Rhodium Plating

Dr. Ronald J. Morrissey

Applications

Rhodium is one of the whitest of metals, and this, together with its hardness and resistance to wear and tarnishing, have established it as a premier finish for jewelry and decorative work of all types. Its stable contact resistance and high melting point have also made it useful in electrical and electronic applications, notably in reed blades, in which its resistance to arcing is particularly advantageous. Rhodium is, however, also the most expensive of the precious metals. In recent years, its use has, with few exceptions, been restricted to very thin deposits, usually over other white metals such as nickel, silver or, in the case of reed blades, ruthenium.

Processes

Although rhodium can be evaporated under vacuum, in practice it is almost always electrodeposited. Electroplating solutions for rhodium are highly acidic, and are usually based on the sulfate or phosphate. In either case, proprietary concentrates of rhodium are ordinarily used. It has been claimed that deposits from the phosphate system are somewhat whiter, and mixed phosphate-sulfate systems are sometimes used. Insoluble hydrous oxides of rhodium can form at quite low pH values. In order to avoid this, it is important to maintain the acidity of rhodium plating solution. All other things being equal, this is more easily accomplished in the sulfate than in the phosphate system.

For decorative applications, rhodium plating solutions rarely contain more than about 2 g/L rhodium, together with about 20 mL/L of concentrated sulfuric acid. For heavier deposits, the rhodium content is increased to about 4-10 g/L, together with about 20-50 mL/L sulfuric acid. In either case, plating is carried out at about 1-5 A/dm^2 at 40-45 °C. Proprietary stress-relieving agents are available, but in any event, it is difficult to plate rhodium in a crack-free condition from aqueous solution at thicknesses much above 2 to 2.5 µm. Rhodium can be plated from molten cyanide systems to thicknesses in excess of 100 µm, but in actual practice this is almost never done.

Post-plating

Rhodium itself does not ordinarily require any type of post-plating treatment. It should be remembered, however, that the current efficiency of aqueous rhodium plating solutions is low. When rhodium is applied to materials in which hydrogen embrittlement is a problem, a post-bake at 200-250 °C for hydrogen relief is recommended.

Health Impact

Rhodium deposits are nontoxic and hypoallergenic. However, since rhodium deposits as ordinarily applied are quite thin and likely to be discontinuous, it is preferable to use gold or silver, rather than nickel, as an underplate for rhodium in applications requiring prolonged contact with the human body.

Environmental Impact

Wastewater limits for rhodium have not been established. The economic value of rhodium is sufficient to justify great care in effecting recovery and retention. This is ordinarily accomplished by direct plateout from dragout rinses, together with ion exchange treatment prior to actual discharge.

Trends

The escalating price of rhodium has acted to reduce overall usage in recent years. It is likely that this trend will continue. Bright palladium finishes, already virtually indistinguishable from rhodium on actual work, will be the major replacement for decorative applications. For engineering applications, the major replacement to date has been gold, although for high-temperature applications, there appears to be no really suitable substitute. Palladium, particularly with a gold overflash, is a suitable replacement for general electronic applications.