X-ray phase-map measurement using an x-ray HARP camera

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When x-rays propagate through an object, the wave-front of the x-rays is deformed due to phase-shifts caused by the object. X-ray phase-contrast imaging detects these phase-shifts to observe inner structures of various objects non-destructively. Since the sensitivity of the x-ray phase-contrast imaging is much higher than that of conventional absorption-contrast imaging methods, many studies have been made of this innovative imaging technique. X-ray interferometry [1], x-ray angle-resolved imaging [2], and so on, have been intensively pursued at the Photon Factory.

For the x-ray phase-contrast imaging, area detectors such as x-ray films, imaging plates and x-ray CCD cameras have been widely used so far. However, to further improve the performance of the overall imaging system requires an x-ray area detector with higher sensitivity and better spatial resolution. One of the most promising candidates satisfying those requirements is an x-ray HARP camera [3]. The x-ray HARP camera is an image pick-up tube with an amorphous selenium (a-Se) photoconductive target and is characterized by its internal avalanche amplification process. The x-ray HARP camera was successfully applied, for the first time, to the x-ray phase-map measurement using an x-ray interferometer.

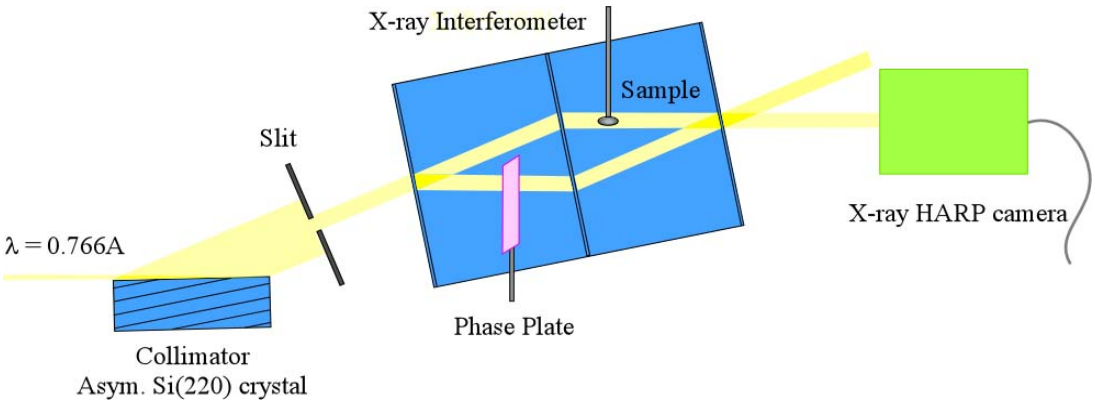

Fig. 1 The experimental setup for phase-map measurement

The experiment was performed at BL-14B of the Photon Factory as shown in Fig. 1. The x-ray wavelength was set at 0.766 A by a Si(111) double-crystal monochromator. The x-ray beam was collimated and expanded by an asymmetric Si(220) crystal. Phase-maps of x-rays transmitted through a sample were measured by a LLL-type x-ray interferometer and an x-ray HARP camera. The pixel-size of the camera was 8 μm × 15 μm. A voltage of 1300 V was applied to the 15μm-thick a-Se layer. The frame rate was 30 fps and 30 images were accumulated for image analyses. A phase-map of rat liver was successfully obtained as shown in Fig. 2. This result indicates that the x-ray HARP camera is very useful for x-ray phase-map measurement of biological samples.

The experiment was approved by the Medical Committee for the use of animals in research of the University of Tsukuba and KEK.

Fig. 2 Phase-map of rat liver. The view-field is 210 pixel (H) × 900 pixel (V) in size.

[1] A. Momose, T. Takeda, Y. Itai and K. Hirano: *Nature Med.*, **2** (1996) 473. [2] K. Hirano : *J. Phys. D, Appl. Phys.*, **36** (2003) 1469. [3] K. Tanioka and T. Hirai : *OYO BUTURI*, **71** (2002) 1376.