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The electrical conductivity of the polypyrrole/(anion containing copolyester) composite films prepared from $FeCl_3$-copolyester surface adsorption was investigated. Copolyester films prepared by dipping in $FeCl_3$ solutions were exposed to pyrrole vapor. $FeCl_3$ solutions were prepared from phenol/TCE and methanol mixtures with three different mixing ratios (phenol/TCE:methanol), that is, 1:1, 2:1, and 3:1. The composite films prepared from the 3:1 and 2:1 solutions showed higher conductivity than those prepared from the 1:1 solution. The Fe content of the films was found to be closely related to the conductivity of the composites. The conductivity of the composite films showed the highest value when DMS, the ionic group, content in the copolyester was 6 mol% for all the solvent compositions examined.

Keywords: copolyester; polypyrrole: composite film; conductivity; $FeCl_3$; surface adsorption

INTRODUCTION

Preparation of conducting polymer composites by polymerizing polypyrrole in thermoplastic polymer matrices has been studied by many researchers in order to enhance the stability and the physical properties of polypyrrole[1-4]. In the previous study[4] we synthesized the ionic group containing copolyesters and examined the effects of the ionic group content on the electrical conductivity of polypyrrole/copolyester composite films. We found that the conductivity of the composite films

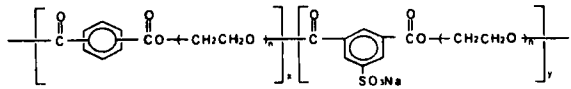
increased with the amount of 5-sodiosulfodimethyl isophthalate (DMS) in the copolyester up to 10 mol% and decreased with DMS content when DMS content was greater than 10 mol%. In the previous study we fixed the amount of $FeCl_3$ which was dissolved with copolyester by the same ratio. Since $FeCl_3$ can break the polymer chain, dissolving $FeCl_3$ and polymer at the same time may not good for the mechanical porperties of the resulting composite films. In the present study, we prepared the polypyrrole/copolyester film by dipping the copolyester films into the $FeCl_3$ solution which were prepared from phenol/1,1,2,2-tatrachloroethane (TCE) and methanol mixtures with three different mixing ratios (phenol/TCE:methanol), that is, 1:1, 2:1, and 3:1. Phenol/TCE was selected as a solvent for copolyesters and methanol as a solvent for $FeCl_3$. The effect of $FeCl_3$ solution system on the electrical conductivity of the composite films was investigated.

EXPERIMENTAL

Copolyesters having DMT:DMI=1:1 and EG:DEG=1:0 were synthesized by conventional two-step polymerization as described in the previous study[2]. The DMS content was controlled to be from 0 to 19 mol%. Copolyester films were prepared by solution cast method from phenol/TCE. $FeCl_3$ solutions were prepared from phenol/TCE(50/50 by vol.) and methanol mixtures with different mixing ratios (phenol/TCE:methanol): 1:1, 2:1, and 3:1. The polypyrrole composites were prepared by vapor phase polymerization of pyrrole with the exposure time of 1 hr. The electrical conductivity was measured at room temperature by van der Pauw method[5].

RESULTS AND DISCUSSION

The copolyesters used in this study have the following structure:



where n means the average composition of diols and x is the DMS mole fraction in all the diacid derivatives present.

TABLE I. Properties of Anion-Containing Copolyesters

Sample	DMS (mol%)[a]	Diol composition(mole fration)[b]			[η] (dl/g)[c]	T_g (°C)[d]
		EG	DEG	TEG		
1	0	0.961	0.039	-	0.771	62.8
2	1.9	0.893	0.107	-	0.512	58.9
3	6.5	0.822	0.178	-	0.379	56.2
4	10.3	0.648	0.283	0.069	0.310	44.6
5	14.5	0.646	0.283	0.071	0.270	49.6
6	19.0	0.570	0.314	0.116	0.217	53.4

[a] Determined by Perkin Elmer Atomic Absorption Spectroscopy Model-3300
[b] Determined by Gas Chromatography HP 5890 Series II
[c] Measured from the dilute solutions in a phenol/1,1,2,2-tetrachloroethane mixture(1:1 by vol.) at 30 °C
[d] Determined by TA Instruments DSC 2910 under nitrogen purging with a heating rate of 20 °C/min.

Table I shows the composition, intrinsic viscosity, and glass transition temperature of copolyester samples used. Figure 1 shows the variation of conductivity of polypyrrole/copolyester composite films prepared from $FeCl_3$ surface adsorption. The conductivity of the composite films increased with the phenol/TCE content in the $FeCl_3$ dipping solution. It was thought that phenol/TCE dissolved the surface of the copolyester film and helped $FeCl_3$ to penetrate into the film. In case of 1:1 solution treated samples, $FeCl_3$ was expected not to penetrate deeply into the film because of the insufficient solvating power of the dipping solution.

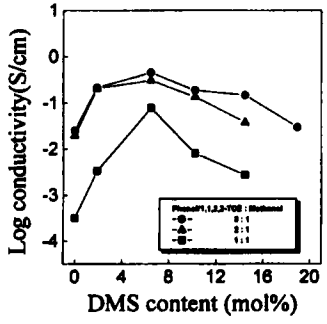


FIGURE 1. Variation of conductivity with DMS content.

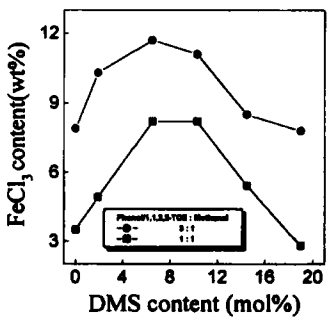


FIGURE 2. Plot of $FeCl_3$ content vs. DMS content.

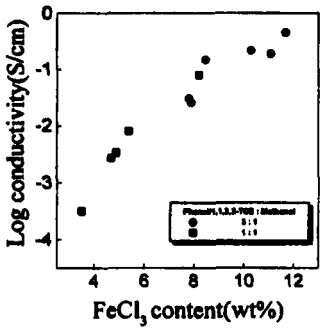


FIGURE 3. Plot of conductivity vs $FeCl_3$ content.

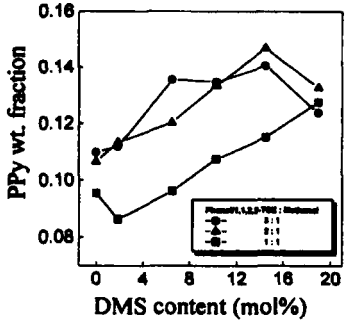


FIGURE 4. Plot of PPy content vs. DMS content.

Figure 2 shows the result of the Fe analysis by Atomic Absorption Spectroscopy. Figure 1 and Figure 2 resemble each other in shape, which implies that $FeCl_3$ content in the copolyester films has close relationship with the conductivity of the composite films. Figure 3 shows the linear relationship between conductivity and $FeCl_3$ content. As can be seen in Figure 4, the composite films treated with 2:1 and 3:1 solution have higher polypyrrole content than 1:1 solution treated films, which is thought to be due to the high $FeCl_3$ content of the 2:1 and 3:1 solution treated samples.

Acknowledgement

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