of P_h’ is about three times narrower than that of P_h. Fig.2 shows the calculated rocking curves by using Wagner’s dynamical theory (Wagner, H. (1956) *Z. Phys.* **146**, 127). The measured rocking curves show excellent agreement with the calculated one. Consequently, the characteristics of P_h, P_h’ and P_t’ in Bragg-Laue case are reproduced by using the theory.

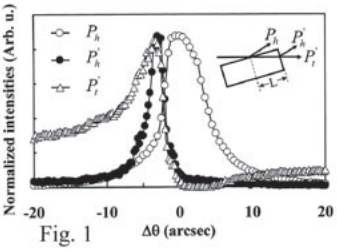

Fig. 1

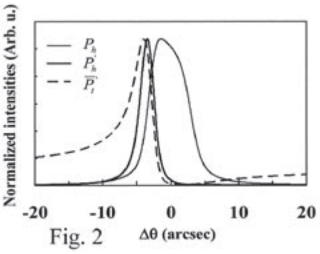

Fig. 2

Keywords: Bragg-Laue case, dynamical diffraction, dynamical X-ray diffraction theory

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

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The interference fringes of the diffraction from the side surface on the finite thin plane parallel crystal have been observed [1]. This diffraction scheme as shown in Fig.1 may be called as Bragg-(Bragg)^{m}-Laue case, where the first Bragg means the Bragg case and the second (Bragg) a sequence of “m” times diffractions in the crystal and the last Laue the last diffraction on the side surface. The measured interference fringes of the diffracted X-rays from the side surface are shown by the solid line in Fig.2. We tried to analyze the origin of the interference fringes using the Wagner’s dynamical theory [2]. In Fig.1, the X-ray beams from the two courses of S1 and S3 are overlapped each other at $x=b$. The calculated interference fringes shown by the broken lines in Fig.2 excellent agree with the measured one’s except the peek at $x=H$. Since the peek at $x=H$ can not produce the interference between two beams of S1 and S3, it peek seems to be obtained by the X-ray confinement effect as pointed out by the reference [3].

[1] Fukamachi, T. et al. (2004,5). JJAP. **43**, L865-867.and **44**, L787-L789.
[2] Wagner, H. (1956). Z. Phys. **146**, 127-168.
[3] Fukamachi, T. et al. (2006). JJAP. **45**, 2830-2832.

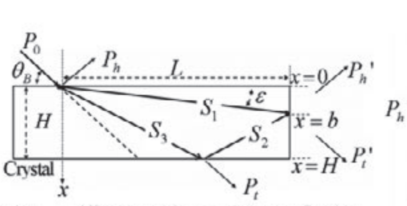

Fig.1 Diffraction scheme. Ge220 reflection, X-ray enagy:11000 eV ,H=43.5 μm ,L=891 μm.

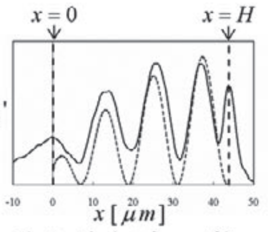

Fig.2 The interference fringes.

Keywords: interference fringe, Bragg case, X-ray confinement effect

P15.08.15

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Observation of in-phase interference fringes

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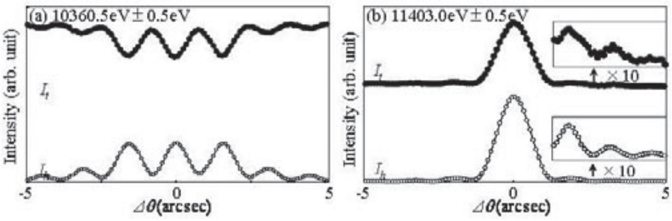
By using X-rays of high angular and energy resolution, we have measured the diffracted and transmitted rocking curves of GaAs 200 reflection near the K-absorption edge of As [1]. X-rays from synchrotron radiation are monochromated by a Si 111 double-crystal monochromator and by an asymmetric GaAs 200 monochromator. The angular resolution of the X-rays after passing the monochromators is 0.23 arcsec. In the figures are shown the diffracted Ih (open circles) and transmitted It (filled circles) rocking curves when the X-ray energy is 10360.5 eV (a) and 11403.0 eV (b), respectively. In (a), well-known Pendellosung fringes that are anti-phase with each other in the diffracted and transmitted waves are observed. In contrast, in (b), the interference fringes are in phase with each other, which is not expected according to conventional theory of diffraction. The insets of (b) show the magnifications of the tail, which show three peaks of the in-phase oscillations. The origin of the in-phase interference fringe is analyzed to be characteristic to the diffraction only by the imaginary part of the atomic scattering factor.

[1] Negishi, R., et al., J. Phys. Soc. Jpn., 2008, 77, 023709.



Keywords: interference fringe, resonant dynamical theory, anomalous scattering factor

P15.08.16

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Anomalously large dispersion angle of refracted wave in Bragg case

