



## Barium (Ba<sup>56</sup>)

### Properties

Barium is a silvery-gray alkaline earth metal with an atomic weight of 137.327 u. Barium has a density of 3.51 g/cm<sup>3</sup>, a melting point of 272 °C and a resistivity of 33.2 μΩ cm. It is very soft with Mohs hardness of 1.25.

Similar to group one elements, it is very reactive and oxidize in the air to form a passive dark gray oxide layer. Because of its high reactivity, barium never occurs in nature as free metal and most of the time occurs as barium sulfate (baryte) and barium carbonate (witherite) in nature. The most common oxidation states for barium are +1, and +2. The standard reduction potential for the Ba<sup>2+</sup>/Ba couple being reported as -2.9 volts. The abundance of barium is 0.0425% in the Earth's crust.

### Plating Solutions

Due to its high reactivity, pure barium plating is not possible from an aqueous electrolyte. Barium compounds can be electroplated in the solutions, containing:

- a) Example #1: barium titanate can be successfully plated on Ti<sub>6</sub>Al<sub>4</sub>V substrate from 0.2M solution of barium titanate in EGMME and acetylacetone (1:9 ratio) and applying a DC voltage of 60 V for 3 min <sup>[1]</sup>.
- b) Example #2: barium perovskite can be also plated from a solution of copper carbonate (0.5 M), yttrium acetate (0.10 M), barium oxide suspension (0.25 M), citric acid (0.22 M) and sodium acetate (0.30 M) with a pH of 3.8 at a current density of 10 mA/cm<sup>2</sup> <sup>[2]</sup>.

### Applications

Because of its high reactivity, the applications of pure barium metal are limited but its compounds have been used widely in industry. Barium is suitable for gas impurities removal because of its reactivity; it bonds easily to oxygen, nitrogen, moisture and even noble gases, and removes them by dissolving them in the crystal lattice <sup>[3]</sup>. Barium titanate has been used in electronics for special properties such as electrooptic effects, piezoelectricity that can be applied to devices within them. Another example is barium perovskite which is the most common high temperature superconductive with the formula of YBa<sub>2</sub>Cu<sub>3</sub>O. Barium oxide coating on the electrodes of fluorescent lamps facilitates the release of electrons.

### References:

- [1] H. Zarkoob, S. Ziaei-Rad, M. Fathi, and H. Dadkhah. *Adv. Eng. Mater.* 14(6), B332-B339, 2012.
- [2] R.L. Hauser, B. Zheng. Electroplating of superconductor elements. *WO 1995007550A1*, published 16 March 1995.
- [3] R. Kresse *et al.*, "Barium and Barium Compounds," in *Ullmann's Encyclopedia of Industrial Chemistry*, 2007.

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