CLAIMS

What is claimed is:

1. An electrically conductive printable composition comprising, in combination:

silver particles;

a dispersing agent;

a solvent;

a first surfactant, comprising a hydrocarbon based surfactant; and

a second surfactant, comprising a fluoro-based surfactant.

2. The electrically conductive printable composition of Claim 1 further comprising water.

3. The electrically conductive printable composition of Claim 2 further comprising an additional additive, wherein the additional additive is a water soluble block copolymer.

4. The electrically conductive printable composition of Claim 3 wherein the copolymer is a tri-block copolymer.

5. The electrically conductive printable composition of Claim 1 further comprising a substrate, wherein the composition is applied to a surface of the substrate.

6. The electrically conductive printable composition of Claim 1 wherein the dispersing agent is one or more of a polyvinylpyrrolidone, a block copolyether, and a block copolyether with polystyrene blocks.

7. The electrically conductive printable composition of Claim 6 wherein the solvent is a co-solvent comprising 1,2 propanediol and a 2-pyrrolidone.

8. The electrically conductive printable composition of claim 6 wherein the solvent is one of ethylene glycol and 2-methyl-1,3-propanediol.

9. The electrically conductive printable composition of Claim 7 wherein the silver particles are silver nanoparticles having a maximum diameter of 150 nm.

10. The electrically conductive printable composition of Claim 7 wherein the silver particles are silver nanoparticles having a mean diameter of 40-80 nm.

11. The electrically conductive printable composition of Claim 9 wherein the first surfactant is one or more of an ethoxylated decyn-diol, an alkyl diphenyloxide disulfonate, and a dioctyl sodium sulfosucccinate.

12. The electrically conductive printable composition of Claim 11 wherein the second surfactant is one or more of a fluorinated polyoxetane and a fluoroaliphatic polymeric ester.

13. The electrically conductive printable composition of Claim 1 wherein:

the first surfactant is one or more of Surfynol 2502, Surfynol 485, Surfynol TG, Surfynol 465, Dowfax 8390, Dowfax 2A1 and Aerosol OT-75; and

the second surfactant is one or more of Polyfox 151N, Polyfox 154N, Novec FC 4430 and Novec FC 4432.

14. The electrically conductive printable composition of Claim 1 wherein

10-60 wt% by weight of the composition are the silver particles;

0.1 to 15 wt% by weight of the composition is the dispersing agent;

5-40 wt% by weight of the composition is the solvent; and

the first surfactant and the second surfactant combined are less than 1 wt% of the weight of the composition.

15. The electrically conductive printable composition of Claim 14 wherein at least 30 wt% by weight of the composition is water.

CLAIMS

What is claimed is:

1. An electrically conductive printable composition comprising, in combination:
silver particles;
a dispersing agent;
a solvent;
a first surfactant, comprising a hydrocarbon based surfactant; and
a second surfactant, comprising a fluoro-based surfactant.

2. The electrically conductive printable composition of Claim 1 further comprising water.

3. The electrically conductive printable composition of Claim 2 further comprising an additional additive, wherein the additional additive is a water soluble block copolymer.

4. The electrically conductive printable composition of Claim 3 wherein the copolymer is a tri-block copolymer.

5. The electrically conductive printable composition of Claim 1 further comprising a substrate, wherein the composition is applied to a surface of the substrate.

6. The electrically conductive printable composition of Claim 1 wherein the dispersing agent is one or more of a polyvinylpyrrolidone, a block copolyether, and a block copolyether with polystyrene blocks.

7. The electrically conductive printable composition of Claim 6 wherein the solvent is a co-solvent comprising 1 ,2 propanediol and a 2-pyrrolidone.

8. The electrically conductive printable composition of claim 6 wherein the solvent is one of ethylene glycol and 2-methyl-1 ,3-propanediol.

9. The electrically conductive printable composition of Claim 7 wherein the silver particles are silver nanoparticles having a maximum diameter of 150 nm.

10. The electrically conductive printable composition of Claim 7 wherein the silver particles are silver nanoparticles having a mean diameter of 40-80 nm.

11. The electrically conductive printable composition of Claim 9 wherein the first surfactant is one or more of an ethoxylated decyn-diol, an alkyl diphenyloxide disulfonate, and a dioctyl sodium sulfosucccinate.

12. The electrically conductive printable composition of Claim 11 wherein the second surfactant is one or more of a fluorinated polyoxetane and a fluoroaliphatic polymeric ester.

13. The electrically conductive printable composition of Claim 1 wherein:
the first surfactant is one or more of Surfynol 2502 (1,4-dimethyl-1,4-bis(2-methylpropyl)-2-butyne-1,4-diyl ether), Surfynol 485 (ethoxylated 2,4,7,9-tetramethyl 5 decyn-4,7-diol), Surfynol TG (alkylarylalkoxylate (30-60 % by weight), ethylene glycol (16 % by weight), acetylenic diol (30-60 % by weight)), Surfynol 465 (ethoxylated 2,4,7,9-tetramethyl 5 decyn-4,7-diol), Dowfax 8390 (mixture of sodium hexadecyl diphenyl oxide disulfonate, sodium hexadecyl diphenyl oxide monosulfonate, sodium dihexadecyl diphenyl oxide monosulfonate and sodium dihexadecyl diphenyl oxide disulfonate (50 % by weight solution in water)), Dowfax 2A1 (mixture of sodium dodecyl diphenyl oxide disulfonate, sodium dodecyl diphenyl oxide monosulfonate, sodium didodecyl diphenyl oxide monosulfonate and sodium didodecyl diphenyl oxide disulfonate (50 % by weight solution in water)) and Aerosol OT-75 (sodium dioctysulfosuccinate (75 % by weight solution in water/ethanol)); and

the second surfactant is one or more of Polyfox 151 N (oxetane-based fluorocarbon surfactant having the formula HO-[CH_2-C(CH_3)($CH_2OCH_2CF_2CF_3$)-CH_2]$_x$-[CH_2CH_2O]$_{20}$-[CH_2-C(CH_3)($CH_2OCH_2CF_2CF_3$)-CH_2]$_{8-x}$ with x = 0-8 (50 % by weight solution in water/diethylene glycol monobutyl ether)), Polyfox 154N (oxetane-based fluorocarbon surfactant having the formula HO-[CH_2-C(CH_3)(CH_2O-$CH_2CF_2CF_3$)-CH_2]$_x$-[CH_2CH_2O]$_{33}$-[CH_2-C(CH_3)($CH_2OCH_2CF_2CF_3$)-CH_2]$_{8-x}$ with x = 0-8 (50 % by weight solution in water/diethylene glycol monobutyl ether)), Novec FC 4430 (2-Propenoic acid, 2-[methyl[(nonafluorobutyl)sulfonyl]amino]ethyl ester, telomer with methyloxirane polymer with oxirane di-2-propenoate) and Novec FC 4432 (2-Propenoic acid, 2-[methyl[(1,1,2,2,3,3,4,4,4-nonafluorobutyl)sulfo-nyl]amino]ethyl ester, telomer with 3-mercapto-1,2-propanediol, 2-methyl-oxirane polymer with oxirane di-2-propenoate)).

14. The electrically conductive printable composition of Claim 1 wherein
10-60 wt% by weight of the composition are the silver particles;
0.1 to 15 wt% by weight of the composition is the dispersing agent;
5-40 wt% by weight of the composition is the solvent; and
the first surfactant and the second surfactant combined are less than 1 wt% of the weight of the composition.

15. The electrically conductive printable composition of Claim 14 wherein at least 30 wt% by weight of the composition is water.