adhesiveness. Examples of such a resin can include an polyacrylic resin, a polyurethane resin, and an adhesive silicone resin, or the like that has one or more selected from the group consisting of an ether bond, an ester bond, an amide bond, an imide bond, a urethane bond, a thiourethane bond, and a thiol group. Meanwhile, the living body contact layer including the conductive film is in contact with the living body, and thus is susceptible to the influence of sweat from the living body. Hence, in the composition of the conductive film of the bio-electrode according to the present invention, the resin (B) preferably has high water repellency and is less susceptible to hydrolysis. To cause the resin to have high water repellency and be less susceptible to hydrolysis, it is effective to use the resin containing silicone.

[0181]

In the composition of the conductive film of the bio-electrode according to the present invention, a blending amount of the component (B) is preferably 0 to 2000 parts by mass, more preferably 10 to 1000 parts by mass relative to 100 parts by mass of the ion polymer (A). One kind of the component ~~(A)~~(B) may be used alone, or two or more kinds thereof may be used in combination.

[0182]

Note that the conductive film is a cured product of the composition of the conductive film for obtaining a bio-signal as described later. By curing the composition, the living body contact layer becomes to have preferable adhesiveness with respect to both the skin and the conductive base material. Note that a curing means is not specifically limited, and a general means can be used. For example, a cross-linking

[0270]

The water-soluble salts can be, specifically, salts selected from the group consisting of sodium chloride, potassium chloride, calcium chloride, magnesium chloride, saccharin sodium salts, acesulfame potassium, sodium carboxylate, potassium carboxylate, calcium carboxylate, sodium sulfonate, potassium sulfonate, calcium sulfonate, sodium phosphate, potassium phosphate, calcium phosphate, magnesium phosphate, and betaine. Note that the above-mentioned polymer compound (A) is not included in the above-mentioned water-soluble salts.

[0271]

More specific examples of the water-soluble salts can include, other than the above-mentioned salts, sodium acetate, sodium propionate, sodium pivalate, sodium glycolate, sodium butyrate, sodium valerate, sodium caproate, sodium enanthate, sodium caprylate, sodium pelargonate, sodium caprate, sodium undecylate, sodium laurate, sodium tridecanoate, sodium myristate, sodium pentadecylate, sodium palmitate, sodium margarate, sodium stearate, sodium benzoate, disodium adipate, disodium maleate, disodium phthalate, ~~sodium butyrate,~~ sodium 2-hydroxybutyrate, sodium 3-hydroxybutyrate, sodium 2-oxobutyrate, ~~sodium stearate,~~ sodium gluconate, sodium methanesulfonate, sodium 1-nonanesulfonate, sodium 1-decanesulfonate, sodium 1-dodecanesulfonate, sodium 1-undecanesulfonate, sodium cocoyl sethionate, sodium lauroyl methylalanine, sodium cocoyl methyltaurate, sodium cocoyl glutamate, sodium cocoyl sarcosinate, sodium methyl lauroyl taurate, ~~laumidopropyl~~ laumidopropyl betaine, potassium isobutyrate, potassium propionate, potassium pivalate, potassium glycolate,

potassium gluconate, potassium methanesulfonate, calcium stearate, calcium glycolate, calcium gluconate, calcium 3-methyl-2-oxobutyrate, and calcium methanesulfonate. Betaine is a general term for intramolecular salts. Specifically, betaine is a compound in which three methyl groups are added to an amino group of amino acid. More specific examples of betaine include trimethylglycine,carnitine,~~trimethylglycine,~~ and proline betaine.

[0272]

The water-soluble salts can further contain monohydric alcohol or polyhydric alcohol having 1 to 4 carbon atoms. The alcohol is preferably selected from the group consisting of ethanol, isopropyl alcohol, ethylene glycol, diethylene glycol, triethylene glycol, glycerin, polyethylene glycol, polypropylene glycol, polyglycerol, diglycerine, and a silicone compound having a polyglycerol structure. The silicone compound having the polyglycerol structure is more preferably shown by the above-mentioned general formula (4).

