United States Patent Office 3,551,302 Patented Dec. 29, 1970

3,551,302

GOLD-PLATING PROCESS

Roger M. Woods, Oxon Hill, Md. (9601 Taylor Court, Washington, D.C. 20022), and David R. Moul, Seat Pleasant, Md. (7203 Clearfield Court, Washington, D.C. 20027)

No Drawing. Filed Sept. 19, 1967, Ser. No. 668,927
Int. Cl. C23b 1/00, 5/06, 5/24
U.S. Cl. 204—32 7 Claims

ABSTRACT OF THE DISCLOSURE

This invention relates to a process of producing a thin, adherent, durable gold plate on a chromium surface of an article. The process comprises the steps of conventional cleaning of the article, activation of the chromium surface, rinsing preferably with an acid dip, plating in a gold plating solution at optimum conditions of about five to ten seconds, and about 25 to 75 amps per square foot, rinsing and thereafter heating the gold plated article at temperatures of about 200° F. to 900° F. for a period of about two minutes to two hours. The gold plate is in the range of about one to ten millionths of an inch.

This invention relates to a process for the electrodeposition of a thin plate of gold on a surface of an article containing an outer layer of chromium plate.

It has been the desideratum of the plating industry to be able to obtain an economical, thin gold plate on chromium surfaces. Previous attempts have been less than satisfactory, due to the fact that the gold plate obtained is soft and is not sufficiently permanent, since it eventually wears or peels off. Another problem encountered in plating gold over a chromium layer, is the fact that the outer chromium layer contains chromium oxides which hinder the obtention of a tenacious uniform gold plate thereon.

An object of this invention, therefore, is to provide a process for producing a hard, lustrous, uniform gold surface on a chromium plate surface.

Another object of this invention is to provide a process for reducing the metallic oxides on a chromium plate, whereby a thin, uniform and adherent gold plate can be plated on the chromium.

A further object of this invention is to provide a process for gold plating upon a reduced metallic surface.

A further object of this invention is to provide a process for converting a thin, non-abrasive, soft gold plate on a chromium surface into a hard, uniform, non-peeling, brilliant gold surface through the use of heat.

Another object of this invention is to provide a process of producing an economical, inexpensive gold colored surface, which will enhance the competitive position of chromium plate, by the addition thereto of a brilliant, hard, abrasive-resistant, and non-peeling gold plate thereto.

Other objects and advantages of this invention will become more apparent by reference to the following description and the specific examples. In accordance with this invention, the objects to be gold plated are first prepared for plating by conventional plating procedures which may include degreasing, alkaline cleaning, acid dipping, polishing, sandblasting, etc.

The articles to be plated and which have a chromium outer layer may have as the base metal, nickel, copper or other applicable conductive surfaces, such as steel, stainless steel, etc. If nickel is used as the underplate, the solutions used should be as stress free as possible to prevent cracking of the chromium plate when heated, since a heating step comprises one step of the present invention.

The base metal may have any suitable sub-plate as long as the outer plate layer is chromium.

The chromium plated objects, after having been prepared for plating by conventional procedures, are then treated for gold plating according to this invention, by activating the surface to reduce the metallic oxides. Proprietary activating solutions are generally available which are especially made for the reduction of metallic oxides, and for the purpose of this invention, which function satisfactorily when used according to directions supplied by the manufacturer. Various formulations may be compounded, however, using reducing agents, stabilizers, etc. to accomplish the activating. An example of a suitable activating aqueous solution successfully used is as follows:

	Gm./liter
Sodium hydroxide	45
Potassium cyanide	45
Ethylene diamine Tetraacetic acid. (EDTA).	7.5

In the activating step, using the above solution, the object is made the cathode and a voltage of 6 to 9 volts is applied. Stainless steel anodes were satisfactorily used. Many conductive materials may be used relative to the efficiency produced and the suitability of the material to the solution used. The activating time is from about 15 seconds to about one minute. The solution temperature may be from room temperature to about 120° F., and preferably from about 70° F. to about 85° F.

