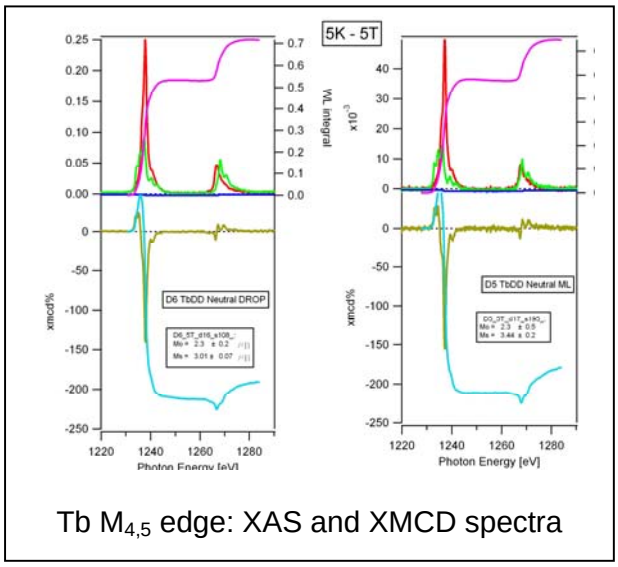
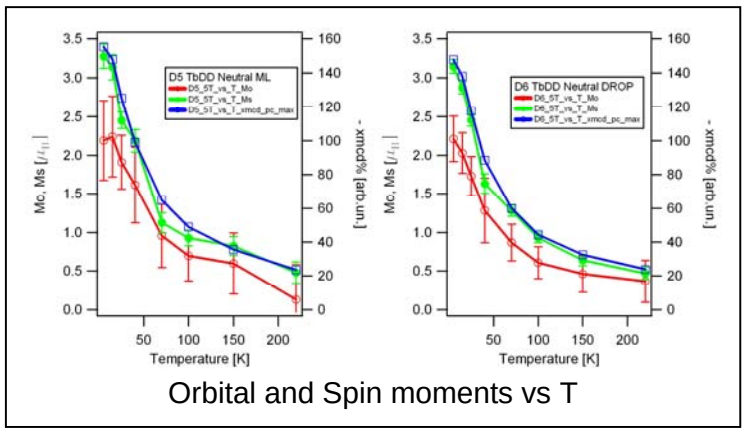
In the beamtime HE2352 on the beamline ID8 we exploited X-ray Absorption Spectroscopy (XAS) and X-ray Magnetic Circular Dichroism (XMCD) to investigated the electronic and magnetic properties of thick films and monolayers of double-decker phthalocyaninato terbium neutral complex $[(Pc)_2Tb^{III}]^0$ (Pc = dianion of phthalocyanine) Single-Molecule Magnets (SMMs) deposited on graphite (HOPG). Unfortunately we could not use the STM because of an instrument malfunctioning.

