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Ionchromatographic Isolation of n.c.a. Se-73,75 and New Cross Sections of its Impurity As-74 with 40 MeV Protons

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Selenium-73 (half-life: 7.1 h; positron energy = 1.3 MeV) is a very promising radionuclide for application in positron-emission-tomography (PET). With its optimal radionuclidic properties it is the only suitable option for PET-tracer analogues of sulfur-compounds and for authentic labelling of organic selenium molecules [1]. It is preferably produced by the nuclear reaction $As-75(p,3n)Se-73$ in the proton energy range of $40 \rightarrow 30$ MeV [2]. To produce adequate amounts of Se-73 for radiosyntheses, a suitable target material withstanding high beam-currents is necessary. For this purpose an alloy of copper and arsenic has proven useful [3]. The currently used dry distillation method [4] for isolation of the n.c.a. radionuclide did not prove reliable enough for routine use. Therefore a new wet-chemical method was developed for its separation from the irradiated target.

Selenium-75 (half-life: 119.8 d), produced by the (p,n)-reaction on the same target material with 17 MeV protons, was used for the determination of mass distribution coefficients and separation factors, due to its longer half-life and easier production possibility at a smaller cyclotron. Therewith a two-step wet-chemical separation was developed and optimized. First, the bulk material of copper and co-produced radiozinc were separated from radioselenium and the bulk of arsenic by use of the cation-exchange resin DOWEX 50Wx8 and diluted hydrochloric acid as eluent. In a second step the separation of radioselenium from arsenic was attained using the anion-exchange resin DOWEX 1x8 and diluted nitric acid as eluent. With this new separation method up to $94 \pm 2\%$ of radiochemically pure radioselenium was obtained in 2 h without the use of any isotopic carrier. For a precise evaluation of the produced radioactivity the cross section data of the main nuclear reactions and relevant side reactions are necessary. Up to now, for arsenic-74 which is the major by-product in the production of selenium-73 no cross section data in the proton energy range under consideration were reported. To close the existing gap and strengthen the available data for Se-73,75 production cross sections of the proton induced reactions $As-75(p,pn)As-74$, $As-75(p,n)Se-75$ and $As-75(p,3n)Se-73$ were measured in the energy range from 40 to 25 MeV. Based on the experimental results an excitation function for the formation of As-74 could be developed for the first time.

References:

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