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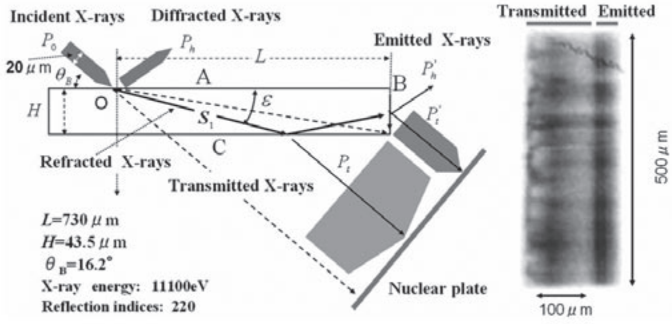
X-rays transmitted from a Ge thin crystal in Bragg case have been observed on a nuclear plate as shown in Fig (b), when the beam intensities from the side surface become maximum. Fig. (a) shows an illustration of geometry in the experiment. The dispersion angle $\delta\theta$ of the incident beam is 0.25 arcsec, and the beam width along the dispersion angle is 20 μm. The width of the observed transmitted beam is 143 μm. Using Wagner`s dynamical theory of diffraction [Wagner H. (1956), Z. Phys. **146**, 120-168.], we have studied why the width of the transmitted beam is so wide. If we choose ε as the angle between the directions of the refracted beam and of the crystal surface as shown in Fig. (a), ε changes from zero to approximately Bragg angle within the angle of $\delta\theta$ in the experiment. When the refracted beams reach at the bottom surface, a part of them come out and are observed as the transmitted beams. The ratio of the dispersion angle $\delta\varepsilon$ of the refracted beams with respect to $\delta\theta$ ($\delta\varepsilon/\delta\theta$) becomes approximately 10^5. This means that the diffraction in this case works as a lens, which is quite useful for development of X-ray microscope, high resolution monochromator and X-ray interferometer.



(a) (b)

Keywords: Bragg case, dynamical diffraction theory, X-ray microscope

P15.08.17

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New mechanism of anomalous transmission, absorption and their additional unusually curious feature

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The recursion formulas of the photon paths in the Borrmann triangle (BT), which satisfies a modified Bragg law [1, 2] could be derived from the binomial distribution (BD) of the *n*-multiple X-ray reflections by regarding the permutation of the stochastic variables of the diffracted and transmitted photons. Sub-BT of the diffraction shows perfectly flawless symmetry but that of the transmission shows inevitable asymmetry. Novel understanding of both the high intense and very weak photon flows in BD, which are known as anomalous transmission and absorption, respectively are revealed from BD approximated to the standard normal distribution of $N(0, 1)$. Incident photons into the vertex "O" of BT propagate through the bypasses parallel to only the complementary half of the integral whole median with the high probabilities from the binomial theorem and emanate them from a very narrow slit of $O'O''$ on the base of the high intense photon flow BT of $\Delta OO'O''$, which could be defined by the standard deviation of $N(0, 1)$. The parallel paths to the whole median also pass as the very weak photon flows from the high exponent of $d^{-n}t^{-0}$ in *n*-degree homogeneous multinomials of *d* and *t* through the triangle $\Delta OO'O''$. It could be undetectable owing to the negligible small of $1/{}_nC_{\sim n/2}$ compared with the high intense photon flows. It is for this reason that X-ray photons never emerge from the crystal at a position, which is directly opposite the entrance point on a straight line on the diffraction plane. Therefore, an additional unusually curious feature could be clearly understood from the above.

[1] T. Nakajima:J. Low Temp. Phys. **138** 1039-1075 (2005).
[2] to be presented in this conference

Keywords: dynamical diffraction, transmission, absorption

P15.09.19

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The influence of mosaic distribution upon the extinction factors in real crystals

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The evaluation of a series of wide ranging tables of secondary extinction factors Y for the spherical mosaic crystal, requires a detailed comparison of the numerical solutions of Darwin transfer equations for cylindrical crystals with different sorts of mosaic distributions [1]. Three probability functions t (n) were used: t (infinity) is close to Gaussian (G), t (1) is Lorentzian (L) and t (2) closely resembles the Lorentzian but the "tail" is shorter. From the figure one can see that when the ratio of absorption cross section to scattering cross section is small and the sample radius is large, the areas under the rocking curves, i.e. integrated reflection power ratio (IRPR), differ appreciably. The corresponding secondary extinction factors Y, which are proportional to IRPR, for G, L and t (2) are 0.0402, 0.1016 and 0.0781, respectively. The Y, for L distribution is 30% higher than that of the t (2). Thus it seems that the most reasonable mosaic distribution for real crystals would be G or t (2) but not L. This result may serve as a guideline for the evaluation of the appropriate extinction table.

[1] Hua-Chen Hu. Acta Cryst. A59, P. 297-310. (2003).

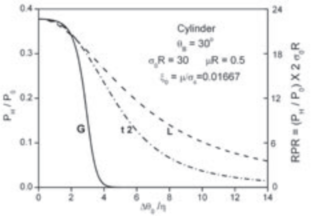

Fig. 1 Rocking curves from three different mosaic distributions for cylindrical crystals.
μ : absorption cross-section.
σ : scattering cross-section.
σ_0: σ at $\Delta\theta_0$.

Keywords: diffraction physics, mosaicity, extinction

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Absorption coefficient of X-rays in crystals in presence of temperature gradient

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The behavior of factor of linear absorption of X-rays in monocrystals on Laue geometry is experimentally investigated and shown, that the presence of a temperature gradient and ultrasonic vibration leads to essential reduction of absorption of X-rays. In the present work the theoretical analysis of the given process in plane wave approximation, in the presence of a temperature gradient is carried out. The theoretical analysis shows that (with beam penetration in a crystal) the presence of the curvature leads to the increase of amplitude diffracted and weakly absorbed field and simultaneously to the reduction of amplitudes of diffracted and strongly absorbed field and as well as amplitude of both passing fields. With magnification of curvature of reflecting atomic planes, transferred energy in diffracted weakly absorbed field is increases and the total energy is transferring via this field at certain value of curvature. As a consequence the crystal absorption coefficient sufficiently decreases. The further magnification of curvature, leads to reduction of energy transferred