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Keywords: microdiffraction, precession, multibeam

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The study of wide-angle incidence X-Ray nano-wires using crystal asymmetric surface diffraction

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Wide-angle incident x-ray Si-wires are devised by using crystal asymmetric surface diffraction. The Si (113) is chosen as an asymmetric surface diffraction for the photon energy 8.8785 keV according to the Si crystal orientation and diffraction geometry. The asymmetric surface diffracted beam propagates alone [110] if the incident beam is parallel to [110]. 2θ-scan (vertical) shows two diffraction peaks; one is the Si(113) Bragg diffraction, and the other is its surface specular reflection. The position of the specular reflection does not vary with photon energy in the range from E=9.05 keV to E=8.75 keV. The positions of these two peaks in vertical (2θ-scan) and horizontal (beta-scan) direction also depend on azimuth angle around [001], which is the angle between [110] and the incident-beam direction. The behavior of the diffracted beams in the vertical direction is governed by the photon energy and azimuth angle. In addition, interference patterns of specular reflection in the vertical direction are detected. The oscillatory intensity is related to the azimuth angle and extinction length, which we believe is a dynamical diffraction effect. The experimental results are in good agreement with the theoretical calculations using the dynamical theory of x-ray diffraction. In conclusion, we have studied the wide-angle incidence x-ray Si-wires using crystal asymmetric surface diffraction. This idea can be applied to design a new type wide-angle incidence x-ray optics using crystal surface diffraction.

Keywords: asymmetric-surface-diffraction

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Implementation of a direct approach to coherent diffractive imaging

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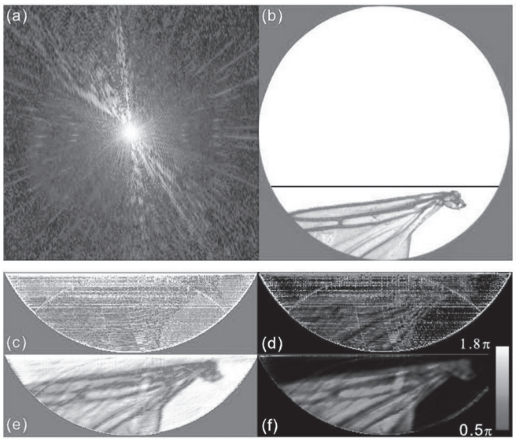
We present a strategy to obtain a high-fidelity reconstruction of the exit-surface wave of an object from its diffraction pattern. The direct solution of a set of linear equations extracted from the inverse Fourier transform of the diffraction pattern (which is the autocorrelation of the exit-surface wave) [1,2] is followed by a simple regularization step in which the solution is also made consistent with the non-linear information in the autocorrelation. This approach is illustrated using the diffraction pattern of a gnat's wing, illuminated with a laser. By considering residuals and condition numbers the well-posedness (uniqueness and consistency) of the reconstruction can be analyzed.

The figure below shows the results as follows: (a) The far-field diffraction pattern of a gnat's wing illuminated with a HeNe laser. (b) A magnified image of the gnat's wing. The black horizontal line indicates the area assumed to contain the object in the linear retrieval method. In (c) we have the retrieved intensity and in (d) the change in phase of the incident wave due to the wing after the solution of the linear equations and prior to the regularization step. After the regularization step we obtain the image shown in (e) and the phase in (f). In the figure the brightness of the phase images have been scaled by the wave's intensity.



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Keywords: coherence, diffraction, imaging

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Observation of topography using resonant scattering and its SEM images

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Near the K-absorption edge of a constituent atom in a crystal, X-ray rocking curves from the crystal sometimes show significant change with small change of X-ray energy due to resonant scattering.

Fig.1 shows measured GaAs 200 diffracted rocking curves I_h, and transmitted ones I_t in Laue case[1] when X-ray energy is just below Ga K-edge (a) and 453.7eV below As K-edge (b). In (a), the rocking curves of I_h and I_t are anti-phase [2], while in (b), the maximum intensities due to anomalous transmission for I_h and I_t appear at the same angle and fringes in their tails are in-phase with each other. Figs. 2(a) and (b) shows
the topographs recorded at X-ray energies corresponding to those in Figs. 1(a) and (b), respectively. The interference fringes are clearly observed at the upper side of defect α (see arrow in (a)). The area around the defect α shows a dark band in (b).

Fig.3 shows a secondary electron image of the same region as in Fig.2 observed from the incident surface of X-ray by SEM (Scanning Electron Microscope). Along the defect band observed in the topographs in Fig. 2, many ditches are observed running in the [110] direction.

It is noted that topography making use of resonant scattering is very