ESRF	Experiment title: Surface Magnetic Scattering in PtCo alloys	Experiment number: SI 97
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Report:

Abstract:

Surface x ray magnetic diffraction experiments have been done for the first time in the (1 11) surface of the ferromagnetic alloy Co_3Pt. This has been achieved by tunning the photon energy to the LIII absorption edge of Pt in order to benefit from the increased magnetic cross section at resonance. To isolate the magnetic contribution in the scattered intensity, the asymmetry ratio $R=(I\uparrow-I\downarrow)/(I\uparrow+I\downarrow)$, for two different orientations of an externally applied magnetic field, has been measured. The resonance curve, R vs. photon energy, for surface diffracted beams has been measured and found to be similar, but not identical, to the corresponding ones for bulk reflections. The measured values of R from surface signals were found to be in the range (2-15)x10^{-3} under grazing incidence conditions. Measurements of R at resonance along the diffraction rods normal to the surface were performed to investigate the surface magnetism. Analysisis of the data reveals that the magnetism of the Pt atoms on the first atomic layer is smaller by almost a factor three than that of the Pt atoms in the bulk.

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We have first performed a structural study of the PtCo3 (1 11) surface by measuring intensities along crystal truncation rods. The results indicate a strong surface segregation of Pt.

The experiments of magnetism have been done by setting the photon energy at the LIII absorption edge of Pt (1 1.564 keV). Under these conditions, the scattering amplitude contains, in addition to the usual Thomson charge scattering f_0, significant contributions of the dispersive (f') and absorptive parts (f") and a resonant magnetic term.

These terms result in a atomic scattering factor which contains a term that changes sign when the magnetization of the sample is inverted, therefore the quantity

$$R = \frac{I\uparrow - I\downarrow}{I\uparrow + I\downarrow}$$

will be different from zero at the resonance energy. At values near resonance R decreases from its maximum and the function R(hv) exhibits a lineshape that resembles a lorenztian.

Our experiments consisted in measuring R at different locations of reciprocal space. For this purpose a movable permanent NdFeB magnet was located inside the UHV chamber.

We will briefly show the results:

The top curve in figure 1 shows the dependence of the asymmetry ratio with the photon energy in the proximity of the LIII absorption for the (006) bulk Bragg reflection. It displays the expected resonant behavior. The energy width (FWHM) is of -6 eV.

The data points at the lowest part of figure 1 are the measured values of R (h,k,l)=(-1,1,2.5) i.e. between two consecutive bulk Bragg reflections, where the surface sensitivity is very high .The value at the maximum is $(6.4\pm0,5)\text{x}\ 10^{-3}$. It shows a similar resonant behaviour as the bulk reflection and it demonstrates the measurability of magnetic x ray signals from surfaces. The continuous lines are calculated.

In order to investigate the magnetic surface structure, measurements of R at resonance were performed for different values of 1 along a given diffraction rod. The data points in figure 2 show the results for the (O, 1) and (1,0) rods. As it may be seen, the data display a rich structure consisting in several maxima and minima. From a numerical analysis with the above formulas and using as an input the results of the crystallographic fit, we obtained that the value of n_m for the surface Pt atoms is about three times smaller than that of the bulk atoms.

FIG 1

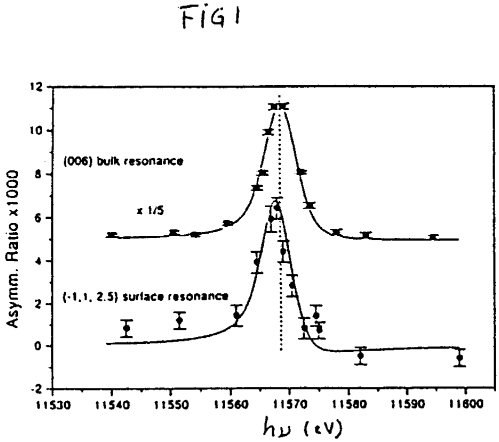

FIG 2