Journal of Labelled Compounds and Radiopharmaceuticals
J Label Compd Radiopharm 2007; **50**: 511–512.
Published online in Wiley InterScience
(www.interscience.wiley.com). DOI: 10.1002/jlcr.1230

JLCR

Short Research Article

Optimization studies on the production of high-purity ^{124}I using (p,2n) reaction†

JAE HONG KIM[1], JI SUB LEE[1], TAE SUP LEE[1,2], HYUN PARK[1] and KWON SOO CHUN[1,*]

[1]Radiopharmaceuticals Laboratory, Korea Institute of Radiological and Medical Sciences (KIRAMS), 215-4 Gongneung-Dong, Nowon-Gu, Seoul 139-706, Korea
[2]Nuclear Medicine Laboratory, Korea Institute of Radiological and Medical Sciences (KIRAMS), 215-4 Gongneung-Dong, Nowon-Gu, Seoul 139-706, Korea

Received 25 June 2006; Revised 14 December 2006; Accepted 14 December 2006

Keywords: ^{124}I production; positron emitter; dry distillation

Introduction

The objective of this study is to produce and provide cyclotron-produced radioisotopes of ^{124}I radionuclide (EC(75%), β^+(25%), half-life (4.2 d)) for nuclear imaging research. The decay characteristics and half-lives have made ^{124}I for a diagnostic PET imaging agent.[1] The positron emitting radioisotopes ^{124}I are produced by the ^{125}Te(p,2n)^{124}I reaction with 22 MeV protons irradiated on a TeO_2 target followed by dry distillation to extract carrier free iodine using a quartz apparatus. Highly enriched $^{125}TeO_2$ (98.5%, 0.5 mg/cm^2) melted on a Pt-backing plate is irradiated in a 4π water-cooled target system with 17 μA beam of protons. During three hours of irradiation to the 45° inclined target, the loss of target material is negligible (<0.1%). After irradiation, the irradiated target is introduced into a quartz tube mounted horizontally in a cylindrical mini-oven, which are heated at 760°C. The carrier free ^{124}I is trapped in a vial filled with NaOH solution (300 μl, 0.01 M) at ice temperature using a stream of oxygen (flow rate 50–80 ml/min). The typical batch yield of ^{124}I was 2.8 mCi/μAh and an isotopic impurity of the less than 1% of ^{123}I at the end of beam (EOB) is determined. ^{124}I is routinely produced about several hundred millicuries at a batch and has applied to taking images of Anti-Fas medicated hepatic apoptosis using Annexin V labelled with ^{124}I.

Results and discussion

Using a 4π solid target as shown in Figure 1 (left), the positron emitter of ^{124}I radionuclide is produced by utilizing MC50 proton cyclotron. The target is prepared by melting of highly enriched $^{125}TeO_2$ (98.5%, 0.5 mg/cm^2) on a Pt-backing plate. To maximize the yield of desired products and minimize the level of radionuclidic impurities, incident energy of proton beam should be optimized in the high cross-section ranges for (p,2n) nuclear reaction. In this study, the main three excitation functions for the ^{125}Te(p,n)^{125}I, ^{125}Te(p,2n)^{124}I, and ^{125}Te(p,3n)^{123}I reactions are considered in the energy ranges of 5–40 MeV. Since the three reactions are overlapped each other, the optimized energy for the ^{124}I production is to be selected in the ranges below 22 MeV and above 14 MeV in order to avoiding the production of ^{123}I and ^{125}I impurities. In order to take full benefit of the cross section, the layer thickness of TeO_2 layer is to be about 400 μm (22 MeV → 14 MeV). The production of ^{126}I was estimated into 0.9% theoretically. In the case of irradiating protons with the beam energy of lower than 22 MeV, ^{123}I radionuclide will not be produced. The radionuclidic purity of ^{124}I is achieved as high as 99.8%, which is enhanced from that of 65.0% after reducing the proton energy from 28–22 MeV. The irradiated target is transported to a quartz tube mounted horizontally in a cylindrical mini-oven, which were heated at 760°C (right in Figure 1). Flowing a stream of

*Correspondence to: Kwon Soo Chun, Radiopharmaceuticals Laboratory, Korea Institute of Radiological and Medical Sciences (KIRAMS), 215-4 Gongneung-Dong, Nowon-Gu, Seoul 139-706, Korea.
E-mail: kschun@kcch.re.kr
†Proceedings of the Ninth International Symposium on the Synthesis and Applications of Isotopically Labelled Compounds, Edinburgh, 16–20 July 2006.

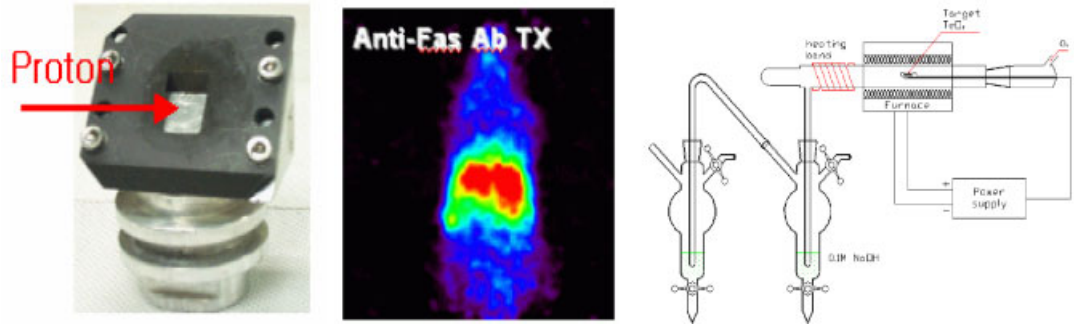

Figure 1 (Left) Schematic diagram of a 4∂ target. The target inclined 45° with respect to the direction of the incident beam. Cooling water flows both front and back faces of the target. (Middle) Anti-Fas mediated hepatic apoptosis image using Annexin V labelled with ^{124}I. (Right) Schematic diagram of ^{124}I a dry extraction system. Figure available in colour online at www.interscience.wiley.com

oxygen (flow rate 50–80 ml/min), the evaporated ^{124}I (MP 452°C) is trapped in a vial filled with NaOH solution (300 μl, 0.01 M) at ice temperature. The typical batch yield of ^{124}I was 2.8 mCi/μAh and an isotopic impurity of the less than 1% of ^{123}I (Eγ=159 keV) at the end of beam (EOB) is determined. ^{124}I is routinely produced for several months and has applied to taking images of Anti-Fas mediated hepatic apoptosis using Annexin V labelled with ^{124}I (see middle in Figure 1).

Acknowledgements

This study was supported by the Korea Science and Engineering Foundation (KOSEF) and Ministry of Science and Technology (MOST), Republic of Korea, through its National Nuclear Technology Program.

REFERENCE

1. Qaim SM. Nuclear data for medical applications: an overview. *Radiochim Acta* 2001; **89**: 189–196.

DOI: 10.1002.jlcr