

Niobium

Nb

General Information

Discovery

Niobium was discovered by C. Hatchett in 1801 in London, in an ore sent to England more than a century before by J. Winthrop, first Governor of Connecticut.

Appearance

Niobium is shiny, white, soft and ductile, and takes on a bluish sheen when exposed to air for a long time.

Source

The main source of this element is in the mineral columbite, which can be found in Canada, Brazil, the former USSR, Nigeria and elsewhere. However, it is commercially prepared as a by-product of tin extraction.

Uses

Niobium is used as an alloying agent in carbon and alloy steels and in non-ferrous metals, as it improves the strength of the alloy. It is also used in jet engines and rockets. This element has superconductive properties and is used in superconductive magnets which retain their properties in strong magnetic fields. This type of application could be used for the large-scale generation of electricity.

Biological Role

Niobium has no known biological role.

General Information

The name niobium was adopted officially in 1950 after years of controversy. The alternative name was columbium, and some metallurgists still use this name.

Niobium resists corrosion due to an oxide film. It can be attacked by hot, concentrated acids but resists attack by fused alkalis. It starts to oxidise in air at 200K, and when processed at even moderate temperatures must be placed in a protective atmosphere.

Physical Information

Atomic Number	41
Relative Atomic Mass ($^{12}\text{C}=12.000$)	92.906
Melting Point/K	2741
Boiling Point/K	5015
Density/kg m ⁻³	8570 (293K)
Ground State Electron Configuration	[Kr]4d ⁴ 5s ¹
Electron Affinity (M-M ⁻)/kJ mol ⁻¹	-109

Key Isotopes

Nuclide	⁹³ Nb	⁹⁴ Nb
Atomic mass	92.91	93.91
Natural abundance	100%	0%
Half-life	stable	2x10 ⁴ yrs

Ionisation Energies/kJ mol⁻¹

M - M ⁺	664
M ⁺ - M ²⁺	1382
M ²⁺ - M ³⁺	2416
M ³⁺ - M ⁴⁺	3695
M ⁴⁺ - M ⁵⁺	4877
M ⁵⁺ - M ⁶⁺	9899
M ⁶⁺ - M ⁷⁺	12100
M ⁷⁺ - M ⁸⁺	
M ⁸⁺ - M ⁹⁺	
M ⁹⁺ - M ¹⁰⁺	

Other Information

Enthalpy of Fusion/kJ mol ⁻¹	27.2
Enthalpy of Vaporisation/kJ mol ⁻¹	680.19

Oxidation States

Main	Nb ⁺⁵
Others	Nb ⁻³ , Nb ⁻¹ , N ⁺¹ , Nb ⁺² , Nb ⁺³ , NB ⁺⁴