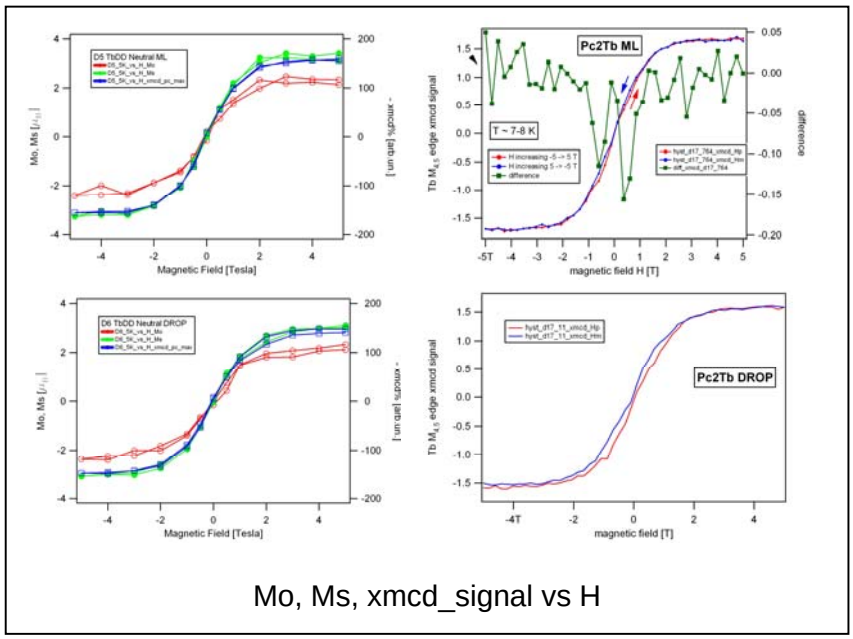
We measured XAS and XMCD at the terbium edge vs magnetic field and vs temperature both on thick (drop) and single molecular layer (ML) of $[(Pc)_2Tb^{III}]^0$ and $Tb(acac)_3$ as a reference compound. We also checked for nitrogen polarization at the N1s edge.
M vs H measurements have been made both by acquiring full spectra (FULL mode) and only the xmcd intensity by limiting the acquisition to a few points of spectra (FAST mode). FULL mode allowed us to to extract the orbital and spin contribution to the total magnetic moment at the price of a long acquisition time, whereas the FAST mode is much faster, but provides less informations and is prone to higher errors. Orbital Mo and spin Ms magnetic moments have been obtained using sum rules. Work is ongoing for simulating the spectra for doing a more accurate analysis.



Tb $M_{4,5}$ edge: XAS and XMCD spectra



Orbital and Spin moments vs T



Mo, Ms, xmcd_signal vs H

To date, main results are:

- XAS, XMCD of ML and DROP looks very similar, an indication that the interaction with the substrate is not very strong;
- Spin S is slightly higher in ML wrt DROP: surface effects or non negligible Tz on ML due to an expected higher ordering of molecules on the surface with respect to the disordered thick film (drop);
- M vs H acquired in FAST mode show the opening of a small butterfly-shaped hysteresis loop, which is not seen in the FULL mode acquisition. The entity of this opening is small, probably comparable to the error bar of the measurement. However, three independent acquisitions provide the same result and no trace of opening is seen on the reference compound ($Tb(acac)_3$), so the result seems to be meaningful.
- The M vs H measurements relative to ML and drop are very similar, although they are different from the bulk ones (measured with SQUID or micro-HALL probes);
- The Mo, Ms vs T behaviour for ML and drop are very similar;
- No evidence for nitrogen magnetic polarization is found. The vibrational modulation is less pronounced in DDTb compounds (both drop and ML) with respect to N_2 from air seen on the Tb(acac)3 compound, may be due to the superposition of N_2 from air and the phtalocyanine nitrogen contributions.

Data elaboration and analysis are still ongoing.

Due to problems occurred during the synthesis, chemists had not been able to supply us the anionic form of the compound, so we could not perform the compared analysis between the neutral and the anionic form of the double-decker phthalocyaninato terbium complex. We then used the beamtime for completing the investigation started in previous shifts at ID8 about the electronic and magnetic properties of films of $\{Cr_8\}$ and $\{Cr_7Ni\}$ antiferromagnetic rings and of monolayers of $\{Cr_7Ni\}$ grafted on Au(111). We could confirm main results and adding some new piece of information, allowing us to publish the data for the thick films on PRB [1]. XMCD measurements show that the exchange coupling between the Cr and Ni spins in the $\{Cr_7Ni\}$ molecular ring switches from antiferromagnetic to ferromagnetic with increasing temperature due to the interplay between Zeeman and isotropic-exchange contributions, a behaviour in full agreement with spin Hamiltonian calculations. For the monolayers the data are still in elaboration and will be presented in the next future. The surprising novelty is that the Ni spin seems to couple ferromagnetically to neighbouring Cr even at the lowest temperature. Calculations to account for this behaviour are actually ongoing.

[1] V. Corradini, F. Moro , R. Biagi, U. del Pennino, V. De Renzi, S. Carretta, P. Santini, M. Affronte, J.C. Cezar, G.A. Timco and R.E.P. Winpenny, “XMCD investigation of spin and orbital moments in Cr8 and Cr7Ni antiferromagnetic rings”, Phys.Rev.B 77, 014402 (2008)