ESRF	**Experiment title:** Magnetic circular x-ray dichroism measurement on different metallic glasses: magnetoelastic studies on $(FeCo)_{75}Si_{15}B_{10}$ and FeZrB alloys	**Experiment number**: HE-1068
Beamline: ID24	**Date of experiment**: from: 31-May-2001 to: 11-June-2001	**Date of report**: 9-October-2001
Shifts: 30	**Local contact(s)**: Olivier Mathon	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

1. Dr. M. L. Fdez-Gubieda, Dept. Electricidad y Electrónica, Univ. País Vasco, P. O. Box 644, E-48080 Bilbao (Spain)

2. Dr. P. Gorria, Dept. Física, Univ. Oviedo, Calvo Sotelo, s/n, E-33007 Oviedo (Spain)

3. Dr. I. Orue, same as (2)

4. Dr. A. García-Arribas, same as (1)

5. R. López Antón, same as (1)

6. García Prieto, same as (1)

7. S. Pizzini, Lab. Louis Néel, CNRS, BP 166, F-38042 Grenoble (France)

Report:

The possible changes in the ferromagnetic character of Fe in Fe-rich metallic glasses is still an open question. Recently, we have performed Fe K-edge Magnetic Circular X-ray Dichroism (MCXD) on FeB and FeP amorphous alloys, showing that FeB alloys are weak ferromagnets, while in the case of FeP alloys a change from weak to strong ferromagnetism occurs [1].

On the other hand, Fe-rich FeZrB glasses constitute a very interesting system in order to explore the ferromagnetic character of Fe, due to their complex magnetic phase diagram, including re-entrant spin-glass bahaviour and INVAR character. One of the most relevant features is the large dependence of the Curie temperature, T_C, on hydrostatic pressure, The value of T_C decreases when pressure is increased. This dependence is larger in low Zr containing glasses (6 - 12 at. %). If simple tensile stress is applied the opposite effect is observed, that is, an increase of T_C with the applied stress. Previous results from MCXD experiment (HE-252) on FeZrB amorphous ribbons show slight changes in the MCXD signal with the amount of boron in the composition, and also when different tensile stress is applied. These results indicate that the maximum amplitude of the dichroism signal is correlated to the magnetic moment of the Fe atom [2].

In order to complete this study, including more samples with different boron content, another experiment at ID24 was carried out (HE-613), but due to many problems with the beam, very bad quality spectra were obtained, and no more information could be extracted from them.

In the last experiment (HE-1068), a new sample-holder designed to apply tensile stress was used. This sample-holder allows to increase the applied stress in steps of 50 MPa with high sensitivity. The measurements done during the first four days of the experiment are useless because the spectra are too noisy and, so, only samples from one of the proposed systems were measured. The composition of the four samples used for the experiment were $Fe_{91}Zr_7B_2$ (B2), $Fe_{88}Zr_8B_4$ (B4), $Fe_{87}Zr_6CuB_6$ (B6) and $Fe_{80}Zr_{10}B_{10}$ (B10). A set of MCXD spectra were obtained for each sample at two different temperatures, one at $T>T_C$ and the other at temperature $T<T_C$ but close to it. The original idea was to measure all the samples at the same reduced temperature ($T/T_C \approx 0.95$).

However, we have found two important problems which have to be solved in order to complete the proposed study.

a) The quality of the XMCD spectra were lower than in previous experiments (see figure 1a). A not systematic noise appears in nearly all the spectra, sometimes inside the MCXD region, making quite ambiguous, at least, the calculation of amplitudes and areas. So, as we want to observe subtle changes with the tensile stress, we are not able to conclude, even some differences are shown between different samples, whether the ferromagnetic character of Fe changes with stress or not.

b) The temperature control must be largely improved. We need to know the exact temperature (± 2 K), to be sure that we perform the same measurement at the same reduced temperature for all the samples.

The preliminary analysis of the data shows an almost linear increase of the peak to peak amplitude of the XMCD signal as the tensile stress increases in all the samples except for B10 (figure 1b). In this sample the effect of stress on the values of T_C is negligible. However, the dispersion of points makes difficult a cuantitative study of the effect. When the relative area of the two peaks is compared, due to the bad quality of most spectra, nothing can be concluded.

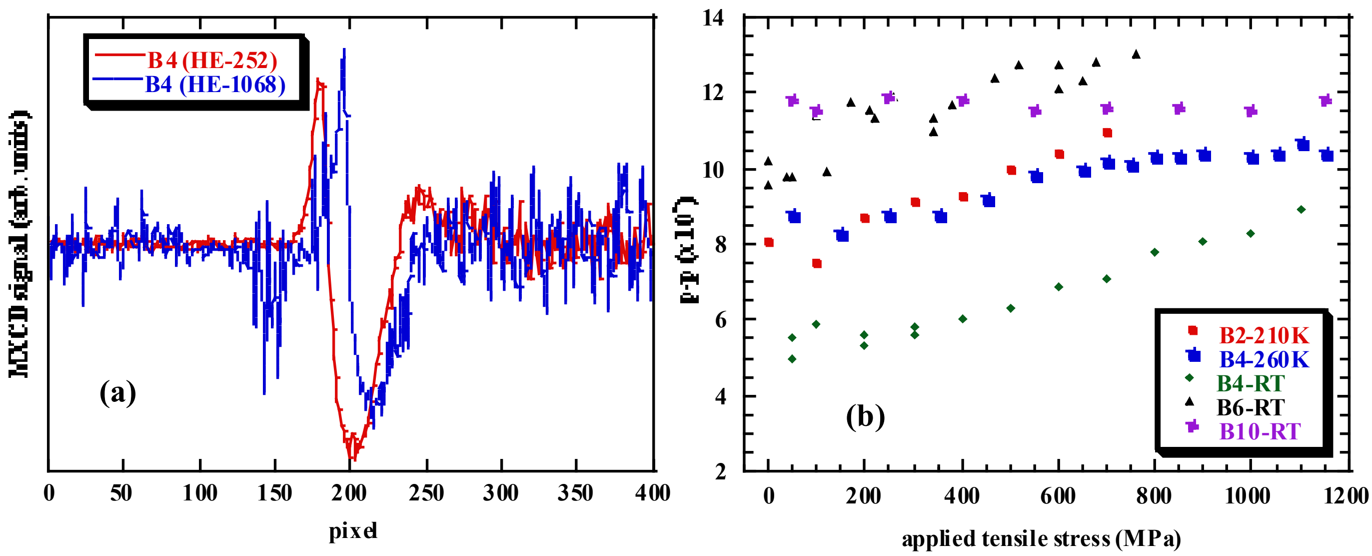

Fig. 1 - (a) Comparison of XMCD spectra corresponding to the same sample, B4 at RT, measured in different experiments. (b) peak to peak amplitude (p-p) as a function of the applied tensile stress for the four compositions.

[1] M.L. Fdez-Gubieda et al. Phys. Rev. B, **62**, (2000) 5746.

[2] I. Orue et al. J. Synchrotron Rad., **8**, (2001) 443.