

= Curium =

Curium is a transuranic radioactive chemical element with symbol Cm and atomic number 96 . This element of the actinide series was named after Marie and Pierre Curie ? both were known for their research on radioactivity . Curium was first intentionally produced and identified in July 1944 by the group of Glenn T. Seaborg at the University of California , Berkeley . The discovery was kept secret and only released to the public in November 1945 . Most curium is produced by bombarding uranium or plutonium with neutrons in nuclear reactors ? one tonne of spent nuclear fuel contains about 20 grams of curium .

Curium is a hard , dense , silvery metal with a relatively high melting point and boiling point for an actinide . Whereas it is paramagnetic at ambient conditions , it becomes antiferromagnetic upon cooling , and other magnetic transitions are also observed for many curium compounds . In compounds , curium usually exhibits valence + 3 and sometimes + 4 , and the + 3 valence is predominant in solutions . Curium readily oxidizes , and its oxides are a dominant form of this element . It forms strongly fluorescent complexes with various organic compounds , but there is no evidence of its incorporation into bacteria and archaea . When introduced into the human body , curium accumulates in the bones , lungs and liver , where it promotes cancer .

All known isotopes of curium are radioactive and have a small critical mass for a sustained nuclear chain reaction . They predominantly emit ?  $\alpha$ - $\alpha$  particles , and the heat released in this process can potentially produce electricity in radioisotope thermoelectric generators . This application is hindered by the scarcity , high cost and radioactivity of curium isotopes . Curium is used in production of heavier actinides and of the  $^{238}\text{Pu}$  radionuclide for power sources in artificial pacemakers . It served as the ?  $\alpha$ - $\alpha$  source in the alpha particle X  $\alpha$ - $\alpha$  ray spectrometers installed on several space probes , including the Sojourner , Spirit , Opportunity and Curiosity Mars rovers and the Philae lander on comet 67P / Churyumov  $\alpha$ - $\alpha$  Gerasimenko , to analyze the composition and structure of the surface .

= = History = =

Although curium had likely been produced in previous nuclear experiments , it was first intentionally synthesized , isolated and identified in 1944 , at the University of California , Berkeley , by Glenn T. Seaborg , Ralph A. James , and Albert Ghiorso . In their experiments , they used a 60  $\alpha$ - $\alpha$  inch ( 150 cm ) cyclotron .

Curium was chemically identified at the Metallurgical Laboratory ( now Argonne National Laboratory ) at the University of Chicago . It was the third transuranium element to be discovered even though it is the fourth in the series ? the lighter element americium was unknown at the time .

The sample was prepared as follows : first plutonium nitrate solution was coated on a platinum foil of about 0  $\alpha$ . $\alpha$  5 cm<sup>2</sup> area , the solution was evaporated and the residue was converted into plutonium ( IV ) oxide (  $\text{PuO}_2$  ) by annealing . Following cyclotron irradiation of the oxide , the coating was dissolved with nitric acid and then precipitated as the hydroxide using concentrated aqueous ammonia solution . The residue was dissolved in perchloric acid , and further separation was carried out by ion exchange to yield a certain isotope of curium . The separation of curium and americium was so painstaking that the Berkeley group initially called those elements pandemonium ( from Greek for all demons or hell ) and delirium ( from Latin for madness ) .

The curium  $\alpha$ - $\alpha$  242 isotope was produced in July ? August 1944 by bombarding  $^{239}\text{Pu}$  with ?  $\alpha$ - $\alpha$  particles to produce curium with the release of a neutron :

<formula>

Curium  $\alpha$ - $\alpha$  242 was unambiguously identified by the characteristic energy of the ?  $\alpha$ - $\alpha$  particles emitted during the decay :

<formula>

The half  $\alpha$ - $\alpha$  life of this alpha decay was first measured as 150 days and then corrected to 162  $\alpha$ . $\alpha$  8 days .

Another isotope  $^{240}\text{Cm}$  was produced in a similar reaction in March 1945 :

<formula>

The half life of the  $^{240}\text{Cm}$  ? decay was correctly determined as 26.7 days .

The discovery of curium , as well as americium , in 1944 was closely related to the Manhattan Project , the results were confidential and declassified only in 1945 . Seaborg leaked the synthesis of the elements 95 and 96 on the U.S. radio show for children , the Quiz Kids , five days before the official presentation at an American Chemical Society meeting on November 11 , 1945 , when one of the listeners asked whether any new transuranium element beside plutonium and neptunium had been discovered during the war . The discovery of curium (  $^{242}\text{Cm}$  and  $^{240}\text{Cm}$  ) , their production and compounds were later patented listing only Seaborg as the inventor .

The new element was named after Marie Skłodowska Curie and her husband Pierre Curie who are noted for discovering radium and for their work in radioactivity . It followed the example of gadolinium , a lanthanide element above curium in the periodic table , which was named after the explorer of the rare earth elements Johan Gadolin :

" As the name for the element of atomic number 96 we should like to propose " curium " , with symbol Cm . The evidence indicates that element 96 contains seven 5f electrons and is thus analogous to the element gadolinium with its seven 4f electrons in the regular rare earth series . On this base element 96 is named after the Curies in a manner analogous to the naming of gadolinium , in which the chemist Gadolin was honored . "

The first curium samples were barely visible , and were identified by their radioactivity . Louis Werner and Isadore Perlman created the first substantial sample of 30  $\mu\text{g}$  curium  $^{242}\text{Cm}$  hydroxide at the University of California in 1947 by bombarding americium  $^{241}\text{Am}$  with neutrons . Macroscopic amounts of curium ( III ) fluoride were obtained in 1950 by W. W. T. Crane , J. C. Wallmann and B. B. Cunningham . Its magnetic susceptibility was very close to that of  $\text{GdF}_3$  providing the first experimental evidence for the + 3 valence of curium in its compounds . Curium metal was produced only in 1951 by reduction of  $\text{CmF}_3$  with barium .

= = Characteristics = =

= = = Physical = = =