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Radiochemical measurement of cross sections for the production of the therapeutic radionuclide ^{193m}Pt

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The radionuclide ^{193m}Pt (T_{1/2} = 4.33 d), a high spin isomer, decaying by highly converted isomeric transition, emits about 33 Auger electrons per decay. It is of great potential interest in internal radiotherapy because of its suitable decay properties and platinum-complexes (like cis-platin and others) used in chemotherapy, i.e., potent antitumor agents. In order to avoid side effects of chemotherapy, it is advisable to use this radionuclide in the same chemical complex with high specific activity. So far the specific activity of ^{193m}Pt produced has been rather low due to the use of the ¹⁹²Pt(n,γ) process at a reactor. In a recent study, the ¹⁹²Os(α,3n) reaction was measured up to 28 MeV [1]. The aim of the present work was to establish reliable and reproducible chemical preparation of thin targets from highly enriched osmium and to extend the measurement of excitation function of the ¹⁹²Os(α,3n) reaction up to 35 MeV, where the optimum energy range was expected, and to increase the yield and the specific activity of the ^{193m}Pt at a cyclotron.
We optimized the dissolution and conversion of osmium to osmium tetroxide vapor and trapping in KOH solution, the electrolytic preparation of thin target samples of highly enriched ¹⁹²Os on Ni, and the complete radiochemical separation of radioplatinum.
The excitation function of the ¹⁹²Os(α,3n)^{193m}Pt reaction was measured from 26 MeV to 39 MeV using the conventional stacked-foil activation technique. Several stacks containing 99.65 % enriched ¹⁹²Os targets and thin Ti and Cu foils were irradiated by 40 MeV α-particle beam of about 100 nA for 2 h at the Brussels Cyclotron. The Ti-nat(α,X)⁵¹Cr reaction induced in the Ti foil was used to monitor the incident beam intensity. After complete separation of radioplatinum, the radioactivity of ^{193m}Pt was measured by X-ray spectrometry using the Pt X-ray line of 66.8 keV. The measured count rates were converted to decay rates by correcting for the X-ray intensities, self absorption in the source, and the efficiency of the detector using the well known formula; thereafter the nuclear reaction cross section was calculated. The cross section of the ¹⁹²Os(α,3n)^{193m}Pt reaction reaches a value of about 1.5 b at the maximum at about 35 MeV. It was also calculated theoretically using the compound-precompound nuclear model codes TALYS and STAPRE. The calculated values are consistent with the measured data. The optimum production of the ^{193m}Pt radionuclide by this method was found in the energy range 30 - 38 MeV; the integral yield of ^{193m}Pt being about 40 times higher than that in the energy region below 28 MeV [1]. The results provide basic information on the production of high-quality ^{193m}Pt for therapeutic application. Tests on impurity, the yield and specific activity are underway.

Reference

[1] K. Hilgers, H.H. Coenen and S.M. Qaim. Appl. Radiat. Isot. 66, 545-551 (2008).

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