ESRF	**Experiment title:** **magnetic ordering of a cobalt nanodots network**	**Experiment number**: 1445a
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Report:

The aim of this project was to analyse by both resonant soft-X ray diffraction and XMCD the magnetic order and magnetic properties in a magnetic dot lattice of several nanometers periodicity. This project number 1445a is the continuation of project 1445, which could not be performed due to technical problems on the cryomagnet of ID08. The first part was devoted to the ordering of the dots measured by resonant Soft X ray diffraction (experimental report 1445).

This report concerns the second part, devoted to the magnetic properties measured by XMCD with the cryo-magnet.

We used a particular experimental configuration, using the 6 K cryomagnet of ID08 fitted with the VT-STM. This configuration allowed us to successfully prepare samples with special growth conditions on vicinal gold surfaces (Au(11 12 12) and Au(788)). Co was deposited in the STM stage at 130 K and then annealed to 300 K in order to form the most regular arrays of Co nanodots. (see Fig. 1) In this way we could reproduce very well the growth conditions we used at home and we were able to really check the quality of the samples analysed.

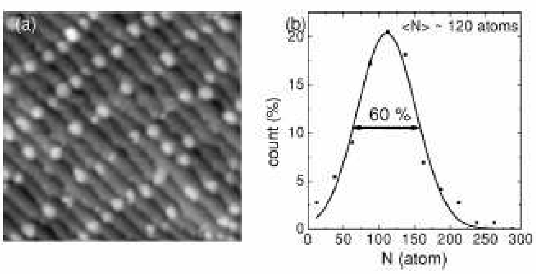

Fig. 1 0.35 ML Co on Au(788) (60 nm x 60 nm) and size distribution

The samples were then transferred in the cryomagnet and analysed with XMCD. Spin and orbital moments were extracted via the sumrules. We obtain a spin moment of 1.7$\mu_B$and an orbital moment of 0.46μ_B (0.36µB) perpendicular (parallel) to the surface, assuming a number of *d* holes of 2.49. We focused on magnetization curves recorded at the cobalt L_3 dichroic maximum (see Fig. 2)

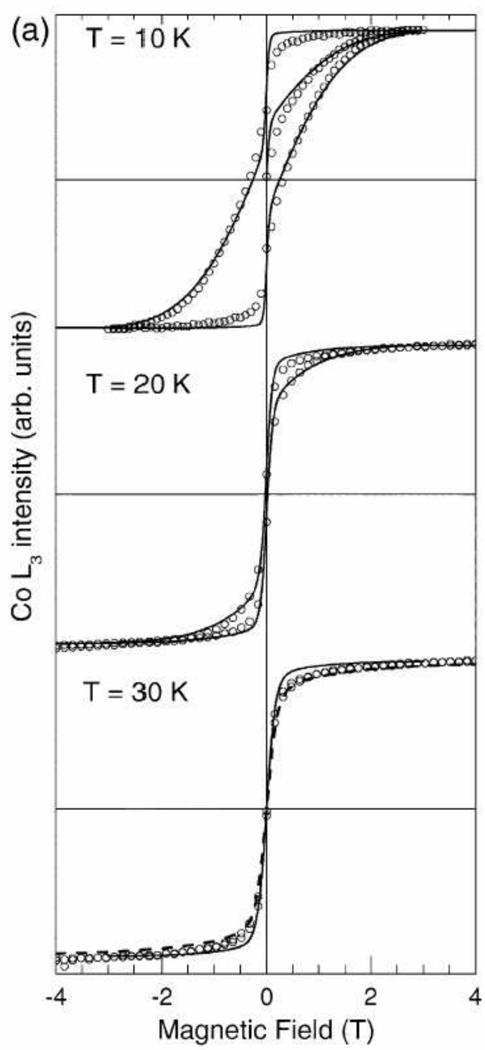

Fig. 2 : XMCD magnetisation curves at the L_3 Co edge as a function of temperature with the magnetic field perpendicular to the sample surface.
The blocking temperature is in the order of 30 K

The full lines are magnetization simulations (see text)

Assuming a simple Langevin shape above the blocking temperature leads to unphysical values of the magnetic moment (the dot size distribution is known from STM, see Fig. 2). On another hand, estimations of the anisotropy based on the blocking temperature leads to an anisotropy of roughly 70 meV per dot, whereas a simple Stoner Wohlfarth model leads to ~40meV/dot. There is a large discrepancy between these two values. To describe properly the magnetization curves in the whole temperature range (blocked and unblocked) we developed a Stoner-Wohlfarth rate equation model with Boltzmann transition probabilities. We also introduced an anisotropy distribution related to the dot size distribution.
This model shows actually that the blocking temperature is related to the highest anisotropy int the dot distribution (~5% of the dots) whereas the coercive field is rather related to the mean dot anisotropy.

Another interesting result from the quantitative analysis in the framework of this model is that in for Co nanodots on Au the anisotropy of the dots is not only related to the perimeter atoms, like it is the case for Co/Pt [1].

[1] S. Rusponi, T. Cren, N. Weiss, M. Epple, P. Buluschek, L. Claude, and H. Brune, Nat. Mater. **2**, 546 (2003).