Summary

Current trends in materials science define the need for the preparation and optimization of new materials with special properties and characteristics. The aim is to create materials with novel applications and uses in new fields of technology and everyday life. Such materials are the nanocomposites materials that combine desirable properties from the area of polymers and inorganic oxides. Such materials are being studied in this thesis.

In particular nanoparticles consisting of polymer (Polydimethylsiloxane-PDMS) adsorbed on the surface of composite oxides were studied. These oxides consist of silica matrix (SiO_2) with grafted nanozirconia (ZrO_2). Specifically 3 types of silica matrices were used (fumed silica A380 [pilot plant Institute of Surface Chemistry, Kalush, Ukraine], fumed silica OX50 [Degussa], silica gel Si-60 [Merck]) and one to four cycles (repetitions) of the zirconia grafting procedure. On these complex oxides polymer PDMS (Mw = 7960 gr / mol) was adsorbed at two contents (40 wt% and 80 wt%). The samples were prepared at the Institute of Surface Chemistry in Kalush, Ukraine, by the research group of Prof. V.M. Gun'ko. Twelve (12) samples were finally produced and studied by dielectric spectroscopy (DRS), thermally stimulated depolarization currents (TSDC) and differential scanning calorimetry (DSC).

The measurements results showed that the composite oxide based on the silica matrix OX50 presents the weakest interaction with the polymer, unlike the A380 and Si-60 which significantly affect the molecular mobility of the polymer. This interaction is expressed by reducing the crystallinity of the polymer and is limiting the mobility of the chains that fail to take positions of crystal symmetry. This is in agreement with the surface and chemical profile of these particles. Secondly, by studying the effect of zirconia is observed that the presence of more zirconia shields the interaction polymer-oxide A380. Unlike that, the presence of more zirconia does not alter the interaction between polymer and Si-60. This is probably due to different surface characteristics of the two oxides (textural to intraparticle porosity respectively). OX50 also shows a picture of reducing further the already weak interaction with the polymer macromolecules. This results in an increase of crystallinity and suppression of the percentage of the amorphous polymer material. Finally is observed that for samples based on Si-60 matrix confinement effects take place. This occurs due to the presence of nanoporous in Si-60 with diameter in the region of 5 nm. The result of this phenomenon is the reduction of the glass transition temperature for the polymer which is adsorbed in the porous. It is also interesting the fact that the samples based on A380 with low polymer content (40 wt%) are exhibiting lower glass transition temperatures than the samples with 80 wt% PDMS. This could be an alternative expression of the confinement effect, since it is possible that the polymer has created a thin film on the surface of the filler. In this occasion the confinement is not introduced by the environment, but by the geometrical characteristics of the polymer.