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SHORT COMMUNICATIONS

Co-continuous Structure in Polycarbonate/Amorphous Nylon 3Me6T Blend

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A blend of polycarbonate (PC) with Nylon is a reasonable pair to compensate for drawbacks, such as processability, impact strength, solvent and moisture sensitivity, and low mold shrinkage.[1] For obtaining desired properties, control of morphology is important. A few studies[2-8] have been reported about the morphologies of PC/Nylon blends. In previous study, dispersion type morphology was observed in PC/Nylon 6,[2-5] PC/Nylon 66,[6] and PC/Nylon 6-*co*-12[7] blends. In particular, a salami structure was obtained in PC/Nylon 66 (50:50) blend with poly(allyl-*co*-maleic anhydride).[6] In recent work,[8] the probability of forming a co-continuous structure in PC/Amorphous Nylon 3Me6T blend was demonstrated. This paper confirmes the co-continuous structure and differences of morphology of PC/Nylon 3Me6T blend at the skin and inside.

EXPERIMENTAL

Materials

Polycarbonate (L-1250, $\overline{M_v}=2.49\times10^4$, $T_g=150°C$, Teijin Chemicals Ltd.) and Nylon 3Me6T (Trogamid T, $\overline{M_w}=6.3\times10^4$, $M_n=2.0\times10^4$, $T_g=152°C$, Dynamit Novel Co.), a condensation product of 2,2,4-trimethyl-1,6-hexanediamine and terephthalic acids, were used. The chemical structure is shown in Figure 1.

Sample Preparation

PC/Nylon 3Me6T blends were prepared with roller mixer (Toyo Seiki Co.). Materials were put into mixer at 230°C and mixed at 30 rpm, 10 min. The blended sample was left at room temperature before electron microscopic observation.

Morphology Observation

Cryogenically fractured surface was covered with gold by a sputtering coating unit and observed by scanning electron microscope (SEM, Hitachi Co., H-700H). Microtomed thin sections of the sample were exposed to the vapor from a 2% aqueous solution of osmium tetraoxide (OsO_4) for 1 h and examined by transmission electron microscope (TEM, Hitachi Co., H-4100) at an acccelerating voltage of 120 kV.

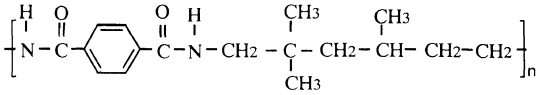


Figure 1. Chemical structure of Nylon 3Me6T.

RESULTS AND DISCUSSION

A schematic fractured surface of PC/Nylon 3Me6T (45:55) blend is shown in Figure 2. The morphologies at the skin A, inside A and skin B (reverse skin) are shown in Figure 3. Homogeneous phase morphology was observed at the skin as seen in Figure 3(a). Inside A, phase separated structure appears and then co-continuous structure is observed. At skin B, a homogeneous phase morphology appears, as seen in Figure 3(c). To observe the phase separation in greater detail, the fractured surface was etched with chloroform. Only the Nylon 3Me6T component was left. The etched surface at skin and inside, is shown in Figures 4(a) and (b), respectively. A co-continuous structure is observed clearly. Inoue *et al.*[9,10] reported that a co-continuous structure in PC/PBT and PC/SAN blend, is formed by shear-induced miscibility. Therefore we presume that PC and Nylon 3Me6T could also be miscible when mixed at high shear rate, and spinodal decomposition should occur in the static state. Coarsened phase morphology will appear inside. As shown in Figure 4(b), Spinodal decomposition was more advanced inside than at skin because of long vitrification time. Figure 5 is a TEM micrograph of the blend where the color of the PC phase is relatively darker. A co-continuous domain structure is observed and small droplets are shown inside the co-continuous domains.

