tried to get the RXS at Ga EA but could not detect the signal within our experimental error. This means the local orbital state at Ga site is quite isotropic in the ab-plane of the compound.

Keywords: orbital ordering, impurity effect, resonant X-ray scattering

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Flipping ratio in circularly polarized X-ray diffraction

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The flipping ratio in circularly polarized x-ray diffraction has been expected to be complementary technique to that in polarized neutron diffraction which is known as a powerful technique to investigate magnetization density distribution in atomic scale. However, the establishment of this technique has been prevented by extremely small flipping ratio. The purpose of the present study is to make this promising technique practicable by applying the helicity modulation technique which has been used in highly accurate x-ray magnetic circular dichroism measurements at BL39XU/SPring-8. This experiment was performed on the synchrotron radiation facility SPring-8. Linearly polarized x-ray from an undulator was transformed into circularly polarized one by a diamond x-ray phase retarder. The Flipping ratio in diffraction intensity was measured by modulating photon-helicity at a certain frequency and detecting synchronized response of diffraction intensity through lock-in amplifier. Charge scattering ought to cancel out in this technique. The result of the first experiment revealed two fatal problems on lock-in amplifier output; an extremely large background and alteration of output on time. The cause of these problems was supposed to be residual charge scattering arising from counter error in degree of circular polarization between right and left handed one, which was induced by shift in incident angle of x-ray beam into a phase retarder. Therefore it became clear that the feedback system for optimizing the incident angle into a phase retarder is essential to eliminate these problems. We have recently invited a feedback system and succeeded in solving the technical problems on measuring flipping ratio in circularly polarized x-ray diffraction by using this feedback system.

Keywords: X-ray diffraction technique, X-ray polarization, magnetic X-ray scattering

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Development of a polarization rotator for X-ray magnetic diffraction

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X-ray magnetic diffraction is a promising method to directly determine not only electronic spin and orbital angular momentum density distributions in materials but also the chirality of higher-order magnetic structure. Moreover the combination of X-ray magnetic diffraction with microbeam technologies will make it possible to investigate magnetic structures in mesoscopic system. However experimental techniques of X-ray magnetic diffraction have remained almost unchanged for two decades. In order to take advantage of high-performance of the third generation synchrotron radiation source, we have developed a polarization rotator for the experimental separation of spin and orbital contribution to magnetization (LS separation). The polarization rotator was assembled from a pair of diamond X-ray phase retarders functioning as quarter-wave plate (QWP). The first QWP transformed linear polarization into circular one and the second QWP did inversely. Inclination angle of the polarization plane of transmitted X-ray is controlled by rotating an optic axis of the second QWP around the traveling direction of transmitted X-ray. The performance of the polarization rotator was evaluated at an X-ray undulator beamline, BL29XUL of the SPring-8. We have confirmed that polarization of transmitted X-ray is manipulated as expected. The performance of the polarization rotator can be designed so as to give priority to degree of polarization or photon flux, which facilitates X-ray magnetic diffraction experiments. We have conducted an LS separation study on holmium using the polarization rotator. The results were well explained by theoretical value of L(K)/S(K)=9.7 within experimental error. This polarization rotator significantly improved measurement precision.

Keywords: X-ray magnetic diffraction, X-ray polarization, polarization rotator

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Multiple-wave X-ray resonant diffraction using iterative Born approximation

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Multiple-wave X-ray diffraction, a phase-sensitive scattering process, is a useful tool for studies in crystallography and solid state physics. According to the dynamical theory, the asymmetry of a three-wave intensity distribution is closely related to x-ray phase, scattering factor, structure factor and charge distribution. Based on this, recently we have successfully connected the information of anomalous fine structure function with the variation of three-wave intensity profiles in the vicinity of an absorption edge. Moreover, by measuring the multiple-wave intensity profiles near absorption edges (at resonance), one can easily obtain the EXAFS/DAFS-like local structure information either by the dynamical theory or iterative Born approximation. However, the iterative Born approximation, not like the dynamical theory, is simpler and easier to handle, which can be applied to diffraction from epitaxial thin films. In this paper, we will report on the iterative Born approximation method and illustrate how it works for the analysis of multiple-wave X-ray resonant diffraction.

Keywords: multiple-wave diffraction, resonant diffraction, iterative Born Approximation