ESRF	**Experiment title:** ***Correlation between structural properties and magnetic behaviors of $Fe_{1-x}Co_x$ thin films grown on Rh(001) and Pd(001) surfaces***	**Experiment number**: SI 2092
Beamline: BM32	**Date of experiment**: from: Nov 03, 2010 to: Nov 09, 2010	**Date of report**: Aug 31, 2011
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Report:

We have used the surface preparation and electron beam deposition techniques at the UHV X-ray diffractometer at BM32 beamline to gather information on the growth of $Fe_{1-x}Co_x$ ($0 < x < 0.5$) alloys. Grazing incidence X-ray diffraction (GIXRD) using 22 keV photons has been employed to optimize the growth route and to measure the crystallographic structure (in-plane and out-of-plane lattice parameters) as function of the coverage and composition on Rh(001) and Ir(001). In the case of the Rh(001) substrate, we were able to study three different compositions (x=0, 0.25, 0.5). A short experiment was done, in addition, on the Ir(001) crystal for the composition x=0.5.

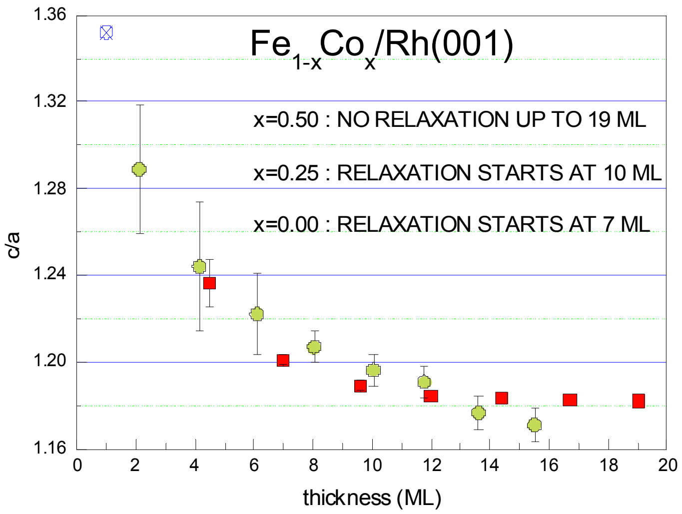
The deposition rate was calibrated for both Fe and Co using a quartz balance. For the x=0.5 sample the calibration was at about 1ML/18min. At each stage of the growth the c/a ratio was determined. At the end of each thin layer preparation, the composition was checked by Auger spectroscopy. A summary of the main results that has been found up to now (further analysis is required) are given below (see figure):

<u>For the deposition of Fe1-xCox alloys on Rh(001), we have got:</u>

x=0.5 (figure, red squares):
There is no in plane layer relaxation at all, i.e., the in-plane parameter of the Fe50Co50 alloy is strictly the same as that of Rh crystal up to 19 ML. The interlayer spacing decreases with increasing thickness and reaches the nearly saturated value of c=3.181A above 12-14 ML. This gives a c/a=1.18A and a cell volume of 11.50A^3.
The analysis has been based on a model where the d-spacing – or c/2 – is the same for the whole thin layer, except for the d-spacing between the Rh surface and the first alloy layer. The blue point (figure) at 1 ML represents that value, which is almost independent on the layer thickness.

x=0.25 (green circles):
The thin layer displays a similar behavior at that composition. However, the layer starts to relax around 8-10 ML, where the (c/a) is about 1.20. One can observe that the (c/a) (green circles) is larger for all unrelaxed (up to 10 ML) thickness compared to x=0.5 (red squares) which is expected because there is more Fe in the composition.

x=0.00 : Qualitatively, we observed a similar behavior with a decreasing (c/a) as thickness increases. In addition, a clear relaxation process starts around 6 to 8 ML. As for x=0.25, the relaxation process is gradual. A quantitative fitting involving both relaxed and unrelaxed phases has to be done.



For the Fe1-xCox/Ir(001), we have obtained some preliminary qualitative results. Pure Fe grows pseudomorphically up to about 8 ML and then starts to relax; the in-plane parameter relaxes to 2.745A (a_Ir=2.715A) and the out-plane parameter to 3.16A, giving a (c/a)=1.15 after relaxation around 8ML.

During the deposition of the x=0.5 alloy, the Co deposition rate was extremely stable. However, the Fe source decreased slowly, giving a composition with an excess in Co. The film started to relax around 12-13 ML. The final sample with about 18 ML gave an in-plane parameter of 2.753A (a_Ir=2.715A) and an out-plane of 3.012A, giving a (c/a)=1.09. Owing to the rather complex magnetic phase diagram (Co content versus thicknes) of the FexCo1-x alloy on Ir(001), these data are not enough to draw a picture of the system. For that, we are asking for another experimental round.