The Chemical State Analysis of Eu in BAM Blue Phosphor by Wavelength-Dispersive X-Ray Fluorescence and XAFS

Shinji Ozaki

Matsushita Technoresearch Inc.

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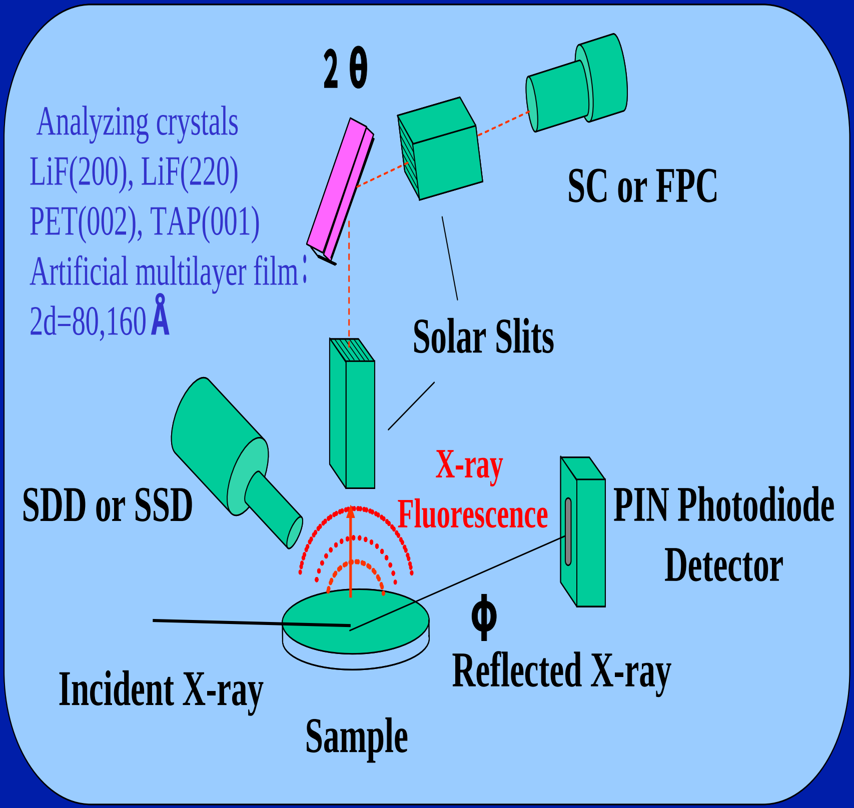
Summary

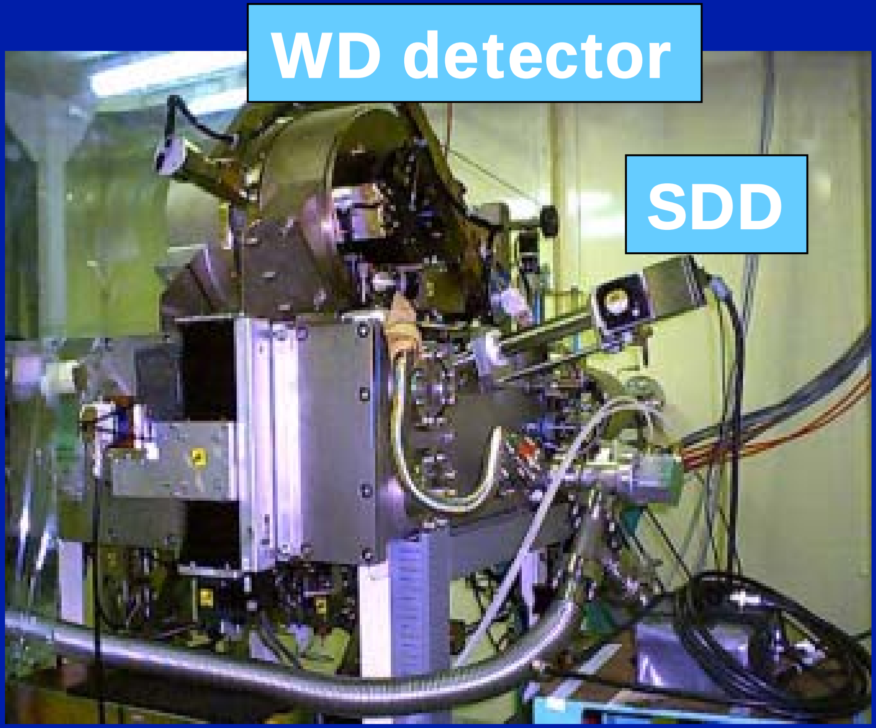
X-ray fluorescence XAFS experiment has been performed for the very small quantity Eu in BAM, with using 19-elements SSD. We investigated the relation among the oxidation number of Eu, the structure near Eu, brightness, and the lifetime of brightness.

- Eu (II) and Eu (III) were detected in BAM. The larger the rate of Eu(II) is , the higher its brightness is.
- In the case of BAM which has different brightness, the BAM with higher brightness has the shorter distance of Eu-O.
- The BAM with a long lifetime of brightness has weak Eu-O peak intensity in its radial structure function.

