ESRF	**Experiment title:** **Magnetic X ray diffraction in Cobalt deposits on Pt(111) surfaces at different temperatures.**	**Experiment number:** **SI 220**
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Report:

The Curie temperature of very thin ferromagnetic films is in general substantially lower than the Curie temperature for bulk samples as it has been shown extensively in the literature for a number of systems. A detailed study by Huang et al [l] shows that the thickness dependence of the Curie temperature of the film depends markedly on the orientation of the substrate. For Co and Ni on Cu(100) for example, the transition temperature increases slowly reaching the bulk value for -12 atomic layers. On the (111) substrates the situation is very different : the Curie temperature of one atomic layer film is very low and that of a two layer film is equal to that of a bulk crystal. Although there are not in the literature similar detailed experiments for Co/Pt interfaces, the work by Mc. Gee et al. [2] on a Co wedge grown on Pt(111) sugests that the dependence of the Curie temperature with thickness is much less abrupt than that reported in [I]. This apparent contradiction has been a motivation for us to study the magnetism of the Pt interface atoms in Co/Pt(lll) by resonant magnetic diffraction experiments. In addition, we wanted to investigate how useful our technique is to this type of problems and to which extent the induced magnetism of the Pt atoms may be used as a probe for the magnetism of the ferromagnetic overlayer .

We measured the asymmetry ratio R (under LIII Pt resonant conditions) at (HKL)=(1, 0, 3) for films of *Co* deposited on Pt (Ill) in UHV for different temperatures in the range 60-400 K.. At this location in reciprocal space, the diffracted intensity originates from the topmost Pt planes.

Figure 1 shows the results for a 4 atomic layers film grown at 200 K. The black and open

symbols correspond to heating and cooling respectively. As it may be seen in the figure the variations of the asymmetry ratio are not reversible with temperature. R goes to almost zero at 400 K and it does not recover upon cooling. In addition between 200 and 300 K, R seems to exhibit a maximum. Although we do not have a complete understanding of the origin of the irreversibility, we discovered in the course of the experiments that surface contamination due to the residual gas in the vacuum system plays a major role.
Figure 2 shows the temporal evolution of the magnetic signal. It shows a more or less linear decay with a slope of 0.5 x10” per hour. The pressure in the chamber was 5 x 10^{-10} mbar. We investigated in more detail this phenomenum by dosing the surface with CO gas. Figure 3 shows the results. Exposure of CO whith the surface at 200 K causes an exponen tial change in the magnetic signal. CO is known to chemisorb on cobalt. The experiment shows that chemisorption of CO on a very thin film of cobalt affects the magnetism of the interface Pt atoms. As it may be seen in the figure, the magnetic signal may be reco vered upon a moderate annealing . Similar type of findings have been observed in the past [3]. Very recently Bland et al. have reported changes of the direction of easy magnetisation in Co/Cu surfaces caused by CO chemisorption [4]. We believe it is worth continuying the se type of studies in order to establish the phenomenolgy and to try to understand the phy sics behind.

[l] F. Huang et al. Phys. Rev. B 49, 3962, (1994)
[2] N. W. E. McGee, et al., J. Appl. Phys. 73, 3418 (1973)
[3] F. Huang et al. Surf. Sci. Lett. 297, L79, (1993)
[4] J. A. C. Bland et al. preprint

Fig. 1: Asymmetry ratio vs. temperature for a 4 atomic layers film deposited on Pt(111) at 200 K.
Fig. 2: Temporal evolution of the magnetic signal for 3 layers of Co on Pt(111)
Fig. 3: CO chemisorption on 4 layers of Co on Pt(ll1). The asymmetry ratio drops to almost zero and recovers again after a mild annealing