Development of high energy resolution detectors for trace chemical characterization

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The development of an advanced detector dedicated to X-ray spectroscopy is significant for trace element analysis. Measuring chemical shifts of absorption edges by X-ray fluorescence detection [1] is a promising way to know the chemical state of trace elements, but the average limit of detection is limited due to the rather poor resolution of the conventional Si(Li) detector. In this case, the separation of the tail of scattering background and the fluorescence signal is crucial.

A super-conducting tunneling junction (STJ) detector is one of the most promising candidate [2]. Preliminary experiments have been carried out using a conventional single Nb/Al junction (prepared by M.Kurakado) with a He^3 cryostat (Photo.1). Monochromatic X-rays of 8 keV (ID Gap 12.4 mm) were used for excitation. Though the measurement of soft X-rays (lower than 1 keV) has been ever reported [3], obtaining X-ray fluorescence spectrum in hard X-ray region is the first trial. Figure 1 shows that the energy resolution is better than a Si(Li) detector. For practical measurement, improving efficiency is strongly required, and therefore, instead of a single junction, a series junction with indirect phonon excitation [2] should be employed for future experiments.

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References

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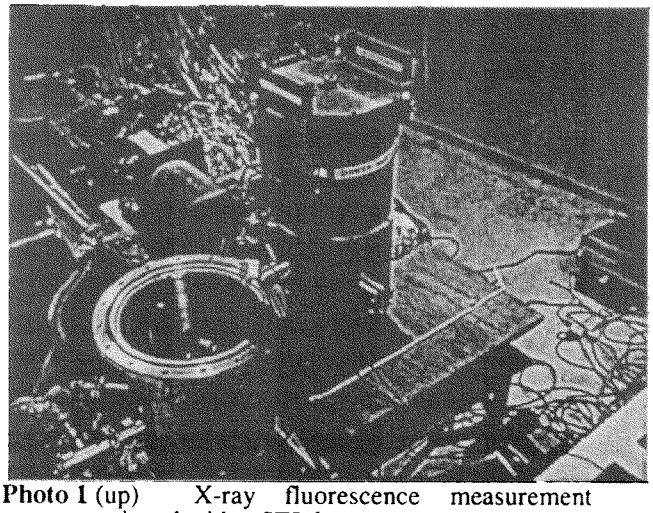

Photo 1 (up) X-ray fluorescence measurement system equipped with a STJ detector.

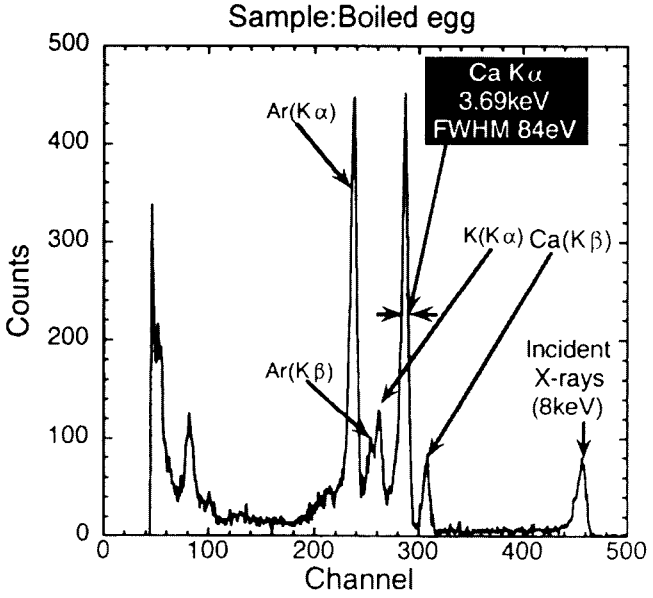

Figure 1 (right) Typical X-ray fluorescence spectrum obtained by a STJ detector. The sample is a boiled egg.