ESRF	**Experiment title: Comparison between surface and interface magnetism in ultra-thin Co films on Pt(111)**	**Experiment number**: SI-1415
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Report:

The aim of the experiment was to study the magnetism of ultra-thin Co films grown on Pt(111) substrate. In order to do that, the growth of Gd overlayers was proposed so that resonant magnetic diffraction loops both from the Pt L_3 edge and from the Gd L_3 edge would give information about the magnetism at the Co/Pt interface and at the Gd/Co interface, respectively. According to that, several Gd / Co / Pt(111) structures were prepared and the Pt magnetism was succesfully measured in all of them. However, the growth of Gd was too much disordered, leading to a very broad peak in the in-plane measurements (figure 1) with not enough intensity to obtain good Gd resonant loops (although a Gd magnetic resonance curve was obtained and the beamline performed very well for switching reproducibly between the Pt and Gd edges). According to this difficulty, we focused the experiment on the influence of the Gd overlayers on the structure and magnetism of the Co/Pt(111) system. Consequently, three different stacking sequences have been prepared:

A) 2 ML Gd / 15 ML Co / 17 ML Gd / 15 ML Co / Pt(111), growth at low temperature (LT), around 200-220 K. This was the more complex stacking, including two Co layers and two Gd layers.
B) 4 ML Gd / 15 ML Co /Pt(111), growth at RT for the 15 ML Co film, and at LT the Gd overlayer.
C) 2.4 ML Gd / 5 ML Co /Pt(111), growth at LT.

The interest of the structures A and B is that the Co layer grown on top of the Pt(111) substrate has been deposited at different temperatures. This leads to different Co stackings, hcp dominated for the A structure and fcc and disorder dominated for the B structure, and the effects of Gd on these two different Co films can be studied. Structure C has been prepared to study the effect of Gd on a thinner Co film.

For each of these structures several measurements have been acquired, including in-plane and out-of-plane scans, Kerr loops and Pt resonant loops. The structural results confirm that Gd has an strong tendency to alloy with Co and to amorphize it and the process has been followed in detail for the different

stackings.This amorphization produces marked shifts of the in-plane 15 ML Co peaks, indicating a reduction of the in-plane Co cell by around 0.4-0.6 % both for the A and B structures (figures 2 and 3, respectively). This amorphization is stabilized after the growth of about 5 ML thick Gd overlayer. Interestingly, for the thinner Co film, structure C, the amorphization proceeds through the opposite behaviour, that is, the increase of the Co in-plane unit cell by about 1.4 %. In this case, the amorphization affects the whole 5 ML Co layer making the Co peak completely disapear (figure 4). The change in the sign of the in-plane unit cell modification may be related to the stronger substrate influence in the case of the 5 ML Co film amorphization. Also, the out-of-plane structure of the Co films has been modified by the Gd overlayers. This modification takes place in a different manner depending on the stacking distribution of the starting film. The analysis of all these effects is currently under way.

Concerning the magnetic properties, strong modifications have been observed upon the growth of Gd overlayers. The amorphization strongly increased the coercive field of the Co films grown at LT, as deduced from the Kerr and Pt loops. This increase is affecting the whole Co layer and is observed in the corresponding Pt resonant loops, sensitive to the magnetism at the Co/Pt interface (figure 5). However, the stronger modifications happened for the thinner Co film where just 0.6 ML of Gd are able to flip the Co magnetization from perpendicular/canted to in-plane anisotropy, and additional growths up to 2.4 ML are enough to make the Pt magnetism disappear, indicating that the amorphization by Gd is affecting even up to the deep Co/Pt interface, in good agreement with the observed in-plane Co peak evolution.

In summary, the Gd overlayer influence on the structural and magnetic properties of Co/Pt(111) structures having different stackings has been intensively studied. The amorphization process has been characterized so that its effects on the in-plane ordering and on the out-of-plane stackings have been determined. The corresponding modifications of the magnetic properties have been measured and their correlation with the structural changes established. The detailed analysis of the data set is currently under way.

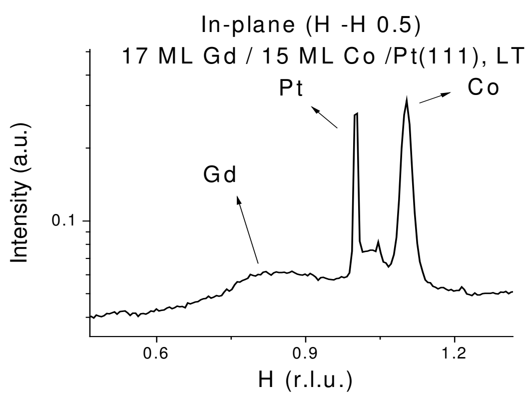

Fig. 1. In-plane (H –H 0.5) scans. LT growth.

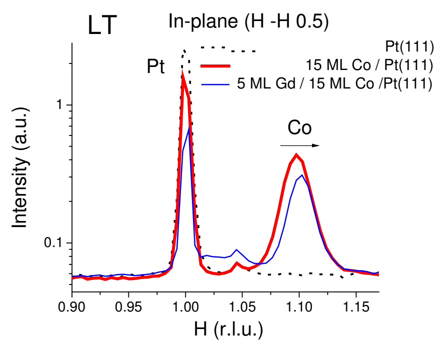

Fig. 2. In-plane (H –H 0.5) scans. LT growth.

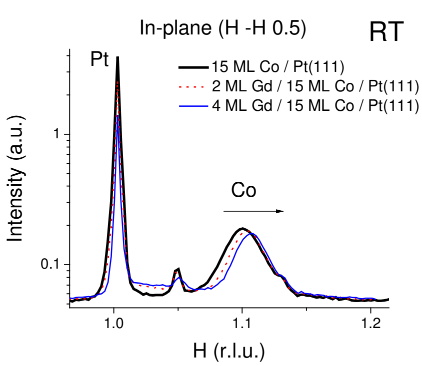

Fig. 3. In-plane (H –H 0.5) scans. RT growth.

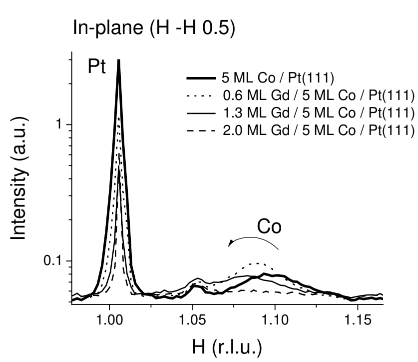

Fig. 4. In-plane (H –H 0.5) scans. LT growth, thin Co film.

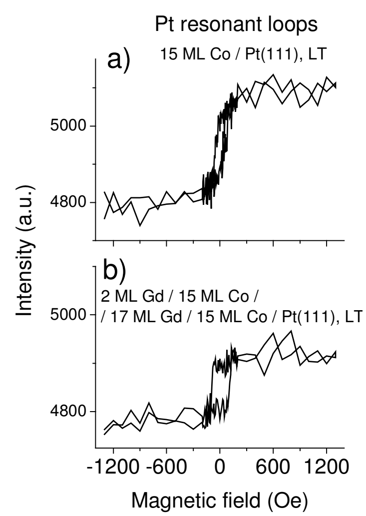

Fig. 5. Pt resonant magnetic loops.