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# Scanning X-ray differential phase contrast imaging with double wedge absorber

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## Introduction

An X-ray phase imaging is one of the most attractive imaging techniques. Recently, many types of X-ray phase imaging technique have been reported by several researchers. One of the unique techniques is using a wedge absorber [1]. The wedge absorber converts quantity about one-dimensional displacement of refracted X-ray beam by an object into X-ray intensity. But phase reconstruction from one-dimensional phase gradient data is inadequate.

In this study, we demonstrated to record two-way phase gradients at the same time and separately using double wedge absorber to reconstruct an artifact-free phase contrast image.

## Experiment

Experiments were performed at BL4A of Photon Factory. A schematic illustration of experimental setup was shown in Fig. 1. White X-rays from the light source were monochromatized by a double multilayer monochromator at 13keV and focused by a KB mirror. Beam size was 3 μm x 3 μm at sample position. The wedge absorbers were made of aluminum and were placed at 1545 mm and 1765 mm from the sample. Size of them was 10 mm (height) x 10 mm (width) x 10 mm (depth).

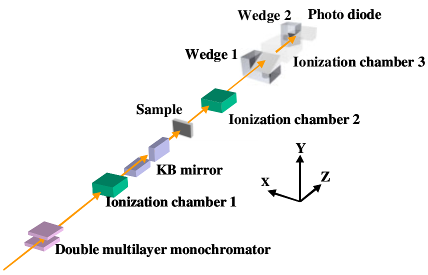


Figure 1: Schematic illustration of experimental setup.

Three ionization chambers and a photo diode were used to record X-ray intensities. First ionization chamber, which was placed in front of KB mirror, recorded incident X-ray intensity. Second ionization chamber, which was placed at downstream of the sample, recorded transmitted X-ray intensity through the sample. Third ionization chamber and the photo diode, which were placed at downstream of first and second wedges, recorded transmitted X-ray intensities through first and second wedge absorbers.

A nylon mesh was used as sample. Width of the nylon fiber was about 40 μm.

## Result and discussion

Figures 2 show some images of sample. An absorption image (Fig. 2(a)) was poor visibility because of high-transmittance of X-rays for the sample. On the other hand, differential phase images (Fig. 2(b), Fig. 2(c)) were high visibility. The differential phase image along x-direction was calculated by dividing the image recorded with the photo diode by the image recorded with the third ionization chamber.

In the case of phase reconstruction by a line integration of differential phase image (Fig. 2(c)), phase reconstruction of the fiber along x-direction was not enough and some linear artifacts existed (Fig. 3(a). To obtain artifact-free phase image, we used Fourier integration technique [2] using two-way differential phase images. A reconstructed phase image of the sample was shown in Fig. 3(b). Compared with line-integrated image, we could obtain an artifact-free image.

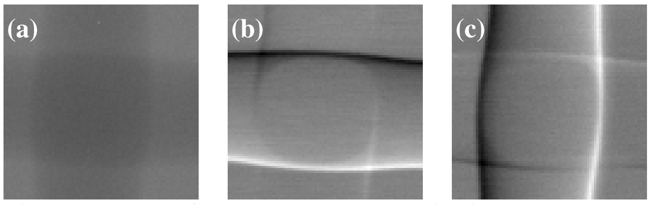


Figure 2: Images of nylon mesh. (a) Absorption image.
(b) Differential phase image along y-direction.
(c) Differential phase image along x-direction.

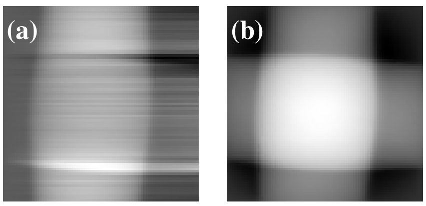


Figure 3: Reconstructed phase images of nylon mesh.
(a) Phase image reconstructed by line integration.
(b) Phase image reconstructed by Fourier integration technique.

## References

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