
Study the effect of addition of some metals chlorides in nanosize on the Physical Properties of polyvinyl alcohol (PVA)

Asmaa Abdalla Hassan Farag Negm

The aim of the present work is to prepare nanocomposite polymer samples based on metal chlorides and polyvinyl alcohol (PVA) for the electronic applications. PVA/CoCl₂, PVA/NiCl₂ and PVA/MnCl₂ have been prepared by means of in situ synthesis via the solvent cast technique. The prepared nanocomposite polymer samples with concentrations (41.6, 32.2, 19.2, 4.5 wt%) of CoCl₂, NiCl₂ and (37.2, 28.3, 16.5, 3.8 wt%) of MnCl₂ have been characterized using various techniques, X-ray diffraction (XRD), the differential scanning calorimetric (DSC) and the scanning electron microscope (SEM). DC and AC conductivities are examined at different temperatures and frequencies; also optical absorption in UV Visible range was studied. The growth of metal chloride crystallites in the polymer matrix in nanoscale for samples of higher contents of metal chlorides has been observed Using XRD and SEM studies. Furthermore, the intensity of PVA characterizing peak has decreased while its broadness has been increased which revealed that the amorphisity of the polymer matrix has increased. The temperature dependence of DC electrical conductivity for all investigated samples has been studied between 303 and 443 K. The results showed that the electrical conduction is thermal activated process obeying Arrhenius relation. The activation energy was calculated and found in the range from 0.64 to 0.26 eV for all investigated samples. The AC conductivity (σ_{ac}), dielectric constant (ϵ'), dielectric loss (ϵ'') and loss tangent ($\tan \delta$) were performed in the temperature range 303-443 K over the frequency range 100 Hz-100 KHz. The frequency dependence of the AC conductivity shows that σ_{ac} increases with increasing frequency for all investigated samples. The AC conductivity obeyed the ω^s power law. The values of the power s of all samples have been extracted at different temperatures which suggest the hopping and tunneling conduction mechanisms. The frequency and temperature dependence of the dielectric constant (ϵ'), dielectric loss (ϵ'') and loss tangent ($\tan \delta$) have been studied. The general behavior showed that ϵ' , ϵ'' and $\tan \delta$ decreased with increasing frequency for all investigated samples obeying Debye dispersion equations. The dependence of the dielectric constant (ϵ') on temperature shows two broad peaks related to α relaxation processes. The optical absorption spectra were performed in the wavelength range (200-900 nm) for all mentioned samples. The absorption mechanism is due to allowed direct and indirect transitions with one optical band gap for composites contained MnCl₂ and two band

gaps for composites contained CoCl_2 and NiCl_2 . Co^{+2} ions are present in mixed octahedral and tetrahedral form while Ni^{+2} ions are present in octahedral form in the polymeric matrix. The optical band gap, absorption edge and Urbach energy were evaluated and their values change with the change in both particle size of metal chlorides and their concentrations inside the polymer matrix.