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Experiment Report Form

	Experiment title: Photomagnetic High Spin Molecules: Characterization of the Metastable State by XMCD.	**Experiment number**: HE2247
Beamline: ID12	**Date of experiment**: from: 11-OCT-2006 to 18-OCT-2006	**Date of report**: 01/03/2007
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Names and affiliations of applicants (* indicates experimentalists):

M.-A. Arrio, Ph. Sainctavit,
Institut de Minéralogie et Physique des Milieux Condensés
CNRS-UMR7590, 140 rue de Lourmel, 75015 Paris

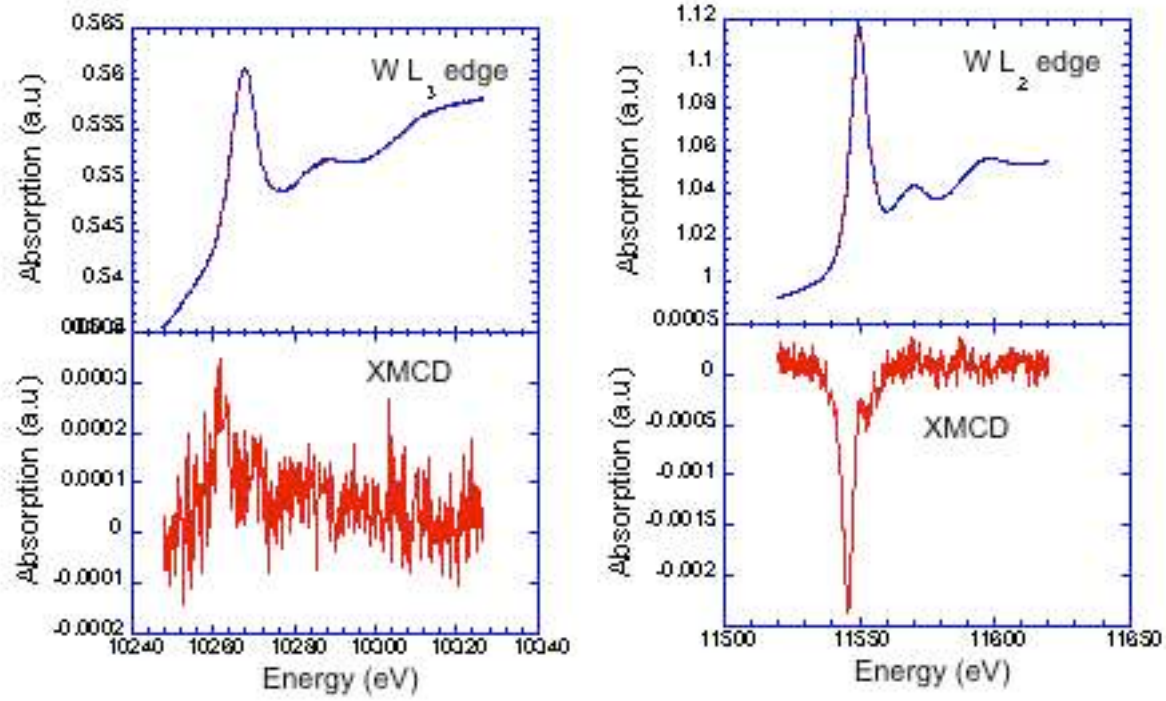
J. Long, V. Marvaud, C. Cartier dit Moulin,
Laboratoire de Chimie Inorganique et Materiaux Moleculaires
Université Paris 6 , 4 place Jussieu, 75252 Paris Cedex 05, FRANCE

Report:

The HE-2247 proposal concerns the domain of molecular magnetism. The Laboratory of Chimie Inorganique et Matériaux Moléculaire of the University Paris VI is developing magnetic molecular systems based on transition metal elements. The systems concerned in this proposal are photomagnetic molecules. Attractive results have been obtained on the tungsten–copper complex, that is simply called $W^{IV}Cu^{II}_6$ (6 Cu ions linked to a central Mo ion by cyano ligands). Before light irradiation, this complex behaves as a paramagnetic system (six isolated paramagnetic Cu^{II} (S=1/2) ions surrounding a low spin W^{IV} (S=0) diamagnetic core). After visible light irradiation ($\lambda \approx 410$ nm), the magnetic properties are found to be consistent with those of a high spin molecule. This change might be explained by a photoinduced charge transfer from W to Cu ions, leading to the formation of W^{V} (S=1/2) in ferromagnetic interaction with the surrounding Cu^{II} ions.[1] In addition, the photo-produced metastable state is persistent up to an unusually high temperature (280 K) and this photo-magnetic effect is thermally reversible.

In preceeding experiments (HE-2003) two photomagnetic molybdenum-based compounds were measured: $MoCu_2$ and $MoCu_6$. We showed that a XMCD signal appears after irradiation of the sample at 10 K. The application of the sum rules demonstrated that Mo ion in the light induced state is high spin Mo^{IV}. These results were presented by Philippe Sainctavit during the last ESRF users meeting.

For the HE-2247 proposal, we measured the XMCD signal at W $L_{2,3}$ edges of two W-based compounds: WCu_6 and WCu_2. Before irradiation of the sample, the XMCD signal is null, as expected. After around 20 hours of irradiation at 10 K, an XMCD signal appears. These experiments were performed by using the x-rays as irradiation source, as it was made for the Mo compounds. The following figure presents the XMCD signal at the W $L_{2,3}$ edges.



The sample was then heated to 300 K to be relaxed. After relaxation, the XMCD was measured at 10 K: the XMCD signal is back to zero.
No significant changes (shape or energy displacement) have been observed in the isotropic spectra of the compound in the ground state and in the light excited state. It seems to show that there is no charge transfer leading to the transformation of W^{IV} in W^{V}.

For the first time, we have been able to measure the apparition of a magnetic moment on the W ion after irradiation of the sample. XMCD provides a unique tool to measure such phenomenon.