[0273]

As the pre-processing method using the solution containing salts, it is possible to moisten a bio-electrode film by an atomizing method or a water droplet dispense method performed on the composition of the cured conductive film (bio-electrode film). It is also possible to moisten the bio-electrode film in a high-temperature and humidity state such as in a sauna. It is also possible to cover the moistened bio-electrode film with a sheet to prevent the bio-electrode film from being dried. The sheet needs to be peeled off immediately before the bio-electrode film is attached to the skin. Thus, the sheet is coated with a peeling

CLAIMS

1. A bio-electrode comprising:

a porous, stretchy base material;

an adhesive, conductive film containing silicon; and

a conducting path,

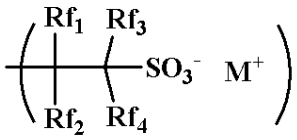
wherein the conductive film is formed on one surface of the porous, stretchy base material,

the conducting path is connected to the conductive film, and penetrates the stretchy base material to be exposed on the opposite side, or is exposed on a side surface of the stretchy base material.

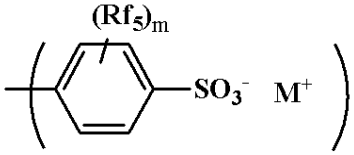
2. The bio-electrode according to claim 1, wherein the porous, stretchy base material is a non-woven fabric or a membrane film.

3. The bio-electrode according to claim 1 or 2, wherein the adhesive, conductive film containing silicon contains an ionic material (A) selected from the group consisting of salts of ammonium, lithium, sodium, potassium, and silver formed with any of fluorosulfonic acid, fluorosulfonimide, and N-carbonylfluorosulfonic amide.

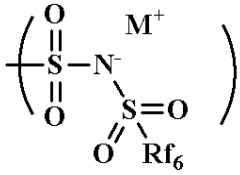
4. The bio-electrode according to claim 3, wherein the ionic material (A) has a partial structure shown by the following general formulae (1)-1 to (1)-4,



