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NEUTRONDEFICIENT NUCLIDES FOR POSITRON EMISSION TOMOGRAPHY. III. SEPARATION OF NO-CARRIER ADDED Cu ISOTOPES FROM IRRADIATED ZINC: Preprint ITEP 93-35/

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The paper is devoted to separation of copper radioisotopes (^{61}Cu, ^{64}Cu, ^{67}Cu) from irradiated zinc. As separation method the extraction with dithizone was used. The suggested method provides high radionuclidic purity and yield of product.

Fig. - 1, ref. - 8

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INTRODUCTION.

Isotopes of copper can be used to label proteins by chelating techniques and are therefore of importance both for diagnostics and for therapy in the use of antibodies. Three copper isotopes have half-lives long enough to be of physiological interest in such applications. Of these two, ^{61}Cu ($T_{1/2}$=3.4 h) and ^{64}Cu ($T_{1/2}$=12.7h), are positron emitters and can be used in the context of PET while a third isotope, ^{67}Cu, is a fairly long-lived ($T_{1/2}$=61.9 h) beta-emitter and has been suggested both for diagnostics with gamma camera and for therapy [1].

Production routes for different copper isotopes from zinc and nickel as targets have been suggested [2, 3, 4, 5, 6]. Production methods to obtain no-carrier added Cu involve techniques like ion exchange separation [2,3], electrodsposition [7] and two faces liquid extraction [8]. We have used an extraction technique using copper-dithizone complex which was suggested in [8] but with several simplifications. Thus, the extraction of gallium radionuclides with diethyl ether was omitted. This procedure leads to certain loss of radiocopper. At the same time, extraction with dithizone provides an acceptable radionuclidic purity of copper. In the original work the copper-dithizone complex was heated to

500° C in order to break down the Cu-dithizone-complex. This method requires a rather long time. We also found a migration of carrier-free copper into the walls of quartz tube, which was used for this purpose which made the separation yield low.

We suggest a modified method where the Cu-dithizone-complex is broken in 6 M HCl. The free dithizone is then removed by further extractions of carbon tetrachloride.

For the development of separations method the nuclide ^{61}Cu was chosen. For the production of ^{61}Cu the natural zinc target was irradiated with 16 MeV protons on MC17 cyclotron at the Uppsala PET-center. Copper was formed via $^{64}Zn(p,\alpha)^{61}Cu$ reaction. For the separation the following procedure was used:

1. The zinc target was dissolved in a minimal amount of concentrated hydrochloric acid.
2. The solution was evaporated to dryness.
3. The residue was dissolved in 3 ml of 0.1 M HCl.
4. If needed the pH was adjusted to 1.
5. The target-solution was shaken with 3 ml freshly prepared 0.001% dithizone in carbon tetrachloride.
6. The organic face was removed and washed twice with with equal volumes of 0.1 M HCl.
7. The organic face was shaken with 3 ml 6 M HCL.
8. The water face, now containing free Cu, was removed and washed with equal amount of carbon tetrachloride to remove any traces of dithizone.

RESULTS.

The separation work was monitored by a solid state detector

working on-line with multi channel analyzer.

A spectrum taken before dissolving the target shows gamma-peaks from ^{66}Ga, ^{67}Ga, ^{61}Cu, ^{65}Zn.

A spectrum taken of the final product is shown in fig. 1 and shows gamma- peaks only of ^{61}Cu. Other gamma- peaks are present at background level.

Radionuclidic purity of ^{61}Cu was found to be better than 99%: The time to make the complete separation was less than 1 hour and the separation yield was found to be 76,6 % (94% decay corrected).

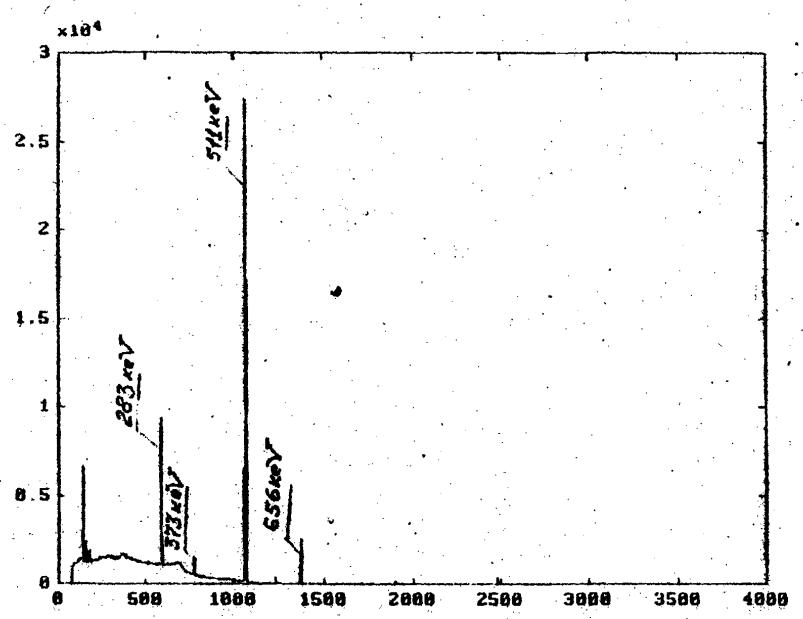

Fig. 1. Gamma-spectrum of extracted copper.

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