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RHODIUM PLATING

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The present application is a continuation in part of my copending application Serial No. 490,335, filed October 21, 1930.

The present invention relates to a process of preparing a solution containing a rhodium salt adapted to deposit metallic rhodium on another metal or alloy in the form of a continuous, adherent coating or plate. The invention does not contemplate the use of any novel apparatus, rather it provides a method whereby a rhodium plating may be applied to an article by standard apparatus.

The invention has particular reference to a process whereby rhodium is plated on articles of jewelry in which the principal noble metal is silver, white gold, platinum or the like.

The color and luster of rhodium are desirable in the art of jewelry making, but owing to the hardness and brittleness of this metal, and the difficulty of polishing, burnishing it or engraving upon it, its use as a metal in the manufacture of jewelry is impractical. An electrodeposit of this metal in the form of a plating which would require polishing after it was applied, would not be desirable or useful in the finishing of jewelry for the reasons set forth above.

The object of the present invention is to make available to the plating industry and jewelry trade the color and brilliance of rhodium by the manufacture of a practical electroplating solution by which the industry or trade may apply a finish, or electroplate after the article is completely manufactured and polished.

Among other attributes of rhodium which make it highly desirable as a coating or plate on jewelry are its color, which is silvery white, its resistance to acidic, basic and organic solvents, and its resistance to atmospheric oxidation. Its chemical inactivity, therefore, causes it to be non-susceptible to tarnishing.

It has also been found that a rhodium plating is much superior to a platinum plating as regards color and hardness, since a rhodium plating has a whiter color than does platinum, and wears much longer than a platinum plating of the same thickness.

The invention is not limited to the coating of noble metals but includes also the coating or plating of base metals, such as brass, nickel, copper, iron and the like. Hence it may be applied to stainless steel, hardware in automobile interior furnishings and in fact on any article where a coating of varying degrees of thickness is desirable, to protect a base metal from the ravages of corrosion,

The rhodium plating solution which I illustrate by specific examples hereinafter set forth, is one of considerable stability. It can, therefore, be made up and placed in bottles of any convenient size, as for example one liter bottles, and then shipped to the various manufacturers of jewelry, who may use it in standard apparatus. The chief purpose of this solution is to produce a plate of rhodium on a highly polished article, which will not detract any of the luster or polish of the metal to be plated, while giving it a protecting coat. Hence, after plating with the above solution in the manner indicated, the article plated will require no polishing after the plating operation.

In the following examples certain proportions of ingredients and procedural steps are set forth, but it is to be distinctly understood that these specific details are purely illustrative and are not to be construed as in anywise limiting the invention.

Example I

To pure distilled water I add 20 grams of rhodium sulphate $\text{Rh}_2(\text{SO}_4)_3 \cdot 12\text{H}_2\text{O}$, and then add 20 grams of potassium aluminum sulphate. I then acidify the solution by adding 50 grams of 92% sulphuric acid. This solution is then made up to one liter by adding pure distilled water. The solution is then placed in the usual deposition or plating apparatus, the details of which are well known. A yellow rolled gold article may be rhodium plated by the above solution, using a voltage of $4\frac{1}{2}$ volts and a current density of 2 amperes per square centimeter during a period of five seconds. The rhodium plated rolled gold article will have a beautiful white appearance when taken from the deposition bath and after drying will require no polishing. The foregoing method is particularly suitable for plating gold to be used as a diamond setting.

Example II

A solution containing about 1% of rhodium chloride, about 10% of aluminum chloride and about 10% of free hydrochloric acid in 1 liter of water was prepared.

The above solution was placed in an electroplating apparatus and a small gold pin was immersed therein, the pin serving as a cathode. The said pin was plated by immersion in the above described solution during a period of one-half minute while employing a current density of 2 amperes per square centimeter and a voltage of about 4 volts, and maintaining the tempera-

ture of the plating solution at about 160° F. At the completion of the plating operation the said pin was removed from the bath, washed with water and dried with a towel. The article thus obtained was of a brilliant white color, having the characteristic appearance of natural rhodium.

Example III

A solution containing about 1% of rhodium phosphate and about 10% of free phosphoric acid in a liter of water was prepared.