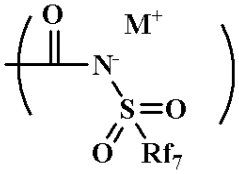
(1)-1



(1)-2



(1)-3

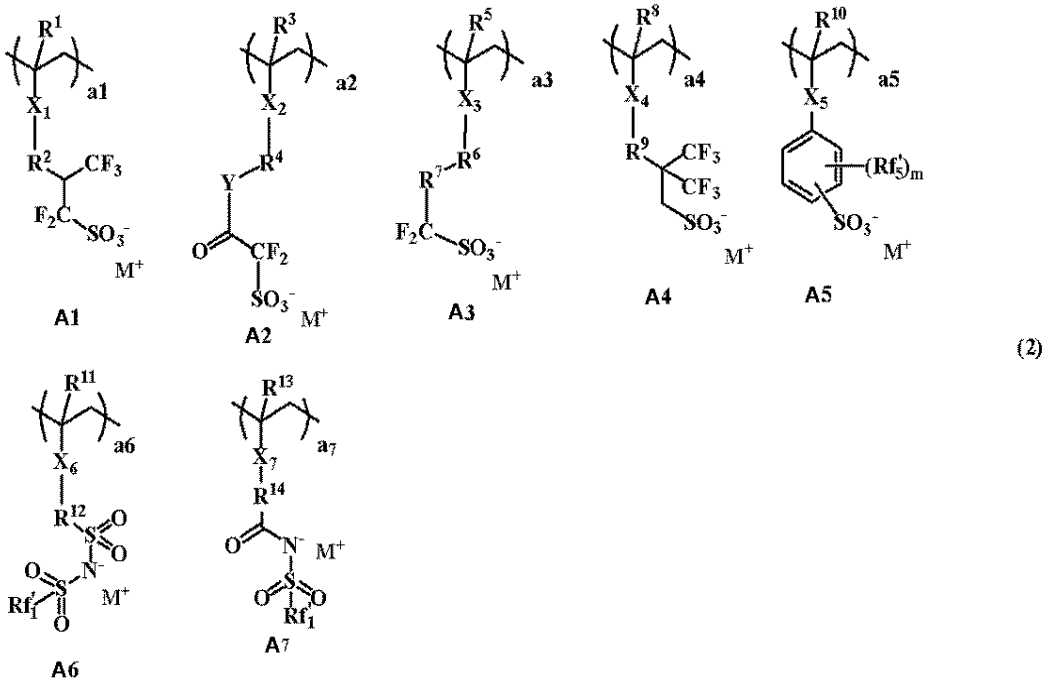


(1)-4

wherein Rf_1 and Rf_2 each represent a hydrogen atom, a fluorine atom, an oxygen atom, a methyl group, or a trifluoromethyl group, provided that when Rf_1 and Rf_2 represent an oxygen atom, the single oxygen atom represented by Rf_1 and Rf_2 bonds to a single carbon atom to form a carbonyl group; Rf_3 and Rf_4 each represent a hydrogen atom, a fluorine atom, or a trifluoromethyl group, provided that at least one of Rf_1 to Rf_4 is a fluorine atom or a trifluoromethyl group; Rf_5, Rf_6, and Rf_7 each represent a fluorine atom, a trifluoromethyl group, or a linear or branched alkyl group having 1 to 4 carbon atoms, and have at least one fluorine atom; M^+ represents an ion selected from the group consisting of an ammonium ion, a sodium ion, a potassium ion, and a

silver ion; and “m” represents an integer of 1 to 4.

5. The bio-electrode according to claim 3 or 4, wherein the ionic material (A) comprises at least one ionic polymer selected from the group consisting of repeating units A1 to A7 shown by the following general formula (2),

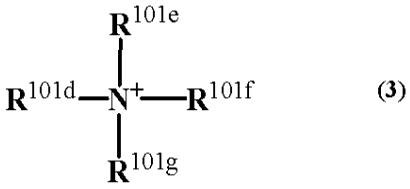


(2)

wherein R^1, R^3, R^5, R^8, R^{10}, R^{11}, and R^{13} each independently represent a hydrogen atom or a methyl group; R^2, R^4, R^6, R^9, R^{12}, and R^{14} each independently represent a single bond, or a linear, branched, or cyclic hydrocarbon group having 1 to 13 carbon atoms, the hydrocarbon group optionally having either or both of an ester group and an ether group; R^7 represents a linear or branched alkylene group having 1 to 4 carbon atoms, and one or two hydrogen atoms in R^7 are optionally substituted with a fluorine atom; X_1, X_2, X_3, X_4, X_6 and X_7 each independently represent any of a single bond, a phenylene group, a naphthylene group, an ether group, an

ester group, and an amide group; X_5 represents any of a single bond, an ether group, and an ester group; Y represents any of an oxygen atom and a $-NR^{19}-$ group; R^{19} represents any of a hydrogen atom, a linear, branched, or cyclic alkyl group having 2 to 12 carbon atoms, and a phenyl group, and optionally have one or more selected from the group consisting of an ether group, a carbonyl group, an ester group, and an amide group; Y optionally forms a ring together with R^4; Rf_1' and Rf_5' each represent a fluorine atom, a trifluoromethyl group, or a linear or branched alkyl group having 1 to 4 carbon atoms, and have at least one fluorine atom; "m" represents an integer of 1 to 4; a1, a2, a3, a4, a5, a6, and a7 are $0 \leq a1 \leq 1.0$, $0 \leq a2 \leq 1.0$, $0 \leq a3 \leq 1.0$, $0 \leq a4 \leq 1.0$, $0 \leq a5 \leq 1.0$, $0 \leq a6 \leq 1.0$, $0 \leq a7 \leq 1.0$, and $0 < a1+a2+a3+a4+a5+a6+a7 \leq 1.0$; M^+ represents an ion selected from the group consisting of an ammonium ion, a sodium ion, a potassium ion, and a silver ion.

