STUDIES FOR THE PRODUCTION OF ^{123}I AT THE CV-28 CYCLOTRON OF IPEN-CNEN/SP

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ABSTRACT

The ideal conditions to produce ^{123}I through the ^{124}Te (p,2n) ^{123}I reaction at the CV-28 cyclotron of IPEN-CNEN/SP (protons , E_{max}= 24MeV) were studied in this work. Two target materials were tested: pure TeO_2 and TeO_2 with 2%Al_2O_3. The chemical separation of ^{123}I was carried out by a dry distillation process with a high frequency induction furnace. The results obtained up to now show the best separation yields (80%) in the following conditions: 1) Target: pure TeO_2; 2) Furnace temperature: 760±5°C; 3) Diffusion time: 2min; 4) Oxygen flux rate: 30-40ml/min.

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ESTUDOS PARA A PRODUÇÃO DE ^{123}I NO CICLOTRON CV-28 DO IPEN-CNEN/SP

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RESUMO

No presente trabalho estudaram-se as condições ideais para a produção do ^{123}I a partir da reação $^{124}Te(p,2n)^{123}I$ no ciclotron CV-28 do IPEN-CNEN/SP (protons, E_{max}=24MeV). Testaram-se dois alvos de irradiação: TeO_2 puro e TeO_2 com 2% de Al_2O_3. Realizou-se a separação química do ^{123}I pelo processo de destilação por via seca utilizando-se um forno de indução de alta frequência. Os resultados obtidos mostraram os melhores rendimentos de separação nas seguintes condições experimentais: 1) Alvo: TeO_2 puro; 2) Temperatura de destilação: 760±5°C; 3) Tempo de destilação: 2min; 4) Fluxo de oxigênio durante a destilação:30-40ml/min.

Trabalho apresentado no "Fourth Workshop on Target Chemistry and Targetry", Villigen, Suiça, 9-12 de setembro de 1991.

INTRODUCTION

^{123}I is one of the most used radioisotopes in nuclear medicine due to its nuclear properties which are the most suitable among the radioisotopes of iodine for in vivo studies (absence of β particle emission, the short half-life, $t_{1/2}$=13.3h, and the emission of a γ ray with a suitable energy, E = 159 KeV). It substitutes ^{131}I in diagnostic procedures with the advantage of reducing the radiation dose given to the patient.

The methods for ^{123}I production involve various nuclear reactions, which can produce ^{123}I with p, d, ^{3}He or α-beams. These reactions lead to ^{123}I formation directly, or indirectly via the decay of ^{123}Xe.

The characteristics of the CV-28 Cyclotron of IPEN-CNEN/SP (protons, E_{max}= 24 MeV) are suitable to produce ^{123}I by the direct method through the reaction ^{124}Te (p,2n) ^{123}I and for ^{123}I production with high radionuclidic purity level is necessary to use enriched ^{124}Te target.

OBJECTIVE OF THE WORK

To establish the optimal conditions to produce ^{123}I at the CV-28 Cyclotron of IPEN-CNEN/São Paulo by the dry distillation method using an induction furnace.

In these preliminary studies were determined:

(1) The influence of Al_2O_3 (added to the TeO_2 target) in the release of radioiodine during distillation, and

(2) The loss of TeO_2 (gravimetrically) during irradiations at different beam currents (up to 10μA with a Wobbling system) and different lengths of time (10min - 2h).

EXPERIMENTAL

Two target materials were tested : pure TeO_2 and TeO_2+ 2% Al_2O_3 (277mg/cm^2).

To prepare the targets, the materials were placed on an 0.78 cm^2 recess of platinum support and melted above 736°C. The targets were proton - irradiated with beam currents up to 10μA (with Wobbling system) during various lengths of time (10min - 2h).

The chemical separation of iodine was carried out by the dry distillation process in an oxygen atmosphere using a high frequency induction furnace (Model "I",8,0 Kw, supplied by POLITRON). The iodine distilled was collected into a 0.01N NaOH solution.

