ESRF

Experiment title: **Structure of the surface alloy PtxCo1-x at the surface of Pt(111): average structure and attempt to measure the surface pair interaction potentials from diffuse X-ray scatterig of the surface alloy.**

Experiment number:

SI-101

Beamline:	**Date of experiment:**	**Date of report:**
BL7, ID3	from: Sept 95 to: Sept 95	**28** Feb 96
Shifts: 18 shifts	**Local** contact(s) : Salvador Ferrer, Xavier Torelles and Jesus Alvarez	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

V.Jahns, R. Baudoing-Savois, M. De Santis, M.C. Saint Lager, P. Dolle

CNRS Laboratoire de Cristallographie BP 166, F-38042 Grenoble CEDEX

C. Guillot, J. Thiele, LURE Orsay et CEA Saclay, France

S. Ferrer, ESRF

Report:

We haved deposited cobalt on Pt(lll) in UHV under two different conditions: one monolayer, on one hand, and about 4 monolayer in the other hand.

The specular beam was monitored during the deposit and found to exhibit oscillations, showing a significant layer by layer contribution to the growth of the cobalt layer at least for the three first layers. This is consistent with STM observations (Grüter and Dürig) of such deposits and with our LEED observations where good diagrams are obtained up to 10 layers.

Satellites

We then explored the reciprocal space along a (h O 0.25) line scan for the following situations: clean Pt(l11) substrate, 1 monolayer, 4 and about 10 monolayer of Cobalt deposited at room temperature.

- a satellite, originating from the cobalt layer, is found close to the substrate platinum (1 O) rod; its position h= 1.1 is very close to the one expected for the cobalt lattice parameter, whatever the thickness. This indicates that the cobalt layer is very little relaxed, and well oriented with respect to the platinum substrate. **fig.1**
- **we** have then studied the plane 1=0.25 to specify which satellites could be observed for the as deposited co layer.

The deposited cobalt layers were then annealed to produce a superficial alloy layer, which also exhibited satellites. These satellites are not at the same position as for the cobalt deposit, indicating a different lattice parameter (alloy):

- “thin” alloy (1 Co monolayer) exhibit only an asymmetrical shape of the Pt rod;
- “thick” alloy yield well defined satellites at h= 1.055 after annealing the 4 layer deposit slightly below 400°C. Assuming no lateral constrain, the corresponding lattice parameter indicates an average composition of about Pt25Co75.

All these results are in good consistency with our systematic LEED study of the formation of such surface alloys and with the results of J. Thiele et al..

Truncation **rods and satellite rods:**

We have then measured, for the "thin" and the "thick" alloys, the (101) (O 11) and (11 1) rods corresponding to the substrate and the (1.05 O 1) (O 1.05 1) and (1.05 1.05 1) rods corresponding to the "thick" alloy. This is under analysis to extract the composition profiles in both cases which, from our LEED and Auger work, are expected to be oscillatory with platinum enrichment in the top layer.

Diffuse scattering:

Our previous LEED work on the surface of a bulk Pt25Co75(111) alloy demonstrated the presence of significant partial order, although no superstructure was observed. We expect partial ordering to occur similarly at superficial alloys; we thus investigated (in the plane l=0.15) possible traces of diffuse scattering at positions compatible with short range ordering:

- the "thin" alloy exhibited a weak signal which might point to a (0.5 0.5) diffuse spot; very little, if any, was observed at (O 1.5) or (0.5 O); it is thus presently impossible to extract further information from our data in this situation.
- the "thick" alloy exhibited clearly half order diffuse spots: again, the (0.5 0.5) signal was the strongest, but (O 0.5) and (0.5 O) diffuse spots were also visible. (fig 2) Actually the widths of these structures are not very large, indicating perhaps longer range order than we expected. This is under work.

Conclusions:

These surface PtCo alloys are very interesting and grazing Xrays are very helpful to investigate their properties, particularly in conjunction with side studies by LEED (and STM if possible!). Already much is known, which helps us in defining a new project towards magnetic properties of these ultrathin alloy layers in collaboration with' the ESRF team of S. Ferrer.

Since this work, we have performed two complementary studies: one by LEED and Auger spectroscopy (at the Crystallography laboratory of Grenoble) and one on the french CRG-IF beam line (as a commissioning experiment including the many facilities necessary for this type of problem). We gained additional knowledge of the complex object under investigation, namely a "simple surface alloy a few layers thick" of much interest for magnetic device applications.

Grüter and Dürig, Phys.Rev. B49 (94) 2021
J.Thiele, N.Barrett, R. Belkhou, C.Guillot and H. Koundi J. Phys. Condens. Matter 6 (94) 5025
P.Dolle, V.Jahns, M.De Santis, M.C.Saint Lager, Y. Gauthier and R. Baudoing-Savois Communication at "Journées Surface et Interfaces" Grenoble, Fev 96

Co/Pt(l 11) as deposits and alloys
(h O 0.25) line scans

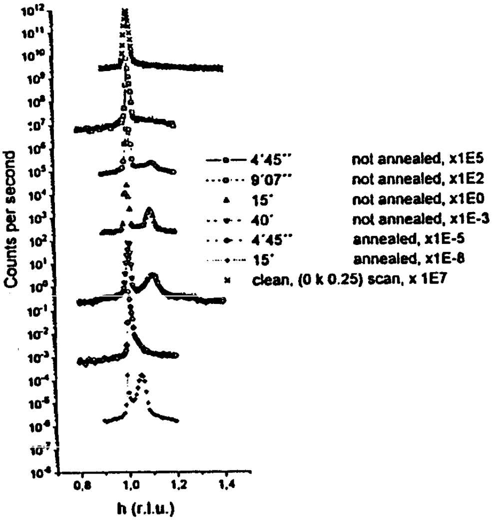

fig.1 satellites observed for the as deposited Co layer

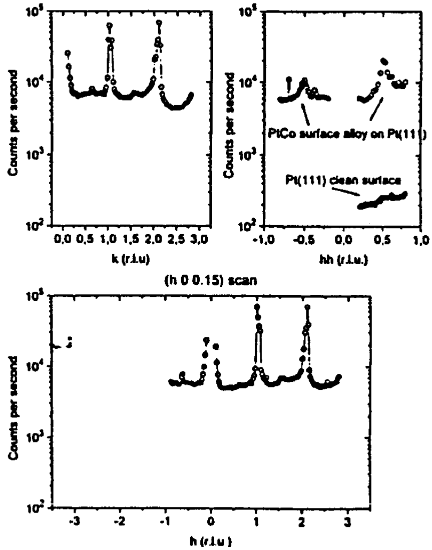

fig. 2 half order rods of the "thick" alloy.