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Thick target yields measurements with natV targets for the production of the theranostic 47Sc

47Sc is an emerging medical radionuclide with potential in the field of theranostic applications. Its favourable decay characteristics, namely β- particles of 162.0 keV mean energy, γ rays of about 159 keV energy, and a half-life of 3.3492 d, make it suitable for use in the radiolabelling of radiopharmaceuticals for cancer diagnosis using SPECT (Single Photon Emission Computed Tomography) cameras and for targeted radiation therapy of the same tumours. Furthermore, 47Sc can be used in combination with 43Sc or 44gSc, two β+ emitters that are useful for PET (Positron Emission Tomography) imaging, to constitute the true theranostic pairs 47Sc/44gSc or 47Sc/43Sc, needed in nuclear medicine. The scientific research concerning this radionuclide currently faces the challenge of identifying the optimal production route, corresponding to the best balance between the amount of 47Sc produced and the purity required for medical applications.

In the context of the LARAMED (LAboratory of RAdionuclides for MEDicine) program, within the PASTA (Production with Accelerator of Sc-47 for Theranostic Applications) project, funded by INFN (National Institute of Nuclear Physics) CSN5 for the years 2017-2018, the production with proton beams on natV and enriched 48Ti targets was investigated. Starting from cross section results, the radionuclidic purity (RNP) and the dose increase (DI) of the final product were assessed considering different energy intervals and irradiation times. For the natV targets, these calculations allowed to identify the energy interval 19-35 MeV as the one that best respects the allowed limits on RNP and DI. This interval is in the proton energy range that perfectly fits the SPES cyclotron of the INFN-LNL (Legnaro National Laboratories).

The objective of the present study is to validate, through experimental means, the energy interval highlighted by calculations. This objective can be achieved by bombarding thick targets of natV with a 35 MeV proton beam. It is estimated that a target with a thickness of 1.7 mm would suffice in covering the energy range down to 20 MeV. To test the RNP and the amount of 47Sc produced, it would be sufficient to have irradiation runs lasting 1 h and with a beam intensity of the order of 102 nA. A chemical dissolution process is required to collect an aliquot of the target and perform γ spectrometry measurements with HPGe detectors. The activity measured through γ spectrometry allows to evaluate the thick targets yields and corresponding RNP, and DI, to be compared to the values predicted in the PASTA project.

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