ESRF	**Experiment title:** Magnetism of very thin Fe epitaxial layer grown on ZnSe(001) semiconductor	**Experiment number**: HE 872
Beamline: former ID 12 B	**Date of experiment**: from: 24/10/200 to: 1/11/2000	**Date of report**: 1/9/2003
Shifts: 18	**Local contact(s)**: Alberto TAGLIAFERRI	*Received at ESRF:*

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Report:

These measurements performed at ID-12 have been concretize in two articles already published.

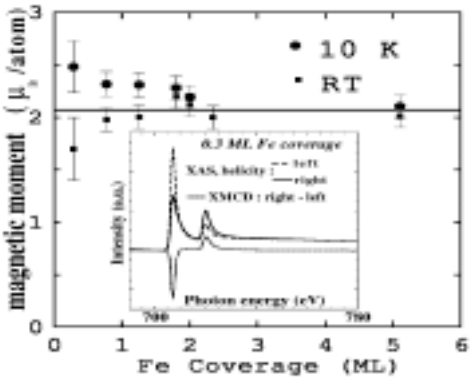
The former is directly linked to the original proposal. Our group, involved in spintronic research, was looking for a convenient way to inject a spin polarized current into a semiconductor from ferromagnetic metals like Co and Fe. However, a fundamental problem must be solved before spins can be injected efficiently: the reactivity of transition metals with semiconductors can lead to magnetically dead layers which suppress the spin polarization across the interface by spin-flip mechanisms. Fe/ZnSe is a promising system: The Fe/ZnSe(001) heterostructure has a low lattice mismatch (1.1%) between two Fe cells and one of ZnSe and, more importantly, the Fe reactivity is small when compared with other semiconductors like GaAs, Si or Ge.

Title and reference of our work are *"Magnetism of the Fe/ZnSe(001) interface"* M. Marangolo, F. Gustavsson, M. Eddrief, P. Sainctavit, V. Etgens, V. Cross, F. Petroff, J. George, P. Bencok and N. Brookes, Phys. Rev. Lett. **88**, 217202 (2002).

The magnetism of epitaxial ultrathin films of Fe on ZnSe(001) has been investigated by X-ray magnetic circular dichroism down to the submonolayer regime. In contrast to other metallic ferromagnet/semiconductor interfaces, no reduction of the Fe magnetic moment was found at the Fe/ZnSe(001) interface. Furthermore, a significant enhancement of the Fe magnetic moment compared to the bulk value was observed for coverages up to one monolayer in agreement with theoretical predictions. We

also demonstrate that the magnetic properties of the Fe/ZnSe(001) interface remain stable against thermal annealing up to 300 ºC, a prerequisite for the future development of efficient spintronics devices.

Figures:



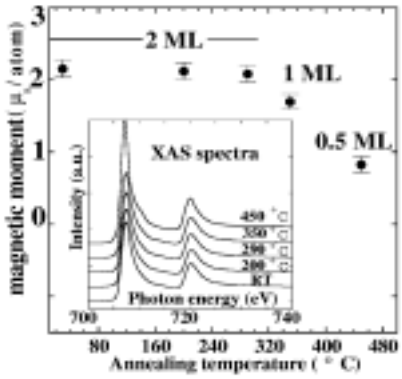


Fig 1 **Fig 2**

Fig 1 Thickness dependence of the total Fe magnetic moment at T = 10 K and at room temperature (RT) as measured by XMCD. Inset : Typical XMCD spectra for a coverage of 0.3 ML of Fe/ZnSe(001) collected at T = 10 K (raw data). The absorption of left and right helicity are shown (taking the direction of the magnetic field as the quantification axis).

Fig 2 Magnetic moments as a function of annealing temperature for 2 ML Fe film. The reduction of the probed quantity of Fe atoms on the top of the heterostructure (from 2 ML to 0.5 ML) suggests the onset of intermixing at such high temperatures. Inset : XAS spectra indicate no evidence of oxidation.}

The second article concerns EXAFS and M(agnetic)EXAFS oscillations observed on tails of XMCD spectra. Title and references are "*Tails of near edges X-ray absorption spectra as a fingerprint of magnetic and structural phase transitions. Application to metallic 3d ultra thin films."* M. Marangolo, P. Ohresser, N. B. Brookes, S. Cherifi, C. Boeglin, M. Eddrief and V. H. Etgens, J. of Appl. Phys. **93**, 5151 (2003).

Abstract:

Tails of XANES/XMCD spectra (50-100 eV above the edges) are characterized by the beginning of the EXAFS/MEXAFS oscillations. We present a systematic study of these tails for three different thin films: Fe and $Fe_{0.65}Ni_{0.35}$ on stepped Cu(111) and Fe/ZnSe(001). The dependance of the detected oscillations on the film thickness leads us to conclude that XANES/XMCD tails are a useful *in situ* probe of the structural and magnetic phase of the sample.