After activation of the objects, they are rinsed in water and then dipped in a 10% solution of hydrochloric acid, rinsed and inspected for water breaks. If water does not flow freely over the object without breaking, the procedure should be repeated. The rinse after acid dipping preferably should be demineralized or distilled water to prevent metal oxides from depositing on the surface. Other mineral acids, such as sulfuric acid, may be used. The acid concentration may be varied, however, concentrations over 10% have a tendency to make the chromium surface non-uniform.

After rinsing, the object to be gold plated is made the cathode in the gold plating solution. To obtain the benefits of this invention, whereby a hard, uniform gold plate is obtained, a subsequent heating step, after the plating step, is required and will be described in detail hereinafter. In order to obtain maximum hardness and uniformity of the gold plate in combination with the heating step, the time and current density in the gold plating steps are critical. The optimum time range is from about 5 to about 10 seconds, and the optimum current density is from about 25 to about 75 amps per square foot. Excellent reuslts have been obtained at about 8 seconds and about 50 amps per square foot. When hardness of the gold plate is not particularly critical within the scope of the invention, the time period may be from about one second to about four minutes and the current density may be from about 10 to over 100 amps per square foot.

Time and current density conditions other than those set forth for the optimum ranges produce a variance in the hardness, uniformity and color of the gold plate.

The gold plating solution may be any of the many formulations known in the art and found in the literature. Either 24 carat gold, or alloy gold solutions may be used. Acid solutions are preferred over the neutral or cyanide solutions. The type of plating solution used may have some effect on the final color obtained on the object.

The thickness of the gold plate obtained in the above procedures is in the range of about one to about ten millionths of an inch. Attempts to apply significantly

heavier thicknesses usually result in poor abrasion resistance or poor adherence.

After the gold plating step, the object should be rinsed according to standard precious metal plating rinsing practices familiar to those skilled in the art. The final rinsing should be in either demineralized or distilled water and air dried. Care should be taken to prevent the plated objects from getting any oil or grease on their surfaces prior to the subsequent heating step.

The gold plate on the objects, prior to the heating step, is not abrasion resistant nor adherent. The gold plate will easily rub off without the subsequent heating step and, accordingly, the heating step is an important one in the process of this invention.

Accordingly, the gold plated objects are put into an oven heated to a temperature of about 750° F. for about one hour. The source of the heat may be gas, electricity, radiant heat, etc. Preferably, the air in the oven should be circulated. The plated articles may be heat treated at temperatures ranging from about 200° F. to about 900° F. In accordance with this invention, the thin, easily abraded plated gold film will be hardened to a substantial degree and made adherent and tougher at the above temperature ranges. The time period should range from about two minutes to about two hours or longer depending upon the base metal's ability to take the heat treatment. Optimum ranges are a time period of about 30 minutes to about two hours, depending on the size of the object and temperatures of about 700° F. to about 760° F. At temperatures stated above, a diffusion of one metal into the other appears to take place and appears to be evident by the lightening of the surface color. Base metals which cannot tolerate the higher temperatures, such as die cast zinc, must accordingly be heated at the lower temperatures, such as about 400° F. or cooler. A lightening of surface color also at the lower temperatures appears to be evident of diffusion taking place, although the hardness of the gold plate is not the optimum desired.

When the plated objects are heat treated in the 850° F.–900° F. range, a slight darkening of the gold plate occurs, approaching a bronze color. It is advisable in certain instances to preheat the objects before proceeding to the high temperature zone whereby a gradual coloring of the objects is obtained.

The gold plated surface obtained in accordance with the process of this invention varies in color from a lemon yellow to a deep bronze, depending upon the operating conditions as set forth hereinbefore. An extremely lustrous appearance of the plated surface is obtained when the gold plating is done over a bright or polished surface. Spectral reflectance of the plated article may be reduced by rendering the surface to be gold plated matte in appearance. Accordingly, different final surface effects may be achieved by varying the surface conditions of the base material or underplate.

