ESRF	**Experiment title:** Time-resolved soft x-ray MCD measurements of magnetisation reversal dynamics of TbFe multilayers, NdFeB spring-magnets and Co ferrite.	**Experiment number**: HE-424
Beamline: ID12B	**Date of experiment**: from: 17/NOV/98 to: 20/NOV/98	**Date of report**: 25/FEB/98
Shifts: 9	**Local contact(s)**: Nick BROOKES	*Received at ESRF:*

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Report:

Time resolved soft x-ray MCD experiments have been successfully carried out at ID12B. The technique takes advantage of the ESRF single bunch structure, associated with a microcoil set-up for generation of pulses of magnetic field synchronised with the photons bunches in a ‘pump-probe’ scheme. The pulse of magnetic field in the nanosecond time scale duration is used as the "pump", while the "probe" is the 100 ps long x-ray pulse delivered in the ESRF single bunch operation mode. The time dependence behaviour is analysed by changing the time delay (phase) between the "pump" and "probe", that have the same repetition rate. A fast photodiode "looking" at the visible beam before the beam line monochromator is used for synchronisation of the delay generator. The absorption signal is measured in total emission yield (fluorescence and photoelectrons) using a photodiode detector with a hole that can be placed on the beam axis at around 10 mm from the sample. This ensures a collection over a very wide solid angle in a highly symmetrical geometry, overcoming the drawback of the lower photon flux available in the single bunch mode. The typical acquisition time for a 400 points dynamic curve is about 5 minutes, including change of photon helicity.

A series of magnetic systems were analysed, including the ones proposed on the original project and also two others not included initially (FeCo alloy and Co/Cu/FeNi spin-valve).

Unfortunately we had a limited success in measuring the original proposed systems, either because of technical limitations associated with the high repetition rate of the pulses together with high fields (high thermal load), or due to the surface contamination that cancels sample magnetic properties. The new samples were then chosen, overcoming the previous problems.

i) $Co_{95}Fe_5$ alloy: magnetically soft isotropic thin film deposited on a Si substrate. The measurements were done with a fixed photon energy, centred on the Co and Fe L_3 absorption edges to probe separately their magnetisation reversal. As the Co and Fe are intimately coupled, they have the same dynamical behaviour, as can be seen in figure 1. For comparison purposes we show also in the figure the Kerr response obtained for the same conditions of applied fields, showing a very good agreement in the dynamical response.

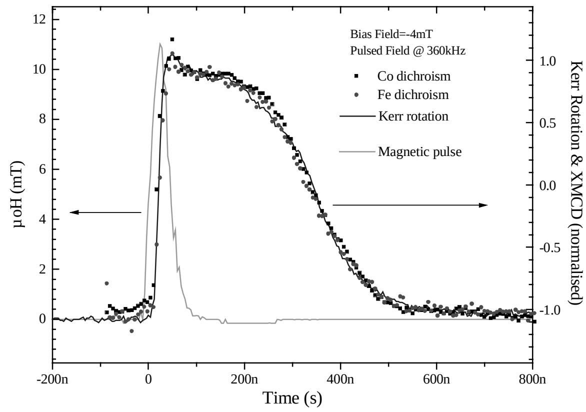

Figure 1: Time response of a $Co_{95}Fe_5$ thin film with an in-plane applied field. XMCD and Kerr results shows a very good agreement.

ii) $Co_{50Å}$ /$Cu_{100Å}$ /$FeNi_{50Å}$ spin-valves: grown by molecular beam epitaxy over a Si substrate, presenting an in-plane uniaxial magnetic anisotropy with the easy axis parallel to the steps induced in each magnetic layer by the substrate's topology. In static magnetic characterisation, this sample shows a composite hysteresis loop, indicating that the FeNi layer is magnetically decoupled from the Co layer. The coercive field for the FeNi layer is about 16Gauss, while for the Co it is about 45Gauss. With a bias field of 50Gauss (strong enough to ensure the same magnetic initial state), pulses of magnetic field with fixed width (80ns) and variable amplitude were applied and the dynamics observed for both layers. The FeNi layer reverses magnetisation for pulsed fields higher than 180Gauss, showing a dynamic coercive field about 8 times bigger then the static one (figure 2(a)). For pulsed fields up to 250Gauss, the Co magnetisation doesn't changes, even if the FeNi is completely reversed. The Co reverses for fields higher than 280Gauss, showing a dynamic coercive field about 5 times bigger then the static one (figure 2(b)). More studies have to be done in order to better understand the dynamic behaviour of each layer as well as the dynamic coupling between both layers.

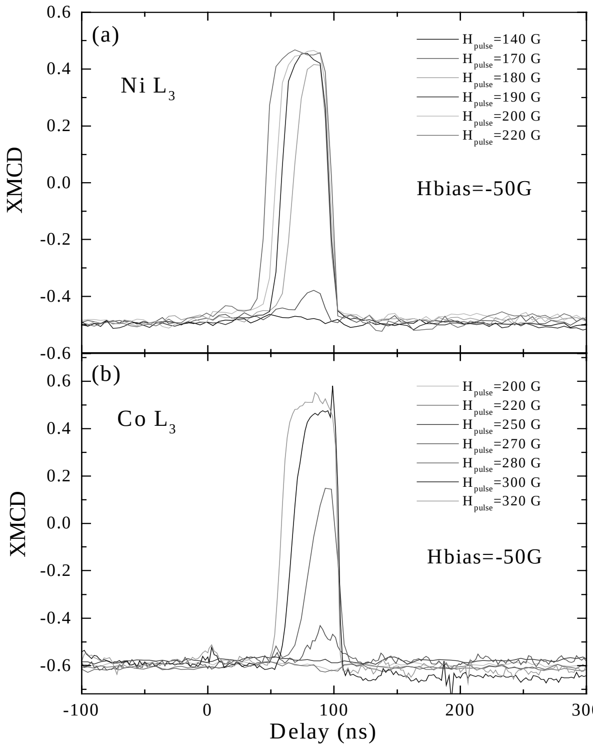

Figure 2: Magnetisation reversal dynamics of Ni (a) and Co (b) L_3 edge in Co/Cu/FeNi, with a reversed bias field of 50 Gauss.