Synthesis and Modification of the Structural, optical, and Thermal Properties of PVA–PEO by LDH Nanoplates

Physica Scripta, 98(3) (2023) 035704. DOI: **10.1088/1402-4896/acb7b2**

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Abstract

Nanocomposites with thermal stability and tunable optical properties became essential for developed optoelectronic and electrochemical devices. This work represents an attempt to synthesize PVA–PEO polymeric blend and modifies its structural, optical, and thermal properties. This was performed by incorporating different ratios of double-layered hydroxide (Zn/Fe-LDH) nanoplates (NP) which were prepared by the co-precipitation process. XRD results revealed that the incorporation of LDH, 43 nm in size and rhombohedral phase, influenced the degree of crystallinity (X_C) of the blend. FE-SEM analysis showed the uniform distribution of LDH NP in the polymer matrix until 7.0 wt% content, beyond this ratio some voids were formed in the blend surface and particle agglomeration took place. FTIR spectroscopy illustrated the good miscibility of the polymers forming the blend, the interaction, and the complexation between LDH NP and the blend functional groups. UV-vis-NIR spectroscopy analysis was performed to study the transmittance of the nanocomposites, extinction coefficient, refractive index, and optical conductivity. Besides, the direct and indirect band gaps of the films were found to decrease with increasing LDH NP content until a certain limit, after which they increased again. TGA&DSC analysis revealed the thermal stability of the films until 240 °C, and the DSC curves indicated three endothermic peaks. The obtained results confirmed that LDH NP incorporation is an interesting approach for tuning the optical and thermal properties to widen the technological applications based on PVA–PEO blend.

Keywords: Thermal stability; LDH/polymer nanocomposites; Band gap engineering; Refractive index; Optical conductivity.