



## Rhodium (Rh<sup>45</sup>)

### Properties

Rhodium is a silvery-white metal with an atomic mass of 102.9 u. Rh has a density of 12.4 g/cm<sup>3</sup>, a melting point of 1964 °C and a resistivity of 4.3 μOhm cm. It is hard with a Brinell hardness of 980 – 1350 MPa (Vickers hardness of 1100-8000 MPa) and Young modulus of 380 Mpa.

The most common compounds have Rh in the +1 and +3 states, while it also exists in other oxidation states such as -3, -1, +2, +4, +5, +6. Its standard electrode potential in respect to Rh<sup>+1</sup> is +0.6V and +0.8V for Rh<sup>+3</sup>. Rhodium is corrosion-resistant and chemically inert noble transition metal. Rhodium metal does not normally form an oxide, even when heated. Only concentrated sulfuric acid, melted potassium disulfate and sodium chloride affect it. Rh is one of the rarest elements with estimated average concentration of 0.0002 parts per million (ppm) in the Earth's crust.

### Plating Solutions

Rhodium can be electrochemically deposited from sulfate, phosphate, chloride, fluoroborate, sulfamate and ammonium chloride aqueous electrolytes<sup>[1-2]</sup>, containing in g/l:

- Example #1. Rhodium as metal – 3, sulfuric acid – 50 at temperature of 50-60 °C and current density of 15-20 mA/cm<sup>2</sup> with current efficiency of 30-40%.
- Example #2. Rhodium as metal – 2, phosphoric acid – 60 at temperature of 15-25 °C and current density of 3 – 5 mA/cm<sup>2</sup> with current efficiency of 12-13%.
- Example #3. Rhodium chloride – 50 and hydrochloric acid – 300 ml/l at temperature of 70 °C and current density of 25 mA/cm<sup>2</sup>.

Rhodium can be also electrodeposited from ionic liquids, such as non-aqueous 1-butyl-3-methylimidazolium chloride ionic liquid medium<sup>[3]</sup>.

### Applications

Rhodium major use (approximately 80% of world rhodium production) is as one of the catalyst in the three-way catalytic converters in automobiles<sup>[4-6]</sup>. Because rhodium metal is inert against corrosion and most aggressive chemicals, and because of its rarity, rhodium is usually alloyed with platinum and palladium for high-temperature corrosion-resistive coatings. White gold is often plated with a thin rhodium layer to improve its appearance while sterling silver is often rhodium-plated for tarnish resistance.

### References:

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