Photograph of SR-XRF equipment



Schematic figure



SR-XRF equipment at BL16XU

The Chemical State Analysis of Eu in BAM by XANES and WD-XRF

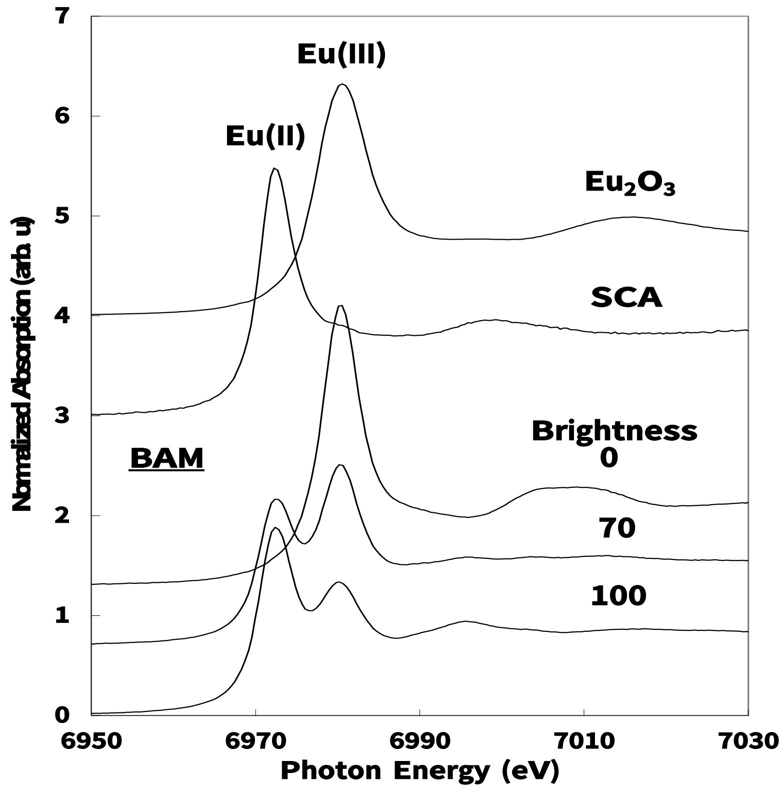


Figure 1 Eu L3 XANES spectra of BAM and its standards which contain Eu(II) or Eu(III)

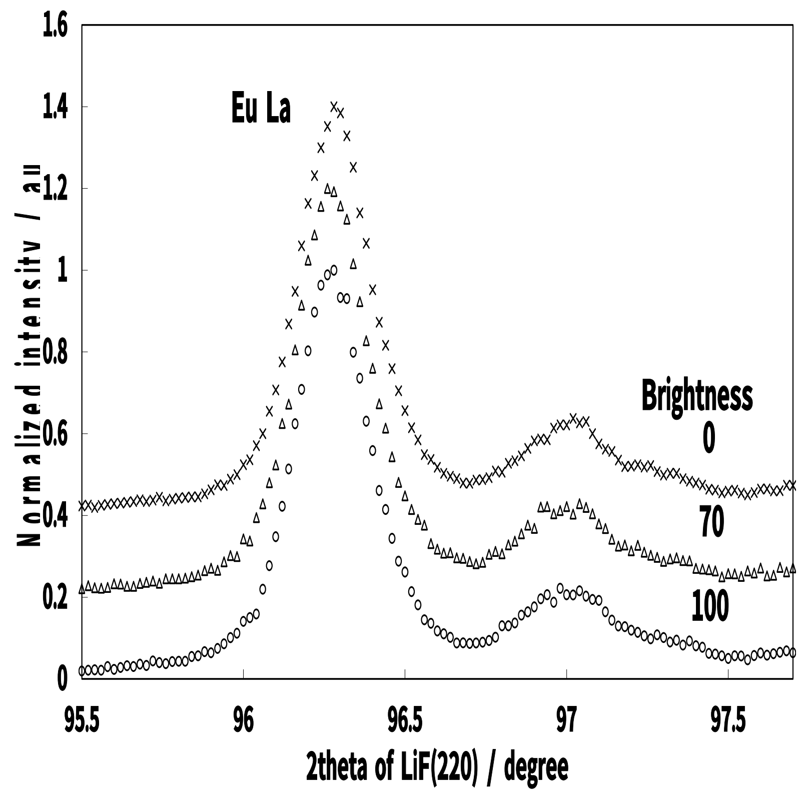


Figure 2 Eu La XRF spectra of BAM, using analyzing crystal LiF(220) .

