ESRF	**Experiment title:** Is there a breakdown of the ferromagnetic order in Ni metal induced by 3d electron correlation	**Experiment number:** HE-350
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Report

The electronic and magnetic structure of ferromagnetic Ni films grown epitaxially on ultrathin films of Co have been studied by x-ray absorption spectroscopy (XAS) using circular polarization. Figure 1(a) shows XAS spectra recorded for a 1ML Ni film grown on Co/Cu(001) with the helicity of the incident x-rays parallel (open circles) and antiparallel (closed circles) to the sample magnetization. The structures, labelled L_3 and L_2, arise due to transitions from the spin-orbit split $2p$ core levels to unoccupied $3d$ states. The arrow indicates a satellite feature at a photon energy ~6eV above the L_3 edge. The inset shows the satellite feature in detail for the 1ML Ni film (top two curves) together with that for a 0.2ML Ni film (bottom two curves). The satellite intensity is strongly attenuated for the 0.2ML Ni film. Figure 1(b) shows the XMCD for a 1ML Ni film which is the difference between the XAS spectra in figure 1(a). The two main peaks are accompanied by satellite features at ~3.5eV higher photon energy, labelled A and A′. The inset shows the region in between the L_3 and L_2 edges together with the XMCD for a 0.2ML Ni film. The modification of the line shape ~860eV is marked by the arrow in the inset of figure 1(b). This feature in the XMCD is present for the 1ML Ni film, but absent for the 0.2ML Ni film. It has not been reported in previously published data which have generally been taken with lower energy resolution.

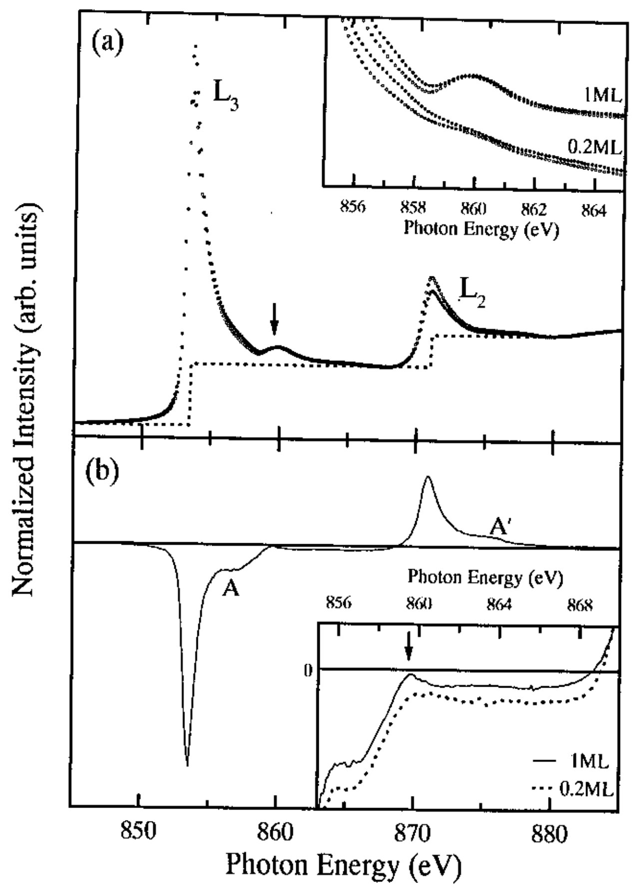

Figure 1 (a) Ni $L_{2,3}$ XAS spectra for a 1ML film. The inset shows details of the 6eV satellite feature (arrow) for the 1ML Ni film (top two curves) and for a 0.2ML Ni film (bottom two curves). (b) XMCD spectrum as the difference between the XAS spectra in (a). The inset shows the region in between the L_3 and L_2 edges (drawn line) together with the XMCD for a 0.2ML Ni (dashed line).

The Ni $L_{2,3}$ XMCD was explained by Jo and Sawatzky [1] and Van der Laan and Thole [2]. The latter authors showed that a parameter choice corresponding to a ground state of 18% d^8, 49% d^9 and 33% d^{10} reproduces the correct XMCD spectra. The claculations show that a change in the ground state d^8 weight should not only change the intensity of the 6eV satellite and the line shape of the XMCD spectra, but also affect the Ni spin moment.

