JOURNAL OF MACROMOLECULAR SCIENCE®, PART B: PHYSICS
2017, VOL. 56, NO. 2, 83–96
http://dx.doi.org/10.1080/00222348.2016.1270904

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Novel Nanocomposites of Polypyrrole Doped with Fullerene C_{60}

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ABSTRACT

This paper reports on the structural, thermal, and dielectric properties of polypyrrole/fullerene C_{60} nanocomposites synthesized by a interfacial polymerization method. Fourier transform infrared (FT-IR) and *ultraviolet-visible* (UV-vis) analyses clearly indicated the existence of interactions between polypyrrole (PPy) and the fullerene C_{60} nanoparticles. Thermal analyses indicated that the extrapolated onset degradation temperature (T_{deg}) of PPy increased with increasing doping level. Scanning electron microscopy (SEM) images showed that the fullerene C_{60} changed the morphology of PPy. Dielectric analyses showed a temperature dependent dielectric relaxation behavior. The relaxation time of the nanocomposites with high doping levels tended to increase with increasing temperature. This behavior of the polypyrrole/fullerene C_{60} nanocomposites indicated that they could be used as a high temperature ultrasonic transducer.

ARTICLE HISTORY
Received 9 March 2015
Accepted 17 November 2016

KEYWORDS
dielectric relaxation; fullerene C_{60}; nanocomposites; polypyrrole; thermal properties

1. Introduction

Fullerene C_{60} (or C_{60}) and its derivatives are being increasingly studied in recent years due to their interesting magnetic and electronic properties.[1,2] Combination of C_{60} with π-conjugated oligomers have been investigated for use in a range of applications, varying from photodiodes, data-storage media and photo-voltaics to solar cells.[3–6] It has been suggested that novel materials prepared by combining p-type semiconducting properties of conjugated polymers with n-type properties of fullerenes would exhibit interesting properties for various technological applications as mentioned above.[7,8] The performance of these materials strongly depends on experimental parameters such as temperature, fullerene concentration, oxidant type, and solvent type during the polymerization process. For example, homogeneous distribution of fullerene in a polymer is extremely difficult to obtain due to its aggregated structure, hence the solvent type used during the synthesis process plays a crucial role[9,10] Studies reported in the literature have shown that the best method for the preparation of polymer/fullerene composites is an aqueous/organic interfacial polymerization method.[3,9] The problem arising from the use of nonpolar organic solvents for fullerenes and polar acidic solvents for conducting polymers has thus been solved, creating an

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