ESRF	Experiment **title:X-Ray Magnetic Circular Dichroisme in the study of epitaxial FeNi Invar alloy film**	**Experiment number:** HE - 353
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Report:

-Ferromagnetic fcc $Fe_{1-x}Ni_x$ alloys, around the so called "Invar" concentration (≈35% at Ni), show almost no thermal expansion as a function of temperature. One of the present goal concerning this system is to investigate if such an "Invar effect" could be present in artificial structure like the $Fe_{1-x}Ni_x$ alloys constrained in the fcc cristal structure.

Recently two kinds of experiments [1,2] have been made on $Fe_{1-x}Ni_x$ alloys grown epitaxially on a Cu(100) surface, and the results are rather controversial.

XMCD experiment performed on both Fe and Ni edges, on several epitaxial systems around the "Invar" concentration will be able to reveal the existence of any anomaly in the behaviour of the magnetic moments, either as a function of concentrations and/or temperatures. Particularly, we hope that the origin of the rather unexpected behaviour of the Stoner gap shown by spin-resolved photoemission experiment may be elucidated.

The XMCD data were collected at the dragon beam line ID12B at the European Synchrotron Radiation Facility (ESRF),[3] using the circularly polarised light emitted by the helical undulator Helios I (circular polarisation rate -85%) [4]. The XMCD spectra (defined as the difference between two absorption spectra collected measuring the sample drain current with the light helicity parallel or antiparallel to the sample magnetisation) were obtained at remanence by reversing the light helicity or by flipping the magnetisation of the samples with a ~0.5 Tesla pulsed magnetic fie!d. The light was at 30° grazing incidence, in the plane containing the (100) surface normal and the sample magnetisation. The photon energy resolution was estimated to be ~0.4 eV.

We investigated the temperature dependance of the Fe-3d and Ni-3d projected contributions to the total magnetic moment using X-ray Magnetic Circular Dichroism (XMCD) at the Ni and Fe $L_{2,3}$ absorption edges of thin FexNi1-x films (x=0.3,0.48, 0.58, 0.62, 0.73, 0.77) epitaxially grown in situ on Cu(100).

The thickness of the samples (10 to 20 monolayers) was chosen in order to have a high Curie temperature (T, > 450K) and an in-plane magnetic remanence along the (010) crystallographic axis. LEED and XPS (hν=1000eV) were performed to check the structural and the chemical quality of the deposits.

On figurel, we report the temperature dependance of the Fe-3d and Ni-3d projected contributions to the total magnetic moment normalised to the number of holes of the respective 3d shell for four concentrations.

For x=0.58, the Fe and Ni moments do not show big variations as a function of the temperature, while for x=0.62, they present a strong deviation from the Brillouin curve, as already reported in the literature. This is why the decrease of the room temperature Fe and Ni moments with respect to the values we find at T > 150K is much higher for x=0.58 than for x=0.62, in spite of the fact that the Curie temperature is above 450K for both samples. Note that the Ni and the Fe 3d moments basically follow the same temperature dependence.

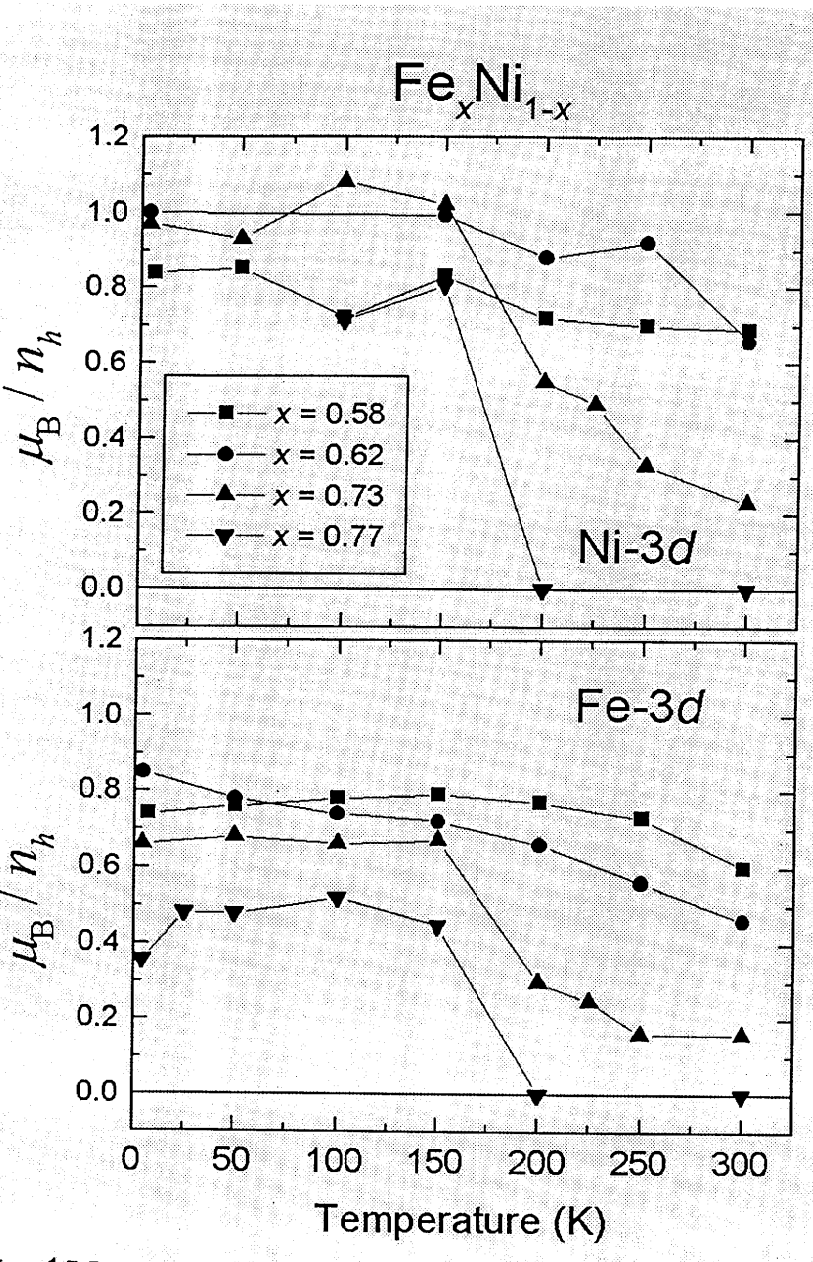

Figure 1: E. Foy *et al.*
Magnetic instabilities in fcc Fe_xNi_{1-x} *films*