Electrical Conductivity of Polypyrrole/Copolyester Composite Films. 2. Composite Films Prepared from Copolyester-$FeCl_3$ Surface Absorption

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1. INTRODUCTION

Polypyrrole (PPy) is regarded as one of the most promising intrinsically or naturally conductive polymer for practical applications due to its relatively high electrical conductivity, environmental stability and low toxicity[1]. The typical PPy, which is insoluble and infusible, exhibits poor processability and lacks essential mechanical properties. A number of papers have concerned the efforts to overcome these drawbacks. Among them, a significant strategy to approach both high electrical conductivity and physical properties of PPy is through the use of preparing the composites based on PPy and conventional polymers by different process[2].

In the previous study[3] we found that conductivity of polypyrrole/copolyester composite films, which is prepared from inducing oxidative polymerization of gaseous pyrrole on $FeCl_3$/copolyester matrix films by use of the vapour phase polymerization method, increased with the DMS content up to 10 mol%, after then decreased when DMS content was greater than 10 mol%.

In the present study we investigated the conductivity of the PPy/copolyester composite films prepared from floating the copolyester films on the oxidant solution composed of various ratios of $FeCl_3$ solvents. This surface absorption method was aimed to PET better mechanical properties of the composite films than the solution cast method.

2. EXPERIMENTAL

Using the same materials of the previous study[3], copolyester films prepared from solution cast method are floating on the surface of the solution of 6wt% $FeCl_3$ to the solvent. $FeCl_3$ was used as a oxidizing agent for pyrrole polymerization[4]. The solvent ratios of phenol/1,1,2,2-tetrachloroethane and methanol were varied from 3:1 to 1:1. Floating was conducted at room temperature for 1 min. The $FeCl_3$ was absorbed directly on the surface of copolyester films and made an another second layer on the surface of copolyester films. The $FeCl_3$/copolyester films were evaporated under vacuum at 50°C for

48 hours. And then the PPy/copolyester composite films were prepared by vapor-phase chemical polymerization under the condition of 160 torr, room temp, and exposure time 1 hr. The electrical conductivity was measured at room temperature by van der Pauw method[5]. The $FeCl_3$ content of composite film is measured by Perkin Elmer Atomic Absorption Spectroscopy Model-3300 and the PPy content is measured by CE Instrument Elemental Analysis 1110 Model.

3. RESULTS AND DISCUSSION

The electrical conductivities of the PPy/copolyester composite films, prepared under different conditions as a function of the solvent ratio in the $FeCl_3$ solution, is illustrated in Figure 1. For the samples of high phenol/1,1,2,2- tetrachloroethane content, the electrical conductivities increase significantly. The reason of increasing conductivity is that phenol/1,1,2,2- tetrachloroethane is so soluble to the matrix copolyester that $FeCl_3$ could easily penetrate into the copolyester matrix. In that effect, pyrrole monomer vapor could also penetrate more deeply into the matrix, which may be an advantage to lower the percolation threshold of composite[6].

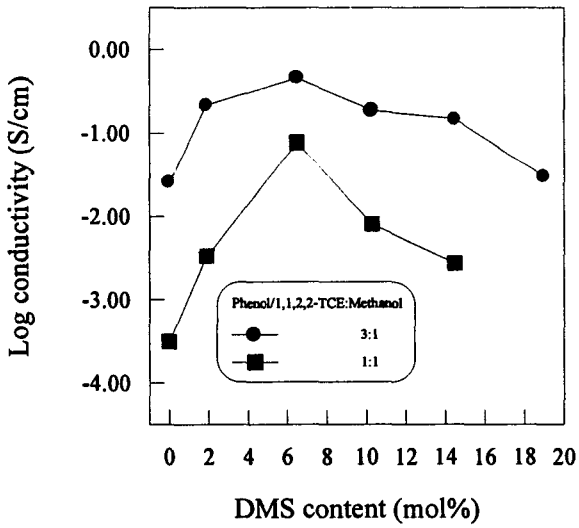

Figure 1. Log conductivities with solvent ratios of $FeCl_3$ for various content of DMS in copolyesters.

Figure 2 shows the variation of Fe content of $FeCl_3$/copolyester matrices with the increase of DMS content of copolyesters. When the DMS content is about 0, 19 mol%, Fe absorption proficiency is lower than any other copolyester matrices. Methanol is less effective to adsorb $FeCl_3$ to copolyester than pheno/1,1,2,2- tetrachloroethane.

Figure 3 shows PPy content of the PPy/copolyester composite sample as a function of the DMS content of copolyesters at two different solvent ratios. PPy content is generally increased with the DMS content of copolyesters and shows higher when solvent ratio is 3:1.

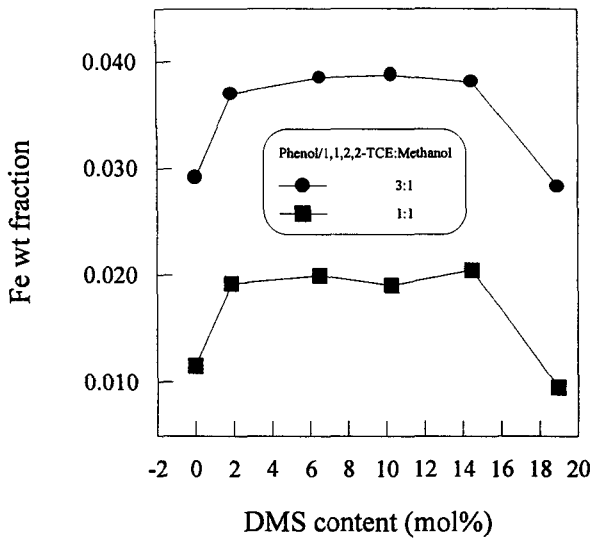

Figure 2. Fe content of $FeCl_3$/copolyester films prepared from different solvent ratios.

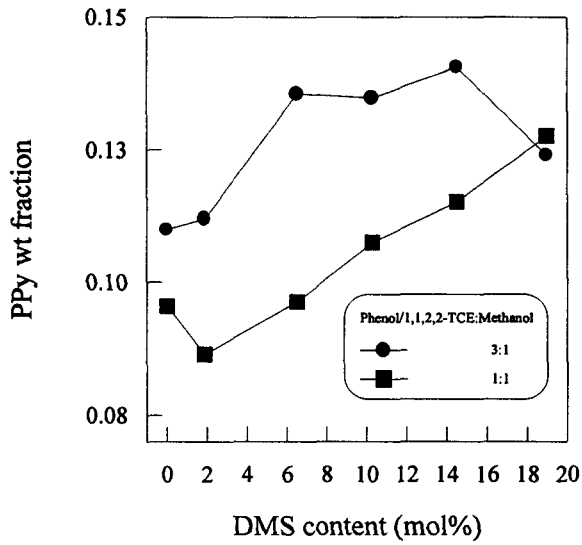

Figure 3. PPy content of PPy/copolyester composite films with DMS content of copolyester.

4. CONCLUSION

When the solvent weight ratio between phenol/1,1,2,2-tetrachloroethane and methanol is 3:1 is found to show high values of conductivity and the improvement of conductivity can be attributed to the capacity of solvent to penetrate into the copolyesters. The

composite films composed of DMS approximate 6 mol% showed highest value of conductivity in any case. The domain of PPy in case of DMS approximate 6 mol% may be spread widely at any region of PPy/copolyester composite films. As a result it take good advantage to make a good conduction path and better conductive composite film.

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