ANTI-SCATTERING XRF SPECTROSCOPY

Wenyang Zhao[1,2], Keiichi Hirano[3], Kenji Sakurai[2,1,*]
[1] University of Tsukuba, 1-1-1, Tennodai, Tsukuba, Ibaraki 305-8577 JAPAN
[2] National Institute for Materials Science, 1-2-1, Sengen, Tsukuba, Ibaraki 305-0047 JAPAN
[3] Institute of Materials Structure Science, High Energy Accelerator Research Organization, 1-1, Oho, Tsukuba, Ibaraki, 305-0801, JAPAN
[*] Kenji.Sakurai@sakuraixlab.com

Synchrotron radiation strengthens XRF analysis not only by its high photon flux with excellent collimation and energy tunability but also by its linear polarization. For many years, in order to reduce the contribution of scattering background in the observed spectra, the XRF detector has been placed in the same 90 deg direction as the polarization due to the minimization of scattering intensity. However, because of the size of the detector itself, quite strong X-ray scattering is still observed in the spectra. In addition, the probe area on the sample is inherently limited even when large area size analysis is demanded. In this study, the combined use of size-expanded polarized synchrotron beam and CCD camera coupled with a collimator plate has been examined to enhance the signal-to-background ratio (SBR) in XRF analysis [1].

As synchrotron beam is inherently narrow (~ 2 mm max.) in the perpendicular direction to the polarization, in the experiment, an asymmetric-cut silicon crystal (α=18˚) was employed to expand the beam (X-ray energy 9.537 keV) for about 19.6 times so that a large area on the sample could be illuminated. The utilized XRF detector was a cooled CCD camera in single-photon-counting mode (1024×1024 pixels, pixel size 13 μm ×13 μm, energy resolution 150 eV @ Mn Kα). Its sensor size was 6 ~ 10 times larger than conventional semiconductor such as Si (Li) and Si-drift detectors. To make full use of polarization, the observation direction was restricted as close as 90 deg even for large area size. A collimator plate, which assembled many parallel straight 6-μm-dia capillaries as a single 1-mm-thick plate [2,3], was stored in the CCD camera housing to accept X-rays from the sample with a very small angular acceptance. It has been found that the SBR was significantly improved by the reduction of scattering. The improvement was estimated as more than 30 times compared to laboratory XRF analysis using unpolarized X-rays. The present method also enabled the measurement of large size samples which were difficult to measure by conventional synchrotron experiments. Other advantage of the present system would be its imaging capability [4].

References

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