Poster Presentation

MS49.P05

In situ Raman spectroscopy of cubic boron nitride to 90 GPa and 800 K

S. Ono[1]

[1]*JAMSTEC, Yokosuka, Japan*

Cubic boron nitride (c-BN) has some outstanding properties, such as hardness, chemical inertness, high temperature stability, and high thermal conductivity. The Raman spectrum of c-BN exhibits two intense lines at 1054 and 1305 cm-1 under ambient conditions, corresponding to the Brillouin zone center transverse optical (TO) and longitudinal optical (LO) modes, respectively. Previous studies have reported the pressure and temperature dependences of the frequency shift of the modes up to 40 GPa and 2300 K. The Raman line of the LO mode overlaps an intense Raman line of diamond at pressures higher than 3 GPa. Therefore, it is difficult to observe the LO line in high-pressure experiments using the diamond anvil cell. In contrast, previous studies proposed that the TO mode could be used as the pressure calibrant in diamond anvil cells under high pressure and temperature conditions. In this study, we used a diamond anvil cell high-pressure apparatus [1] combined with a Raman spectrometer system to investigate changes in the Raman line of c-BN. The use of a synchrotron radiation source made it possible to determine the precise pressure in the sample chamber. In this study, the temperature and pressure dependences of the Raman spectrum of the TO mode of cubic boron nitride were calibrated for applications to a Raman spectroscopy pressure sensor in optical cells to about 800 K and 90 GPa. A significant deviation from linearity of the pressure dependence is confirmed at pressures above 20 GPa. At ambient temperature, dv/dP slopes are 3.41 and 2.04 cm-1/GPa at 0 and 90 GPa, respectively. The pressure dependence does not significantly change with temperature, as determined from experiments conducted up to 800 K. At pressures above 90 GPa, the Raman spectrum of the TO mode cannot be observed because of an overlap of the signals of cubic boron nitride and diamond used as the anvils in the high-pressure cell.

[1] *S. Ono, K. Mibe, Phys. Rev. B, 2011, 84, 054114.*

Keywords: Boron nitride, Diamond anvil cell, High temperature and high pressure