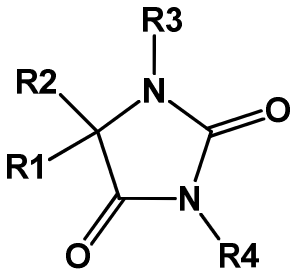
Claims

1. Aqueous cyanide-free electrolyte for the electrolytic deposition of silver and silver alloy coatings, which has the following constituents in dissolved form:

a) at least one silver compound in a concentration of 0.1 - 150 g/l silver,

b) at least one compound of an alloy metal in a concentration of 0 to 100 g/l alloy metal,

c) at least one compound of formula (I)



(I)

wherein

R1, R2, R3 and R4 independently represent hydrogen, a linear or branched alkyl group having 1 to 5 carbon atoms, an alkoxy group having 1 to 5 carbon atoms, a hydroxyalkyl group having 1 to 5 carbon atoms or an aryl group,

and

wherein the at least one compound of formula (I) is present in a concentration of 1 to 350 g/l,

d) at least one brightener carrier selected from

i. at least one amino acid in a concentration of 0.0001 - 5 mol/l, in particular 0.01 - 5 mol/l,

and/or

ii. at least one pyridinecarboxylic acid in a concentration of 0.01 - 5 mol/l

e) at least one brightening agent selected from sulfonamide, 2,2'-sulfanediyldiethanol, cysteine, methionine, aliphatic and aromatic heterocyclic compounds having 5 to 7 ring atoms, wherein the sulfonamide has R_1-SO_2-NR_2R_3 as structural element, and

wherein R_1, R_2 and R_3, independently of one another, is (C_1-C_{10}) alkyl, (C_3-C_{10}) cycloalkyl, (C_6-C_{10}) aryl, (C_5-C_{10}) heteroaryl, (C_5-C_{10}) heterocycloalkyl or is selected

from sulfonamides substituted with a (C_6 to C_{10}) aryl radical, which bears an amino group in the para position on the aryl radical,

wherein the ring of the aliphatic and aromatic heterocyclic compounds contains at least one heteroatom selected from nitrogen and sulfur, and wherein the aliphatic and aromatic heterocyclic compounds optionally contain one or more further heteroatoms selected from nitrogen, oxygen and sulfur, and also mixtures of these brightening agents, wherein the concentration of the brightening agent or of the mixture of brightening agents is 0.005-25 g/l,

wherein, if the at least one brightening agent is selected from cysteine and/or methionine and at least one amino acid according to d)i) is selected as brightener carrier, the brightener carrier amino acid is neither cysteine nor methionine,

f) an alkali metal hydroxide selected from lithium hydroxide, sodium hydroxide, potassium hydroxide and mixtures thereof in a concentration of 1 - 200 g/l,

g) wherein the electrolyte has a pH of greater than or equal to 7.

~~2. Electrolyte according to claim 1,~~

~~characterized in that~~

~~the sulfonamide has R_1-SO_2-NR_2R_3 as structural element,~~

~~wherein~~

~~R_1, R_2 and R_3, independently of one another, is (C_1-C_{10}) alkyl, (C_3-C_{10}) cycloalkyl, (C_6-C_{10}) aryl, (C_5-C_{10}) heteroaryl, (C_5-C_{10}) heterocycloalkyl.~~

2. ~~3.~~ Electrolyte according to claim 1 ~~and/or 2~~,

characterized in that

the silver compound is selected from silver methanesulfonate, silver carbonate, silver phosphate, silver pyrophosphate, silver nitrate, silver oxide, silver lactate, silver fluoride, silver bromide, silver chloride, silver iodide and silver sulfate.

3. ~~4.~~ Electrolyte according to one of the preceding claims,

characterized in that

the compound of the at least one alloy metal is selected from compounds of tin, palladium, antimony, cobalt, indium, iron, nickel, ruthenium, rhodium, platinum, copper, zinc, selenium, tellurium, bismuth, iridium, germanium, gallium, rhenium, tungsten, molybdenum, dysprosium, cerium and gold.

4. ~~5.~~ Electrolyte according to one of the preceding claims,

characterized in that

the at least one compound of formula (I) is selected from 1-methylhydantoin, 1,3-dimethylhydantoin, 5,5-dimethylhydantoin, 1-hydroxymethyl-5,5-dimethylhydantoin, 5,5'-diethylhydantoin and 5,5-diphenylhydantoin and mixtures thereof.

5. ~~6.~~ Electrolyte according to one of the preceding claims,

characterized in that

the at least one amino acid is selected from glycine, alanine, proline and sarcosine and mixtures thereof.

6. ~~7.~~ Electrolyte according to one of the preceding claims,

characterized in that

the at least one pyridinecarboxylic acid is selected from picolinic acid, picolinic acid amide, nicotinic acid, nicotinamide, isonicotinic acid, isonicotinamide and mixtures thereof.

7. ~~8.~~ Method for the electrolytic deposition of silver coatings and silver alloy coatings from an electrolyte according to claims 1 to 6 ~~7~~,

characterized in that

an electrically conductive substrate is immersed in the electrolyte and a flow of current is established between an anode in contact with the electrolyte and the substrate as cathode.

8. ~~9.~~ Method according to claim 7 ~~8~~,

characterized in that

the temperature of the electrolyte is 20°C to 90°C.

9. ~~10.~~ Method according to any of claims 7 to 8 ~~8 to 9~~,

characterized in that

the current density during electrolysis is 0.2 to 100 A/dm^2.

10. ~~11.~~ Method according to any of claims 7 to 9 ~~8 to 10~~,

characterized in that

the pH is continuously adjusted to a range between 9 and 11 during the electrolysis.

11. ~~12.~~ Method according to any of claims 7 to 10 ~~8 to 11~~,

characterized in that

a soluble silver anode and/or an insoluble anode is used as anode.