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Eu L3 XANES spectra of BAM which have diferent brightness

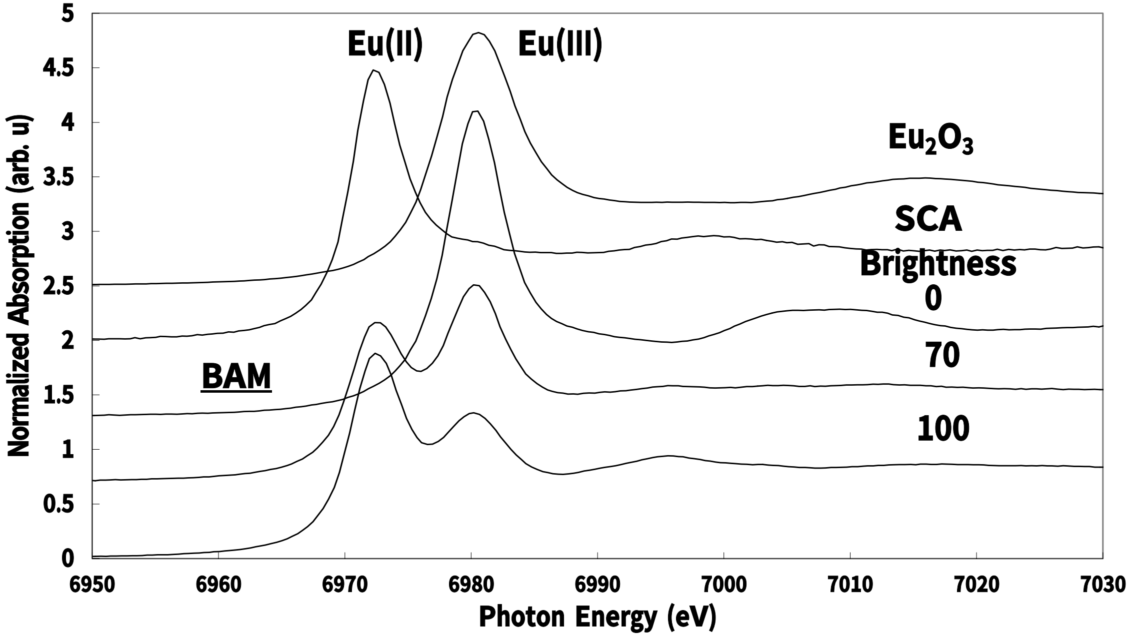


Figure 1 Eu L3 XANES spectra of BAM and its standards which contain Eu(II) or Eu(III)

- The peak of low energy side corresponds to Eu(Ⅱ). And the peak of high energy side corresponds to Eu(III).
- In the case of BAM which have brightness 0, most of Eu is Eu(III), and the other is increasing Eu(Ⅱ) in order of the increase in brightness.

Eu L3 radial structure functions of BAM which have diferent brightness

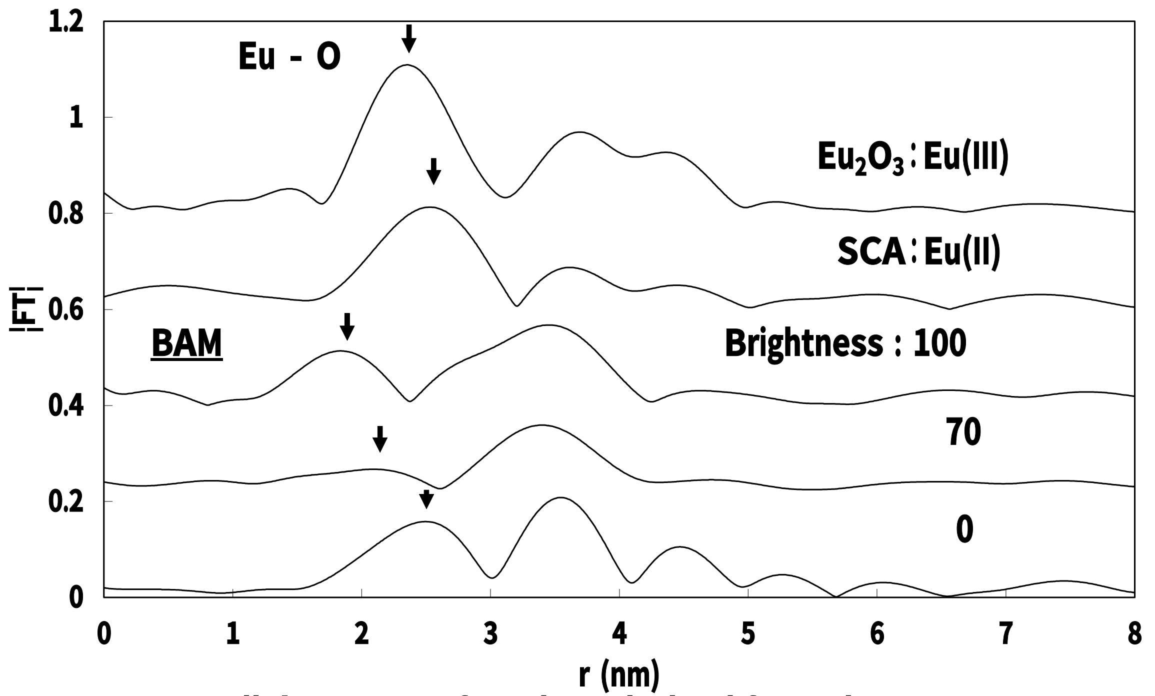


Figure 2 Eu L3 radial structure functions derived from those XAFS spectra.

- The BAM with higher brightness has the shorter distance of Eu-O.
- BAM of brightness 70 has the extremely weak peak intensity of Eu-O.

