ELECTROPLATING BRIGHT GOLD

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This invention relates to improvements in the process of producing an electrochemical alloy gold plate and to the electrolyte for producing the same.

Among the objects of the invention is to provide a process and an electrolyte bath for producing a ductile, hard, corrosion and abrasion-resistant gold or gold alloy deposit of pale uniform color which deposit is bright as it is removed from the bath.

Among other objects of the invention is to provide a stable electroplating bath which is easily maintained, has good throwing power and is capable of producing uniform deposition when the temperature, pH, current density, agitation or cathode to anode ratio varies somewhat.

These objects and others ancillary thereto are obtained by providing a relatively weak acid bath containing (1) a weak, stable, organic acid, (2) gold as a cyanide (potassium gold cyanide, for example), and (3) one or more base metal salts soluble in the bath.

Examples of acids which may be employed are formic, acetic, citric, tartaric, lactic, kojic, or similar acids and mixtures of these acids. The acid should be present in proportions of about 10 to 150 grams per liter and may be partially neutralized with ammonium or alkali hydroxide to give a pH of about 3–5. It is this weak organic acid and the procedure of maintaining the bath within a limited pH range that produces the desired effect of a gold alloy deposition.

The gold may be added as the double cyanide of gold and an alkali metal, potassium gold cyanide for example, and may be present in proportions of about 1 gram per liter to 15 grams per liter of gold.

Base metal salts which may be added comprise the sulfates, sulfamates, formates, acetates, citrates, lactates, tartrates, fluoroborates, borates, phosphates, etc., of nickel, zinc, cobalt, indium, iron, manganese, antimony, copper, etc. These metal salts are added in the proportion of from 1 to 50 grams per liter. Very satisfactory results are obtained when two of such base metal salts are included in the bath. Although the addition of base metal salt is necessary, it does not matter which salt or mixture of salts is added as long as the added salts are soluble and compatible with all other bath ingredients.

The bath may be operated at a current density of 1 to 100 amperes per square foot. Moderate to rapid agitation improves the operation. The bath may be operated at normal room temperature (70°F), which is advantageous because no thermocstatic regulation is necessary but higher or lower temperatures of from 50°F to 120°F may be employed. The maximum cathode/anode ratio should be about 4:1.

The deposits obtained have a pale yellow color of pure gold, but depending upon which base metal is added the deposit may have a greenish or yellow-orange tinge. The gold deposits are from about 21 to 23 karat gold.

The invention both as to its organization and its method of operation, together with additional objects and advantages thereof, will best be understood from the following description of specific embodiments thereof:

Example 1

An electrolytic bath is made by dissolving the following components:

<table>
<thead>
<tr>
<th>Component</th>
<th>G./liter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Citric acid plus sodium citrate</td>
<td>80</td>
</tr>
<tr>
<td>Gold (as potassium gold cyanide)</td>
<td>8</td>
</tr>
<tr>
<td>Nickel (as nickel sulfate)</td>
<td>2</td>
</tr>
<tr>
<td>Zinc (as zinc acetate)</td>
<td>0.5</td>
</tr>
<tr>
<td>Water</td>
<td>Remainder</td>
</tr>
</tbody>
</table>

The amount of sodium citrate is adjusted by adding it until the bath has a pH of 4 to 5. A clean and polished steel or other metal body is made the cathode in said bath, at a current density of 10 amperes per square foot, while the bath is maintained at a temperature of about 70°F.

The deposit obtained from this bath is hard, corrosion-resistant with a uniform, brilliant, pale yellow-green coloration. The gold deposits assay 23 karat gold. Deposits of thicknesses of 25 to 50 microns are readily obtained from this bath.

Example 2

An electrolytic bath is made by dissolving the following components:

<table>
<thead>
<tr>
<th>Component</th>
<th>G./liter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetic acid and sodium acetate</td>
<td>50</td>
</tr>
<tr>
<td>Gold (as cyanide)</td>
<td>4</td>
</tr>
<tr>
<td>Indium (as sulfamate)</td>
<td>5</td>
</tr>
<tr>
<td>Cobalt (as sulfate)</td>
<td>3</td>
</tr>
<tr>
<td>Water</td>
<td>Remainder</td>
</tr>
</tbody>
</table>

An alkali is added to the bath, if necessary, to give a pH of 3 to 4. A deposit obtained from this bath under conditions such as specified in Example 1 is hard, corrosion-resistant, and pale yellow in color. The deposit is 21 karat.

