

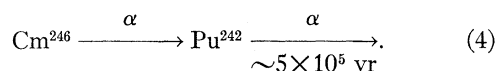
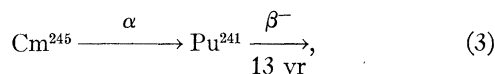
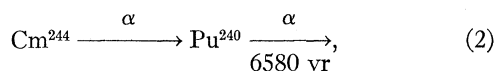
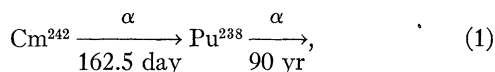
Alpha Half-Lives of Cm²⁴⁴, Cm²⁴⁵, and Cm²⁴⁶

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The alpha half-lives of Cm²⁴⁴, Cm²⁴⁵, and Cm²⁴⁶ measured from mass spectrometric analyses of curium and its plutonium daughters are 18.4±0.5 years (weighted average of present results and those reported in reference 1), 1.15±0.5×10⁴ years, and 4.0±0.6×10³ years, respectively.

THE alpha half-lives of Cm²⁴⁴, Cm²⁴⁵, and Cm²⁴⁶ have been determined by a technique which depends on the growth of the plutonium daughters from a curium sample of known isotopic composition. The decays involved in this experiment are



The curium, produced by the irradiation of plutonium 239 in the Materials Testing Reactor (MTR), was initially chemically separated from plutonium by anion and cation resin columns.¹ After a two week interval, the plutonium daughters were separated from their curium parents. This plutonium sample was analyzed in a 12-inch, 60° mass spectrometer with multiple filament surface ionization source.² The possibility of nonradiogenic plutonium contamination of the curium at the beginning of the first growth period necessitated a second growth period of the plutonium daughters and their separation from the curium. The isotopic composition of this second plutonium sample measured in the same mass spectrometer is given in column 4 of Table I. Column 2 of Table I gives the mole percent of each curium isotope in the parent curium sample. Since the time necessary to complete the experiments was short in comparison to the half-lives involved (a correction was made in the mole percent of Cm²⁴² due

to decay) the following type expression can be written for the unknown half-lives.

$$T_{\frac{1}{2}}(\text{Cm}^{244}) = T_{\frac{1}{2}}(\text{Cm}^{242}) \frac{\text{mole percent Cm}^{244}}{\text{mole percent Cm}^{242}} \times \frac{\text{mole percent Pu}^{238}}{\text{mole percent Pu}^{240}}. \quad (5)$$

Substituting in Eq. (5), the values obtained from the mass spectrometer for the curium and plutonium isotopic ratios and the value of 162.5 days³ for the Cm²⁴² half-life gives a value of 17.9±0.5 years for the Cm²⁴⁴ half-life. Since the Cm²⁴² isotopic content depends on a decay correction, the alpha half-lives of Cm²⁴⁵ and

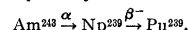
TABLE I. Mass spectrometric analyses in mole percent of a curium sample and its plutonium daughters.

Curium isotope	Mole percent ^a	Plutonium isotope	Mole percent
⁹⁶ Cm ²⁴²	1.52 ± 0.04	⁹⁴ Pu ²³⁸	38.9 ± 0.3
⁹⁶ Cm ²⁴³	... ^b	⁹⁴ Pu ²³⁹ ^c	0.132 ± 0.005
⁹⁶ Cm ²⁴⁴	95.83 ± 0.07	⁹⁴ Pu ²⁴⁰	61.0 ± 0.3
⁹⁶ Cm ²⁴⁵	1.27 ± 0.04	⁹⁴ Pu ²⁴¹	0.0013 ± 0.0005
⁹⁶ Cm ²⁴⁶	1.36 ± 0.04	⁹⁴ Pu ²⁴²	0.0040 ± 0.0005
⁹⁶ Cm ²⁴⁷	0.016 ± 0.002		

^a These data are the same as those published previously (reference 1) with a correction due to the Cm²⁴² decay.

^b Cm²⁴³ was not determined due to Am²⁴³ impurity in the curium.

^c The presence of Pu²³⁹ is partially accounted for by the reactions



Cm²⁴⁶ are calculated relative to the alpha half-life of 18.4 years for Cm²⁴⁴ (this is a weighted average of the 17.9 years and earlier values reported in reference 1). Using an equation similar to Eq. (5), the calculated half-lives of Cm²⁴⁵ and Cm²⁴⁶ are 1.15±0.5×10⁴ years and 4.0±0.6×10³ years, respectively.

The amount of Pu²⁴² formed by electron capture of Am²⁴² [see footnotes (b) and (c) of Table I; this americium is 99.95 mole percent Am²⁴³] is negligible compared to that formed by Cm²⁴⁶ alpha decay.

³ Hanna, Harvey, and Moss, Phys. Rev. 78, 617 (1950).

¹ Stevens, Studier, Fields, Mech, Sellers, Friedman, Diamond, and Huizenga, Phys. Rev. 94, 1083 (1954).

² M. G. Inghram and W. A. Chupka, Rev. Sci. Instr. 24, 518 (1953).