The usefulness of x-ray magnetic circular dichroism for spintronics materials

Alouani, Mebarek[1]

[1]*IPCMS, UMR 7504 CNRS-ULP, 23 rue du Loess, Strasbourg, France*

In the first part of the talk we will show that in a non-polar geometry for non-cubic ferromagnetic materials, the x-ray absorption dichroism spectrum is composed of a non-magnetic contribution (natural dichroism) emanating from the reduced crystal symmetry and a magnetic contribution from spin-orbit coupling and spin polarization. Their computation at the $L_{2,3}$ edges of the half metal CrO_2 chromium site, illustrates that the agreement with experiment is possible only when both dichroic contributions are taken into account. Moreover, it will be shown that x-ray magnetic dichroism sum rules can be applied directly to extract the spin and orbital magnetic moments only after removing the natural dichroism from the full spectrum. The method is then used to investigate the electronic structure and x-ray magnetic circular dichroism of the important material Sr_2FeMoO_6 for spintronics. It is found that the compound is half-metallic ferrimagnet with a well defined gap in the minority spin channel. The opposite direction of spin magnetic moments in Fe site and Mo site gives direct confirmation of ferrimagnetic ordering and settles the controversy existing between the earlier experimental works. Furthermore, the overall comparison obtained between the theory and experiment ensures that the density functional theory is sufficient for the description of the experimental data. The second part of the talk will be devoted to Fe/MgO/Fe heterojunction. We will show that the different structural defects observed in Fe/MgO samples, i.e., the roughness at the interface and the presence of FeO layers, are responsible of the reduced experimental tunneling magneto-resistance (TMR) compared to that of the perfect junction. We will show again that the use of XMCD is crucial for accessing the existence or not of FeO layers at the Fe/MgO interface.