Example 3

An electrolytic bath is made by dissolving the following components:

<table>
<thead>
<tr>
<th>Component</th>
<th>G./liter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Citric acid and sodium citrate</td>
<td>80</td>
</tr>
<tr>
<td>Gold (as potassium gold cyanide)</td>
<td>8</td>
</tr>
<tr>
<td>Indium (as sulfamate)</td>
<td>5</td>
</tr>
<tr>
<td>Water</td>
<td>Remainder</td>
</tr>
</tbody>
</table>

The pH of the bath is adjusted to 3–4 by addition of more acid or alkali. The deposit obtained from this bath under conditions such as specified in Example 1 is hard, corrosion-resistant, and uniformly pale yellow in color. The fineness of the deposit is 21 karat.

In the above examples, tartaric acid, lactic acid, kojic acid, formic acid or similar organic acids may be substituted for the acetic or citric acid specified. Such baths are brought to the proper pH by the addition of an alkali or the acid in use.

The features and principles underlying the invention described above in connection with specific exemplifications will suggest to those skilled in the art many other modifications thereof. It is accordingly desired that the appended claims shall not be limited to any specific feature or details thereof.

I claim:

1. A method of electrodepositing bright gold which comprises electrolysing a solution consisting of 10–150 g./liter of a weak, stable, organic acid, partially neutralized with alkali to provide a pH of 3–5, 1–15 g./liter of gold added as a gold cyanide, and 1–50 g./liter of at least one soluble base metal salt.

2. A method as claimed in claim 1 in which said base metal salt comprises a nickel salt.

3. A method as claimed in claim 1 in which said base metal salt is a mixture of nickel and zinc salts.
4. A method as claimed in claim 1 in which said base metal salt comprises a zinc salt.

5. A method as claimed in claim 1 in which said base metal salt comprises an indium salt.

6. A method as claimed in claim 1 in which said base metal salt comprises a mixture of a cobalt salt and an indium salt.

7. An electrolyte for depositing bright gold coatings consisting of 10–150 g./liter of a weak, stable, organic acid partially neutralized with alkali to provide a pH of 3–5, 1–15 g./liter of gold added as a gold cyanide and 1–50 g./liter of at least one soluble base metal salt.

8. An electrolyte for depositing bright gold coatings with a greenish tinge consisting of about 80 g./liter of citrate radical neutralized with alkali to provide a pH of 4–5, about 1–15 g./liter of gold as potassium gold cyanide, about 3 g./liter of nickel as nickel sulfamate, and about 0.5 g./liter of zinc as zinc acetate.

9. An electrolyte for depositing bright pale yellow gold coatings consisting of about 50 g./liter of weak organic acid radical partially neutralized with alkali to provide a pH of 3–4, 1–15 g./liter of gold as cyanide gold, about 5 g./liter of indium as indium sulfate, and about 3 g./liter of cobalt as cobalt sulfate.

10. A method of electrodepositing bright gold which comprises electrolyzing a solution consisting of 10–150 g./liter of citric acid, partially neutralized with alkali to provide a pH of 3–5, 1–15 g./liter of gold added as a gold cyanide, and 1–50 g./liter of at least one soluble base metal salt.

11. A method of electrodepositing bright gold which comprises electrolyzing a solution consisting of 10–150 g./liter of acetic acid, partially neutralized with alkali to provide a pH of 3–5, 1–15 g./liter of gold added as a gold cyanide, and 1–50 g./liter of at least one soluble base metal salt.

12. An electrolyte for depositing bright gold coatings consisting of 10–150 g./liter of citric acid partially neutralized with alkali to provide a pH of 3–5, 1–15 g./liter of gold added as a gold cyanide and 1–50 g./liter of at least one soluble base metal salt.

13. An electrolyte for depositing bright gold coatings consisting of 10–150 g./liter of acetic acid partially neutralized with alkali to provide a pH of 3–5, 1–15 g./liter of gold added as a gold cyanide and 1–50 g./liter of at least one soluble base metal salt.

14. An electrolyte for depositing bright gold as claimed in claim 7 in which said base metal salt comprises a nickel salt.

15. An electrolyte for depositing bright gold as claimed in claim 7 in which said base metal salt comprises a mixture of nickel and zinc salts.

16. An electrolyte for depositing bright gold as claimed in claim 7 in which said base metal salt comprises a zinc salt.

17. An electrolyte for depositing bright gold as claimed in claim 7 in which said base metal salt comprises an indium salt.

18. An electrolyte for depositing bright gold as claimed in claim 7 in which said base metal salt comprises a mixture of a cobalt salt and an indium salt.

References Cited in the file of this patent

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