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Raman and Dielectric Relaxation Investigations of Polyester-$CoFe_2O_4$ Nanocomposites

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Abstract : In this work, we present for the first time the study of Raman spectra and dielectric relaxation of polyester polymer-$CoFe_2O_4$ (5.0, 10.0, 15.0, and 20.0 wt%) nanocomposites. Raman spectroscopy was applied as a sensitive structural identification technique to characterize the polyester-$CoFe_2O_4$ nanocomposites. The images of AFM confirmed the uniform distribution of $CoFe_2O_4$ inside the polymer matrix. Dielectric relaxation was employed as an important analytical technique to obtain information about the ability of the polymer nanocomposites to store and filter electrical signals. The dielectric relaxation analyses were carried out on the polyester-$CoFe_2O_4$ nanocomposites at different temperatures. An increase in dielectric constant ε_1 was observed for all samples with increasing temperatures due to the alignment of the electric dipoles with the applied electric field. In contrast, ε_1 decreased with increasing frequency. This is attributed to the difficulty for the electric dipoles to follow the electric field. The α relaxation peak that appeared at a high frequency shifted to higher frequencies when increasing the temperature. The activation energies for Maxwell-Wagner Sillar (MWS) changed from 0.84 to 1.01 eV, while the activation energies for α relaxations were 0.54 – 0.94 eV. The conduction mechanism for the polyester-$CoFe_2O_4$ nanocomposites followed the correlated barrier hopping (CBH) model.

Keywords : AC conductivity, activation energy, dielectric permittivity, polyester nanocomposites
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