Crystallography

15C/2003G211

Observation of Interference Fringes Induced by Lattice Distortion in Resonant Scattering X-ray Topography

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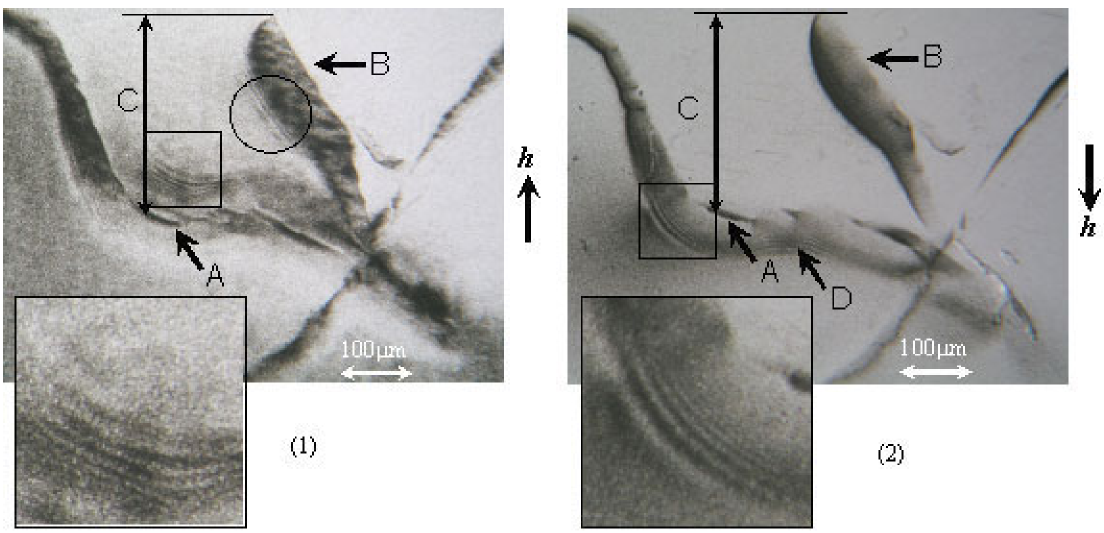
In the X-ray dynamical diffraction with resonant scattering, Fourier coefficient χ_{hi} of the imaginary part of X-polarizability can become zero under a certain condition even in an absorbing crystal. In this condition, the amplitude of Pendellösung fringe is maximized, because the electric wave fields of two brunches become equal to each other at the Bragg angle. In this paper, we report on the observation of the Pendellösung fringe induced by lattice distortion in the GaAs 200 reflection when $\chi_{hi} = 0$.

The experiment was carried out at BL-15C in KEK-PF. The X-rays from synchrotron radiation were monochromated by a Si 111 double-crystal and a GaAs 200 monochromator. The resultant topographic images are shown in Figs. (1) and (2) which were recorded on the nuclear plate when $\chi_{hi} = 0$ at an X-ray energy of 10362eV. The darker contrast corresponds to the higher X-ray intensity. Fig (1) was the image taken when only Si 111 monochoromator was used, and Fig (2) when both Si111 and GaAs monochromators were used. The lower left image in each figure shows the twice magnified image of the square region. The reciprocal lattice vector ***h*** is in the upward direction in Fig. (1) and downward in Fig. (2).

As for the kinematical image of a lattice defect, the intensities of X-rays from the lattice defect area are higher than those from the perfect area. In addition, the relative distance between two defect images does not change with ***h*** direction, because the defect sites are reflected directly. In Figs. (1) and (2), the relative distance from the defect image A to B is the same and both contrasts of A and B are dark. The defect images A and B are kinematical ones.

In Fig. (1), the band area in the lower side of A is bright, and that in the upper side is dark. As shown in the magnified image, the interference fringes of approximately five lines are observed clearly. The fringe spacing increases from the lower side to the upper. The interference fringe is not observed either in the right or left of the □ region, although the regions show dark contrasts. In Fig. (2), the corresponding bright-dark contrasts around A are reversed. The interference fringes can also be observed in the area marked by □ and in the area marked by an arrow D, whose fringe spacing becomes narrow from the lower side to the upper. In addition, some interference fringes are observed within the zone marked by ○ located at the lower side of the defect image B in Fig. (1), but they are not observed in Fig. (2).

In Figs. (1) and (2), the interference fringes are observed in restricted areas and only in one side of each image. This fact implies that the observed interference fringes are reflected by the lattice distortion. Thus it is noted that the interference fringe for $\chi_{hi} = 0$ should be quite useful in elucidating the distortion structures.



The topographs for GaAs 200 reflection at X-ray energy equal 10362eV.

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