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Melting curve of Fe-Si alloy up to core-mantle boundary pressure

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Earth's core consists of iron-Ni alloys and 10 wt% of light elements, such as Si, S, O, C, H. And it is composed of the inner core (solid) and the outer core (liquid) (Birch 1952). But the thermal structure of the Earth's core has not been constrained yet. Melting relation of the iron alloy is essential to estimate the thermal structure and temperature of the core, since the temperature of the inner core-outer core boundary (ICB) corresponds to the melting temperature of iron alloy at ICB pressure. Furthermore, the temperature of the outer core-mantle boundary (CMB) has to be higher than the melting temperature of iron alloy at CMB pressure. Therefore, measuring melting temperature of iron alloy under high pressure has a significant role to estimate the thermal structure of the Earth. In this study, melting temperature of Fe-17 wt%Si alloy was determined up to 120 GPa based on change of laser heating efficiency and texture of the recovered samples using Laser heated diamond anvil cell. The measured melting curve of Fe-17 wt%Si is slightly lower than that of pure Fe and melting temperature was 3300 K at 120 GPa (CMB pressure). Extrapolated melting temperature to 330 GPa (ICB pressure) shows 4000 K using Simon's equation. In order to clarify the solid phase of Fe-17 wt%Si, in situ X-ray diffraction study was also carried out at the BL13A beamline in PF for KEK. The high-pressure, and high-temperature behavior of Fe-17 wt%Si alloy was investigated up to 27 GPa and 1800 K. Fe-17 wt%Si was bcc phase and there was no phase transition in the range of experimental pressure and temperature.