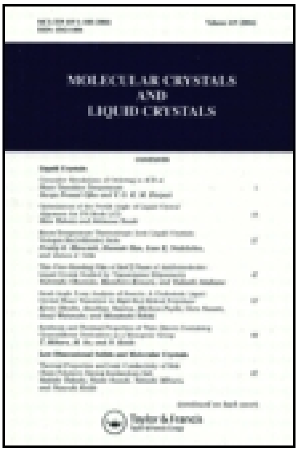

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Environmental Staility of EMI Shielding PET Fabric/Polypyrrole Composite

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PET fabric/polypyrrole composites with high electrical conductivity were prepared by polymerization of polypyrrole on a PET fabric through both chemical and electrochemical oxidation of pyrrole monomer. We investigated environmental stability of the composite and measured activation energy using the Arrhenius Equation.

Keywords PET fabric/polypyrrole composite; Electrical conductivity; Environmental stability; Activation energy

INTRODUCTION

Polypyrrole (PPy) is known to possess high conductivity, good environmental stability and less toxicological problem [1]. It was reported that coating PPy on the textiles gave rise to the electrically conducting textiles useful for many applications [2]. In this study, we

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* Corresponding Author

report the effects of preparation conditions on the environmental stability and activation energy for degradation of the composite.

EXPERIMENTAL

PET fabric/PPy composites were prepared by polymerization of PPy on a PET fabric through chemical and electrochemical oxidation of pyrrole in sequence. In chemical polymerization, pyrrole dissolved in an aqueous solution without or with polyvinyl alcohol (PVA) as a surfactant was first sprayed on the PET fabric and oxidized by spraying an aqueous solution of a ferric p-toluenesulfonate (FTS) as an oxidant and p-toluenesulfonic acid (PTSA) or 1-naphthalene sulfonic acid (NSA) as the dopants. Electrochemical polymerization was carried out in an aqueous anthraquinon-2-sulfonic acid sodium salt (AQSA-Na) solution by applying a constant. We examined thermal stability of the composite by monitoring the change of specific resistivity upon isothermal heating at various temperatures and measured the activation energy using the Arrhenius equation.

RESULTS AND DISCUSSION

Figure 1 (a) and (b) show change of the surface resistivity upon isothermal heating at 70℃ in air and under constant temperature (25℃) and humidity (65% RH), respectively. As shown in Figure 1, the composites prepared by electrochemical as well as chemical polymerization exhibited much more excellent thermal stability than the composites prepared by only chemical polymerization. We believe the much better stability must result from much denser PPy coating formed by electrochemical polymerization, which prevents oxygen from diffusing into the inside of PPy coating.

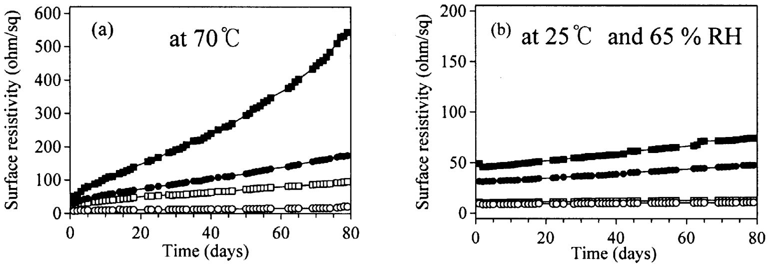

FIGURE 1. Environmental stability of PET fabric/PPy composites prepared by only chemical polymerization using (■) APS and (●) FTS and by electrochemical as well as chemical polymerization using (□) APS and (○) FTS.

Figure 2 displays the changes of the surface resistivities of the composites upon isothermal heating at various temperatures. At low temperatures the composites prepared by different methods only showed little difference in the degradation behavior, while at high temperatures degradation of the composite prepared by only chemical polymerization proceeded much faster. Activation energies for the degradation process were measured by the Arrhenius Equation. In all cases plotting the natural log of the rate constant A vs the inverse of the temperature in Kelvin gave rise to the straight lines. The measured activation energies are listed in Table 1. We confirmed the more unstable composite exhibited larger activation energy, implying more temperature-dependent degradation rate.

CONCLUSIONS

We prepared PET fabric/PPy composites with very high electrical conductivity and examined their thermal stability. Arrehenius equation was employed to measure the activation energy for degradation, giving rise to the activation energy in the range from 20 to 40 kcal/mol.

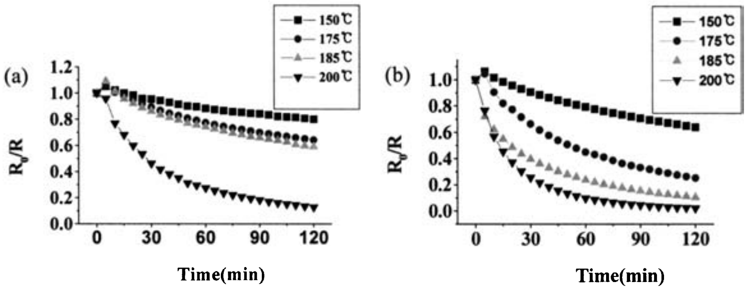

FIGURE 2. Degradation curves of PET fabric/PPy composites prepared by (a) chemical and electrochemical polymerization and (b) chemical polymerization.

TABLE 1. Activation energies for degradation of PPy composite

Activation energy (kcal/mol)		Chemical polymerization	Chemical and electrochemical polymerization
PTSA	PVA (O)	34.5	34.1
	PVA (X)	49.1	36.3
NSA	PVA (O)	32.8	26.8
	PVA (X)	36.3	22.6

Acknowledgments

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