

Niobium - Nb

Chemical properties of niobium - Health effects of niobium - Environmental effects of niobium

| | |
|--|--|
| Atomic number | 41 |
| Atomic mass | 92.91 g.mol ⁻¹ |
| Electronegativity according to Pauling | unknown |
| Density | 8.4 g.cm ⁻³ at 20°C |
| Melting point | 2410 °C |
| Boiling point | 5100 °C |
| Vanderwaals radius | 0.143 nm |
| Ionic radius | 0.070 nm (+5) ; 0.069 nm (+4) |
| Isotopes | 14 |
| Electronic shell | [Kr] 4d ⁴ 5s ¹ |
| Energy of first ionisation | 652 kJ.mol ⁻¹ |
| Discovered by | Charles Hatchett 1801 |



Niobium

Niobium is a rare, soft, malleable, ductile, gray-white metal. It has a body-centered cubic crystalline structure and in its physical and chemical properties it resembles tantalum. It must be placed in a protective atmosphere when processed at even moderate temperatures because it tends to react with oxygen, carbon, the halogens, nitrogen, and sulfur. The metal is inert to acids, even to aqua regia at room temperatures, but is attacked by hot, concentrated acids, and especially by alkalis and oxidizing agents.

Applications

Niobium is used for the production of high-temperature-resistant alloys and special stainless steels. Small amounts of niobium impart greater strength to other metals, especially those that are exposed to low temperatures. Niobium carbide is used in cutting tools. It is used in stainless steel alloys for nuclear reactors, jets, missiles, cutting tools, pipelines, super magnets and welding rods.

Niobium-tin and niobium-titanium alloys are used as wires for superconducting magnets capable of producing exceedingly strong magnetic fields. Niobium is also used in its pure form to make superconducting accelerating structures for particle accelerators. Niobium alloys are used in surgical implants because they do not react with human tissue.

Niobium in the environment

Plants generally show only traces of niobium and many have none at all, although some mosses and lichens can contain 0.45 ppm. However, plants growing near niobium deposits can accumulate the metal to levels above 1 ppm.

Niobium was mined chiefly as columbite, and is formerly known as columbium (Cb). Another mined metal is pyrochlore and this is now the most important. The main mining areas are Brazil, which produces more than 85% of the world's niobium, Zaire, Russia, Nigeria and Canada. World production is around 25,000 tonnes per year. The amount of unmined reserves is not known, but there are extensive deposits of pyrochlore.

Health effects of niobium

Niobium and its compounds may be toxic (niobium dust causes eye and skin irritation), but there are no reports of human being poisoned by it. Apart from measuring its concentration, no research on niobium in humans has been undertaken.

Niobium, when inhaled, is retained mainly in the lungs, and secondarily in bones. It interferes with calcium as an activator of enzyme systems. In laboratory animals, inhalation of niobium nitride and/or pentoxide leads to scarring of the lungs at exposure levels of 40 mg/m³.

Environmental effects of niobium

No negative environmental effects have been reported.