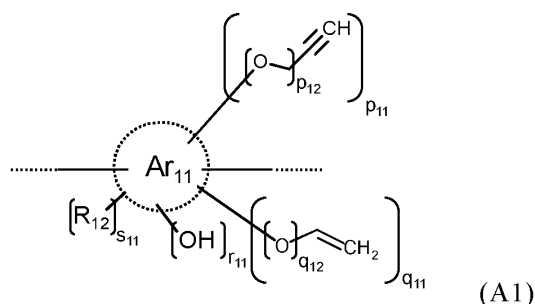


Claims

We claim:

1. A spin coating composition comprising a carbon material (A), a metal organic compound (B), and solvent (C), wherein

(i) carbon material (A) comprises unit (A1) represented by formula (A1):



wherein:

Ar_{11} is a C_{6-60} hydrocarbon unsubstituted or substituted by R_{11} ,

R_{11} is a C_{1-20} linear, branched or cyclic alkyl, amino, or alkylamino,

R_{12} is I, Br or CN,

p_{11} is an integer of 0-5, p_{12} is an integer of 0-1, q_{11} is an integer of 0-5, q_{12} is an integer of 0-1, r_{11} is an integer of 0-5, and s_{11} is an integer of 0-5, and

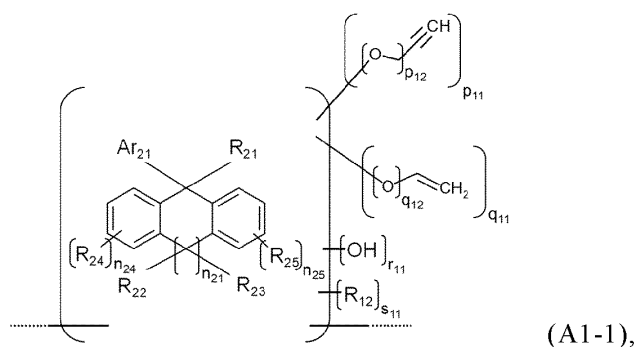
provided that p_{11} , q_{11} and r_{11} do not take 0 at the same time;

(ii) solvent (C) comprises an organic solvent; and

(iii) a mass ratio of the carbon material (A) to the mass of the metal organic compound (B) is approximately 5 to approximately 100 mass%, preferably approximately 10 to approximately 75 mass%, and more preferably approximately 10 to approximately 50 mass%.

2. The spin coating composition according to claim 1, wherein the formula (A1) is one or more of:

(i) formula (A1-1):



wherein

Ar₂₁ is a C₆₋₅₀ aromatic hydrocarbon ring,

R₂₁, R₂₂ and R₂₃ are each independently a C₆₋₅₀ aromatic hydrocarbon ring, hydrogen or single bond boding to another unit,

R₂₄ and R₂₅ each independently a C₁₋₄ alkyl, optionally plural R₂₄s and/or R₂₅s can bind each other to make aromatic ring with an adjacent benzene,

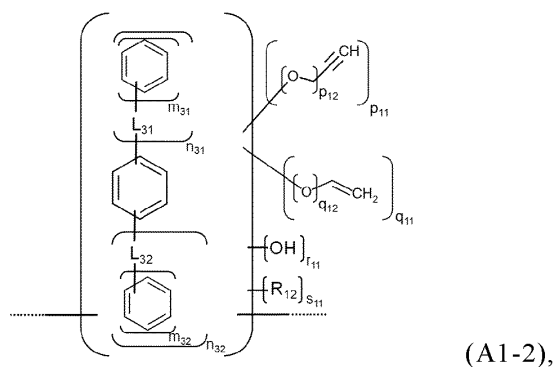
n₂₁ is an integer of 0-1, n₂₄ and n₂₅ are each independently an integer of 0-3, and

R₁₂ is I, Br or CN,

p₁₁ is an integer of 0-5, p₁₂ is an integer of 0-1, q₁₁ is an integer of 0-5, q₁₂ is an integer of 0-1, r₁₁ is an integer of 0-5, and s₁₁ is an integer of 0-5, and

provided that p₁₁, q₁₁ and r₁₁ do not take 0 at the same time;

