

Effect of M Nitrates on the Optical, Dielectric Relaxation and Porosity of PVC/PMMA Membranes (M= Cd, Co, Cr or Mg)

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Abstract

This work aims to study the influence of loading the inorganic nitrate salts of Cd, Co, Cr and Mg on the physical properties of the organic PVC/PMMA blend. The pure and composite (PVC/PMMA/nitrate salt) membranes were prepared via the casting technique. The structure, morphology, thermal, optical properties and dielectric relaxation of the samples were studied. XRD results showed that introducing the nitrate salts increase the films' amorphicity. FTIR spectra confirmed the complexation between the nitrate salts and the blend via hydrogen bonding. SEM revealed that the addition of Cd or Mg salt turned the blend surface from a fingerprint-like morphology to wrinkle-like appearance or sponge-like structure, respectively. Differential scanning calorimetry (DSC) confirmed the miscibility between PVC and PMMA and illustrated that loading these salts decrease the melting point T_m of the blend. UV-vis-IR spectroscopy showed that adding the Cd or Mg salts maintain transmittance $> 80\%$ in the visible region. Moreover, the added salts create semiconducting behavior for these films. The dielectric properties were studied in the frequency (f) range (10 Hz-20 MHz) at RT. The change of the ac conductivity (σ_{ac}) with f was analyzed in view of ac universality law. An increase in σ_{ac} with complexing nitrate salts was reported. The electrical modulus (M' , M'') formalism predicts a non-Debye type conductivity relaxation and that the doped films are ionic conductors. Based on the obtained results, the obtained membranes are candidates for Cr and Co batteries application as well as water treatments and filtration process.

Keywords: PVC/PMMA; Polymer/nitrates complexation; Band gap; Porous structures; Dielectric relaxation; Filtration membranes