	Experiment title: High-pressure high-temperature sound velocity of gamma-Fe by inelastic x-ray scattering: implications for the lunar core	Experiment number: HS-4650
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Report:

We performed sound velocity and density measurements on polycrystalline iron in both bcc and fcc phase, up to 19 GPa and 1150 K.

IXS measurements have been performed on polycrystalline iron samples compressed in a diamond anvil cell (DAC) using the Si(8,8,8) instrument configuration. Spectra have been collected in transmission geometry, with the x-ray beam impinging on the sample through the diamonds, along the main compression axis of the cell, and hence probing exchange momenta q perpendicular to the cell-axis. The x-ray beam was focused at sample position down to 12x7 μm^2 (horizontal x vertical, FWHM) by optics in Kirkpatrick-Baez configuration. Momentum resolution was set to 0.25 nm^{-1}.

By scanning the scattering angle at the elastic energy (*i.e.* q-scan at $\Delta E=0$) we also collected diffraction pattern for phase determination and to directly derive the density.

High-purity polycrystalline iron (99.998% powder from Alfa Aesar) was loaded in composite rhenium-cubic boron nitride gasket without using any pressure-transmitting medium and compressed in a DAC equipped with 500-µm beveled anvils. The initial sample size was about 120 µm in diameter and 30 µm in thickness. High pressure and temperature were generated using an externally heated DAC (conventional symmetrical Mao-type diamond anvil cells). The samples were heated by a Pt wire resistive micromachined furnace placed around the diamonds. Stable and uniform high temperatures (up to 1,200 K) were efficiently generated in the microfurnace, which is thermally insulated from the body of the cell by use of ceramic seats. Temperature was measured by means of an S-type thermocouple placed at a junction between the gasket and the diamond. Pressure was measured at ambient temperature by ruby fluorescence, while, at high temperature, pressure was estimated from measured temperature and density using the iron equation of state.

Two cells were used in this experiment. These were watercooled and placed in a specifically designed vacuum chamber to reduce oxidation of the heating elements, and to minimize the quasi-elastic scattering contribution from air.

Details of the scientific results and of their significance can be found in

"Toward a mineral physics reference model for the Moon's core", D. Antonangeli et al., PNAS 112, 3916 (2015)