(ii) formula (A1-2):



wherein

L₃₁ and L₃₂ are each independently a single bond or phenylene,

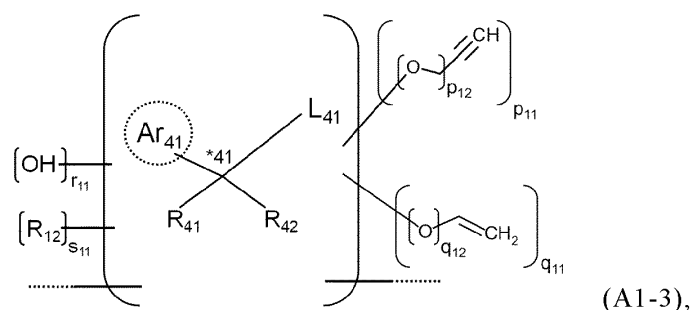
n_{31} , n_{32} , m_{31} and m_{32} are each independently an integer of 0-6,

R₁₂ is I, Br or CN,

p_{11} is an integer of 0-5, p_{12} is an integer of 0-1, q_{11} is an integer of 0-5, q_{12} is an integer of 0-1, r_{11} is an integer of 0-5, and s_{11} is an integer of 0-5, and

provided that p_{11} , q_{11} and r_{11} do not take 0 at the same time; and

(iii) formula (A1-3):



wherein:

Ar₄₁ is a C₆₋₅₀ aromatic hydrocarbon,

R₄₁ and R₄₂ are each independently a C₁₋₁₀ alkyl, optionally R₄₁ and R₄₂ constitute cyclic hydrocarbon,

the carbon atom at the *41 position is a quaternary carbon atom,

L₄₁ is a C₆₋₅₀ arylene, or a single bond bonding to another unit,

R₁₂ is I, Br or CN,

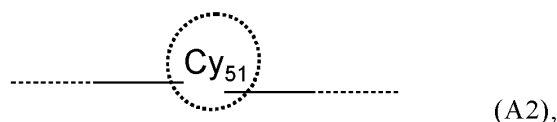
p_{11} is an integer of 0-5, p_{12} is an integer of 0-1, q_{11} is an integer of 0-5, q_{12} is an integer of 0-1, r_{11} is an integer of 0-5, and s_{11} is an integer of 0-5, and

provided that p_{11} , q_{11} and r_{11} do not take 0 at the same time; and

wherein when carbon material (A) is polymer, the polymer consists essentially of or consists of no secondary carbon atoms and tertiary carbon atoms except at a terminal position of the polymer.

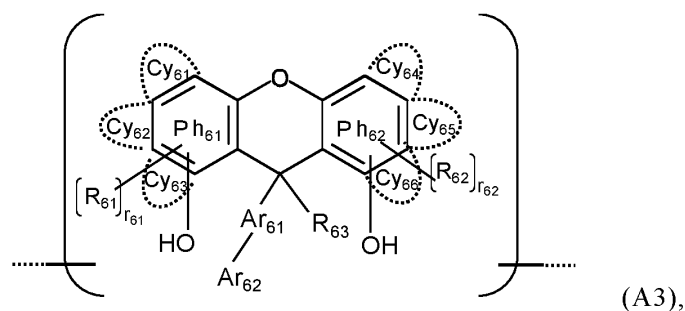
3. The spin coating composition according to any of claims 1-2, wherein the carbon material (A) further comprises one or more of:

(iv) unit (A2) represented by formula (A2):



wherein Cy₅₁ is a C₅₋₃₀ cyclic hydrocarbon ring; and

(v) unit (A3) represented by formula (A3):



wherein:

Ar₆₁ is a single bond, C₁₋₆ alkyl, C₆₋₁₂ cycloalkyl, or C₆₋₁₄ aryl,

Ar₆₂ is a C₁₋₆ alkyl, C₆₋₁₂ cycloalkyl, or C₆₋₁₄ aryl,

R₆₁ and R₆₂ are each independently a C₁₋₆ alkyl, hydroxy, halogen, or cyano,

R₆₃ is a hydrogen, C₁₋₆ alkyl, or C₆₋₁₄ aryl,

when Ar₆₂ is a C₁₋₆ alkyl or C₆₋₁₄ aryl and R₆₃ is a C₁₋₆ alkyl or C₆₋₁₄ aryl, Ar₆₂ and R₆₃ are optionally linked to each other to form a hydrocarbon ring,

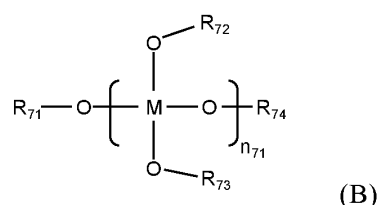
r₆₁ and r₆₂ are each independently an integer of 0-5,

at least one of the Cy₆₁, Cy₆₂, and Cy₆₃ rings surrounded by the broken line is an aromatic hydrocarbon ring fused with the adjacent aromatic hydrocarbon ring Ph₆₁, and

at least one of the Cy₆₄, Cy₆₅, and Cy₆₆ rings surrounded by the broken line is an aromatic hydrocarbon ring fused with the adjacent aromatic hydrocarbon ring Ph₆₂.

