Synthesis and Investigation of the Electric and Dielectric Properties of Co_3O_4/(CMC+PVA) Nanocomposite films

Journal of Polymer Research, volume 22, 2015, 97:1-12

A.M. El Sayed*, S. El-Gamal

Abstract

Cobalt oxide (Co_3O_4) nanoparticles (NPs), with average crystallite size < 61 nm, were prepared by a sol-gel method. Two allowed direct optical band gaps of 1.445 and 1.915 eV are found for Co_3O_4 NPs. Sodium carboxymethyl cellulose (Na-CMC)/polyvinyl alcohol (PVA) blend was doped with Co_3O_4 at different concentrations < 1.0 *wt. %* to study the electrical and dielectric properties of these nanocomposite films. Scanning electron microscopy images revealed a good dispersion of Co_3O_4 NPs on the surface of the CMC/PVA films. The current-voltage characteristics are of non-ohmic behavior. The dielectric permittivity (ε') was studied in the frequency and temperature range of 5.0 kHz- 5.0 MHz and 308-408 K and was found to depend on the Co_3O_4 content. The dielectric loss (ε'') also increases and shows wave-like behavior with increasing Co_3O_4 ratio. Increasing Co_3O_4 NPs content leads to the formation of more number of three-dimensional semiconducting connected networks inside CMC/PVA matrix, leading to increasing both DC and AC conductivities. The correlated barrier hopping (CBH) is the most suitable mechanism to explain the AC conduction behavior in the Co_3O_4/ Na-CMC/PVA nanocomposite films.

Key words: Cobalt oxide; band gap; CMC/PVA; Nanocomposite; Conductivity; Dielectric relaxation; Conduction mechanism.

***Corresponding author**: ams06@fayoum.edu.eg& adel_sayed_2020@yahoo.com