CLAIMS

1. A method for forming noble metal nanostructures on a support, wherein a mean diameter of a noble metal nanostructure size is below 3.0 nm, comprising:

mixing one or more noble metal precursor with a first solvent and a base to obtain a noble metal precursor solution;

feeding the noble metal precursor solution to a spiral tube reactor;

heating the spiral tube reactor containing the noble metal precursor solution to reduce the one or more noble metal precursor to obtain noble metal nanostructures;

mixing a support ink with the noble metal nanostructures obtained after heating, wherein the support ink comprises a second solvent, the support and an ink acid.

2. The method according to claim 1, wherein heating comprises irradiation of the spiral tube reactor in a microwave reactor or a millimeter reactor.

3. The method according to claim 1 or claim 2, wherein the noble metal precursor solution further comprises a polybasic carboxylic acid, and/or its salt, wherein the polybasic carboxylic acid, and/or its salt is added to the one or more noble metal precursor with a first solvent before the base is added to increase the solution pH.

4. The method according to claim 3, wherein the polybasic carboxylic acid is selected from a group consisting of citric acid, tartaric acid, malic acid, oxalic acid, or their salts.

5. The method according to any one of claims 1-4, wherein a pH value of the noble metal precursor solution is higher than 7, and more preferably higher than 9.

6. The method according to any one of claims 1-5, wherein the base of the noble metal precursor solution is an inorganic base, optionally a hydroxide of sodium or potassium.

7. The method according to any one of claims 1-6, wherein a pH value of the support ink, before being mixed with the noble metal nanostructures obtained after heating, is lower than 7, and more preferably below 5.5.

8. The method according to any one of claims 1-7, wherein the spiral tube reactor is immersed in a heating medium.

9. The method according to any one of claims 1-8, wherein the spiral tube reactor has more than one spiral tube, wherein at least two spiral tubes of the more than one spiral tube run concurrent to each other.

10. The method according to any one of claims 1-9, wherein the one or more noble metal precursor is selected from the group consisting of an oxide, a halide, a nitrite, a sulphate, or a complex of platinum, ruthenium, palladium, gold, silver, rhenium, rhodium, iridium, osmium, and a combination thereof.

11. The method according to any one of claims 1-10, wherein the noble metal precursor solution further comprises a transition metal precursor.

12. The method according to claim 11, wherein the transition metal precursor is selected from the group consisting of an iron cation, a ruthenium cation, an osmium cation, a cobalt cation, a rhodium cation, nickel cation, an iridium cation, and a combination thereof.

13. The method according to any one of claims 1-12, wherein the support comprises one or more carbon material selected from the group consisting of carbon black, carbon nanotube, carbon fibre, graphene, graphene oxide, graphite, carbon mesosphere, and a combination thereof.

14. The method according to any one of claims 1-13, wherein mixing the support ink with the noble metal nanostructures comprises addition of the noble metal nanostructures to the support ink under a controlled pH value of below 5.5.

15. Noble metal nanostructures on a support, which are produced by the method of any one of claims 1-14, wherein a mean diameter of a noble metal nanostructure size is below 3.0 nm.

16. The noble metal nanostructures on a support according to claim 15, wherein the noble metal nanostructures further comprise a transition metal.

17. The noble metal nanostructures on a support according to claim 16, wherein the transition metal is selected from the group consisting of iron, ruthenium, osmium, cobalt, rhodium, iridium, nickel, and a combination thereof.

18. The noble metal nanostructures on a support according to claim 16 or claim 17, wherein a molar ratio between the noble metal to the transition metal is between 10:1 to about 1:5.

19. The noble metal nanostructures on a support according to any one of claims 16-18, wherein the noble metal nanostructures are nanosized alloys and/or nanosized core-shell particles.

20. Use of the noble metal nanostructures on a support according to any one of claims 15-19 as an electro-catalyst in an electrode for fuel cell applications.