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Photonuclear production of platinum radioisotopes promising for theranostics

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In recent years radionuclides or radionuclide pairs applicable for theranostics (a combination of therapeutics and diagnostics in a medical procedure) have gained a lot of interest. Such radionuclides are known with the examples like 67Ga, 117mSn, 123I, 86Y(90Y), 64Cu(67Cu), 124I(131I), 195mPt and are extensively investigated. Radionuclides 195mPt and 193mPt have one of the highest numbers of Auger-electrons which are extremely effective in damaging cancer cell when targeted to an area of a malignancy. The former radionuclide also provides soft X-radiation which allows for simultaneous monitoring of the biodistribution of the radiopharmaceutical and thus diagnostics.

In this work we discuss the production of 193mPt and 195mPt by irradiating platinum compounds of natural isotopic composition with bremsstrahlung at the microtron MT-25 (JINR, FLNR) according to the nuclear reactions: 196Pt(γ,n)195mPt, 195Pt(γ,γ')195mPt, 194Pt(X,n)193mPt. The product is obtained with a carrier, so the specific activity is low. The methods of collecting recoil nuclei described in the literature allow increasing the specific activity, but the yield decreases significantly.

To increase the specific activity, we tested a target consisting of a mixture of cisplatin and nanostructured cryptomelane material (K2(Mn4+,Mn2+)8(O,OH)16). Cryptomelane acts as a collector of platinum recoil nuclei. After irradiation, the mixture is extracted, dissolved in water, and the undissolved cryptomelane residue is filtered from the resulting cisplatin solution. Then, cryptomelane is dissolved in a mixture of HCl and H2O2, and platinum is isolated from the manganese solution. This work aims to establish the effectiveness of the proposed materials and the yield of the required radionuclide in the obtained samples.

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