APPARATUS FOR THE RADIOCHEMICAL SEPARATION OF RADIOACTIVE IODINE FROM THE TARGET

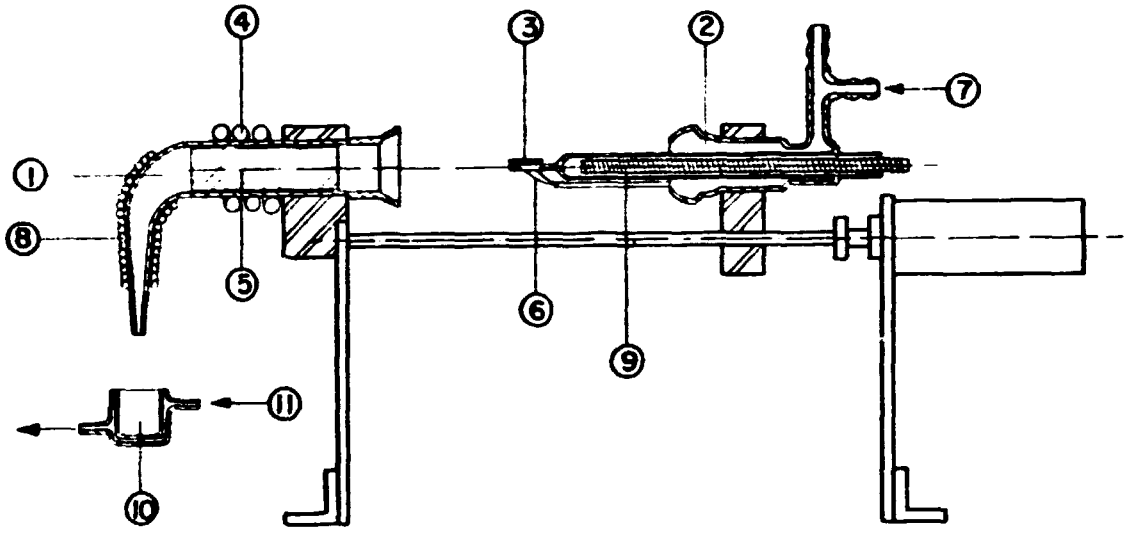

FIG.1 - Schematic diagram of remotely controlled automated apparatus for dry distillation of radioiodine from irradiated TeO_2 target: 1. Outer quartz tube (fixed). 2. Inner quartz tube (movable). 3. Platinum support with TeO_2. 4. Induction coil. 5. Pt tube ϕ = 22mm. 6. Thermo couple. 7. O_2 flow (30-40ml/min). 8.Heating ribbon. 9. Electrical resistance. 10. NaOH solution. 11. Cooling liquid circulation.

RESULTS AND CONCLUSIONS

TABLE 1. Separation yield of radioiodine from TeO_2 and TeO_2 + 2%Al_2O_3 targets by the dry distillation method using a induction furnace. Furnace temperature = 760 ± 5°C. Diffusion time = 2min. Oxygen flow rate = 30-40ml/min.

	TARGETS			
	Pure TeO_2		TeO_2 + 2% Al_2O_3	
	Target 1	Target 2	Target 1	Target 2
Release of radioiodine from the target (%)	92.1±2.9	97.1±2.0	50.7±2.2	47.2±4.4
Radioiodine collected in .01 NaOH solution(%)	73.2±8.2	73.2±8.0	40.1±6.3	38.9±1.9

Number of experiments: 6

When Al_2O_3 was added to the TeO_2 target, about 40% of iodine activity was retained in the target during distillation and when pure TeO_2 target was used, only 5%.

With beam currents up to 10μA there was practically no mass loss even in long irradiations (2h) what agrees with the results of Michael and collaborators[1]. The physical resistance of the melted pure TeO_2 target was satisfactory.

The loss of TeO_2 during distillation was less than 0.5%. This small mass loss confirms the advantage to use an induction heating system instead of conventional heating in agreement with Oberdofer and collaborators[2].

The chemical form of the radioiodine collected in 0.01N NaOH solution was 100% iodide.

REFERENCES

(1) Michael, H; Rosezin, H; Apelt, J; Blessing, G; Knieper, J. and Qaim, S.M. Some technical improvements in the production of ^{123}I via the ^{124}Te (p,2n) ^{123}I reaction at a compact cyclotron. Int. J. Appl. Rad. Isot., 32:581-7, 1981.

(2) Oberdofer, F; Helus, F; Mayer-Borst, W. Experiences in the routine production of ^{123}I via the ^{124}I (p,2n) ^{123}I reaction with a low energy cyclotron. J. Radioan. Chem. 65(1-2):51-56, 1981.