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

Antimony (Sb^{51})

Properties

Antimony is a silvery-white lustrous metalloid with an atomic mass of 121.8 u. Sb has a density of 6.7 g/cm^3, a melting point of 630 ^{o}C and a resistivity of 41.7 µOhm cm. It is very brittle and has a Brinell hardness of 294 – 384 MPa.

The most common compounds have Bi in the +3 and +5 states, while it also exists in other oxidation states such as -3, -2, -1, +1, +2, +4. Its standard electrode potential in respect to Sb^{+3} is +0.24V. Antimony is stable in dry air, dilute acids or alkalis. Sb is estimated to be at average concentration of 0.2-0.5 parts per million (ppm) in the Earth's crust.

Plating Solutions

Antimony can be electrochemically deposited from sulfate, chloride, fluoroborate, ammonium, citrate, and tartrate aqueous electrolytes [1], containing in g/l:

a) Example #1. Antimony pentoxide – 55, glyconic acid (50 wt.%) – 100 ml/l, citric acid – 190, potassium citrate – 145 with pH 3.5-3.7 at temperature of 50-70 ^{o}C and current density of 10 mA/cm^2.
b) Example #2. Antimony trifluoride – 150, citric acid – 190, bismuth nitrate pentahydrate – 1.3, thiourea – 0.05 at temperature of 18-25 ^{o}C and current density of 10 – 20 mA/cm^2.
c) Example #3. Antimony potassium tartrate – 60, potassium sodium tartrate – 4, hydrochloric acid – 5 ml/l, formalin – 0.7 ml/l with pH 1.7-1.9 at temperature of 18-25 ^{o}C and current density of 10 – 20 mA/cm^2.

Electrodeposition of antimony (Sb), tellurium (Te) and their alloys can be also performed from molten mixtures of acetamide - antimony chloride and tellurium chloride at temperature of ~100 ^{o}C and current density of 70 mA/cm^2 [2].

Antimony can be also electrodeposited form ionic liquids, such as water-stable 1-ethyl-3-methylimidazolium-chloride-tetrafluroborate ([EMIM)Cl-BF_4) at temperature of 120 ^{o}C [3]. Antimony can be also deposited from non-aqueuous electrolytes, such as chloride-free ethylene glycol solution [4].

Applications

About 60% of antimony is consumed in flame retardants, and 20% is used in alloys for batteries, plain bearings, and solders. Antimony forms a highly useful alloy with lead, increasing its hardness and mechanical strength. For most applications involving lead, varying amounts of antimony are used as alloying metal. In lead-acid batteries, this addition improves plate strength and charging characteristic. Antimony is increasingly being used in semiconductor technology as a dopant in n-type silicon wafers for diodes, infrared detectors, and Hall-effect devices.

References:

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3. M.-H. Yang, M.-C. Yang, and I.-W. Sun. *J. Electrochem. Soc.* **150**, C544, 2003.
4. M. Wu, K. Binnemans, and J. Fransaer. *Electrochimica Acta* **147**, 451-459, 2014.

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