# X-ray phase imaging with grating interferometer using inverse Compton scattering compact X-ray source

Y. Wu[1], M. P. Olbinado[1], K. Sakaue[2], M. Fukuda[3], S. Araki[3], Y. Taira[4], R. Kuroda[4], M. Kageyama[5], M. Kuribayashi[5], N. Terunuma[3], J. Urakawa[3], A. Momose[1]

[1]*Institute of Multidisciplinary Research for Advanced Materials, Tohoku University, Sendai, Japan*
[2] *Research Institute for Science and Engineering, Waseda University, Tokyo, Japan*
[3]*High Energy Accelerator Research Organization, Tsukuba, Japan*
[4]*Association for Iron & Steel Technology, Tokyo, Japan*
[5] *Rigaku Co. Ltd,, Haijima, Tokyo, Japan*

**E-mail: wu@tagen.tohoku.ac.jp*

**Abstracts:** *The inverse Compton scattering compact X-ray source is suitable for X-ray phase imaging with an X-ray grating interferometer since the spectrum of the source (about 10%) is compatible with the interferometer. Here we report the first results of X-ray phase imaging with a Talbot interferometer using the inverse Compton scattering compact X-ray source (LUCX) at KEK, which was operated at a 9 keV X-ray mean energy.*

Since an X-ray Talbot interferometer functions with cone beam of a broad energy band width, the combination with various X-ray sources is flexible for phase imaging applications to samples consisting of low-Z elements. The property of inverse Compton scattering X-ray beam is preferable for Talbot interferometry from viewpoints of spectrum and beam size. Inverse Compton scattering compact X-ray sources are formed by the collision between an electron beam and a high power pulsed laser beam, and the spectrum is quasi-monochromatic having a bandwidth of 10%. Since a grating interferometer can be operated for such a bandwidth with a performance similar to that in the case of monochromatic beam, an inverse Compton scattering X-ray beam can be used effectively as it is without any spectrum filtering for X-ray phase imaging.

Here we report the first results of X-ray Talbot interferometry using the inverse Compton scattering compact X-ray source (LUCX) at KEK, where mean energy of X-rays was 9 keV. The Talbot interferometer consisted of a $\pi/2$ phase grating and an amplitude grating 6 μm in period. The spatial coherence required for the Talbot interferometer was ensured by the source size of 120 μm (FWHM) and the distance (about 6 m) from the source to the interferometer.

The obtained moiré fringes in a $2 \times 2$ cm$^2$ field of view of the X-ray Talbot interferometer were recorded by a photon-counting image detector (HyPix-3000, Rigaku), whose pixel size was 100 μm. A five-step fringe-scanning method was applied with an exposure time of 30 minutes/step. The visibility of the moiré fringes was about 33%. X-ray phase imaging was successfully performed for insect samples. However, since there was artifact due to mechanical drift of gratings and the beam intensity instability during the long fringe scan time, the resultant images were not satisfactory. The drift problem will be relaxed in the near future by the increase in the beam intensity by improving the LUCX system. Then, the practical application of the combination of an inverse Compton scattering source and an X-ray Talbot interferometer will be explored extensively for X-ray phase imaging.