14A/2002G280

Intensity ratios of Kβ X-ray emissions from lanthanide compounds

Masaaki HARADA[1] and Kenji SAKURAI*[2]
[1]Fukuoka University of Education, Munakata, Fukuoka 811-4192, Japan
[2]National Institute for Materials Science, Tsukuba, Ibaraki 305-0047, Japan

Introduction

Chemical effects in transition metal compounds are often discussed in terms of their X-ray emission spectra [1]. However, in high-energy region above 35 keV, there are a lot of technical difficulties in high-resolution measurements with wavelength-dispersive spectrometer [2]. In this report, the intensity ratios of Kβ X-ray emissions from lanthanide compounds are investigated using an energy-dispersive configuration and digital detector electronics [3].

Experimental

X-ray fluorescence (XRF) spectra were collected by an energy-dispersive spectrometer when the storage ring was operated at 3 GeV. The excitation energy was set at 80 keV using a Si(553) monochromator, and the beam intensity was monitored by an ion chamber (Kr gas used). The beam size was limited by slits and a 5mmϕ collimator. The samples measured are metals, oxides, and fluorides of Sm, Gd, Tb, Dy, Er, and Yb. The fluorescent X-rays were observed by a Ge detector (Canberra GL0055PS) at the perpendicular. The detector output was fed to the digital signal processor unit (ORTEC DSPEC Jr.).

Results and Discussion

The XRF spectrum of a Sm fluoride (SmF_3) pellet (10mm dia., 5mm thick) is shown in Fig 1. The accumulation time was 3600 seconds, and the dead time was 3.5%. All the emission lines were assigned as indicated in Fig. 1. The Compton peak of the 80 keV excitation line is observed at around 68 keV. The energy resolution at 45.413 keV (Sm $K\beta_1$) is 395 eV. Ge K escape peaks and parasitic lines originating from Cu are also seen.

The intensity ratios of Kβ X-ray emissions from several lanthanides were measured. The results are shown in Fig. 2, where gross area intensities are used. For all of the lanthanides measured, the intensity ratios of metals are larger than those of oxides and fluorides. The exception is Er metal, where the ratio is irregular because Er Kβ-lines are overlapped by Kα-lines of Ta contaminated during the production process. The results break down into 3 groups in descending order of $K\beta_1/(K\beta_1+K\beta_2)$: i) metal>oxide>fluoride (Sm and Gd), ii) metal>fluoride>oxide (Tb), and iii) metal>oxide, fluoride (Dy and Yb). Group i) includes Ce (earlier unpublished data). Repeatability and precision are to be confirmed, but there seems to be a tendency of chemical effect. The authors would like to thank Professor S. Kishimoto for his kind assistance during the experiment.

References

[1] K.Sakurai and H.Eba, *Nucl. Instrum. & Methods* **B199**, 391 (2003).
[2] M.Shoji, M.Harada, and K.Sakurai, *Photon Factory Activity Report* **#20,** 288 (2003).
[3] M.Harada and K.Sakurai, *Photon Factory Activity Report* **#20**, 286 (2003).
*sakurai@yuhgiri.nims.go.jp

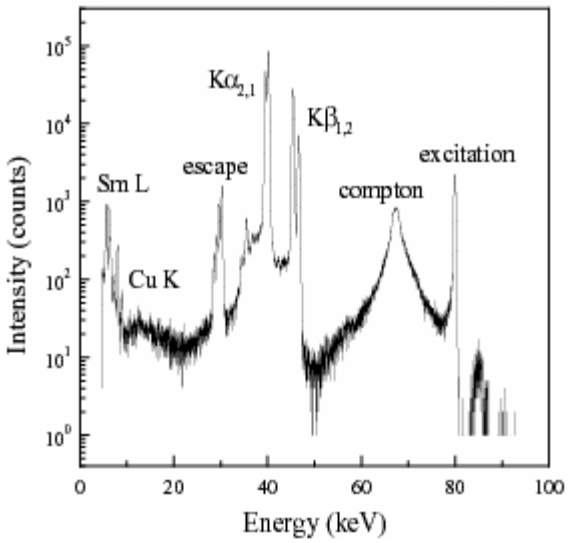

Figure 1 High-energy XRF spectrum of SmF_3.

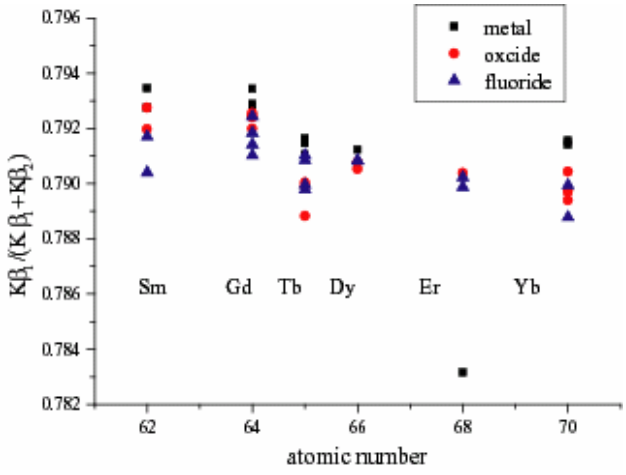

Figure 2 The Kβ intensity ratios of several lanthanides.