High pressure neutron diffraction experiments for icy materials with diamond anvil cell

Shinichi Machida*[1], Takanori Hattori[2], Asami Sano-Furukawa[2], Ken-Ichi Funakoshi[1], and Jun Abe[1]

[1]Neutron Science and Technology Center, CROSS – Japan
[2]J-PARC Center, JAEA – Japan

Abstract

Neutron diffraction experiments under high pressure have been limited because intensity of neutron scattering is weak and large sample volume is required. Recently, high intensity pulsed neutron beam is produced by the spallation neutron sources such as the MLF, J-PARC in Japan and the SNS, ORNL in USA. Then, new high-pressure neutron-scattering technics using high intensity neutron beam have been developed. For example, new design of diamond anvil cell (DAC) was developed and the neutron diffraction data up to 94 GPa were obtained in the SNAP beamline (BL3) at SNS (Boehler et al., 2013).
At present, we are also developing the DAC for neutron diffraction experiments at the PLANET beamline (BL11) in MLF, J-PARC. The conically shaped diamond anvil with culet of ϕ1.5 mm was applied. The pressure of 29 GPa was generated and we succeeded in obtaining the neutron diffraction data of ice VII. Now we are proceeding with the developing to generate higher pressures. In addition, we have made an attachment to load the gas into the DAC using a gas loading system at NIMS in Japan. We are planning to load hydrogen gas with water into the DAC to perform the high pressure neutron experiments for hydrogen hydrate.
In order to analyze the neutron diffraction data, Guthrie et al. (2017) suggested that the Bragg condition of the diamond must be considered when single crystal diamond is used as the anvil. It is because a part of the incident beam is lost by the Bragg refraction of the diamond anvils before reaching the sample, which modifies the diffraction intensities from samples. We have measured the transmission of the DAC, and corrected the intensity loss by the methodology invented by Guthrie et al. (2017). Subsequently, we will establish the correction method for data taken at PLANET beamline.

*Speaker