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CARRIER-FREE RADIOISOTOPES FROM CYCLOTRON TARGETS

XXI. PREPARATION AND ISOLATION OF $Tl^{200,201,202}$ FROM MERCURY

Jeanne D. Gile, Warren M. Garrison, and Joseph G. Hamilton

July 16, 1951

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XXI. PREPARATION AND ISOLATION OF $Tl^{200,201,202}$ FROM MERCURY*

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This paper reports a procedure used in isolating radio-thallium in the carrier-free state from a mercury target which had been bombarded with 19-Mev deuterons in the 60-inch cyclotron at Crocker Laboratory. At this energy deuteron bombardment of mercury produces(1) $Tl^{200,201,202}$ by the nuclear reactions $Hg^{199}(d,n)Tl^{200}$, $Hg^{200}(d,2n)Tl^{200}$, $Hg^{200}(d,n)Tl^{201}$, $Hg^{201}(d,2n)Tl^{201}$, $Hg^{201}(d,n)Tl^{202}$, and $Hg^{202}(d,2n)Tl^{202}$. Other shorter-lived radioisotopes of thallium, notably the 7-hour Tl^{199}, were allowed to decay out prior to chemical separation.

The target chamber(2) was made from a 100 ml pyrex flask and had a concave glass window approximately 4 cm in diameter and 0.15 mm in thickness with a total volume of 30 ml. The target flask was connected to a small reflux condenser and the flask was cooled by a stream of air during bombardment. The target was filled with liquid mercury(3) and bombarded with 19-Mev deuterons for a total of 30 μa-hr. at an average beam intensity of 3.5 μa. After removal of the mercury from the target, it was found that the radio-thallium had deposited quantitatively on the walls of the glass flask. The mercury was discarded and the flask was washed twice with 16 N HNO_3. The HNO_3 solution which contained

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(1) G. T. Seaborg and I. Perlman, Rev. Mod. Phys., 20,585, (1948).

(2) W. M. Garrison, H. R. Haymond, and J. G. Hamilton, Carrier-Free Radioisotopes from Cyclotron Targets; Preparation of F^{18} from Water. (Unpublished data).

(3) The mercury was C.P., tripple distilled, thallium-free.

the radio-thallium, and traces of mercury which had adhered to the glass surface, was evaporated to 2 ml, treated with excess 12 N HCl to destroy the HNO_3, and diluted to approximately 3 N HCl. This solution was then extracted with ethyl ether which had previously been equilibrated with 3 N HCl. Over 95 per cent of the carrier-free radio-thallium was removed from the aqueous phase. The ether fraction was washed with water to remove HCl and the activity was quantitatively retained in the organic phase. Fifty mg of NaCl was added to the ether solution and the mixture evaporated to dryness on a steam bath. The carrier-free $Tl^{200,201,202}$ redissolved quantitatively in 5 ml of distilled water and was adjusted to pH 6 to give an isotonic saline solution for biological investigation.

The radio-thallium was identified by half-life determinations, absorption measurements, and by a chemical separation procedure in which Au, Hg, and Tl were used as carriers. The decay curve was followed for 60 days and showed three periods: 27-hour Tl^{200}, 72-hour Tl^{201}, and 11.8-day Tl^{202}. Eleven days after bombardment the activity showed only the 11.8-day period. The aluminum absorption measurements four days after bombardment showed an end-point of $\sim$130 mg/cm^2.(4) Lead absorption measurements showed the 0.4-Mev gamma-ray assigned to Tl^{202}.(1) Milligram amounts of Au, Hg, and Tl were added to an aliquot from the preparation and 98 per cent of the activity was recovered in the Tl fraction, using a standard chemical procedure for isolation of the Tl.(5)

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(4) R. S. Krishnan and E. A. Nohum, Proc. Comb. Phil. Soc., 36, 490, (1940).

(5) A. A. Noyes and W. C. Brag, A System of Quantitative Analysis For The Rare Elements. The MacMillan Company, New York, (1927).