Eu L3 XANES spectra of BAM which have a diferent lifetime of brightness

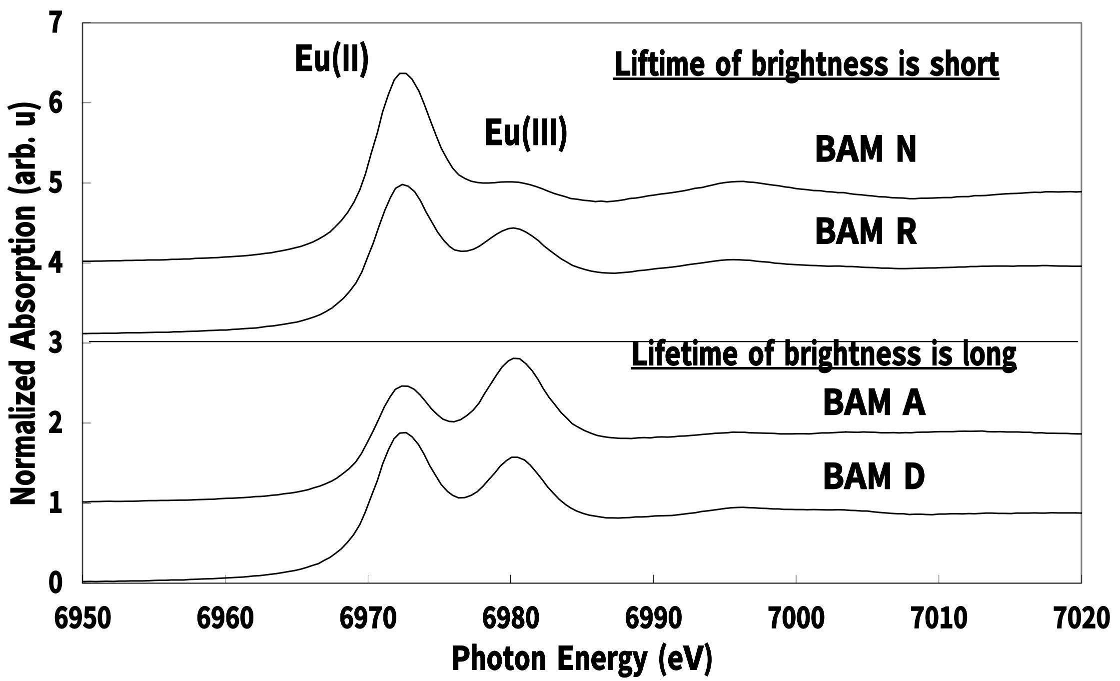


Figure 1 Eu L3 XANES spectra of BAM which have diferent lifetime of brightness.

- The BAM with more Eu(II) dose not necessarily have the longer lifetime of brightness.
- It is suggested that the structure near Eu influences a lifetime of brightness.

Eu L3 radial structure functions of BAM which have a diferent lifetime of brightness

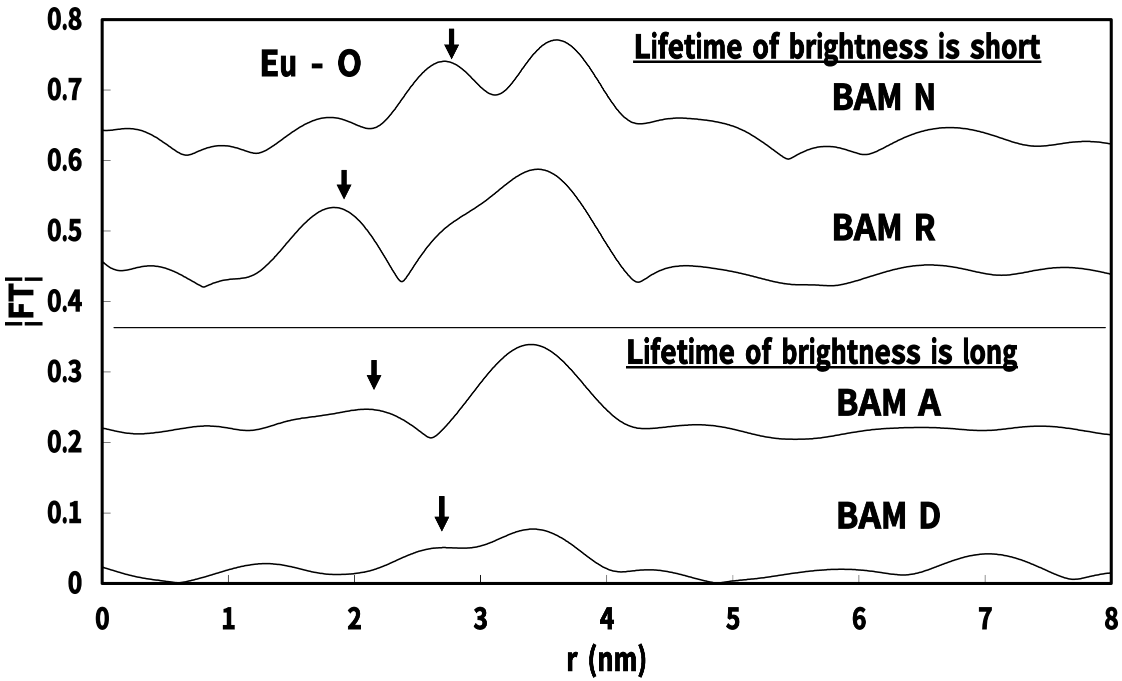


Figure 2 Eu L3 radial structure functions derived from those XAFS spectra.

