In situ X-ray study of iron hydride at high pressures and temperatures

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Seismic data indicate both the inner and outer cores are less dense than pure iron under core conditions [Jephcoat et al., 1986; Mao et al., 1990], suggesting that one or more light elements be dissolved into the Earth's core. The possible candidates for the light elements are proposed as hydrogen, sulfur, oxygen, silicon, carbon [e.g., Poirier, 1994]. Hydrogen in the Earth's core was proposed from reaction between water and iron [Stevonson, 1977]. Since experimental works showed that substantial enhancement of the solubility of hydrogen in iron was observed with increasing pressure [Antonov et al., 1980; Fukai et al., 1982], these experiments led to be of interest in hydrogen in the core, including a study of iron-water reaction [e.g. Badding et al., 1991; Yagi and Hishinuma, 1995; Okuchi, 1997]. However, the experimental data on the iron-hydrogen system are limited up to 10 GPa and 1500 K because of the difficulty in the experimental techniques. In particular, no experiments at high pressures and temperatures are performed using a diamond-anvil cell. The purpose of this work is to carry out high pressure and high temperature experiment by a laser-heated diamond-anvil cell in order to understand the stable phases and the reaction between iron and hydrogen under high pressure and temperature.

Hydrogen was introduced by the gas loading system installed at NIMS, together with the starting material of iron. The samples were pressurized to the desired pressure at room temperature, and then heated to the desired temperature using single-side laser heating techniques with multimode continuous wave Nd: YAG laser. Pressures were measured by the ruby fluoresencence method. The tungsten foil was used as a gasket. In situ X-ray diffraction experiments were performed at BL13A beamline of the Photon Factory, High Energy Accelerator Research Organization (KEK). Powder X-ray diffraction experiments under high pressures were carried out by the angle dispersive method using an imaging plate detector.

High pressures and temperatures experiments on iron hydride with a laser-heated diamond-anvil cell allows in situ X-ray measurements to temperature over 1000 K at 38 GPa. The detail analysis are now in progress and the results will be reported.