ESRF	**Co-FeNi based spin-valves: Element-selective magnetization dynamics investigated by time-resolved XMCD**	**Experiment number**: HE-641
Beamline: ID12B	**Date of experiment**: from: 12/12/1999 to: 17/12/99	**Date of report**:
Shifts: 18	**Local contact(s)**: Nicholas BROOKES, Philippe OHRESSER	*Received at ESRF:*

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We have successfully developed original time-resolved XMCD measurements on beamline ID12B. The technique takes advantage of the ESRF single bunch structure, associated with a microcoil set-up for generation of pulses of magnetic field synchronized with the photon bunches in a pump-probe scheme. The pump is the magnetic pulse and the probe is the 100psec long x-ray bunch. The time-dependence of the magnetisation of the probed sample during and after the field pulse is studied by changing the delay between the pump and the probe, and by measuring, for each delay, the corresponding L_3-edge XMCD signal. The details of the experimental set-up are reported elsewhere (experimental report HE-424 attached).

Magnetization dynamics of $Co/Cu/Fe_{20}Ni_{80}$ based spin-valves was studied with this element selective nanosecond-resolved technique. Samples grown by MBE on step-bunched Si substrates present an in-plane uniaxial magnetic anisotropy induced on each magnetic layer by the substrate topology. The dynamic coupling between soft and hard magnetic layers was studied in three samples with different copper thickness (60, 80 and 100 Å). For the dynamic measurements, a magnetic field pulse (30 ns wide, variable amplitude) was applied in the easy axis direction, superimposed to a continuous bias field of 5 mT, opposite to the pulse to reverse the magnetization. Quasi-static hysteresis loops (insets in figure 1) show a strong coupling between the hard and the soft layer for the samples with 60 and 80Å Cu thickness (single loop), while for 100Å Cu the hard and soft layers have a weak coupling (two steps loop). XMCD measurements in the nanosecond regime is similar to the quasi-static behaviour for the samples with 60 and 100Å copper spacer. With the thin spacer the time dependence of the magnetization is identical for soft and hard layer– the layers are strongly coupled and the dynamics of the slower cobalt layer is transferred to the permalloy layer. With the thick 100Å spacer a weak coupling is maintained - an antiparallel alignment of the magnetization can be obtained between soft and hard layer for a wide range of fields.

Interestingly for intermediate Cu thickness the dynamical behaviour differs from the quasi-static regime. In this case the soft and hard layers seem to be partially decoupled. Contrary to the static regime, a field condition (18mT) can be found for which the magnetizations of soft and hard layers are antiparallel. Note that in this case the dynamics of the FeNi and Co magnetizations are, as expected, very different –fast for NiFe and slower for the Co layer. It can however be seen (tail of the time curve at the Ni L edge) that part of the permalloy layer exhibits a time behaviour identical to that of cobalt – this part of the signal comes from the permalloy in direct contact with cobalt, through pinholes.

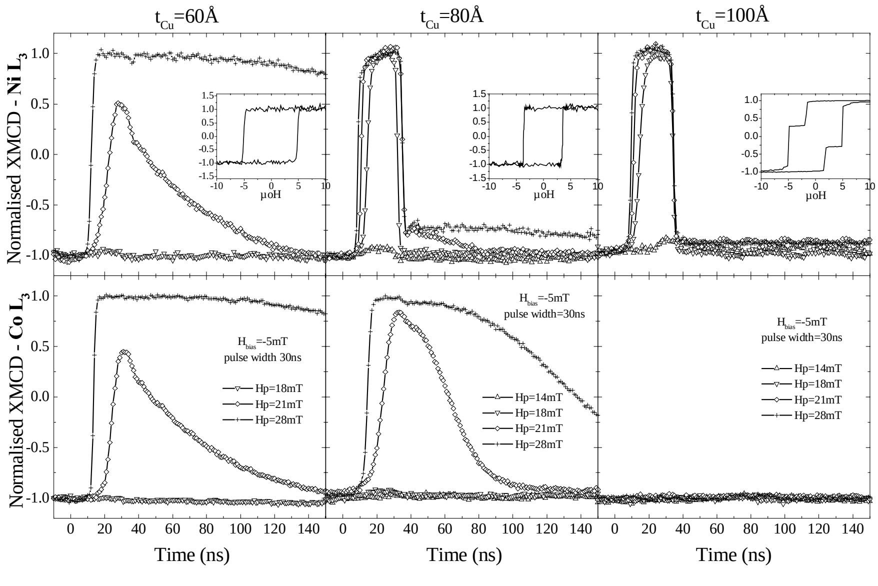

Figure 1 : XMCD dynamic response of the Co/Cu/FeNi spin valves for three different thickness of the copper layer (60, 80 and 100 Å). The insets show the global quasi-static hysteresis loops measured by GFM.

This study shows that time-resolved XMCD is a unique way to compare static and dynamic magnetisation reversal with chemical selectivity