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Thallium (Tl^{81})

Properties

Thallium is a bluish-gray metal with an atomic mass of 204.4 u. Tl has a density of 11.85 g/cm^3, a melting point of 304 ^{o}C and a resistivity of 18 μOhm cm. It is soft and has a Brinell hardness of 26.5 – 44.7 MPa.

Thallium tends to oxidize to the +3 and +1 oxidation states. Its standard electrode potential in respect to Tl^{+1} is -0.336V and Tl^{+3} is +0.71B. Thallium and its salts are toxic. It is chemically resistant in ambient atmosphere. Nitric, sulfuric and hydrofluoric acids dissolve thallium. Thallium is hardly attacked by concentrated hydrochloric acid. Alkaline hydroxide solutions do not dissolve thallium. Thallium is a modestly abundant element in the Earth's crust, with a concentration estimated to be about 0.7 mg/kg, mostly in association with potassium-based minerals.

Plating Solutions

Thallium can be electroplated in acidic electrolytes, containing in g/l:

a) Example #1. Thallium sulfate – 60, sulfuric acid to pH ~1 at temperature of 15 - 25 ^{o}C and current density of 30 mA/cm^2.
b) Example #2. Thallium perchlorate – 60, hydrochloric acid – 20 at temperature of 15 - 20 ^{o}C and current density of 1 - 5 mA/cm^2 or Thallium perchlorate – 160, perchloric acid – 60, cresylic acid – 10, peptone – 10 at 50 ^{o}C and current densities of 5 – 18 mA/cm^2.
c) Example #3 [1]. Thallous sulphamate – 20, gelatin – 5 at pH 1.5 and current density of 2.5 mA/cm^2 with current efficiency of ~95%.

Electrodeposited thallium is not suitable for wear or corrosion resistance purposes but thallium-lead alloys can be used with increased wear-resistance and reduce friction. Thallium-lead alloys with up to 55 wt% of Tl can be deposited from a perchlorate solution [2], consisting in g/l: thallium perchlorate – 32 g/l, lead perchlorate – 39, perchloric acid – 30, peptone – 10, glue – 10 at room temperature with a current density of 5 mA/cm^2.

Applications

Approximately 60–70% of thallium production is used in the electronics industry, and the remainder is used in the pharmaceutical and in glass manufacturing. It is also used in infrared detectors. The thallium-barium-calcium-copper oxide high-temperature superconductor was discovered in 1988[3]. Thallium cuprate superconductors have been discovered that have transition temperatures above 120 K. Some mercury-doped thallium-cuprate superconductors have transition temperatures above 130 K at ambient pressure, nearly as high as the world-record-holding mercury cuprates [4].

References:

1. C.P.S Johal, D.R. Gabe, and D.R. Eastham. *Surface and Coatings Technology* **35** (1-2), 181-194, 1988.
2. N.V Korovin et al. *Electroplat. Metal Finish* **13**, 102, 1960.
3. Z.Z. Sheng and A.M. Hermann. *Nature* **332** (6160), 138–139, 1988.
4. Y.X. Jia, C.S. Lee, and A. Zettl. *Physica C*. **234** (1–2): 24–28, 1994.

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