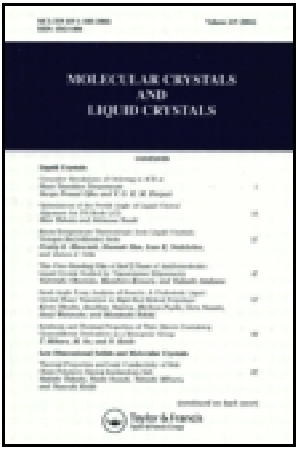

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Electrically Conducting Poly(Acrylonitrile-Co-Pyrrolylmethylstyrene)-G-Polypyrrole

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Synthesis and the characteristics of an electrically conducting graft copolymer, poly(acrylonitrile-co-pyrrolylmethylstyrene)-g-polypyrrole (PANPMS-g-PPy) are reported. It was found that pyrrolyl groups in PANPMS acted as the nuclei for the electrochemical polymerization of PPy. Conductivity of PANPMS-g-PPy was 100 times higher than that of poly(acrylonitrile-co-chloromethylstyrene)/PPy (PANCMS/PPy) composite prepared under the same condition.

Keywords: Electrically conducting polymer; Graft copolymer; Poly(acrylonitrile-co-pyrrolylmethylstyrene)-g-polypyrrole

INTRODUCTION

Polypyrrole (PPy) is one of the most attractive electrically conducting polymers since it exhibits a high electrical conductivity and good environmental stability[1], but poor processibility limits its practical applications. Therefore, a number of researches have been carried out to combine excellent physical properties of processible polymers and the electrical conductivity of PPy. Since PPy does not interact strongly with the matrix polymers in most of the simple composites, it is expected that the introduction of chemical bonds between matrix polymer and PPy moiety may improve the environmental stability of composites.[2, 3]

In this work, we report a synthetic route to a graft copolymer (PANPMS-g-PPy) of PPy and an insulating copolymer (PANPMS) of acrylonitrile (AN) and pyrrolylmethylstyrene (PMS). We also compare the characteristics of PANPMS-g-PPy with those of polyacrylonitrile-co-chloromethylstyrene (PANCMS)/PPy composite.

EXPERIMENTAL

Monomers and solvents were purified using appropriate methods.[4] PANPMS-g-PPy was synthesized as following procedure shown in Figure 1.[4] Electrochemical polymerization of PPy was carried out on the electrodes coated with PANPMS or PANCMS by applying constant potentials for various periods of time in a standard 3-electrode cell. 0.1M of pyrrole and 0.1M of Et_4NBF_4 as a supporting electrolyte and acetonitrile or acetonitirle/dichloromethane mixture as a solvent were used.

RESULTS AND DISCUSSION

In the FT-IR spectrum of PANCMS (Figure 2(B)), a new absorption

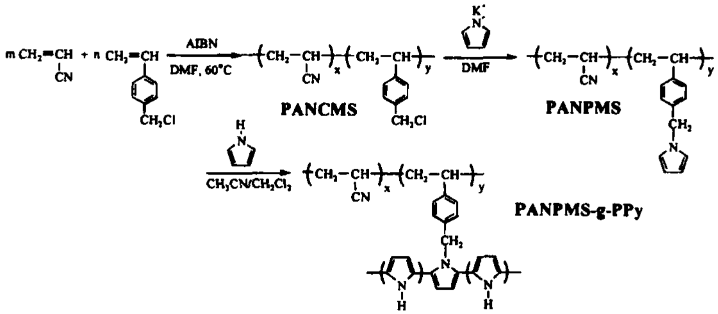

FIGURE 1. Schematic synthetic route to PANPMS-g-PPy.

peak was observed at 712 cm^{-1}, corresponding to the aromatic absorption of phenyl group in CMS. Reaction of chlorine in CMS with pyrrolyl group was also confirmed by a new absorption peak in PANPMS spectrum at 1228 cm^{-1}, corresponding to C-N stretching in PMS as shown in Figure 2(C).

It was found that the solvent exhibited significant effects on the electrochemical polymerization of PPy. Acetonitrile, dichlromethane or their mixture gave rise to a good quality of PANPMS-g-PPy polymer film, while DMF or DMSO did not.

As shown in Figure 3, it was observed that the electrical conductivity increased with the increase of oxidation potential. During the electrochemical polymerization PPy grew much faster on the electrode coated with PANPMS than on that coated with PANCMS. Electrical conductivity of PANPMS-g-PPy was in the range of 10^{-5} to 10^{-2} S/cm, while the conductivity of PANCMS/PPy was 100 times lower than that of PANPMS-g-PPy prepared under the same condition. The higher conductivity of PANPMS-g-PPy and the faster growth of PPy suggested the different polymerization path of PPy in PANPMS from that in PANCMS.

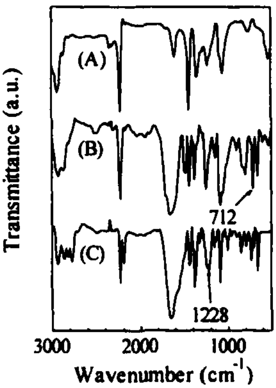

FIGURE 2. FT-IR spectra of (a)PAN, (b)PANCMS and (c)PANPMS.

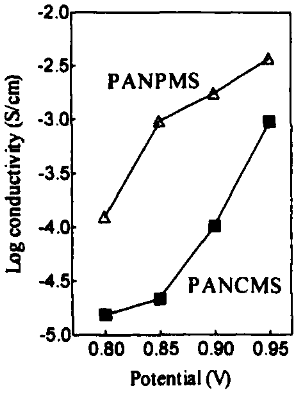

FIGURE 3. Conductivities of PANPMS-g-PPy and PANCMS vs. polymerization potential.

CONCLUSIONS

An electrochemical method to give high electrical conductivity to PAN polymer was introduced, which may be utilized for preparing an antistatic acrylic fiber materials.

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