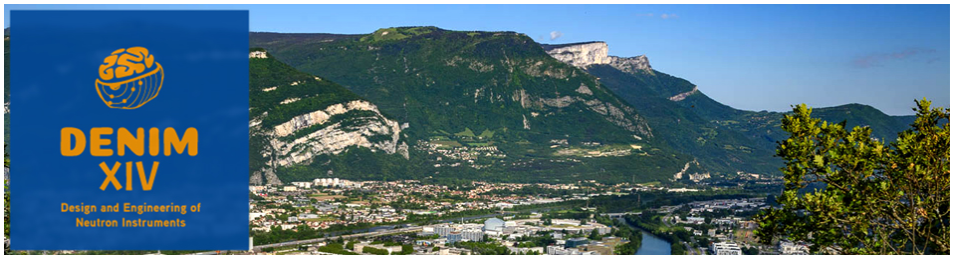

Contribution ID: **20** Type: **Poster**

Development of High-Pressure Sample Environments at the China Spallation Neutron Source (CSNS)

High pressure can reduce atomic distances, increase the density of the electron cloud, and alter the crystal and magnetic structures of materials. High-pressure technology serves as a vital tool for regulating the crystal structure and physical properties of materials. By leveraging the high penetrability of neutrons, in-situ high-pressure neutron scattering experiments can be conducted under extreme conditions. However, conducting neutron diffraction experiments at high pressure presents several challenges. The principal limitation is the restricted sample volume within the high-pressure cell. Additionally, the transmission of the neutron beam through the cell walls can be compromised, leading to potential background scattering issues. Currently, the China Spallation Neutron Source is equipped with three types of high-pressure apparatus: gas, liquid, and solid high-pressure systems. The gas handling system can reach a maximum pressure of 200 MPa and can be coupled with low-temperature environments. An alternative pressure panel can elevate the pressure of the isotope gas to 60 MPa, suitable for deuterium gas and deuterated methane. The liquid high-pressure system utilizes a clamp cell, capable of reaching pressures up to 2.0 GPa and functioning as a high-pressure cell for neutron diffraction, achieving a maximum pressure of 0.8 GPa. The solid high-pressure equipment adheres to the Paris-Edinburgh cell, with a maximum loading capacity of 200 tons, and can be combined with high-temperature environments, reaching maximum temperatures of up to 1300 K. These systems provide a diverse array of high-pressure environments for neutron scattering experiments.

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Session Classification: POSTER SESSION