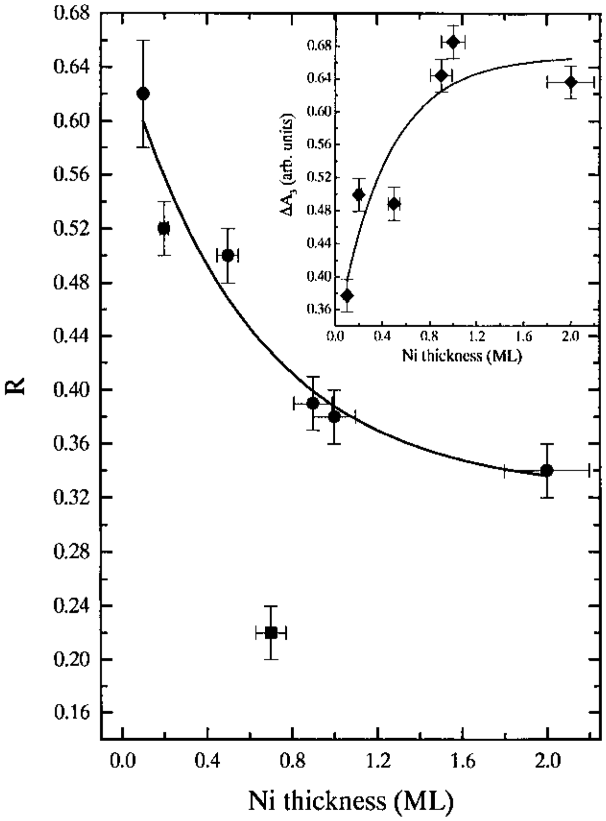

Figure 2 Orbital moment per spin moment, R, as a function of Ni film thickness obtained from the measured XMCD using the sum rules. The inset shows the absolute value of the integrated area of the dichroism at the L_3 edge as a function of Ni film thickness. The lines are a guide to the eye.

The ground state magnetic moments were obtained from the XMCD sum rules at the Ni 2*p* edge. Figure 2 shows the orbital to spin moment ratio (R) as a function of Ni film thickness obtained using sum rule analysis. The inset of Fig. 6 shows the integrated L_3 signal of the XMCD spectra as a function of Ni film thickness. The sharp decrease in magnitude of the dichroism for a Ni film thickness below 1 ML indicates that the magnetic moment is quenched for the lower coverages. The single data point represented by the solid square is for a Ni/Co alloy grown by co-deposition of Co and Ni onto the Cu(001) surface. From the XAS edge jumps at the Ni and Co edges it is estimated that 0.7 ML of Ni was deposited with ML of Co. We note that the increased coordination of the Ni sites in the NiCo alloy leads to the dramatic reduction in the value of R which implies that the thin Ni films grown on the Co film do not form an alloy.

Further analysis based on the individual sum rules for the spin and orbital moments indicate that the orbital moment slightly increases as the Ni film thickness is decreased. However, the spin moment is signifcantly decreased by nearly 50% of its bulk value for the thinnest film studied (0.2ML). This is the main reason for the dramatic increase in R shown in figure 2. The observations have can be explained in terms of a modified hybridization of the Ni with its neighbours which affects the d^8 weight. The changes in the Ni XAS and XMCD line shapes can also be understood using the concepts of a configuration interaction model.

[1] T. Jo and G. A. Sawatzky, Phys. Rev. B **43**, 8771 (1991).
[2] G. van der Laan and B. T. Thole, J. Phys.Condens. Matter **4**, 4181 (1992).

Publications from beam time:

1) Electronic and magnetic structure of thin Ni films on Co/Cu(001); S.S.Dhesi *et al.* (accepted for publication in Phys. Rev.)
2) Correlation between L_3 absorption satellite intensity and spin moment in ultrathin Ni films; S.S.Dhesi *et al.* (submitted to Surf. Sci.)
3) Charge redistribution in interface magnetism: A high resolution x-ray absorption study ;S.S.Dhesi *et al.* (submitted to Phys. Rev.)