Claims

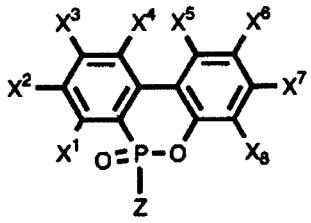
[Claim 1]

A resin composition comprising

a polyphenylene ether (A);

a phosphorous-containing cyanate ester compound (B) represented by general formula (1):

[Formula 1]

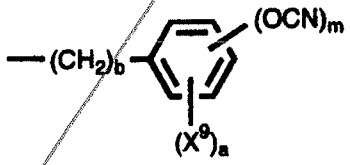


(1)

wherein X^1 to X^8 represent a hydrogen atom, an alkyl group, a cycloalkyl group, an aryl group, or an aralkyl group, which may be the same or different from each other, and

Z represents a group represented by general formula (2):

[Formula 2]

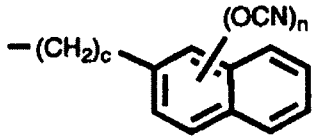


(2)

wherein X^9 represents a hydrogen atom, an alkyl group, a cycloalkyl group, an aryl group, or an aralkyl group, which may be the same or different from each other, and a represents an integer of 1 to 4, b represents an integer of 0 to 4, and m represents an integer of 1 to 4, or

a group represented by general formula (3):

[Formula 3]



(3)

wherein c represents an integer of 0 to 4, and n represents an integer of 1 to 3;

a non-halogenated epoxy resin (C);

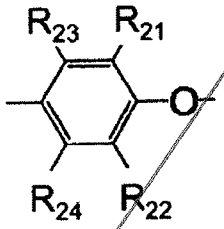
a cyanate ester compound (D) other than the compound represented by the formula (1); and

a filler (E).

[Claim 2]

The resin composition according to Claim 1, wherein the polyphenylene ether (A) is a polymer comprising at least a repeating unit represented by general formula (4):

[Formula 4]



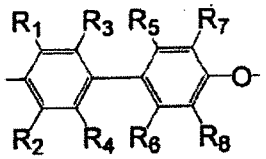
(4)

wherein R_{21}, R_{22}, R_{23}, and R_{24} may be the same or different from each other, and represent an alkyl group having 6 or less carbon atoms, an aryl group, halogen, or hydrogen.

[Claim 3]

The resin composition according to Claim 2, wherein the polymer further comprises a repeating unit represented by general formula (5):

[Formula 5]

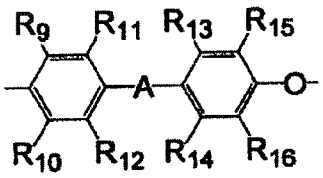


(5)

wherein R_1, R_2, R_3, R_7, and R_8 may be the same or different from each other, and are an alkyl group having 6 or less carbon atoms or a phenyl group, and R_4, R_5, and R_6 may be the same or different from each other, and are a hydrogen atom, an alkyl group having 6 or less carbon atoms or a phenyl group, and/or

a repeating unit represented by general formula (6):

[Formula 6]



(6)

wherein R_9, R_{10}, R_{11}, R_{12}, R_{13}, R_{14}, R_{15}, and R_{16} may be the same or different from each other, and are a hydrogen atom, an alkyl group having 6 or less carbon atoms or a phenyl group, and -A- is a linear, branched, or cyclic divalent hydrocarbon group having 20 or less carbon atoms.

[Claim 4]

The resin composition according to any one of Claims 1 to 3, wherein the polyphenylene ether (A) comprises a modified polyphenylene ether having an ethylenically unsaturated group at both ends.

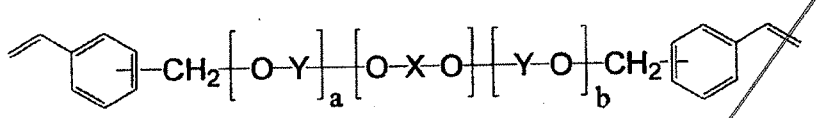
[Claim 5]

The resin composition according to Claim 4, wherein the ethylenically unsaturated group is at least one selected from the group consisting of an alkenyl group, a cycloalkenyl group, and an alkenyl aryl group.

