Crystallography

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X-ray Diffraction in Bragg-Laue Case

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The crystal X-ray wave guide in the Bragg-(Bragg)^m-Laue case has been studied by Fukamachi et al. [1-3] using a parallel thin crystal film. The first “Bragg” means the first diffraction in the Bragg case for the incident beam, and the second “(Bragg)^m” a sequence of “*m*” time reflections in the crystal and the final “Laue” the last diffraction in the Laue case before emitting from the side surface. The present study of Bragg-Laue case is one of the series of studies for the Bragg-(Bragg)^m-Laue case.

The experiment was carried out at beam line 15C, Photon Factory (PF), KEK, Japan. The schematic diagram of the measuring system is shown in Fig.1. X-rays from synchrotron radiation were monochromated by a Si 111 double crystal monochromator, a Ge 220 asymmetric monochromator (the asymmetry factor *a* is 22) and a Ge 220 monochromator. X-rays of σ-polarization were used. The X-ray energy was 11100±0.5eV, which was 3eV below the Ge K-absorption edge (11103eV). The vertical and horizontal widths of the incident beam after slit 2 were 20 µm and 500 µm, respectively. The 220 reflection was measured from a Ge single crystal whose thickness was 43 µm. In Fig.1, the reflected intensity from the incident plane is IR, the transmitted and diffracted intensities from the side surface are IT’ and IR’, respectively. The slit 3 was used to measure the intensities IR and IR’ separately.

Fig. 2 shows the measured rocking curves IR, IT', and IR'. The peak heights of the three rocking curves are normalized to show the same height. The abscissa is the angle from the exact Bragg condition. The center of the rocking curve is taken at the exact Bragg angle of the IR. The peak position of IR' is located between those of IR and IT', and at 1 arcsec higher angle side from the peak of IT'. The curve of IR is approximately symmetric. The FWHM (full widths at half maximum) of IR is 7.5 arcsec. The curve of IT’ is not symmetric having higher background on the lower angle side. The FWHM of IT’ is 3.5 arcsec. The curve of IR’ is also symmetric. The FWHM of IR’ is 2 arcsec and is the narrowest among these three peaks.

In the present experiment, it is found that the intensities of IR' and IT’ are about 10 times smaller than those of IR, and the FWHM of IR’ is about four times narrower than that of IR. These characteristic features of IR' should be quite useful for development of a high resolution monochromator. It may be useful to use the beam of IT’ in the Bragg-Laue case as a phase-retarder.

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References

[1] T. Fukamachi et al., JJAP **43**, L865 (2004).
[2] T. Fukamachi et al., JJAP **44**, L787 (2005).
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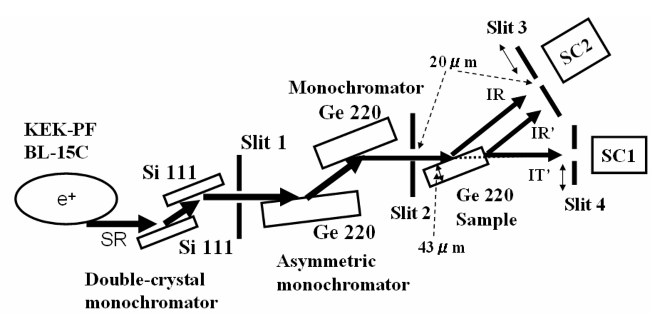

Fig. 1. Schematic diagram of the measuring system.

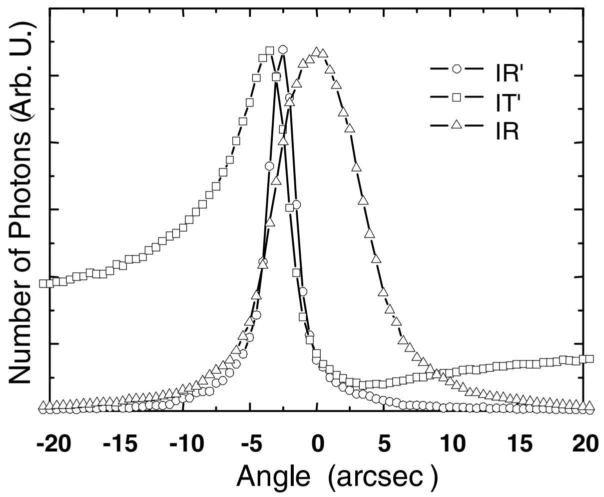

Fig. 2. The measured rocking curves of IR, IT’ and IR’.