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Sulfur: a new solvent-catalyst for diamond synthesis under HPHT conditions and unique diamond morphology.

Abstract: In the sulfur-graphite system, euhedral diamond crystals up to 150 μm could be synthesized by spontaneous nucleation at conditions of 8-8.5 GPa and 1600-1800°C within 1 hour. This is the first report of diamond synthesis from graphite using a single element as solvent-catalyst since elemental phosphorus has been clarified to be a solvent-catalyst for diamond formation in 1993 [1]. At even so high-temperature as 1600-1800°C, crystallized diamond grains were cubo-octahedron morphology which were bounded by (100) and (111), although only octahedral or aggregated diamond crystals have been reported to be crystallized in the syntheses using metals or carbonates solvent-catalysts at such high-temperatures. Compared forming conditions with those using non-metallic solvent-catalyst such as carbonates and sulfates, the temperature conditions required for spontaneous nucleation were lowered to 1600°C. The process of diamond formation in the S-C system is categorized into the type in which the melting temperature and the graphite-diamond equilibrium boundary are not sufficient for spontaneous nucleation and it can be occurred at higher temperatures and higher pressures of 8-8.5 GPa and 1600-1800°C.
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