

CLAIMS

1. A composite coating for increasing atmospheric condensation on a surface of a substrate, wherein the composite coating comprises:

one or more hydrophobic polymers; and

wherein the composite coating comprises a plurality of inclusions.
2. The composite coating according to claim 1, wherein the inclusions comprise voids.
3. The composite coating according to claim 2, having a percentage void volume of about 20% or more.
4. The composite coating according to any one of claims 1 to 3, wherein the hydrophobic polymer comprises fluoropolymer, organosiloxane, or blends thereof.
5. The composite coating according to claim 4, wherein the hydrophobic polymer comprises PVDF-HFP, PDMS, or blends thereof.
6. The composite coating according to any one of claims 1 to 5, further comprising one or more hydrophilic substances.
7. The composite coating according to claim 6, wherein the hydrophilic substance comprises one or more of inorganic particles and hydrophilic polymers.
8. The composite coating according to claim 7, wherein the inorganic particles comprise silica particles.
9. The composite coating according to claim 8, wherein the silica particles comprise polydisperse silica nano/micro-particles having a diameter of from about 0.25 μm to about 20 μm .
10. The composite coating according to claim 8, wherein the silica particles comprise monodisperse silica nano/micro-particles having a mean diameter of from about 0.25 μm to about 8 μm .
11. The composite coating according to claim 7, wherein the hydrophilic polymers comprise one or more of polyacrylate, polyester and polyether.

12. The composite coating according to claim 11, wherein the hydrophilic polymers comprise one or more of PMMA and PEG.
13. The composite coating according to any one of claims 1 to 12, further comprising one or more surface modifying agents selected from the group consisting of polyurethane, polystyrene and silane.
14. The composite coating according to any one of claims 1 to 13, wherein the composite coating is a layer having a thickness between 50 and 200 μm .
15. The composite coating according to any one of claims 1 to 14, wherein the composite coating comprises at least two layers, and wherein the outer layer comprises one or more surface modifying agents comprising organosiloxane, polyurethane, fluoropolymer, polystyrene, polyacrylate and silane.
16. The composite coating according to claim 15, wherein the outer layer has a thickness of at least 500 nm.
17. The composite coating according to claim 15 or claim 16, wherein the one or more surface modifying agents comprise one or more of PDMS, PVDF, PMMA, alkylsilane and haloalkylsilane.
18. The composite coating according to any one of claims 1 to 17, wherein a surface of the coating comprises hydrophobic and hydrophilic regions and/or topographical bumps.
19. A liquid composite coating comprising the composite coating according to any one of claims 1 to 14 or 18 and:
 - a solvent which is capable of substantially dissolving the hydrophobic polymer; and
 - a non-solvent, in which the hydrophobic polymer is insoluble, or sparingly soluble.
20. The liquid composite coating according to claim 19, wherein the mass ratio of the hydrophobic polymer to the solvent is from about 1:10 to about 1:5.
21. The liquid composite coating according to claim 19 or 20, wherein the mass ratio of the solvent to the non-solvent is from about 10:1 to about 5:1.

22. The liquid composite coating according to any one of claims 19 to 21, wherein the non-solvent comprises water.
23. The liquid composite coating according to any one of claims 19 to 22, wherein the solvent comprises a water-miscible organic solvent.
24. The liquid composite coating according to claim 23, wherein the water-miscible organic solvent has a higher vapour pressure at 20°C than water.
25. The liquid composite coating according to claim 23 or 24, wherein the water-miscible organic solvent comprises one or more of acetone, tetrahydrofuran and 1,3-dioxolane.
26. The liquid composite coating according to any one of claims 19 to 25, further comprising N-methyl-2-pyrrolidone
27. A method for producing a liquid composite coating according to any one of claims 19 to 26, comprising:

mixing a hydrophobic polymer, optionally hydrophilic substance and surface modifying agents, and a solvent together to form a mixture, wherein the solvent is capable of at least partially dissolving the hydrophobic polymer; and

