Study of Earth Core Dynamics with Intense Laser

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The iron is the main constituent of Earth's core. The pressure and the temperature of the earth's center is 350 GPa and 5000-7000 K, respectively. It is important to compare the measured sound velocity of iron under the earth's core condition to the result of seismological studies. Previous measurements of sound velocity were carried out by a single shock with gas guns (J.H.Nguyen et al, 2004). However, the earth's inner core condition cannot be created by a single shock compression because the temperature of compressed target increases too much. We measured the sound velocity of iron relevant to earth's inner core condition with double shock by intense laser. To prevent the preheating, we employed three layered foils of polystyrene, gold and iron from laser irradiated surface.

Experiments were done on the HIPER laser facility at the GEKKO-XII system at the Institute of Laser Engineering, Osaka University. The sound velocity is obtained from trajectories of laser irradiated target surface and rear surface. When the target is irradiated by intense laser, the shock wave propagates in the target. After the shock breakout, the rear surface begins to move, and rarefaction wave propagates to the front surface of the target with sound velocity. When the rarefaction wave reaches the front surface, the bulk of target starts to move. The sound velocity of the compressed target can be obtained from the thickness of compressed target and the timing between the shock breakout and the rarefaction breakout. These trajectories of laser irradiated target images can be obtained by using the side-on x-ray backlighting technique. We can obtain more parameters of compressed iron from the side-on x-ray backlighting measurement, i.e. specific heat ratio and averaged density. From these parameters, we can calculate the averaged pressure of the compressed iron. In addition, we measured the temperature of the compressed iron with a pyrometer.

In the presentation, we are going to report the experimental results on the measurement of sound velocity of iron relevant to earth's inner core condition.