Development of Cubic Anvil type pressure cell for neutron scattering experiments under pressure

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During last few decades, intensive studies have been performed on strongly correlated electron systems and/or magnetic materials under high pressure. As a result, with discovery of many interesting physical phenomena at high pressure and low temperature, new technique and know-how of high pressure experiments have been accumulated. However, in the field of neutron experiments, high pressure technique is less common compared to other experiments due to the inevitable difficulty, such is a significant decrease in intensity by absorption and scattering when the neutrons pass through a pressure device that surrounds the sample: it is difficult to conduct experiments with reliability and accuracy.

Recently, we have developed small high pressure apparatus for transport and magnetic measurements, a clamp type of palm cubic anvil cell (PCAC) [1]. This cubic anvil type pressure apparatus can generate superior hydrostatic pressure to other high pressure apparatus. Then, we optimized anvil material for neutron scattering experiments [2], from tungsten carbide (WC) to ZrO2, relatively transparent to neutron beams. In this work, pressurization test was carried out at room temperature. For gasket, two types of material are used, a duralumin (A7057) and a mesoalite which is Al-based hard material. Glycerol is chosen as a pressure transmitting medium because of its good hydrostatic property. A single crystal of NaCl, 1.5 x 1.5 x 1.5 mm3 in size, was set in the gasket and pressurized with a hydraulic press. Generated pressures in the gasket were estimated from a compressibility of NaCl by determining a lattice constant from (200) reflection at each external load. Fig. 1 shows load dependence of the profiles of (200) reflection in θ-2θ scan. As shown in the figure, palpable profiles were obtained. No significant difference was found between the two materials of gasket. We confirmed in generating pressure about 7 GPa at the load of 80 ton. We expect that PCAC will be useful apparatus in the field of high pressure neutron experiments.

[1] Y. Uwatoko et al., Recent Absorbing Topics in the Research of the Earth's Interior, 18 (2008) 230. (in Japanese)
[2] T. Fujiwara et al., Activity Report on Neutron Scattering Research: Experimental Reports 15 (2008) 658.

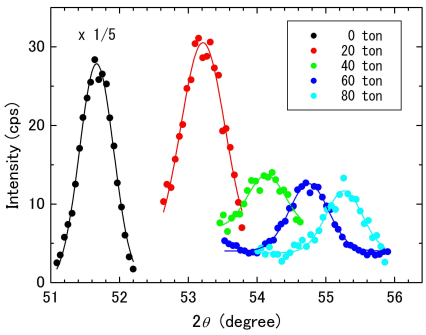

Fig. 1. Profiles of (200) reflection of NaCl in θ-2θ scan at various external loads. At the result of 0 ton, intensity is multiplied by factor of one fifth. The load of 80 ton is equivalent to 7 GPa.