The 524th Geodynamics Seminar

Inter-comparison of pressure scales

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The inter-comparisons of pressure scales at multi-megabar pressure are poorly understood due to its experimental difficulty. Recently, many technical developments aiming generation of above 500 GPa, such as the double-stage diamond anvil cell (ds-DAC) [1-8] and the toroidal diamond anvil cell (t-DAC) [9-10], are reported. However, these techniques do not become a common experimental procedure yet due to some technical difficulties [5]. We have also developed the micro-paired ds-DAC technique using the focused ion beam (FIB) system to reduce experimental difficulties but maximum pressure has been limited to 430-460 GPa [6]. In our previous trial, the 2nd stage anvils were always fractured before breaking the 1st anvils. In order to generate ultra-high pressure, the strength of the material for the 2nd stage anvil is important. Thus, we newly developed the conical support type ds-DAC. Using a FIB system, A cavity was made at the center of 1st stage anvil culet, then micro-anvil was embedded in the cavity and fixed by platinum deposition in FIB system. Combination of a use of a well-focused X-ray sub-micron beam and conically supported micro-anvils with 10 μm culet enable us to obtain good quality XRD peaks from the sample at around 400 GPa [11].

We also developed the convex type DAC (c-DAC) which is consist of single crystal (single stage) diamond anvil only but has an identical whole shape to the conical support type ds-DAC. Our c-DAC does not have a “groove”, but as a result, its shape is quite similar to that of t-DAC reported by [9]. We performed simultaneous compression studies of copper+rhenium and platinum+rhenium, and obtained volume-volume (V-V) relationship between these materials using c-DAC. The consistency between equations of state for these materials at around 400 GPa will be discussed.

[1] Dubrovinsky et al. (2012). [2] Dubrovinsky et al. (2015). [3] Dubrovinskaia et al. (2016). [4] Sakai et al. (2015). [5] Sakai et al. (2018). [6] Lobanov et al. (2015). [7] Vohra et al. (2015). [8] Moore et al. (2018). [9] Dewaele et al. (2018). [10] Jenei et al. (2018). [11] Sakai et al. under review.

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