Preparation and Electrical Evaluation of Processable Conductive PANI/PI Blends

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INTRODUCTION

Polyaniline (PANI) is superior to other conducting polymer in that it is soluble, and therefore processable, in the conducting form, and it is both environmentally and thermally stable[1,2], together with high conductivity when it is doped by functionalized protonic acids like camphorsulfonic acid (CSA) and dodecylbenzenesulfonic acid (DBSA)[3]. The charged (SO_3^-) head group of these dopants associate easly with the positively charged polymer backbon, providing side chain compatibility with organic solvents such as xylene, m-cresol, dimethylsulfoxide, toluene, and chloroform in addition to N-methyl-2-pyrrolidone[4]. And protonation of emeraldine base form of PANI with these dopants can lead both processability and compatibility with other insulating polymers. Thus, conducting polyblends can be made by co-dissolving the conducting PANI complexes and a suitable matrix polymer in a common solvent and processing the conducting blend directly from solution.

In this research, we report our observation of electrical properties of polyaniline/polyimide blend films between polyamic acid made from pyromellitic dianhydride (PMDA) and 4, 4′ - oxydianiline (ODA) as a host material and PANI-CSA, PANI-DBSA as a conducting material with solution blending method by using N-methyl-2-pyrrolidone as a solvent.

EXPERIMENTAL

Polyaniline powder was prepared by conventional chemical method[5]. PANI-complex solution was obtained by mixing emeraldine base powder with DBSA,

CSA and dissolving it in NMP. PANI : dopant mixture molar ratio was 1 : 0.5 (H^+/PhN = 0.5)[6]. And after sonicating the resulting solution was further filtered to remove any undissolved particles.

Polyamic acid was synthesized with ODA and PMDA in NMP. Then, these blend solution was prepared by blending PANI-complex solution with PAA solution with proper weight ratio. And the films were prepared by solvent casting at 50℃ under vacuum. These PANI-complex/PAA films were converted to polyimide state by thermal imidization process.

RESULTS AND DISCUSSIONS

The electrical conductivity of the blend films versus the weight fraction of polyaniline is plotted in Figure 1. The conductivity of the blends rapidly increases as the PANI content increases up to 5 wt%. Above 20 wt%, blends shows higher conductivity than pure PANI-DBSA film prepared from NMP solvent, and the minor increase of conductivity is observed with further increasing PANI content.

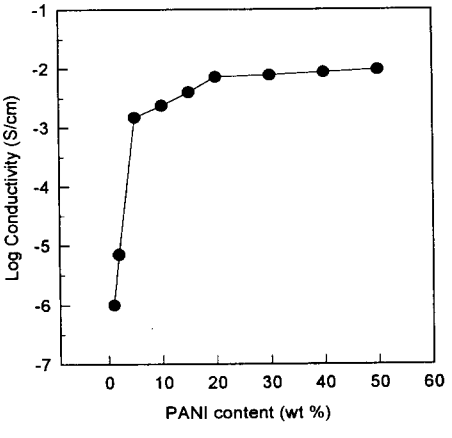

Figure 1. Log (conductivity) versus PANI content of PANI-DBSA/PAA blends.

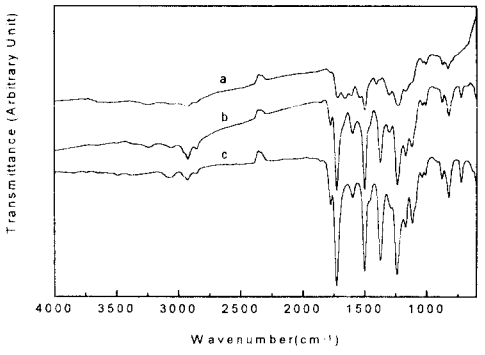

Figure 2. FT-IR spectra of PANI-DBSA/PI ; (a) imidized upto 120℃, (b) 180℃, (c) 250℃

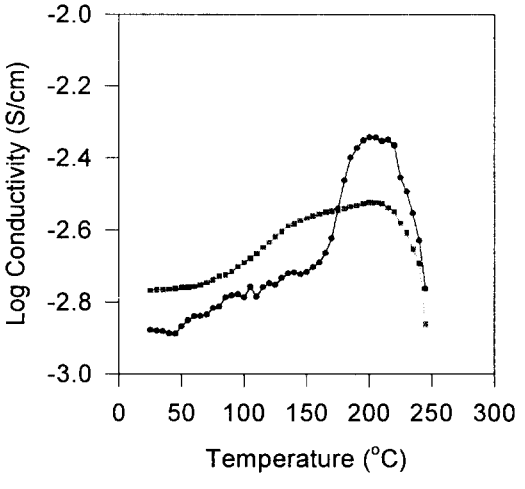

Figure 3. Conductivity versus temperature of PANI-DBSA/PAA(▲) and PANI-DBSA/PI(■).

Figure 2. shows the assignment of FT-IR spectra of the blends. C=O inphase and C=O out of phase stretching indicate that these blends converted to imide state. And this imide state was increased as the temperature of thermal imidization increased.

Variation of conductivity of the PANI-DBSA/PAA and PANI-DBSA/PI film as the function of temperature are shown in figure 3. The temperature was raised 3℃/min. The initial conductivity of PANI-DBSA/PI is higher than that of PANI-DBSA/PAA. The conductivity of PANI-DBSA/PI showed more stable behavior than PANI-DBSA/PAA. From this results, PANI-DBSA/PI has superior thermal stability of conductivity.

CONCLUSIONS

It was shown that polyaniline/polyamic acid blend films could be prepared with DBSA-doped, CSA-doped polyaniline solution and polyamic acid solution by solvent casting using NMP as a co-solvent. The electrical conductivity of the blends was incresed as the PANI content increased, and showed higher conductivity than pure PANI-DBSA and PANI-CSA. As the thermal imidization proceeded, the blends converted from polyamic acid to polyimide. And after converted to imide state, the blends showed more stable thermal · electrical behavior.

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