NANO3D SYSTEMS LLC
1110 NE Circle Blvd., ATAMI/Bldg. 11, Corvallis, Oregon 97330-4254
T 503-927-4766| F 541-758-9320| http://www.nano3dsystems.com

Niobium (Nb^{41})

Properties

Niobium is a light-gray, ductile metal with an atomic mass of 92.91 u. Niobium has a density of 8.57 g/cm^3, a melting point of 2477 ^oC and a resistivity of 15.2 µOhm cm. It is relatively hard and has a Brinell hardness of 735 – 2450 MPa. Pure Niobium has a hardness similar to that of pure titanium, and it has similar ductility to iron.

Niobium shows in its compounds a wide variety of oxidation states, ranging from -1 to +5. The most common compounds have niobium in the +3 and +5 states. Its standard electrode potential in respect to Nb^{+3} is -1.1V and Nb^{+5} is -0.96B. It is chemically resistant in ambient atmosphere, hydrochloric, sulfuric, nitric and phosphoric acids, but dissolves readily in hydrofluoric acid and hydrofluoric/nitric acid mixture. Niobium is estimated to be at average concentration of 20 parts per million (ppm) in the Earth's crust.

Plating Solutions

Niobium can be electroplated in an aqueous electrolyte, containing in g/l: niobic acid – 16, hydrofluoric acid – 180, ammonium fluoride – 18, formaldehyde - 10 at temperature of 40 – 60 ^oC and current density of 100 – 200 mA/cm^2 with the current efficiency of 0.1%.

Niobium can be also electrodeposited in an organic solution, containing: niobium pentachloride – 13 g/l, benzole – 550 ml/l, amyl acetate – 25 ml/l, methanol – 400 ml/l at temperature of 40 – 50 ^oC and current density of 5 - 15 mA/cm^2.

Electrodeposition of niobium can be also performed from the ionic liquid 1-butyl-1-methylpyrrolidinium bis(trifluoromethylsulfonyl)amide ([$Py_{1,4}$]TFSA) at various temperatures ranging from RT to 170 ^oC [1].

Electrodeposition of niobium-aluminum alloy with up to 75-80 wt.% of Nb can be obtained from molten NaCl-$AlCl_3$ at 190 – 245 °C [2].

Applications

An estimated 90% of niobium is used in high-grade structural steel. The second largest application is superalloys for jet engine components, gas turbines, rocket subassemblies, turbo charger systems, heat resisting, and combustion equipment. Niobium is also used in various superconducting materials. These superconducting alloys, also containing titanium and tin, are widely used in the magnets of MRI scanners. Other applications of niobium include welding, nuclear industries, electronics, optics, and jewelry. Lithium niobate, which is ferroelectric, is used extensively in mobile phones and optical modulators, and for manufacture of surface acoustic wave devices.

References:

1. P. Giridhar, S. Zein El Abedin, A. Bund, A. Ispas, and F. Endres . *Electrochim. Acta* **129**, 312-317, 2014.
2. Y. Sato, K. Iwabuchi, N. Kawaguchi, H. Zhu, M. Endo, T. Yamamura, and S. Saito, in: *Proceedings of the 10th Symposium on Molten Salts*, Vol. 96-7, The Electrochemical Society, Inc., p.179, 1996.

CONTACT NANO3D SYSTEMS LLC TO FORMULATE NIOBIUM PLATING SOLUTION PER YOUR REQUIREMENTS