6. The bio-electrode according to any one of claims 3 to 5, wherein the ionic material (A) comprises an ammonium ion shown by the following general formula (3) as an ammonium ion for forming the ammonium salts,



(3)

wherein R^{101d}, R^{101e}, R^{101f}, and R^{101g} each represent a hydrogen atom, a linear, branched, or cyclic alkyl group having 1 to 15 carbon atoms, a linear, branched, or cyclic alkenyl group or alkynyl group having 2 to 12 carbon atoms, or an aromatic group having 4 to 20 carbon

atoms, and optionally have one or more selected from the group consisting of an ether group, a carbonyl group, an ester group, a hydroxy group, an amino group, a nitro group, a sulfonyl group, a sulfinyl group, a halogen atom, and a sulfur atom; and R^{101d} and R^{101e}, or R^{101d}, R^{101e}, and R^{101f}, are optionally bonded to each other together with a nitrogen atom bonded therewith to form a ring in which R^{101d} and R^{101e}, or R^{101d}, R^{101e}, and R^{101f}, represent an alkylene group having 3 to 10 carbon atoms, or to form a heteroaromatic ring having the nitrogen atom in the general formula (3) within the ring.

7. The bio-electrode according to any one of claims 3 to 6, further comprising, in addition to the component (A), an adhesive resin as a component (B) that is different from the component (A), which is one or more selected from the group consisting of a silicone resin, a (meth) acrylate resin, and a urethane resin.

8. The bio-electrode according to claim 7, wherein the component (B) comprises a diorganosiloxane having an alkenyl group and an organohydrogenpolysiloxane having a SiH group.

9. The bio-electrode according to claim 7 or 8, wherein the component (B) further comprises a silicone resin having an SiO_2 unit and an $R_xSiO_{(4-x)/2}$ unit, wherein R represents a substituted or unsubstituted monovalent hydrocarbon group having 1 to 10 carbon atoms, and “x” represents a number in a range of 2.5 to 3.5.

10. The bio-electrode according to any one of claims 3 to 9, further comprising a component (C), which is one

or more selected from the group consisting of a carbon powder, a metal powder, a silicon powder, and a lithium titanate powder.

11. The bio-electrode according to claim 10, wherein the carbon powder is one or both of carbon black and carbon nanotube.

12. The bio-electrode according to any one of claims 1 to 11, wherein the conducting path comprises one or more selected from the group consisting of gold, silver, silver chloride, platinum, aluminum, magnesium, tin, tungsten, iron, copper, nickel, stainless steel, chromium, titanium, carbon, and a conductive polymer.

13. The bio-electrode according to any one of claims 1 to 12, wherein the conducting path has a snap shape.

14. The bio-electrode according to any one of claims 1 to 13, wherein a total film thickness of the stretchy base material and the conductive film in combination is 1 mm or less.

15. The bio-electrode according to claim 14, wherein the total film thickness of the stretchy base material and the conductive film in combination is 500 μm or less.

16. The bio-electrode according to any one of claims 1 to 15, wherein the stretchy base material includes an adhesive layer.

17. The bio-electrode according to any one of claims 1

to 16, wherein a top of the conductive film is covered with a release liner.

