NOVEL DENTAL NANOCOMPOSITES BASED ON SILANIZED NANOPARTICLES AND ACRYLATE-BASED RESINS FOR DENTAL APPLICATIONS

The current work focuses on the development of dental nanocomposites based on three types of nanoparticles: silica (SiO_2), zirconium dioxide (ZrO_2), and hydroxyapatite ($Ca_5(PO_4)_3OH$)) and seven mixtures of monomers Bis-GMA with unsaturated monomers, urethanedimethacrylate (UDMA), methylmethacrylate (MMA), methacrylic acid (MAA), and bisphenol A dimethacrylate in the presence of 1,6-hexanediol methacrylate (HDODA) as a crosslinking agent. To start the copolymerization of matrix resins, camphorquinone (CQ) of 0.5 wt.% and 2-(dimethyl amino) ethyl methacrylate (DMAEMA) of 0.5 wt.% are utilized as photoinitiation systems. These nanocomposites have the potential for posterior restorative applications. For improving the properties of these composite materials, the fillers are previously modified with 3-(methacryloyloxy)propyltrimethoxysilane (MPTMS), to improve bonding between the nanoparticles and resin matrix, to reduce the agglomeration and thus to reduce the water sorption and to increase the mechanical properties. The characterization of products was carried out using scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FTIR), complex thermal analysis but also by assessing the water sorption, the polymerization shrinking and especially by assessing the relevant mechanical properties (flexural and compressive strength, wear resistance and hardness). As a general conclusion of the thesis, based on the results obtained for the 7 series of samples (based on the polymer matrices composition), the three nanofillers (including the 3 different percentage of MPTMS used in silanization) and the different loading ratio (2.5; 5.0; 7.5; 10; 12.5; 15.0%wt) it can conclude that the best results are obtained for the sample DNC B loaded with 10%wt SiO_2 modified with 2.5% MPTMS. In this case, the lowest water solubility (WSL), water sorption (WS) and volumetric shrinkage (VS) were obtained while the mechanical properties were the highest.