree of orientation of the PVA fibril depended on the P_n, syndiotacticity, and D.S. of PVA. When the same draw ratio was applied to the fibrils showing similar degrees of orientation, higher molecular orientation was achieved for the fibrils having higher P_n, syndiotacticity, and D.S. of PVA.

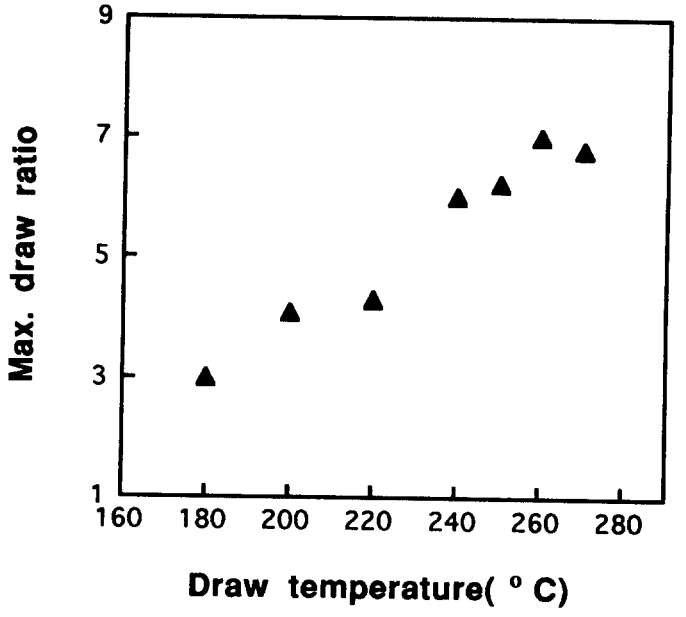

Figure 1. Effect of draw temperature on the maximum draw ratio of PVA 1.

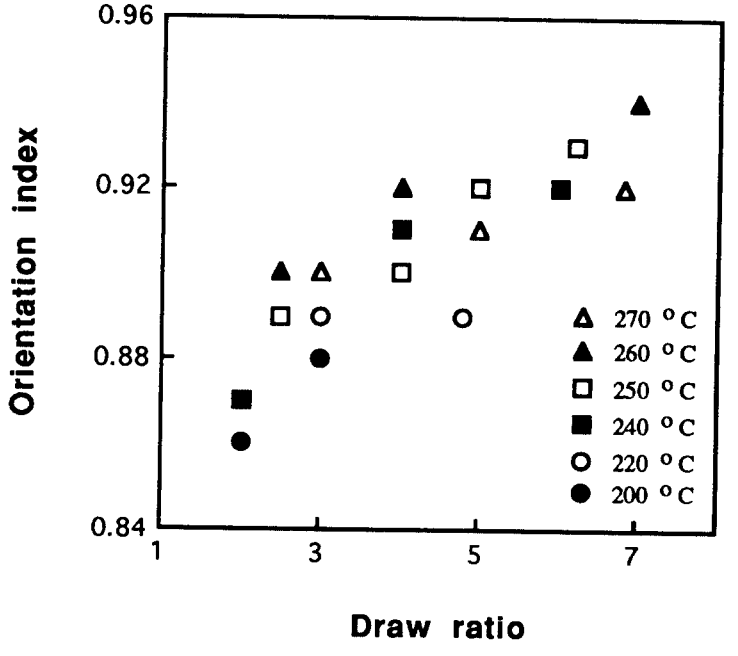

Figure 2. Plots of orientation indices vs. draw ratios of PVA fibrils obtained by stretching PVA 1.