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Phase transition of Fe_2O_3at high pressures and high temperatures

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Introduction
$Fe_2O_3$is an important material to clarify the behavior of trivalent iron such as a spin transition in the deep Earth. Several studies on the structural phase transition under high pressure and temperature have been reported, but there are many discrepancies among reported results and the true situation remains unclear. It has been reported that hematite (corundum structure) transforms to a Rh_2O_3(II)-type structure with a volume decrease of 10% at around 50GPa at room temperature[1,2]. This transition has been reported to occur in the lower pressure region at elevated temperature, but the reported P-T conditions are quite different [3,4]. We have made careful study to clarify the discrepancy by X-ray diffraction experiments at the Photon Factory.

Experiment
We conducted all experiments using diamond anvil cell(DAC) and laser heating system. Fe_2O_3 powder of reagent quality (purity 99.99%) was formed into a pellet and sandwiched between NaCl, which works as a pressure medium, thermal insulator, and pressure marker. Three different types of lasers, YAG, fiber or CO_2laser, were used for heating the sample to see the effect of the way of heating. Samples were pressurized at room temperature and X-ray measurements were made after the heating by a laser.

Result
According to [4], Fe_2O_3heated at about 30GPa should transform from hematite to Rh_2O_3(II)-type structure while it should remain as hematite according to [3]. In the present study, however, some new diffraction lines which were not reported before, appeared in the samples heated using YAG or fiber laser at 30GPa. Samples heated at lower temperatures using CO_2laser were observed to transform into a mixture of the new phase and Rh_2O_3(II)-type structure.
Three different lasers have each characteristic features as follows. In YAG laser heating the fluctuation of temperature is very large while in fiber or CO_2laser heating the temperature was very stable. In fiber laser the heated area was very small and a large temperature gradient was formed in the heated spot. On the other hand, CO_2laser can heat larger area at once but because of the restriction of the optical system, we can't heat from two sides simultaneously, which results temperature gradient along the direction of irradiation. These differences could affect the results. We will report the details of these results as well as the results of high temperature in situ X-ray observation at SPring 8.

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[3]Ono et al. (2005) J.Phys.,17,269-276
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