sources extends. Therefore the generator $^{68}Ge$ - $^{68}Ga$ represents a major interest for a positron emission tomography due to unique accuracy and informativity.

Electrochemical deposition of metals is widely used in cyclotron technology for producing of cyclotron targets. The given method has the following advantages:

1. This method is relatively cheap.

2. The opportunity to receive high purity metallic coating as, in many cases, at electrochemical deposition of metals there is additional purification (refining) of settled metals. Thus the bulk of impurities remains in electrolyte solution. Selecting compositions of electrolyte and conditions of deposition, in many cases, it is possible to achieve very high-purity of some settled metals. This effect has a huge technological value as allows to avoid some additional impurities of undesirable isotopes. In turn the effect of refining of superimposed metals allows to a yield a radionuclide with very high radiochemical purity.

3. The electrochemical method allows to adjust very precisely both thickness of a covering, and physical properties of covering - density of a settled covering and its crystal structure.

Besides, it is necessary to underline that on the contrary to other methods of producing of cyclotron targets, the electrochemical method does not require the complex of expensive instrumentation.

We had explored various systems for gallium - nickel cyclotron targets productions. Systems for deposition of two-layer gallium - nickel targets, and conditions of deposition of gallium basic layer and coating nickel layer were selected.

The requirements for reliable production of the two-layer cyclotron target with adjustable thickness of gallium and nickel layers were determined. Received results allow to develop technological parameters for production of gallium - nickel cyclotron targets.

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## RADIOCHEMICAL SEPARATION OF CADMIUM-109

**Egamediev S., Mukhtarov A., Nurbaeva D., Rakhmanov A.**
*Institute of Nuclear Physics, Tashkent, Uzbekistan*

Cadmium-109 has a half-life of 461.9 days and decays by electron capture to $^{109}Ag$ with the emission of 88 keV γ-ray (3.79%) along with the characteristic X-ray from the K level of Ag, with energy of 22.5 keV.

This radionuclide has found widespread use as a photon source in x-ray fluorescence analysis devices employed in industry for numerous applications such as the direct determination of gold in ores, the analysis of metals and identification of steels. Other applications range from its use as an electron source for measurement of densities of air-pollution samples, to tracer studies in mushrooms and mice and rats. In the nuclear medicine field there is growing interest in employing $^{109}Cd$ in a $^{109}Cd/^{109m}Ag$ generator, as an alternative to other biomedical generators of ultra short-lived gamma emitters.

There are several methods for the production of $^{109}Cd$ in literature:

1. Bombardment of silver cyclotron target via $^{109}Ag(d,2n)^{109}Cd$ reaction with 16 MeV deuterons.
2. Bombardment of natural silver target via $^{109}Ag(p,n)^{109}Cd$ reaction with 14 MeV protons.

3. Proton bombardment of natural indium target with 96 MeV protons.
4. Irradiation of enriched $^{107}Ag$ target in high-flux nuclear reactor at neutron flux $2 \times 10^{15}$ n·cm$^{-2}$·s$^{-1}$ via $^{107}Ag(n,\gamma)\ ^{108}Ag \rightarrow\ ^{108}Cd\ (n,\gamma)\ ^{109}Cd$ reaction.
5. Irradiation of enriched $^{108}Cd$ target in nuclear reactor at neutron flux $1 \times 10^{14}$ n·cm$^{-2}$·s$^{-1}$ via $^{108}Cd\ (n,\gamma)\ ^{109}Cd$ reaction.

The production of $^{109}Cd$ with proton beam via $^{109}Ag(p,n)\ ^{109}Cd$ reaction is ideal for the cyclotron U-150, since it is not required the change of the regime for the machine functioning. Because of its relatively long half-life the time required for separation is also not an important factor, but its use as an X-ray source requires a very high radiochemical purity.

In the present work we studied two methods for separation of $^{109}Cd$ from model solution of silver targets.

First method is based on precipitation of silver as chlorides with 6 M HCl from nitric acid solutions of Ag, Cu and Cd. Then the solution is filtered to remove silver. The filtrate is evaporated almost to dryness and the solid residue is dissolved in 2 M HCl. The solution obtained is passed through an anion-exchange column with DOWEX 1×8. Cadmium is retained on column at this concentration of HCl while Cu is completely eluted with 30 ml of 2 M HCl. Finally cadmium is eluted with 200 ml of 1 N $HNO_3$, while the traces of silver remain on the column. Thus a pure solution of cadmium nitrate is obtained that can be evaporated to the desirable volume. Measuring the activity of the initial and obtained quantity of $^{109}Cd$ it is found that 80% of the total cadmium is recovered.

Second method is based on the selective adsorption of silver on column containing 0.5 g of polyethenemonosulphide (PEMS or trade name TR-1) from nitric acid solutions of Ag, Cu, Zn and Cd. This sorbent has high adsorptive capacity to silver, its adsorptive capacity reaches to 1920 mg/g from 1.5 M nitric acid solutions. After adsorption of silver the solution obtained evaporated to dryness and the solid residue is dissolved in 0.5 M nitric acid containing 0.1 M hydrobromic acid. Then the solution obtained is percolated through the column, containing 5 ml of Dowex1×8 resin. The copper(II) and zinc are completely eluted with 70 ml of 0.5 M $HNO_3$ + 0.1 M HBr. The cadmium-109 is eluted with 50 ml of 3 M nitric acid. The obtained solution is evaporated to dryness and the dry residue is treated by evaporation with 2 ml of 12 M hydrochloric acid. After treatment the damp residue is dissolved in 0.1 M hydrochloric acid. The yield of cadmium-109 is higher than 90% and the radiochemical purity was more than 99.9%.

These methods will be used for separation and purification of cadmium-109 to make of sealed sources for X-ray fluorescence analysis.

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# EVALUATION OF NEUTRON FLUX IN THE WWR-SM REACTOR CHANNEL AND IN THE IRRADIATING ZONE OF U-150 CYCLOTRON

**Sadikov I.I., Zinov'ev V.G., Sadikova Z.O., Salimov M.I.**
*Institute of Nuclear Physics, Tashkent, Uzbekistan*

For effective work of a reactor, and correct planning of experiments related to the reactor irradiation of various materials it is required to control a neutron flux in the given irradiation