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2D diffraction imaging of monoclinic and cubic ZrO_2

Mari MIZUSAWA and Kenji SAKURAI*
National Institute for Materials Science, Sengen, Tsukuba, Ibaraki 305-0047, Japan

Introduction

Powder diffraction imaging of a specimen in the order of mm^2 ~cm^2 is extremely attractive from the standpoint of practical materials analysis, which often deals with inhomogenous specimens [1]. This report describes the application of a projection-type X-ray diffraction microscope [2] to the analysis of normal monoclinic and cubic phases of zirconia.

Experimental

The sample studied here was a pellet of ZrO_2 powder consisting of two different parts, normal monoclinic and cubic stabilized with Y_2O_3 (see Fig.1). The instrumental details of the present X-ray diffraction microscope have been given elsewhere [2]. Typical exposure time for one image was 10 sec. The viewing area is 13mm × 13mm.

Results and Discussion

Figure 2 shows powder X-ray diffraction patterns for the monoclinic and cubic parts of the sample, respectively. In the present study, reflections of monoclinic (140) (d=1.285Å) and cubic (400) (d=1.266Å) are chosen because they contrast well even though their d values are quite close. In this case, the CCD camera is set at ca. 90 deg, the corresponding X-ray energies for those Bragg reflections are 6787 eV and 6889 eV, respectively. The energies were experimentally confirmed by the monochromator scanning from 6700 eV to 7500 eV, which gives X-ray diffraction patterns as movie images for the whole sample area.

Figure 3 shows the distribution of monoclinic and cubic ziconia. The images were simply converted from experimentally obtained X-ray images at 6787 eV and 6889 eV. One can see the results agree well with the real distribution of the sample. The present method can perform quantitative imaging for the mixture of the monoclinic and cubic phases, although the present sample is a very simple case - two separate phases. The authors would like to thank Drs. H. Sawa, Y. Wakabayashi, Y. Uchida, for their assistance and advice during the experiment.

References

[1] Y.Chikaura, Y.Yoneda and G.Hildebrandt, *J. Appl. Cryst.,* **15,** 48 (1982); T.Wroblewski and E.Woldt, *Adv .in X-Ray Anal.,* **42,** 258 (2000).
[2] K.Sakurai and M.Mizusawa, *Photon Factory Activity Report 2003*, **#21,** p.260 (2004).
*sakurai@yuhgiri.nims.go.jp

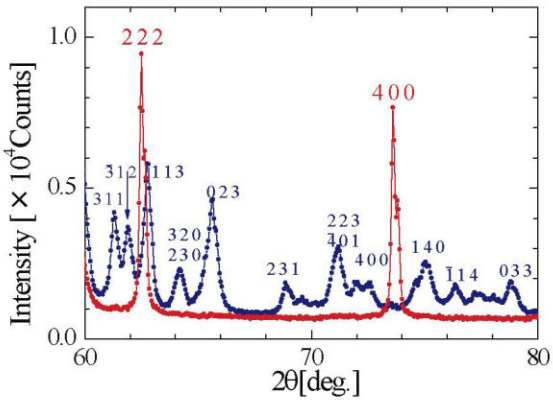
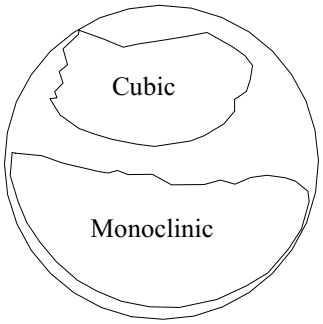


Figure 2 X-ray powder diffraction patterns for monoclinic and cubic zirconia.



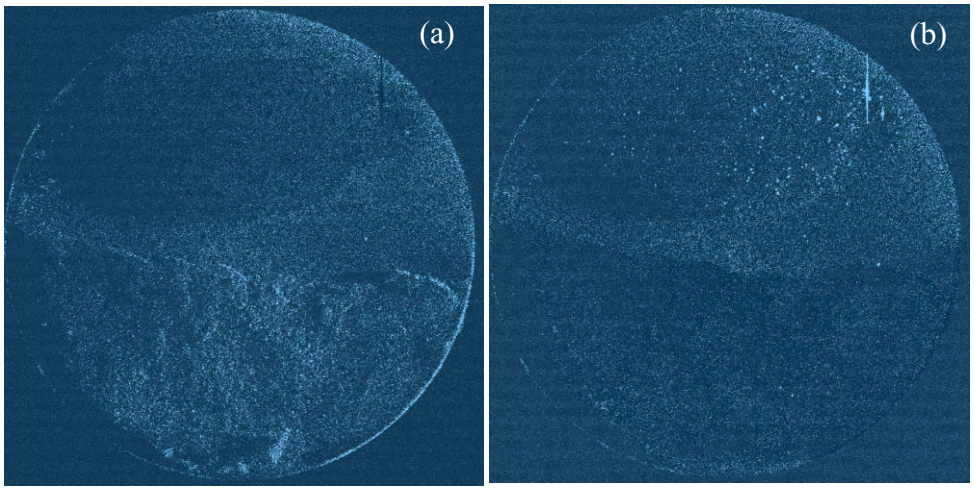


Figure 1 (left) A schematic drawing of the sample. The sample consists of monoclinic and cubic zirconia.
Figure 3 (right) (a) monoclinic zirconia image, (b) cubic zirconia image. The images were obtained from XRD images collected at two different energies of 6787eV and 6889eV, which correspond to Bragg reflections of cubic (400) and monoclinic (140), respectively.