



	Experiment title: Local order and nanostructure in Al-Y-Fe amorphous alloy	Experiment number: ME973
Beamline: BM30B	Date of experiment: from:03/11/2004 to: 09/11/2004	Date of report:
Shifts:	Local contact(s): Vivian Nassif, Olivier Proux, Jean-Louis Hazemann	<i>Received at ESRF:</i>
Names and affiliations of applicants (* indicates experimentalists): A. Sadoc ^{1*} , O. Heckmann ^{1*} , L.Q. Xing ² , K.F. Kelton ² ¹ LPMS, Université de Cergy-Pontoise, Neuville sur Oise, 95031 Cergy-Pontoise, Cedex, France ² Department of Physics, Washington University, St. Louis, MO 63130, USA.		

Preliminary report:

Amorphous AlYFe alloys doped either with titanium or vanadium have been studied by EXAFS in order to determine the local structure around the doping element and to compare it to the short range order obtained previously around the major constituents. Amorphous ribbons of $\text{Al}_{87.5}\text{Y}_7\text{Fe}_5\text{Ti}_{0.5}$, $\text{Al}_{86}\text{Y}_7\text{Fe}_5\text{Ti}_2$, $\text{Al}_{87.5}\text{Y}_7\text{Fe}_5\text{V}_{0.5}$ and $\text{Al}_{87.35}\text{Y}_7\text{Fe}_5\text{V}_{0.65}$, prepared in Washington University ^{1,2}, were investigated on the BM30B beam line. The X-ray absorption spectra at the Ti (4964 eV) and V (5463 eV) K edges were recorded with a Si (220) monochromator in the fluorescence mode. A 32-elements fluorescence detector was used. The data were collected at room temperature and, with a liquid helium cryostat, at low temperature (16 K). The ribbons were only 1mm wide and the well focused X-ray beam available on BM30B was essential for these experiments. Moreover, the use of the fluorescence detector was also determining since the signal to noise ratio was very small for these dilute samples with low concentration (0,5 to 2%). The spectra are given in figure 1 for the different samples and the two different temperatures.

1 - , L.Q. Xing, S.Y. Tao and K. F. Kelton, 2002, Appl. Phys. Lett., **81**, 3371

2 - L.Q. Xing, Anindita Mukhopadhyay, William E. Buhro, and K. F. Kelton, 2004, Phil. Mag. Let. 84, 293.

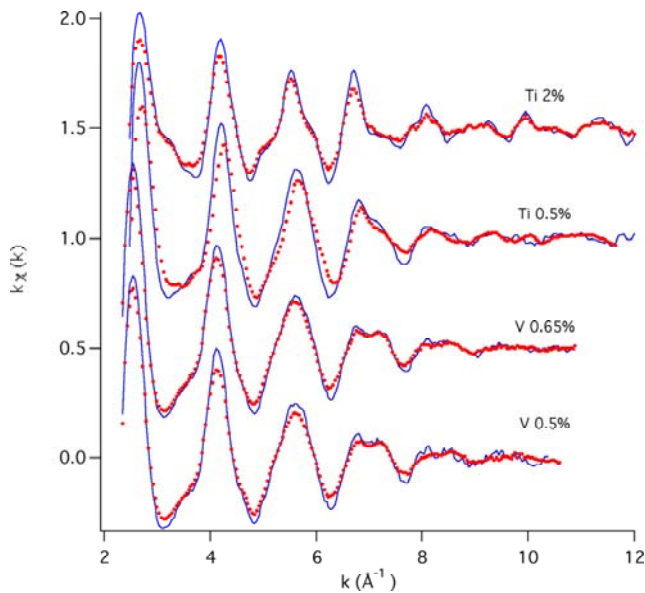


Figure 1: The EXAFS spectra, $k\chi(k)$, of the samples (red dots: room temperature, blue solid curve: 16K) studied for the Ti and V K edges and for the different concentrations: Ti: 2 and 0.5 %, V: 0.65 and 0.5 %.

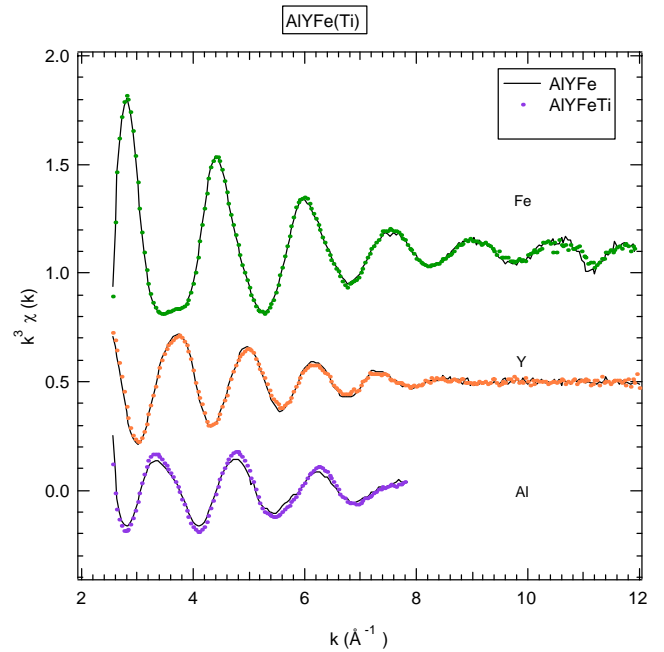


Figure 2: EXAFS spectra for the Al, Y and Fe K absorption edges of $\text{Al}_{88}\text{Y}_7\text{Fe}_5$ (solid curve) and $\text{Al}_{87.5}\text{Y}_7\text{Fe}_5\text{Ti}_{0.5}$ (dots).

The spectra become a little more intense with decreasing temperature and, consequently, decreasing dynamic disorder. They are very similar for the two vanadium concentrations, 0.5 and 0.65 %. The spectra obtained for the two titanium concentrations, 0.5 and 2 %, show similarities. They are, however, more structured for the highest concentration, in particular near 5 and 7 \AA^{-1} . Nevertheless, all these spectra appear structured, the effect being more evident for titanium than for vanadium, and for the highest titanium concentration. The important point is that these spectra look different from those obtained for the Al, Y and Fe K edges in the same amorphous samples with or without titanium (figure 2). Likewise, the Fourier transforms of the spectra clearly show peaks of second neighbours around Ti and V atoms, while they do not around the major constituents of the samples. Consequently the local order should be different.

This is confirmed by preliminary calculations using the program feffit. The spectra for the Al, Y and Fe edges can be reconstructed using one shell of 12 Al first neighbours at a distance from the absorbing atom between 2.70 and 3.12 \AA , depending of the central element. However, it is not possible to reconstruct the experimental spectra for the Ti and V edges with only one shell of Al neighbours. Second Al nearest neighbours are necessary (Al atoms at about 4.3 \AA), which is the fingerprint of intermediate-range order.

Therefore, titanium and vanadium may change, enhance local ordering in these amorphous alloys.