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# Neutron beam filter system for fast neutron cross-section measurement at the ANNRI beamline of MLF/J-PARC

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In the Accurate Neutron-Nucleus Reaction Measurement Instrument (ANNRI) beamline of the Materials and Life Science (MLF) experimental facility at the Japan Proton Accelerator Research Complex (J-PARC) continuous efforts have been ongoing in order to measure the neutron-induced cross sections of long-lived minor actinides (MAs) and fission products (FP) by means of the time-of-flight (TOF) methodology. The J-PARC accelerator is currently operated in double bunch mode in which two 0.1 μs wide proton bunches impinge into a Hg spallation target with a time difference of 0.6 μs in order to increase the thermal pulsed neutron fluence. In the present state, cross section measurements in the keV regions are unattainable as this time difference introduces serious ambiguities when measuring neutron-induced reactions. The reason for this is that the 0.6 μs time difference is not negligible since it is comparable to the TOF of keV-neutrons, e.g., 100 and 120 keV neutrons have a TOF of 5.8 and 6.4 μs, respectively. In order to circumvent the current double-bunch predicament in the keV region, a neutron filtering system involving the use of filter material with the intrinsic characteristic of a sharp minima in the neutron total cross section was implemented at the ANNRI beamline. Quasi-monochromatic neutron beam can be created using such materials with the appropriate thickness as only the neutrons with the energy of the sharp minima can be transmitted through. natFe, natSi, natCr have been selected as suitable candidates to tailor quasi-monoenergetic neutron peaks with averaged energies of 23.5 keV (Fe); 54 and 144 keV (Si); and 46 and 136 keV (Cr). In this presentation, the main features of the neutron filtering system together with performance evaluations will be presented. A complete analysis for the Si and Fe neutron filters has already been published [1]. The time distribution of the incident filtered neutron flux at ANNRI was measured in both capture experiments with a NaI(Tl) spectrometer and transmission experiments involving the use of Li-glass detectors. In addition, the neutron energy distribution within the filtered peaks was determined from Monte-Carlo simulations with the PHITS code[2]. Finally, the first cross section results using the neutron filtering system will be shown and discussed in order to assess the performance in neutron capture cross section measurements.

[1] G. Rovira et al., "Neutron beam filter system for fast neutron cross-section measurement at the ANNRI beamline of MLF/J-PARC,"Nucl. Instruments Methods Phys. Res. Sect. A Accel. Spectrometers, Detect. Assoc. Equip., vol. 1003, no. April, p. 165318, 2021, doi: 10.1016/j.nima.2021.165318.

[2] T. Sato et al., "Features of Particle and Heavy Ion Transport code System (PHITS) version 3.02,"J. Nucl. Sci. Technol., vol. 55, no. 6, pp. 684–690, 2018, doi: 10.1080/00223131.2017.1419890.

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