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hcp 構造 Fe-Si-H 合金の状態方程式の決定
Compression of hcp Fe-Si-H alloy to 130 GPa

田川 翔 [1*] ; 太田 健二 [1] ; 廣瀬 敬 [2] ; 大石 泰生 [3]
TAGAWA, Shoh[1*] ; OHTA, Kenji[1] ; HIROSE, Kei[2] ; OHISHI, Yasuo[3]

[1] 東京工業大学 地球惑星科学専攻, [2] 東京工業大学 地球生命研究所, [3] 高輝度光科学研究センター
[1]Department of Earth and Planetary Sciences, Tokyo Institute of Technology, [2]Earth-Life Science Institute, Tokyo Institute of Technology, [3]SPring-8, Japan Synchrotron Radiation Research Institute

The light elements in the Earth's core have not been identified yet, but hydrogen is now collecting more attention because recent planet formation theory suggests that large amount of water (e.g. 10 to 100 times seawater) should have been brought to the Earth during the late stage of its formation. Hydrogen is a strong siderophile element and thus it is possibly present in the core. The effect of hydrogen on the property of iron alloy is little known yet. Moreover, the presence of $\sim$ 6 wt.% silicon has been also strongly supported by geochemical and cosmochemical arguments. Here we report hydrogenation of $Fe_{0.88}Si_{0.12}$ (6.5 wt. % Si) alloy and the compression behavior of $Fe_{0.88}Si_{0.12}H_{0.8}$ alloy to 130 GPa at room temperature. $Fe_{0.88}Si_{0.12}$ foil was loaded into a diamond anvil cell (DAC), and then liquid hydrogen was introduced at temperatures below 20 K. The results demonstrate that the octahedral sites of Fe-Si-H alloys are not fully occupied by hydrogen unlike the case of FeH and as a consequence $Fe_{0.88}Si_{0.12}H_{0.8}$ is formed under hydrogen-saturated condition. The compressibility of hcp $Fe_{0.88}Si_{0.12}H_{0.8}$ is similar to that of pure iron. Assuming that liquid and solid alloys have identical density and ideal solution of hydorogen and silicon in the hcp phase, we found that the observed density profile in the outer core may be reconciled with $Fe_{0.88}Si_{0.12}H_{0.4}$. It means that the amount of hydrogen corresponding to about 90 times seawater could be in the Earth's core. This study suggests that Fe-Si-H system is a plausible chemical composition of the core.

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