α-Fe_2O_3 /(PVA + PEG) Nanocomposite films; synthesis, optical, and dielectric characterizations

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Abstract Hematite (α-Fe_2O_3) nanorods with an average diameter of 40 nm were prepared using a template-free sol–gel method. These nanorods then mixed with polyvinyl alcohol (PVA)/polyethylene glycol (PEG) blend at concentrations of 0.0, 0.5, and 1.0 *wt.*%. The transmittance percentage (*T%*) of the films showed a decrease from 80.26 to 33.24 %. The direct optical band gap also decreased from 5.28 to 4.83 eV whereas the refractive index significantly increased with increasing the hematite content. The dielectric measurements were performed in the temperature range 303–413 K and frequency range 30 kHz–3.0 MHz. According to the temperature dependence of the dielectric constant (ε'), α_a -relaxation peaks observed in all films and assigned to the micro-Brownian motion of the polymer blend chains. The behavior of the ac conductivity, σ_{ac} *(f),* of the nanocomposite films indicated that the homogenous distribution of α-Fe_2O_3 nanorods allows the formation of conductive three-dimensional networks throughout the nanocomposite film. Also, indicated that the correlated barrier hopping is the most suitable conduction mechanism.