Title

CARRIER-FREE RADIOISOTOPES FROM CYCLOTRON TARGETS IX. PREPARATION AND ISOLATION OF Re183,184 FROM TANTALUM

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CARRIER-FREE RADIOISOTOPES FROM CYCLOTRON TARGETS IX. PREPARATION AND ISOLATION OF $Re^{183,184}$ FROM TANTALUM*

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

April 10, 1950

Crocker Laboratory, Radiation Laboratory, and Divisions of Medical Physics, Experimental Medicine, and Radiology
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The long-lived radioisotopes[1] of rhenium, $Re^{183,184}$, were produced by bombardment of tantalum with 40 Mev alpha particles in the 60-inch cyclotron at Crocker Laboratory. At this energy, radioactive rhenium is produced[2] by the nuclear reactions: $Ta^{181}(\alpha,n)Re^{184}$, $Ta^{181}(\alpha,2n)Re^{183}$, $Ta^{181}(\alpha,3n)Re^{182}$. 46-day Hf^{181} is produced concurrently by (n,p) reaction. The short-lived[2] activities (Re^{182} and isomer of Re^{184}) were allowed to decay out prior to the chemical separation reported here.

A C.P. tantalum metal target (1/4" Ta strip, silver-soldered to a water-cooled copper plate) was bombarded for a total of 80 μa-hr. at a maximum beam intensity of 10 μa. The bombarded surface (approximately 0.5 g) was removed by milling and dissolved in a minimum volume of 16 N HNO_3 containing 10% HF by volume. The HF was removed by evaporation and the bulk of the tantalic acid was separated by centrifugation with repeated reduction in volume of the HNO_3 solution. The carrier-free $Re^{183,184}$ as perrhenate, was quantitatively retained in supernatant. The HNO_3 solution was evaporated almost to dryness and transferred to an all-glass[3] distilling flask with 15 ml of 36 N H_2SO_4· 9 N HBr was added dropwise while a stream of CO_2 was bubbled through the H_2SO_4 solution at 240°C. The distillate, containing the carrier-free radio-rhenium, HBr, Br_2 and a small amount of H_2SO_4, was collected in a trap of 16 N HNO_3 cooled with ice.

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

[2] G. Wilkinson and H. G. Hicks, Phys. Rev. 77, 314 (1950)

[3] J. A. Scherrer, J. Research Natl. Bur. Standards 21, 95 (1938)

This solution was evaporated on a steam bath to the 1 ml volume of H_2SO_4 carried over in the distillation. The H_2SO_4 was diluted to 3 N and the $Re^{183,184}$ was co-precipitated with 2 mg. of Cu^{++} by the addition of H_2S. The CuS was dissolved in a minimum volume of dilute HNO_3. This solution was evaporated to dryness, diluted with water to 25 ml; heated to 60°C. and neutralized with a stoichiometric amount of NaOH. Under these conditions CuO is precipitated without scavenging the carrier free radio-rhenium. The supernatant was evaporated to dryness on 20 mg. of added NaCl and re-dissolved quantitatively with the addition of 2 ml of water to give an isotonic saline solution of carrier-free Re^{183} for subsequent biological investigation.

The activity was identified by chemical separation with carrier, by absorption measurements and by half-life determinations. A tracer amount of activity added to a solution containing carrier amounts of Ta, Hf and Re was quantitatively recovered in the Re fraction following chemical separation[4]. The radiation characteristics were obtained by aluminum and lead absorption measurements and showed the 0.2 and 0.8 Mev beta particles and 1.0 Mev gamma ray previously reported[2] for Re^{184}. 14 days after bombardment the activity showed an approximately 60-day half-life which began to lengthen perceptibly after 6 weeks. The difference between this value and the 52-day period previously found[2] for Re^{184} is presumably due to the 240-day Re^{183} which is produced concurrently.

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[4] F. P. Treadwell and W. T. Hall, Analytical Chemistry Vol. II, John Wiley & Sons, New York 1942.