adding a non-solvent to the mixture to form the liquid composite coating, wherein the hydrophobic polymer is insoluble, or sparingly soluble in the non-solvent.
28. A method for coating a surface of a substrate with a composite coating according to any one of claims 1 to 14 or 18, comprising applying the liquid composite coating according to any one of claims 19 to 26 to the surface of the substrate, and removing at least a portion of the solvent and/or non-solvent to form the composite coating.
29. A method for coating a surface of a substrate with a composite coating comprising:

applying the liquid composite coating according to any one of claims 19 to 26 to the surface of a substrate;

removing at least a portion of the solvent and/or non-solvent from the liquid composite coating to form a first layer of the composite coating; and

applying one or more surface modifying agents comprising organosiloxane, polyurethane, fluoropolymer, polystyrene and polyacrylate to the first layer to form a second layer of the composite coating.

30. The method according to claim 29, wherein the one or more surface modifying agents comprise one or more of PDMS, PVDF and PMMA.
31. The method according to any one of claims 28 to 30, further comprising applying a primer to the substrate prior to applying the liquid composite coating.
32. The method according to claim 31, wherein the primer comprises one or more of acrylic, epoxy and polyurethane polymer, anticorrosion pigment, reflective pigment, IR emitter (for example SiC and Si₃N₄) and adhesion promoting additives.
33. The method according to claim 31 or claim 32, wherein the primer is a layer having a thickness between about 30µm and 100µm.
34. A method for increasing atmospheric condensation on a surface of a substrate exposed to sky, comprising coating the substrate with the composite coating according to any one of claims 1 to 18.
35. The method according to claim 34, which is a method for cooling a surface of the substrate.
36. A method for collecting atmospheric water, said method comprising:

 exposing a substrate coated with the composite coating according to any one of claims 1 to 18 to sky, under atmospheric conditions having a relative humidity of about 30% or more, to condense atmospheric water on the substrate; and

 collecting the condensed atmospheric water.
37. A method according to claim 36, wherein between 0.01 L and 2 L of condensed water is collected per m² of coated substrate surface per 24 hour day.
38. A method according to claim 36, wherein greater than 0.1 L of condensed water is collected per m² of coated substrate surface per 24 hour day.

39. A method according to claim 36, wherein greater than 0.3 L of condensed water is collected per m² of coated substrate surface per 24 hour day.
40. A method according to claim 36, wherein greater than 0.5 L of condensed water is collected per m² of coated substrate surface per 24 hour day.
41. A system for collecting condensed atmospheric water, said system comprising:
- a substrate coated with the composite coating according to any one of claims 1 to 18, wherein the coated substrate is exposed to the sky; and
- means for transporting condensed atmospheric water from the coated substrate to one or more collection units.
42. A system according to claim 41, further comprising at least one primer according to claim 32 or claim 33, disposed between the substrate and the composite coating.
43. A system according to claim 41 or claim 42, wherein the composite coating comprises an outer layer comprising one or more surface modifying agents.
44. A system according to any one of claims 41 to 43, wherein at least one surface of the coated substrate is tilted relative to horizontal.
45. A system according to any one of claims 41 to 44, wherein the composite coating has a thickness from about 50 μm to about 500 μm, or from about 50 μm to about 300 μm, or from about 50 μm to about 200 μm.
46. A system according to any one of claims 43 to 45, wherein the outer layer has a thickness of at least about 500 nm.
47. The method according to any one of claims 28 to 40, or a system according to any one of claims 41 to 46, wherein the substrate is an external surface of an object that is exposed to sky.
48. The method or system according to claim 47, wherein the object is one or more of a roof, a wall and a panel.

49. The method according to any one of claims 28 to 40, 47 or 48 or a system according to any one of claims 41 to 48, wherein the substrate comprises one or more of wood, glass, paper, textile, cement, concrete, plastic, metal, ceramic, and composite materials.