

Lawrence Berkeley National Laboratory

Recent Work

Title

Carrier-Free Radioisotopes from Cyclotron Targets IV. Preparation and Isolation of Mn54 and Co56, 57, 58

Permalink

<https://escholarship.org/uc/item/7st5z5pt>

Authors

Maxwell, R.D.
Gile, J.D.
Garrison, W.M.
et al.

Publication Date

1949-08-17

UNIVERSITY OF
CALIFORNIA

*Radiation
Laboratory*

TWO-WEEK LOAN COPY

*This is a Library Circulating Copy
which may be borrowed for two weeks.
For a personal retention copy, call
Tech. Info. Division, Ext. 5545*

BERKELEY, CALIFORNIA



DISCLAIMER

This document was prepared as an account of work sponsored by the United States Government. While this document is believed to contain correct information, neither the United States Government nor any agency thereof, nor the Regents of the University of California, nor any of their employees, makes any warranty, express or implied, or assumes any legal responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by its trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof, or the Regents of the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof or the Regents of the University of California.

UNCLASSIFIED
UNIVERSITY OF CALIFORNIA

Radiation Laboratory

Contract No. W-7405-eng-48

CARRIER-FREE RADIOISOTOPES FROM CYCLOTRON TARGETS
IV. PREPARATION AND ISOLATION OF Mn⁵⁴ AND Co^{56,57,58}

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

August 17, 1949

Berkeley, California

CARRIER-FREE RADIOISOTOPES FROM CYCLOTRON TARGETS
 IV. PREPARATION AND ISOLATION OF Mn^{54} AND $Co^{56,57,58}$ ¹

Roy D. Maxwell², Jeanne D. Gile, Warren M. Garrison, and Joseph G. Hamilton.

Crocker Laboratory, Radiation Laboratory, and Divisions of Medical Physics, Experimental Medicine, and Radiology; University of California, Berkeley, and San Francisco.

Carrier free radioisotopes of manganese and cobalt of useful half-life may be obtained only by cyclotron bombardment. The present paper describes chemical methods of isolating Mn^{54} and $Co^{56,57,58}$ from an iron target bombarded with 19 Mev deuterons in the 60-inch cyclotron at the Crocker Laboratory. At this energy Mn^{54} and $Co^{56,57,58}$ are produced in a thick target by the nuclear reactions³: $Fe^{56}(d,\alpha)Mn^{54}$, $Fe^{56}(d,2n)Co^{56}$, $Fe^{56}(d,n)Co^{57}$, $Fe^{57}(d,2n)Co^{57}$, $Fe^{57}(d,n)Co^{58}$. Other possible shorter-lived radioisotopes of manganese and cobalt were allowed to decay out prior to the separation.

The iron⁴ target was silver soldered to a water cooled copper probe and bombarded for 2000 μ a-hr at an average beam intensity of approximately 50 μ a. The bombarded surface was dissolved off in 6 N HCl.

All but approximately 10 mg. of the target iron was extracted with ether. The aqueous phase was neutralized with NH_4OH , a few drops of bromine were added, and $Fe(OH)_3$ was precipitated with 15 N NH_4OH in excess. Under these conditions carrier free radio manganese was quantitatively carried, presumably in the

- (1) This document is based on work performed under the auspices of the Atomic Energy Commission.
- (2) Lieutenant Colonel, U. S. Army, now stationed at Walter Reed Hospital, Washington, D. C.
- (3) G. T. Seaborg and I. Perlman, Rev. Mod. Phys. 20, 585 (1948).
- (4) The iron was obtained from Johnson Mathey & Co. Manganese and cobalt were not detected by spectrographic analysis.

quadrivalent state. Over 98% of the radio cobalt remained in the supernatant⁵. The $\text{Fe}(\text{OH})_3$ plus radio-manganese was reprecipitated twice with $\text{Br}_2\text{-NH}_4\text{OH}$ in the presence of 1 mg of cobalt hold-back carrier. Three additional precipitations removed traces of carrier cobalt. The $\text{Fe}(\text{OH})_3$ was washed, dissolved in 6 N HCl and iron was extracted with ether. The solution of carrier-free radio-manganese in 6 N HCl was evaporated to dryness after the addition of 5 ml of isotonic saline solution. Addition of 5 ml of distilled water gave an isotonic solution of carrier-free Mn^{54} for subsequent biological experiments.

The activity was identified by the 310-day half-life and by the 0.85 Mev gamma ray reported⁶ for Mn^{54} . As further identification, a small amount of activity added to a solution containing carrier amounts of Mn, Fe and Co was quantitatively recovered in the Mn fraction from a chemical separation.⁷

The supernatant from the first $\text{Fe}(\text{OH})_3$ precipitation containing carrier-free radio-cobalt, NH_4Cl and NH_4OH was evaporated to dryness and treated with 16 N HNO_3 to destroy ammonium salts. 12 N HCl was added to remove HNO_3 and the solution was evaporated to dryness on 40 mg of NaCl. The activity dissolved quantitatively in 5 ml of water.

The radio-cobalt showed the 72-day half-life of $\text{Co}^{56,58}$; after 200 days the longer period of Co^{57} was apparent. In addition, chemical separation with added Mn, Fe and Co carriers identified the activity as cobalt. Mass absorption measurements showed the 1.2 Mev beta reported⁸ for Co^{56} . The combined gamma radiation had a half-thickness of approximately 10 gm/cm² in lead.

We are grateful to Professor G. T. Seaborg for reading this manuscript, to the staff of the 60-inch cyclotron for bombardments, and to Mrs. Alberta Mozley and Mrs. Helen Haydon for technical assistance.

(5) E. G. Ardagh and G. R. Bongard, J. Ind. Eng. Chem. 16, 297 (1924).

(6) J. J. Livingood and G. T. Seaborg, Phys. Rev. 54 391 (1938)

(7) F.P.Treadwell and W.T.Hall, Analytical Chemistry, Vol. I, John Wiley & Sons, NY, 1942

(8) J. J. Livingood and G. T. Seaborg, Phys. Rev. 60, 913 (1941).

August 1949