

High-pressure neutron beamline at J-PARC and applications to earth and planetary sciences

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Construction of the high-pressure dedicated beamline, PLANET, in Japan Proton Accelerator Research Complex (J-PARC) has been completed in 2012 and scientific programs for general users have just started in 2014. The PLANET beamline has a focusing mirror for incident neutron and two 90-degree detector banks. Each bank has 160 pieces of Position Sensitive Detectors (PSDs) filled with ³He gas. Each bank has a detector coverage of 90 ± 11 degree against the incident beam in the horizontal direction and 0 ± 35 degree in the vertical direction. Radial collimators are attached in front of the detector banks to reduce the background. The instrumental resolution is 0.6% in $\Delta d/d$. The accessible d-spacing is normally 0.2-4.2 Å and is doubled in a double-frame setup. The power of the proton beam is around 300 kW and will be increased to 600 kW in 2014. The most characteristic feature of the PLANET beamline is the multi-anvil apparatus with six independently acting 500-tonne rams (6-axis press called ATSUHIME). Using ATSUHIME, we successfully observed neutron diffraction patterns of hydrous minerals at high pressure and high temperature without any contamination from sample-surrounding materials such as pressure transmitting media, anvils, and so on. This clearly shows that the incident slit and radial collimator installed in the beamline are very effective to obtain the diffractions under high pressure.

We focus on pressure-responses on the structure of materials with hydrogen-bonding networks through neutron diffraction measurements at high pressure. These results will contribute to fundamental understanding of hydrous materials in the deep earth and icy material in the planets.

Keywords: neutron, neutron diffraction, hydrogen, water, high pressure, ices