Activation cross sections of α-induced reactions on ^{nat}Zn for Ge and Ga production[†]

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Gallium-68 ($T_{1/2}$ = 67.71 min) is used in positron emission tomography (PET). The production of ^{68}Ga is important for its application in PET. In addition to ^{68}Ga, the production of its long-lived parent, ^{68}Ge ($T_{1/2}$ = 270.95 d), is worthy of investigation for a ^{68}Ga generator. One of the reactions to produce ^{68}Ge is the α-induced reaction on ^{nat}Zn. Two sets of experimental data[1,2] could be found in the EXchange FORmat (EXFOR) library. The two datasets deviate from each other. Therefore, we measured the cross sections of α-induced reactions on ^{nat}Zn for ^{68}Ge production.

The experiment was performed at the AVF cyclotron of the RIKEN RI Beam Factory using standard methods, stacked foil activation method, and off-line γ-ray spectrometry. Thin metallic foils of ^{nat}Zn (99.9% purity, Nilaco Corp., Japan) and ^{nat}Ti (99.6% purity, Nilaco Corp., Japan) were stacked as the target. The stacked target was irradiated by a 51.5 MeV α beam. The incident beam energy was measured by the time-of-flight method using a plastic scintillator monitor.[3] The irradiation of the α beam lasted for 2 hours. The average intensity was 82.0 nA, which was measured by a Faraday cup. The decrease in the energy of projectiles in the target was estimated using the SRIM code.[4] γ spectra from the irradiated foils were measured with a high-resolution HPGe detector.

To assess the beam parameters and target thicknesses, the cross sections of the ^{nat}Ti(α, x)^{51}Cr monitor reaction were derived. Consequently, we could confirm that our results were significantly consistent with the recommended values.[5]

The 1077.34-keV γ-line (I_γ = 3.22%) from the ^{68}Ga decay was measured after a long cooling time of approximately 80 days. Directly produced ^{68}Ga could completely get decayed in this period and the decay of ^{68}Ga was in equilibrium with that of its parent ^{68}Ge. The cross sections of ^{68}Ge are shown in Fig. 1 with previous experimental data[1,2] and TENDL-2017 data.[6] The peak position of our result is consistent with the experimental data, although the amplitude is slightly larger. The tendency of TENDL-2017 data is different from the experimental data.

The integral yield of ^{68}Ge was estimated from the cross sections measured in this work and stopping powers calculated by the SRIM code.[4] The derived integral yield is shown in Fig. 2 with the previously obtained experimental data.[1,2] The values obtained in our result are greater than other data above 30 MeV as expected from the cross sections measured in this work.

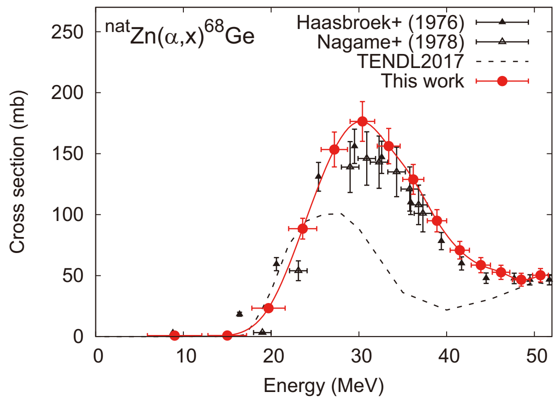

Fig. 1. Excitation function of ^{nat}Zn(α, x)^{68}Ge reaction.

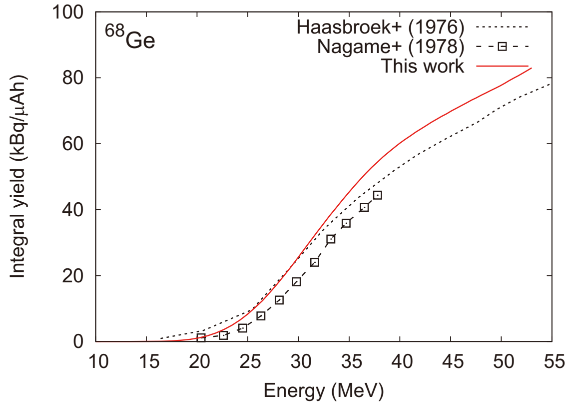

Fig. 2. Integral yield of ^{68}Ge.

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