

New development of a 6-8-2 type multi-anvil system: A performance test for third-stage anvils with various diamond materials

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We developed a 6-8-2 cell for multi-anvil apparatus, where a pair of diamond rods placed in the pressure medium are used as the pressure intensifier. We tested single crystal diamond (SCD), conventional sintered diamond with cobalt binder (SD), and nano-polycrystalline diamond (NPD), as the third-stage anvils for the 6-8-2 system. In situ X-ray diffraction experiments were conducted to test the performance of the present cell and also to evaluate the three types of diamond anvils using the 6-8-2 system operated in multi-anvil apparatus at SPring-8. Pressure generation of ~90 GPa has been achieved with a press load of 700 ton at room temperature, regardless of the diamond anvils. Upon heating of the sample under pressure, however, the pressure substantially dropped with increasing temperature above 800 K, when SCD and SD were used as third-stage anvils, and ultimately decreased down to 20-30 GPa at 1400 K. Inspection of the recovered third-stage anvils revealed that the pressure drop was presumably due to plastic deformation of the culet surface of diamonds. In contrast, pressures of 80-90 GPa were maintained at temperatures up to about 1250 K using NPD anvils. The pressure then decreased significantly at further higher temperatures, but remained obviously higher (~55GPa, at 1400 K) than those observed by using SCD and SD anvils. The plastic deformation of the culet surface of the NPD anvils was actually far smaller than observed in other anvils, suggesting that NPD is the most suitable anvil material for the 6-8-2 system.