Characterization of Pure and Pb^{2+} ion Doped Methylcellulose Based Biopolymer Electrolyte Films: Optical and Electrical Properties

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Pb^{2+} ion-conducting biopolymer electrolyte films, based on methylcellulose (MC) were prepared, using the solution cast technique. The effect of Pb^{2+} doping concentration on the optical and electrical properties of host MC are described in this manuscript. Fourier transform infrared (FTIR) spectra indicated the occurrence of complexation between Pb^{2+} and biopolymer host in the synthesis biopolymer-based electrolyte films. Ultraviolet-visible (UV-Vis) spectroscopy accounts for a considerable continuous decline in optical band gap and band tail energy, which attributed to the formation of charge-transfer complex and increasing in the crystalline nature of the polymer electrolyte films, respectively. The dispersion of the refractive index was discussed in term of the single-oscillator model. The frequency-dependent electrical conductivity and dielectric constants of the prepared samples were investigated as a function of temperature and frequency by impedance spectroscopy. Temperature-dependent behavior of the frequency-exponent reveals that the correlated barrier hopping (CBH) model is the most suitable model to describe the conduction mechanism for the present system. The highest value of ion conductivity at ambient temperature was found to be 2.68×10^{-6} S/m for the polymer incorporated with 20 wt.% Lead acetate. The non-Debye type relaxation behaviour has been confirmed by the asymmetric relaxation peak of the imaginary part of the electric modulus. The present biopolymer electrolyte films were specified as promising materials for electrochemical device applications.

Keywords: biopolymer electrolytes; ion conductivity; charge-transfer complex; band structure; conduction mechanism

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