The above solution was placed in an electroplating apparatus and a brooch was immersed therein, the brooch serving as a cathode. The plating operation was carried out as in Example II with respect to current density, voltage, time of immersion of the brooch in the plating bath and temperature.

In the foregoing examples equivalent quantities of any mineral acid may be used. I may use any simple rhodium salt which is soluble in water in place of the above rhodium salts which have been disclosed in the specific examples. Similarly I may also use any soluble aluminum salt in place of the aluminum sulphate or aluminum chloride above disclosed.

I find that rhodium may be electrolytically deposited from solutions, such as the above by using a voltage ranging from 3 to 13 volts, depending on the concentration of rhodium salt, and also that the solution may be either hot or cold.

The plating solution is so compounded that using the concentration of Example I it will function and produce a good plate, when using a voltage of about three to four volts. By diluting with an equal volume of water it will function with six to seven volts; by again diluting with an equal volume of water or a concentration of one in four, it will function at from ten to fifteen volts. The preferred amperage is from about one to two amperes per square centimeter. When the concentration of the solution equals twenty grams of crystallized rhodium sulphate a voltage of from three to 4 and ½ volts, ten grams of rhodium sulphate (crystallized), six to seven volts, five grams of rhodium sulphate (crystallized), and 10 to 15 volts are used. Similarly in the other examples, the voltage should be increased when the solution is diluted in accordance with the above ratios, viz., the voltage should be approximately double when the dilution is twofold and quadrupled when it is fourfold. Hence, if in any of the foregoing specific examples, it is desirable to use a solution more dilute than that specified therein, the voltage should be modified as above.

By the above method of dilution which has the effect of adding resistance to the solution, the manufacturing jeweler can purchase a concentrated solution and use the same with his present plating outfit, without the necessity of installing new electrical generating equipment, which would be required if this solution would only operate at a fixed voltage.

An excess of sulphuric acid or other mineral

acid is advisable; first to stabilize the solution and second, to increase the conductivity of the solution. The object of the alum or other salt is that since they are inert they will further increase conductivity in the solution, without increasing the acidity thereof, as would sulphuric acid or other mineral acids, with resultant attack of the article to be plated.

The above described plating solutions give equally good results at 20° C. or 90° C., and may be boiled without any danger of decomposition. As an anode of rhodium is insoluble in this solution and would be very expensive, any insoluble anode such as platinum, gold, or an alloy of these metals or carbon may be used.

The loss in rhodium due to the deposit of rhodium may be compensated for by adding rhodium hydroxide, or a concentrated solution of rhodium sulphate, phosphate or chloride. The metallic content of the solution should be kept constant by the addition of rhodium hydroxide, and when it is not desirable to increase the conductivity of the solution, rhodium sulphate solution in concentrated form is added when it is desirable to increase the conductivity.

The above described methods provide means whereby rhodium may be recovered from a solution after the other metals of the platinum group have been removed.

I claim:

1. An electrolyte adapted to deposit a bright, lustrous layer of rhodium on a metal, comprising an aqueous solution of a soluble rhodium salt, a soluble aluminum salt and a free mineral acid.

2. The method of plating rhodium on a noble metal to produce a white, lustrous finish requiring no subsequent polishing, comprising immersing the said noble metal in a solution containing an inorganic rhodium salt, a soluble aluminum salt and an inorganic acid and a free mineral acid and passing a current of electricity through the solution.

3. A rhodium plating solution adapted to produce a bright, lustrous plating on a noble metal, containing 5 to 20 grams of rhodium sulphate per liter of water and a mineral acid.

4. The method of plating rhodium on a noble metal to produce a white, lustrous finish requiring no subsequent polishing, comprising immersing the said noble metal in a solution containing 5 to 20 grams of rhodium sulphate per liter of water and a mineral acid and passing a current of electricity having a voltage of 3 to 15 volts and a current density of about 2 amperes per square centimeter through said solution.

5. A rhodium plating solution adapted to produce a bright plating on a metallic surface containing approximately twenty grams of crystalline rhodium sulphate, twenty grams of potassium aluminum sulphate and fifty grams of sulphuric acid per liter of water.

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