Decay of V^{49}

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(Received September 29, 1954)

V^{49}, produced by proton bombardment of chromium, has been found to be a pure K-capture nuclide with less than 0.05 percent β^+ branching or gamma radiation; the half-life is 334±20 days.

VANADIUM-49 is listed in the literature[1] as a K-capture nuclide of 600-day half-life with converted gamma rays of energy 0.12 Mev and 0.08 Mev. The basis of this assignment is work done by Cork *et al.*,[2] who observed such an activity in vanadium irradiated in the ORNL graphite reactor. The presumption was that the activity observed was formed by an $(n,2n)$ reaction on the 0.25 percent abundant V^{50}. No chemical separation was performed. It was thus of interest to verify the decay of V^{49}.

A chromium target was irradiated with 22-Mev protons in the ORNL 86-in. cyclotron. Vanadium-49 could be produced by the reaction $Cr^{50}(p,2p)V^{49}$, $Cr^{52}(p,\alpha)V^{49}$ and $Cr^{50}(p,2n)Mn^{49}$ with decay to V^{49}. In addition, some vanadium-48 (16-day) might be expected from a $Cr^{52}(p,\alpha n)V^{48}$ reaction. The chromium target after irradiation also contained Cr^{51}(27.8-day), Mn^{52}-(6-day), and Mn^{54}(310-day). It was dissolved in hydrochloric acid and allowed to stand five months to permit the V^{48} to decay. In addition, this cooling period reduced the level of radioactivity in the sample, since the manganese-52 activity was lowered to a non-detectable level, and the Cr^{51}(27.8-day) was reduced to about one-fortieth of its original value.

A portion of the target solution (containing 1 mg of vanadium carrier and 10 mg of manganese holdback carrier) was evaporated to near dryness, made to 10 ml in volume with 4 percent sulfuric acid, cooled in ice, and a cupferron precipitation of the vanadium was made by addition of a few drops of 6 percent cupferron solution.[3]

The vanadium precipitate was centrifuged, washed, and redissolved in sulfuric acid. After addition of chromium and manganese holdback carrier, the precipitation was repeated.

After three cycles of the above procedure, the vanadium cupferron precipitate was filtered, washed, and ignited to V_2O_5.

By use of a calibrated argon-methane filled proportional counter spectrometer equipped with linear amplifier and differential and integral pulse-height selector, the x-ray peak resulting from the K capture in V^{49} was observed. The energy calibration was made using x-rays from Fe^{55}, Mn^{54}, and Cr^{51}. The x-rays from the vanadium source were of the energy calculated for titanium x-rays. The total number of K-capture processes occurring in the sample ($\sim 10^7$ dis/min) was estimated from a previous calibration of the counter. This V_2O_5 source was then examined using a 3 inch×3 inch NaI(Tl) gamma-ray spectrometer. No photopeaks corresponding to gamma rays of any energy above 30 kev were observed. It is thus concluded that the upper limit of β^+ branching is about 0.05 percent; the same limit is placed on any γ rays of energy <0.51-Mev. Absorption data in aluminum obtained with a helium-filled Geiger-Mueller counter (window thickness 2.3 mg/cm^2) failed to reveal any conversion electrons or beta particles.

Portions of V_2O_5 from two different separations were used to make decay measurements. The decay was followed on a windowless methane-flow beta proportional counter. The data for eight weeks, when analyzed by "least squares", indicate the half-life of V^{49} to be 334±20 days.

Another target which had cooled only one month was processed through the chemical procedure. Vanadium-48 was found in addition to the vanadium-49. The relative amounts were roughly in the ratio 300 to 1 in favor of the V^{49}. No other activity was found to carry through with the vanadium precipitate.

The author is indebted to Farno Green, who suggested the problem and supervised the irradiations, and to A. R. Brosi who assisted in the decay measurements.

[1] Hollander, Perlman, and Seaborg, Revs. Modern Phys. **25**, 469 (1953).
[2] Cork, Keller, and Stoddard, Phys. Rev. **76**, 575 (1949).
[3] G. E. F. Lundell and J. I. Hoffman, *Outlines of Methods of Chemical Analysis* (John Wiley and Sons, Inc., New York, 1938), p. 117.