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Compression of Fe_3S up to 76GPa at room temperature

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It has long been recognized that iron and sulfur are possible elements in the cores of the terrestrial planets. Fei et al. [1] have revealed three new iron-sulfur compounds, Fe_3S_2, Fe_2S, Fe_3S formed at pressure greater than 14GPa. In particular, model Martian core containing 14.2 wt % sulfur, 88% of the Martian core would be made of Fe_3S (with 16.1 wt % S). Therefore, the density of Fe_3S will determine the physicochemical characteristics of the core. In this study, we report in situ measurements of the specific volumes of Fe_3S at high pressure by synchrotron X-ray diffraction.

High-pressure X-ray diffraction experiments were performed using the DAC high-pressure apparatus up to 76GPa. Fe_3S as starting material of DAC was synthesized at 21GPa and 1950℃ using a multi-anvil press at Tokyo Institute of Technology. Fe_3S sample was loaded in to 125 μm holes drilled in rhenium gaskets preindented to a thickness 50 μm and a few grains of ruby were loaded in the center of the sample chamber between two diamond anvils. Pressure was measured from the calibrated wavelength shifts in the R_1 line of the laser-induced fluorescence spectra of ruby. Angular-dispersive X-ray diffraction measurements were carried out at the synchrotron beamline BL10XU. The incident X-ray beam was monochromatized to wavelength of 0.4130Å. The X-ray beam size was collimated to 20 μm diameter. X-ray diffraction patterns were obtained on an imaging plate (IP). The observed intensities of the IP were integrated as a function of 2θ in order to give conventional, one-dimension diffraction profiles.

Fig. 1. shows the compression data of Fe_3S at room temperature. The tetragonal unitcell parameters for Fe_3S at different pressure were primarily derived from the more than five peaks. Our result is in good agreement with previous study and no indication of phase transition was observed up to 76GPa. Further experiments under high pressure and high temperature conditions to delineate the stability field of Fe_3S are in progress.

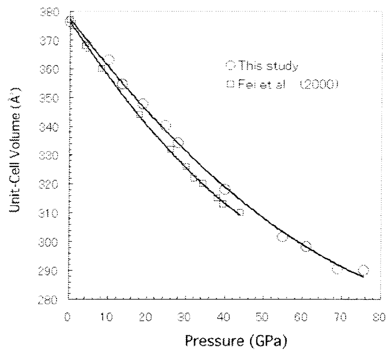

Fig. 1. Pressure-volume data of Fe3S at 300K. Open circles are experimental results from this study and open squares represent data from Fei et al. (2000).

[1] Fei Y. *et al.*, Ame.Mine. 85, 1830 (2000).

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Structural changes of the coexicting ferromagnetism and super-conductivity $RuSr_2MCu_2O_8$ (M = Gd, Eu) Oxide under high pressure

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Coexisting ferromagnetism and superconductivity have recently been discovered in the 1212-type layered cuprate superconductivity $RuSr_2GdCu_2O_8$ (Ru1212). This material is isostructural with $YBa_2Cu_3O_{7-\delta}$ with Y, Ba, and Cu1 (the chain copper atom) being completely replaced by Gd, Sr, and Ru, respectively and displays bulk superconductivity below T_c = 0 - 46K which is associated with the CuO_2 planes, and a Curie transition at T_f = 132 K. The ferromagnetism occurs in RuO_2 planes and is like that in $SrRuO_3$ which is an itinerant electron ferromagnet below T_f = 165 K. It is interesting to study the pressure effects of this material for the understanding of the coexisting ferromagnetism and super-conductivity in these systems. Recently, we reported the pressure dependence of the superconducting and ferromagnetic transition temperature of the Ru1212 [1]. In this work, we have investigated the crystal structure of Ru1212 by means of synchrotron radiation X-ray powder experiment under high pressure.

The Ru1212 samples were synthesized by solid-state reaction of stoichiometric powders of RuO_2, $SrCO_3$, Gd_2O_3 and CuO. Magnetisation and resistivity measurements show that this sample has a Curie transition at T_M = 135 K and a superconducting transition at T_c = 42 K.

High-pressure X-ray powder diffraction was performed at Spring8, BL10XU beamline at various temperatures using a diamond anvil cell (DAC). The wavelength of the incident X-ray is 0.579997 Å. The diffraction patterns were fitted using the tetragonal *P4/mmm* symmetry model. We plotted in Fig. 1 the lattice as a function of pressure. The linear change of lattice parameters as a function of pressure was observed up to 6 GPa. More detail results will be reported elsewhere.

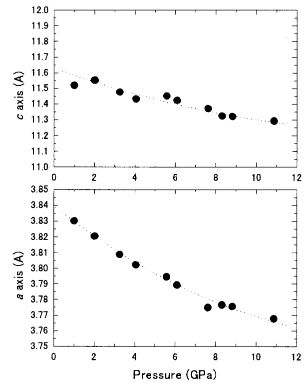

Fig.1 The change of lattice parameters as a function of pressure.

[1] Y. Yamada *et al.* J. Phys (2002) in press.