PC-controlled radiochemistry system for preparation of NCA ^{64}Cu

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Due to the rapid increase of the use of nuclear medicine techniques in modern clinical diagnosis and in a selected series of therapies, researchers' efforts are focusing for the standardization and optimization of different production routes for a series of emerging radioisotopes like ^{64}Cu, ^{67}Cu, ^{114m}In, ^{211}At.

In particular the EC/β^+/β^- decay of ^{64}Cu makes it a promising candidate for both PET imaging and internal targeted radio therapy. In the last decades several groups studied different production routes like for this radio nuclide, i.e. ^{64}Ni(p,n), ^{64}Ni(d,2n),^{64}Zn(d,2p).

Taking into account the wider availability of the medium energy proton beam machines, the (p,n) reaction on ^{64}Ni seems to be the most attractive one, although ^{64}Zn(d,2p) may be considered as an alternative where lower activity is necessary, as it may require less investment in enriched material.

The production of large activities of ^{64}Cu on regular basis requires a fast and reliable chemistry system. Based on the experience gathered in the last decades in our laboratory we present here and efficient, remote controlled chemistry system for production of the non carrier added ^{64}Cu via ^{64}Ni(p,n) reaction.

To avoid excessive investment in a gold target carrier, a good practice is to coat the copper target carrier with a thin inert material, i.e. 5-6 μm of gold, followed by electrodeposition of the ^{64}Ni target layer. In that way, the cross contamination of the non carrier added ^{64}Cu with the copper present in the target carrier is excluded. In general the irradiations are performed with protons having incident energy of about 15 MeV, and, depending on irradiation condition, may lead to curie amount of induced activity of ^{64}Cu.

To reduce the thickness of the ^{64}Ni target layer, and, as consequence, to minimize the problems related with the plating and dissolution of the target layer, a low beam/target angle geometry (6 degrees) is desired. Nevertheless, the separation of target / activation product is required. Upon irradiation, our chemistry system proposes the dissolution of the ^{64}Ni layer in a heated flow trough stripper by means of diluted nitric acid. Next, the non carrier added ^{64}Cu is selective extracted into benzene (containing 0.1 M benzoylacetone) at pH 4.5, leaving the enriched ^{64}Ni and possible Co induced isotopes in the inorganic phase. The back extraction of ^{64}Cu is done in a small volume of diluted hydrochloric acid (6 N). The final purification step is achieved using an anion exchange column Dowex 1X8. Finally, the NCA ^{64}Cu is eluted with a small volume (10 ml), diluted hydrochloric acid (1 N).

The overall yield of the chemistry is estimated as being higher than 95% with a short total chemistry time, less than 2 hours, while the gold plated target carriers can be reused as long as the thin gold layer remains intact, meaning that scratches and cracking by careless handling are avoided.