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## Analysis of the dysprosium M5 circularly polarized X ray absorption spectrum to detect magnetically uncoupled rare earth atoms to TM in TM-RE amorphous alloys

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The circularly polarized absorption spectrum of Dy M5 in DyCo4.5 amorphous alloys was decomposed in its spectral components related to transitions to states with the dysprosium angular moment parallel, antiparallel and perpendicular to the applied field [1]. This was done taking advantage of the atomic-like behavior of the 4f electrons, and the fact that, due to their large orbital moment in dysprosium, the parallel and antiparallel spectral components have very small overlap, being easily deconvoluted from the XMCD related spectrum. The intensity of the deconvoluted components in the analyzed dysprosium M5 spectra at RT and 2 K did not match the expected deduced from the magnetic moment values obtained from the XMCD sum rules. This indicates that the spectra must be formed by dysprosium atoms in different magnetic states, which are attributed to those related to strongly coupled to cobalt, and those uncoupled or weakly coupled to cobalt. A model is proposed that place most of the uncoupled dysprosium atoms at the surface of the alloy, as photoemission spectroscopy measurements done in similar samples proved, indicating rare earth segregation at the surface. This is also coherent with the surface sensitivity of the method used to detect the absorption spectra (TEY). The proposed spectral deconvolution analysis can be extended to other rare earths like Tb and Nd, whose orbital moment in their 4f orbital is not zero. The method is specially sensitive to detect if the rare earth has more than a single magnetic state in the analyzed material. The measurements were done in BL29, in the HECTOR end station, at the ALBA synchrotron.

[1] J. Díaz and C. Blanco. Phys. Rev. B 104, 054439 (2021)

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