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SIT03-07 会場:418 時間:4 月 29 日 10:30-10:45

# Semiconductor diamond heater (SCD): An innovation for ultrahigh temperature experiments in the Kawai cell

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We developed the semi-conductor diamond heater in the Kawai high pressure cell. The starting material of the semi-conductor diamond heater is born(B)-doped burned-graphite. We succeeded to improve the machinability of the B-doped burned-graphite by decreasing porosity. Following is the motivation and the background of the semi-conductor diamond heater project.

It is important to generate extremely high temperature (~3000 ℃) in a large sample volume (~0.1mm$^3$) in the Kawai apparatus.X-ray transparency is also desirable for in-situ synchrotron analysis. However, any traditional heater used in the Kawai apparatus so far does not satisfy the both requirements simultaneously.

Semiconductor diamond is a candidate material to generate temperatures higher than 3000 ℃ with low x-ray absorption. Anton Shatskiy (2009) have generated a temperature of 3500 ℃ by using the semiconductor diamond heater in a large-volume Kawai-type high-pressure apparatus, although their temperature measurement is questionable from a viewpoint of the power-temperature relation. Furthermore, their semi-conducted diamond heater, made of boron and graphite powders, was not machinable and difficult to control the temperatures. It often became unstable at around 1000~1300 ℃ and impossible to generate higher temperature.

Systematic experiments have done to improve the performance of the semiconductor heater. We used a machinable block of graphite contain 3 wt.% boron as the starting material for the semi-conductor diamond heater. The graphite-diamond transformation started at ~1000-1200 ℃ at 15 GPa in the Kawai apparatus. After the transformation, we stably generated temperature to 2000 ℃. Activation energy of B-doped diamond is about 0.1 eV, which is much lower than that of pure diamond (5.45eV).

References:

Anton Shatskiy, Daisuke Yamazaki, Guillaume Morard, Titus Cooray, Takuya Matsuzaki et al. , Review of Scientific Instruments 80, 023907 (2009).

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