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Compression of $FeAlO_3$ at high temperature

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Introduction

Fe-substituted Al_2O_3 and Al-substituted Fe_2O_3 have been investigated because of the importance of these oxides not only in nature but also in industry. It is known that the solid solution between isostructural Fe and Al end members is limited. The intermediate phase, $FeAlO_3$ with the defected spinel structure is known to be isostructural with $FeGaO_3$ and has very small stability field in the composition-temperature phase diagram. Since Shannon (1966)[1] reported that $FeGaO_3$ transforms to a corundum structure at high P, T conditions, $FeAlO_3$-defected spinel may transform to a corundum structure at high P, T conditions. This idea is a starting point of our project. Recently Gramsch and Prewitt (2002)[2] reported that $FeAlO_3$-defected spinel transforms to the garnet structure and then the perovskite structure with increasing pressure.

Experimental

When $FeAlO_3$-defected spinel was synthesized from the mixture of Al_2O_3 and Fe_2O_3, contamination by either Al_2O_3 or Fe_2O_3 was always observed even after a week of firing at 1350 °C. Thus, the production methods of starting $FeAlO_3$-defected spinel were based on the use of oxalic precursors described in Devaux et al. (1990)[3]. Finally we obtained a single phase of $FeAlO_3$-defected spinel.

Sample was pressurized in a diamond anvil cell with a small ruby chip for pressure calibration. Argon was loaded into a sample chamber as pressure medium and thermal insulator using facilities of Prof. Yagi's Laboratory in the Institute for Solid State Physics, the University of Tokyo.

Sample was pressurized to desired pressures at room temperature and then heated using an Nd-YAG laser installed in BL13A in the PF. Temperature was not measured but the intensity of the visual emission from the hot spot indicated a temperature of the order of 1000 °C.

Angle-dispersive X-ray diffraction measurements using an image plate detector were performed at the same beamline after heating. The monochromatized incident beam to the wavelength of 0.4263 Å is available and is collimated to 0.03 mm in diameter. Typical exposure time was 1 hour. Two-dimensional diffraction images recorded on an IP were converted to intensity-2θ diffraction patterns using a Program PIP [4].

Results and discussion

No structure change was observed up to 30 GPa at room temperature. However, some drastic changes could be observed in diffraction patterns measured after heating at 18 GPa (Fig. 1) and 28 GPa (Fig. 2). Analysis is now progressing and detailed results will come up soon.

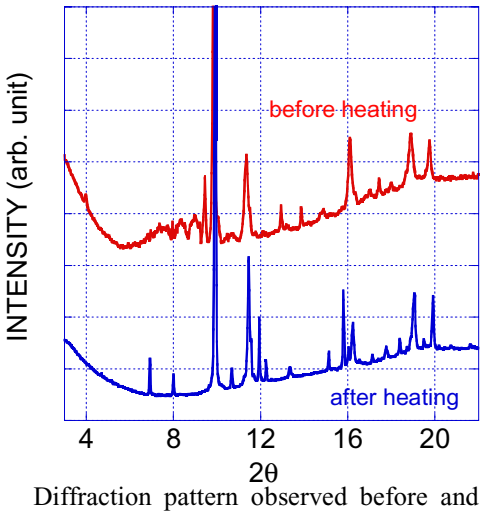

Fig.1 Diffraction pattern observed before and after heating at 18 GPa. Strong diffractions come from Argon.

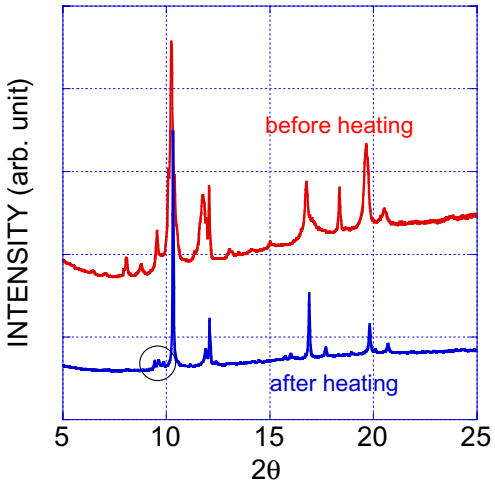

Fig.2 Diffraction pattern observed before and after heating at 28 GPa. Strong diffractions come from Argon. Three diffraction peaks in a circle may indicate the existence of an orthorhombic perovskite.

References

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