CLAIMS

~~1. A method for coating nickel on an organosiloxane polymer comprising:~~

~~forming a transition metal oxide on the organosiloxane polymer;~~

~~etching the transition metal oxide with a basic solution;~~

~~contacting the organosiloxane polymer comprising the etched transition metal oxide with an aqueous solution comprising a positively charged species to attach the positively charged species on the etched transition metal oxide;~~

~~depositing a metal catalyst on the positively charged species; and~~

~~treating the metal catalyst with an acidic solution to develop an activated organosiloxane polymer before transferring the activated organosiloxane polymer to a solution comprising nickel and/or nickel derivatives.~~

~~2. The method according to claim 1, wherein the organosiloxane polymer is selected from the group consisting of polydimethylsiloxane, vinyl methyl polysiloxane, phenyl methyl polysiloxane, phenyl vinyl methyl polysiloxane, fluoro vinyl methyl polysiloxane and derivatives of silicone rubber, wherein the polysiloxane comprises at least one quaternary silicon.~~

~~3. The method according to claim 1 or 2, wherein the transition metal oxide comprises titanium oxide.~~

~~4. The method according to claim 3, wherein the transition metal oxide is selected from the group consisting of titanium oxide, zirconium oxide, vanadium oxide, hafnium oxide, niobium oxide and tantalum oxide.~~

~~5. The method according to any one of claims 1 to 4, wherein the forming comprises contacting the organosiloxane polymer with a solution comprising a swelling agent and a transition metal oxide precursor for up to 30 minutes, and drying the organosiloxane polymer in ambient conditions comprising a temperature from 15°C to 30°C and a relative humidity from 30% to 70% to form the transition metal oxide on the organosiloxane polymer.~~

~~6. The method according to claim 5, wherein the organosiloxane polymer is contacted with the solution comprising the swelling agent and the transition metal oxide precursor for 5 minutes.~~

~~7. The method according to claim 5 or 6, wherein the swelling agent comprises isopropyl alcohol.~~

~~8. The method according to claim 7, wherein the swelling agent is selected from the group consisting of isopropyl alcohol, methanol, 2-methoxyethanol, ethanol, 1-propanol, tert-butanol and their mixtures thereof.~~

~~9. The method according to any one of claims 5 to 8, wherein the transition metal oxide precursor comprises titanium isopropoxide.~~

~~10. The method according to claim 9, wherein the transition metal oxide precursor is selected from the group consisting of titanium isopropoxide, titanium propoxide, titanium methoxide, titanium ethoxide, titanium butoxide, titanium tert-butoxide, titanium 2-ethylhexyloxide, zirconium tert-butoxide, zirconium isopropoxide, vanadium isobutoxide, vanadium oxytriethoxide, vanadium oxytriisopropoxide, vanadium oxytripropoxide, hafnium n-butoxide, hafnium tert-butoxide, niobium ethoxide, tantalum methoxide, tantalum ethoxide and tantalum butoxide.~~

~~11. The method according to any one of claims 5 to 10, wherein the transition metal oxide prescursor and the swelling agent comprises a volume ratio of 1:1 to 1:99.~~

~~12. The method according to claim 1, wherein the etching occurs for at least 30 seconds.~~

~~13. The method according to claim 1, wherein the basic solution comprises NaOH.~~

~~14. The method according to claim 13, wherein the basic solution comprises a concentration of 0.1 to 10 M.~~

~~15. The method according to claim 13 or 14, wherein the basic solution is selected from the group consisting of NaOH, KOH, LiOH and ammonia.~~

~~16. The method according to any one of claims 13 to 15, wherein the NaOH comprises a concentration of 3 M.~~

~~17. The method according to claim 1, wherein the positively charged species attached on the etched transition metal oxide changes polarity of charges present on the etched transition metal oxide.~~

~~18. The method according to claim 1, wherein the aqueous solution comprises 0.01 wt% to 1 wt% of the positively charged species.~~

~~19. The method according to claim 17 or 18, wherein the positively charged species is selected from the group consisting of positively charged nanoparticles or nanocolloids, dendrimers comprising nitrogen, polymers having at least one primary amine, secondary amine, tertiary amine, pyridinyl, quaternized amine and/or quaternized pyridinyl and their mixtures thereof.~~