18. The bio-electrode according to claim 17, wherein the release liner is selected from the group consisting of a fluorine resin, polyethylene, polypropylene, cyclic polyolefin, polyethylene terephthalate, polybutylene terephthalate, polyethylene naphthalate, polybutylene naphthalate, polyvinyl chloride, polymethylmethacrylate, polyvinyl acetate, polystyrene, polymethylpentene, polyimide, polyphenylene sulfide, polysulfone, polyethersulfone, polyetherketone, polyamide-imide, polyetherimide, polyacetal, polycarbonate, polyphenylene ether, polyacrylonitrile, cellophane, and paper, to which, excluding the fluorine resin, a fluorine-based peeling agent or a silicone/fluorine-based peeling agent is applied.

19. A production method for the bio-electrode according to any one of claims 1 to 18, the method comprising:

preparing a conducting path that penetrates a porous, stretchy base material, or preparing a conducting path on the stretchy base material so that the conducting path is exposed on a side surface of the stretchy base material and forming an adhesive, conductive film comprising silicon so as to be connected to one side of the conducting path, the one side being attached to a skin.

20. The production method for the bio-electrode according to claim 19, the method comprising:

forming the adhesive, conductive film containing silicon on one side of the conducting path that

penetrates the porous, stretchy base material, or the conducting path that is on the stretchy base material and exposed on a side surface of the stretchy base material, the one side being attached to a skin,

by transferring the formed, adhesive, conductive film comprising silicon onto a release linear or by directly printing the formed, adhesive, conductive film comprising silicon onto the conducting path.

21. The production method for the bio-electrode according to claim 19 or 20, further comprising applying an adhesive, conductive film material comprising silicon onto a release linear and curing the adhesive, conductive film material.

22. A measurement method for a bio-signal comprising:

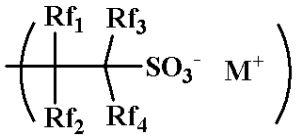
attaching the bio-electrode according to any one of claims 1 to 18 to a skin; and

measuring the bio-signal after showering, or during bathing or showering.

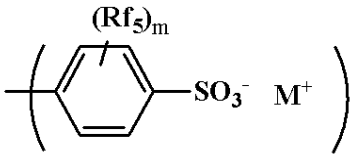
23. A composition of adhesive, conductive film containing silicon:

wherein the composition of conductive film contains an ionic material (A) selected from the group consisting of salts of ammonium, lithium, sodium, and potassium formed with any of fluorosulfonic acid, fluorosulfonimide, and N-carbonylfluorosulfonic amide.

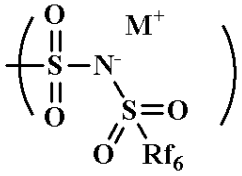
24. The composition of conductive film according to claim 23, wherein the ionic material (A) has a partial structure shown by the following general formulae (1)-1 to (1)-4,



