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

Lead (Pb^{82})

Properties

Lead is a dark-gray metal with an atomic mass of 207.2. It has a density of 11.34 g/cm^3, a melting point of 327 ^{o}C and a resistivity of 20.8 μOhm cm. It is very soft and has a Brinell hardness of 38 – 50 MPa.

Lead has the valences in compounds of +2 and +4 while it also exists in other oxidation states such as -4, -2, -1, +1, +3. Its standard electrode potential in respect to Pb^{+2} is -0.13V and Pb^{+4} is +0.8B. It is chemically resistant in ambient atmosphere, sulfuric and diluted hydrochloric acids. Nitric acid and bases dissolve Pb. Lead makes up to 14 parts per million (ppm) of the Earth's crust.

Plating Solutions

Lead electroplating can be electroplated in acidic electrolytes (fluoroborate, fluorosilicate, sulfonate, sulfamate, perchlorate, pyrophosphate, acetate, bromide, iodide, nitrate, methansulfonate etc) [1-5], containing in g/l:

a) Example #1. Lead fluoroborate – 210, fluoroboric acid – 70, boric acid – 20, glue – 0.4 at temperature of 15 – 25 ^{o}C and current density of 10 – 30 mA/cm^2.
b) Example #2. Lead fluorosilicate – 115, boric acid – 5, fluorosilicic acid – 30 at temperature of 15 – 25 ^{o}C and current density of 10 – 12 mA/cm^2.
c) Example #3. Lead phenol sulfonate – 180, phenolsulfonic acid – 30, glue – 0.7 at temperature of 18 – 60 ^{o}C and current density of 5 – 40 mA/cm^2.
d) Example #4. Lead sulfamate – 160 at pH 1.5, temperature of 25 – 50 ^{o}C and current density of 5 – 10 mA/cm^2.

Lead can be also deposited from alkaline solutions [6, 7], urea/choline chloride eutectic mixture [8] and other plating solutions.

Applications

Lead's high density, low melting point, ductility and relative inertness to oxidation make it useful. These properties, combined with its relative abundance and low cost, resulted in its extensive use in construction, plumbing, batteries, bullets and shot, weights, solders, pewters, fusible alloys, white paints, leaded gasoline and radiation shielding. Lead's toxicity limits its applications.

References:

1. A.T. Kuhn. *The Electrochemistry of Lead*. Academic Press, London, 1979.
2. N.V. Parthasaday. *Practical Electroplating Handbook*. Prentice-Hall, Englewood Cliffs, NJ, 1989.
3. V.S. Protsenko, E.A. Vasil'eva, and F.I. Danilov. *Journal of Chemical Technology and Metallurgy* **50**(1), 39-43, 2015.
4. J. Mostany, J. Parra, and B.R. Scharifker. *Journal of Applied Electrochemistry* **16**, 333-338, 1986.
5. C.O. Avellaneda, M.A. Napolitano, and E.K. Kaibara. *Electrochimica Acta* **50**(6), 1317-1322, 2205.
6. S.M. Wong and L.M. Abrantes. *Electrochimica Acta* **51**(4), 619-626, 2005.
7. I.A. Carlos, J.L.P. Siqueira, G.A. Finazzi, and M.R.H. de Almeida. *J. Power Sources* **117**, 179-186, 2003.
8. H. Yang and R.G. Reddy. *J. Electrochem. Soc.* **161**(10), D586-D592, 2014.

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