

General Information

Discovery

Cerium was discovered by J.J. Berzelius and W. Hisinger in 1803 in Vestmanland, Sweden. It was first isolated by Hillebrand and Norton in 1875, in Washington, USA.

Appearance

Cerium is an iron-grey, lustrous, malleable metal. It oxidises easily at room temperature.

Source

Cerium is the most abundant of the lanthanides and is found in a number of minerals, chiefly bastnaesite (found in Southern California) and monazite (found in India and Brazil). Metallic cerium can be prepared by two methods. The first is the metallothermic reduction of cerium(III) fluoride with calcium, used to produce high-purity cerium. The second is the electrolysis of molten cerium(III) chloride.

Uses

Cerium is the major component of mischmetall alloy (just under 50%), which is used extensively in the manufacture of pyrophoric alloys for products such as cigarette lighters. Cerium(III) oxide is used as a catalyst in self-cleaning ovens, incorporated into oven walls to prevent the build-up of cooking residues. It is also a promising new petroleum-cracking catalyst.

Biological Role

Cerium has no known biological role.

General Information

Cerium tarnishes in air and reacts rapidly with water, especially when hot. It burns when heated. It is attacked by alkali solutions and all acids. The pure metal is likely to ignite when scratched with a knife.

Cerium is interesting because of its variable electronic structure. The energy of the inner 4f level is nearly the same as that of the 6s level, and this gives rise to variable occupancy of these two levels and subsequent variable oxidation states.

Physical Information

Atomic Number	58
Relative Atomic Mass ($^{12}\text{C}=12.000$)	140.12
Melting Point/K	1072
Boiling Point/K	3716
Density/kg m ⁻³	6773 (298K)
Ground State Electron Configuration	[Xe]4f ¹⁵ d ¹ s ²
Electron Affinity (M-M ⁻)/kJ mol ⁻¹	-50

Key Isotopes

Nuclide	¹³⁶ Ce	¹³⁸ Ce	¹³⁹ Ce	¹⁴⁰ Ce	¹⁴¹ Ce	¹⁴² Ce
Atomic mass		137.9		139.9		141.9
Natural abundance	0.19%	0.25%	0%	88.48%	0%	11.08%
Half-life	stable	stable	140 days	stable	32.5 days	stable
Nuclide	¹⁴³ Ce	¹⁴⁴ Ce				
Atomic mass						
Natural abundance	0%	0%				
Half-life	33 h	284.9 h				

Ionisation Energies/kJ mol⁻¹

M - M ⁺	527.4
M ⁺ - M ²⁺	1047
M ²⁺ - M ³⁺	1949
M ³⁺ - M ⁴⁺	3547
M ⁴⁺ - M ⁵⁺	6800
M ⁵⁺ - M ⁶⁺	8200
M ⁶⁺ - M ⁷⁺	9700
M ⁷⁺ - M ⁸⁺	11800
M ⁸⁺ - M ⁹⁺	13200
M ⁹⁺ - M ¹⁰⁺	14700

Other Information

Enthalpy of Fusion/kJ mol ⁻¹	8.87
Enthalpy of Vaporisation/kJ mol ⁻¹	398
Oxidation States	
Main	Ce ⁺³
Others	Ce ⁺⁴