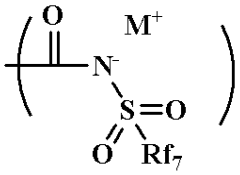
(1)-1



(1)-2



(1)-3

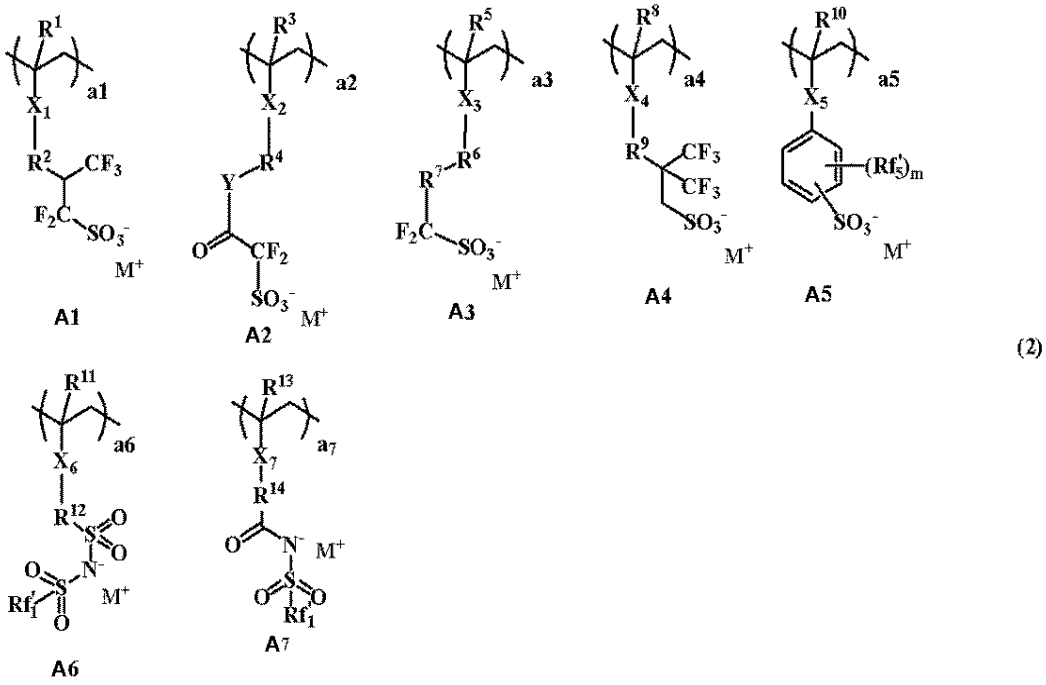


(1)-4

wherein Rf_1 and Rf_2 each represent a hydrogen atom, a fluorine atom, an oxygen atom, a methyl group, or a trifluoromethyl group, provided that when Rf_1 and Rf_2 represent an oxygen atom, the single oxygen atom represented by Rf_1 and Rf_2 bonds to a single carbon atom to form a carbonyl group; Rf_3 and Rf_4 each represent a hydrogen atom, a fluorine atom, or a trifluoromethyl group, provided that at least one of Rf_1 to Rf_4 is a fluorine atom or a trifluoromethyl group; Rf_5, Rf_6, and Rf_7 each represent a fluorine atom, a trifluoromethyl group, or a linear or branched alkyl group having 1 to 4 carbon atoms, and have at least one fluorine atom; M^+ represents an ion selected from the group consisting of an ammonium ion, a sodium ion, and a potassium ion; and

"m" represents an integer of 1 to 4.

25. The composition of conductive film according to claim 23 or 24, wherein the ionic material (A) comprises at least one ionic polymer selected from the group consisting of repeating units A1 to A7 shown by the following general formula (2),

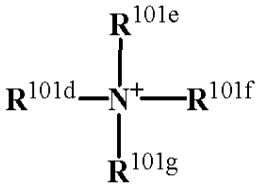


(2)

wherein R^1, R^3, R^5, R^8, R^{10}, R^{11}, and R^{13} each independently represent a hydrogen atom or a methyl group; R^2, R^4, R^6, R^9, R^{12}, and R^{14} each independently represent a single bond, or a linear, branched, or cyclic hydrocarbon group having 1 to 13 carbon atoms, the hydrocarbon group optionally having either or both of an ester group and an ether group; R^7 represents a linear or branched alkylene group having 1 to 4 carbon atoms, and one or two hydrogen atoms in R^7 are optionally substituted with a fluorine atom; X_1, X_2, X_3, X_4, X_6 and X_7 each independently represent any of a single bond, a phenylene group, a naphthylene group, an ether group, an