- BAM with the longer lifetime of brightness has the extremely weak peak intensity of Eu-O.
- The peak intensity of D is weaker than others.

XANES Analysis of Eu in BAM by Wavelength- and Energy-Dispersive XRF

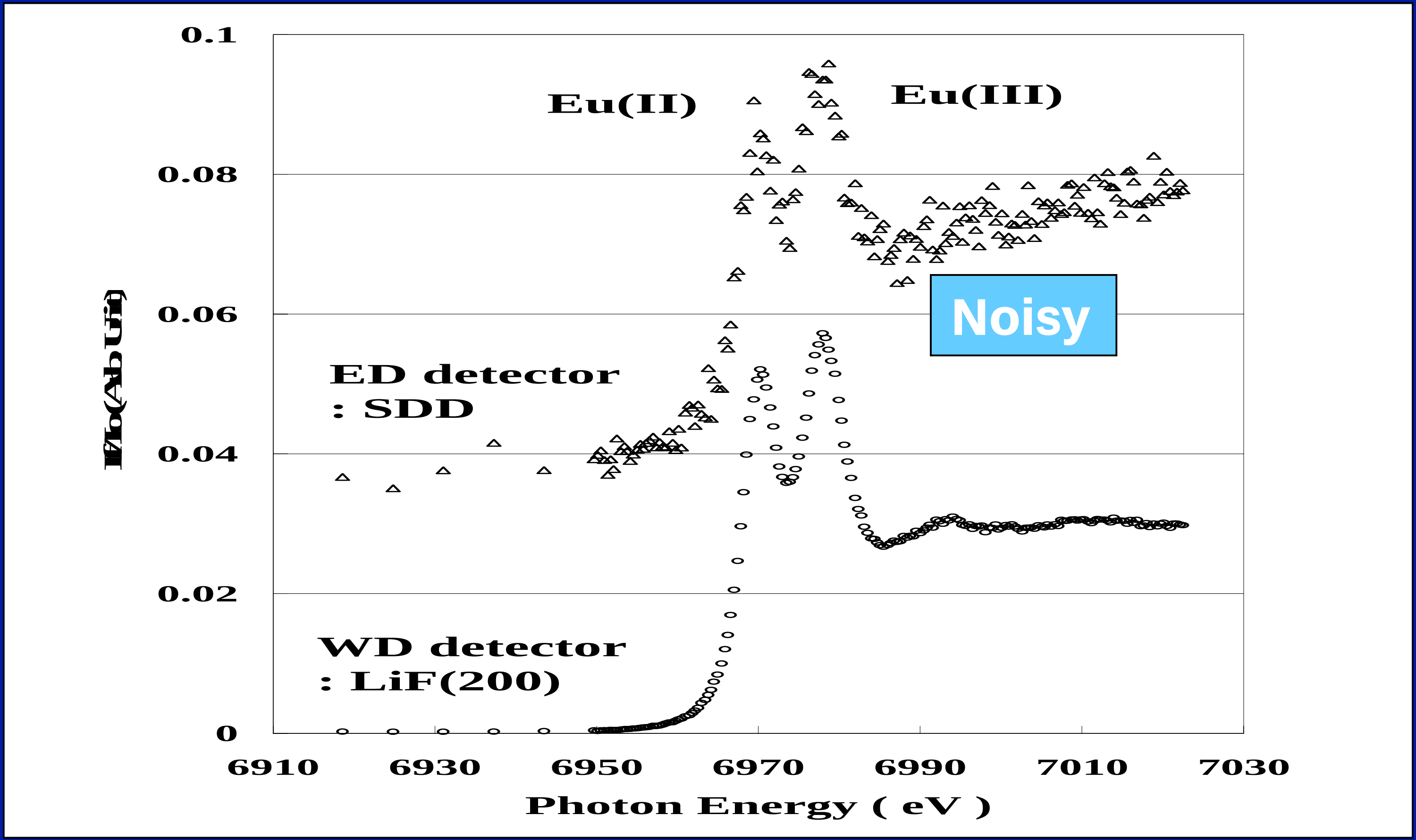


Figure 1 Eu L3 XANES spectra of BAM, using WD spectrometer or ED detector.