[Claim 6]

The resin composition according to any one of Claims 1 to 5, wherein the polyphenylene ether (A) comprises a modified polyphenylene ether represented by general formula (7):

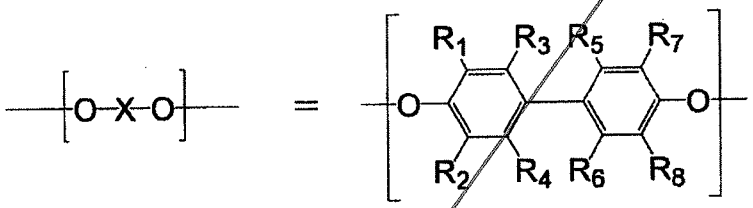
[Formula 7]



(7)

wherein -(O-X-O)- comprises a structure represented by general formula (8):

[Formula 8]

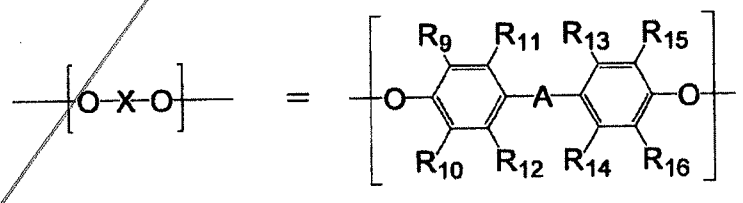


(8)

wherein R_1, R_2, R_3, R_7, and R_8 may be the same or different from each other, and are an alkyl group having 6 or less carbon atoms or a phenyl group, and R_4, R_5, and R_6 may be the same or different from each other, and are a hydrogen atom, an alkyl group having 6 or less carbon atoms or a phenyl group, or

general formula (9):

[Formula 9]

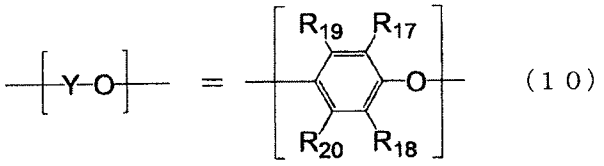


(9)

wherein R_9, R_{10}, R_{11}, R_{12}, R_{13}, R_{14}, R_{15}, and R_{16} may be the same or different from each other, and are a hydrogen atom, an alkyl group having 6 or less carbon atoms or a phenyl group, and -A- is a linear, branched, or cyclic divalent hydrocarbon group having 20 or less carbon atoms, and

-(Y-O)- is represented by general formula (10):

[Formula 10]



(10)

wherein R_{17} and R_{18} may be the same or different from each other, and are an alkyl group having 6 or less carbon atoms or a phenyl group, and R_{19} and R_{20} may be the same or different from each other, and are a hydrogen atom, an alkyl group having 6 or less carbon atoms or a phenyl group, and

a sequence of the -(Y-O)- units comprises one -(Y-O)- unit or two or more different-(Y-O)- units arranged randomly, and a and b represent an integer of 0 to 100, with at least either of a and b being not 0.

[Claim 7]

The resin composition according to any one of Claims 1 to 6, wherein a number average molecular weight of the polyphenylene ether (A) is 500 to 3000.

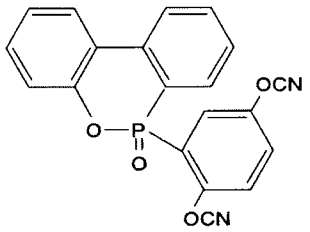
[Claim 8]

The resin composition according to any one of Claims 1 to 7, wherein the phosphorus-containing cyanate ester compound (B) is a compound wherein, in formula (1), X^1 to X^8 are a hydrogen atom or a methyl group, which may be the same or different from each other, Z represents a group represented by formula (2), X^9 is a hydrogen atom, an alkyl group, or an aryl group, a is 1 to 4, b is 0 to 2, and m is 1 to 2.

