Measurement of neutron capture cross sections of Tc-99 at ANNRI of J-PARC MLF

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The neutron capture cross section of ^{99}Tc was measured at the ANNRI beamline in the J-PARC MLF facility. Prompt γ-rays from the capture reactions were measured with a NaI(Tl) detector. The time-of-flight method was employed to determine the incident energy.

Keywords: ^{99}Tc, J-PARC, ANNRI, Neutron Capture Cross Section, Time-Of-Flight Method, Long-Lived-Fission-Products.

1. Introduction

Technetium-99 is a fission product which undergoes β decay with a half-life of 211,100 years. This long-lived nature, relative abundance of production (approximately 6% of fission events produce ^{99}Tc) and environmental migration poses difficulties for long term waste storage. As such it is a possible candidate for reducing the amount of LLFPs via nuclear transmutation. The ^{99}Tc(n, γ)^{100}Tc produces ^{100}Tc which undergoes β decay to stable ^{100}Ru with a half-life of 15.46 min. To design systems that could drive these reactions, more accurate neutron capture cross section data are needed. There are large differences between experimental data of the neutron capture cross sections, especially in the keV neutron energy range [1]. This motivated us to perform the present measurement of the neutron capture cross section of ^{99}Tc.

2. Experimental Setup

The experiment was carried out at the Accurate Neutron-Nucleus Reaction measurement Instrument (ANNRI) beamline at the Materials and Life Science Experimental Facility (MLF) at the Japan Proton Accelerator Research Complex (J-PARC). A NaI(Tl) detector set at a scattering angle of 90 degrees with respect from the neutron beam axis was used to measure prompt γ rays from the neutron capture cross reactions. The ^{99}Tc sample with a total mass of 78 mg was sealed in an aluminum container. The sample was placed at a neutron flight distance of 27.9 m. Blank, a dummy case and a carbon sample were also measured for the purposes of background subtraction. The time-of-flight (TOF) method was employed to determine the incident neutron energy. The incident neutron energy spectrum was determined by detecting 478-keV γ-rays from the ^{10}B(n,αγ)^{7}Li reaction placing a boron sample at the sample position. The anode signal from the NaI(Tl) detector was fed into a data acquisition system, recording the TOF and pulse height of detected events.

3. Results

A TOF spectrum for ^{99}Tc is shown in Fig. 1. Resonance peaks of ^{99}Tc were successfully observed.

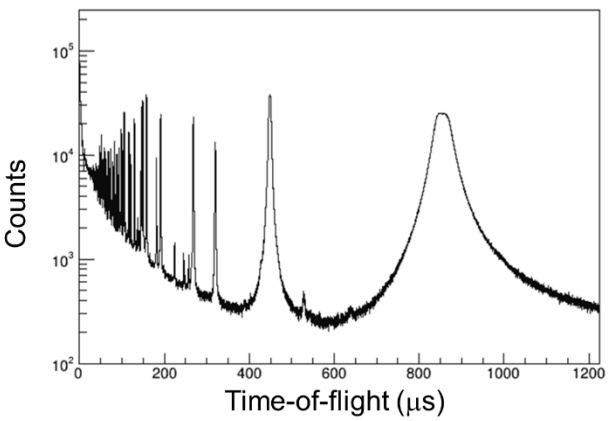

Figure 1 TOF spectrum of neutron capture events for ^{99}Tc

4. Conclusions

In order to derive the neutron capture cross section of ^{99}Tc, prompt γ-rays from ^{99}Tc(n,γ)^{100}Tc have been measured from thermal to the keV energy range using the TOF method at ANNRI of J-PARC MLF. Detailed results and comparison with past measurements will be presented in the presentation.

References

[1] G. Noguere et al. Phys. Rev. C, 102, 015807 (2020).