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Possibilities of production and isolation of the promising Auger emitter 195mPt for potential application in radiotheranostics

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Recently radionuclides emitting Auger and conversion electrons have gained a lot of attention in radiotherapy. If their decay is accompanied by soft ⊠-radiation those radionuclides can potentially be used for theranostics which implies combination of therapy and diagnostics in a single medical procedure with the same radioisotope and is currently considered extremely advantageous strategy for cancer treatment. Such radionuclides are known with the examples like 67Ga, 117mSn, 123I, 86Y(90Y), 64Cu(67Cu), 124I(131I), 195mPt and some of them are already successfully used in clinical practice.

195mPt emits one of the highest numbers of Auger electrons and γ-radiation appropriate for detection which makes it an ideal candidate for theranostics. Introduction of 195mPt into cisplatinum would enhance therapeutic effect at a lower cytotoxicity [1]. However, there is so far no suitable method to produce 195mPt with a sufficient yield and specific activity high enough to meet the requirements for carrying out radionuclide therapy. In this work we investigate two perspective ways to produce the radioisotope of interest and characterise nuclear reactions involved with respect to their cross sections.

The first method takes advantage of photonuclear production by irradiation of natural Pt with bremsstrahlung at the microtron MT-25 (JINR, FLNR) according to the reactions 196Pt(γ,n)195mPt and 195Pt(γ,γ')195mPt. Photonuclear method is a powerful and effective tool to produce isomeric radioisotopes with high yield particularly relevant for nuclear medicine. The results of the flux-weighted average cross section <σ> determination for the reactions mentioned will be presented. It is important to add here that we have increased the initial specific activity by one order of magnitude with the respective chemical yield of 80% using a target mixture of cisplatinum and cryptomelane with latter serving as a recoil nuclei catcher and further separation of these two target components.

The second approach aimed to boost the specific activity of the radioisotope studied is indirect production of no-carrier-added 195mPt by double neutron capture reaction of enriched 193Ir at a reactor by the nuclear process 193Ir(n,γ)194Ir(n,γ)195mIrβ- ⟶ 195mPt. This approach was proposed by the American researchers but was not characterised numerically [2]. Our work is a detailed study of the process mentioned by an activation technique at IBR-2 reactor (JINR, FLNP) and contains the first results of the unknown cross sections determination for the reaction 194Ir(n,γ)195mIr. We have found the reaction 194Ir(n,γ)195mIr resonance neutrons cross section to be 2900 b substantially prevailing the corresponding value for thermal neutrons with the specific activity of 195mPt after 17 days of irradiation of 20 mg of 193Ir at IBR-2 amounting to 38.7 MBq/(mg Pt), making a reactor with a higher flux of fast neutrons to be a preferential condition for 195mPt production [3].

References

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Notes

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