Evaluation of a new magnetic type of X-PEEM

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Introduction

We constructed a new magnetic type X-PEEM (X-ray photoemission electron microscope) which has a salient feature of wavelength-scan capability suitable for spectroscopic X-ray microscopy. This is especially effective in the case of elemental analysis of biological sample. High resolution, operational easiness and compactness were aimed as the basic design concept. Performance test as X-PEEM was carried out using light source from BL-12A at the PF after testing as the TEM and target-X-PEEM at Tohoku University.

Results and Discussion

Lenz paremeters of the objective of the X-PEEM are as follows: Cs = 8 mm, Cc = 7 mm, fo = 8 mm, accelerating potential for photocathode V = 15-16 kV. As the photocathode, thin gold film (30 nm thick) was used among tested several materials such as Au, CsI, CuI, MgF because of chemical stability. As the standard sample of resolution, diatomite having very small holes (0.2-0.3 μm in diameter) from Toyokuni Diatomite Industry Co., Oita, Japan was used. As a biological sample, critical point dried HeLa cells were prepared.

Figure 1 shows an example of the diatomite taken using 0th order X-ray beam with 100 μm objective aperture in comparison with SEM image of the corresponding field. It is seen that about 0.2 μm holes are rather clearly separated.

Figure 2 shows X-ray images of a HeLa cell taken at different wavelength. Image (b) taken with 24 Å X-rays is much clearer than image (a) taken with 0th order synchrotron light. It was proved that the microscope has wavelength-scan capability as expected in the range 11-35 Å and also stably operative during long and repeated exposures.

At the beginning of the present plan, resolution better than 100 nm was expected as X-PEEM but the practically attained resolution is about 200-300 nm, though the resolution when operated at TEM mode is about 30 nm. It seems that rather large energy spread in the photoelectron by X-ray irradiation plausibly causes large chromatic defect. Image filtering will be necessary in the future for better resolution.

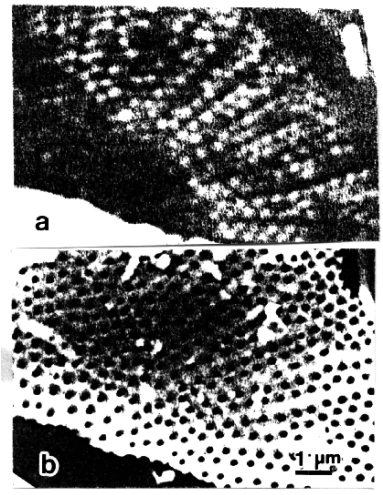

Fig. 1. X-ray image (a) and SEM image (b) of diatomite.

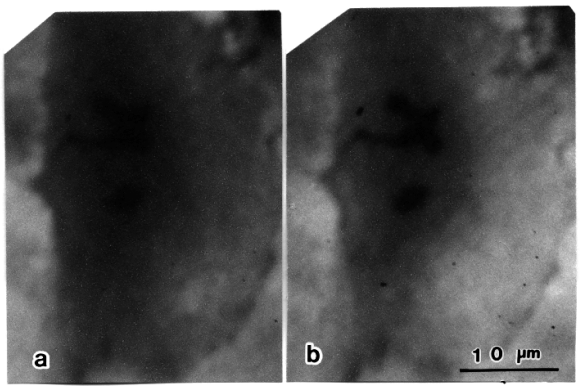

Fig. 2. HeLa cell taken with 0th order light (a) and with 24 Å light (b).

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