Biological Science

11A/2010G065

Evaluation of the Effect of Coherence on the Blur-Corrected Images in Soft X-ray Projection CT Microscopy

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Introduction

Our project is to achieve positive results for blur-correction to observe image in the soft X-ray projection CT microscope by iteration procedure [1-3]. In the present study, we examined the effect of the coherence of soft X-ray beams on the blur-correction by comparing the results at the Photon Factory with the experiment at the SPring-8. The optical setup at the SPring-8 was almost the same as that at the Photon Factory.

Results and Discussion

Figure 1 shows a blur-corrected image of a latex particle with a diameter of 8μm observed at BL-11A of the Photon Factory. The energy of soft X-rays was 0.7keV. The magnification of the projection microscope was x110. The iteration procedure of the inverse Fourier transformation to eliminate the diffraction fringes was conducted only once to compare with the results obtained at the SPring-8. Since the spatial coherence was not enough at the Photon Factory, the number of observed fringes was only 2 to 3. Consequently some fringe structure still remained in the reconstructed image. Since the less coherence and the non-uniform intensity distribution should be compensated by the iteration procedure. The iteration of about 50 times was conducted and the median filtering was also performed on the image obtained by the beam with partial coherence in the next step. The authors have accomplished the blur-correction for the image illuminated by the partially coherent light as shown in Fig. 2. In this figure, the latex particle was 1μmϕ coincided with the actual size.

Figure 3 shows the results of 8μmϕ latex observed at the SPring-8 that offers more coherent beams, although the X-ray energy is 8keV in the hard X-ray region. The iteration was only once, which means that the transformation was reconstructed mathematically. The reconstructed image has the same size as the actual size of the specimen. Since the observed image at SPrng-8 had more number of fringes, we are improving the coherence of the exposed beams to specimens by inserting a pinhole with a smaller diameter of 0.5 μm than the present 1 μm at the Photon Factory. The preliminary observation suggested much more fringes of 3 to 4.

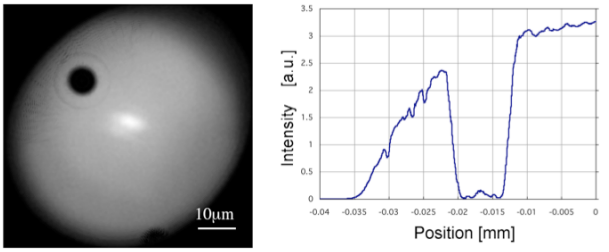

Fig.1 Blur-corrected image (latex particle of 8μmϕ) observed at the Photon Factory.

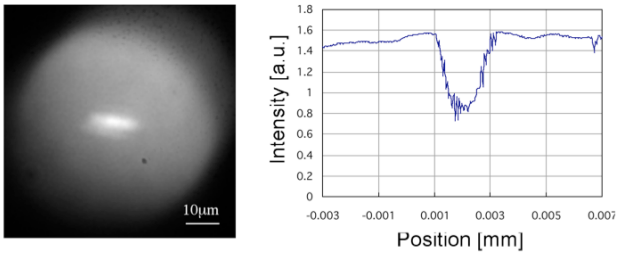

Fig.2 Blur-corrected image (latex particle of 1μmϕ) with median filter observed at the Photon Factory.

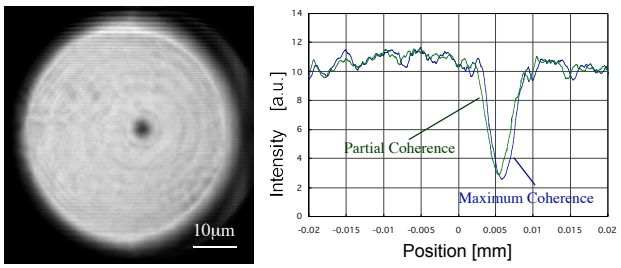

Fig.3 Blur-corrected image (latex particle of 8μmϕ) observed at the SPring-8.

References

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