[Claim 9]

The resin composition according to any one of Claims 1 to 8, wherein the phosphorus-containing cyanate ester compound (B) is a compound represented by formula (11):

[Formula 11]



(11)

[Claim 10]

The resin composition according to any one of Claims 1 to 9, wherein a content of the polyphenylene ether (A) is 50 to 90 parts by mass with respect to 100 parts by mass of a total of the (A) to (D) components.

[Claim 11]

The resin composition according to any one of Claims 1 to 10, wherein a content of the phosphorus-containing cyanate ester compound (B) is 10 to 25 parts by mass with respect to 100 parts by mass of a total of the (A) to (D) components.

[Claim 12]

The resin composition according to any one of Claims 1 to 11, wherein the non-halogenated epoxy resin (C) is at least one selected from the group consisting of a naphthalene modified epoxy resin, a biphenyl aralkyl-based epoxy resin, and a cresol novolac-based epoxy resin.

[Claim 13]

The resin composition according to any one of Claims 1 to 12, wherein a content of the non-halogenated epoxy resin (C) is 1 to 15 parts by mass with respect to 100 parts by mass of a total of the (A) to (D) components.

[Claim 14]

The resin composition according to any one of Claims 1 to 13, wherein the cyanate ester compound (D) is a bisphenol A-based cyanate ester resin or a naphthol aralkyl-based cyanate ester resin.

[Claim 15]

The resin composition according to any one of Claims 1 to 14, wherein a content of the cyanate ester compound (D) is 1 to 15 parts by mass with respect to 100 parts by mass of a total of the (A) to (D) components.

[Claim 16]

The resin composition according to any one of Claims 1 to 15, wherein a content of the filler (E) is 10 to 200 parts by mass with respect to 100 parts by mass of a total of the (A) to (D) components.

[Claim 17]

A prepreg obtained by impregnating or coating a base material with the resin composition according to any one of Claims 1 to 16.

[Claim 18]

A metal foil-clad laminate obtained by stacking at least one prepreg according to Claim 17, disposing a metal foil on one surface or both surfaces of the prepreg or the stacked prepregs, and lamination-molding the metal foil and the prepreg or the stacked prepregs.

[Claim 19]

A resin sheet obtained by coating the surface of a metal foil or a film with a solution of the resin composition according to any one of Claims 1 to 16, and drying the solution.

Claims

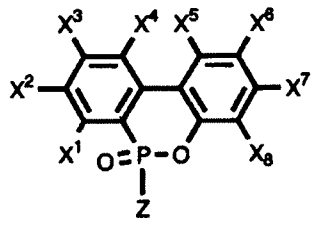
[Claim 1]

A resin composition comprising

a polyphenylene ether (A);

a phosphorous-containing cyanate ester compound (B) represented by general formula (1):

[Formula 1]

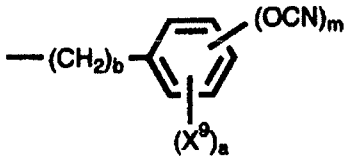


(1)

wherein X^1 to X^8 represent a hydrogen atom, an alkyl group, a cycloalkyl group, an aryl group, or an aralkyl group, which may be the same or different from each other, and

Z represents a group represented by general formula (2):

[Formula 2]

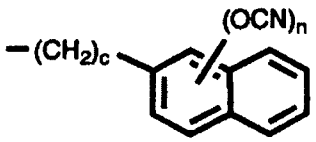


(2)

wherein X^9 represents a hydrogen atom, an alkyl group, a cycloalkyl group, an aryl group, or an aralkyl group, which may be the same or different from each other, and a represents an integer of 1 to 4, b represents an integer of 0 to 4, and m represents an integer of 1 to 4, or

a group represented by general formula (3):

[Formula 3]



(3)

wherein c represents an integer of 0 to 4, and n represents an integer of 1 to 3;

a non-halogenated epoxy resin (C);

a cyanate ester compound (D) other than the compound represented by the formula (1); and

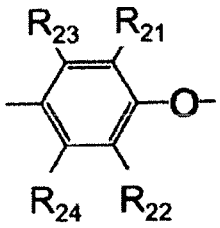
a filler (E),

wherein the polyphenylene ether (A) comprises a modified polyphenylene ether having an ethylenically unsaturated group at both ends.

