Potable total reflection X-ray fluorescence spectrometer: Comparison between non-monochromatic and monochromatic X-ray sources

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We have developed portable TXRF spectrometers with one watt X-ray tube (without monochromatization). Even non-mono X-ray source, pico gram detection limits are realized. The reasons for this are; (1) X-ray fluorescent yield is higher than monochromatic X-ray source because the energy difference from the absorption edge is small, (2) total integral intensity of incident X-rays is stronger than monochromatic X-rays, and (3) the scattered X-rays from a small amount of sample are negligibly weak even for continuous X-rays. However, the white incident X-rays are not suitable for single crystal silicon wafer because of X-ray diffraction. The white incident X-rays will penetrate into the sample in the higher energy region. Thus the control of X-ray impinging angle is crucial for (1) lower detection limits, (2) probing depth, and (3) fluorescent yields. One of the examples of these is intensity ratio of a doublet in X-ray spectra. The Lα/Lβ intensity ratio changes as the change of glancing angle when the white X-ray source is used, whereas it keeps constant when monochromatic. In order to utilize this phenomenon, we can choose the glancing angle for selective excitation of a certain element, which is an alternative to use multi-target or multiple X-ray tubes suitable for a certain element.

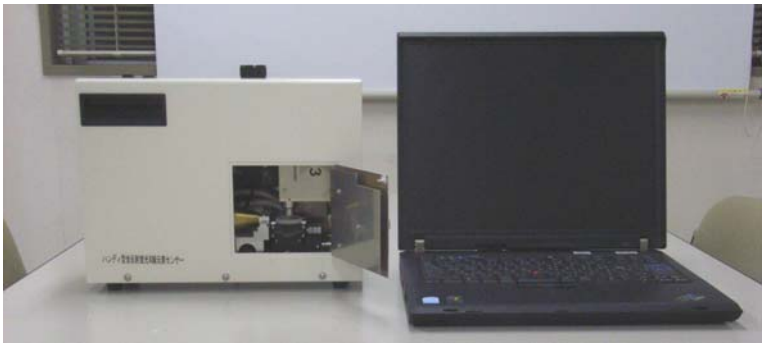

Fig. 1. Portable TXRF spectrometer with a notebook computer.