BL-10A/2012G182

Crystal structures of swelling minerals

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1 Introduction

Swell minerals, example for montmorillonite, hectorite, are used for functional materials. Most swell minerals have layer structures and molecular water exists within the layer. The water move from or into the interlayer, and the structure is changed with the water content. Swelling minerals are also nanometer-sized crystal grain. Therefore, details of the crystal structure have not been clarified.

An unknown mineral with a Ca-B-Si-O-H component was discovered from Fuka Mine, Okayama prefecture, Japan. The unknown mineral has swelling characteristics, and the lattice parameters are changed under dry and wet conditions. We propose here a study based on X-ray diffraction analyses to elucidate the crystal structure of the swelling minerals.

2 Experiment

The examined sample was collected from Fuka Mine, Okayama, Prefecture, Japan. The mineral occurs in crystalline limestone near gehlenite–supurrite skarns. The samples are aggregates up to several ten millimeters in width, which are comprised of sub-micron sized crystals.

X-ray diffraction experiments were performed using the automated four-circle X-ray diffractometer installed at the beam line BL-10A, Photon Factory, High Energy Accelerator Research Organization. The wavelength (λ = 0.7785 Å) of synchrotron radiation was calibrated by the unit cell volume of the NIST ruby standard crystal at ambient temperature.

Powder X-ray diffraction patterns were measured by a convenient diffractometer at Tohoku University and by using the imaging plating system on the BL-10A.

3 Results and Discussion

All X-ray reflections from the crystal are weak and broad. Firstly, Laue photographs were taken by using the imaging plate system. Obtained Laue photographs was shown in Figure 1. And then some reflections were collected by the four-circle X-ray diffractometer. On the basis of the reflection data, the electron diffraction pattern, which was obtained by using a transmission electron microscope, was indexed (Figure 2). Electron diffraction analyses showed the mineral to be orthorhombic. By using the results of the Laue camera analyses, and the lattice parameters was refined from powder X-ray diffraction patterns; a = 7.223(1), b = 11.23(1), c = 12.29(1) Å, V = 996.9(1) Å^3. Under dry condition, c-axis decreases to approximately 10.9 Å, and reflection intensities were weaken with high-disordered stacking structure.

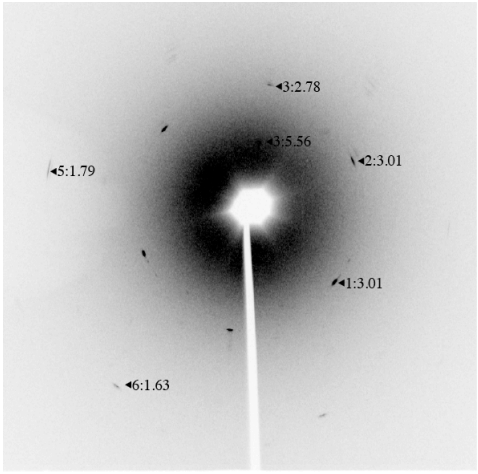

Fig. 1: Laue photograph of the Fuka unknown mineral.

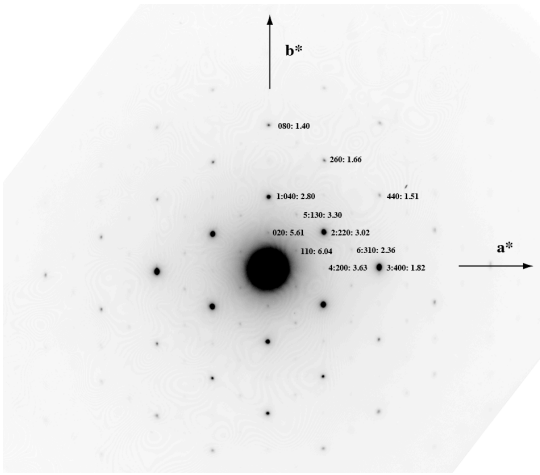

Fig. 2: SAED pattern (a*-b*) of Fuka unknown mineral.

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