~~20. The method according to claim 19, wherein the positively charged nanoparticles or nanocolloids comprise cetyltrimethylammonium bromide (CTAB) stabilized gold nanoparticles, spermidine stabilized silver nanoparticles, 2-(dimethylamino)ethanethiol-capped CdTe quantum dots and/or their mixtures thereof.~~

~~21. The method according to claim 19, wherein the dendrimers comprise polyamidoamine dendrimers, polyethylenimine dendrimers, polypropylenimine hexadecaamine dendrimers, ammonium-capped thiophosphoryl chloride dendrimers, ammonium-capped cyclotriphosphazene dendrimers and/or their mixtures thereof.~~

~~22. The method according to claim 19, wherein the polymers comprise polyamine, polyallylamine, polyetheramine, polyethylenimine, polyvinylpyridine, polybrene, chitosan, poly(2-(trimethylamino)ethyl methacrylate), poly(diallyldimethylammonium chloride), poly(N,N-dimethyl-3,5-dimethylene piperidinium chloride), poly(2-vinyl-1-methylpyridinium bromide) and/or their mixtures thereof.~~

~~23. The method according to claim 1, wherein the organosiloxane polymer of the contacting step is contacted with the aqueous solution for at least 5 minutes.~~

~~24. The method according to claim 1, wherein the depositing comprises contacting the positively charged species with a solution comprising the metal catalyst for at least 5 minutes to deposit the metal catalyst on the positively charged species.~~

~~25. The method according to claim 24, wherein the metal catalyst comprises tin-palladium (Sn-Pd) colloidal metal catalyst.~~

~~26. The method according to claim 25, wherein the tin-palladium colloidal metal catalyst is prepared by:~~

~~dissolving $PdCl_2$ in an amount of 0.05 gram to 0.15 gram in 30 ml to 50 ml of HCl to form a first solution;~~

~~dissolving $SnCl_2$ in 10 ml to 30 ml of HCl and subsequently adding 10 ml to 30 ml of water to form a second solution;~~

~~mixing the first and second solutions, and continuously stirring the mixture for 10 minutes to 30 minutes;~~

~~dissolving 4 gram to 5 gram of NaCl, 0.4 gram to 1.2 gram of $NaSnO_3$ and 5 gram to 15 gram of $SnCl_2$ in 40 ml to 60 ml of water to form a third solution;~~

~~adding the third solution to the mixture over a duration of 20 minutes to 40 minutes; and~~

~~incubating the mixture under continuous stirring for 3 hours to 5 hours at 60°C to 70°C.~~

~~27. The method according to claim 26, wherein the $SnCl_2$ is dissolved in an amount at least three times the $PdCl_2$ amount dissolved.~~

~~28. The method according to claim 26 or 27, wherein the $SnCl_2$ is dissolved in an amount of 0.5 g to 1.5 g.~~

~~29. The method according to claim 26, wherein concentration of the HCl forming the first solution and second solution is 4 to 8 M and 9 to 12 M, respectively.~~

~~30. The method according to claim 29, wherein concentration of the HCl forming the first solution and second solution is 6 M and 12 M, respectively.~~

~~31. The method according to claim 1, wherein the metal catalyst is treated with the acidic solution for at least 1 minute.~~

~~32. The method according to claim 1, wherein the acidic solution comprises HCl.~~

~~33. The method according to claim 1, wherein the solution comprising the nickel and/or nickel derivatives is an electroless nickel plating (ENP) solution.~~

~~34. The method according to claim 33, wherein the activated organosiloxane polymer is contacted with the ENP solution for at least 2 minutes.~~

~~35. The method according to claim 33 or 34, wherein the ENP solution is prepared by mixing 4 to 6 g/l of $NiSO_4$, 0.5 to 1.5 g/l of NaH_2PO_4, 0.5 to 1.5 g/l of oxycarboxylic acid and an amount of ammonia sufficient to maintain pH of the ENP solution between 4.5 and 5.5.~~

~~36. The method according to claim 35, wherein the ENP solution is prepared by mixing 4.7 g/l of $NiSO_4$, 1 g/l of NaH_2PO_4, 1 g/l of oxycarboxylic acid and an amount of ammonia sufficient to maintain pH of ENP solution at 4.9.~~

~~37. The method according to claim 33, wherein the nickel derivatives comprise nickel sulphate.~~

