High-pressure generation to 150 GPa in multianvil apparatus using the 6-8-2 system with nano-polycrystalline diamond anvils.

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The pressures available in Kawai-type multianvil apparatus (KMA), using second-stage anvils of tungsten carbide (WC) or sintered diamond (SD), have been limited to about 30 GPa and 60 GPa, respectively [e.g.1,2]. Recent efforts in introductions of new WC and SD materials and improvements in cell assemblies significantly expanded these limits to 60 GPa for WC anvils and 120 GPa for SD anvils [3,4,5]. An attempt has also been made to the harder nano-polycrystalline diamond (NPD) as the second-stage anvils demonstrated the potential importance of this noted ultra-hard material for KMA, but the available pressures have been limited to ~90 GPa because of the limitation in the size of the NPD anvils [6].

Kunimoto and Irifune (2010) introduced a newly-designed cell assembly for 6-8-2 type cell with NPD as third-stage anvils, and reported generation of pressures up to 125 GPa [7], but it was difficult to produce further higher pressures. So, we have been trying to improve the cell assembly for the 6-8-2 system to generate the pressure equivalent to the Earth' s core-mantle boundary (CMB), for better understanding of this heterogeneous region using advantages of KMA over competing diamond anvil cell.

In situ X-ray experiments were conducted using the KMA (SPEED-Mk.II) at SPring-8, BL04B1. We used sintered polycrystalline $MgSiO_3$-perovskite (Pv) synthesized in a KMA as a starting material. Generated pressures were determined from the unit cell volumes of Au and MgO using adequate equation of state [8,9]. Upon compression, the X-ray diffraction profile showed the $MgSiO_3$-Pv changed to an amorphous-like phase above ~70 GPa at the room temperature. Eventually, we reached pressures of about 150 GPa in two independent runs, which are the highest pressure ever reported in KMA, although we were unable to identify the crystal structure of the sample due to amorphization. The pressure achieved in these runs completely cover the entire D" region (approx. 125-135 GPa), and some attempts have also been made to produce high temperatures under such pressures.

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