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Structural Role of Titanium in Glass and Glass Ceramic Materials

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Titanium glasses were studied aiming a better understanding of the nucleation process in glass and glass-ceramic materials. Two species of glass, namely a Phosphate glass containng Titanium and Niobium, TiO_2-NbO_2-P_2O_5, and a Spinel glass-ceramic, were measured using neutron diffraction at the D4c instrument at the Institut Laue-Langevin (ILL) and x-ray diffraction at the ID15a beamline at the European Synchrotron ESRF. The analysis of their pair distribution functions (PDF) following the method described by Fischer et al. resulted on the preliminary determination of the distances between pairs of atoms and their coordination numbers. Numerous consistency checks are performed during the data processing and analysis to indicate the reliability of these results. In addition to these systems more samples of the same families, i.e. the Phosphate and the Spinel, are being prepared with varying concentrations and annealing stages to extend and complement the analysis.

Nucleation and crystal growth within amorphous materials are of increasing interest among industry due to the potential versatility of their designs. Titanium glasses are important because the presence of this metal has been observed to play a structural role on the crystal growth process. The goal of this research is to develop a model that explains how Titanium affects the crystallisation taking place within the glass in order to effectively design and produce new glass-ceramics. However, the study of glasses is not easy and careful manipulation of the measured data is required in order to identify the differences on the structure of the materials. In this study, the complementary of x-rays and neutrons together with the negative neutron scattering length of Titanium are exploited in order to maximise the information extracted from the data. Results from the two families will be presented, comparing the neutron and x-ray diffraction results, explaining the key steps on the data processing and pointing the main features that can be extracted from the data.

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