Development of 10 GPa class cubic anvil type high pressure apparatus for neutron scattering experiments

Tetsuya Fujiwara[a], Kazuyuki Matsubayashi[b], Yoshiya Uwatoko[b], Naofumi Aso[b], Masakazu Nishi[b], Hideki Yoshizawa[b]
[a]*Yamaguchi Univ.*, [b]*ISSP, Univ. of Tokyo*

Over the past few decades, a considerable number of studies have been devoted the physical properties of Ce-, Yb- and U-based intermetallics, the so-called strongly correlated electron systems. In these systems, an external pressure is often a key to bring about a new type of ground state accompanied with exotic physical phenomena, such as a heavy fermion superconductivity or valence transition and so on. Accordingly, nowadays the concern with an application of high pressure generation techniques to various sorts of experimental measurements has been growing remarkably. In this work, we have developed a cubic anvil type high pressure cell (CAC). CAC can generate superior hydrostatic pressure to other high pressure apparatuses. In CAC, however, sample space is surrounded and enclosed by thick sliding anvil blocks made of tungsten carbide (WC) whose neutron transmittance is remarkably poor. So, to optimize CAC for neutron scattering experiments, We conducted a review of apparatus volume and a material of anvil block. Consequently, we succeeded in reducing the diameter of cell from 180 mmϕ to 80 mmϕ and the mass of apparatus from 26.8 kg to 1.4 kg. Fig. 1 is photograph of downsized CAC. Furthermore, anvil block made of ZrO_2 with superior neutron transmittance to WC was prepared. Pressurization examination was performed at room temperature. Daphne 7373 and a single crystal of NaCl were used as a pressure transmitting medium and a manometer, respectively. Transmittance of apparatus keeps up above $\sim$30 %. At present, applying external load, pressure distribution brings about materially, so that an intensity of NaCl (200) Bragg reflection remarkably decreases. There is room for improvement in homogenization of generated pressure.

Fig. 1. Downsized Cubic anvil type high pressure cell optimized for neutron scattering experiments