Poly(tetrametylene succinate)/Polycarbonate copolymer의 가수분해시의 구조변화

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Structural Changes of Poly(tetrametylene succinate)/Polycarbonate copolymers on Hydrolysis

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1. Introduction

The durability and anti-microbial stability of plastics, which have been thought to be favorable characteristics, cause ecoloical problems due to non-degradation after disposal. For a possible solution of these ecological and environmental problems, the biodegradable polymers, especially aliphatic polyesters, have been widely investigated. Poly(tetramethylene succinate)(PTMS) is one of the most promising biodegradable polyesters. In order to promote biodegradability or extend the application fields of aliphatic polyester, many investigations on modification by means of physical blending or chemical treatment such as copolymerization have been done. However, in the case of PTMS, these modifications have been little investigated compared with other aliphatic polyesters. In this study, structural changes such as the crystallinity, lamellar thickness, long period and surface morphology of PTMS/PC copolymers during hydrolysis were investigated.

2. Experimental

2.1. Material

PTMS/PC copolymers were kindly supplied by Mitsubishi gas chemical company. All samplas were used after drying for over 48 hours in vacuum at room temperature. (350; PTMS/PC 90/10, 550; PTMS/PC 80/20)

2.2. Hydrolysis

Hydrolysis was performed in 100ml NaOH solutions (2%, 3%) and stirred at 90 rpm in stirring bath at 38℃. Degraded films were dried for 24 hours in vacuum at room temperature and were measured the weight loss. From this, the degradability was obtained by following equation.

$$\degree\ radability(\%) = \frac{A - R_s}{A}$$

were A is the amount of specimen polymer added (mg), Rs is the amount of specimen polymer remaining after degradation (mg).

3. Result & Discussion

Fig. 1 shows the weight loss of PTMS/PC films during hydrolysis. The degradation of 550 was faster than 350. The faster rates of degradation for the 550 might be attributed to less crystallinity and low packing of molecular chain due to the introduction of carbonate units in molecular chains. Calculated from the WAXD data, crystallinity increased in all samples during the initial degradation period indicating the reduction of amorphous region. However the crystallinity of 350 was level off and that of 550 was decreased after the degradation about 6 weeks. From the SAXS data, lamellar thickness increased at initial degradation and decreased after 4 weeks degradation, while amorphous size continuously decreased during hydrolysis as shown in Fig. 2.

4. Conclusion

The faster rates of degradation of 550 was resulted from the less crystallinity and low packing of molecular chain due to the incorporation of carbonate units in molecular chains. The crystallinity increased in all samples during the initial degradation period indicating the reduction of amorphous region. Additionally, from the SAXS data, the long period and amorphous size were significantly decreased during the hydrolysis while the crystalline thickness little increased at initial perioid. It is supposed that the further crystallization process was occurred by annealing effects from hydrolysis temperature 37℃ and an increase of mobility by molecular chain scissions of amorphous region.
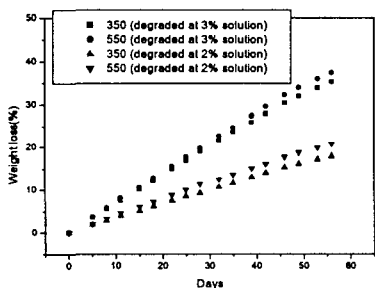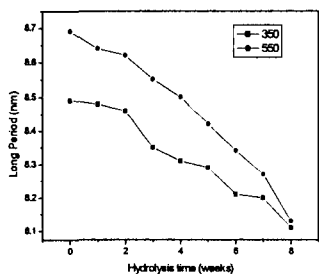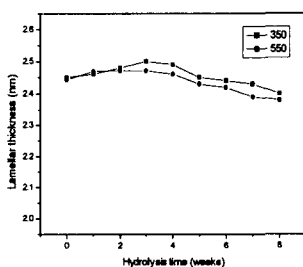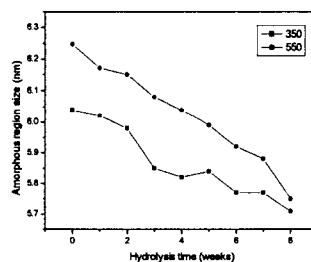

Fig. 1 The weight loss of PTMS/PC copolymers during hydrolysis

(a) (b) (c)

Fig. 2 Microstructural parameters change during hydrolysis. (a) long period, (b) lamellar thickness, (c) amorphous regions size