EUROPEAN SYNCHROTRON RADIATION FACILITY

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ESRF

Experiment Report Form

The double page inside this form is to be filled in by all users or groups of users who have had access to beam time for measurements at the ESRF.

Once completed, the report should be submitted electronically to the User Office using the **Electronic Report Submission Application:**

http://193.49.43.2:8080/smis/servlet/UserUtils?start

Reports supporting requests for additional beam time

Reports can now be submitted independently of new proposals – it is necessary simply to indicate the number of the report(s) supporting a new proposal on the proposal form.

The Review Committees reserve the right to reject new proposals from groups who have not reported on the use of beam time allocated previously.

Reports on experiments relating to long term projects

Proposers awarded beam time for a long term project are required to submit an interim report at the end of each year, irrespective of the number of shifts of beam time they have used.

Published papers

All users must give proper credit to ESRF staff members and proper mention to ESRF facilities which were essential for the results described in any ensuing publication. Further, they are obliged to send to the Joint ESRF/ ILL library the complete reference and the abstract of all papers appearing in print, and resulting from the use of the ESRF.

Should you wish to make more general comments on the experiment, please note them on the User Evaluation Form, and send both the Report and the Evaluation Form to the User Office.

Deadlines for submission of Experimental Reports

- 1st March for experiments carried out up until June of the previous year;
- 1st September for experiments carried out up until January of the same year.

Instructions for preparing your Report

- fill in a separate form for each project or series of measurements.
- type your report, in English.
- include the reference number of the proposal to which the report refers.
- make sure that the text, tables and figures fit into the space available.
- if your work is published or is in press, you may prefer to paste in the abstract, and add full reference details. If the abstract is in a language other than English, please include an English translation.

ESRF	**Experiment title: Magnetic Circular dichroism of phthalocyanines adsorbed on Co(100).**	**Experiment number**: **HE-3107**
Beamline: ID8	**Date of experiment**: from: 18/02/10 to: 23/02/10	**Date of report**: 12/04/10
Shifts: 18	**Local contact(s)**: P. Kumar	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

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Report:

The purpose of the experiments was to study the properties of the interface between Mn-pthalocyanine (Mn-Pc) molecules and ferromagnetic Co(100). In particular, we wanted to:

1. Confirm the ferromagnetic coupling we observed previously between Mn in Mn-Pc and Co;
2. Check if there is a sizeable XMCD signal at the N K edge of the Mn-Pc molecules due to the interaction with the Co(100);
3. Check if the Mn-Pc molecules modify the properties of the underlying Co layer.

All samples were prepared in the ID8 prepration chamber equiped with a scanning tunneling microscope (STM). We deposited 1 ML of Mn-Pc molecules either on a Cu(100) single crystal or on various thicknesses of epitaxial Co/Cu(100). We obtained molecular resolution with the STM, and were thus able to prove the quality of the MnPc layer and crosscheck the thickness calibration (cf. fig 1).

We select in the following two samples as a summary to show that we could address the 3 points mentionned above.

As reference layer, we measured the hysteresis loop of 0.9 ML Co/Cu(100) using the intensity of the XMCD at the Co L3 edge (fig. 2). The magnetic properties are those expected for a film with such a thickness in this sytem. At room temperature the film is (super)paramagnetic. At 8 K, the film is ferromagnetic with an magnetic easy axis in plane. By applying the sum rules, we find $m_L = 0.2\ \mu_B$ and $m_S=1.50\ \mu_B$.

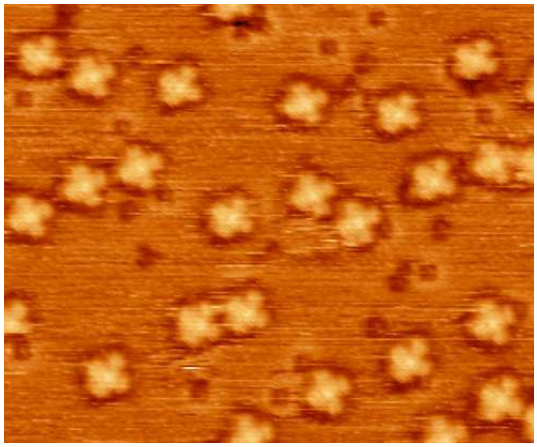

Figure 1: STM image of Mn-Pc molecules on Cu(100) (20x25 nm). The bright spot at the center of each molecule is due to Mn.

Next we added 1 ML Mn-Pc on top of this sample to obtain 1ML MnPc/0.9 ML Co/Cu(100). The hysteresis loop on Co is qualitatively the same as the one obtained on the uncovered sample (fig. 3). The easy magnetization axis is still in-plane. Interestingly, the hysteresis loop on Mn is similar to the loop obtained on Co, which confirm the magnetic coupling between Mn in Mn-Pc and the underlaying Co layer (fig. 3). As there are much less Mn atoms than Co atoms, the loop on Mn is noisier, with an opening for the loop measured at 70° that is probably an artefact. By applying the sum rules on the Co XMCD, we find $m_L = 0.2\ \mu_B$ and $m_S=1.43\ \mu_B$. This small reduction of the Co spin moment might be within error bars and has to be confirmed.

