BL-11A/2016G098

Measurement of Beam Coherency at BL11A for Soft X-ray Projection Microscopy

Tatsuo SHIINA[1*], Prane Mariel Basco Ong[1], Yasuhito KINJO[2], and Atsushi ITO[3]
[1]Graduate School of Advanced Integration Science, Chiba Univ., Chiba-shi, Chiba, 263-8522, Japan
[2]Tokyo Metropolitan Industrial Technol. Res. Inst., Koto-ku, Tokyo 135-0064, Japan
[3]School of Engineering, Tokai Univ., Hiratsuka-shi, Kanagawa, 259-1292, Japan

1 Introduction

We have developed soft X-ray projection microscopy system with the correction technique to improve blurred projection images due to Fresnel diffraction. The iteration procedure was applied to biological samples and their successful corrections were achieved with the magnification of more than 300 times for the soft X-rays of 700eV–1keV.[1] Biological images at higher magnification had less contrast to apply the blur correction procedure. To conduct the image correction procedure efficiently, we improved contrast of biological specimens by using platinum blue staining and examined about beam coherency. In this report, we focus on the consideration of the beam coherency using double pinholes at BL11A bending magnet beamline.

2 Experiment

The sizes of the double pinholes were 0.5 μmϕ – 2.0 μmϕ and their intervals were 20 μm – 2 μm. The experimental setup is shown in Fig. 1. The post pinhole was 1 μmϕ. Distance between the post pinhole and the double pinhole was measured with a micrometer whose scale was from 13 mm to 20 mm. The actual distance was 0.5 mm when the scale was 13 mm. The experiments were conducted with the various combination of experimental parameters including photon energy, double pinholes' size, their interval, and the distance described above. Figure 2 shows the interferecne fringes with various double pinhole conditions. In the case of (a) where pinholes' size is 1 μmϕ with their interval 5 μm under the photon energy 1 keV, 5 interference fringes were observed. The spatial coherency was estimated as 6 nm (=1240/1keV*5). They increased to 13 fringes (coherency 16 nm) in the case of (b) with smaller pinholes' size 0.5 μmϕ with shorter interval 2 μm. When the photon energy was lowered to 800 eV, the fringe number was decreased as seen in the case (c) with pinholes' size 1 μmϕ and their interval 10 μm, and (d) with the size 1 μmϕ and the interval 2 μm. The total variation of interference generating conditions were summarized in Table 1. As a result, the double pinholes' size largely affected the beam coherency under the experimental setup. The coherency did not change at any observation distances under the condition of the same pinholes and photon energy, while it was disappeared at wider intervals with smaller distances. It also seems to depend on the post pinhole size and thickness.

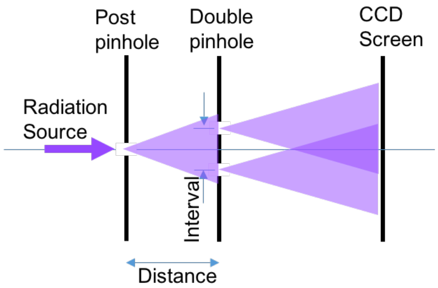
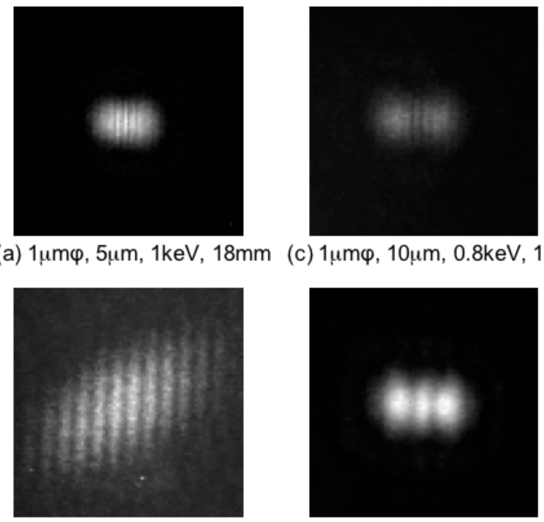


Fig.1 : Experimental setup of double pinhole.



(a) 1μmφ, 5μm, 1keV, 18mm (c) 1μmφ, 10μm, 0.8keV, 16mm

(b) 0.5μmφ, 2μm, 1keV, 15mm (d) 1μmφ, 2μm, 0.8keV, 14mm

Fig.2 : Interference fringes with some doube pinhole conditions. Values are pinholes size, interval, photon energy, and distance.

Table 1 : Variation of interference generating conditions.

Energy	Double Pinhole	Interval	Distance [mm]						Fringe Number
			13.5	14	15	16	18	20	
1keV	1.0μmϕ	10μm	×	×	×	×	×	×	0
		5μm	×	×	×	×	○	○	5
		2μm	×	○	○	○	○	○	3
	0.8μmϕ	5μm	×	×	×	○	○	○	9
		2μm	×	○	○	○	○	○	3
	0.5μmϕ	2μm	○	○	○	○	○	○	13
800eV	1.0μmϕ	10μm	×	×	×	○	○	○	5
		2μm	×	○	○	○	○	○	3

References

[1] T. Shiina et al., PF Activity Report 2016 #34 B (2017).
http://pfwww.kek.jp/acr/2016pdf/u_reports/pf16b0186.pdf

* shiina@faculty.chiba-u.jp