PBT 시트의 연신 방법에 따른 미세구조 변화

이선희, 조현혹, 中山 和朗*
부산대학교 섬유공학과, *産業技術綜合研究所

Changes on the Fine Structure of PBT Sheets with Various Drawing Methods

Sun-Hee Lee, Hyun-Hok Cho and Kazuo Nakayama*
Department of Textile Engineering, Pusan National Univwesity, Busan, Korea
**Macromolecular Technology Reasearch Center, National Institute of Advanced Industrial Science a Technology, Tsukuba, Ibaraki, Japan*

1. Introduction

Poly(butylene terephthalate)(PBT) has long history as an engineering thermoplastic. PBT was first introduced commercially to the market place as an injection molding resin about 1969 by Celanese Plastics in the U.S.A. It is still widely used as a molding resin.

Processing or forming methods for solid-phase deformation, such as stretching, hydrostatic extrusion, roller stretching, rolling, and so on can improve the mechanical properties effectively. These processes have been extensively studied and have also received attention as potential methods for producing high-performance oriented materials [1]. In our early papers [2-3], we reported on the mechanical behaviors and structural modification of uniaxially stretched PBT sheets and fibers.

In this study, we present a study of the formation of sheets from PBT. We present a study of formation of biaxially oriented PBT sheet using film stretcher. Also, PBT sheets are prepared by roller-drawing method. The structure and physical properties of PBT sheets with various drawing method were investigated by using WAXD, MOA, etc.

2. Experimental

2.1. Materials

PBT chips (IV= 1.14dl/g) used in this study was a Duranex obtained from Polyplastics Co., Ltd. PBT sheets were extruded from T-die using a single extruder(LABOPLASTOMILL, Toyoseiki Co.), after the pellets were dried at 130℃. The extruder temperature was set 240, 250, and 255℃. The die temperature was controlled at 255℃. The screw rotation speed was fixed at 40rpm. PBT sheets were winded by a take-up roller whose temperature was controlled at 90℃ and speed at 4m/min.

2.2. Drawing method

The biaxial drawing of as-extruded sheets was conducted by using a biaxial stretching machine (Toyoseiki Co.). The undrawn sheets were cut to dimensions, 10cm x 10cm x 0.05cm. Drawing experiments were conducted at draw speed of 600mm/min in the temperature range 80-180℃.

The roller drawing was carried out using an apparatus schematically. The PBT sheets used for the roller drawing were cut into dimensions, 5cm x 20cm . Drawing experiments were conducted at drawing speed of 100mm/min at the temperature of 100℃.

2.3. Characterization

Wide angle X-ray diffraction (WAXD, Rigaku Denki Co., Ltd) experiments were carried out by using a Ni-filterd CuK α radiation(40kV, 40mA). WAXD profiles were prepared with a reflection method. Dielectric measurements at microwave frequencies were carried out by means of a MOA analyzer (MOA-3020A, New Oji Paper Co., Ltd.). Information about the orientation in the sheet plane could be obtained.

3. Results and Discussion

Figure. 1 presents WAXD profiles of original sheets. Original sheets exhibited crystalline reflections at 9.2°, 15.8°, 17.2°, 20.5° and 23.5°. These are equivalent to the PBT (001), $(0\bar{1}1)$, (101), $(\bar{1}10)$ and (100) of the α-crystal phase. Figure. 2 shows the effect of drawing temperature on the WAXD profiles of biaxial stretched PBT sheets. The reflections of original PBT sheets almost disappeared and one peak remain. The reflection observed at 2θ=23.5° is assigned to the (100). As drawing temperature is the higher, the intensities of the reflection of (100) increased. Therefore, it known that crystallization occurred with biaxial stretching. Figure. 3 presents tridirectional WAXD patterns of roller-drawn PBT sheets. The through directional WAXD patterns showed increasing of the $(010)_\alpha$ reflection of PBT crystal. The edge and end directional patterns showed development of the $(100)_\alpha$ reflection. The equatorial reflections of $(010)_\alpha$ and $(100)_\alpha$ were used to characterize the crystalline orientation of the PBT crystals. With increasing the roller-draw ratio, these planes of preferred orientation have the strongest intensity on the equator.

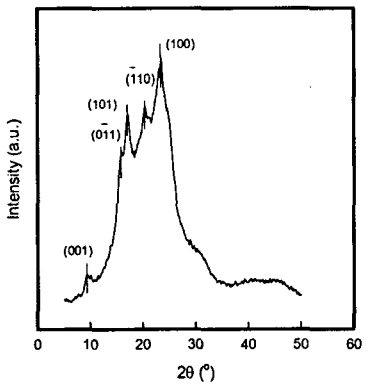

Figure 1. WAXD profiles of original PBT sheets.

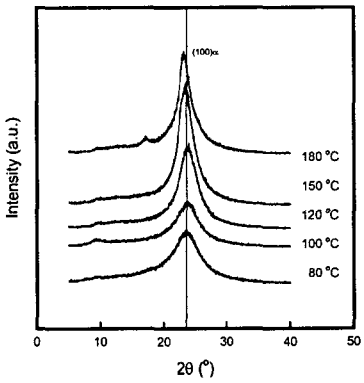

Figure 2. WAXD profiles of biaxial stretched PBT sheets at various drawing temperature.

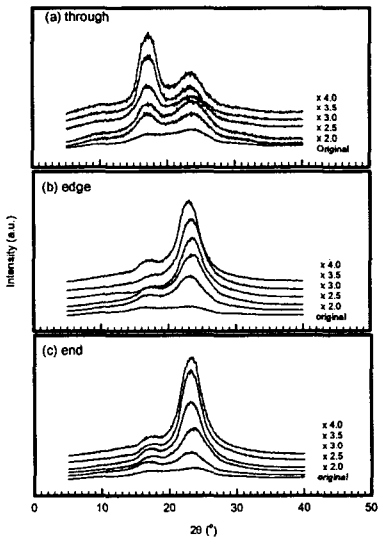

Figure. 3 Tridirectional WAXD patterns of roller-drawn PBT sheets at 100°C

4. References

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