Calibration of cubic anvil cell using sintered diamond

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It is well known that the sintered diamond is one of the hard materials. It seems obvious that the sintered diamonds are suitable for high pressure apparatus. This study reports the performance of a sintered diamond anvil high pressure and temperature cell.

A experiment was carried out with an 6-8 type high pressure apparatus (SPEED-1500) at the High Temperature Research beamline, BL04B1. The inner cubic assemblies of eight sintered diamond anvils with Co binder were compressed with a pair of guide blocks in a uniaxial 1500 ton press. Cubic sintered diamond anvils which corners were truncated into triangular faces 2 mm in edge length were used. The anvils were separated by pyrophyllite gaskets. The sample assembly used in this study was composed of MgO pressure medium. We used pure synthetic gold and MgO which were grounded in a agate mortar. The press load was increased slowly because the intense deformation of pressure medium and gaskets cause serious damage of sintered diamond anvils. During this process, X-ray diffraction data were acquired by an energy-dispersive system. We observed the change of diffraction lines of gold and MgO (Fig. 1) as increasing press load. Generated pressure values were determined from unit cell volumes of gold and MgO measured at each experimental conditions on the basis of Anderson's and Jamieson's equation of states. The results show that the maximum generated pressure is approximately 40 GPa at 650 ton (Fig. 2). The slope of relation between press load and pressure generation is approximately constant below 35 GPa. However, the slope changes at the conditions more than 35 GPa. It seems that it is difficult to achieve more than 50 GPa using our designed cell.

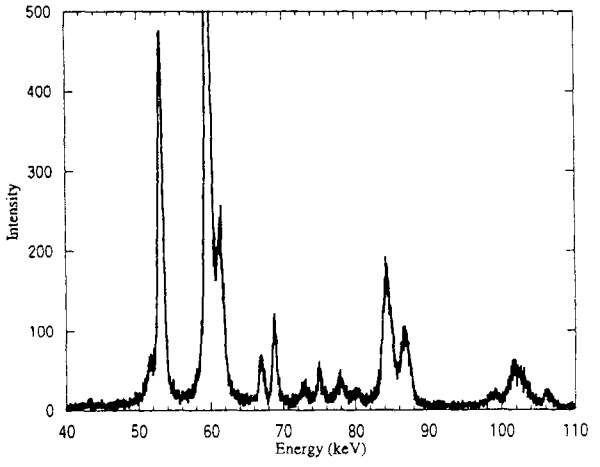

Fig. 1
Diffraction profile of the sample at about 40 GPa and 300 K. Counting time is 200 s and 2 θ angle is 6.001°.

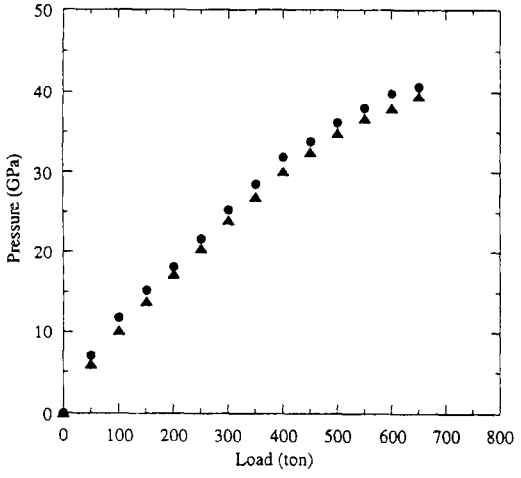

Fig. 2
Generated pressures of the sintered diamond cubic anvil cell for 14 mm each side and 2 mm truncated length. Solid circles and triangles are generated pressures calculated by pressure makers of gold and MgO respectively.