ester group, and an amide group; X_5 represents any of a single bond, an ether group, and an ester group; Y represents any of an oxygen atom and a $-NR^{19}-$ group; R^{19} represents any of a hydrogen atom, a linear, branched, or cyclic alkyl group having 2 to 12 carbon atoms, and a phenyl group, and optionally have one or more selected from the group consisting of an ether group, a carbonyl group, an ester group, and an amide group; Y optionally forms a ring together with R^4; Rf_1' and Rf_5' each represent a fluorine atom, a trifluoromethyl group, or a linear or branched alkyl group having 1 to 4 carbon atoms, and have at least one fluorine atom; "m" represents an integer of 1 to 4; a1, a2, a3, a4, a5, a6, and a7 are $0 \leq a1 \leq 1.0$, $0 \leq a2 \leq 1.0$, $0 \leq a3 \leq 1.0$, $0 \leq a4 \leq 1.0$, $0 \leq a5 \leq 1.0$, $0 \leq a6 \leq 1.0$, $0 \leq a7 \leq 1.0$, and $0 < a1+a2+a3+a4+a5+a6+a7 \leq 1.0$; M^+ represents an ion selected from the group consisting of an ammonium ion, a sodium ion, and a potassium ion.

26. The composition of conductive film according to any one of claims 23 to 25, wherein the ionic material (A) comprises an ammonium ion shown by the following general formula (3) as an ammonium ion for forming the ammonium salts,



(3)

wherein R^{101d}, R^{101e}, R^{101f}, and R^{101g} each represent a hydrogen atom, a linear, branched, or cyclic alkyl group having 1 to 15 carbon atoms, a linear, branched, or cyclic alkenyl group or alkynyl group having 2 to 12

carbon atoms, or an aromatic group having 4 to 20 carbon atoms, and optionally have one or more selected from the group consisting of an ether group, a carbonyl group, an ester group, a hydroxy group, an amino group, a nitro group, a sulfonyl group, a sulfinyl group, a halogen atom, and a sulfur atom; and R^{101d} and R^{101e}, or R^{101d}, R^{101e}, and R^{101f}, are optionally bonded to each other together with a nitrogen atom bonded therewith to form a ring in which R^{101d} and R^{101e}, or R^{101d}, R^{101e}, and R^{101f}, represent an alkylene group having 3 to 10 carbon atoms, or to form a heteroaromatic ring having the nitrogen atom in the general formula (3) within the ring.

27. The composition of conductive film according to any one of claims 23 to 26, further comprising, in addition to the component (A), an adhesive resin as a component (B) that is different from the component (A), which is one or more selected from the group consisting of a silicone resin, a (meth) acrylate resin, and a urethane resin.

28. The composition of conductive film according to claim 27, wherein the component (B) comprises a diorganosiloxane having an alkenyl group and an organohydrogenpolysiloxane having a SiH group.

29. The composition of conductive film according to claim 27 or 28, wherein the component (B) further comprises a silicone resin having an SiO_2 unit and an $R_XSiO_{(4-x)/2}$ unit, wherein R represents a substituted or unsubstituted monovalent hydrocarbon group having 1 to 10 carbon atoms, and “x” represents a number in a range of 2.5 to 3.5.

30. The composition of conductive film according to any one of claims 23 to 29, further comprising a component (C), which is one or more selected from the group consisting of a carbon powder, a metal powder, a silicon powder, and a lithium titanate powder.

31. The composition of conductive film according to claim 30, wherein the carbon powder is one or both of carbon black and carbon nanotube.

32. A conductive film on top of a release liner, wherein the conductive film being a cured film of the composition of conductive film according to any one of claims 23 to 31.

33. The conductive film according to claim 32, wherein the release liner is selected from the group consisting of a fluorine resin, polyethylene, polypropylene, cyclic polyolefin, polyethylene terephthalate, polybutylene terephthalate, polyethylene naphthalate, polybutylene naphthalate, polyvinyl chloride, polymethylmethacrylate, polyvinyl acetate, polystyrene, polymethylpentene, polyimide, polyphenylene sulfide, polysulfone, polyethersulfone, polyetherketone, polyamide-imide, polyetherimide, polyacetal, polycarbonate, polyphenylene ether, polyacrylonitrile, cellophane, and paper, to which, excluding the fluorine resin, a fluorine-based peeling agent or a silicone/fluorine-based peeling agent is applied.

34. The conductive film according to claim 32 or 33, wherein a top of the conductive film is covered with

other release liner.