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Measurement of neutron capture cross-sections of ^{99}Tc at ANNRI of J-PARC MLF/J-PARC MLF ANNRI を用いた^{99}Tc の中性子捕獲断面積の測定

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

Technetium-99 is a long-lived fission product (LLFP) which undergoes γ-decay with a half-life of 211,100 years. This long-lived nature and relative abundance of production (approximately 6% of fission events produce ^{99}Tc) and environmental mobility makes long term waste storage challeng-ing. As such it is a possible candidate for being reduced via nuclear transmutation. The ^{99}Tc(n, γ)^{100}Tc produces ^{100}Tc which undergoes γ-decay to the 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 is required. There are large differences between experimental data of the neutron capture cross-sections, especially in the keV neutron energy range [1][2][3][4]. This motivated the present measurement of the neutron capture cross-sections of ^{99}Tc.

The experiment was conducted at the Accurate Neutron-Nucleus Reaction measurement In-strument (ANNRI) beamline at the Materials and Life Science Experimental Facility (MLF) at the Japan Proton Accelerator Research Complex (J-PARC). Capture γ-rays from neutron capture events were measured using a NaI(Tl) detector placed at a 90 degree angle to the neutron beam axis. The total mass of the 99Tc sample was 78 mg with a diameter of 6.3 mm and an activity of 1.4 mCi at time of preparation and was contained in an aluminum sample case. The sample was placed at a neutron flight distance of 27.9 m and capture γ-rays were measured from thermal to the keV energy range. The time-of-flight (TOF) method was employed to determine the incident neutron energy. The incident neutron spectrum was determined by placing a sample of boron enriched with 10B at the sample position and detecting 478-keV γ-rays from the ^{10}B(n,γ)^{7}Li reaction. A blank run, a dummy case and a carbon sam-ple were also measured for the purposes of background subtraction. From this raw TOF spectrum the neutron capture yield was calculated using the pulse height weighting technique. Self-shielding and multiple scattering were accounted for using PHITS simulation code. The neutron capture-cross section of ^{99}Tc from the thermal to keV energy region were derived. This presentation will compare present results with past data and provide a discussion.

References:
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