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keV-neutron capture cross section measurement of ^{129}I using a Si-filter neutron beam/Si フィルターを用いた^{129}I の keV 中性子捕獲断面積測定

Thursday, 14 November 2024 16:00 (2 hours)

Diminishing the amount of high-level nuclear waste accumulated through reactor operation has always been a one of the most important obstacles regarding the long-term implementation of nuclear technologies. While the main efforts have been targeting minor actinides (MAs), long-lived fission products (LLFPs) remain another clear target for which several solutions have already been proposed. Among these solutions is the nuclear transmutation of LLFPs by means of fast nuclear reactors, the feasibility of which has been proven in recent studies [1,2]. For this approach, accurate nuclear data in the keV-neutron region are required for most LLFPs such as ^{129}I, ^{126}Sn, ^{93}Zr and ^{79}Se. In particular, iodine-129 poses an environmental threat for geological disposals in comparison with other LLFPs due to being soluble [3]. Moreover, ^{129}I uncertainties in the keV-neutron capture cross section that were estimated to be of 20-29% due to the lack of experimental data [3]. Hence, in order to improve the accuracy of the nuclear data for ^{129}I, further experimental efforts are required.

Neutron filter experiments were performed using the NaI(Tl) spectrometer of the ANNRI beamline at J-PARC to determine the neutron capture cross section at the neutron energies of 51.5 and 127.7 keV. A sample containing 404 mg of ^{129}I was measured, while having the incident neutron flux stream through a 20-cm-thick natSi filter to remove the influence of the double-bunch mode of J-PARC. In addition, a ^{197}Au sample was also measured to normalize the cross-section results.

In this study, the results of the ^{129}I neutron capture cross-section at the neutron energies of 51.5 and 127.7 keV are presented. These results were determined relative to the ^{197}Au neutron capture yield measured in the present experiment and the evaluated nuclear data from JENDL-5. This work complements a past experiment using the time-of-flight methodology, in which the neutron capture cross-section of ^{129}I was measured from 10 meV to about 30 keV [4].

[1] Chiba S, Wakabayashi T, Tachi Y, et al. Method to Reduce Long-lived Fission Products by Nuclear Transmutations with Fast Spectrum Reactors. Sci Rep. 2017;7:1–10.

[2] Wakabayashi T, Tachi Y, Takahashi M, et al. Study on method to achieve high transmutation of LLFP using fast reactor. Sci Rep . 2019;9:2–12.

[3] Iwamoto N. Evaluation of Neutron Capture Cross Sections and Covariances on ^{99}Tc and ^{129}I in the keV Energy Region. EPJ Web Conf. 2016;111:1–6.

[4] Rovira G, Kimura A, Nakamura S, et al. Neutron capture cross section measurement of ^{129}I and ^{127}I using the NaI(Tl) spectrometer of the ANNRI beamline at J-PARC. Eur Phys J A. 2024;123.

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