Preparation and Characterization of PbO/ Carboxymethyl Cellulose/ Polyvinylpyrrolidone Nanocomposite Films

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M.S. El-Bana[1] , Gh. Mohammed[2,3], Adel M. El Sayed[3,4], S. El-Gamal[2,3]

[1]Nanoscience and Semiconductor Laboratories, Department of Physics, Faculty of Education, Ain Shams University, Cairo, Egypt
[2]Physics Department, Faculty of Education, Ain Shams University, Roxy, Cairo 11757, Egypt
[3]Physics Department, Faculty of Science, Northern Border University, Arar 91431, KSA
[4]Physics Department, Faculty of Science, Fayoum University, Fayoum 63514, Egypt

Abstract

Lead oxide nanoparticles (PbO NPs) and Carboxymethyl cellulose (CMC)/Polyvinylpyrrolidone (PVP) nanocomposite films were prepared by sol-gel and solution casting methods respectively. The structural properties of the samples were investigated by X-ray diffraction (XRD), high-resolution transmission electron microscopy (HR-TEM) and Fourier transformation infrared spectroscopy (FTIR). Scanning electron microscopy (SEM) revealed the good dispersion of PbO NPs on the surface of the blend films. CMC film exhibits a transmittance (T) of 72 %, increased after mixing with PVP and then decreased to < 38% after adding 4.0 *wt.%* PbO NPs. Both the direct and indirect optical band gaps (E_g) of CMC equal to 3.97 and 3.7 eV respectively. These values were increased after PVP addition and then decreased after loading PbO NPs. The conduction mechanism in CMC/PVP blend has changed from Schottky emission to Poole–Frenkel due to the effects of temperature and PbO NPs content. The effect of adding PVP & PbO NPs on the DC conductivity and the activation energy E_a values of the CMC are discussed. The dielectric constant (ε') was investigated in the frequency and temperature ranges of 1 kHz–1.0 MHz and 293–393 K respectively. Its values depend on both the PbO content and temperature. The AC conductivity σ_{ac} was increased with increasing PbO content. The correlated barrier hopping (CBH) was found to be the most appropriate mechanism for explaining the AC conduction behavior.

Keywords: Band gap; Conductivity; Conduction mechanism; Nanocomposites.