

# ABSTRACT

Polyurethanes are a modern technological material with plenty every-day uses in clothing, building, paints, furniture. New developments in material science and research on polymer nanocomposites promise further improvements to already known materials and improvements to their usability. This PhD thesis deals with the properties of nanocomposite materials based on polyurethanes derived by following different architectures in the synthesis.

In the first part of the thesis, we add POSS moieties, a type of Silicon Oxide with dimensions of 1-2 nm, and chemically tether them on the polymer chains. We compare hybrid materials where POSS moieties are extending the polymer chain, act as side-groups, as heavy chemical cross links or are just blended in the matrix. We perform morphological, thermal and dielectric studies to detect changes on the microscale morphology and the molecular dynamics. We find that the moieties affect the matrix mainly indirectly and its properties are affected towards what the changes of microphase separation of polyurethane impose. Also we study how the molecular weight of the soft segments or the type of hard segments affects the matrix. We conclude on the origin of  $\alpha'$ -relaxation for polyurethanes that is observed at frequencies lower than dynamic glass transition,  $\alpha$ -relaxation (related to the glass transition of the soft phase of the polymer matrix).

In the second part of the thesis we add nanoparticles of SiO<sub>2</sub> with size of 50 nm in a polyurethane-urea matrix. This time the dominating mechanism of interaction has to do with immobilization of polymer in the matrix/particles interfaces. Based on immobilization results as a function of dielectric and calorimetric glass transition temperatures we make general conclusions about the nature of interaction and immobilization on various polymer nanocomposites.