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Shifts: 18	**Local contact(s)**: Peter Bencok	*Received at ESRF:*

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Report:

1) Introduction

Non-magnetic transition metals (TM) such as Cr and Rh metals may exhibit novel magnetic properties in reduced dimensions.[1] For instance unsupported Cr clusters undergo an *fcc–bcc* phase transition with increasing cluster size[2] whilst Cr ultra-thin films are predicted to order in a coplanar non-collinear anti-ferromagnetic (120º) structure for a thickness of 1ML.[3] On the other hand, the 4*d* moment in gas-phase clusters of ferromagnetic Rh can exceed values for traditional ferromagnetic materials such as Ni.[4] Further, the spin-orbit coupling is much stronger in 4*d* TM such as Rh which should lead to clusters with a much larger magneto-crystalline anisotropy energy (MAE) and hence a higher blocking temperature.

This project was devoted to analyze the magnetic properties by XMCD of Cr and Rh clusters, grown by self-organization on the reconstructed Au(111) surface. The purpose was to measure the XMCD signal as a function of cluster size (which is proportional to coverage), from isolated atoms to few monolayers.

II) Results

1) Cr/Au(111)

For room temperature growth, we observe that the dichroic signal measured at about 5 K decreases with increasing cluster size, from 10% of the L_3 edge jump for ~0.05 ML to less than 0.1% for ~2 ML (Fig.1). With increasing the measurement temperature, the XMCD signal decreases.

We also deposited Cr clusters of various sizes at low temperatures, between about 6 K and 30 K. We observe that, for similar coverages, the XMCD signal is higher for the samples fabricated at low temperature (Fig. 2). This behavior is due to the higher nucleation density obtained when reducing the growth temperature. As for room temperature deposition, the XMCD signal decreases with increasing cluster size. Moreover, the shape and the amplitude of the dichroic signal evolves with time. This dynamic behavior is not yet understood, but it might be related to slow surface diffusion, leading to aggregation of atoms. This phenomenon is limited to the very low coverages, at which one expects isolated atoms on the surface.

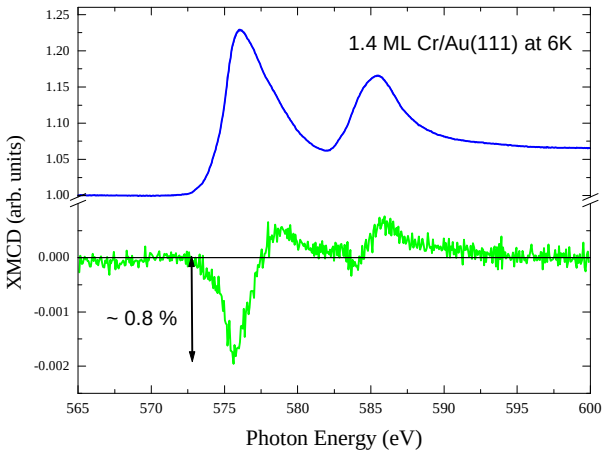

Fig. 1 : XMCD signal of 1.4 ML Cr/Au(111) deposited at RT and measured at 6 K

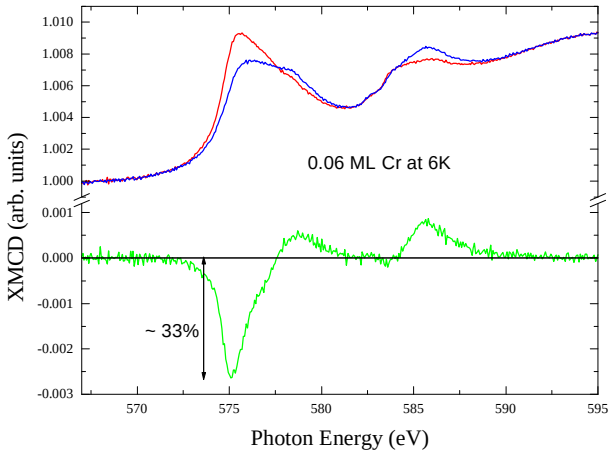

Fig. 2 : XMCD signal of 0.06 ML Cr/Au(111) deposited and measured at 6 K

Magnetization curves obtained by recording the L_3 signal as a function of the external field always show a paramagnetic-like shape (Fig.3). In case of a pseudomorphic growth of Cr on Au(111), one could have expected a ferromagnetic behavior linked to a new expanded fcc Cr phase, but this is not the case here.

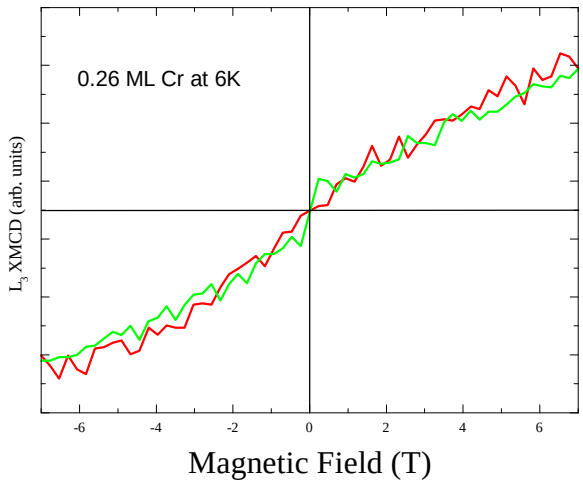

Fig. 3 : Magnetization curve of 0.26 ML Cr/Au(111) deposited and measured at 6 K

2) Rh/Au(111)

Similarly we wanted to deposit Rh on Au(111). We only managed to deposit two different cluster sizes at low temperature on Au(111). No dichroic signal was observed at all. Some preliminary earlier experiments on ID12B (see experimental report HE-772) evidenced a weak but clear dichroic signal for room temperature grown Rh clusters on Au(111). Unfortunately, the sample holder broke and we could not confirm these results.

References

[1] see e.g. Dreyssé and Demangeat, Surface Sci Rep. **28** (1997) 65, and ref. therein
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[3] Ph. Kurz, G. Bihlmayer, K. Hirai, and S. Blügel, Phys. Rev. Lett. **86**, 1106 (2001)
[4] Reddy et al. Phys. Rev. Lett. **70** (1993) 3323; Cox et al. Phys. Rev. Lett. **71** (1993) 923