Evaluation of Hard X-Ray Con-Focal Optics

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Con-focal optics is widely applied in optical microscopy since the method has advantages in the sensitivity, spatial resolution, and depth resolution. However, the con-focal optics has never been applied as microscopy in x-ray region. We will present about evaluation of hard x-ray con-focal optics constructed by using two Fresnel zone plates (FZPs) with identical characteristic.

Experimental work has been carried out at beamline 20XU of SPring-8. The 20XU has an undulator source, and monochromatized 8 keV x-rays were used. The “end station” is about 200 m apart from the monochromator, and long propagation length is available at the 20XU.

The con-focal optics consists of an illumination system confugured with FZP1 and a detection system with FZP2 having same characteristics with FZP1 (Fig.1). In a general situation, these two systems are required to be symmetric with respect to an object point. For our setup, however, magnification factor of the detection system is set to be much smaller than demagnification factor of the illumination system. It is because a quite long source-to-FZP1 distance (~200 m) is required for a fully-coherent illumination to the FZP1. Therefore, a small aperture (1/100 of source size) is needed at detector for configuring a con-focal condition. A high-spatially resolving imaging detector coupled with optical microscope is used instead of the aperture. Spatial resolution of the detector is about 1 micron and it is enough for experimental condition (magnification of detection system: 20, diffraction-limited focusing size of FZP: 120 nm)

The con-focal optics is evaluated by knife-edge response at con-focal point, and by scanning profile of a test pattern. The con-focal optics shows different characteristics from the optics without FZP2.

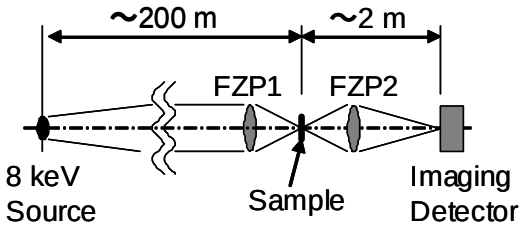

Figure 1: Schematic diagram of x-ray con-focal optics constructed at BL20XU of SPring-8