

Hydrogen solubility into Fe-C and Fe-Si alloys at high pressure

TERASAKI, Hidenori^{1*}, SHIBAZAKI, Yuki², NISHIDA, Keisuke², TAKAHASHI, Suguru², ISHII, Miho², OHTANI, Eiji², HIGO, Yuji³

¹Osaka Univ., ²Tohoku Univ., ³JASRI

The most of the Fe-Ni cores of terrestrial planets are considered to contain light elements, such as S, Si, O, C and H. Hydrogen is considered to be one of the plausible light elements in the planetary cores. It is important to understand the effect of coexisting light elements, i.e. C and Si, on the solubility of H into Fe. Here, we have carried out in-situ X-ray diffraction experiments on the Fe₃C-H and FeSi-H systems to investigate the solubility of hydrogen into Fe-C and Fe-Si alloys under high pressure.

The experiments were performed up to 19 GPa and 2073 K for FeSi-H system and up to 17 GPa and 1973 K for Fe₃C-H system. Hydrogen dissolved in FeSi and FeSiH_x hydride was formed above 10 GPa. This hydrogenation pressure is much larger than that of Fe, suggesting that presence of Si in Fe metal increases the minimal pressure for H incorporation. Hydrogen content (x) increases from 0.07 to 0.22 with increasing pressure for P > 10 GPa and the H content in FeSiH_x is lower than that in FeH_x. The effect of carbon on hydrogenation pressure and H solubility will also be discussed.

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