	Experiment title:	Experiment number:
ESRF	**Experiment title:** Local magnetostrictive strain in RE- Fe systems: a feasibility study	**Experiment number**: HS2946 and HS2942
Beamline: ID24	**Date of experiment**: from: 23/11/05 to: 9/12/05	**Date of report**: 24/2/06
Shifts: 24 +15	**Local contact(s)**: O. Mathon/S. Pascarelli	*Received at ESRF:*

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Report:

These two experiments were devoted to investigating the possibility of performing differential XAS measurements on magentostrictive induced strain in RE-Fe systems. Details of the experimental setup and on the data acquisition procedure for differential XAS may be found in the experimental report IH HC 474 and in reference [1].

This report illustrates part of the results obtained on FeTb thin amorphous films. The films were sputtered on thin vitreous Carbon up to thicknesses of a few microns, and then peeled off from the substrates. Two samples were investigated, with different composition. Figure 1 shows Fe K-edge and Tb L_3 edge XAS on the two samples. We obtained the following jump ratios for the two samples:

C3: J_{Fe}/J_{Tb} ~ 0.95/0.52 ~1.827

C2: J_{Fe}/J_{Tb} ~ 0.50/0.72 ~0.700

From here we deduce that sample C2 has a much higher Tb content (probably close to the compound $FeTb_2$) with respect to sample C3. It is interesting to note that whereas the Tb L_3 edge data on the two samples differs (the EXAFS oscillations are not in phase, as is better seen in Figure 2) , indicating a different average local structure around the rare earth, those at the Fe K-edge are very similar, indicating that local order around the 3d metal site is rather insensitive to composition in this system.

In this report, we will illustrate the differential XAS signals obtianed on sample C3. Similar data has been obtained on sample C2.

In Figure 3 we show the differential XAS signals measured at the Fe K-edge and Tb L_3 edge on sample C3. At the Fe K-edge, a differential signal extending beyond the absorption edge is visible, although it is very weak (P-P amplitude of ~ $1x10^{-4}$). This signal is reproducible (four differential signals XTbFe2_11/12/13/14 were recorded) and follows rather well the derivative of the XAS signal, indicating that its origin could be due to atomic displacements induced by magnetostrictive strain.

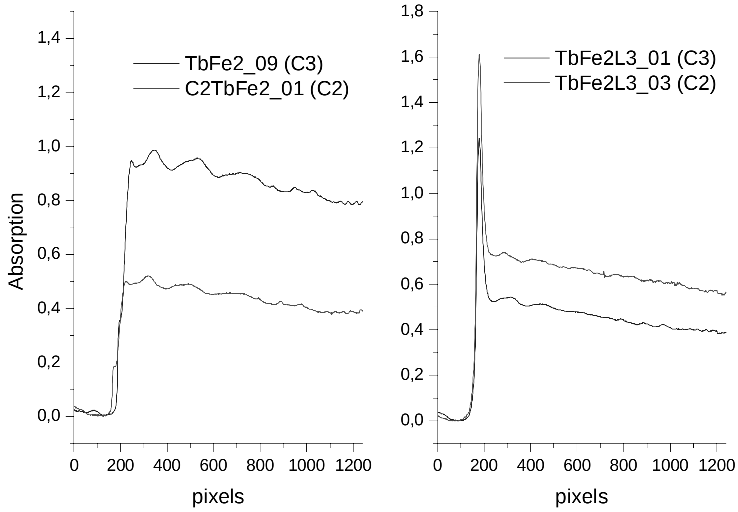

Figure 1

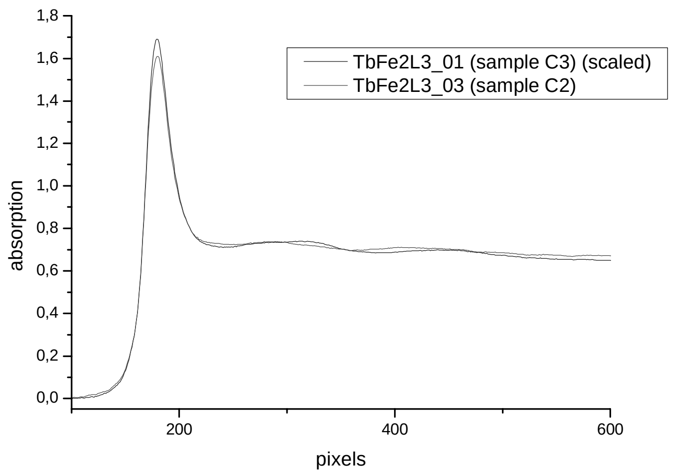

Figure 2

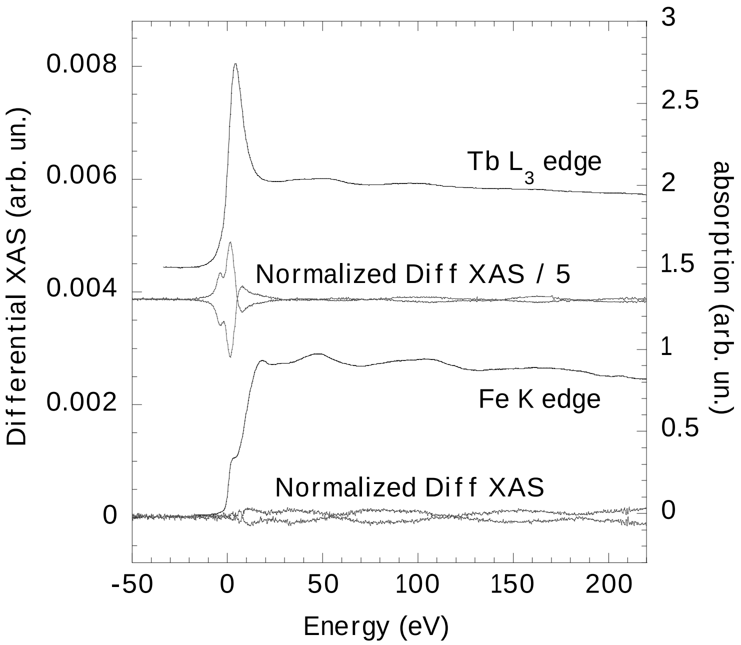

Figure 3 shows differential XAS (red and green) and XAS (blue) obtained at the Tb L_3 edge and Fe K-edge on sample C3.

At the Tb L3 edge, besides the presence of a similar signal extending beyon the absorption edge, an interesting feature is visible near the edge, where large oscillations appear that are not proportional to the derivative of the XAS. It is a reproducible, big (2.5e-3) that was observed on all samples. We think it could indicate a change is the oscillator strength of the 2p3/2->4f multiplet when the magnetisation is rotated 90 degrees.
The data analysis is not straighforward, since prior to simulating the differential signals it is necessary to simulate the XAS signal starting from a model structure. This is in progress.
During these experiments, we performed a large number of different measurements on other systems as well. We tried to understand the effect of the sample mounting on the signal, in particular on whether strain due to mounting (glueing the sample on the sample holder for example) would modify its magnetic properties. Also, on whether the presence of the substrate would affect the measurement. We were not able to obtain clear answers to these questions. Therefore we plan for the future to carry out a preliminary characterization in the lab of the samples (with and without substrates) already mounted in the final sample holder to be used for the differential XAS measurements.

References

1. R. Pettifer, O. Mathon, S. Pascarelli, M. Cooke and M. Gibbs, Nature 435, 79-81(2005)