Abstract

The aim of the present study is to prepare nanocomposite polymer electrolyte based on PVA: C ($NaI/CuCl_2$), for the application of photovoltaic cells. Therefore, nanocomposite films have been sensitized using solution cast technique. The prepared nanocomposite polymer electrolyte films of different ratio of C=$NaI/CuCl_2$ (C=0, 1.66, 3.33, 5, 6.67, 8.33 and 10) have been characterized using various techniques, XRD, SEM, FTIR, TGA, AC measurements and optical absorption in UV-Visible range. Using XRD study, the growth of CuI crystallites in the polymer matrix in nanoscale in the range approximately 55nm with hexagonal phase has been observed. Furthermore, the intensity of PVA characterizing peak has decreased while its broadness has been increased which reveal that the amorphisity of the polymer matrix has increased. The morphology of polymer electrolyte films has been studied using SEM technique, which showed grain distribution at surface morphology and grain aggregates with increasing C ratio ($NaI/CuCl_2$).

The total conductivity of polymer electrolytes was studied in the frequency range 100 Hz-100 KHz and in the temperature range 303-373 K. The behavior of conductivity frequency dependence was found to be divided into two regions; one is observed at low frequency (dc conductivity) while the other appears at relatively higher frequency range. In general, this behavior obeys the relation, $\sigma_{tot}(\omega) = \sigma_{dc} + A\omega^s$. The values of the power (s) of all samples have been extracted at different temperature and found in the range from 0.026 to 0.73 which suggest the hopping conduction mechanism.

The bulk conductivity σ_b was calculated using complex impedance technique. The values of bulk conductivity σ_b of the polymer electrolyte films were obtained for different ratios of C in the polymer electrolyte. Also, the temperature dependence of bulk conductivity σ_b at different C ratio was studied which obeys an Arrhenius relation, with activation energy in the range 0.33 to 1.24 eV.

The frequency and temperature dependence of the dielectric constant ε' and dielectric loss ε'' have been studied for nanocomposite polymer electrolyte films. The general behavior showed that both ε' and ε'' were decreased with increasing the frequency and increased with increasing temperature. Obeying Debye dispersion equations.

The optical absorption spectra were performed. The optical energy band gap (direct E_{gd} & indirect E_{gi}) and the Urbach energy tail E_u were evaluated and their dependence on concentration of salt was recorded. The absorption mechanism is due to allowed direct transitions for all samples and the mean value was 2.05eV. Also, the indirect optical band gaps E_{gi} were obtained and the mean value was 0.97eV. Urbach's energy corresponding to the width of the band tails of the localized states in the band gap was calculated and its value was in the range between 0.35 to 1.17eV.