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The local magnetic properties of $[Mn^{III}_6\ Cr^{III}]^{3+}$ and $[Fe^{III}_6\ Cr^{III}]^{3+}$ single-molecule magnets deposited on surfaces studied by spin-polarized photoemission and XMCD with circularly polarized synchrotron radiation

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Synopsis It is demonstrated that local magnetic moments of single molecule magnets (SMM) normally studied by XMCD at very low temperatures and high magnetic fields can be measured by means of spin-resolved electron emission in the paramagnetic phase at room temperature by use of circularly polarized radiation.

Comprehensive studies of the $[Mn^{III}_6\ Cr^{III}]^{3+}$ and $[Fe^{III}_6\ Cr^{III}]^{3+}$ single-molecule magnets deposited on Au and Si substrates by use of Spin-Resolved Electron Spectroscopy (SPES) and X-ray Magnetic Circular Dichroism (XMCD) are presented. The $[Mn^{III}_6\ Cr^{III}]^{3+}$ SMM consists of two bowl-shaped Mn_3-triplesalen units linked by a hexacyanochromate. It exhibits a spin ground state of S_T =21/2 [1,2]. For excitation energies covering the Mn- and Fe-$L_{2,3}$ regions, the spin polarization of Auger electrons originating from the Mn^{III} and Fe^{III} has been measured at room temperature and without applying external magnetic fields [3]. Radiation damage was controlled by XAS at the Mn-L_3 edge [4]. Corresponding XMCD data have been obtained at 2K and 7T. The local magnetic properties of the Mn and Fe constituents in $[Mn^{III}_6\ Cr^{III}]^{3+}$ and $[Fe^{III}_6\ Cr^{III}]^{3+}$ SMM derived from spin polarization data in the paramagnetic phase are compared to results obtained by XMCD. Thus as already studied for solid Gd [5] the spin polarization of electrons emitted from paramagnetic molecules should show the same values of opposite signs as the XMCD intensity asymmetries for spin-ordered systems measured at very low temperatures and with high magnetic fields as shown in Figs. 1 and 2.

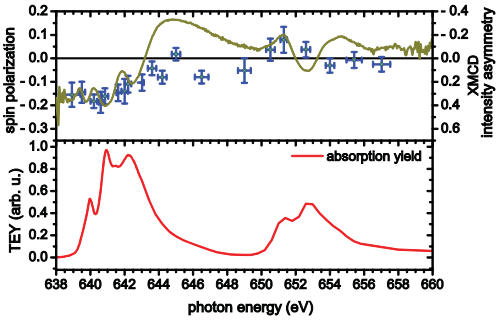

Figure 1. Spin polarization of LMV Auger electrons (error bar crosses) (60eV below valence band maximum) from single molecule magnets ($[Mn^{III}_6\ Cr^{III}](ClO_4)_3$ deposited on a gold surface emitted following excitation with circularly polarized synchrotron radiation in the region of the Mn-$L_{2,3}$ absorption edge (absorption spectrum yield in the lower part of Fig. 1) measured at room temperature without any magnetic field in cross comparison with the XMCD intensity asymmetry (curve in the upper part of Fig. 1) of the same system measured at very low temperatures (2K) and using a high magnetic field (7T) for spin orientation in the initial state.

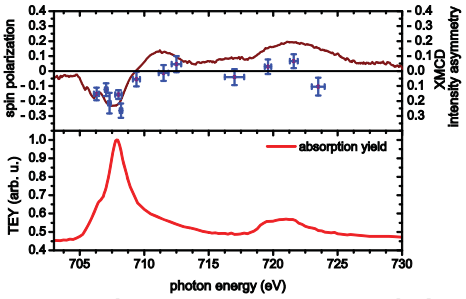

Figure 2. The same as in Fig. 1. But with electrons from $[Fe^{III}_6\ Cr^{III}]\ (ClO_4)_3$ single molecule magnets at the Fe $L_{2,3}$ absorption edge .

References

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