高圧下でのFe-Si合金の磁性・構造転移
Magnetic and Structural transition of Fe-Si alloy under high pressure

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The Earth’s core is consider to be divided into the liquid outer core and solid inner core based on seismological observations. The Earth’s core is mainly composed of Fe although the density of the core is smaller than that of pure iron under the core conditions. Therefore, the core has been considered to contain light elements, such as H, S, Si, C, and O. In particular, Si is one of the most important light elements in the core. Although the phase relations and compression behaviors in the Fe-Si alloy have been studied at high pressure and temperature in order to investigate properties of the inner core, magnetic properties of the alloys have not been studied well. In order to clarify the relationship between the magnetic transition and the structural transition of the Fe-Si alloy, we made simultaneous measurements of X-ray diffraction and synchrotron Mössbauer spectroscopy the Fe-Si alloy up to 40 GPa at room and high temperature.
The starting materials of Fe-Si alloys used for the measurements had compositions of $Fe_{0.95}Si_{0.05}$ or $Fe_{0.88}Si_{0.12}$ enriched with ^{57}Fe. The mixture powder were heated in the Ar-H_2 atmosphere by a double sided laser heating system and the molten samples were quenched to room temperature by shutting the laser. Mössbauer spectra and XRD patterns were obtained at the beamlines, BL10XU and BL11XU of SPring-8 up to 40 GPa at room and high temperature. Our Mössbauer data together with X-ray diffraction data revealed that the magnetic transition started to transform from magnetic to non-magnetic phase at around 15 GPa for $Fe_{0.95}Si_{0.05}$ and 14 GPa for $Fe_{0.88}Si_{0.12}$. This transition was likely simultaneous transition with the bcc to hcp transition. The magnetic and structural transition pressures increased as increasing Si amounts in the Fe-Si alloys. In addition, Mössbauer spectra and XRD patterns were obtained from room temperature to 700 K at about 7 GPa. As the temperature raised, the internal magnetic fields became small and bcc structure started to transform to fcc structure at 870 K and 8.0 GPa and only fcc structure was observed at 920 K and 8.0 GPa.

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