X-ray Talbot-Lau Interferometer for Phase Contrast Imaging at PF BL14C

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An X-ray Talbot interferometer consisting of two gratings has a relaxed temporal coherence requirement [1], making it possible to take advantage of the full brightness of the white synchrotron radiation. High-speed phase contrast imaging and time-resolved tomography have been demonstrated so far [2, 3].

The synchrotron radiation source size is large in the horizontal, and the spatial coherence requirement for the operation of the Talbot interferometer at BL14C located 37 m from the source is satisfied only in the vertical direction. Therefore, the grating lines of the Talbot interferometer should be aligned horizontally and the sample rotation axis for CT scans should also be oriented horizontally. However, a vertical rotation axis is preferable for many kinds of samples like soft matter due to gravity. Therefore, we have constructed an X-ray Talbot-Lau interferometer consisting of three gratings, whose lines were aligned vertically, allowing a vertical CT rotation axis. The Talbot-Lau interferometer is formed by adding an amplitude grating (multi-slit) upstream of a Talbot interferometer. Because of the coherence filtering function of the multi-slit, the disadvantage of the Talbot interferometer is overcome.

In this work, an X-ray Talbot interferometer optimal for 28 keV X-rays was operated with white synchrotron radiation at BL14C, and moiré patterns with a visibility more than 20% were generated successfully. Next, we have plans to perform four-dimensional X-ray phase tomography with a time resolution of 1 second by using this system.

[1] A. Momose, et.al, Jpn. J. Appl. Phys. 45, (2006) 5254.
[2] A. Momose, et.al., Opt. Express 17 (2009) 12540.
[3] A. Momose, et.al., Opt. Express 19 (2011) 8423.