ABSTRACT

The present work deals with the study of dielectric properties and molecular dynamics in semi-interpenetrating polymer networks based on polyurethane. Semi-IPNs were prepared from a polyurethane (PU) network and linear poly(2-hydroxyethyl methacrylate) (PHEMA) in the weight ratio of 83:17. Silica nanoparticles, differing by the state of their surface, were introduced on the amounts of 0,25 or 3,0 wt %. The silica nanoparticles were used functionalized by –OH, –$CH=CH_2$ or –NH_2 groups.

PHEMA is a hydrophilic polymer and thus it is necessary to determine the effect of water content in the studied materials. Hydration properties of PU/PHEMA semi-IPNs were investigating by Equilibrium Water Sorption Isotherms (ESI) method, Immersion and Dynamic Water Desorption Isotherms (DSI). It was found that despite the low concentration of PHEMA, hydration of semi-IPNs is doubled compared to that of pure polyurethane. With these methods it is possible to obtain information related to the interactions between the components of this complex system.

Molecular dynamics and interfacial relaxation phenomena in polymer nanocomposite materials were studied through Differential Scanning Calorimetry (DSC, -100 ^{o}C to 150 ^{o}C), Thermally Stimulated Depolarization Currents (TSDC, -150^{o}C to 110^{o}C) and Dielectric Relaxation Spectroscopy (DRS, -150^{o}C to 110^{o}C, 10^{-1}-10^{6} Hz). The dielectric properties were performed in a wide range of frequencies and temperatures with the goal to establish the relation between the relaxation and the structure.

In order to determine water effects on dielectric properties, measurements were made in three conditions : dry (0,02 rh), ambient humidity (~ 0,40 rh) and hydrated (0,98 rh). For semi-IPNs two secondary relaxations were detected, which attributed to βsw and γ relaxation of PHEMA, overlapping the respective secondary relaxation of PU. At higher temperatures, main relaxation of PU was observed. Furthermore, the conductivity phenomena were studied, in order to provide answers to questions concerning the morphology of interpenetrating polymer networks.