Instrumentation and Technique

NE1/2002G280

Reproducibility of Gd Kβ X-ray fluorescence intensity measurement by Compton spectrometer at BL-NE1A1

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Introduction

Gadolinium is a very important element in the development of lasers, phosphors and magnetic materials. The Compton spectrometer at BL-NE1A1 can be used to record the element's K-X-ray fluorescence spectra, which are in quite a high energy region [1]. In this study, the reproducibility of the measurements has been investigated.

Experimental

The sample measured was a Gd metal powder (Furuuchi Chemical Corp.) cast into a pellet (10 mmϕ x 5 mm thick). The fluorescent X-rays were dispersed by a Si(422) analyzer and observed at a scattering angle of 160 degrees, and were recorded on the image plate (FUJI MS-2025). The incident X-ray energy was set at 70 keV

Results and Discussion

Figure 1 shows typical K-X-ray fluorescence spectra of a metallic gadolinium pellet. In addition to the Kα and Kβ lines of Gd, a Compton scattering peak was observed at around 55 keV. The K lines of Ta, which is contained as an impurity in gadolinium powder, were also seen. In the present study, particular interest was paid to the Kβ lines, which are shown in the inset of Fig.1, mainly because of the possibility of chemical characterization [1]. The energy resolution was ca 75 eV at around Gd $K\beta_1$. In order to evaluate the reproducibility of the spectra, the exposure was repeated with almost the same conditions. The measurement was done so that the intensity of $K\beta_1$ became as close as possible to the maximum recordable values for the imaging plate, and the measuring time was 3-7 hours, depending on the ring current and the lifetime. The number of photons of the incident X-rays was monitored by an ionization chamber and the corresponding digital values were added up during the exposure. Figure 2 shows the intensities of Kβ peaks normalized by value. Although the intensities are still scattered, with a range of ±5%, if we take the ratios between the intensities, this stabilizes the deviation to within a range of ±1% as listed in Table 1. The result suggests that it is possible to detect the change of spectra due to chemical effects etc., if the variation of the intensity ratio is over several %. The authors would like to thank Professor N. Shiotani for his kind assistance during the experiment.

References

[1] M. Harada, H. Eba, M. Shoji, K. Sakurai, I. Matsumoto, and H. Kawata, *Photon Factory Activity Report* **#20**, 287 (2003).

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Table 1 Reproducibility of the intensity ratios of Gd Kβ spectra. The normalizing factor corresponding to the integration of incident X-ray intensity (IC) is also tabulated.

Data	IC	$K\beta_1$/ $K\beta_2$	$K\beta_{1,3,5}$ / $K\beta_2$,$O_{II,III}$
1	34115462	2.3823	3.4898
2	33964785	2.3817	3.4999
3	31582130	2.3784	3.4538
4	27397125	2.3688	3.4692
5	24488254	2.3742	3.4759

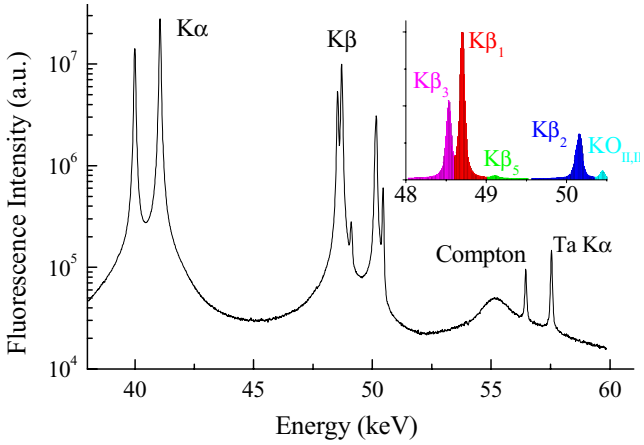

Figure 1 The K spectrum of a Gd metal pellet.

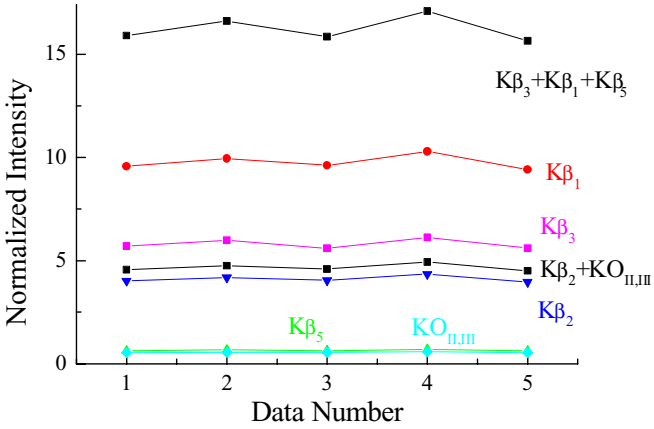

Figure 2 Reproducibility of the intensities of Gd Kβ lines.