



Lithium (Li³)

Properties

Lithium is a silvery-white, alkaline metal with an atomic mass of 6.94 amu. Lithium has a density of 0.534 g/cm³, a melting point of 180.50 °C and a resistivity of 92.8 μOhm cm. It is soft and has a Brinell hardness of 5 MPa.

It never occurs freely in nature and is isolated electrolytically from a mixture of lithium chloride and potassium chloride. Lithium in its compounds shows only a +1 oxidation state. Its standard electrode potential in respect to Li⁺ is -3.0401 V. Lithium reacts with water easily to form hydrogen gas and lithium hydroxide in aqueous solution, but with noticeably less vigor than other alkali metals.

Plating Solutions

Lithium can be electroplated in organic electrolytes including propylene carbonate, containing in g/l: lithium bromide – 9 at temperature of 25 °C and current density of 0.1 mA/cm².^[1] Li can be also electrodeposited from ionic liquids such as pyrrolidinium-based electrolytes^[2], 1-ethyl-3-methylimidazolium bis(trifluoromethylsulfonyl) imide ([EMIM]Tf₂N) and 1-methyl-1-propylpiperidinium bis(trifluoromethanesulfonyl) amide (PP13Tf₂N) solutions with lithium bis(trifluoromethanesulfonyl) imide (LiTFSI) as the lithium source^[3] et al.

Lithium alloys with transition metal oxides can be fabricated by electroplating in concentrated lithium hydroxide solutions. For example, the plating bath for deposition of lithium cobalt oxide consists in g/l: lithium hydroxide 100, cobalt powder and temperature of 150 °C with a current density of 2 mA/cm².^[4]

Applications

Lithium coating is particularly useful in making lithium anodes for voltaic cells and for recharging secondary cells having a lithium anode with organic solvent electrolyte. It has applications in manufacturing of other metal articles, for example lithium plated electrical contact. Lithium oxide is widely used in ceramics and glass as a flux for processing silica, to reduce the melting point and lower thermal expansion coefficient. Another major application of lithium cobalt oxide is in microbattery systems as power sources for the microelectronics^[5].

References:

- [1] T.B. Reddy. Electrodeposition of lithium, US Patent US3580828, published May 25, 1971.
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- [3] J. Park, J. Lee, and C.K. Lee. *Applied Mechanics and Materials* **217**, 1049-1052, 2012.
- [4] K. S. Han, S. W. Song, H. Fujita, M. Yoshimura, E. J. Cairns, and S. H. Chang. *J. Am. Ceram. Soc.* **85** (10), 2444-2448, 2002.
- [5] H. Zhang et al., *Sci. Adv.* **3** (5), 2017.

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