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Significantly enhanced electroactive β phase crystallization and UV-shielding properties in PVDF nanocomposites flexible films through loading of ATO nanoparticles: synthesis and formation mechanism

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Abstract

In this work, we report on the preparation and characterization of a poly(vinylidene fluoride) (PVDF) film filled with antimony tin oxide nanoparticles (ATO-NPs), films were prepared via a facile solution casting method to investigate the electroactive β -polymorph formation mechanism and the optical properties of the (ATO/PVDF) nanocomposite films. The impact of the ATO loading on the structural and morphological properties of PVDF were investigated by Fourier transform infrared spectroscopy, X-ray diffraction and scanning electron microscopy techniques. Designing nanocomposites with a combination of the advantages of both PVDF and ATO nanofiller leads to a feasible route to a remarkable increase of the electroactive phase enriched PVDF films. The (0.05) ATO/PVDF composite film exhibits a maximum β -phase fraction of 86% compared with other loadings this may be assigned to the presence of interfacial interactions at the interface between NPs surface and CH_2/CF_2 dipoles of PVDF inducing the electroactive phases. Furthermore, the thermal properties of the composites were investigated by differential scanning calorimetry technique revealed the effect of the ATO loading on the structural and morphological properties of PVDF. Studying the optical properties of the nanocomposite films exhibit a strong absorbance in the entire UV region compared with neat PVDF, which is very appealing for UV blocking properties.

1. Introduction

Recently, based on quite efficient electroactive nanocomposites, major numerous attempts have been devoted to achieving flexible vibration-based energy harvesting systems[1] with essential electrical power outputs have the ability to keep pace with the requirements of the market, which are becoming more varied, functional and power hungry[2, 3]. Most of flexible nanocomposites commonly belong to piezoelectric ceramics such as lead zirconate titanate (PZT) and barium titanate (BaTiO_3)[4] etc. or piezoelectric polymer[5], the most studied piezoelectric polymers are the PVDF family.

PVDF polymer is one of the most interesting polymers, has obtained a widespread of advanced technological applications[6] as smart materials including infrared detectors[7], piezoelectric sensors[8],

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