Synthesis, Structural and Optical Properties of Tin Oxide Nanoparticles and Its CMC/PEG–PVA Nanocomposite Films

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N.H. El Fewaty[a], A.M. El Sayed[b]*, R.S. Hafez[a]

[a]Physics Department, Faculty of Science, Cairo University, Cairo, 12613 Egypt
[b]Physics Department, Faculty of Science, Fayoum University, Fayoum, 63514 Egypt

Abstract

Polyethylene glycol–polyvinyl alcohol (PEG–PVA) blend is a multifunctional material and controlling its properties is important for various medical and industrial uses. In this paper, we report the influence of carboxymethyl cellulose (CMC) and doping with tin oxide (SnO_2) nanoparticles (NPs) on the structural and optical properties of PEG–PVA. The prepared samples were investigated by X-ray diffraction (XRD), high-resolution transmission electron microscopy (HR-TEM), scanning electron microscopy (SEM), Fourier transform infrared (FTIR) and UV–Vis-NIR spectroscopies. SnO_2 NPs of rutile structure, average crystallite size of ~30.2 nm and optical band gap (E_g) of 3.68 eV were prepared by a simple sol–gel process. CMC addition enhances the crystallinity of PEG–PVA that then gradually reduced by increasing SnO_2 doping ratio. The optical transmittance of PEG–PVA increased from 77 to 90% after mixing with CMC and then decreased to 64% with increasing SnO2 content to 1.5%. Also, the E_g of PEG–PVA increased from 5.20 to 5.28 eV and then decreased to 4.88 eV due to CMC addition and SnO2 incorporation, respectively. The refractive index, the dispersion parameters and the optical conductivity of PEG–PVA, CMC/PEG–PVA and of its nanocomposite films are discussed. The correlation between the structural modifications and the resultant optical properties are reported.