Hydrogen solubility into Fe-alloys under high pressure

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Hydrogen, the most abundant element in the solar system, is known to incorporate into Fe and form FeHx above 3 GPa. The solubility of H in Fe is closely linked to light element in the terrestrial core and H reservoir in the planet interiors. In order to understand more realistic case of H in planet interiors, H solubility into Fe-alloys (such as Fe-Si, Fe-C, and Fe-S) needs to be clarified.
In this study, we have performed in situ X-ray diffraction measurements combined with Kawai-type multianvil press under high pressures and temperatures to study H solubility in FeSi and Fe3C. H solubility can be estimated from a volume expansion associated with hydrogen incorporation into metal. The lattice volumes and phase relations of FeSi-H and Fe3C-H systems were measured up to 19 GPa and 1973 K.
H starts to dissolve in FeSi and form FeSiH*x* (x=0.07-0.22) above 10 GPa, suggesting that presence of Si in metal increases the minimal pressure for H incorporation. H incorporation into Fe3C does not occur and H is unlikely to coexist with C in Fe-alloy up to 14 GPa (Terasaki et al. 2014). Therefore, hydrogenation pressures of Fe-alloys are different from that of pure Fe and more pressure is required for H incorporation into the Fe-alloy core.

Keywords: Hydrogen, Fe-alloy, core

