

Zirconium

Zr

General Information

Discovery

Zirconium was discovered by M.H. Klaproth in 1789 in Berlin, Germany, and isolated by J.J. Berzelius in 1824 in Stockholm, Sweden.

Appearance

Zirconium is a hard, lustrous, greyish-white metal.

Source

Zirconium occurs in about 30 mineral species, the major ones being baddeleyite and zircon, found in Brazil. It is produced commercially by reduction of the chloride with magnesium.

Uses

Zirconium has very low absorption for neutrons, and is therefore useful in nuclear energy applications. More than 90% of zirconium production is used in this field, as reactors use many metres of zirconium alloy tubing.

Zirconium is exceptionally resistant to corrosion by most agents including sea water, acids and alkalis, and so is used extensively by the chemical industry where corrosive agents are in use.

With niobium, zirconium is superconductive at low temperatures and is used to make superconductive magnets.

Impure zirconium(IV) oxide is used for crucibles which will withstand heat shock, for furnace linings, and by the glass and ceramics industries.

Biological Role

Zirconium has no known biological role. It is non-toxic.

General Information

The solid metal will burn in air, but with difficulty. When finely divided, however, it ignites spontaneously.

Physical Information

Atomic Number	40
Relative Atomic Mass ($^{12}\text{C}=12.000$)	91.224
Melting Point/K	2125
Boiling Point/K	4650
Density/kg m ⁻³	6506 (293K)
Ground State Electron Configuration	[Kr]4d ² 5s ²
Electron Affinity (M-M ⁻)/kJ mol ⁻¹	-43

Key Isotopes

Nuclide	⁹⁰ Zr	⁹¹ Zr	⁹² Zr	⁹⁴ Zr	⁹⁵ Zr	⁹⁶ Zr
Atomic mass	89.90	90.91	91.90	93.91	94.91	95.91
Natural abundance	51.45%	11.32%	17.19%	17.28%	0%	2.76%
Half-life	stable	stable	stable	stable	65 days	3.6x10 ¹⁷ yrs
Nuclide	⁹⁷ Zr					
Atomic mass						
Natural abundance	0%					
Half-life	17 h					

Ionisation Energies/kJ mol⁻¹

M - M ⁺	660
M ⁺ - M ²⁺	1267
M ²⁺ - M ³⁺	2218
M ³⁺ - M ⁴⁺	3313
M ⁴⁺ - M ⁵⁺	7860
M ⁵⁺ - M ⁶⁺	9500
M ⁶⁺ - M ⁷⁺	11200
M ⁷⁺ - M ⁸⁺	13800
M ⁸⁺ - M ⁹⁺	15700
M ⁹⁺ - M ¹⁰⁺	17500

Other Information

Enthalpy of Fusion/kJ mol ⁻¹	23
Enthalpy of Vaporisation/kJ mol ⁻¹	566.7
Oxidation States	
Main	Zr ⁴⁺
Others	Zr ⁰ , Zr ⁺¹ , Zr ⁺² , Zr ⁺³