Core Level Absorption Measurements of ZrO_2 and Y_2O_3 at BL11

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Core level absorption spectroscopy in the energy region of several hundred eV is quite effective because photon energy resolution is relatively high compared to higher energy x-rays. For example, Ti $L_{2,3}$ edges (2p XAS) are known to reflect the difference in the electronic states between rutile and anatase, the isomers of TiO_2. [1, 2]. In this energy region, there are also M edges of the fifth row of the atomic table. As examples, we report on $M_{2,3}$ edges of Y and Zr in this short note.

XAS measurements have been carried out at the BL-11 beamline of the Ritsumeikan University SR Center. The powder samples were placed on carbon tape, and measurements were performed in both total electron yield (TEY) and fluorescence yield methods. Results of the former are presented in this article. Photon energy in the region between 250 and 380 eV was calibrated by setting the π*-peak of C K edge of graphite as 285.5 eV [3]. That in the region between 380 and 500 eV was calibrated by setting the π*-peak of h-BN as 401.4 eV.

The measured results of Ti $L_{2,3}$ edges of rutile and anatase are shown in Fig. 1. The lineshapes are consistent with the reported results [1, 2]. The lineshapes have led to discussions about electron excitation dominated by 2p to 3d dipole transition.

Y and Zr $M_{2,3}$ edges of Y_2O_3 and ZrO_2, respectively, are shown in Fig. 2. M_2 and M_3 Y (Zr) peaks are found around 302 and 314 eV (334 and 347 eV). For each edge, a structure is found at about 2 eV above the main peak. The spectral lineshape is expected to reflect the unoccupied 4d band through the 3p→4d electric dipole transition. It is quite characteristic that the $M_{2,3}$ peak heights are nearly one order of magnitude smaller than the Ti $L_{2,3}$ edges.

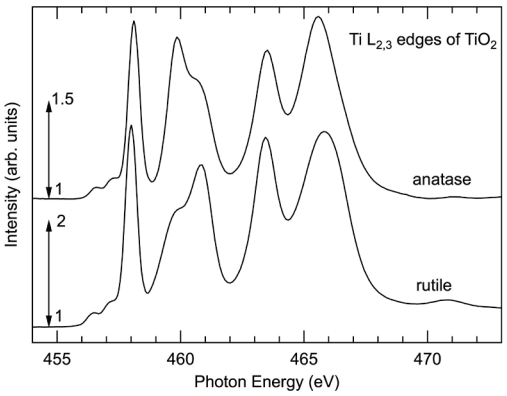

Fig. 1. Total electron yield spectra of anatase and rutile. The sample current is normalized using the current of Au mesh in front of the sample. The arrows and the numbers indicate the relative intensities at the ends of the arrows.

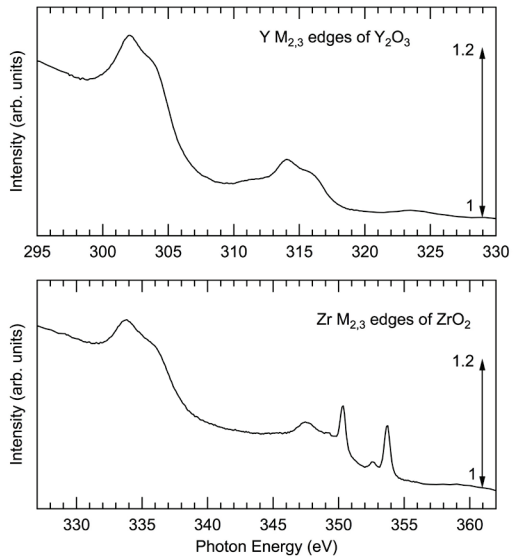

Fig. 2. Total electron yield spectra at the $M_{2,3}$ edges of Y and Zr of Y_2O_3 and ZrO_2. The arrows and the numbers indicate the relative intensities at the ends of the arrows. In the lower panel, the structures between 350 and 360 eV are presumably due to Ca contamination.

References

[1] R. Brydson, H. Sauer, W. Engel, J. M. Thomass, E. Zeitler, N. Kosugi, and H. Kuroda, *J. Phys.: Condens. Matter*, **1986**, *1*, 797.
[2] F. M. F. de Groot, M. O. Figueiredo, M. J. Basto, M. Abbate, H. Petersen, and J. C. Fuggle, *Phys. Chem. Minerals*, **1992**, *19*, 140.
[3] R. A. Rosenberg, P. J. Love, and V. Rehn, *Phys. Rev. B*, **1986**, *33*, 4034.