Oral | Symbol S (Solid Earth Sciences) | S-IT Science of the Earth's Interior & Techtonophysics

[S-IT39_2AM2]Deep Earth science: Dynamics of plate, mantle, and core

Convener:*Shingo Watada(Ocean Hemisphere Research Center, Earthquake Research Institute, University of Tokyo), Takeshi Sakai(Geodynamics Research Center, Ehime University), Takashi Nakagawa(JAMSTEC/IFREE), Chair:Kenji Kawai(Department of Earth and Planetary Sciences, Tokyo Institute of Technology)

Fri. May 2, 2014 11:00 AM - 12:45 PM 416 (4F)

This session aims at discussing various dynamic phenomena in the Earth's deep interior, such as the interactions among the plates, mantle and core. Presentations of theoretical experimental/observational studies on high-pressure physics, seismology, and mantle/core dynamics are widely accepted.

12:15 PM - 12:30 PM

[SIT39-P06_PG]Melting experiments on the MgO-$MgSiO_3$ system using double CO_2 lasers heated diamond anvil cell

3-min talk in an oral session

*Satoka OHNISHI[1], Tomoaki KIMURA[1], Yasuhiro KUWAYAMA[1] (1.Geodynamics Research Center, Ehime University)

Seismological studies suggest the presence of ultralow-velocity zones (ULVZ) near the core mantle boundary (CMB). Partial melting of the lower mantle materials has been proposed to explain these zones, but experimental validation at the appropriate temperature and pressure regimes remains challenging. The melting curve of the lower mantle material is a key to constrain the existence of melt at the base of the mantle. A laser heated diamond anvil cell (LHDAC) provides an enabling tool for determination of melting temperatures of materials under high *P-T* conditions. Although YAG, YLF lasers (the wavelengths are about 1 μ m) have been generally used for LHDAC experiments, the use of metal absorber is required to heat silicate materials. However, the thermal absorber may cause a chemical reaction and a temperature gradient in the sample. The accuracy of temperature determination is suffered from the chemical reaction and the temperature gradient. In contrast, the CO_2 laser with the wavelength of about 10 μ m can directly heat silicate materials. For the minimization of temperature gradients, double-sided heating system for LHDAC was suggested by Shen *et al*. (1996). This technique using the YAG laser has been widely used to study the behavior of materials under high *P-T* conditions. However, the double CO_2 laser heating system has not been used due to the wavelength of this laser is different from that of visible light.The requirements for the pressure medium in laser heating experiments are low thermal conductivity and chemical inertness. Ar, which is a noble gas, is one of the suitable pressure mediums. However, loading Ar into the DAC is difficult under room temperature and ambient pressure. Therefore, a simplified method to load Ar into the DAC is required. In this study, I established new experimental technique for the minimization of temperature gradients and chemical reactions and performed melting experiments of the lower mantle materials using LHDAC.First, a double-sided heating system using CO_2 laser was developed by separating optical elements. This system consists of the heating system using two CO_2 lasers which have the high power (100 W), the observation systems and the temperature measurement system. By using lenses designed for the CO_2 laser wavelength, the laser system is separated from observation and temperature measurement system. Two dimensional images and radiation spectrums are observed by Charge Coupled Device (CCD) camera and spectrometer, respectively.Second, a simplified method to load Ar into the DAC was developed by the cryogenic technique. In this technique,

Ar is cooled using liquefied N_2 until it forms a liquid, and the liquefied Ar is loaded into the sample chamber of the DAC. Cu was used to enhance cooling efficiency.Finally, I performed melting experiments of the lower mantle materials using the double CO_2 lasers heated diamond anvil cell and Ar as the pressure medium. I used forsterite (Mg_2SiO_4) and mixtures of MgO and $MgSiO_3$ as the starting material. After the complete pressure release, the sample was recovered from the DAC and examined by FE-SEM. From the surface texture of recovered samples, I discussed melting temperatures of the lower mantle materials under high *P-T* conditions.The double CO_2 laser heating and loading Ar methods developed in this study could powerful tool for determination of melting temperatures of the lower mantle materials.