Experimental study on transport properties of molten iron alloy

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Iron is the main component in of the Earth's core. Also, since the density of the Earth's central nucleus is lower than the density of iron, it is predicted that the Earth's core contains light elements besides iron. However, the kind and composition of light elements contained in the Earth's core has not been discussed yet.

Although research on iron under high temperature and high pressure has been widely conducted, experiments on iron alloys containing light elements existed only in the pressure range of 150 GPa or less. In this study, data points of the state equation of iron alloy of 350 GPa are gathered using laser shock compression method, which is considered to be the pressure in the center of the earth. We used silicon as a light element to be included in the iron alloy. Silicon is one of the most likely possibilities thought to exist in the Earth's core.

Also, reflectance of molten iron and molten iron alloy under impact compression is measured to calculate electric transport characteristics. We look into the influence of silicon on molten iron under high temperature and high pressure and investigate the composition of the outer core composed of liquid.

As a result of the experiment, three points of good data on the state equation were obtained in the pressure range over 300 GPa. For reflectance measurement, we confirmed the formation of a high-pressure iron alloy in the 200 - 400 GPa from the interface velocity between iron alloy and MgO measured by VISAR. In addition, since the temperature measured by SOP was above the temperature of around 5000 K, it was confirmed that the liquid state of the iron alloy could be generated.

The result of the reflectance measurement suggests that the addition of silicon may increase the electric conductivity of the iron alloy. This phenomenon is different from the behaviors by other light elements that have been considered until now.