

## MICRO X-RAY FLUORESCENCE IMAGING WITHOUT SCANS

Kenji SAKURAI and Hiromi EBA

National Research Institute for Metals, Sengen, Tsukuba, Ibaraki 305-0047

Introduction

So far, micro X-ray fluorescence (XRF) imaging has been performed by a 2D positional scan of a sample against a collimated beam. Although a synchrotron microbeam can enhance the spatial resolution down to 1~0.1  $\mu\text{m}$ , the total measuring time becomes quite long (a few hours to a half day), since one needs a number of scanning points in order to obtain a high-quality image. In this report, the performance of alternative technique based on completely different concept [1] is demonstrated.

Experimental

The experiment was carried out at BL-4A. A grazing-incidence arrangement is employed to make primary X-rays illuminate the whole sample surface. Parallel-beam optics and extremely-close-geometry are adopted in order to detect XRF with a CCD camera. Since scanning of the sample and/or incident beam is not necessary, the measuring time is reasonably short, typically 20sec.~3min. The spatial resolution is given as a product of the collimation (i.e., angular divergence),  $\phi$  and distance from the sample surface to the CCD device,  $d$ . Therefore it is extremely important to shorten the distance  $d$ . Details of the present XRF microscope are described elsewhere [1].

Results and Discussion

Figure 1 shows an X-ray image for a patterned chromium thin film ( $\sim 1000\text{\AA}$ ) evaporated on the glass substrate (commercially available, for checking resolution). The image is in very good agreement with the optical image, and that X-rays can distinguish elements. The estimated spatial resolution is around 20  $\mu\text{m}$ . It should be noted that the exposure time required is only 50 sec.

Another example is shown in Fig.2. This is an image for silver dendrites grown from solution dropped on a silicon wafer. Different patterns are observed, for example, in the area A and B. This

is because of different reaction rate due to concentration fluctuation and other conditions for diffusion. The image is obtained by 4 shots to the different part of the sample, because the synchrotron beam is vertically small. Although a CCD camera is not used as an energy-dispersive detector in this case, the use of tunable monochromatic synchrotron radiation can identify the kind of elements by differentiating the images obtained at the incident X-ray energy below and above the absorption edge of the element of interest. In the same way, chemical-state imaging can be also performed by using chemical shifts of absorption edges [2,3]. The authors would like to thank Prof. A. Iida for his valuable discussion.

References

- 1) K.Sakurai, Spectrochimica Acta B54, 1497 (1999).
- 2) K.Sakurai and H.Eba (submitted).
- 3) K.Sakurai et al., Jpn. J. Appl. Phys., 27 (1988) L1768.

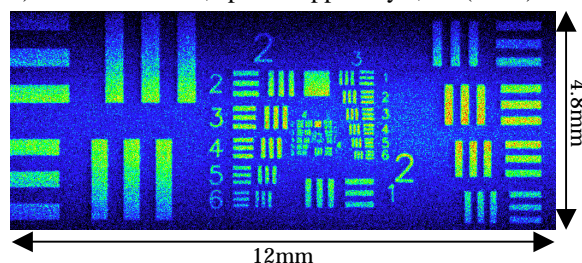


Fig.1 Metallic Cr thin film on glass substrate  
Incident X-ray Energy 7.2keV / Exposure Time 50sec.

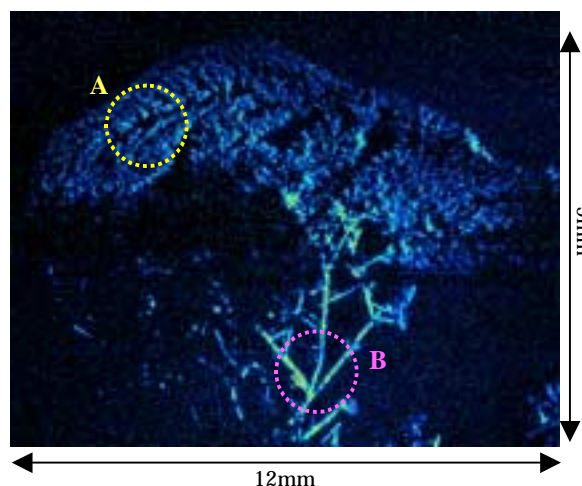


Fig.2 Ag dendrites precipitated from solution  
Incident X-ray Energy 7.2keV / Exposure Time 2min  $\times$  4

