BL-3C/2012G643, 2014G594

Polarization Factor in Monochromatic X-ray Method of X-ray Magnetic Diffraction

Tokiko Osawa[1], Hidefumi Shimoyama[1], Kohei Kato[1], Masahito Takashima[1], Kosuke Suzuki[1], Hiroshi Sakurai[1], Keiichi Hirano[2] and Masahisa Ito[1]
[1]Graduate School of Sci. and Tech., Gunma Univ., Kiryu, Gunma 376-8515, Japan
[2]Photon Factory, Tsukuba 305-0801, Japan

1. Introduction

Most of the X-ray magnetic diffraction (XMD) experiments on PF-BL-3C had been carried out with elliptically polarized white X-rays for ferromagnetic single crystals. Recently we have started a XMD experiment with monochromatic X-rays by using a Si double crystal monochromator [1,2]. We report here the polarization factor $f_P = P_C/(1-P_L)$ (P_L and P_C are the degree of linear and circular polarization) for the monochromatic XMD method.

2. Experiment

We have utilized the XMD system installed on PF-BL3C and a Si(111) double-crystal monochromator as shown in Fig. 1 (b). Elliptically-polarized monochromic X-rays are irradiated on the sample of a pure iron single crystal. We have measured the flipping ratio *R* of the 220 diffraction intensity for various vertical positions of the slit around the electron orbital plane position. As the *R* is proportional to f_P, we can investigate f_P through *R*.

3. Results and Discussion

Observed *R* values for the monochromatic XMD method are shown in Fig. 2 (b) as solid circles, which are compared with those for white XMD method shown in Fig. 2 (a). These data were previously shown in Ref. 1. In Fig. 2 it is noted that the *R* profile for monochromatic method is slightly asymmetrical with respect to the origin, which is in contrast to the one of the white X-ray method that shows a symmetrical profile.

The solid line in Fig 2. (a) is the calculated *R* by using P_L and P_C of the X-rays emitted from the bending magnet of this beamline. The calculated curve in Fig. 2 (a) reproduces the observed symmetrical profile. The solid line in Fig. 2 (b) is calculated by using P_L and P_C of this beamline and an inclination angle $\Delta\chi$ of the axis of ellipse of the polarization from the horizontal line. The angle $\Delta\chi$ has been taken into account to introduce asymmetrical feature to the polarization factor [3]. By a least squires fitting analysis we have obtained $\Delta\chi$=2.9°. The calculated *R* curve is shown in Fig. 2 (b). The calculated curve produces the observed data and asymmetrical feature is represented by a new polarization factor with $\Delta\chi$. The new polarization factor will be applied to monochromatic XMD experiments of multilayers in the near future.

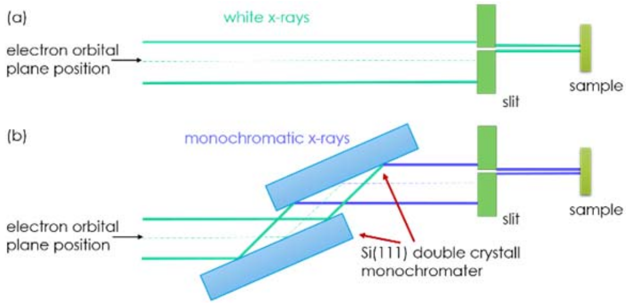

Fig.1: (a) White X-ray method and (b) monochromatic X-ray method using a double crystal monochromator.

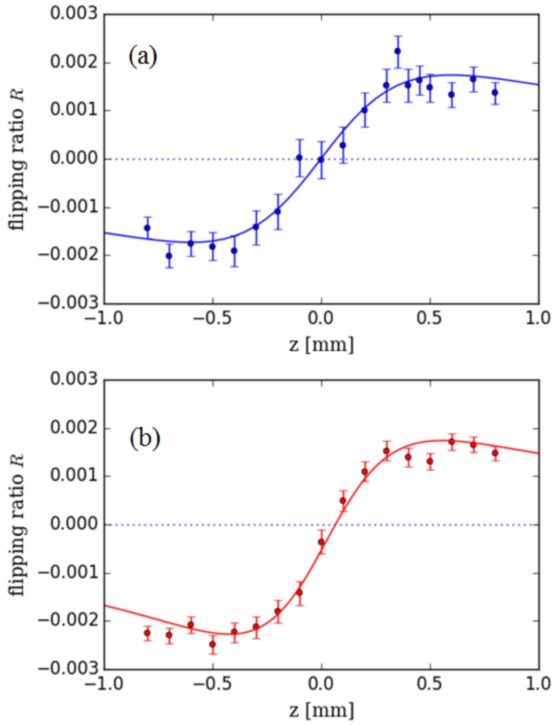

Fig. 2 : Flipping ratio of Fe220 diffraction intensity for (a) white and (b) monochromatic X-ray method

References

[1] H. Shimoyama et al., *Photon Factory Activity Report*, 30B 209 (2013).
[2] H. Shimoyama et al., *Photon Factory Activity Report*, 31B 331 (2014).
[3] H. Shimoyma, Master thesis (Gunma Univ., 2015).

*itom_phys@gunma-u.ac.jp