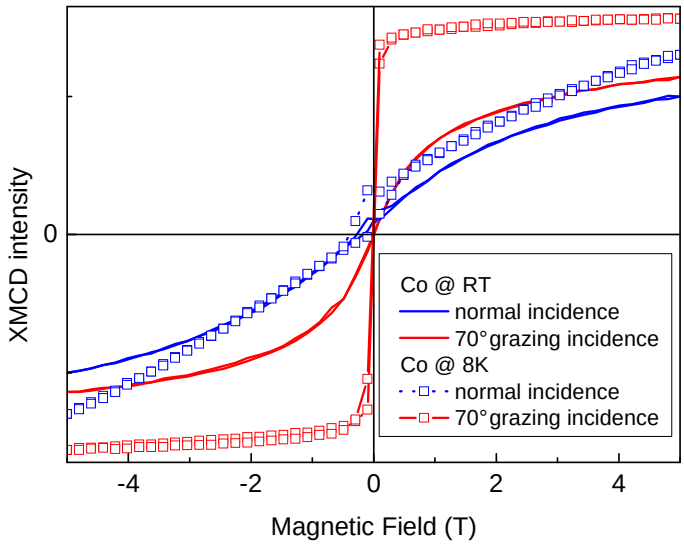

Figure 2: Hysteresis loops of 0.9 ML Co/Cu(100)

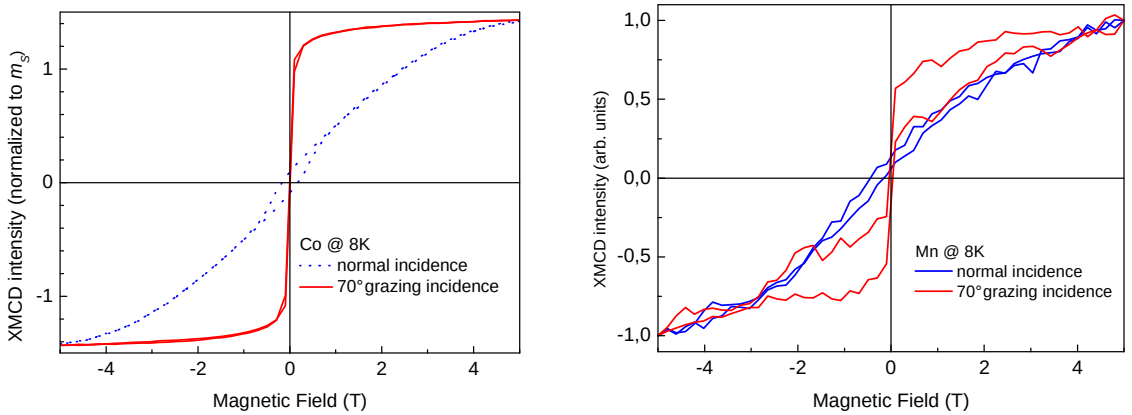

Figure 3 : Hysteresis loop for Co (left) and Mn (right) in 1 ML MnPc/0.9 ML Co/Cu(100)

This result nevertheless shows that adsorption of Pc molecules have a minor impact on the Co surface magnetization, in agreement with our DFT calculations. Similar measurements have been performed incresing Co thickness.
As we confirmed that the Mn is coupled to the Co, we tried to check if it's possible to measure an XMCD signal at the N K edge. The hope was to confirm experimentally what we proved based on theoretical calculations in an article to appear : the polarization of N due to the underlaying Co is of main importance in spintronics in these systems. The XMCD signal can be seen on fig. 4. Due to the presence of harmonics, we had to substract the Co XMCD occuring around 397 eV. The residual signal is very small and a more detailed analysis is under progress, also taking into account measurements on different samples, before this feature can be attributed definitively to the XMCD at the N K edge.

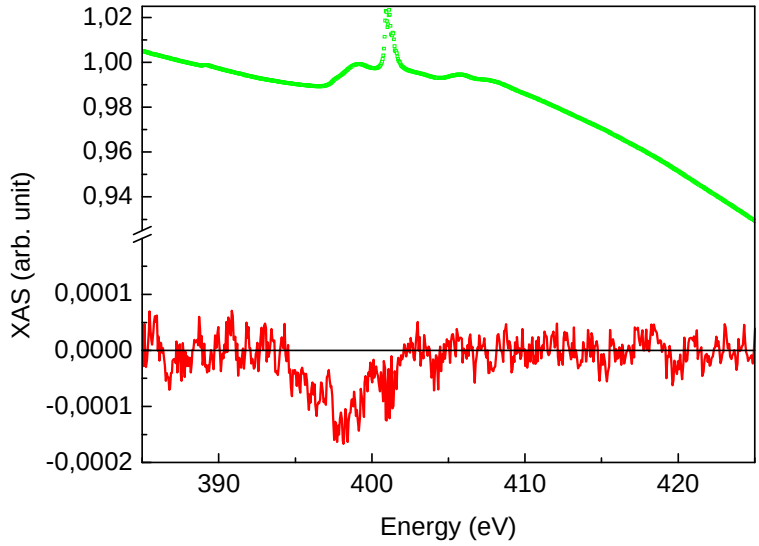

Figure 4: XMCD signal at the N K edge for 1 ML Mn-Pc/0.9 ML Co/Cu(100)