These results indicate that PC and Nylon 3Me6T are miscible at high shear rate. By spinodal decomposition, co-continuous structure appeared in PC/Nylon 3Me6T blend. Depth profile of morphology is schematically

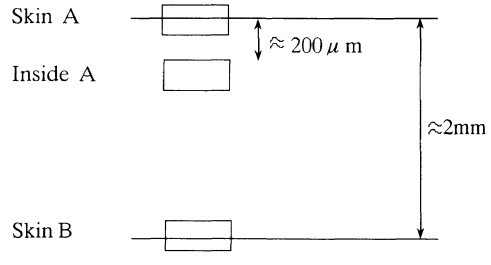
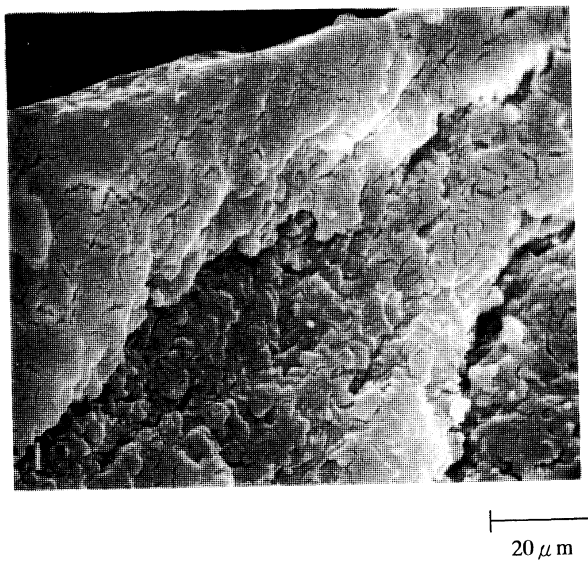
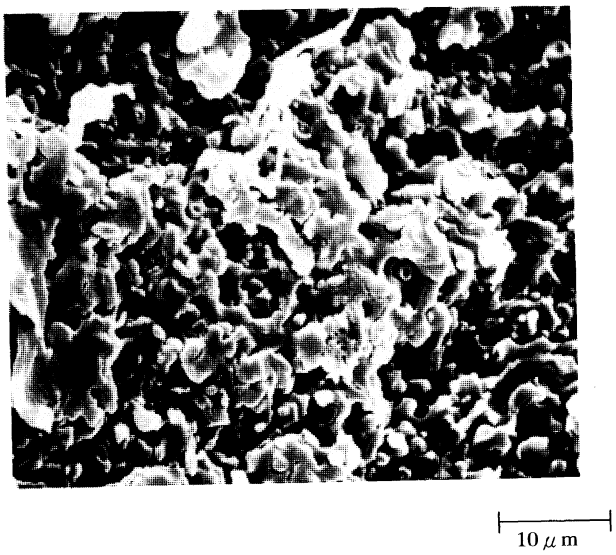


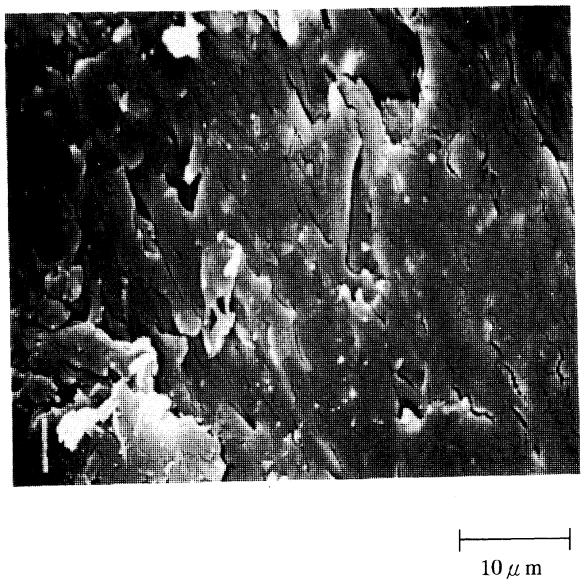
Figure 2. Schematic fractured surface of PC/Nylon 3Me6T (45:55) blend.



