Attenuation correction for multi-anvil high-pressure apparatus

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High Pressure Neutron Diffractometer “PLANET (Pressure Leading Apparatus for Neutron Diffraction)” [1] has been constructed at BL11 in J-PARC. “PLANET” is equipped with a multi-anvil high-pressure apparatus which compresses sample from six directions. In neutron experiments using a high-pressure apparatus, the neutron beam are attenuated by components of a high-pressure cell assembly. This attenuation causes the decrease of the peak intensities in a neutron diffraction pattern from the ideal values. A correction for the attenuation is therefore required for quantitative studies such as structure refinements. In this study, we developed a program to calculate the attenuation correction coefficient for multi-anvil high-pressure apparatus, and verified the results by determining peak intensities of a neutron diffraction pattern obtained with a cubic-anvil high-pressure apparatus and comparing them with those from a pattern obtained using a standard sample holder.

The attenuation factor (A) is calculated using attenuation coefficient (μ) of a component, and neutron path length (t). The μ is dependent on the wavelength, and t is dependent on the scattering angle. A program for the calculation of A was written in FORTRAN 90/95. The t is evaluated via a ray tracing method or vector calculation, and the μ values are obtained experimentally.

For verification, neutron diffraction experiments were performed for a standard powder sample, in and out of another small-type multi-anvil high-pressure apparatus (Palm Cubic multi-anvil apparatus)[2] at BL19 “TAKUMI” in J-PARC. The Al_2O_3 powder was set in the center of the gasket of the Palm Cubic apparatus. The neutron diffraction pattern of Al_2O_3 powder in a standard sample holder (vanadium can) was also measured. The attenuation factor was obtained from peak intensity ratio of Al_2O_3 powder between using a high-pressure apparatus and a standard sample holder.

The attenuation factors calculated using the program showed good agreement with the result evaluated experimentally. This confirms that the program developed in this study enabled the attenuation effect to be properly corrected. In the presentation, we will talk about the details of the program and the result. In addition, the attenuation value evaluated for the results obtained at “PLANET” will be shown.

References

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