EuL3 χ(k) spectra of Eu in BAM by SDD with 7 elements or Ge SSD with 19 elements

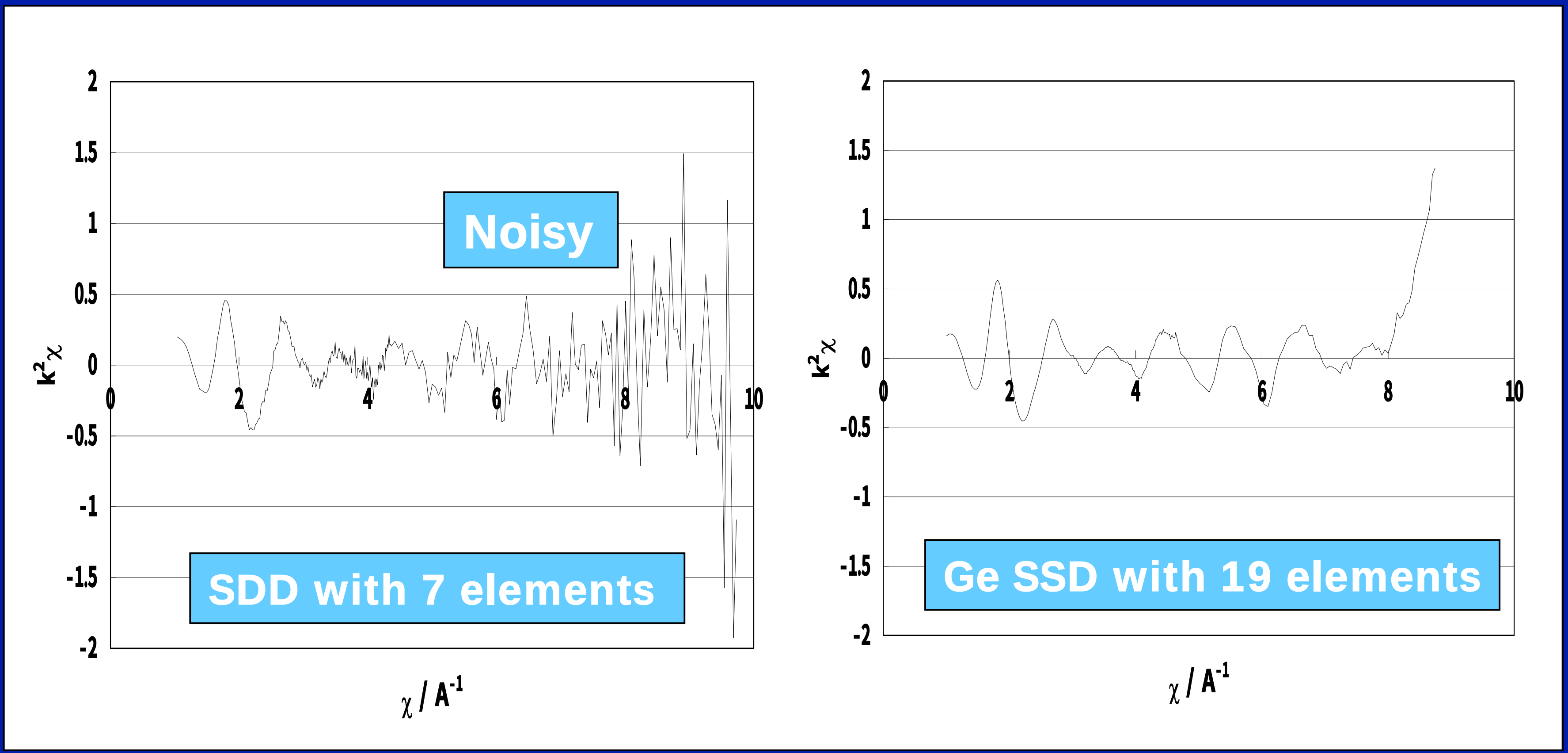
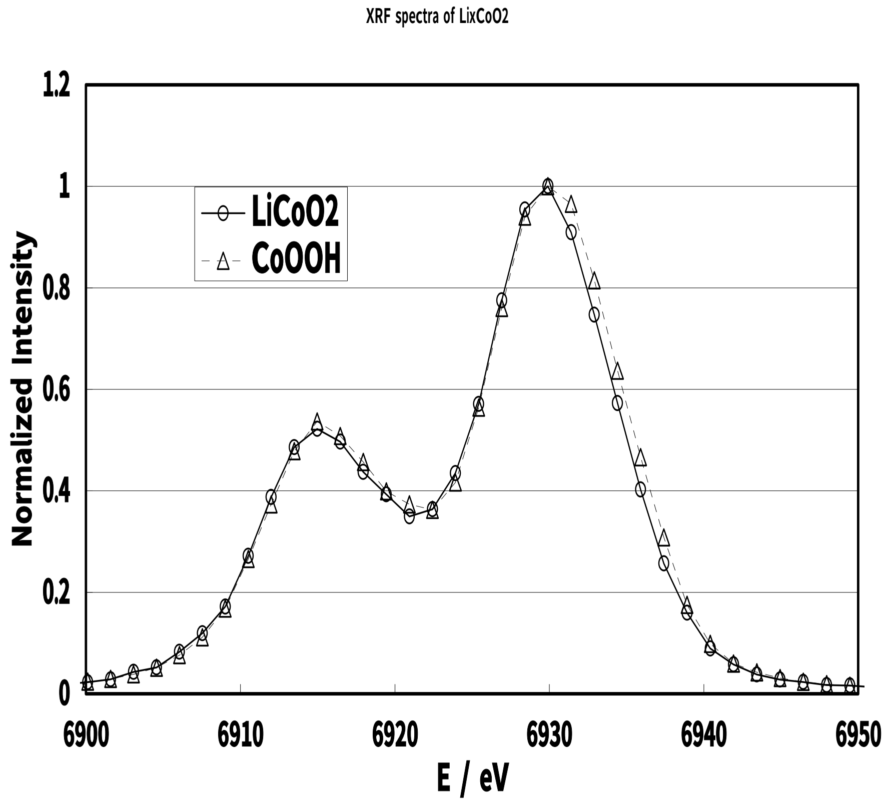


