Cyclotron production of ^{62}Zn generator radioisotope via ^{nat}Zn$(p,x)^{62}$Zn

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^{62}Zn is an important radioisotope with several clinical and industrial applications. With a moderately short half-life of 9.2 hours, the radionuclide is widely used as a precursor of ^{62}Zn/^{62}Cu generator system to produce short-lived ^{62}Cu ($T_{1/2} = 9.8$ min). The daughter isotope, ^{62}Cu has vital chemical and nuclear decay characteristics for clinical applications in PET. The short half-life makes it compatible in image acquisition with appreciable counting statistics and yet is short enough for repetitive scanning in the same imaging session (such as in stress/rest perfusion studies).[1)] Moreover, ^{62}Cu exhibits desirable characteristics when labeled with the lipolytic agent for PET-perfusion imaging (in vivo).[1)] The ^{62}Cu is also an important tool for other clinical applications such as for blood flow studies in the brain and heart. A thorough review of past studies revealed substantial discrepancies in reported ^{62}Zn cross-sections from proton irradiation of zinc targets, highlighting the need for further investigation. This work aims to reduce large discrepancies in proton-induced cross-sections on ^{nat}Zn and enhance the Zn production database by presenting new, precise measurements.

In our experiment, a ^{nat}Zn target (99.9% purity; Nilaco, Japan) was irradiated with 30 MeV proton beam using the AVF cyclotron of the RIKEN RI Beam Factory, Japan.[2)] This study used a well-known stacked-foil activation approach. The prepared target stack (Ti → Zn → Gd → Al) was kept in a Faraday cup-like target holder and irradiated for 1.0 hour. The γ-ray spectrometry using high-purity Ge detectors was used for the cross-section measurements. The initial beam intensity of 97.87 nA was first determined from the measured activities of the front Ti foil in the stack.

The ^{nat}Ti$(p,x)^{48}$V ($E_{\mathrm{p}} = 29.65$ MeV, $\sigma = 35$ mb) monitor reaction recommended by IAEA[3)] was used for the evaluation of the beam intensity. The foil that was positioned at the front of the stack was used for this purpose. At the exit point of the AVF cyclotron beam line, the proton beam energy was determined to be 29.7 MeV via the time-of-flight method together with a plastic scintillator monitor. Using natural zinc as the target material, apart from the ^{62}Zn, we can produce several clinically important radioisotopes, each with different applications. The production cross-sections of these radionuclides have also been assessed with their relevant total uncertainties.

The results in this work are compared with the previous experimental data as well as the theoretical data extracted from the TENDL-2021 library. Due to space constraints, only cross-sections for ^{62}Zn are presented in this report (Fig. 1). The excitation function of ^{62}Zn was assessed using its interference-free γ line ($E_\gamma = 596.6$ keV; $I_\gamma = 26.00\%$). The TENDL-2021 library indicates that the ^{62}Zn production is mainly from contribution through to the ^{64}Zn(p,x) reaction below 30 MeV. Our result agrees favorably well with some of the earlier reported studies, with negligible discrepancies.

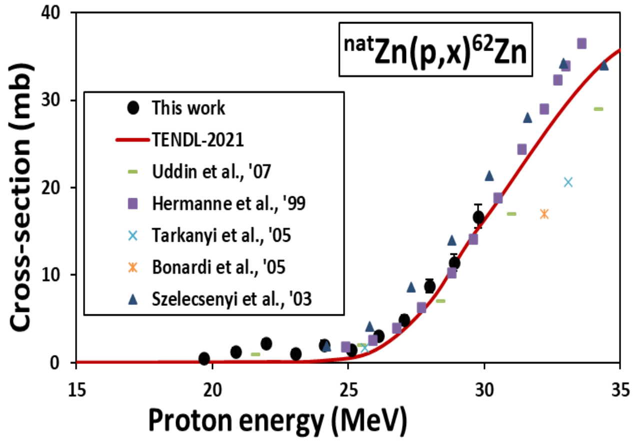

Fig. 1. Excitation function of the ^{nat}Zn$(p,x)^{62}$Zn reaction.

References
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