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Normal Hologram Subtraction from X-ray Fluorescence Hologram obtained in Inverse Mode

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Introduction

X-ray fluorescence holography (XFH) is a new technique that allows us to visualize a 3D local structure around a specific element [1]. From the hologram obtained with different incident X-ray energies in inverse mode, the clear atomic image without twin images can be constructed using Barton's algorithm [2]. However, the measured holographic pattern is a sum of the inverse hologram and a part of normal one, the normal component clouds the image. In this report, we used the Fourier transform (FT) subtraction method through an application to II-VI semiconductor ZnTe as an example.

Experiment

The Zn-K_α XFH data were recorded at nine incident X-ray energies of 11-15 keV in steps of 0.5 keV by rotating two axes ($0° \le \phi \le 360°$ in steps of 0.5°, $0° \le \theta \le 70°$ in steps of 1°) of a single-crystal sample. The fluorescent X-rays were collected using an avalanche photodiode detector with a cylindrical graphite energy-analyzer at RT.

Results and Discussion

The raw XFH data is shown in Fig. 1(a). A broad stripe due to the normal XFH was seen. In order to subtracting the component, we removed several spots which exist along the frequency ω_ϕ axis at $\omega_\theta = 0$ in the FT pattern of the raw data. After optimal removing the spots, the data were inverse Fourier transformed as shown in Fig. 1(b). The obtained atomic image of ZnTe is depicted in Fig. 2,

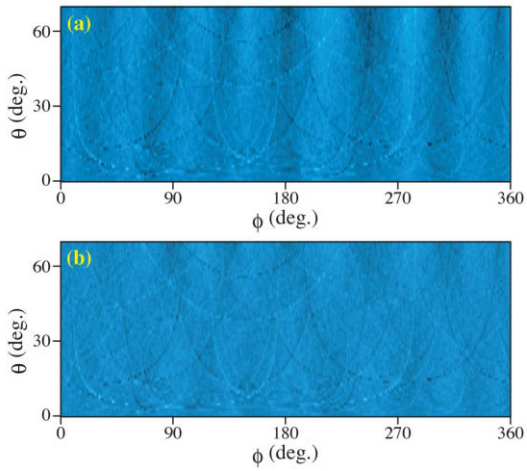

Fig. 1. The inverse XFH of ZnTe at 11.5 keV. (a) Raw Data. (b) Data after removing the normal component.

for the (110) plane around the Zn atoms. The green cross at the center of figure indicates the position of the central Zn atom, and the red and black colors represent the neighboring atoms. The image without removing the normal component is not clear, as shown in Fig. 2(a). On the other hand, the nearest-neighbor atoms to the third are clearly visualized, as shown in Fig. 2(b).

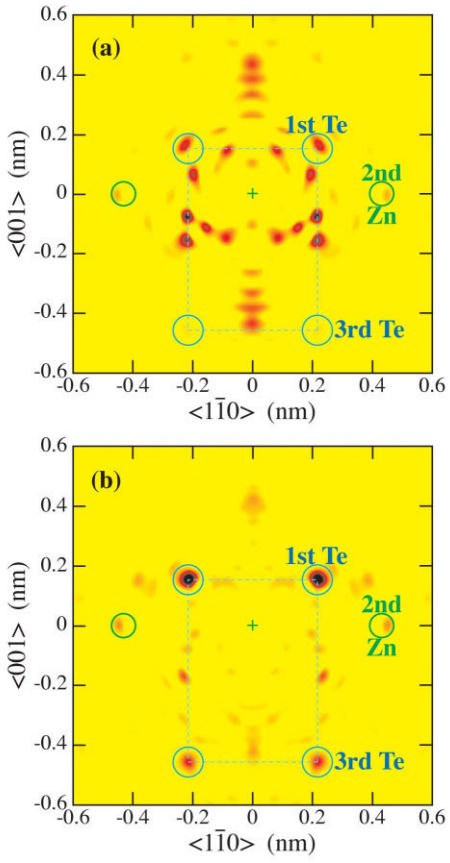

Fig. 2. The atomic image for the (110) plane of ZnTe before (a) and after (b) removing the normal component.

References

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