Synthesis of polycrystalline diamond from glassy carbon by direct conversion at high pressure and temperature

Chinatsu Ogawa[1], *Tetsuo Irifune[1], Sayako Inoue[1], Takehiro Kunimoto[1], Toru Shinmei[1], Akimasa Suzumura[2], Shoichi Itoh[2]

1. Ehime University, 2. Kyoto University

Synthesis and characterization of polycrystalline diamond from bulk samples of glassy carbon have been made at pressures 9, 12, and 15 GPa and temperatures from 1800 to 2300℃ using multi-anvil apparatus. The minimum temperature for synthesis of pure polycrystalline diamond was determined as 1700℃ at 15 GPa, which significantly increases with decreasing pressure and reaches 2300℃ at 12 GPa and the minimum temperature is suggested to be even higher than 3000℃ at 9 GPa based on the present and earlier studies. TEM observations on some recovered samples show developments of graphitic layers in the disorganized nano-structures of original glassy carbon, particularly in those samples synthesized at temperatures around 2000℃ at 9 and 12 GPa. The significant increase in the minimum temperature with decreasing pressure may be due to the metastable growth of graphitic layers in glassy carbon, which should kinetically hinder complete conversion to diamond at the lower pressures approaching the graphite-diamond phase boundary.

Keywords: diamond, high-pressure synthesis, nano-polycrystals, glassy carbon, TEM observations