	Experiment title: Structural relaxation and excess free volume in metallic glasses studied by in situ X-ray Diffraction	**Experiment number**: HC1141
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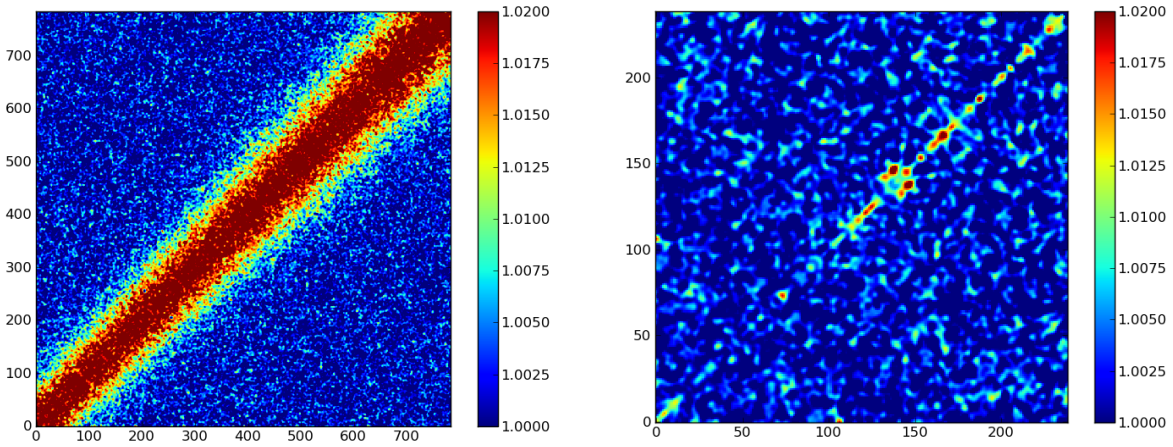
Report:

Amorphous Ni-Nb-Zr alloy ribbons prepared by melt spin methods membranes are becoming increasingly important in gas separation applications; these alloys are expected to replace the expensive Pd alloys that are being currently used. Our current scientific understanding is limited to permeation and hydrogen solubility, but, broader issues such as short range order and stability of the alloys under temperature and pressure are not well known. The aim of this experiment was to shed light on the microscopic details of the hydrogen-ribbons interactions, by studying the evolution of the structural relaxation process at the atomic level by means of X-ray Photon Correlation Spectroscopy (XPCS).

We carried out XPCS measurements on a thin ribbon of $Ni_{60}Nb_{40}$ and we found a dramatic effect of the hydrogen in the atomic dynamics of the glass at 373K. Figure 1 compares preliminary two-time correlation functions for $Ni_{60}Nb_{40}$ in (a) vacuum, and (b) 0.6 bar Hydrogen atmosphere. The broadening of the reddish line along the main diagonal from the bottom left corner to the right top corner is proportional to the structural relaxation time. We found that the addition of Hydrogen decreases the relaxation time abruptly by approximately two orders of magnitude from 1000 seconds to about 20 seconds in a very narrow time interval. In addition this process seems to be reversible.



(a) 373K – Vacuum (b) 373K – 0.6 bar Hydrogen

Figure 1. Preliminary two-time correlation functions measured with XPCS in $Ni_{60}Nb_{40}$ at T = 373K for (a) under vacuum and (b) under 0.6 bar Hydrogen.

Albeit the interesting results, there was insufficient time to complete the series of the alloys that we originally proposed and to perform more detailed experiments (at different temperatures). It also appears that improvements in the sample chamber may be needed; we can provide a heating stage top chamber (from an older Rigaku heating unit from Reno), that will fit with a slight modification to the system.

Therefore we would need to extend our previous work in order to understand the effected played by the in-situ hydrogen interactions on the particle level dynamics in Ni-Nb-Zr ribbons with different concentration of alloying element, Zr. Complementary measurements show that the hydrogen solubility increases as the amount Zr is increased in the alloy.