

Designing of neutron guide for the high pressure and high temperature material science beamline at J-PARC

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The high-pressure science community supported by High Pressure Society of Japan submitted a proposal for the development of a high-pressure beamline at Material Life Science Facility (MLF). The proposal has been accepted formally, and we started to design the new high-pressure beamline. The scientific targets of our beamline are crystal structure of hydrogen-bearing materials including hydrous minerals, order-disorder transitions of minerals, structure of light element liquid at high pressure, etc. We set diffraction measurements up to 50 GPa as our goal.

In order to realize TOF diffraction measurements up to 50 GPa, non parallel neutron guide is needed for the high-pressure material science station. One of experimental obstacles for diffraction measurements under such high-pressure condition is weak signals from tiny sample volume of a few mm^3 . Hence, it is necessary to focus neutron beams into small spot below 1 mm^2 by installing non parallel neutron guide so as to increase the flux at the sample position.

Designing of neutron guide is therefore very important to enhance the performances of the beamline. Generally, conventional, linearly straight guides effective to keep low divergence entering a sample, but the predicted gain factor at small sample position is small. However, the non parallel guide fabricated adequately can be efficient for focusing neutrons on small sample position and improving neutron flux by a high gain factor.

Several designs of super mirror guides were optimized by Monte Carlo simulation using McStas. The intensity, divergence and these energy dependence for the tapered straight, elliptical and parabolic guides are compared with these of a linearly straight guide. From the results, the elliptical guide is considered as the best choice. The guide can be lead to flux gain more than 5 compared to free flight and realize a spot size of approximately 2 mm. Details of the mirror guide design will be discussed in the presentation.