[Claim 2]

The resin composition according to Claim 1, wherein the polyphenylene ether (A) is a polymer comprising at least a repeating unit represented by general formula (4):

[Formula 4]



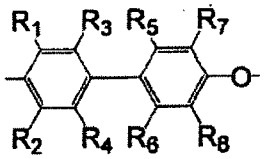
(4)

wherein R_{21}, R_{22}, R_{23}, and R_{24} may be the same or different from each other, and represent an alkyl group having 6 or less carbon atoms, an aryl group, halogen, or hydrogen.

[Claim 3]

The resin composition according to Claim 2, wherein the polymer further comprises a repeating unit represented by general formula (5):

[Formula 5]

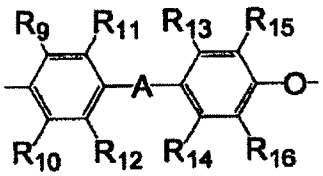


(5)

wherein R_1, R_2, R_3, R_7, and R_8 may be the same or different from each other, and are an alkyl group having 6 or less carbon atoms or a phenyl group, and R_4, R_5, and R_6 may be the same or different from each other, and are a hydrogen atom, an alkyl group having 6 or less carbon atoms or a phenyl group, and/or

a repeating unit represented by general formula (6):

[Formula 6]



(6)

wherein R_9, R_{10}, R_{11}, R_{12}, R_{13}, R_{14}, R_{15}, and R_{16} may be the same or different from each other, and are a hydrogen atom, an alkyl group having 6 or less carbon atoms or a phenyl group, and -A- is a linear, branched, or cyclic divalent hydrocarbon group having 20 or less carbon atoms.

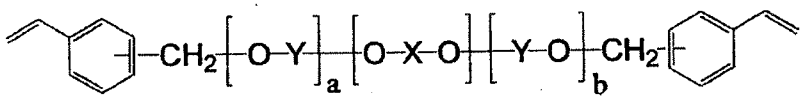
[Claim 4]

The resin composition according to any one of Claim 1 to 3, wherein the ethylenically unsaturated group is at least one selected from the group consisting of an alkenyl group, a cycloalkenyl group, and an alkenyl aryl group.

[Claim 5]

The resin composition according to any one of Claims 1 to 4, wherein the polyphenylene ether (A) comprises a modified polyphenylene ether represented by general formula (7):

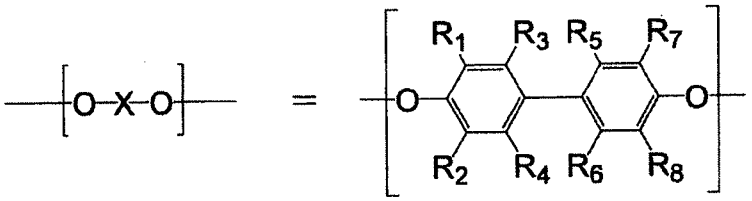
[Formula 7]



(7)

wherein -(O-X-O)- comprises a structure represented by general formula (8):

[Formula 8]

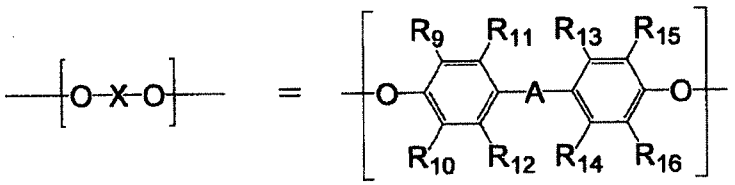


(8)

wherein R_1, R_2, R_3, R_7, and R_8 may be the same or different from each other, and are an alkyl group having 6 or less carbon atoms or a phenyl group, and R_4, R_5, and R_6 may be the same or different from each other, and are a hydrogen atom, an alkyl group having 6 or less carbon atoms or a phenyl group, or

general formula (9):

[Formula 9]



