High-pressure deformation experiments with Kawai-type apparatus for triaxial deformation (KATD)

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In order to understand material behavior in the Earth deep mantle, knowledge of rheological property of mantle constituent minerals is important. Griggs apparatus has been widely used for high-pressure deformation experiments. However, by using Griggs apparatus, deformation experiments under pressures higher than 4 GPa has been impossible due to limitation of mechanical strength of cylinder. Recently, rotational Drickamer apparatus (RDA) (e.g. Yamazaki and Karato, 2001) and deformation-DIA apparatus (D-DIA) (e.g. wang et al., 2003) were newly developed for deformation experiments at pressures greater than 5 GPa. By using RDA, deformation experiments were successfully conducted at up to 17 GPa and 1800 K. However, it is still challenging to reduce uniaxial stress in sample less than 1 GPa in RDA. By using D-DIA, precise high-pressure deformation experiments have been carried out. However, it is still difficult to conduct experiments at pressures greater than 10 GPa.

We have newly developed [Kawai-type Apparatus for Triaxial Deformation (KATD)] at Magama Factory, Tokyo Institute of Technology. KATD is a modification of Kawai-type apparatus with controllable top and bottom differencial first stage anvils. The KATD has the following technical advantages compared to RDA and D-DIA. By using Kawai-type apparatus, experimental techniques to generate high pressures up to 30 GPa has been established. Thus, KATD has potential for deformation experiments at lower mantle conditions (higher than 23 GPa). Since pressure is generated through eight cubic anvils, sample can be kept under quasi-hydrostatic conditions before deformation. Thus, high-pressure deformation experiments under very low differencial stress condition are expected to be possible by using KATD.

We have conducted testing experiments using dummy octahedral pressure medium (MgO + Cr2O3), and confirmed that the KATD can be operated without any serious trouble up to load of 600 ton. In this presentation, we will introduce design and performance of KATD and technical and research plan using KATD.

References

Wang et al. (2003) The deformation-DIA: A new apparatus for high temperature triaxial deformation to pressures up to 15 GPa. Rev. Sci. Instrum., 74, 3002-3011.

Yamazaki and Karato (2001) High-pressure deformation apparatus to 15 GPa. Rev. Sci. Instrum., 72, 4207-4211.