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Influence of Eu^{3+} on the structural, optical and electrical properties of PEO–PVA: dual bandgap materials for optoelectronic applications

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ABSTRACT

Solid-polymer electrolytes (SPE) based on rare-earth doping is a growing approach for the development of various optoelectronic and ion-conducting devices. Eu^{3+}/PEO–PVA SPE was prepared by solution casting. The impacts of Eu^{3+} content on the microstructure, chemical composition, and complexation with the functional groups of the blend as well as on the film morphology were evaluated by X-ray diffraction, FT-IR spectroscopy, and FE-SEM microscopy. It was revealed that the film's crystallinity and optical transmittance can be tailored by Eu^{3+} content. Tauc's method illustrated that the films exhibit dual band gaps on both the low energy side (2.0–2.8 eV) and the high energy side (4.0–4.38 eV). In addition, the refractive index and optical conductivity of SPE were greatly enhanced with increasing Eu^{3+} content. The current–voltage characteristic curves were recorded at an applied voltage range of 0–10 V, and temperature range of 30–100 °C. The materials exhibited non-Ohmic behavior. The DC conductivity (σ_{dc}) values of the pure and 6 wt% Eu^{3+}-doped blend were in the range of 1.16×10^{-6}–2.05×10^{-6} S/cm and 1.73×10^{-6}–3.36×10^{-6} S/cm, respectively. The relations between the current density and the electric field revealed that the Schottky emission is the most suitable conduction mechanism. The results indicate that Eu^{3+}/PEO–PVA SPE is suitable for some optoelectronic applications and ion-conducting devices.

1 Introduction

Blending of two or more polymers is considered one of the most promising and advantageous green chemistry processes for creating new compositions with a wide variety of distinct properties [1, 2]. Solid polymer electrolytes (SPE) have advantages over their liquid counterparts including ease of preparation, leakage-free, a wide range of operating temperatures, good shelf life, higher energy density, lower flammability, stability during the charge/discharge processes, thermal stability, and good mechanical behavior. Therefore, developing SPE based on polymeric blends with improved physicochemical properties, enhanced ionic conductivities,

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