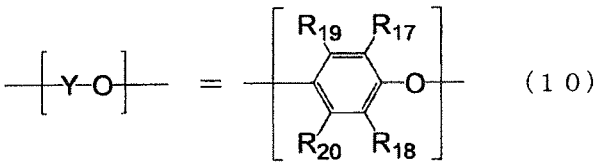
(9)

wherein R_9, R_{10}, R_{11}, R_{12}, R_{13}, R_{14}, R_{15}, and R_{16} may be the same or different from each other, and are a hydrogen atom, an alkyl group having 6 or less carbon atoms or

a phenyl group, and -A- is a linear, branched, or cyclic divalent hydrocarbon group having 20 or less carbon atoms, and

-(Y-O)- is represented by general formula (10):

[Formula 10]



(10)

wherein R_{17} and R_{18} may be the same or different from each other, and are an alkyl group having 6 or less carbon atoms or a phenyl group, and R_{19} and R_{20} may be the same or different from each other, and are a hydrogen atom, an alkyl group having 6 or less carbon atoms or a phenyl group, and

a sequence of the -(Y-O)- units comprises one -(Y-O)- unit or two or more different-(Y-O)- units arranged randomly, and a and b represent an integer of 0 to 100, with at least either of a and b being not 0.

[Claim 6]

The resin composition according to any one of Claims 1 to 5, wherein a number average molecular weight of the polyphenylene ether (A) is 500 to 3000.

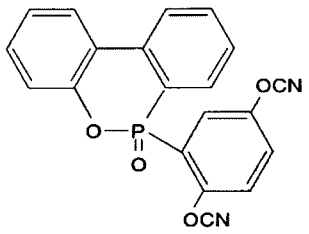
[Claim 7]

The resin composition according to any one of Claims 1 to 6, wherein the phosphorus-containing cyanate ester compound (B) is a compound wherein, in formula (1), X^1 to X^8 are a hydrogen atom or a methyl group, which may be the same or different from each other, Z represents a group represented by formula (2), X^9 is a hydrogen atom, an alkyl group, or an aryl group, a is 1 to 4, b is 0 to 2, and m is 1 to 2.

[Claim 8]

The resin composition according to any one of Claims 1 to 7, wherein the phosphorus-containing cyanate ester compound (B) is a compound represented by formula (11):

[Formula 11]



(11)

[Claim 9]

The resin composition according to any one of Claims 1 to 8, wherein a content of the polyphenylene ether (A) is 50 to 90 parts by mass with respect to 100 parts by mass of a total of the (A) to (D) components.

[Claim 10]

The resin composition according to any one of Claims 1 to 9, wherein a content of the phosphorus-containing cyanate ester compound (B) is 10 to 25 parts by mass with respect to 100 parts by mass of a total of the (A) to (D) components.

[Claim 11]

The resin composition according to any one of Claims 1 to 10, wherein the non-halogenated epoxy resin (C) is at least one selected from the group consisting of a naphthalene modified epoxy resin, a biphenyl aralkyl-based epoxy resin, and a cresol novolac-based epoxy resin.

[Claim 12]

The resin composition according to any one of Claims 1 to 11, wherein a content of the non-halogenated epoxy resin (C) is 1 to 15 parts by mass with respect to 100 parts by mass of a total of the (A) to (D) components.

[Claim 13]

The resin composition according to any one of Claims 1 to 12, wherein the cyanate ester compound (D) is a bisphenol A-based cyanate ester resin or a naphthol aralkyl-based cyanate ester resin.

[Claim 14]

The resin composition according to any one of Claims 1 to 13, wherein a content of the cyanate ester compound (D) is 1 to 15 parts by mass with respect to 100 parts by mass of a total of the (A) to (D) components.

[Claim 15]

The resin composition according to any one of Claims 1 to 14, wherein a content of the filler (E) is 10 to 200 parts by mass with respect to 100 parts by mass of a total of the (A) to (D) components.

[Claim 16]

A prepreg obtained by impregnating or coating a base material with the resin composition according to any one of Claims 1 to 15.

[Claim 17]

A metal foil-clad laminate obtained by stacking at least one prepreg according to Claim 16, disposing a metal foil on one surface or both surfaces of the prepreg or

the stacked prepregs, and lamination-molding the metal foil and the prepreg or the stacked prepregs.

[Claim 18]

A resin sheet obtained by coating the surface of a metal foil or a film with a solution of the resin composition according to any one of Claims 1 to 15, and drying the solution.