

Title: Excitation functions of helion-induced nuclear reactions on natural copper up to 55 MeV

Author: Mayeen Uddin Khandaker, Kotaro Nagatsu, Katsuyuki Minegishi, Ming-Rong Zhang, Mustafa Mahmoud, Samer K.I. Ali , Naohiko Otuka

Abstract: Excitation functions for the $\text{natCu}(3\text{He},x)^{66,67}\text{Ga}$, $^{62,65}\text{Zn}$, $^{61,64}\text{Cu}$ and $^{56,57,58,60}\text{Co}$ nuclear reactions were measured from the respective threshold up to 55 MeV incident energy by using the conventional stacked foil activation technique combined with HPGe γ -ray spectrometry. Independent cross-sections for the $\text{natCu}(3\text{He},x)^{62}\text{Zn}$ and $^{61,64}\text{Cu}$ reactions are reported here for the first time in the energy region of 35–53 MeV. Measured data were critically compared with the relevant earlier experimental data and also with the theoretical data obtained from the model calculations. Present results confirmed some of the previous experimental data, whereas only a partial agreement was found with the evaluated data in the TENDL-2023 library and data calculated by Empire-3.2 code. Such discrepancies indicate that the nuclear reaction sub-models and parameters adopted in the codes were insufficient to accurately characterize the reactions under investigation. The measured cross-sections were used to infer the physical thick target yields for the reaction products under investigation. The measured data are useful for reducing the existing discrepancies in the literature, improving the nuclear reaction model codes, and enriching the experimental database for various other applications including medical isotope production, thin layer activation analysis, etc.

Keywords: Green Supply Chain Management (GSCM), Circular Economy (CE), Carbon Emissions (CO_2), Economic Growth (RGDP), European Union (EU), Panel ARDL.

DOI: <https://doi.org/10.1016/j.jenvman.2024.123109>