CLAIMS

1. A method for adjusting work function of a metal nanostructure-based conductive film, the method comprising:

providing a plurality of metal nanostructures, each metal nanostructure having an outer surface; and

forming a dipole surface layer on the outer surface of the metal nanostructure, wherein the dipole surface layer includes a plurality of dipole ligands.

2. The method of claim 1 wherein forming the dipole surface layer on the outer surface of the metal nanostructure includes:

forming an ink composition that comprises the plurality of metal nanostructures and the plurality of dipole ligand, and

coating the ink composition on a substrate to provide the conductive film.

3. The method of claim 1 or claim 2, wherein adjusting work function includes increasing the work function by about 0.8-1.2 eV as compared to a conductive film form of metal nanostructures without a dipole surface layer.

4. The method of any one of claims 1-3, wherein the dipole ligand is a polar molecule.

5. The method of claim 4 wherein the polar molecule is a surfactant.

6. The method of claim 5 wherein the surfactant is an anionic fluorosurfactant.

7. The method of any one of claims 1-6 wherein the dipole ligand is lithium carboxylate anionic fluorosurfactant.

8. An ink composition comprising:

a plurality of metal nanowires, and

a dipole ligand, wherein the dipole ligand is present at about 10^{-6} to 10^{-4} moles per m^2 surface area of the metal nanostructures.

9. The ink composition of claim 8 wherein the dipole ligand is present at about 10^{-5} to 10^{-4} moles per m^2 surface area of the metal nanostructures.

10. The ink composition of claim 8 or claim 9 wherein the metal nanostructures are silver nanowires.

11. The ink composition of any one of claims 8-10 wherein the dipole ligand is an anionic fluorosurfactant.

12. The ink composition of claim 11 wherein the anionic fluorosurfactant is a lithium carboxylate anionic fluorosurfactant.

13. The ink composition of any one of claims 8-12, further comprising: a surfactant, wherein a weight ratio of the plurality of the metal nanowires and the surfactant is in a range of 560:1 to 5:1.

14. The ink composition of any one of claims 8-13, further comprising a viscosity modifier.

15. The ink composition of claim 14 wherein the viscosity modifier is HPMC.

16. An organic light emitting diode (OLED) device comprising:

a cathode,

an anode, and

an organic emissive stack disposed between the cathode and the anode,

wherein the anode includes a conductive film of a plurality of metal nanostructures, each metal nanostructure having an outer surface and a dipole surface layer disposed on the outer surface, and wherein the dipole surface layer includes a plurality of dipole ligands.

17. The OLED device of claim 16, wherein the dipole ligands are present at 10^{-6} to 10^{-4} moles per m^2 surface area of the metal nanostructures.

18. The OLED device of claim 16, wherein the dipole ligands are present at 10^{-5} to 10^{-4} moles per m^2 surface area of the metal nanostructures.

19. The OLED device of any one of claims 16-18, wherein the dipole ligands are anionic surfactants

20. The OLED device of any one of claims 17-19, wherein the anode has a work function of 5.2-5.7 eV.

CLAIMS

1. A method for adjusting work function of a metal nanostructure-based conductive film, the method comprising:

providing a plurality of metal nanostructures, each metal nanostructure having an outer surface; and

forming a dipole surface layer on the outer surface of the metal nanostructure, wherein the dipole surface layer includes a plurality of dipole ligands, and wherein the dipole ligands are present at about 10^{-6} to 10^{-4} moles per m^2 surface area of the metal nanostructures.

2. The method of claim **1** wherein forming the dipole surface layer on the outer surface of the metal nanostructure includes:

forming an ink composition that comprises the plurality of metal nanostructures and the plurality of dipole ligand, and

coating the ink composition on a substrate to provide the conductive film.

3. The method of claim **1**, wherein adjusting work function includes increasing the work function by about 0.8-1.2 eV as compared to a conductive film form of metal nanostructures without a dipole surface layer.

4. The method of claim **1**, wherein the dipole ligand is a polar molecule.

5. The method of claim **4** wherein the polar molecule is a surfactant.

6. The method of claim **5** wherein the surfactant is an anionic fluorosurfactant.

7. The method of claim **1** wherein the dipole ligand is lithium carboxylate anionic fluorosurfactant.

8. An ink composition comprising:

a plurality of metal nanowires, and

a plurality of dipole ligands, wherein the dipole ligands are present at about 10^{-6} to 10^{-4} moles per m^2 surface area of the metal nanostructures.

9. The ink composition of claim **8** wherein the dipole ligands are present at about 10^{-5} to 10^{-4} moles per m^2 surface area of the metal nanostructures.

10. The ink composition of claim **8** wherein the metal nanostructures are silver nanowires.

11. The ink composition of claim **8** wherein the dipole ligand is an anionic fluorosurfactant.

12. The ink composition of claim **11** wherein the anionic fluorosurfactant is a lithium carboxylate anionic fluorosurfactant.

13. The ink composition of claim **8**, further comprising: a surfactant, wherein a weight ratio of the plurality of the metal nanowires and the surfactant is in a range of 560:1 to 5:1.

14. The ink composition of claim **8**, further comprising a viscosity modifier.

15. The ink composition of claim **14** wherein the viscosity modifier is HPMC.

16. An organic light emitting diode (OLED) device comprising:

a cathode,

an anode, and

an organic emissive stack disposed between the cathode and the anode,

wherein the anode includes a conductive film of a plurality of metal nanostructures, each metal nanostructure having an outer surface and a dipole surface layer disposed on the outer surface, and wherein the dipole surface layer includes a plurality of dipole ligands, and wherein the dipole ligands are present at about 10^{-6} to 10^{-4} moles per m^2 surface area of the metal nanostructures.

17. The OLED device of claim **16**, wherein the dipole ligands are present at 10^{-5} to 10^{-4} moles per m^2 surface area of the metal nanostructures.

18. The OLED device of claim **16**, wherein the dipole ligands are anionic surfactants.

19. The OLED device of claim **16**, wherein the anode has a work function of 5.2-5.7 eV.

20. A method for adjusting work function of a metal nanostructure-based conductive film, the method comprising:

providing a plurality of metal nanostructures, each metal nanostructure having an outer surface; and

forming a dipole surface layer on the outer surface of the metal nanostructure, wherein the dipole surface layer includes a plurality of dipole ligands, wherein adjusting work function includes increasing the work function by about 0.8-1.2 eV as compared to a conductive film form of metal nanostructures without a dipole surface layer.

21. The method of claim **20** wherein the dipole ligand is a fluorosurfactant.

22. A transparent electrode comprising: a conductive film having a plurality of metal nanostructures, each metal nanostructure having an outer surface and a dipole surface layer disposed on the outer surface, wherein the dipole surface layer includes a plurality of dipole ligands and wherein the transparent electrode has a work function of 5.2-5.7 eV.

23. An organic light emitting diode (OLED) device comprising the transparent electrode of claim **22**.