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Compressional sound velocity and density measurements of hcp-Fe under core conditions

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Sound velocity measurements of Fe and Fe-alloy at high temperature and high pressure are necessary to understand the Earth's inner core. Despite seismological observations providing density-sound velocity data of Earth's core, there are few experimental reports about sound velocity of hcp-Fe at ultrahigh pressure and temperature conditions. In order to push forward with research, we have developed a portable laser-heating system for diamond anvil cell, which is called COMPAT (Fukui et al., 2013). We have succeeded in measuring the sound velocity of hcp-iron up to 160 GPa and 3000 K by inelastic X-ray scattering measurements combining with a laser-heated diamond anvil cell. The obtained pressure and temperature dependence of the sound velocity suggest that compressional sound velocity of hcp-Fe at inner core boundary (330 GPa and 5500 K) is higher than that of Earth's inner core. Thus, we can conclude that the light elements or combination of the light elements and nickel in the inner core decreases both density and compressional sound velocity of hcp-Fe simultaneously under the inner core conditions.

Reference
Fukui et al., 2013. A compact system for generating extreme pressures and temperatures: An application of laser-heated diamond anvil cell to inelastic X-ray scattering. Review of Scientific Instruments 84, 113902; doi: 10.1063/1.4826497.

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