L Edge Absorption Measurements of ZrO_2 and Y_2O_3 at BL13

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$L_{2,3}$ edges of Y and Zr are known to have sharp structures depending on chemical composition [1, 2]. We have performed measurements of not only the $L_{2,3}$ edges but also the L_1 edge of Y_2O_3 and ZrO_2 in which Y and Zr are formally in Y^{3+} and Zr^{4+} states, both having the same electronic configuration as Kr.

Measurements have been carried out at BL-13 of the SR Center of Ritsumeikan University in the total electron yield method. Powdered samples of Y_2O_3 (Kojundo Chemical Lab., 99.9 %) and ZrO_2 (NewMet, 99.8 %) were attached on the carbon tape.

In Fig. 1, $L_{2,3}$ spectra of Y_2O_3 and ZrO_2 are shown. The L_3 lineshape of Y_2O_3 is similar with the reported one [1]. The $L_{2,3}$ lineshape of ZrO_2 is similar with the reported spectrum of monoclinic ZrO_2 (m-ZrO_2), which is the room-temperature phase [2]. In each of the L_3 and L_2 edges, two structures roughly 2 eV apart, are seen. The intensity of the higher energy structure is relatively stronger at the L_3 edge than at the L_2 edge. Furthermore, the intensity of the higher energy structure is relatively stronger for ZrO_2 than for Y_2O_3.

According to Ikeno et al.[2], the above mentioned structures in the $L_{2,3}$ edges mainly reflect the ligand-field splitting of the unoccupied 4d state of Y and Zr, whereas multiplet effects play secondary roles. The 2-eV split lineshape of Y-$L_{2,3}$ edges in Y_2O_3, which resembles the lineshape of the reported Zr-$L_{2,3}$ edges in $SrZrO_3$[2], reflects the t_{2g}-e_g splitting because of the octahedral (six-fold) coordination [3]. On the other hand, the lineshape of m-ZrO_2 was explained by splitting into five levels due to seven-fold coordination with lower symmetry [2].

Y and Zr L_1 spectra of Y_2O_3 and ZrO_2 are shown in Fig. 2. In the Y L_1 spectrum, a structure is found at about 10 eV above the main peak. In the Zr L_1 spectrum a broader and weaker hump seems to exist around 10 eV above the main peak. These lineshapes probably reflect the unoccupied Y and Zr 5p states.

References

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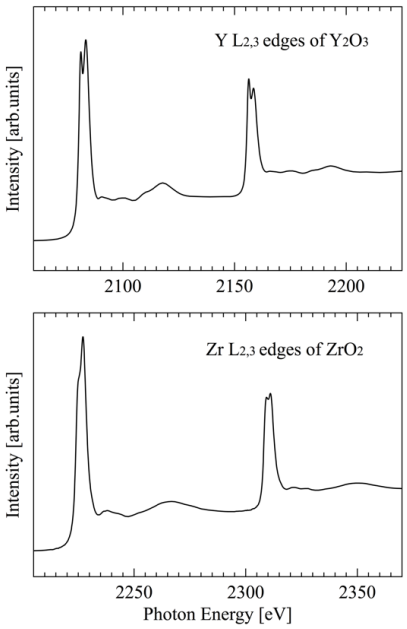

Fig. 1. Total electron yield spectra at Y and Zr $L_{2,3}$ edges of Y_2O_3 and ZrO_2.

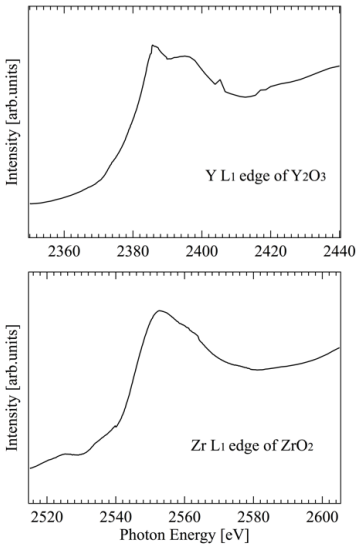

Fig. 2. Total electron yield spectra at Y and Zr L_1 edge of Y_2O_3 and ZrO_2.