Sound velocity of B2-FeNiSi alloy at high pressure determined with inelastic X-ray scattering: Implications for the composition of the Earth's inner core

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Geochemical and geophysical studies provide evidence that Earth’s core contains iron with 5-7 wt.% of nickel [1] and a small amount of light elements (such as silicon, sulfur, oxygen, hydrogen, and carbon) that can justify the observed density deficit with respect to pure iron [e.g., 2]. The cosmochemical abundance of Si and its involvement in chemical reactions at the core mantle boundary (CMB) indicate that it can be considered as one of the major alloying elements in the Earth’s core [1].

We measured the sound velocity of $Fe_{78}Ni_7Si_{15}$ alloy with a B2 structure at room temperature up to 90 GPa employing inelastic X-ray scattering to constrain the constitution of the inner core. The density of the alloy was also determined by X-ray diffraction under the same conditions. The relation of the P-wave velocity (v_P) and density (ρ) of B2-$Fe_{78}Ni_7Si_{15}$ alloy follows Birch’s law. We discuss the possibility that the inner core is composed of the B2-$Fe_{78}Ni_7Si_{15}$ alloy or the mixture of hcp and B2 alloys based on Birch’s law determined here for B2-$Fe_{78}Ni_7Si_{15}$ alloy and that for hcp-Fe and FeSi alloys reported previously [3, 4]

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