Figure 1 EuL3 χ(k) spectrum of Eu in BAM using SDD with 7 elements

Figure 2 EuL3 χ(k) spectrum of Eu in BAM using Ge SSD with 19 elements

CoKa1 spectra of Co Oxides with good energy resolutin

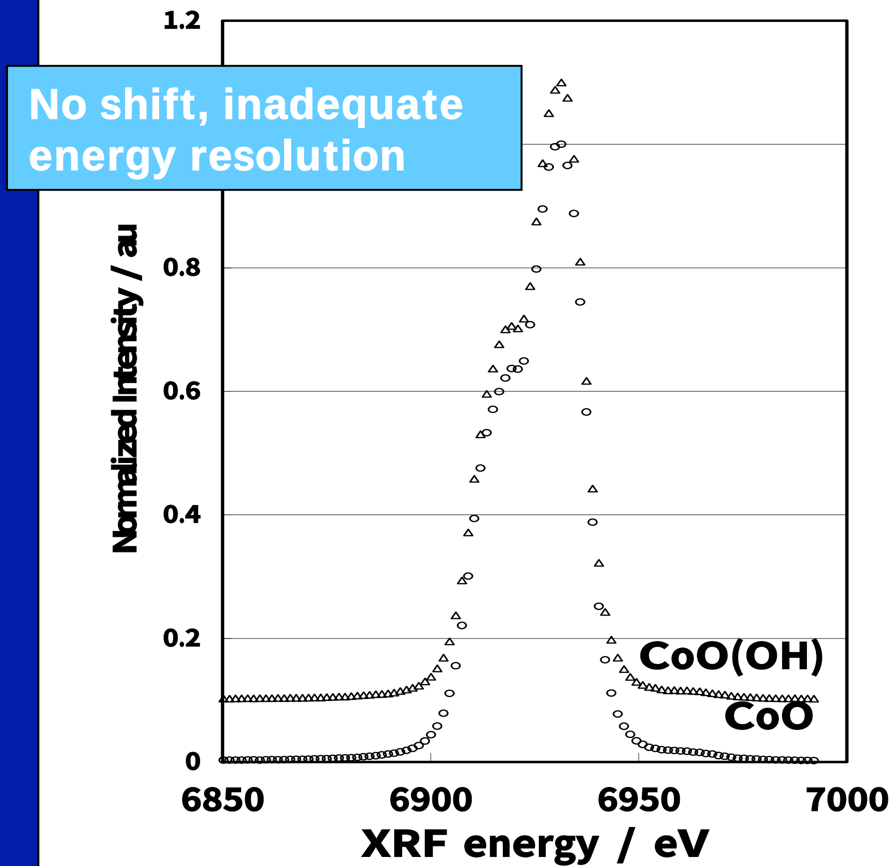


	$LiCoO_2$	CoO	Co_3O_4	CoOOH
Oxidation number	3	2	2.67	3
$CoK_{\alpha 1}$ peak (eV)	6929.9	6930.3	6930.1	6930.2
FWHM (eV)	10.4	10.5	10.3	10.8

Figure 1 Co Ka XRF spectra of $LiCoO_2$ and CoOOH with good energy resolution.

Table 1 Peak position and FWHM of Co oxides for Co Ka1 XRF.

