

Polyurethanes (PUs) are an important group of polymers that could be used for production of a wide range of products, such as elastomers, rigid and elastic foams, coatings and adhesives. In the PU synthesis process one of the major components are isocyanates which show some toxicity and which production process requires the use toxic phosgene. An alternative route that is currently extensively developed utilizes the reaction of polycyclic carbonates and polyamines leading to non-isocyanate polyurethanes (NIPUs), considered as a PU class close to 'green chemistry' ideas. NIPU, thanks to their properties, such as improved hydrolytic and thermal stability, are the subject of substantial research interest as e.g. coatings. Chemical and physical modifications of NIPU make it possible to induce controlled changes of the structure and morphology of composite materials; among useful nanoadditives polyhedral oligomeric silsesquioxanes (POSS) with general formula  $(\text{RSiO}_{1.5})_n$ , where  $n$  is an integer and  $R$  a substituent like hydrogen, alkyl, alkenyl, phenyl or siloxy group. POSS cages built of Si-O-Si bridges are showing advantageous properties, such as bioactivity. It is worth mentioning that hybrid organic-inorganic composite materials in which inorganic nanoparticles are covalently bonded with macromolecules are starting to play a key role in the development of advanced functional materials. The properties of hybrid materials are not only the sum of the individual contributions of both phases, but originate from the nature of the new materials formed. Incorporation of POSS moieties into polymer structure may lead to improvement of different properties, such as mechanical properties, hydrolytic stability, fire resistance and thermal stability. Thanks to their non-toxicity, cytocompatibility and anti thrombogenicity POSS are considered for application as nanocarriers in drug delivery systems and for fabrication of biomedical composites in tissue engineering. As the literature references on NIPU/POSS systems are very scarce and come from the last two years, getting new knowledge on the influence of functionalized POSS (POSS-glycidyl, POSS-acid) on the structure and thermal / mechanical properties and bioactivity of non-isocyanate polyurethane composites, as well as determination of NIPU modification routes and NIPU/POSS hybrid composites fabrication by extrusion and electrospinning techniques are original and justified research challenges with high impact on the development of disciplines chemistry, chemical technology and engineering of composite materials.