(a)

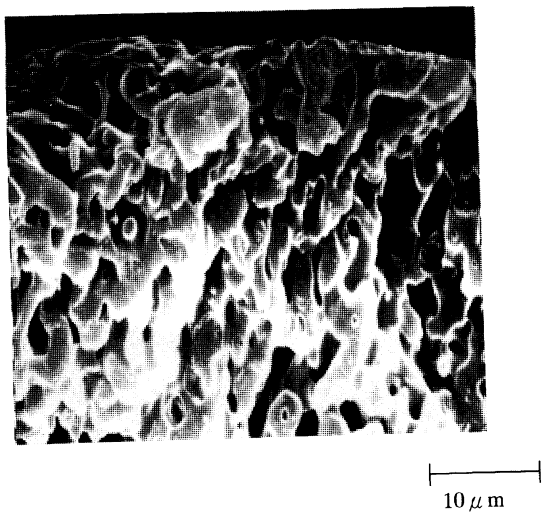


(b)

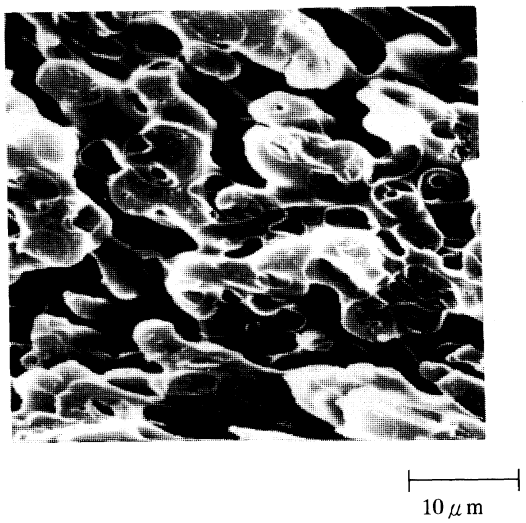


(c)

Figure 3. Scanning electron micrographs of PC/Nylon 3Me6T (45 : 55) blend. (a) skin A; (b) inside A (about 200 μm from the surface); (c) skin B (reverse skin).



(a)



(b)

Figure 4. Scanning electron micrographs of PC/Nylon 3Me6T (45 : 55) blend (etched with $CHCl_3$). (a) skin; (b) inside.

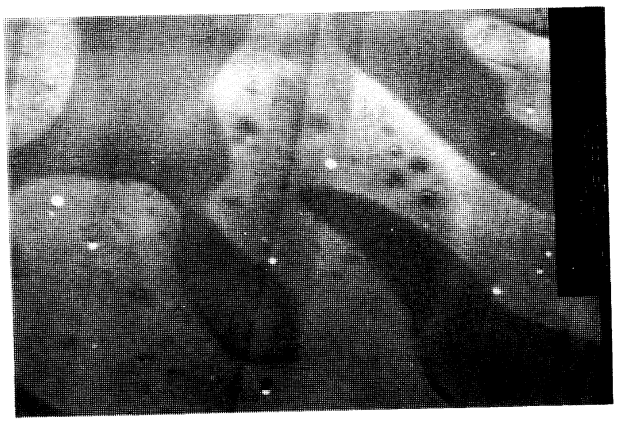


Figure 5. Transmitted electron micrograph of the PC/Nylon 3Me6T (45 : 55) blend.

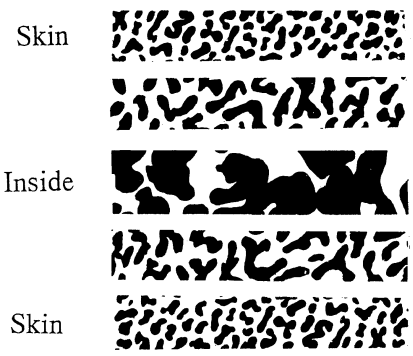


Figure 6. Model of co-continuous structure of the PC/Nylon 3Me6T (45 : 55) blend.

shown in Figure 6. This co-continuous structure may be relevant to solvent and moisture sensitivity and low mold shrinkage. Shear-induced miscibility between PC and Nylon 3Me6T should be confirmed.

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