Accordingly, the invention has provided a process for plating on an extremely difficult metal, a thin gold plate of extreme sensitivity and the production of a final gold surface of a pleasing color, which is hard, durable, weather resistant and adherent.

For the purpose of illustrating the invention, the following specific embodiments are set forth, however they are not intended to be limiting in any sense.

EXAMPLE 1

A solid brass bathroom faucet was prepared for plating according to conventional procedures. The faucet was plated with copper, nickel, and an outer chromium plate according to conventional plating procedures. After rinsing, the faucet was activated for one minute in a proprietary chromium activating solution, cold water rinsed, and immersed into a 10% solution of sulfuric acid for five seconds and rinsed. The faucet was transferred to a 23 carat alloy proprietary gold solution wherein plating was conducted for 1½ minutes at a current density of 75 amps per square foot. The faucet was then removed and rinsed in cold tap water, then distilled water, and dried. The thickness of the gold deposit was determined to be approximately seven millionths of an inch. The faucet was then placed in an electric oven at 700° F. for a period of two hours. The faucet, when removed from the oven, had a light colored, hard and lustrous gold plate diffused into the chromium plate. The faucet was several shades lighter in color than when placed in the oven. The abrasion resistance of the gold deposit was very good.

EXAMPLE 2

A stainless steel spoon was prepared for chromium plating directly onto the base metal, according to conventional procedures. After rinsing, the spoon was chromium plated for five minutes using conventional plating procedures. After rinsing, the spoon was activated in a solution composed of 45 grams per litre of sodium hydroxide, 45 grams per litre of potassium cyanide, and 7.5 grams per litre of E.D.T.A. for a period of one minute. The spoon was cold water rinsed and dipped into a 5% solution of hydrochloric acid for three seconds, and then cold water rinsed. The spoon was transferred to a 24 carat proprietary gold strike solution wherein plating was conducted for 15 seconds at 25 amps for square foot. The spoon was cold tap water rinsed, followed by a rinsing in demineralized water and air dried. The spoon was placed in an electric air circulated oven for 30 minutes at a temperature of 750° F. When removed from the oven, the spoon had a hard, lustrous, and light colored gold finish. The abrasion resistance was very good.

EXAMPLE 3

A previously chromium plated zinc die cast faucet handle was lightly colored, buffed on a cotton wheel, cleaned of oils and grease, using conventional procedures and activated in a proprietry activating solution for one minute, cold water rinsed and acid dipped in a solution containing 10% hydrochloric acid technical grade 20° baume. The handle was inspected for water breaks and, because surface tension was not good, it was reactivated for one more minute and re-acid dipped and rinsed in cold water. The handle was plated in a 24 carat proprietary gold strike solution for eight seconds at 50 amps per square foot. The handle was cold tap water rinsed, followed by a rinse in demineralized water and air dried. The handle was placed in an oven for 30 minutes at 400° F. When removed from the oven, the handle had a lustrous, hard, gold colored finish slightly lighter in color than when placed in the oven. The part could now be handled in a normal manner for good wearability.

EXAMPLE 4

A solid brass bathroom faucet was prepared for plating according to conventional procedures. The faucet was plated with copper, nickel and an outer chromium plate according to conventional plating procedures. After rinsing, the faucet was activated for one minute in a proprietary chromium activating solution, cold water rinsed, and immersed in a 10% solution of sulfuric acid for five seconds, and rinsed. The faucet was transferred to a 23 carat alloy proprietary gold solution wherein plating was conducted for five minutes at a current density of 75 amps per square foot. The faucet was then removed and rinsed in cold tap water, then distilled water, and dried. The thickness of the gold deposit was determined to be approximately 28 millionths of an inch. The faucet was then placed in an electric oven at 700° F. for a period of two hours. The faucet when removed from the oven had very little color change. When tested, the abrasion resistance was much less than the part in Example 1.

