ESRF	**Experiment title:** Magnetic anisotropy in Fe/pd ribbons made by the atomic saw method.	**Experiment number:** HE-236
Beamline: BL26/ID12B	**Date of experiment:** from: 16-juil-97 7:00 to: 21-juil-97 7:00	**Date of report:** 25 Fev. 98
Shifts: 15	**Local contact(s):** Nicholas Brookes	*Received at ESRF:* 0 2 MAR. 1998

Names and affiliations of applicants (* indicates experimentalists):

A.R Fert*, J.P. Peyrade, D. Bertrand*, H. Jaffres*, L. Ressier,
LPMC, INS A, Complexe scientifique de Rangueil, 3 1077 Toulouse Cedex, France
A. Schuhl, F. Nguyen Van Dau
CNRS-Thomson CSF, Domaine de Corbeville, 91404 Orsay Cedex, France
J. Vogel*, A. Fontaine*
Laboratoire Louis Neel, CNRS, BP 166,38042 Grenoble Cedex, France

Report:

Title: Magnetic anisotropy in Fe/pd ribbons made by the atomic saw method.

XMCD measurements at the $L_{2,3}$ absorption edges of Fe have been carried out on epitaxial Pd/Fe thin films nanostructured into stripes by the « atomic saw » method which allows to relax strains along the narrow side of the stripe. A strong uniaxial anisotropy was revealed by MOKE in such magnetic systems (Ha=1500-2500 Oe). The aim of XMCD experiment was to probe the orbital magnetic moment to establish a quantitative relation between the macroscopy anisotropy and the Fe orbital moment anistropy caused by a change of the cubic lattice symmetry of the Fe site imposed by the uniaxial strain relaxation.

Experiments have been done on 3 structured samples, originated from continuous 50 A Fe films elaborated by MBE at the CNRS-LCR Thomson laboratory. The « atomic saw » method, permits to prepare nanostructured samples formed by strained Fe stripes cut by quasiregular shears of the MgO lattice. Stripes with three different strain magnitudes were realized. The stripes geometry was seen to be closely dependant on the strain which led to anisotropy fields ranging from 1500 Oe to 2500 Oe.

For each sample, we collected XMCD data in the energy range 690-760 eV with left and right circular polarisation by photocurrent measurement. In addition for a given helicity we measured XAS under a saturating field alternately positive and negative. Each sample has been investigated by applying the field along the easy and hard magnetic axes, respectively perpendicular and parallel to the stripes, in order to reveal the anisotropy of the orbital moment of Fe. Sets of numerous data have been collected for each configuration to improve statistics. We have systematically extracted the dichroism signal by difference of the absorption spectra for the two opposite polarisations.

After integration over energy, we used the sum rules to determine the ratio of the magnetic moment $r = {M_{orb}}/{M_{spin}}$. (M_{spin} has to be thought as effective M_{spin} since it includes the expected value of the Tz operator) . Continuous films have also been investigated as references.

Signifiant results have been obtained on the 50 A film structured by 6% strain (Ha=2000 Oe). For a saturating magnetic field applied along the hard axis, the r ratio is found to be close to the reference one ($r_{\parallel} =$ 0.016). In contrast, when the orbital magnetic moment is aligned along the easy axis, the mean r value is largely enhanced by a factor 4/3 ($r_{\perp}$ = 0.021) Fig[1]. This analysis correlates the value of the anisotropy of the orbital moment to the macroscopic magnetic anisotropy, as expected.

Unfortunately, for the two other samples previously studied, unexpected problems prevented us to take off similar fine informations. First non perfect electrical contacts provoked fluctuations in the photocurrent measurement. Second, we noted an appreciable deviation of the incident X-ray beam position which produced a time-dependent probed area so far from the center that the probed region cannot be considered as uniformly strained. These artefacts caused a too large dispersion of the outputs of the XMCD sum rules to extract an accurate evaluation of the orbital moment.

In conclusion, anisotropy of the orbital moment in a 50 A Fe layer structured by the atomic saw method and characterized by an anisotropy field of 2000 Oe has been highlighted by XMCD measurements. XMCD is then a sensitive method able to probe the local anisotropic orbital moment in our systems. In order to validate this analysis one should carry out measurements on a series of samples characterized by different anisotropy fields (1500 Oe to 3000 Oe) so as to establish a quantitative relationship between the anisotropy of the orbital moment and the magnetoelastic energy. New experiments would be performed by taking care to probe an uniformly strained part of the sample by delimiting a window which isolates stripes of the same width.

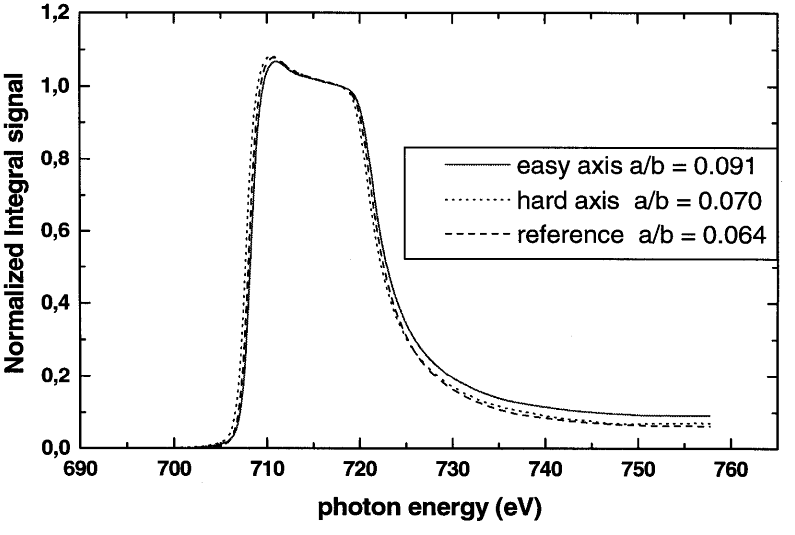

Fig.1