THE RADIOACTIVE TARGET OF ^{44}Ti

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The fusion-evaporation reaction is a promising tool to study ^{100}Sn nucleus. To date, the ^{101}Sn rate obtained by using fusion-evaporation reactions at the GSI ISOL is one to two orders of magnitude higher than that reached by nuclear fragmentation at GANIL and GSI, respectively [1,2]. The measurement of the atomic mass of ^{100}Sn, performed by using [3] ^{58}Ni(^{50}Cr,2p6n) fusion-evaporation reactions, seems to support this conclusion [2]. The corresponding cross-section was estimated as 0.4 μb [2], which could be compared with cross-section 11 pb of the GSI fragmentation experiment [4]. The possible use of GSI ISOL system to study ^{100}Sn in the reaction ^{50}Cr(^{58}Ni,2p6n) was discussed in [2]; the serious disadvantage is a strong contamination of A=100 samples by isobars of lower Z.

The radioactive target of ^{44}Ti ($T_{1/2}$ = 47.3 y) could open new possibilities to produce and to study the ^{100}Sn nucleus and other rare nuclei using the fusion reactions with the stable beams like ^{64}Zn or ^{58}Ni (e.g. ^{44}Ti(^{58}Ni,2n)^{100}Sn). Much higher cross-section could be achieved in comparison with above mentioned reaction.

We prepared the ^{44}Ti atoms using reaction ^{45}Sc(p,2n) at the parasitic beam of our cyclotron with proton energy of 20 – 25 MeV and intensity ~ 8 μA. The maximum cross-section of this reaction is at 25 MeV. The original proton beam with energy of 30 MeV and intensity of 80 μA irradiated a production target (Tl or Zn) for radiopharmaceuticals at small angle of 1°. The parameters of parasitic beam (protons scattered from the production target) were calculated using Monte Carlo simulation (code GEANT) and verified experimentally using Cu foils. The reactions ^{63}Cu(p,2n)^{62}Zn and ^{65}Cu(p,n)^{65}Zn were identified by the methods of γ - ray spectroscopy. The optimum position of the Sc foil - the highest energy and intensity of the proton beam - was identified at the place close to the plane of the production target.

Scandium foils 2.5 cm ◈ 5 cm ◈ 0.2 mm were placed in cyclotron chamber on the water cooled holder and irradiated during two years. We obtained the amount of ^{44}Ti ~2 ◈ 10^{16} atoms in the scandium foils.

We followed and modified chemical procedures described in [5,6]. The yield of ^{44}Ti atoms obtained was 50 %.

According the tests, we are able to obtain in short time radioactive target of ^{44}Ti on thin (1 μm) Ta backing containing ~10^{16} atoms for experiments at heavy ion beams.

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