

Physical-chemical characterization of $\text{Si}_3\text{N}_4\text{-TiO}_2$ ceramic nanocomposites obtained to biomedical applications

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Silicon nitride based ceramics (Si_3N_4) are very important materials in the engineering and medical fields because of their physical, chemical, tribological and mechanical properties. However, some researchs have been carried out in order to obtain silicon nitride ceramics with improved biological behavior, including studies about the effect of nanoparticles on their bioactivity. In this work, $\text{Si}_3\text{N}_4\text{-TiO}_2$ nanocomposites were synthesized and characterized by their physical, chemical and bioactive properties. Initially, Si_3N_4 , MgO, SiO_2 and CaO powders were mixed in a ball mill for 24 h. The mixture was then dried at 100 °C for 1 h under the nitrogen atmosphere. Subsequently, the samples were coated with TiO_2 from the sol-gel process. The precursor solution of titanium dioxide (TiO_2) was prepared from the mixture of titanium (IV) isopropoxide and isopropanol at a ration of 1:10. The pH of the solution was adjusted to 3 by the addition of sulfuric acid. The precursor solution was dispersed by constant stirring at 50 °C for 1 h. The samples were immersed for 10 minutes in this solution at room temperature and then dried for 24h under UV light. The samples were calcined at 400 and 500 °C for 60 min to obtain $\text{Si}_3\text{N}_4\text{-TiO}_2$ nanocomposites. The microstructure of the materials were analyzed by scanning electron microscopy, atomic force microscopy, and X-ray diffraction. The samples bioactivity was evaluated by *in vitro* tests using SBF (Simulated Body Fluid) solution at 37 °C for 9 days of immersion. The nanocomposites showed good quality, high uniformity of coating and greater adhesion to TiO_2 to the substrate of Si_3N_4 . The formation of CaP deposits with globular structure on the samples surface during the SBF experiment is a strong indication of the bioactivity of the nanocomposites. The results suggest that $\text{Si}_3\text{N}_4\text{-TiO}_2$ ceramic nanocomposites have great potential to be used in biomedical applications.