WD-XRF with Various Analyzing Crystal for High Energy Resolution



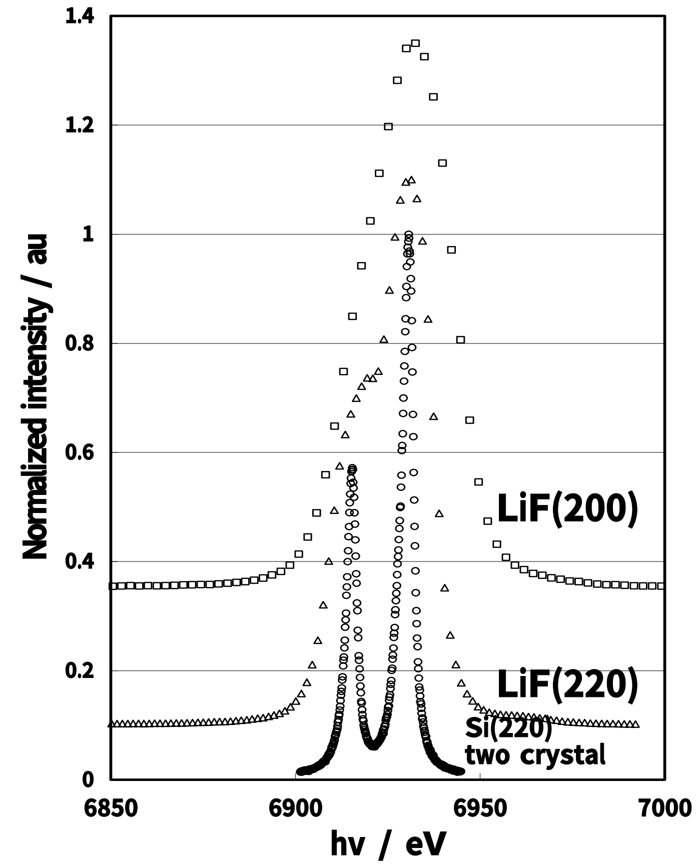
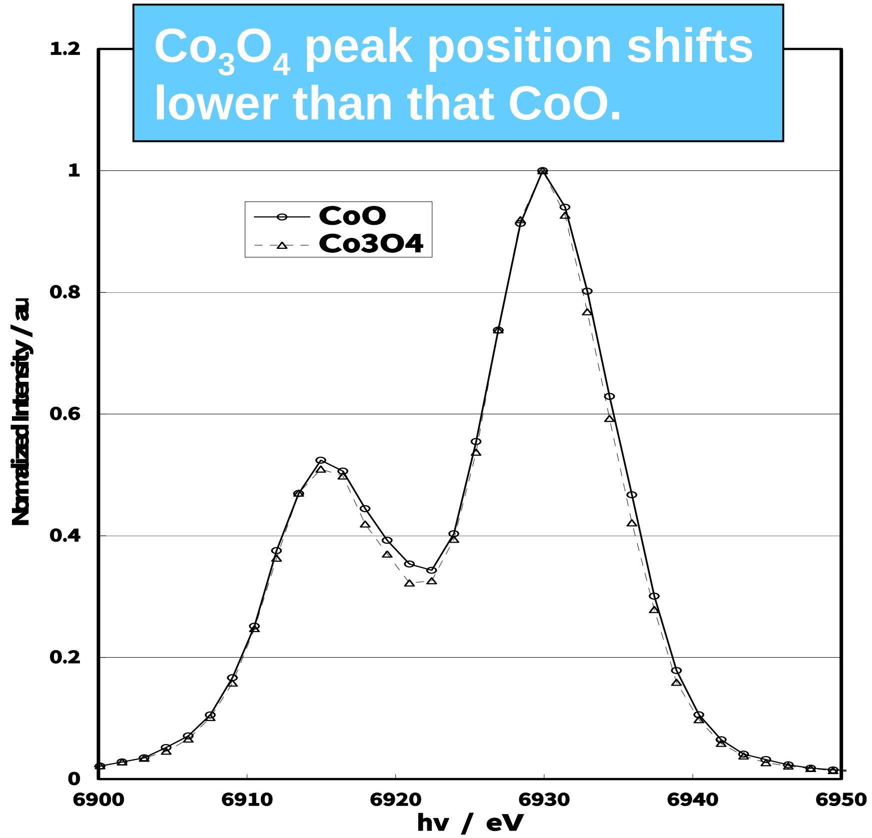


Figure 1 Co Ka XRF spectra of CoO and CoO(OH) for LiF(220).

Figure 2 Co Ka XRF spectra of CoO for various analyzing crystal.

WD-XRF with Good Energy Resolution for the Chemical State Analysis



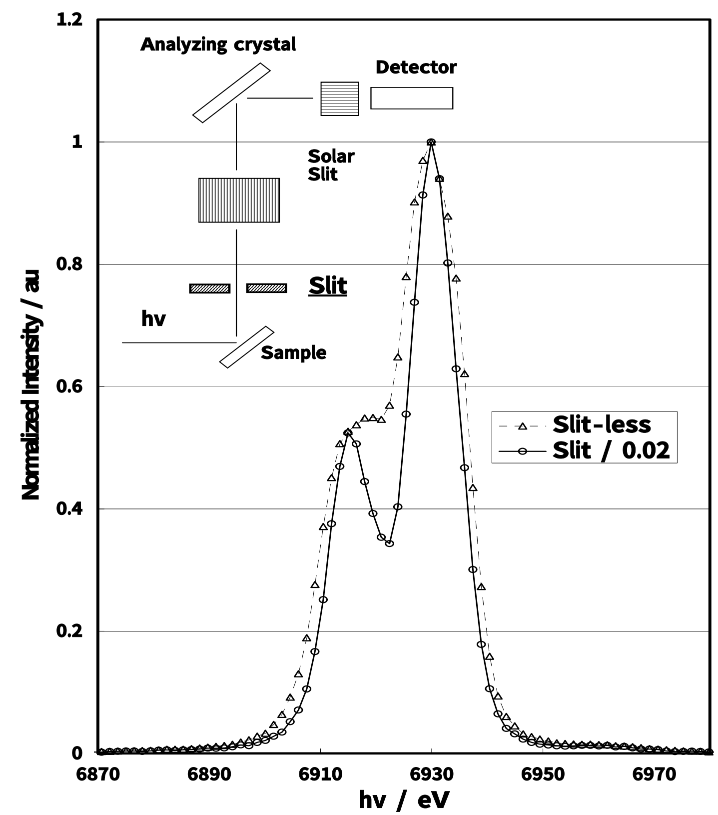


Figure 1 Co Ka XRF spectra of CoO and Co_3O_4 with a slit installed.

Figure 2 Co Ka XRF spectra of CoO with or without a slit.

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