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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 , $E_{\text{max}} = 24\text{MeV}$) 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: $760 \pm 5^\circ\text{C}$; 3) Diffusion time: 2min; 4) Oxygen flux rate: 30-40ml/min.

Paper present at "Fourth Workshop on Target Chemistry and Targetry", Villigen, Switzerland, September 9-12, 1991.

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 $^{124}\text{Te}(p,2n)^{123}\text{I}$ no ciclotron CV-28 do IPEN-CNEN/SP (protons, $E_{\text{max}}=24\text{MeV}$). 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: $760\pm 5^\circ\text{C}$; 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, Suíça, 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, $t_{1/2}=13.3\text{h}$, and the emission of a γ ray with a suitable energy, $E = 159 \text{ KeV}$). 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, ^3He 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, $E_{\text{max}} = 24 \text{ MeV}$) are suitable to produce ^{123}I by the direct method through the reaction $^{124}\text{Te} (p,2n) ^{123}\text{I}$ 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 $10\mu\text{A}$ with a Wobbling system) and different lengths of time (10min - 2h).

EXPERIMENTAL

Two target materials were tested : pure TeO_2 and $\text{TeO}_2 + 2\% \text{Al}_2\text{O}_3$ (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 $10 \mu\text{A}$ (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

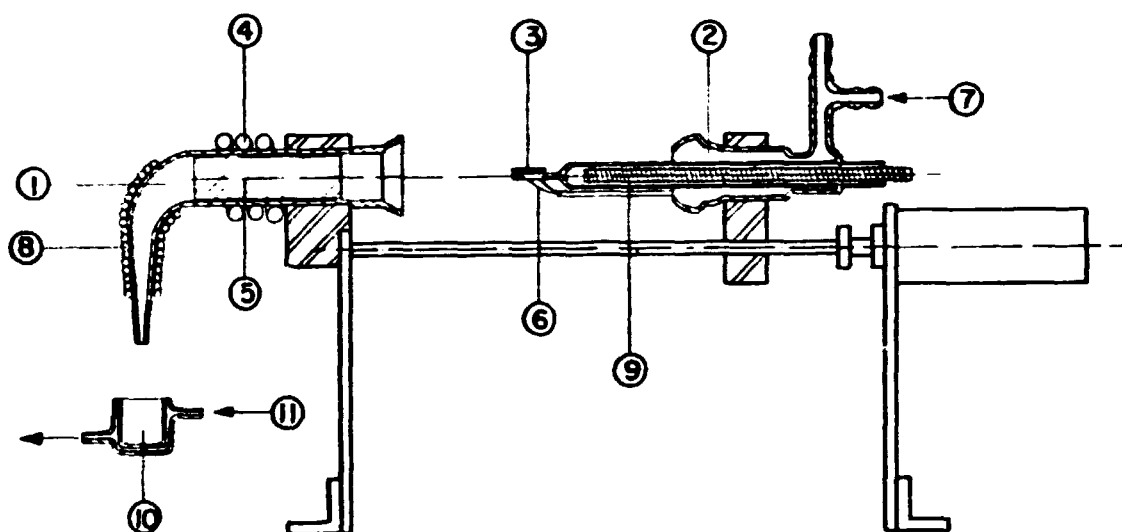


FIG.1 - Schematic diagram of remotely controlled automated apparatus for dry distillation of radioiodine from irradiated TeO_2 target: 1. Outer quartz tube (fixed). 2. Inner quartz tube (movable). 3. Platinum support with TeO_2 . 4. Induction coil. 5. Pt tube $\phi = 22\text{mm}$. 6. Thermo couple. 7. 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 $\text{TeO}_2 + 2\text{XAl}_2\text{O}_3$ targets by the dry distillation method using a induction furnace. Furnace temperature = $760 \pm 5^\circ\text{C}$. Diffusion time = 2min. Oxygen flow rate = 30-40ml/min.

	TARGETS			
	Pure TeO_2		$\text{TeO}_2 + 2\% \text{Al}_2\text{O}_3$	
	Target 1	Target 2	Target 1	Target 2
Release of radioiodine from the target (%)	92.1 $\pm$ 2.9	97.1 $\pm$ 2.0	50.7 $\pm$ 2.2	47.2 $\pm$ 4.4
Radioiodine collected in .01 NaOH solution(%)	73.2 $\pm$ 8.2	73.2 $\pm$ 8.0	40.1 $\pm$ 6.3	38.9 $\pm$ 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 10 μA 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 radiiodine collected in 0.01N NaOH solution was 100% iodide.

REFERENCES

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