2D diffraction imaging of monoclinic and cubic ZrO$_2$

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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$_2$O$_3$ (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 zirconia. 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 Ds. H. Sawa, Y. Wakabayashi, Y. Uchida, for their assistance and advice during the experiment.

References
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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.