CLAIMS

1. Sensitized aqueous composite paste for a photoelectrode or a photoelectrochemical cell comprising metal oxide particles, a photosensitizer, and ~~optionally~~ carbon nanotubes.

2. Sensitized aqueous composite paste according to claim 1, wherein the metal oxide particles comprise oxide of a metal selected from Group 4 to Group 14 of the Periodic Table of Elements.

3. Sensitized aqueous composite paste according to claim 1 or 2, wherein the metal oxide particles comprise oxide of a metal selected from the group consisting of titanium, zinc, tin, iron, tungsten, and combinations thereof.

4. Sensitized aqueous composite paste according to any one of claims 1 to 3, wherein the metal oxide particles are selected from the group consisting of ZnO, TiO_2, Fe_2O_3, WO_3, and combinations thereof.

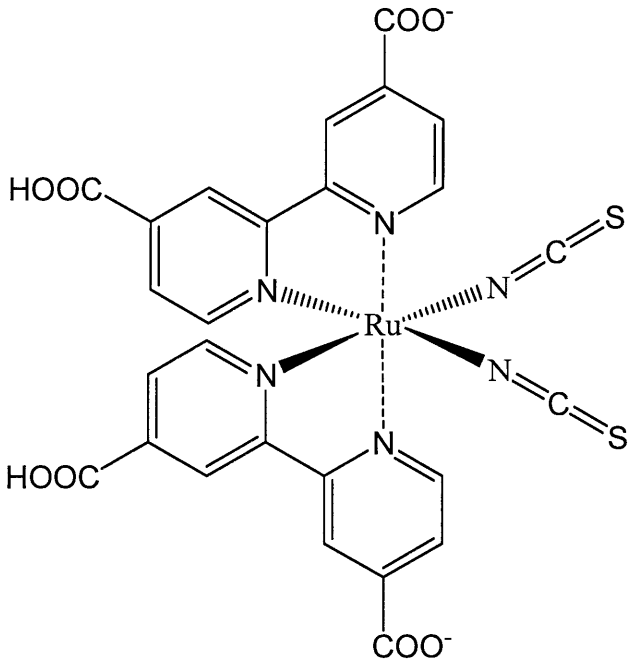
5. Sensitized aqueous composite paste according to any one of claims 1 to 4, wherein the metal oxide particles comprise or consist of ZnO.

6. Sensitized aqueous composite paste according to any one of claims 1 to 5, wherein the metal oxide particles are metal oxide nanoparticles.

7. Sensitized aqueous composite paste according to any one of claims 1 to 6, wherein the photosensitizer is selected from the group consisting of an organic dye, a metal-complex dye, polymers capable of producing free electrons under light irradiance, chromophores, and combinations thereof.

8. Sensitized aqueous composite paste according to claim 7, wherein the metal-complex dye is a ruthenium-based dye.

9. Sensitized aqueous composite paste according to claim 8, wherein the ruthenium-based dye has formula



$(Bt_4N)_2^{2+}$

10. Method for manufacturing a sensitized aqueous composite paste according to any one of claims 1 to 9, the method comprising

a) providing metal oxide particles, optionally grinding the metal oxide particles;

b) mixing the metal oxide particles with an aqueous solution, preferably deionized water, to form a paste-like mixture;

c) adding a photosensitizer to the paste-like mixture in the dark;

d) ~~optionally~~ adding carbon nanotubes to the paste-like mixture; and

e) mixing evenly to form the sensitized aqueous composite paste.

11. Method according to claim 10, wherein the photosensitizer is added in a drop-wise manner to the paste-like mixture.

12. Method according to claim 10 or 11, wherein the carbon nanotubes is added to the paste-like mixture after the photosensitizer has been added.

13. Method for manufacturing a photoelectrode, the method comprising

a) providing a sensitized aqueous composite paste according to any one of claims 1 to 9 or a sensitized aqueous composite paste manufactured by a method according to any one of claims 10 to 12;

b) depositing the sensitized aqueous composite paste on an electrically conducting substrate to form a sensitized aqueous composite paste layer; and

c) drying the sensitized aqueous composite paste layer to form a photoelectrode.

14. Method according to claim 13, wherein the photoelectrode is mesoporous.

15. Method according to claim 13 or 14, wherein drying the sensitized aqueous composite paste layer is carried out at ambient conditions.

16. Method according to any one of claims 13 to 15, further comprising annealing the composite paste layer at a temperature that is less than about 200 °C after drying.

17. Photoelectrode manufactured by a method according to any one of claims 13 to 16.

18. Photochemical cell comprising a photoelectrode manufactured by a method according to any one of claims 13 to 16.

19. Method for manufacturing a photochemical cell, the method comprising

a) providing a photoelectrode manufactured by a method according to any one of claims 13 to 16, and

b) encapsulating the photoelectrode with an electrolyte and a counter electrode to form the photochemical cell.

