X-ray magnetic circular dichroism at rare-earth $L_{2,3}$ absorption edges in various compounds and alloys

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Recent progress in techniques of synchrotron light sources has enabled us to study many phenomena which had been barely observable up to now. Among these, the X-ray magnetic circular dichroism (XMCD) in the X-ray absorption spectroscopy (XAS) in various materials displays a unique and powerful ability to reveal detailed information on electronic and magnetic properties of a selected atom and even a selected shell. A theoretical interpretation of the XMCD at rare-earth (called R hereafter) L_{23} absorption edges is reviewed using differing models depending on the material under investigation. In a first part we present an overview of the recent developments of XMCD in XAS with general remarks, especially at R-atom absorption edges. Then we discuss two examples of XMCD spectra in : (i) RFe_2 Laves-phase compounds, using a tight-binding approximation for R 5d and Fe 3d conducting states, and (ii) $R_2Fe_{14}B$ metallic compounds, with the help of a cluster model. The good agreement for $R_2Fe_{14}B$ suggests that a cluster model provides a valuable method to quantitatively calculate XMCD spectra of R systems, even with quite complicated atomic arrangements. Actually we essentially focus our talk on the special case of Ce-systems, related to XAS and XMCD studies at the Ce L_{23} edges. Two clearly differing cases are presented both from experimental and theoretical points of views: (i)A well localized $4f^1$ system, i.e. Ce Ru_2Ge_2 (ii)A less localized $4f^1$ system, i.e. $CeFe_2$, with a 3d partner. Also we investigate the influence of substitution on the low temperature properties of $CePd_3$: $Ce(Pd_{1-x}Ni_x)_3$ with x taken up to about 0.25. Moreover the Ce L_{23} XMCD signal measured in $CePd_3$ demonstrates that in the Ce based dense Kondo materials, only the $4f^1$ channel gives a magnetic response. At last we give another example : $Ce(Pd_{1-x}Mn_x)_3$ where x is about 0.03 giving rise to $(CePd_3)_8Mn$ where Mn sublattice undergoes a ferromagnetic transition and where Ce ions form a dense Kondo lattice and are in a paramagnetic state.

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