Experimental Study on Accelerator-Driven System at Kyoto University Critical Assembly

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The experimental study on the accelerator-driven system (ADS) is being conducted for a next-generation neutron source with the combined use of the Kyoto University Critical Assembly (KUCA; A-core: solid-moderated and -reflected core) and the accelerators: the pulsed neutron generator and the fixed-field alternating gradient (FFAG) accelerator, in the Kyoto University Research Reactor Institute. The world's first spallation neutrons generated by 100 MeV protons from the FFAG accelerator had been successfully injected into the uranium-loaded core [1], and also into the thorium-loaded core [2]. For the ADS experiments with 100 MeV protons, the static conditions and kinetic behaviors were examined in aiming at the establishment of measurement techniques of reactor physics parameters, including the reaction rates, the neutron spectrum, the neutron multiplication, the neutron decay constants and the subcriticality, and the confirmation of numerical simulation precision by MCNPX with the combined use of JENDL/HE-2007, JENDL-4.0, JENDL/D-99, and ENDF/B-VII.0.

Another item of upcoming ADS in KUCA is aimed at research and development of nuclear transmutation techniques with the use of ADS composed of the reactor core in high-energy neutron spectrum and the spallation neutrons generated from the high-energy protons. An upcoming ADS at KUCA could be composed of highly-enriched uranium-fueled and Pb-Bi-loaded core, in consideration of an actual ADS designed by the Japan Atomic Energy Agency. Especially the neutronic characteristics of Pb-Bi are considered importantly analyzed from the viewpoint of experimental reactor physics: neutron yield and neutron spectrum by Pb-Bi solid target; uncertainties of Pb-Bi cross sections in the core.

At KUCA, as preliminary study on the Pb-Bi solid characteristics, the critical mass and the sample worth experiments relating Pb-Bi were conducted to investigate the uncertainties of Pb-Bi cross sections with the use of Pb and Pb-Bi solid plates. In addition, the experiments on sample worth of Bi solid plates could be carried out to investigate the uncertainties of Bi cross sections. For the nuclear transmutation, irradiation experiments of the minor actinides (^{237}Np and ^{241}Am) could be conducted in hard spectrum core at KUCA to examine the feasibility of capture (^{237}Np) and fission (^{237}Np and ^{241}Am) reaction rate analyses.

References

[1] C. H. Pyeon, *et al.*, *J. Nucl. Sci. Technol.*, **46**, 1091 (2009).
[2] C. H. Pyeon, *et al.*, *Ann. Nucl. Energy*, **38**, 2298 (2011).