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Sound velocity measurements of liquid Fe-C alloy under high pressure

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The liquid Earth's outer core consists predominantly of iron with c.a. 10 wt.% lighter elements, such as hydrogen, carbon, oxygen, silicon, and sulfur. Other terrestrial planets such as Mars, Mercury and Venus are also similar to the Earth in that they have central metallic cores, which are considered to be at least partially molten. Popular models for those planetary cores also favor the presence of lighter elements. The nature of the light elements is important for understanding the core formation processes and the present core structure and dynamics in terrestrial planets, both of which are still not well understood. The seismic wave speed is the primary information on the Earth's core. The sound velocity of liquid Fe alloying with light-elements is therefore key to constrain the lighter component in the Earth's core and provide a reference for future surveys of other planets. Recently we have developed the techniques for inelastic X-ray scattering (IXS) measurements combined with diamond-anvil cell (DAC) experiments at the SPring-8 IXS spectrometers in order to investigate sound velocities of liquid Fe alloying with light-elements under the high pressure and high temperature conditions relevant to planetary cores. We determined the sound velocity of liquid Fe-C alloy up to 70 GPa. We will discuss the effect of carbon on the sound velocity of liquid iron and implications for planetary cores.

Keywords: sound velocity, light element in the core, liquid iron carbide, high pressure