

PROJECTION-TYPE XRF IMAGING USING IDEAL POLARIZATION CONDITION

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The present talk reports a unique scheme of projection-type XRF imaging using ideal polarization condition [1]. For many years, projection-type XRF imaging has been efficient for investigating the element composition of a sample and the corresponding spatial distribution [2,3]. In order to observe a small number of elements clearly, it is better to utilize the linear polarization of synchrotron beam to reduce the scattering background in observed XRF images. For this, sample surface and X-ray camera sensor should be placed perpendicular to the polarization. However, the bottleneck has been the narrow size of synchrotron beam in the perpendicular direction to the polarization, as only a thin strip of the sample can be illuminated and imaged. In this study, we expanded the synchrotron beam in the perpendicular direction. Wide XRF images were obtained using ideal polarization condition, while the scattering background was significantly reduced.

The experiment was carried out at BL-14B, Photon Factory, KEK, Japan. The synchrotron beam (X-ray energy 9.537 keV) was linearly polarized. The beam size was originally narrow (~ 2 mm max.) in the perpendicular direction to the polarization but was expanded by an asymmetric-cut silicon crystal ($\alpha=18^\circ$) for about 19.6 times. The X-ray camera was an energy-resolved CCD camera operated in single-photon-counting mode (1024×1024 pixels, pixel size 13 μm × 13 μm , energy resolution 150 eV @ Mn K α). A 1-mm-thick collimator plate was inserted in the 3-mm-wide gap between the camera sensor and sample surface to project XRF images. The collimator plate assembled many parallel straight capillaries of which the diameter is 6 μm . The capillaries' small angular acceptance leads to not only a fine spatial resolution of 15 ~ 30 μm but also an ideal polarization condition with blocking most unexpected scattering X-rays [4].

References

- [1] W. Zhao, K. Hirano, and K. Sakurai, *Rev. Sci. Instrum.* **90**, 113704 (2019).
- [2] K. Sakurai, *Spectrochim. Acta, Part B At. Spectrosc.* **54**, 1497 (1999).
- [3] K. Sakurai and H. Eba, *Anal. Chem.* **75**, 355 (2003).
- [4] W. Zhao, K. Hirano, and K. Sakurai, *J. Anal. At. Spectrom.* **34**, 2273 (2019).