ABSTRACT

The master thesis presented, focuses on the study of molecular dynamics of poly(dimethylsiloxane) (PDMS), a crosslinked semicrystalline polymer, with inclusions of titania nanoparticles. The nanoparticles were prepared in situ using the sol-gel method.

The aim was to investigate the degree to which the dynamics of the polymer is affected by the nanoparticles, as well as the mechanism through which this take place. This study follows up on a previous study on PDMS/silica nanocomposites, which showed that near the surface of the nanoparticles an interfacial layer with modified dynamics is formed.

The experimental methods used for this purpose, include Differential Scanning Calorimetry (DSC), Thermally Stimulated Polarization Currents (TSDC), as well as Dielectric Relaxation Spectroscopy (DRS).

DSC was used in order to obtain information on the thermal properties of the samples and importantly on the dependence of the degree of crystallinity on the nanoparticle content or the thermal protocol used for the dynamic measurements.

Dielectric measurements (TSDC, DRS) allowed the separation of the α relaxation connected with the glass transition in the amorphous regions and the α_c relaxation attributed to the dynamics of polymer chains in the crystalline regions. Furthermore, it allowed the detection of the α_{int} relaxation, which was attributed to an interfacial polymer layer in the vicinity of the nanoparticles.