Poly(3,4-ethylenedioxythiophene)으로 코팅된 Polycarbonate 필름의 전기적 특성과 열적 특성에 관한 연구

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Study on Electrical and Thermal Properties of Poly(3,4-ethylenedioxythiophene)-coated Polycarbonate Films

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1. Introduction

There was little development in transparent conductive polymer films and their limited studies have been mainly focused on polymer films coated by water-soluble PEDOT doped with the polymeric counteranion poly(4-styrenesulfonate) (PEDOT-PSS)[1-3]. However PEDOT-PSS as coating material has some difficulties because of high viscosity and low solubility in organic solvent except for in water. In this study, in order to extend practical applications of PEDOT and to prepare conductive PC films, we tried to prepare PEDOT-coated PC films and investigated their conductivity and thermal stability.

2. Experimental

2.1 Materials

3,4-ethylenedioxythiophene (EDOT) was obtained from Bayer AG. Iron (III) chloride, Dodecylbenzenesulfonic acid (DBSA), Hydroxy-propyl cellulose (HPC) were purchased from Sigma Aldrich and D-sorbitol was purchased from Fluka.

2.2. Preparation of conductive coating solution and transparent PEDOT-coated PC films with high conductivity

The DBSA-doped EDOT monomer was prepared, and $FeCl_3$, oxidizing agent, was quickly syringed into the reaction mixture. The reaction mixture was stirred for 20 hrs at 30 ℃. The conductive coating solution was prepared by mixing PEDOT colloid with small amount of binder (HPC) and D-sorbitol in ethanol with various ratios. The PEDOT-coated PC films were prepared by spin coating at 1500 rpm for 180s. The coated PC films were denoted as CPEDOT0, CPEDOT-S1, CPEDOT-S3, CPEDOT-S5. The end numbers in code represent the weight(10^{-2} g) of D-sorbitol.

3. Result & Discussion

The surface resistances of all the PEDOT-coated PC films prepared by spin coating were 10^3 order of Ω/square. Fig.1 shows the effect of annealing of PEDOT-coated PC films with time. Annealing was carried out at 175 ℃for 3 hrs. Surface resistance of all samples increase with increasing annealing time. CPEDOT0 and CPEDOT-S1 exhibit significant increase in surface

resistance for 1 hr annealing time and increases from 103 order to 107 order of Ω/square. On the other hand, CPEDOT-S5 shows insignificant change in surface resistance. This result indicates that the incorporation of 0.05 g of D-sorbitol lead to optimum thermal stability for surface resistance. To compare the effect of heat treatment PEDOT-coated PC films were annealed at 175 ℃ for 7 min. The annealed films were denoted as -A. Surface resistance of CPEDOT0 was higher than CPEDOT0-A, but CPEDOT-S1-A, CPEDOT-S3-A, and CPEDOT-S5-A had lower surface resistance than pristine PEDOT-coated PC films. In the case of preparing PEDOT-coated PC films from dispersions containing D-sorbltol, the decrease in surface resistance could be the result of giving the PEDOT molecules more time to get into a more favorable position.

The transparency of PEDOT-coated PC films was measured by UV-vis spectra. Fig.2 shows the UV-vis spectra of CPEDOT0, CPEDOT-S5, CPEDOT0-A and CPEDOT-S5-A. Annealed PEDOT-coated PC films showed higher transparency than pristine PEDOT-coated PC films.

Adhesion strength and surface hardness of a coating to a PC film were measured by ASTM D3359 and ASTM D3363, respectively. Adhesion strength of the CPEDOT0 and CPEDOT-S5 was 0B, but that of annealed films (CPEDOT0-A and CPEDOT-S5-A) was 5B. Surfce hardness of CPEDOT0 and CPEDOT-S5 was HB, but that of CPEDOT0-A and CPEDOT-S5-A was higher than 4H

4. Conclusion

Transparent PEDOT-coated PC films with high conductivity were successfully prepared by spin coating using conductive polymer coating solutions. Addition of D-sorbitol to the coating solution increased the thermal stability for PEDOT-coated PC films. The annealed (at 175 ℃ for 7 min) PEDOT-coated PC films had lower surface resistance than that of pristine PEDOT-coated PC films and showed good transparency, adhesive strength, and surface hardness

5. References

1. H. Tsutsumi, M. Araki, K. Onimura, T. Oishi, *Synth. Met.*, 1998, 97, 53-56.
2. L. Groenendaal, F. Jonas, D. Freitag, H. Pielartzik, J. R. Reynolds, *Adv. Mat.*, 2000, 7, 481-494.
3. L. A. A. Pettersson, S. Ghosh, O. Inganas, *Org. Electro.*, 2002, 3, 143-148.

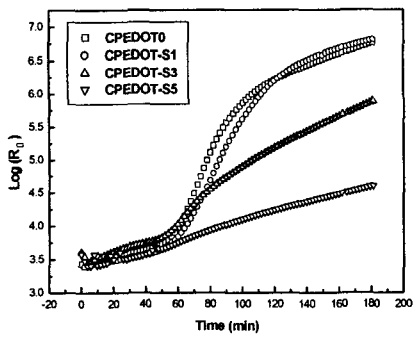

Fig.1. Variation of surface resistance as a function of annealing time : annealing temperature: 175 ℃, time: 3hrs

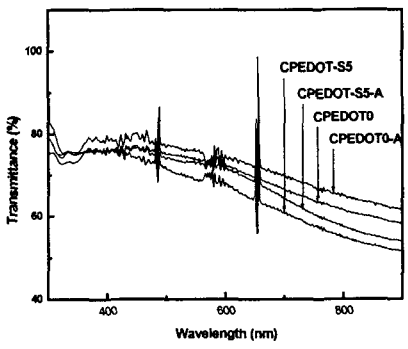

Fig.2. UV-vis. spectra of PEDOT-coated PC films and its annealed films