CLAIMS

1. Sensitized aqueous composite paste for a photoelectrode or a photoelectrochemical cell comprising metal oxide particles, a photosensitizer, and carbon nanotubes.

2. Sensitized aqueous composite paste according to claim 1, wherein the metal oxide particles comprise oxide of a metal selected from Group 4 to Group 14 of the Periodic Table of Elements.

3. Sensitized aqueous composite paste according to claim 1 or 2, wherein the metal oxide particles comprise oxide of a metal selected from the group consisting of titanium, zinc, tin, iron, tungsten, and combinations thereof.

4. Sensitized aqueous composite paste according to any one of claims 1 to 3, wherein the metal oxide particles are selected from the group consisting of ZnO, TiO_2, Fe_2O_3, WO_3, and combinations thereof.

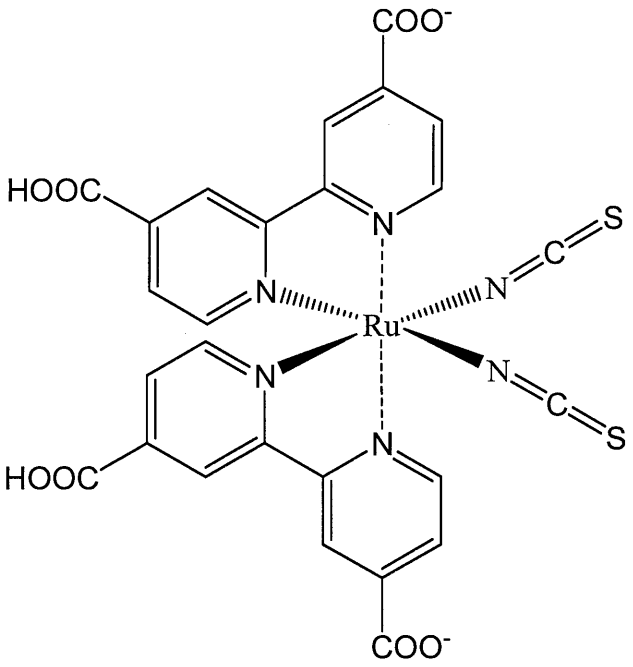
5. Sensitized aqueous composite paste according to any one of claims 1 to 4, wherein the metal oxide particles comprise or consist of ZnO.

6. Sensitized aqueous composite paste according to any one of claims 1 to 5, wherein the metal oxide particles are metal oxide nanoparticles.

7. Sensitized aqueous composite paste according to any one of claims 1 to 6, wherein the photosensitizer is selected from the group consisting of an organic dye, a metal-complex dye, polymers capable of producing free electrons under light irradiance, chromophores, and combinations thereof.

8. Sensitized aqueous composite paste according to claim 7, wherein the metal-complex dye is a ruthenium-based dye.

9. Sensitized aqueous composite paste according to claim 8, wherein the ruthenium-based dye has formula



$(Bt_4N)_2^{2+}$

10. Method for manufacturing a sensitized aqueous composite paste according to any one of claims 1 to 9, the method comprising

a) providing metal oxide particles, optionally grinding the metal oxide particles;

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c) adding a photosensitizer to the paste-like mixture in the dark;

d) adding carbon nanotubes to the paste-like mixture; and

e) mixing evenly to form the sensitized aqueous composite paste.

11. Method according to claim 10, wherein the photosensitizer is added in a drop-wise manner to the paste-like mixture.

12. Method according to claim 10 or 11, wherein the carbon nanotubes is added to the paste-like mixture after the photosensitizer has been added.

13. Method for manufacturing a photoelectrode, the method comprising

a) providing a sensitized aqueous composite paste according to any one of claims 1 to 9 or a sensitized aqueous composite paste manufactured by a method according to any one of claims 10 to 12;

b) depositing the sensitized aqueous composite paste on an electrically conducting substrate to form a sensitized aqueous composite paste layer; and

c) drying the sensitized aqueous composite paste layer to form a photoelectrode.

14. Method according to claim 13, wherein the photoelectrode is mesoporous.

15. Method according to claim 13 or 14, wherein drying the sensitized aqueous composite paste layer is carried out at ambient conditions.

16. Method according to any one of claims 13 to 15, further comprising annealing the composite paste layer at a temperature that is less than about 200 °C after drying.

17. Photoelectrode manufactured by a method according to any one of claims 13 to 16.

18. Photochemical cell comprising a photoelectrode manufactured by a method according to any one of claims 13 to 16.

19. Method for manufacturing a photochemical cell, the method comprising

a) providing a photoelectrode manufactured by a method according to any one of claims 13 to 16, and

b) encapsulating the photoelectrode with an electrolyte and a counter electrode to form the photochemical cell.