연신조건이 PTT 섬유의 배향에 미치는 영향(II)

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Effect on the Orientation of Poly(trimethylene terephthalate) Fibers in Drawing Conditions(II)

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1. Introduction

Since Poly(trimethylene terephthalate)(PTT)'s synthetic method was first reported in 1941 by Whinfield et al.[1], many scientifical studies have worked for commercializing. Nevertheless, it was never commercialized because of many unstable sources.

Like report of preceeding researchers, PTT was known to us that it had unique crystal structure such as coiled spring due to conformation of *tggt*. Accordingly, PTT have superior properties such as good elastic recovery and resilience. However, as difference between T_g and $T_{c\ cold}$ are about 1 5℃, many time-dependent changes in fiber were taken place the structural unstability[3,4].

In works about PTT fibers up to the present, the structural changes was seldom studied. Accordingly, we confirmed that the solvent induced crystallization characterized by acetone-solvent take place in PTT fiber and that the properties of PTT fiber were improved with drawing-velocity in aceton solvent. Also, Cho et al. reported that drawing of low temperature, nearly Tg, have more superior properties than high temperature. However, the properties such as initial modulus and tenacity of PTT fiber is not satisfied yet.

In this study, we aimed to obtain satisfactory properties from various drawing condition. Hence, Setting up two-step drawing condition, that is, heat-drawing after solvent-drawing, we evaluate fine structural analysis and mechanical properties of PTT fibers and propose to suggest basic work of production of stable DTY.

2. Experimental

2.1. Sample Preparation

Intrinsic viscosity of the polymer chip was 0.92(dℓ/g). After the polymer was first dried in vaccum oven at 100℃ for 6 hours, the temperature was raised to 160℃ and maintained for 8 hours for the crystallization of the polymer. In the fiber spinning process, the PTT polymer was extruded from 10 hole spinneret of 0.6mm diameter at 270℃. The mass flow rate was controlled with 10.2g/min and take-velocity was 1km/min.

2.3. Drawing Condition of Sample

Drawing conditions of sample are listed in Table 1

2.2. Structural Analysis

To confirm the change of crystalline structure, WAXD intensity curves for equatorial scans were measured using D/max-III-A X-ray diffractometer system(Rigaku Co., Japan). To confirm the orientation of fiber, birefringence was measured using polarizing microscope (Berek conpensator, Olympus B201).

Table 1. PTT fibers drawn at various conditions (drawing-velocity 180mm/min)

Sample Name	1st step (Acetone 30℃)		2nd step (Oil-bath)		DR-final
	Temp.	DR	Temp.	DR	
[a]DR-AT	30℃	2.7	-	-	2.7
[b]DR-80	30℃	2.5	80℃	1.04	2.60
DR-100		2.5	100℃	1.1	2.75
DR-120		2.5	120℃	1.14	2.85
[c]HS-80	30℃	2.7	80℃	-	2.7
HS-100		2.7	100℃	-	2.7
HS-120		2.7	120℃	-	2.7

※ a : solvent-drawing at acetone solvent(40℃)
b : solvent-drawing at acetone solvent(40℃) → heat drawing(80℃)
c : solvent-drawing at acetone solvent(40℃) → heat setting(80℃, 10min)

3. Results and Discussion

Equatorial WAXD scans of PTT fibers at two-step drawing condition are shown in Figure 1. In the case of PTT fiber, the reflection from (010) plane was known at around 2θ≈ 15.6°[5]. In DR-AT, the reflection from (010) plane was already observed at around 2θ= 15.6°. With increasing heat-drawing temperature after solvent-drawing, this peak became stronger. Hence, this is considered that increase of orientation by heat-drawing and temperature condition bring out crystalline formation. Equatorial WAXD scans of PTT fibers at various heat-setting temperature after solvent-drawing are shown in Figure 2. Compared with DR-AT, heat-setting samples have a better influence on crystalline formation like Figure 1. By observing weaker peak intensity of heat-setting in comparision with heat-drawing in same condition, however, we can confirm that two-step drawing condition have a better effect on crystalline formation.

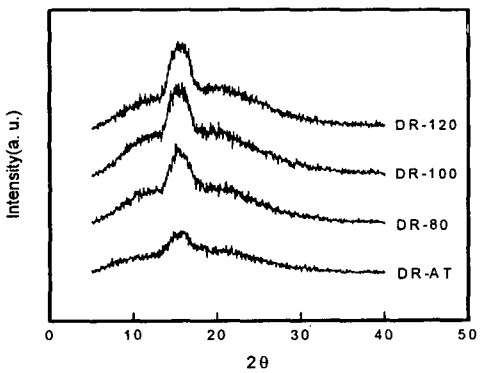

Figure 1. Equatorial WAXD scans of PTT fibers drawn at various conditions. (solvent-drawing→heat drawing)

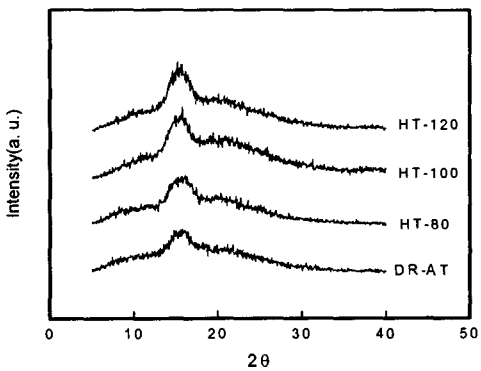

Figure 2. Equatorial WAXD scans of PTT fibers drawn at various conditions. (solvent-drawing→heat setting)

4. 참고문헌

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