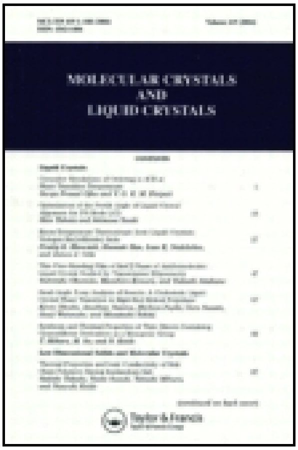

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Electrostatic Interactions in Conducting Polymer Composite PAN/PPy

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Electrostatic Interactions in Conducting Polymer Composite PAN/PPy

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Conducting polymer composite was prepared by the in-situ polymerization of pyrrole in the presence of poly(acrylonitrile)(PAN) matrix. In order to enhance the electrostatic interaction between the two components, the anion-containing PAN ionomer was used as a matrix. It was observed that the anion-containing matrix allowed better electrical properties and the stability than homo PAN. It was also observed that the addition of a small amount of aryl sulfonate dopant resulted in the greatly improved electrical stability.

Keywords: conducting polymer composite, electrostatic interaction, electrical stability

INTRODUCTION

Conducting polymers exhibit excellent electrical properties, however, common usage of these materials has been restricted due to the lack of processability and stability. Polymer composite formation using a commodity polymer as a matrix is a simple method providing processability to the conducting polymer. The idea of utilizing an anion-containing polymer as a matrix is based on the introduction of the electrostatic interaction between the insulating matrix polymer and conducting polymers.[1] The special interaction between the two components in composite formation provides better adhesion as well as regular dispersion. The stability of electrical conductivity is of the utmost importance for any practical application. The environmental stability of the conducting polymer is highly dependent on the selection of dopant ions.[2] In this paper, the role of the polymeric dopant as well as aryl sulfonate molecules in conducting composite is monitored in terms of the electrical properties and the stability.

EXPERIMENTAL

The copolymer, [poly(acrylonitrile-co-styrene sulfonate), PAN-co-PSS], was synthesized by the published method.[3] The matrix films were prepared by solution casting using DMSO solvent. The composite film was prepared by the in-situ polymerization of pyrrole. The matrix film was immersed in the deionized water medium containing pyrrole monomer. Subsequently aqueous ferric chloride solution was added dropwise and the reaction allowed for 1 hr. Electrical conductivity was measured by the four-in-line probe using Keithley 236 source measure unit.

RESULTS AND DISCUSSIONS

The composite film was obtained by the in-situ polymerization of pyrrole in the presence of matrix film. The conductivity of the resulting composite was monitored with the reaction conditions, such as initial pyrrole concentration and the reaction time, of which data were shown in Figures 1 and 2, respectively. The conductivity increased as the initial pyrrole concentration incresed up to 0.04M. The conductivity also increased with the reaction time. The conductivity constantly increased until 45 min and reached an asymptotic level. According to this observation, all the composite films was prepared at the identical conditions, 0.05M of pyrrole concentration and 60 min reaction time.

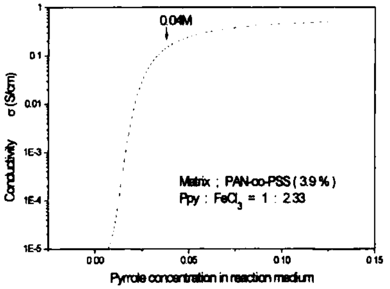

FIGURE 1. Conductivity vs. [pyrrole]

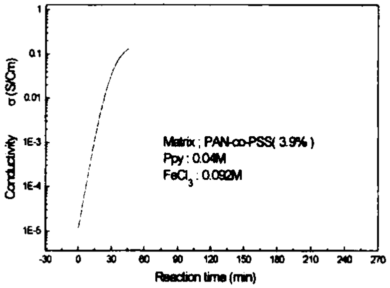

FIGURE 2. Conductivity vs. time

The stability of the electrical conductivity was monitored as a function of matrix ion content. In the thermal aging experiment, the anion- containing matrix exhibited the improved electrical stability, as shown in Figure 3. The polypyrrole doped with Cl^- was not stable at elevated temperature, which might be due to the dedoping phenomenon involving HCl volatilization from the polypyrrole. In the case of composite using anion-containing matrix, polymeric anions acted as dopant ions and the dedoping phenomena was restricted due to the thermally stable styrene sulfonate ions.

The stability of the composite was further improved by the addition of a small amount of aryl sulfonate dopants, such as anthraquinone-2-sulfonic acid sodium salt (AQSA), 2,6-naphthalene disulfonic acid disodium salt (NDSA), sodium *p*-toluenesulfonate(PTS), and 2-naphthalenesulfonic acid sodium salt (NSA). The composite containing AQSA exhibited the best result in the stability test, as shown in Figure 4. The higher stability of aryl sulfonate doped composites is conceivably due to the much higher stability of these doping species with respect to volatilization, decomposition or chemical reactivity.[4]

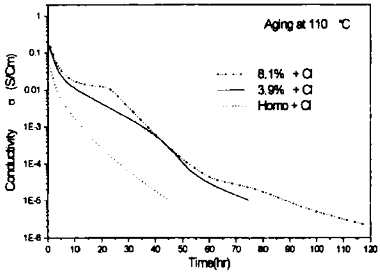

FIGURE 3. The stability with different ion content .

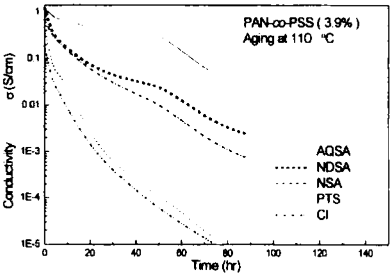

FIGURE 4. The stability with various dopants

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