Perspectives in x-ray dichroism and magnetic resonance spectroscopy

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We present a new method to measure continuous-wave magnetic resonance spectra based on the core-level absorption of circularly polarized x-rays [1]. The technique is demonstrated by using a monochromatic x-ray beam incident on an yttrium iron garnet (YIG) sample excited by a microwave field $\mathbf{B}_1$ at 2.47 GHz. Ferromagnetic resonance (FMR) spectra are obtained by monitoring the x-ray absorption intensity at the photon energy corresponding to the maximum of the magnetic circular dichroism effect at the iron $L_{2,3}$ edges as a function of bias field $\mathbf{B}_0$, applied parallel to the x-ray beam and perpendicular to $\mathbf{B}_1$. The x-ray FMR (XFMR) signal is shown to be energy-dependent, which makes the technique element-sensitive. We discuss possible applications of x-ray magnetic resonance detection methods to a broad range of magnetic and paramagnetic systems.

Recent XMCD studies on single-layer paramagnetic metal-organic compounds will also be presented as an example of combined structural and magnetic characterization of nanostructures carried out at the ESRF. Metal-organic supramolecular networks constructed by the sequential assembly of organic linkers and transition-metal atoms on a metal surface constitute a novel class of molecular materials whose functionality depends on the balance between intermolecular and substrate interactions. X-ray absorption spectra and scanning tunneling microscopy show that coordination bonds form between Fe atoms and terephthalic acid molecules upon sequential deposition of the metallic and organic species. Low-temperature XMCD data reveal that the magnitude of the Fe spin and orbital moment as well as the occurrence of in-plane, out-of-plane magnetic anisotropy are effectively controlled by the ligands rather than by the susbtrate.

[1] *X-ray ferromagnetic resonance spectroscopy*, G. Boero, S. Rusponi, P. Bencok, R. S. Popovic, H. Brune, and P. Gambardella, *Appl. Phys. Lett.* **87**, 152503 (2005).