4. The spin coating composition according to any of claims 1-3, wherein the metal organic compound (B) is a metal organic complex comprising a hydrolyzable group, a hydrolyzed product of an metal organic complex comprising a hydrolyzable group, a hydrolysis-condensation product of an metal organic complex comprising a hydrolyzable group, or any combination of any of these.

5. The spin coating composition according to any of claims 1-4, wherein the metal organic compound (B) is represented by below formula (B);



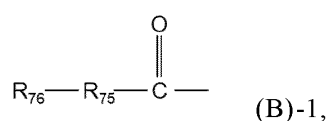
wherein:

M is a metal having a valence of four (4) and is preferably at least one selected from the group consisting of Zr, Ta, Hf, Ti, Sn, Pb, Nb, Mo, Ge and W,

n_{71} is number of 1 to 20, and

R_{71} , R_{72} , R_{73} and R_{74} are each independently selected from the group consisting of:

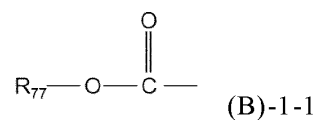
(a) a first organic moiety (B)-1 represented by formula (B)-1:



wherein:

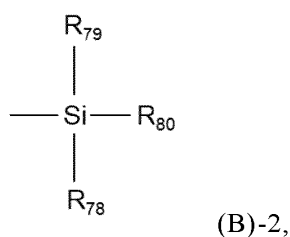
R_{75} is selected from the group consisting of a C_{2-10} alkylene, C_{3-12} branched alkylene, C_{5-12} cycloalkylene, C_{2-10} alkylene containing a C=C double bond, C_{3-12} branched alkylene containing a C=C double bond, and C_{5-12} cycloalkylene containing a C=C double bond, and

R₇₆ is a hydrogen or alkyloxycarbonyl represented by a formula (B)-1-1:



wherein R₇₇ is a C₁₋₈ alkyl;

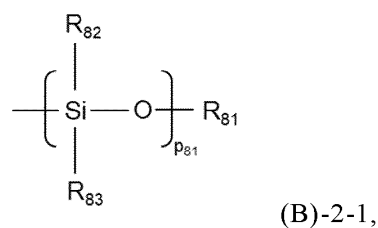
(b) a silicon bearing organic moiety having at least 2 carbons (B)-2 represented by formula (B)-2:



wherein:

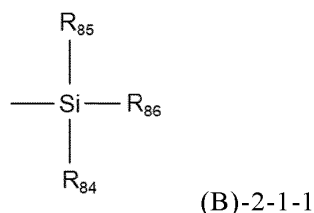
R₇₈ and R₇₉ are each independently selected from the group consisting of a C₁₋₈ alkyl, C₃₋₁₂ branched alkyl, C₁₋₈ alkyloxy, C₃₋₁₂ branched alkyloxy, and C₆₋₁₆ aryl;

R₈₀ is selected from the group consisting of a C₁₋₈ alkyl, C₆₋₁₆ aryl, hydroxyl and siloxane having the structure (B)-2-1:



wherein:

R₈₁ is selected from the group consisting of a hydrogen, C₁₋₈ alkyl, C₁₋₈ alkyl substituted with a hydroxyl, a C₆₋₁₆ aryl, and a silyl moiety having structure (B)-2-1-1:



wherein: R_{84} and R_{85} are each independently selected from the group consisting of C_{1-8} alkyl, C_{3-12} branched alkyl, C_{1-8} alkyloxy, C_{3-12} branched alkyloxy, and C_{6-16} aryl; and R_{86} is selected from the group consisting of C_{1-8} alkyl, and C_{6-16} aryl;

R_{82} and R_{83} are each independently selected from the group consisting of C_{1-8} alkyl, C_{3-12} branched alkyl, C_{1-8} alkyloxy, C_{3-12} branched alkyloxy, and C_{6-16} aryl; and p_{81} represents the number of repeat units in the siloxane moiety (B)-2-1; and

- (c) a second organic moiety selected from the group consisting of a C_{2-8} alkyl, C_{2-8} alkyl carboxyl, C_{6-20} aryl carboxyl, fluorenyl carboxyl, fluorinated C_{2-8} alkyl carboxyl, C_{2-8} alkyl sulfonyl, fluorinated C_{2-8} alkyl sulfonyl, and any combination of any of these, and
- (d) any combination of (a), (b) and (c).