EXAMPLE 5

A stainless steel spoon was prepared for chromium plating on the base metal according to conventional proce-

dures. After rinsing, the spoon was chromium plated for five minutes using conventional plating procedures. The activation step of the previous examples was omitted. After cold water rinsing following the chromium plating, the spoon was transferred to a 24 carat proprietary gold strike solution wherein plating was conducted for 15 seconds at 25 amps per square foot. The spoon was cold tap water rinsed, followed by a rinsing in demineralized water and air dried. The spoon was placed in an electric air circulated oven for 30 minutes at a temperature of 750° F. When removed from the oven, the spoon had a dark, non-uniform, spotty appearance. When tested, the abrasion resistance was poor.

EXAMPLE 6

A brass pen cap was prepared for plating according to conventional procedures. The pen cap was then plated with copper, nickel and an outer chromium plate according to conventional procedures. After rinsing, the part was activated for 30 seconds in a proprietary chromium activating solution, cold water rinsed, and immersed in a 10% solution of sulfuric acid for five seconds and rinsed. The cap was transferred to a 23 carat alloy proprietary gold solution and plating was conducted for one minute at a current density of 60 amps per square foot. The pen cap was removed and rinsed in cold tap water, then distilled water, and air dried. It was then placed in an electric oven at 900° F. for 30 minutes. The pen cap, when removed from the oven, had a uniform golden appearance, darker in shade than the parts in the previous examples, the color approaching a bronze shade. The finish was hard and very abrasion resistant.

EXAMPLE 7

A brass pen cap was prepared for plating according to conventional procedures. The pen cap was then plated with copper, nickel and an outer chromium plate according to conventional procedures. After rinsing, the part was activated for 30 seconds in a proprietary chromium activating solution, cold water rinsed, and immersed in a 10% solution of sulfuric acid for five seconds, and rinsed. The cap was transferred to a 23 carat alloy proprietary gold solution and plating was conducted for one minute at a current density of 60 amps per square foot. The pen cap was removed and rinsed in cold tap water, then distilled water, and air dried. It was then placed in an electric oven at 980° F. for 30 minutes. The pen cap, when removed from the oven, had a non-uniform deep blue color. However, the abrasion resistance was good.

What is claimed is:

1. A process of gold plating an article having a chromium surface, which comprises cathodically treating said chromium surface in an aqueous activating solution having a temperature of from about room temperature to about 120° F. for about 15 seconds to about one minute and at a voltage of about six to about nine volts, whereby metallic oxides on said chromium surface are reduced,

rinsing said activated chromium surface, dipping said rinsed activated surface in an acid solution having a concentration of about 10% and rinsing in water, plating said activated chromium surface with gold in a gold plating solution for a period of time from about five to about ten seconds at a current density of from about 25 to 75 amps per square foot, rinsing said gold plated surface, and heat treating said plated surface at temperatures of from about 200° F. to about 900° F. for a period of time of from about two minutes to about two hours, whereby a gold plate is obtained having a thickness of from about one to about ten millionths of an inch on said chromium surface and which is hard, durable and adherent.

2. The process of claim 1 wherein said activating solution is at a temperature of from about 70° F. to about 85° F. and comprises sodium hydroxide, potassium cyanide and E.D.T.A.

3. The process of claim 1 wherein said gold plating is conducted for a period of from about one second to about four minutes and current densities of from about 10 to about 100 amps per square foot.

4. The process of claim 1 wherein said gold plating solution is an alloy gold solution.

5. The process of claim 1 wherein said heat treatment of said gold plated surface is at temperatures of from about 700° F. to about 760° F. for a period of time of from about 30 minutes to about two hours.

6. The process of claim 1 wherein said chromium surface is chromium plate.

7. The process of claim 1 wherein said chromium surface is chromium plate on an underplate of a metal other than chromium.

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HOWARD S. WILLIAMS, Primary Examiner

T. TUFARIELLO, Assistant Examiner

U.S. Cl. X.R.

29—199; 204—37, 41, 46, 141