



Cadmium (Cd⁴⁸)

Properties

Cadmium is a silvery bluish-gray metal with an atomic mass of 112.4. Cd has a density of 8.65 g/cm³, a melting point of 321.07 °C and a resistivity of 7.27 μOhm cm. It is the soft, malleable, ductile metal that has a Brinell hardness of 203-220 MPa.

Like zinc, Cd demonstrates oxidation state +2 in most of its compounds while it also exist in the +1 and -2 oxidation states. Unlike most other metals, cadmium is resistant to corrosion and is used as a protective layer on other metals. Hydrochloric acid, sulfuric acid, and nitric acid dissolve cadmium. Its standard electrode potential in respect to Cd⁺² is -0.4V. Cadmium makes up ~ 0.1 parts per million (ppm) of the Earth's crust. It is much rarer than zinc, which makes up about 65 ppm.

Plating Solutions

Cadmium electroplating can be performed in acidic (sulfate, fluoroborate etc.), alkaline (cyanides, pyrophosphate et al), and organic electrolytes, containing in g/l:

- Example #1. Cadmium sulfate – 50, ammonium sulfate – 250 at pH 4 – 6, temperature of 18 – 30 °C and current density of 8 – 12 mA/cm².
- Example #2. Cadmium fluoroborate – 150, fluoroboric acid – 40, glue – 2 at pH 3-4, temperature of 18 – 25 °C and current density of 30 – 40 mA/cm².
- Example #3. Cadmium oxide – 30, sodium cyanide – 110, sodium hydroxide – 25, ammonium sulfate – 40 at temperature of 18-25 °C and current density of 5-20 mA/cm².

Cadmium chalcogenides are very attractive as the band gap of CdTe (E_g = 1.45 eV), CdSe (E_g = 1.75 eV), and CdS (E_g = 2.4 eV) allows to work successfully in the visible part of the sunlight to convert solar energy into electric energy. Cadmium telluride can be deposited from choline chloride-urea ionic liquid^[1] and aqueous solutions (fluoroborate et al). CdSe and CdS can be deposited from aqueous and nonaqueous electrolytes containing dimethyl sulphoxide, sodium thiosulphate, dimethyleneglycolic and propylenecarbonate solutions et al^[2].

Applications

Cadmium is a common component of electric batteries, pigments, coatings, and electroplating. Most of cadmium is used in batteries, predominantly in rechargeable nickel-cadmium batteries. Cadmium electroplating is used in the aircraft industry to reduce corrosion of steel component. Cadmium is a component of some compound semiconductors, such as cadmium sulfide, cadmium selenide, and cadmium telluride, used for light detection and solar cells. HgCdTe is sensitive to infrared light and can be used as an infrared detector, motion detector, or switch in remote control devices. Because of the adverse effects of cadmium on the environment and human health, the supply and use of cadmium is restricted.

References:

1. F. Golgovici and T. Visan. *Chalcogenide Letters* **9**(4), 165-174, 2012.
2. M.N. Mammadov, A.Sh. Aliyev, and M. Elrouby. *Int. J. Thin Sci. Tec.* **1**(2), 43-53, 2012.

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