Patent claims

1. Mixture containing

   a) metal oxide particles and, if applicable, metal particles, characterised in that the weight ratio of metal particles to metal oxide particles is at most 6 to 1, and

   b) an organic compound represented by Formula I:

   $$R^1\text{-}COR^2 \qquad (I),$$

   whereby R^1 is an aliphatic residue having 8 to 32 carbon atoms, and R^2 is either –OM or comprises the moiety $–X\text{-}R^3$, whereby X is selected from the group consisting of O, S, N-R^4, whereby R^4 is a hydrogen atom or an aliphatic residue, R^3 is a hydrogen atom or an aliphatic residue, and M is a cation.

2. Mixture according to claim 1, characterised in that the metal oxide particles are fully or partly coated with organic compound b).

3. Mixture according to any one or more of the claims 1 or 2, characterised in that the organic compound b) is a C_8-C_{30} fatty acid, preferably a C_8-C_{24} fatty acid, more preferably a C_{12}-C_{18} fatty acid or a derivative thereof.

4. Mixture according to any one or more of the claims 1 to 3, characterised in that the average primary particle size of the metal oxide particles coated with organic compound b) is between 0.1 and 3.0 µm, preferably between 0.3 and 2.5 µm.

5. Mixture according to any one or more of the claims 1 to 4, characterised in that the fraction of metal particles is less than 30 % by weight, preferably less than 10 % by weight, more preferably less than 2 % by weight, specifically between 0.01 % by weight and 2.0 % by weight, each relative to the total weight of the mixture.

6. Mixture according to any one or more of the claims 1 to 5, characterised in that the metal oxide particles are selected from the group consisting of copper oxide, silver oxide, and palladium oxide.

7. Mixture according to any one or more of the claims 1 to 6, characterised in that the metal particles are selected from the group consisting of copper, silver, and palladium, whereby it

is preferred that silver is present together with silver oxide or copper is present together with copper oxide or palladium is present together with palladium oxide.

8. Mixture according to any one or more of the claims 1 to 7, characterised in that the mixture is a paste, which, in addition, comprises a dispersing agent c).

9. Mixture according to claim 8, characterised in that dispersing agent c) is selected from the group consisting of alpha-terpineol, beta-terpineol, gamma-terpineol, delta-terpineol, mixtures of the afore-mentioned terpineols, N-methyl-2-pyrrolidone, ethylene glycol, dimethylacetamide, 1-tridecanol, 2-tridecanol, 3-tridecanol, 4-tridecanol, 5-tridecanol, 6-tridecanol, isotridecanol, dibasic esters, preferably dimethylesters of glutaric, adipinic or succinic acid or mixtures thereof, glycerol, diethylene glycol, triethylene glycol or mixture thereof.

10. Mixture according to any one or more of the claims 1 to 9, characterised in that the fraction of glass is less than 2 % by weight, preferably less than 0.5 % by weight, in particular 0.0 to 0.3 % by weight, each relative to the total weight of the mixture.

11. Mixture according to any one or more of the claims 1 to 10, characterised in that the metal oxide is silver oxide.

12. Mixture according to any one or more of the claims 1 to 11, characterised in that the mixture contains an amount of silver oxide of 60 to 95 % by weight, preferably 70 to 90 % by weight, each relative to the total weight of the mixture.

13. Mixture according to any one or more of the claims 1 to 12, characterised in that the mixture is a polymer that comprises oxygen atoms.

14. Method for connecting a component having a first surface to a substrate having at least a second surface comprising the following steps:

a) contracting the component via the first surface to the substrate via at least a second surface by means of a mixture according to any one or more of the claims 1 to 13, whereby the mixture is situated between the first surface of the component and the second surface of the substrate, to obtain a structure, and

b) heating the structure.

15. Method according to claim 14, characterised in that at least one of the surfaces contains at least one metal selected from the group consisting of copper, nickel, gold, aluminium, and silver.

16. Method according to claim 15, characterised in that the fraction of the volume formed by the product of the at least one surface and a depth of 1 µm accounted for by the at least one metal is at least 50 % by weight, preferably at least 90 % by weight, in particular 100 % by weight, each relative to the total weight of the metals in said volume.

17. Method according to any one or more of the claims 14 to 16, characterised in that the at least one surface comprises one or more metals selected from the group consisting of nickel and aluminium.

18. Method according to any one or more of the claims 14 to 17, characterised in that the at least one surface is fully or partly covered with a carbon-containing compound.

19. Method according to any one or more of the claims 14 to 18, characterised in that the carbon-containing compound is a polymer.

20. Method according to any one or more of the claims 14 to 19, characterised in that the mixture comprises 60 to 95 % by weight metal oxide particles, in particular silver oxide particles, which are preferably coated with organic compound b), and in that the heating, preferably the sintering, of the structure proceeds at a process pressure of 5 to 20 MPa, preferably at 7 to 15 MPa.

21. Method according to any one or more of the claims 14 to 19, characterised in that the mixture comprises 10 to 80 % by weight metal particles, in particular silver particles, which are preferably coated with organic compound b), and in that the heating, preferably the sintering, of the structure proceeds at a process pressure of 0 MPa to 3 MPa, preferably 1 MPa to 2.5 MPa, is preferred.

22. Module comprising

i) an electronic component having a first surface,

ii) a substrate having at least one second surface, and

iii) a mixture according to any one or more of the claims 1 to 13 that directly contacts the first surface and the second surface.

23. Module according to claim 20, characterised in that the mixture is sintered.

24. Module according to any one or more of the claims 20 and 21, characterised in that at least one surface is selected from the group consisting of copper, silver, gold, nickel, and aluminium.

25. Module according to any one or more of the claims 20 to 22, characterised in that at least one surface is fully or partly covered with a carbon-containing compound.

