
The influence of titanium on the structure and some properties of calcium and sodium zinc-phosphate glasses

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Abstract

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Phosphate glasses (PGs) exhibit attractive properties such as low glass transition and melting temperatures, high thermal expansion coefficients and among other also biocompatibility. Recently, PGs are intensively studied as third-generation biomaterials, i.e. as materials capable of specific biological response. Their advantage is that they can be prepared to include ions commonly found in human body as Ca²⁺ and Na⁺ and the composition can be widely tailored by the addition of other metals (Ti, Ga, Zn ..) to modify their properties.

In this work, bulk glasses of systems TiO₂-CaO-ZnO-P₂O₅ and TiO₂-Na₂O-ZnO-P₂O₅ were prepared by conventional melting procedure. The Raman spectroscopy and both ³¹P and ²³Na MAS NMR spectroscopy were used to obtain information on their short as well as intermediate-range structure. As Ti^{IV}(d⁰ system) was partially reduced to Ti^{III}(d¹ system) during synthesis, the vicinity of this paramagnetic sites could be also studied by means of electron paramagnetic resonance. The thermal properties of glasses were studied by differential scanning calorimetry and thermomechanical analysis.

Subsequently, prepared glasses were used to form protective coatings on a corundum and b-titanium substrate by spin coating method. Resulted glass ceramic layer was described using XRD, Raman and optical microscopy. The crystalline phase has been found to be titanium diphosphate.

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The surface of glasses and layers was evaluated by contact angle measurements and microhardness. Being a significant property in medical use, attention was also paid to the study of the glass dissolution kinetics in the physiological solution.

Keywords: phosphate glasses, structure, MAS NMR, Raman spectroscopy