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Influence of TiO_2 rutile doping on the thermal and dielectric properties of nanocomposite films based PVA

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Abstract

In this work, nanocomposite polymer films based polyvinyl alcohol with different weight ratios of nanoparticles TiO_2 were prepared by the casting method. Scanning Electron Microscopy (SEM), Differential Scanning Calorimetry (DSC), Fourier Transform Infrared Spectroscopy (FTIR) and dielectric spectroscopy of all compositions have been investigated. The SEM analysis showed that TiO_2 nanoparticles were well dispersed in the PVA matrix. However, below 30 wt % aggregates were observed. Differential Scanning Calorimetry evaluated the degree of crystallinity and transition temperature. Infrared spectroscopy evidenced the presence of interactions between the PVA and TiO_2. Impedance spectroscopy measurements of all samples were studied as functions of temperature and frequency. Dielectric permittivity and loss tangent reveal seven relaxation processes ascribed to electrode polarization, conduction phenomena, Grain–Boundary–Relaxation, MWS relaxation, and (α_a, α_c and β) relaxations. The activation energy values E_a associated with DC conductivity confirm the protonic type of the conductivity and present a lower value for the PVA with 5% amount of TiO_2. In addition, the temperature dependence of the exponent power s denoted that conduction in the sample bulk follows the CBH model.