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;

   wherein the composite coating comprises a plurality of inclusions,

   wherein the inclusions comprise voids;

   wherein the composite coating has a percentage void volume of 20% or more; and wherein the composite coating comprisies two layers, wherein an outer layer comprises one or more surface modifying agents.

2. The composite coating according to claim 1, wherein the hydrophobic polymer comprises fluoropolymer, organosiloxane, or blends thereof.

3. The composite coating according to claim 2, wherein the hydrophobic polymer comprises PVDF-HFP, PDMS, or blends thereof.

4. The composite coating according to any one of claims 1 to 3, further comprising one or more hydrophilic substances.

5. The composite coating according to claim 4, wherein the hydrophilic substance comprises one or more of inorganic particles and hydrophilic polymers.

6. The composite coating according to claim 5, wherein the inorganic particles comprise silica particles.

7. The composite coating according to claim 6, wherein the silica particles comprise polydisperse silica nano/micro-particles having a diameter of from 0.25 μm to 20 μm.

8. The composite coating according to claim 6, wherein the silica particles comprise monodisperse silica nano/micro-particles having a mean diameter of from 0.25 μm to 8 μm.

9. The composite coating according to claim 5, wherein the hydrophilic polymers comprise one or more of polyacrylate, polyester and polyether.

10 The composite coating according to claim 9, wherein the hydrophilic polymers comprise one or more of PMMA and PEG.

11. The composite coating according to any one of claims 1 to 10, wherein the composite coating is a layer having a thickness between 50 and 200 μm.

12. The composite coating according to any one of claims 1 to 11, wherein the outer layer comprises one or more surface modifying agents comprising organosiloxane, polyurethane, fluoropolymer, polystyrene, polyacrylate and silane.

13. The composite coating according to claim 12, wherein the outer layer has a thickness of at least 500 nm.

14. The composite coating according to claim 12 or claim 13, wherein the one or more surface modifying agents comprise one or more of PDMS, PVDF, PMMA, alkylsilane and haloalkylsilane.

15. The composite coating according to any one of claims 1 to 14, wherein a surface of the coating comprises hydrophobic and hydrophilic regions and/or topographical bumps.

16. A method for coating a surface of a substrate with a composite coating according to claim 1 comprising:

applying a liquid comprising a hydrophobic polymer, 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 to the surface of the substrate,

removing at least a portion of the solvent and/or non-solvent from the liquid 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.

17. The method according to claim 16, wherein the mass ratio of the hydrophobic polymer to the solvent is from 1:10 to 1:5.

18. The method according to claim 16 or 17, wherein the mass ratio of the solvent to the non-solvent is from 10:1 to 5:1.

19. The method according to any one of claims 16 to 18, wherein the non-solvent comprises water.

20. The method according to any one of claims 16 to 19, wherein the solvent comprises a water-miscible organic solvent.

21. The method according to claim 20, wherein the water-miscible organic solvent has a higher vapour pressure at 20°C than water.

22. The method according to claim 20 or 21, wherein the water-miscible organic solvent comprises one or more of acetone, tetrahydrofuran and 1,3-dioxolane.

23. The method according to any one of claims 16 to 22, further comprising N-methyl-2-pyrrolidone

24. The method according to claim 16, wherein the one or more surface modifying agents comprise one or more of PDMS, PVDF and PMMA.

25. The method according to claim 16, further comprising applying a primer to the substrate prior to applying the liquid.

26. The method according to claim 25, wherein the primer comprises one or more of acrylic, epoxy and polyurethane polymer, anticorrosion pigment, reflective pigment, IR emitter (for example SiC and Si_3N_4) and adhesion promoting additives.

27. The method according to claim 25 or claim 26, wherein the primer is a layer having a thickness between 30µm and 100µm.

28. 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 15.

29. The method according to claim 28, which is a method for cooling a surface of the substrate.

30. 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 15 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.

31. A method according to claim 30, wherein between 0.01 L and 2 L of condensed water is collected per m^2 of coated substrate surface per 24 hour day.

32. A method according to claim 30, wherein greater than 0.1 L of condensed water is collected per m^2 of coated substrate surface per 24 hour day.

33. A method according to claim 30, wherein greater than 0.3 L of condensed water is collected per m^2 of coated substrate surface per 24 hour day.

34. A method according to claim 30, wherein greater than 0.5 L of condensed water is collected per m^2 of coated substrate surface per 24 hour day.

35. 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 15, 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.

36. A system according to claim 35, further comprising at least one primer according to claim 26 or claim 27, disposed between the substrate and the composite coating.

37. A system according to claim 35 or 36, wherein at least one surface of the coated substrate is tilted relative to horizontal.

38. A system according to any one of claims 35 to 37, wherein the composite coating has a thickness from 50 μm to 500 μm, or from 50 μm to 300 μm, or from 50 μm to 200 μm.

39. A system according to any one of claims 35 to 38, wherein the outer layer has a thickness of at least 500 nm.

40. The method according to any one of claims 16 to 27, or a system according to any one of claims 35 to 39, wherein the substrate is an external surface of an object that is exposed to sky.

41. The method or system according to claim 40, wherein the object is one or more of a roof, a wall and a panel.

42. The method according to any one of claims 16 to 27, 40 or 41, or a system according to any one of claims 35 to 41, wherein the substrate comprises one or more of wood, glass, paper, textile, cement, concrete, plastic, metal, ceramic, and composite materials.