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Controlling the Structural, Optical, and Electrical Properties of PVA/PEO Blend by Clay Nanoparticles Content

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Abstract:

Synthesis of polymeric blends and nanocomposites of tuned properties gained increasing attention worldwide. In the present report, semicrystalline PVA/PEO blend films loaded with clay nanoparticles (Nps), at doping ratios in the range 3–12 wt.%, were prepared and characterized by various techniques. XRD, SEM, and FTIR were used for probing the semicrystalline nature, morphology, and microstructure of the blend and complexation between its constituents. UV-vis-IR spectroscopy was performed to study the optical properties and optical constants of the prepared nanocomposites. Moreover, the dielectric properties were studied in the frequency range 0.1 Hz to 20 MHz and at different temperatures. Clay Nps incorporation decreased the blend crystallinity and affect its surface morphology without changing the blend structure. Strong interaction and complexation between the films' constituents are noted through the change in XRD peaks position and FTIR band intensity. The values of optical transmittance and absorption index of the films as well as the bandgap (E_g), refractive index (n), and optical dispersion parameters depend mainly on the clay Nps doped ratio. The direct E_g decreased from 4.5 to 3.9 eV and n increased from 3.28 to 4.78. The dielectric constant, dielectric loss tangent, dielectric moduli (M', M''), and ac conductivity were improved with the clay Nps content and also influenced by the temperature. The nature of the relaxation peaks in tan (δ) and M'' indicate the deviation of the conduction process from the ideal Debye type behavior. Increasing the semiconducting nature and the value of ac conductivity encourage the utilization of these nanocomposites in various electric and optoelectric applications.

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