~~38. The method according to claim 37, wherein the nickel derivatives are selected from the group consisting of nickel sulphate, nickel chloride, nickel acetate, nickel nitrate and any acceptable nickel salts thereof.~~

~~39. The method according to claim 1, wherein the forming further comprises preparation of the organosiloxane polymer, the preparation comprising the steps of:~~

~~blending an organosiloxane polymer precursor with a cross-linking agent to form a blended mixture and curing the blended mixture at 170°C to 180°C under 8 MPa to 12 MPa for at least 5 minutes; or~~

~~mixing two organosiloxane polymer precursors with a curing agent and curing at 25°C to 35°C for 48 hours.~~

~~40. The method according to claim 39, wherein the cross-linking agent is dicumyl peroxide.~~

~~41. The method according to claim 39, wherein the curing agent comprises platinum.~~

~~42. The method according to claim 1, wherein the method further comprises rinsing the organosiloxane polymer with isopropyl alcohol before the etching and water after each of the etching, the contacting, the depositing and the treating.~~

~~43~~1. A nickel organosiloxane polymer composite comprising:

a transition metal oxide layer formed on the organosiloxane polymer; and

a positively charged species attached on the transition metal oxide layer with nickel coated on the positively charged species.

~~44~~2. The nickel organosiloxane polymer composite according to claim ~~43~~1, wherein the nickel organosiloxane polymer further comprises a trace amount of Sn-Pd catalyst under the nickel coated on the positively charged species.

~~45~~3. The nickel organosiloxane polymer composite according to claim ~~43~~1 or ~~44~~2, wherein the organosiloxane polymer is selected from the group consisting of polydimethylsiloxane, vinyl methyl polysiloxane, phenyl methyl polysiloxane, phenyl vinyl methyl polysiloxane, fluoro vinyl methyl polysiloxane and derivatives of silicone rubber, wherein the polysiloxane comprises a quaternary silicon.

~~46~~4. The nickel organosiloxane polymer composite according to any one of claims ~~43~~1 to ~~45~~3, wherein the transition metal oxide layer comprises titanium oxide.

~~47~~5. The nickel organosiloxane polymer composite according to claim ~~46~~4, wherein the transition metal oxide layer is selected from the group consisting of titanium oxide, zirconium oxide, vanadium oxide, hafnium oxide, niobium oxide and tantalum oxide.

~~48~~6. The nickel organosiloxane polymer composite according to any one of claims ~~43~~1 to ~~47~~5, wherein the positively charged species is selected from the group consisting of positively charged nanoparticles or nanocolloids, dendrimers comprising nitrogen, polymers having at least one primary amine, secondary amine, tertiary amine, pyridinyl, quaternized amine and/or quaternized pyridinyl and their mixtures thereof.

~~49~~7. The nickel organosiloxane polymer composite according to claim ~~48~~6, wherein the positively charged nanoparticles or nanocolloids comprise cetyltrimethylammonium bromide (CTAB) stabilized gold nanoparticles, spermidine stabilized silver nanoparticles, 2-(dimethylamino)ethanethiol-capped CdTe quantum dots and/or their mixtures thereof.

~~50~~8. The nickel organosiloxane polymer composite according to claim ~~48~~6, wherein the dendrimers comprise polyamidoamine dendrimers, polyethylenimine dendrimers, polypropylenimine hexadecaamine dendrimers, ammonium-capped thiophosphoryl

chloride dendrimers, ammonium-capped cyclotriphosphazene dendrimers and/or their mixtures thereof.

~~51~~9. The nickel organosiloxane polymer composite according to claim ~~48~~6, wherein the polymers comprise polyamine, polyallylamine, polyetheramine, polyethylenimine, polyvinylpyridine, polybrene, chitosan, poly(2-(trimethylamino)ethyl methacrylate), poly(diallyldimethylammonium chloride), poly(N,N-dimethyl-3,5-dimethylene-piperidinium chloride), poly(2-vinyl-1-methylpyridinium bromide) and/or their mixtures thereof.

~~52~~10. The nickel organosiloxane polymer composite according to any one of claims ~~43~~1 to ~~51~~9, wherein the nickel, the Sn-Pd catalyst, the positively charged species and the transition metal oxide layer comprise a thickness of 2.52 to 3 µm.