Hard X-ray Phase Imaging and Tomography using a Fresnel Zone Plate and a Transmission Grating

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Non-destructive and quantitative visualization of internal structures of materials consisting of light elements in nanometer scale will bring dramatic progress in life and material sciences. We have proposed a hard X-ray phase imaging microscopy that consists of an objective lens and a transmission grating [1,2]. Our simple optical system provides a quantitative phase image using the fringe-scanning technique, and works with partially coherent illumination on the objective lens. Its sensitivity and spatial resolution were compared with those of the absorption contrast microscope that was attained by simply removing the grating; we showed that our method has a spatial resolution almost the same as that of the absorption contrast microscope, and a sensitivity of about two orders of magnitude higher for light elements.

Since our method provides a quantitative phase image, phase tomography is also possible. We successfully performed phase tomography for a strong phase object by our method. Figure 1 shows examples of phase image (left) and tomogram (right) of a 55-μm-diameter polystyrene (PS) sphere obtained at an X-ray energy of 9 keV. In the right figure a void inside is clearly seen. Thus our approach can prove to be a promising technique to visualize internal structures even in relatively thick samples with a high spatial resolution and high sensitivity.

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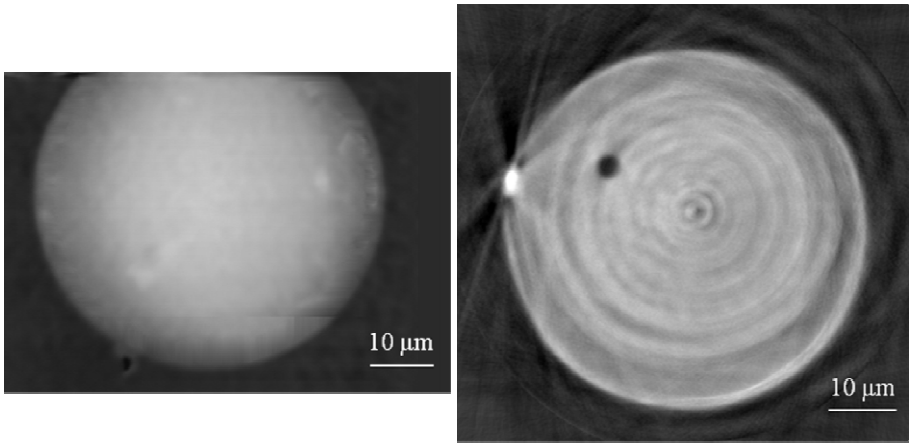

Fig. 1: Phase image (left) and tomogram (right) of a 55-μm-diameter PS sphere.

[1] W. Yashiro *et al. Phys. Rev.* A **82** (2010) 043822-1-16.
[2] W. Yashiro *et al.*, *Phys. Rev. Lett.* **103** (2009) 180801-1-4.