

Plutonium

Pu

General Information

Discovery

Plutonium was discovered by G.T. Seaborg, A.C. Wahl and J. W. Kennedy in 1940 in California, USA.

Appearance

Plutonium is a radioactive silvery metal that tarnishes in air to give an oxide coating with yellow tinge.

Source

The greatest source of plutonium - and one that produces 20,000 kilograms every year - is the irradiation of uranium in nuclear reactors. This produces the isotope ^{239}Pu , with a half-life of 24,400 years.

Uses

Plutonium was used in several of the first atomic bombs, and is still used in bomb-making. The complete detonation of a kilogram of plutonium produces an explosion equivalent to over 10,000 tonnes of chemical explosive. Plutonium is also a key material in the development of nuclear power. It has been used as a compact energy source on space missions such as the Apollo lunar missions.

Biological Role

Plutonium has no known biological role. It is extremely toxic due to its radioactivity.

General Information

Plutonium is attacked by oxygen, steam and acids, but not by alkalis. The metal is warm to the touch because of the energy given off in alpha decay, and a large piece of the metal can boil water. Plutonium forms compounds with oxygen, the halides, carbon, nitrogen and silicon.

Physical Information

Atomic Number	94
Relative Atomic Mass ($^{12}\text{C}=12.000$)	244 (radioactive)
Melting Point/K	914
Boiling Point/K	3505
Density/kg m ⁻³	19840 (298K)
Ground State Electron Configuration	[Rn]5f ⁶ 7s ²

Key Isotopes

Nuclide	²³⁹ Pu	²⁴² Pu	²⁴⁴ Pu
Atomic mass	239.05	242.06	244.06
Natural abundance	0%	0%	0%
Half-life	24400 yrs	3.79x10 ⁵ yrs	8.2x10 ⁷ yrs

Ionisation Energies/kJ mol⁻¹

M - M ⁺	585
M ⁺ - M ²⁺	
M ²⁺ - M ³⁺	
M ³⁺ - M ⁴⁺	
M ⁴⁺ - M ⁵⁺	
M ⁵⁺ - M ⁶⁺	
M ⁶⁺ - M ⁷⁺	
M ⁷⁺ - M ⁸⁺	
M ⁸⁺ - M ⁹⁺	
M ⁹⁺ - M ¹⁰⁺	

Other Information

Enthalpy of Fusion/kJ mol ⁻¹	2.8
Enthalpy of Vaporisation/kJ mol ⁻¹	343.5

Oxidation States

Main	Pu ⁴⁺
Others	Pu ²⁺ , Pu ³⁺ , Pu ⁵⁺ , Pu ⁶⁺ , Pu ⁷⁺