01-Instrumentation and Experimental Techniques (X-rays, Neutrons, Electrons)

The largest resonant enhancements have been observed for incident X-rays near the Mν absorption edges of the actinides and near the Lγ edges of the rare earths and transition metals. The polarization and energy dependence of the resonant cross-section has provided a new spectroscopy of magnetic states which is only beginning to be developed in both scattering and absorption geometries. Current experimental work is reviewed and perspectives related to the operation of new, third generation synchrotron radiation sources are discussed.

MS-01.04.04 MAGNETIC CIRCULAR X-RAY DICHROISM: PROBING LOCAL MAGNETIC STRUCTURES by Gaëlle Schutz, Experimentalphysik II, Universität Augsburg, Germany, and Silke Stühler, Fakultät Physik, E12, Technische Universität München, Germany

Circular magnetic x-ray dichroism is core-level absorption is the absorptive counterpart of magnetic resonance in polarized light. It is based on the same physical phenomenon, the difference in the imaginary part of the charge scattering amplitude for right and left circularly polarized photons in magnetic matter and a complementary element- and symmetry-selective methods to study the magnetic aspects of the electronic structure of solids. Typical magnetic absorption effects at K- and L-edges in the hard and soft x-ray range are presented. Their relation to the spin polarization of unoccupied bands as well as local magnetic spin and orbital moments are discussed in the frame of single-particle band-structure pictures and atomic multiplet theories. Focusing on magnetic multilayered systems as Co/Pt and Co/Cu it is demonstrated that the magnetic circular dichroism measurements yield important new information on the exchange coupling mechanism especially the role of the pure element non-magnetic interlayer. Also in the EXAFS range the existence of a magnetic port (SPEXAFS) has been established to be an universal phenomenon, which allows to study local magnetic structures in ferro- or ferri-magnetic materials. A comparison of the EXAFS allows a clear distinction between magnetic and nonmagnetic neighborhood also in case of non-magnetic absorbing atoms. Comparing the peak heights in the SPEXAFS strength for various magnetic systems a direct correlation between the magnetic contribution to the EXAFS and the spin moment of the neighboring atom is found providing a new possibility of a quantitative investigation of local magnetic short-range order.

MS-01.04.05 SITE SPECIFIC MAGNETIC XANES. By H. Kawata, Photon Factory, National Laboratory for High Energy Physics, Tsukuba, Japan.

Magnetic X-ray Absorption Near Edge Structure (XANES) using circularly polarized X-rays gives the spin polarized unoccupied electron states [1, 2]. Recently, the study for ferro- or ferrimagnetic materials by using the experimental method have been rapidly developed. In a case of ferri-magnetic materials, however, there are two different sites for magnetic atoms. For example in the case of YFe₂(O₃Fe)(O₃)[1], the magnetic ions Fe²⁺ have two different sites. One is an octahedral site and another is a tetrahedral site. The directions of magnetic moments on these sites are opposite to each other. It is naturally expected that the magnetic XANES spectra of Fe K-edge for Fe³⁺ ions at the octahedral site differ from that for the tetrahedral site, because of the different chemical bonding and the different direction of the magnetic moment. Therefore, it is necessary to analyze the tetrahedral and octahedral sites in order to study these materials. Here we present the first measurement of the site-specific magnetic XANES of YIG by means of the following two methods.

<Magentic XANES under a standing wave field>
The standing wave field method, which is obtained by exposing a dynamical Bragg diffraction in a crystal, gives us site-specific information. Therefore, magnetic XANES measurement under a standing wave field gives us the site-specific magnetic XANES[3]. Figure 1(a) and (b) show the site-specific XANES and magnetic XANES at Fe K-absorption edge. The black and open circles in each figure are those of the octahedral site and tetrahedral site, respectively. As shown in this figure, the characteristic structure at the pre-edge is mainly given by the tetrahedral site.

<Resonant magnetic Bragg scattering>
Recently, Stehr et al. presented the site-specific normal XANES by means of DAFS[4]. The resonant magnetic Bragg scattering corresponds to the magnetic DAFS. Therefore, the resonant magnetic Bragg scattering from the different diffraction index also brings us the site-specific magnetic XANES. Figure 2(a) and (b) show the results from (444) and (864) diffraction. The structure factor of these indices are as follows:

F(444) = -12 y₁f₁O₂[12 f₁T₁
F(864) = 8 y₁f₁O₁

Here, y₁, f₁O₂ and f₁T₁ are atomic form factors of Y, Fe at the octahedral site, and Fe at the tetrahedral site, respectively. In the case of 864 diffraction, Fe at the tetrahedral site only contributes to the structure factor, and the spectrum of Fig. 2(b) is well explained by the magnetic XANES of the tetrahedral site in Fig. 1(b).


PS-01.04.06 MAGNETIC STRUCTURAL STUDIES USING LONG-WAVELENGTH PULSED NEUTRONS. By J. B. Forsterth, C. J. Carville and P. S. R. Krishna, Rutherford Appleton Laboratory, Chilton, Oxon. OX11 0QX, U.K.

Powder diffractometers at pulsed neutron sources such as ISIS can provide very high resolution in backscattering, odd x 10⁻², which are almost constant over the whole range of d-spacings down to d = 0.3 Å. Whilst this is very effective for atomic structural studies, it is less adapted to the measurement of magnetic scattering since the intensity falls off rapidly with increasing sin θ/λ due to the magnetic form factor. The low order reflections of interest occur at low sin θ/λ and are weak due to the paucity of long λ neutrons from the 90 K moderators normally used. We report here a measurement in which the incident beam came from a 25 K liquid H₃ moderator. The enhanced low λ flux gives powder patterns having good intensity, excellent...