

Detection of trace metals by X-ray fluorescence using total reflection

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Very recently, a new grazing incidence X-ray spectro-reflectometer installed at the beamline 39XU has been commissioned. In the present report, preliminary experiments on X-ray fluorescence using total reflection are described. Another important aspect, i.e., the performance in reflection/scattering experiments will be discussed elsewhere (K.Sakurai, 1998A0226-CM).

Since we already evaluated the horizontal axis geometry (K.Sakurai, 1997B025-NS), vertical axis arrangement (Photo 1) was chosen for the present work. A Si(Li) detector is placed at 90 deg direction to the beam in the horizontal plane. This geometry can make full use of linear polarization of undulator radiation, leading to the reduction of scattering background.

The measurement was done using 10 keV monochromatic X-rays (ID Gap 14.46 mm) with the size of 0.05(H) x 2(V) mm², and higher order harmonics were rejected by the beamline Pt mirror (5 mrad). A Si(Li) detector is placed at 160 mm distance from the sample. The chamber is evacuated

(around 100 mTorr) to reduce air scattering of the incident beam. To minimize a parasitic fluorescent X-rays, the sample holder has been carefully designed, and also a part of the inside wall is covered with Teflon plates.

Figure 1 shows the X-ray fluorescence spectrum of a Si wafer, of which surface is intentionally contaminated by several 3d transition metals. The concentration is around 3×10^{11} atoms/cm². One can confirm that almost all metals are detected very easily, and in this case, the scattering does not restrict the detection limit. When the concentration is lowered to 10^9 or 10^8 atoms/cm², the low-energy-side tail of the scattering becomes a main part of the background again. It has been found that optimization of the geometry can enhance signal to background ratio further, and in the future, we plan to renew the record of the detection power for trace metals. The authors thank Prof. Nakai (Science Univ. of Tokyo) for his valuable advice.

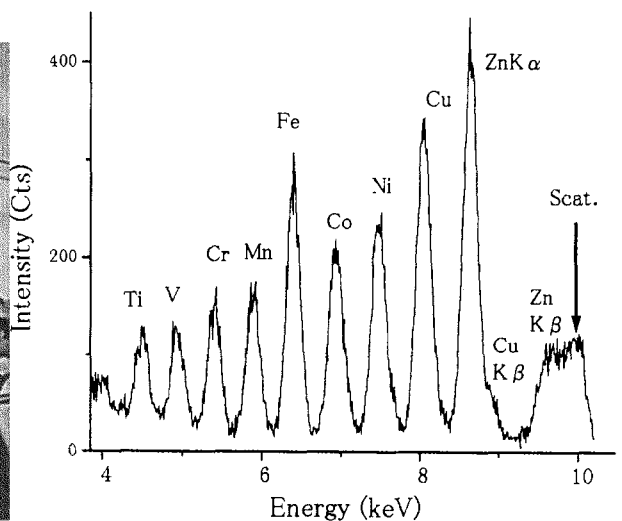
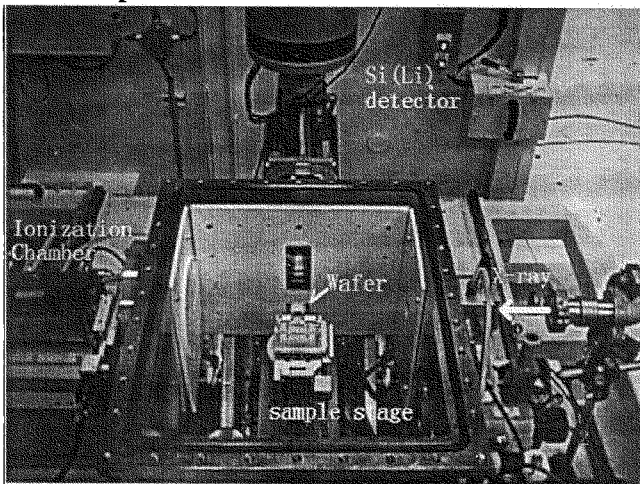


Photo 1 (left) Grazing incidence X-ray spectro-reflectometer installed at the BL-39XU.

Figure 1 (right) Total-reflection X-ray fluorescence spectrum of trace 3d transition metals on a Si wafer. The concentration is 3×10^{11} atoms/cm².