생분해성 Poly(lactic acid)(PLA) / Poly(butylene succinate) (PBS) ionomer blend의 특성

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Characterization of Poly(lactic acid) PLA / Poly(butylene succinate) (PBS) Ionomer Blend

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1. Introduction

Poly(lactic acid) (PLA) is well known biodegradable material with good mechanical property and biocompatibility. However, brittleness and poor thermal stability of PLA are very fatal drawbacks to be expaned its application area. Up to date, considerable efforts have been made to improve these shortcomings of PLA, for example, blend with other biodegradable polymers and nanocomposites made by adding a small amount of inorganic materials. Among them, we focused on the PLA/PBS ionomer blend. At previous study, It was reported that PLA could form miscible blend with poly(butylene succinate) (PBS)[1]. Recently, we synthesized poly(butylene succinate) based ionomers (PBSi)[2] and investigated its overall properties. Among them, we selected PBS3i (containing ion groups of 3 mol%) for blending with PLA, since PBS3i have improved physical properties. The thermal and structure properties of two series blend (PLA/PBS3i, PLA/PBS) were compared by DSC and WAXD. We anticipate PLA/PBS ionomer blend have good physical property and misciblility better than PLA/PBS blend, because ionic interaction of ion group within PBS ionomer can interact effectively with PLA matrix. The weight ratios of the PBS3i and PBS to PLA in the blend samples were made to be 5, 10, 20, and 30 wt%. Afterward, the miscibility of PLA/PBS3i will be investigated detail.

2. Experimental

2.1. Materials

PLA2002D was supplied from Nature Works®. and used after dried for 24 hr at 60 ℃. 1,4-butandiol(99%), succinic acid(99%), titanium(IV) butoxide(97%), dimethyl fumarate, sodium hydrogensulfide were purchased to synthesis PBS and PBS ionomer from Aldrich Chemical co.

2.2. Preparation of PBS ionomer and PBS

PBS and PBS ionomer were prepared by in-situ polymerization[2][3]. Polymerization was carried out two steps-esterification and polycondensation. And, we synthesized Sodium Dimethyl Fumarate (SDMF) with dimethyl fumarate, sodium hydrogensulfide to prepare PBS ionomer. The ratio of materials to synthesis PBS were 1.0 mol succinic acid, 1.2 mol 1,4-butandiol and 0.3 wt% titanium (IV) butoxide as a catalyst. In order to synthesis PBS ionomer 3 mol% (PBS3i), added SDMF 3

mol% about succinic acid compare with ratio of materials to synthesized PBS.

2.4. PLA/PBS ionomer and PLA/PBS blends

PLA/PBS ionomer and PLA/PBS blends were prepared by melt blending using co-rotating twin screw (Haake co.) at 100rpm of roll speed for 1 min at 180 ℃. Each blending ratio were 5, 10, 20, 30wt% in PLA matrix.

2.5. Characterization

In order to confirm ionic groups within PBS3i, we measured by using H-NMR spectra VARIAN Unitylniva operating at 300 MHz. The thermal behavior of PLA/PBS and PLA/PBS ionomer blends were conducted using TA instrument DSC under a nitrogen atmosphere and scanning range from 30 ℃ to 200 ℃. In order to eliminate thermal history, all the samples hold at 200 ℃ for 5 min. Then cooling run and second scanning of heating was carried out at a rate of 10 ℃/min. Wide angle X-ray diffraction (WAXD) experiments were conducted by using a Rigaku X-ray generator operated at 40kV and 100mA and scanspeed of 5°/min with a 2Θ range of 5~40° with CuK_α radiation (λ=1.54Å).

3. Results and Discussion

We confirmed PBS3i was successfully synthesized from the H-NMR data. Fig. 1 shows glass transition temperature(T_g) of PLA/PBS3i and PLA/PBS blends. With the increase of PBS3i or PBS contents, T_g of two series of blends shift gradually to lower temperature. However, the Tg of PLA/PBS blends was higher than that of PLA/PBS3i blend. This phenomenon can explain the miscibility of PLA/PBS ionomer blend become better than PLA/PBS blend. With the increase PBS ionomer and PBS contents, crystallizaion temperature peak appeared clearly than pure PLA. This result indicates PBS or PBS ionomer assist the crystallization of PLA. As seen in Fig. 2, we confirmed new crystallization peak through the WAXD.

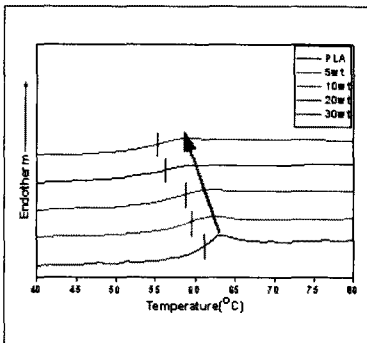

Fig. 1(a) DSC thermogram PLA/PBS3i

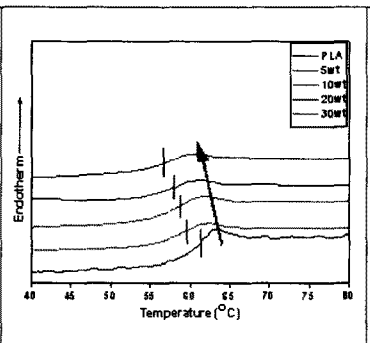

Fig. 1(b) DSC thermogram PLA/PBS

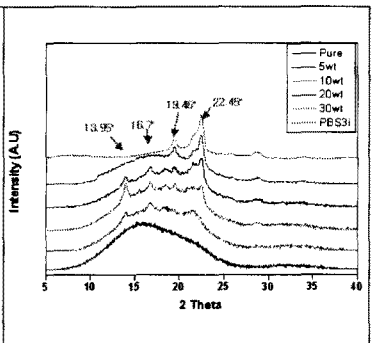

Fig. 2 WAXD profile of PLA/PBS3i

4. Reference

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