분자량 차이가 폴리비닐알코올 섬유의 구조에 미치는 영향

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Effects of Different Molecular Weight on the Structure of PVA Fiber

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1. Introduction

The crystal modulus of Poly(vinyl alcohol) (PVA) and the strength of perfectly oriented PVA fiber are high; they are estimated to be 250- 300 GPa. To this day, despite various attempts, the limited values have not been obtained experimentally for PVA. A Young's modulus of 115 GPa is the highest value reached so far. It does not reach the theoretical values. This is considered to be caused by intermolecular hydrogen bonding, which interferes with the drawing.[1)]

PVA is an amorphous polymer. Therefore, the acetic acid groups in the polymer chains of PVA interfere with the crystallization of PVA. The existence of acetic acid groups in the polymer chains of PVA is expected to support the ultra-drawing of fibers and films of PVA. Recently, some high modulus, high strength organic fibers have been commercialized, The high performance acryl and PVA fibers have attracted attention as substitutes for asbestos in fiber reinforced concrete. To improve the mechanical performance of the PVA fiber, several novel spinning methods such as gel-spinning and dry-jet wet spinning have been adopted. Although the gel spinning produces fibers with excellent mechanical properties, it requires an ultra high molecular weight polymer.

This study investigates some important factors in the preparation of different number-average degree of polymerization (P_n) PVA and the effect of draw ratio on structure.

2. Experimental

2.1. Materials

The PVA with number-average degree of polymerization (P_n) of 1,700 and 2,400 (DC Chemical Co., Ltd) was used. PVA spinning dope was prepared from dimethyl sulfoxide (DMSO) at 80 ℃ and extruded in methanol, at 0 ℃, through a spinning machine kept at 70 ℃. The rheological behavior was determined using Anton Paar Rheometer Physica MCR-301, with a bob and cup contric cylinder type.

3. Results and discussion

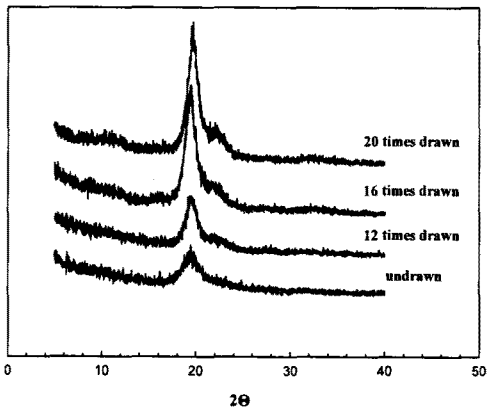

Figure 1. XRD of gel-spinning PVA fiber peak

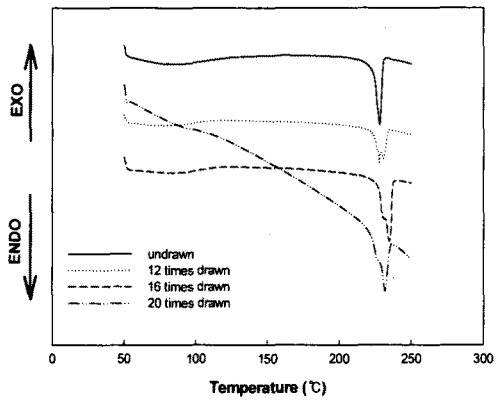

Figure 2. DSC of gel-spinning PVA fiber peak

Figure 1. shows the X-ray diffraction scans of the gel-spinning fibers drawn to 12, 16 and 20 times. Generally, the diffraction peak at $2\Theta=19.5^{\circ}$ (101) became clearer and their intensity was higher with the draw ratio, than that of the undrawn fiber, due to the high crystallite and orientation of the oriented fibers. This fact can be identified by DSC results.

Figure 2. show the DSC thermography of the gel-spinning fibers drawn to 12, 16 and 20 times. The sharp peak at 230 ℃ must correspond to the melting of crystal. Generally, the greater the draw ratio was, the higher the degree of crystallization was the high the melting temperature was.

4. Acknowledgement

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5. Reference

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