



Yttrium (Y³⁹)

Properties

Yttrium is a silvery-white transition metal with an atomic mass of 88.91 u. Yttrium has a density of 4.472 g/cm³, a melting point of 1526 °C and a resistivity of 59.6 μOhm cm. It has a Brinell hardness of 200 – 589 MPa.

Yttrium is found predominantly in +3 oxidation state. Its standard electrode potential in respect to Y⁺³ is -2.43V. Yttrium is chemically similar to the lanthenides. Its abundance has been estimated to be about 31 parts per million. It is found primarily in most rare-earth minerals and some uranium ores.

Plating Solutions

Electroplating of pure yttrium from aqueous solutions is believed to be unattainable due to intensive hydrogen evolution at large over potentials of yttrium reduction. This problem can be solved using ionic liquids as solvent and electrolyte. Yttrium can be electrodeposited in different ionic liquids with quaternary ammonium cations at 100°C^[1], 1-ethyl-3-methylimidazolium tetrafluoroborate^[2] et al.

Yttrium can be electrodeposited from a nonaqueous baths, such as isopropyl alcohol, ethanol, acetone, dimethyl formamide (DMF) and dimethyl sulfoxide (DMSO)^[3].

Yttrium-magnesium alloys can be deposited from molten salts, containing LiF-YF₃ with magnesium oxide and yttrium oxide as raw materials at temperature of 1050 °C^[4].

Yttrium hydroxynitrate compound can be electrodeposited from a Y(NO₃)₃ solution in water with 50 vol.% ethyl alcohol. Subsequent thermal treatment led to an Y₂O₅ coating^[5].

Applications

Yttrium is used in production of a large variety of synthetic garnets. Ytria is used to make yttrium iron garnets (Y₃Fe₅O₁₂), which are very effective microwave filters. Yttrium is a key ingredient in the yttrium barium copper oxide (YBa₂Cu₃O₇) high temperature superconductor. Small amounts of yttrium have been used to reduce the grain size of Cr, Mo, Ti, and Zr. Yttrium is also used to increase the strength of aluminum and magnesium alloys. The oxygen reduction reaction (ORR) can be greatly improved when the traditional used Pt catalyst is alloyed with yttrium.

References:

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