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Sound Velocity of $Fe_{0.83}Ni_{0.09}Si_{0.08}$alloy to Core Pressures

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Inelastic x-ray scattering measurements have been performed on the BL35XU beamline at SPring-8. We have measured the IXS spectra of the $Fe_{0.83}Ni_{0.09}Si_{0.08}$alloy in diamond anvil cell from 50 GPa to 135 GPa at room temperature. Spectra were collected in a transmission geometry with the X-ray beam impinging on the sample through the diamonds along the compression axis of the diamond anvil cell.
The sound velocity and the density of the alloy follow a liner relation, i.e., the Birch's law. The Vp-density (d) relation for $Fe_{0.83}Ni_{0.09}Si_{0.08}$alloy can be expressed as Vp (m/sec) = 1.50(0.17)d(kg/m2)-6 570(1690) of which slope is steeper than that of pure iron. The extrapolation of the sound velocity, Vp, to the inner core conditions along the Birch's law indicates that the P-wave velocity of the alloy is 4.5% faster than that of the inner core observed in the PREM. The discrepancy of the P-wave velocity of the $Fe_{0.83}Ni_{0.09}Si_{0.08}$alloy and that of the PREM inner core may be reduced by taking account of the anharmonic temperature effect at high temperature of the core. Slightly smaller amount of Ni and/or larger amount of Si than the present alloy might be a suitable candidate for the inner core of the Earth.

Keywords: sound velocity, FeNiSi alloy, core, inelastic x-ray scattering, Birch's law, PREM