Experimental Validation of Thermal Neutron Scattering Law Data for Innovative Reactor

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Abstract: Improvement of accuracy of thermal neutron scattering law data of hydrides as a candidate moderator is required for developing innovative reactor system. In order to meet the requirement, the project entitled as “Development of Nuclear Data Evaluation Framework for Innovative Reactor” is ongoing in collaboration with Kyoto University, Japan Energy Agency, Tokyo Institute of Technology and Kindai University. In the project, the validation of thermal neutron scattering law data of candidate moderator materials is one of the most important technical issues. In JENDL-5, the thermal scattering law data for 16 materials containing light water, heavy water were newly evaluated with the molecular dynamics simulations and the data for 17 materials containing yttrium hydride and zirconium hydride as a candidate solid moderator were taken from ENDF/B-VIII.0.

Therefore, we performed the integral experiments to validate the thermal neutron scattering law data of JENDL-5 using a 46-MeV electron linear accelerator pulsed neutron source at Institute for Integrated Radiation and Nuclear Science, Kyoto University. Fast neutrons from a Ta target as a photo-neutron source without a moderator were directly used. The collimated fast neutrons were incident on the sample assembly located at a 12m flight station. The neutrons moderated in the assembly were measured by a ^{6}Li-glass detector with a TOF method. The distance between the center of the assembly and the detector was 40 cm. On the other hands, the time-dependence of 2.2-MeV capture gamma rays from hydrogen in the assembly was also measured by a BGO detector. In this study, we used light water, calcium hydride, and zirconium hydride as samples. We compared the experimentally obtained time dependences of neutron and capture gamma-ray with the calculated ones using the Monte-Carlo simulation code and the evaluated data of JENDL-5.