Sound velocity measurements on liquid Fe-P alloy up to 80 GPa

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The Earth’ s liquid outer core is composed mainly of iron, alloying with 5% nickel and 10% lighter elements [1]. The core composition is important to understand the environment and mechanism of the core formation process and the present-day magnetic field. The sound velocity of liquid iron alloys under relevant high-pressure and -temperature conditions in the core is key to constraining the core composition because the direct observations for the core is seismologic wave passing through the core only. Phosphorous is one of the candidates for light elements in the core because it is found in iron-meteorites [2] and depleted in the silicate mantle relative to chondrites [3]. In this study, we determined the P-wave velocity of liquid $Fe_{75}P_{25}$ up to 80 GPa using a laser-heated diamond-anvil cell in combination with an inelastic X-ray scattering (IXS) spectroscopy. We performed IXS measurements at a beamline BL43LXU [4] of the RIKEN SPring-8 Center in Japan. The P-wave velocity of liquid $Fe_{75}P_{25}$ were obtained based on the observed acoustic phonon dispersion. The present results exhibit that the influence of phosphorus on liquid iron sound velocity is almost negligible under the present experimental conditions. On the other hands, the density of liquid Fe can be reduced by phosphorous.

References

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