6. The spin coating composition according to any of claims 1-5, wherein solvent (C) is selected from the group consisting of an aliphatic hydrocarbon solvent, aromatic hydrocarbon solvent, monoalcohol solvent, polyol solvent, ketone solvent, ether solvent, ester solvent, nitrogen-containing solvent, sulfur-containing solvent, and any combination of any of these.

7. The spin coating composition according to any of claims 1-6, further comprising surfactant (D); and

optionally further comprising another additive (E) preferably the selected from the group consisting of a cross linker, acid generator, radical generator, photo

polymerization initiator, an agent for enhancing adhesion to substrates, an anti-foaming agent and combinations thereof.

8. The spin coating composition according to any of claims 1-7, wherein a molecular weight of the carbon material (A) is approximately 500 to approximately 4,000.

9. The spin coating composition according to any of claims 1 to 8, wherein a mass ratio of the metal organic compound (B) to the total mass of the spin coating composition is approximately 5 to approximately 100 mass%, preferably approximately 10 to approximately 75 mass%, and more preferably approximately 10 to approximately 50 mass %);

wherein a mass ratio of the solvent (C) to the total mass of the spin coating composition is approximately 5 to approximately 100 mass%, preferably approximately 10 to approximately 75 mass%, and more preferably approximately 10 to approximately 50 mass %); and

wherein a mass ratio of the surfactant (D) to the mass of the metal organic compound (B) is approximately 5 to approximately 100 mass%, preferably approximately 10 to approximately 75 mass%, and more preferably approximately 10 to approximately 50 mass %).

10. A spin on metal hard mask composition consisting of the spin coating composition according to any of claims 1-9.

11. A method of manufacturing method a metal oxide film comprising

(1) spin coating the spin coating composition according to any of claims 1-9 above a substrate; and

(2) heating the spin coating composition to make a metal oxide film, wherein the heating is preferably performed at approximately 200 to approximately 800 °C and/or approximately 30 to approximately 240 seconds.

12. The method according to claim 11, wherein a metal content of the metal oxide film is approximately 10 to approximately 85 mass% to the total mass of the film.

13. A method of manufacturing method a resist coating comprising:

(3) applying a resist composition above the metal oxide film manufactured by the method according to any of claims 11-12.

14. A method of manufacturing resist patterns comprising:

(4) exposing the resist coating manufactured by the method according to claim 13 to radiation light;

(5) developing the exposed resist coating with a developer; and

(6) removing the developer from the substrate.

15. A method of manufacturing a processed substrate comprising:

(7) etching the resist patterns manufactured by the method according to claim 14; and

(8) processing the substrate.

16. A method of manufacturing a device comprising:

(9) forming wiring in the processed substrate manufactured by the method according to claim 15, wherein the substrate is preferably a stepped substrate.

17. The spin coating composition of claim 1, wherein the spin coating composition

consists essentially of a carbon material (A), a metal organic compound (B), and solvent (C).

18. The spin coating composition of claim 1, wherein the spin coating composition consists essentially of a carbon material (A), a metal organic compound (B), solvent (C) and a surfactant (D).

19. The spin coating composition of claim 1, wherein the spin coating composition consists essentially of a carbon material (A), a metal organic compound (B), solvent (C), surfactant (D) and an additive (E) selected from the group consisting of a cross linker, acid generator, radical generator, photo polymerization initiator, an agent for enhancing adhesion to substrates, an anti-foaming agent and combinations thereof.

20. The spin coating composition of claim 1, wherein the spin coating composition consists of a carbon material (A), a metal organic compound (B), and solvent (C).

21. The spin coating composition of claim 1, wherein the spin coating composition consists of a carbon material (A), a metal organic compound (B), solvent (C) and surfactant (D).

22. The spin coating composition of claim 1, wherein the spin coating composition consists of a carbon material (A), a metal organic compound (B), solvent (C), surfactant (D) and an additive (E) selected from the group consisting of a cross linker, acid generator, radical generator, photo polymerization initiator, an agent for enhancing adhesion to substrates, an anti-foaming agent and combinations thereof.