

ABSTRACT

The production of Copper-64 (^{64}Cu) radioisotope plays an important role in theranostic applications due to its suitable properties for cancer diagnosis and therapy. This study aims to produce ^{64}Cu radioisotope using natural zinc oxide (natZnO) and enriched ^{64}ZnO targets through the $^{64}\text{Zn}(n,p)^{64}\text{Cu}$ reaction. Secondary neutrons were generated from the irradiation of a titanium target by 11 MeV protons using a cyclotron at Darmas Cancer Hospital. Neutron flux and ^{64}Cu production were calculated using PHITS 3.24 simulations, and the results were validated experimentally. 1 gram natZnO and ^{64}ZnO targets were placed in a special target system made of 7075 aluminum, equipped with titanium foil (1 mm) and havar foil (50 μm) for energy transfer optimization and system stability. Radioactivity measurements were performed using a FLIR identiFINDER 2 (R400) gamma spectrometer and an Atomlab 500 dose calibrator. The results showed that enriched ZnO produced higher Cu activity (31 ± 5.57 kBq) compared to natZnO (20 ± 4.47 kBq), consistent with simulation results showing a maximum activity of 35 kBq for ZnO and 25 kBq for natZnO . Cu activity increased with irradiation time, with a significant increase in the enriched target. This study proves that the use of enriched ZnO is more efficient in the production of secondary neutron-based Cu radioisotopes.

Keywords: *Copper-64, Zinc Oxide, Secondary neutrons, Proton irradiation, PHITS*