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Interference fringe in Bragg-(Bragg)^m-Laue case

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Interference fringes in diffraction beam from side surface of a Ge finite plane-parallel crystal have been observed when the effective linear absorption coefficient μ becomes minimum due to dynamical diffraction effect (Borrmann effect) in Bragg-(Bragg)^m-Laue (BB^{m}L for short) case (Fig.1) [1,2]. In this paper, we report on the observed results and the origin of interference fringe in BB^{m}L case.

The experiment was carried out using X-rays from synchrotron radiation at BL-15C KEK-PF. The X-rays were σ polarized and were monochromated using a Si 111 double crystal monochromator and a Ge 220 monochromator. The used X-ray energy was 11100 $\pm$0.5eV. The thickness H of a Ge specimen crystal is 45.5$\pm$2.0 μm. The intensities of transmitted (P_t) and diffracted (P_h) beams, diffraction beams from side surface in the transmitted ($P_t^{'}$) and diffracted ($P_h^{'}$) directions were measured. The photograph of $P_h^{'}$ for 220 reflection (b) and its intensity distribution (black line in (a)) are shown in Fig. 2.

According to dynamical theory of diffraction, the angle of refraction ε greatly changes when μ becomes minimum. Under the present experimental condition, ε changes from zero to approximately the Bragg angle θ_B when the incident angle changes about 0.2. When ε is smaller than $\varepsilon_E = \tan^{-1}(H/L)$, the refracted beam S_1 reaches directly to the surface B as shown in Fig.1 (BL case). When ε is larger than ε_E , the beam of S_2 is reflected to the beam of S_3 at the bottom surface C. The beam of S_3 reaches to the surface B (BBL case). The dispersion angle of incident beam in the present experiment is about 5 arcsec and the incident beam can be regard as a spherical wave. The two beams corresponding S_1 and S_2 are excited simultaneously so that the interference occurs between these two beams at the side surface B. The calculated results (red line) of $P_h^{'}$ using Wagner's approach [3] are also shown in Fig.2 (a). The peaks of the measured interference fringe are well reproduced by the calculated ones except for the peak at $x = H$. The peak at $x = H$ cannot be explained by the interference effect but can be explained by the confined beam effect [4], because the observed peak width is much narrower than that of interference fringe. The above results should be useful for designing a new type of X-ray interferometer.

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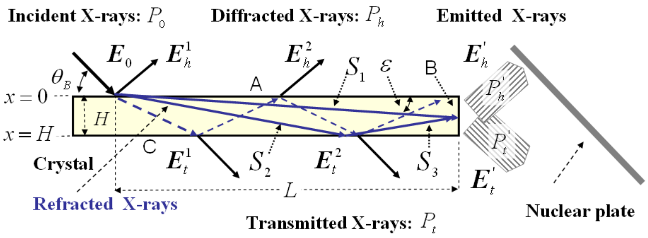

Fig. 1. Schematic diagram of Bragg-(Bragg)^m-Laue case with m=0 and 1. L is the distance from the incident point to the side surface B.

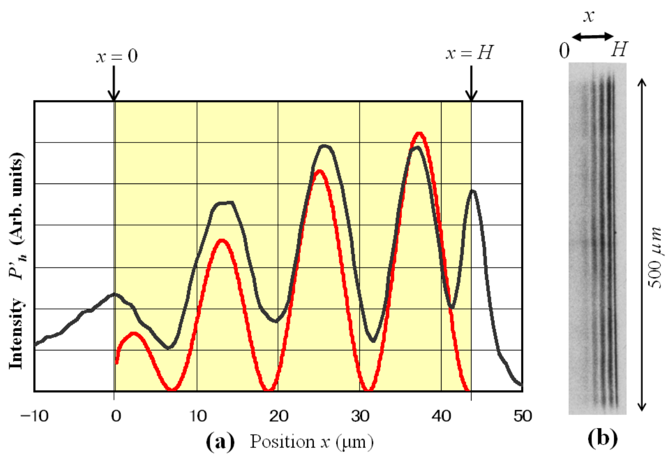

Fig. 2. Interference fringes of $P_h^{'}$. (a) Intensity distributions and (b) Photograph of P_h. L =891 μ m.

References

[1] T. Fukamachi et al., JJAP **43**,L865(2004).
[2] T. Fukamachi et al., JJAP **44**,L787(2005).
[3] H. Wagner: Z. Phys. **146**,127(1956).
[4] T. Fukamachi et al., JJAP **45**,2830(2006).

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