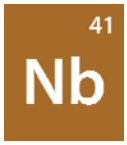
Stable Isotopes of Niobium

Isotope	Z(p)	N(n)	Atomic Mass	Natural Abundance	Nuclear Spin
Nb-93	41	52	92.906376	100%	9/2+



Niobium was discovered in 1801 by Charles Hatchett. Its name comes from the Greek name *Niobe,* meaning “daughter of Tantalus” (tantalum is closely related to niobium in the periodic table of elements). Because the niobium was discovered in an ore called *columbite*, it was known temporarily as *columbium.*

Niobium, a gray or silvery soft metal, is ductile and very malleable at room temperature and does not tarnish or oxidize at room temperature. It only reacts with oxygen and halogens when heated. It is less corrosion-resistant than tantalum is at high temperatures. Niobium is not attacked by nitric acid up to 100 °C but is vigorously attacked by the mixture of nitric and hydrofluoric acids. It is unaffected at room temperature by most acids and by *aqua regia*. It is attacked by alkaline solutions, to some extent, at all temperatures. Niobium becomes a superconductor at 9.15 °K. It is insoluble in water, hydrochloric acid, nitric acid and *aqua regia*; soluble in hydrofluoric acid; and soluble in fused alkali hydroxide.

At ordinary temperatures niobium does not react with most chemicals; however, the metal is slowly attacked by hydrofluoric acid and dissolves and is attacked by hydrogen fluoride and fluorine gases, forming niobium pentafluoride. Niobium is oxidized by air at 350 ºC, first forming a pale yellow oxide film of increasing thickness, which changes its color to blue. On further heating to 400 ºC, it converts to a black film of niobium dioxide. It absorbs nitrogen, similarly to hydrogen, forming an interstitial solid solution. The reaction is exothermic, and the composition of such intersititial solid solution varies with the temperature. Niobium combines with carbon, boron, silicon and other elements at very high temperatures, forming interstitial binary compounds of varying compositions.

Niobium is a very important metal in both ferrous and nonferrous metallurgies. As an additive to alloys, or when alloyed with other metals, niobium imparts high mechanical strength, electrical conductivity and ductility. It enhances the corrosion resistance of most alloys. The metal and several of its alloys exhibit superconductivity. Niobium is used as an additive in the manufacture of most high-strength, low-alloy carbon steels, as well as microalloyed steels used in the construction of oil and gas pipelines, bridges, buildings, automobiles and concrete bars. Other applications of niobium are in electronic and propulsion devices, electrodes, catalysis, vacuum tubes and high-pressure sodium vapor lamps.

Properties of Niobium

Name	Niobium
Symbol	Nb
Atomic number	41
Atomic weight	92.906
Standard state	Solid at 298 °K

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Properties of Niobium (continued)

CAS Registry ID	7440-03-1
Group in periodic table	5
Group name	None
Period in periodic table	5
Block in periodic table	d-block
Color	Gray metallic
Classification	Metallic
Melting point	2468 °C
Boiling point	4742 °C
Thermal conductivity	53.7 W/cm/K at 298.2 °K
Electrical resistivity	12.5 μΩ·cm at 0 °C
Electronegativity	1.6
Specific heat	0.27 kJ/kg K
Heat of vaporization	689.9 kJ/mol^{-1}
Heat of fusion	26.8 $kJ \cdot mol^{-1}$
Density of solid	8.57 g/cm^3
Electron configuration	$[Kr]4d^45s^1$
Atomic radius	1.47 Å
Ionic radius	Nb^{5+}: 0.68 Å
Atomic volume	10.8 cm^3/mol
Oxidation states	+3, +4, +5
Most common oxidation state	+5

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