26. Method for producing the mixture according to any one or more of the claims 1 to 13, characterised in that the metal oxide particles and, if applicable, the metal particles are being mixed with organic compound b).

Patent claims

1. Mixture containing

   a) silver oxide particles and, if applicable, silver particles, characterised in that the weight ratio of silver particles to silver oxide particles is at most 6 to 1, and

   b) an organic compound represented by Formula I:

   $$R^1\text{-}COR^2 \qquad (I),$$

   whereby R^1 is an aliphatic residue having 8 to 32 carbon atoms, and R^2 is either –OM or comprises the moiety $–X\text{-}R^3$, whereby X is selected from the group consisting of O, S, N-R^4, whereby R^4 is a hydrogen atom or an aliphatic residue, R^3 is a hydrogen atom or an aliphatic residue, and M is a cation, and

   wherein the mixture comprises 0.05 to 2.0 % by weight of a polymer selected from the group consisting of methylcellulose, ethylcellulose, ethylmethylcellulose, carboxycellulose, hydroxypropylcellulose, hydroxyethylcellulose, hydroxymethylcellulose or mixtures thereof .

2. Mixture according to claim 1, characterised in that the silver oxide particles are fully or partly coated with organic compound b).

3. Mixture according to any one or more of the claims 1 or 2, characterised in that the organic compound b) is a C_8-C_{30} fatty acid, preferably a C_8-C_{24} fatty acid, more preferably a C_{12}-C_{18} fatty acid or a derivative thereof.

4. Mixture according to any one or more of the claims 1 to 3, characterised in that the average primary particle size of the silver oxide particles coated with organic compound b) is between 0.1 and 3.0 µm, preferably between 0.3 and 2.5 µm.

5. Mixture according to any one or more of the claims 1 to 4, characterised in that the fraction of silver particles is less than 30 % by weight, preferably less than 10 % by weight, more preferably less than 2 % by weight, specifically between 0.01 % by weight and 2.0 % by weight, each relative to the total weight of the mixture.

6. Mixture according to any one or more of the claims 1 to 5, characterised in that the mixture is a paste, which, in addition, comprises a dispersing agent c).

7. Mixture according to claim 6, characterised in that dispersing agent c) is selected from the group consisting of alpha-terpineol, beta-terpineol, gamma-terpineol, delta-terpineol, mixtures of the afore-mentioned terpineols, N-methyl-2-pyrrolidone, ethylene glycol, dimethylacetamide, 1-tridecanol, 2-tridecanol, 3-tridecanol, 4-tridecanol, 5-tridecanol, 6-tridecanol, isotridecanol, dibasic esters, preferably dimethylesters of glutaric, adipinic or succinic acid or mixtures thereof, glycerol, diethylene glycol, triethylene glycol or mixture thereof.

8. Mixture according to any one or more of the claims 1 to 7, wherein the mixture further comprises glass having a fraction of less than 2 % by weight, preferably less than 0.5 % by weight, in particular 0.0 to 0.3 % by weight, each relative to the total weight of the mixture.

9. Mixture according to any one or more of the claims 1 to 8, characterised in that the mixture contains an amount of silver oxide of 60 to 95 % by weight, preferably 70 to 90 % by weight, each relative to the total weight of the mixture.

10. Method for connecting a component having a first surface to a substrate having at least a second surface comprising the following steps:

a) contacting the component via the first surface to the substrate via at least a second surface by means of a mixture according to any one or more of the claims 1 to 9, whereby the mixture is situated between the first surface of the component and the second surface of the substrate, to obtain a structure, and

b) heating the structure.

11. Method according to claim 10, characterised in that at least one of the surfaces contains at least one metal selected from the group consisting of copper, nickel, gold, aluminium, and silver.

12. Method according to claim 11, characterised in that the fraction of the volume formed by the product of the at least one surface and a depth of 1 µm accounted for by the at least one metal is at least 50 % by weight, preferably at least 90 % by weight, in particular 100 % by weight, each relative to the total weight of the metals in said volume.

13. Method according to any one or more of the claims 10 to 12, characterised in that the at least one surface comprises one or more metals selected from the group consisting of nickel and aluminium.

14. Method according to any one or more of the claims 10 to 13, characterised in that the at least one surface is fully or partly covered with a carbon-containing compound.

15. Method according to any one or more of the claims 10 to 14, characterised in that the carbon-containing compound is a polymer.

16. Method according to any one or more of the claims 10 to 15, characterised in that the mixture comprises 60 to 95 % by weight silver oxide particles which are preferably coated with organic compound b), and in that the heating, preferably the sintering, of the structure proceeds at a process pressure of 5 to 20 MPa, preferably at 7 to 15 MPa.

17. Method according to any one or more of the claims 10 to 16, characterised in that the mixture comprises 10 to 30 % by weight silver particles which are preferably coated with organic compound b), and in that the heating, preferably the sintering, of the structure proceeds at a process pressure of 0 MPa to 3 MPa, preferably 1 MPa to 2.5 MPa, is preferred.

18. Module comprising

i) an electronic component having a first surface,

ii) a substrate having at least one second surface, and

iii) a mixture according to any one or more of the claims 1 to 9 that directly contacts the first surface and the second surface.

19. Module according to claim 16, characterised in that the mixture is sintered.

20. Module according to any one or more of the claims 16 and 17, characterised in that at least one surface is selected from the group consisting of copper, silver, gold, nickel, and aluminium.

21. Module according to any one or more of the claims 16 to 18, characterised in that at least one surface is fully or partly covered with a carbon-containing compound.

22. Method for producing the mixture according to any one or more of the claims 1 to 9, characterised in that the silver oxide particles and, if applicable, the silver particles are being mixed with organic compound b).