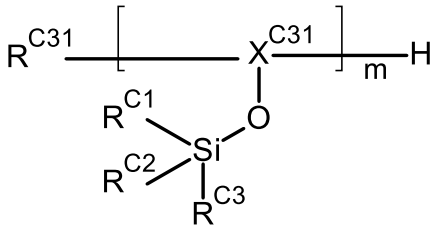
Claims

1. A resin composition, comprising

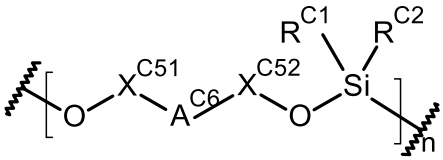
(a) an epoxy resin,

(b) a siloxane-type curing agent of formula C22~~ or C31~~



(C22)

~~(C31)~~



wherein

R^{C1}, R^{C2}, R^{C3} are independently selected from methyl, ethyl and 1-propyl;

X^{C31} is a divalent group selected from a C_{10} to C_{30} alkylaryl of formula $-X^{C32}-A^{C1}-[X^{C32}-A^{C2}]_p-X^{C32}-$;

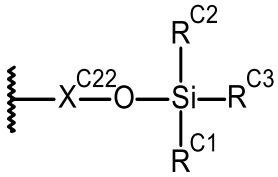
A^{C1} is selected from a biphenylene group, a naphthylene group, an anthracenylene group, a phenantrenylene group, a pyrenylene group, and a fluorenylene group, all of which may be unsubstituted or substituted by C_1 to C_4 alkyl;

A^{C2} is selected from a phenylene group, which may be unsubstituted or substituted by C_1 to C_4 alkyl;

p is 0, 1 or 2;

X^{C32} is a chemical bond or C_1 to C_4 alkanediyl, preferably a chemical bond or methanediyl;

R^{C31} is selected from H, C_1 to C_6 alkyl, C_6 to C_{30} aryl or alkylaryl, and



X^{C22} is a divalent group selected from a C_1 to C_4 alkanediyl, and C_6 to C_{30} aryl or alkylaryl;

m is an average number of repeating units and is from 1.05 to 20.

~~A^{C6} is selected from a divalent group selected from a C_6 to C_{30} aryl or alkylaryl, which may be unsubstituted or substituted by C_1 to C_4 alkyl;~~

~~X^{C51}, X^{C52} are independently selected from a chemical bond and a linear or branched C_1 to C_6 alkandiyl;~~

~~n is an average number of repeating units and is from 1.05 to 1000, preferably from 1.5 to 500, most preferably from 2 to 100.~~

and wherein the resin composition does essentially not contain any fluoride or bromide.

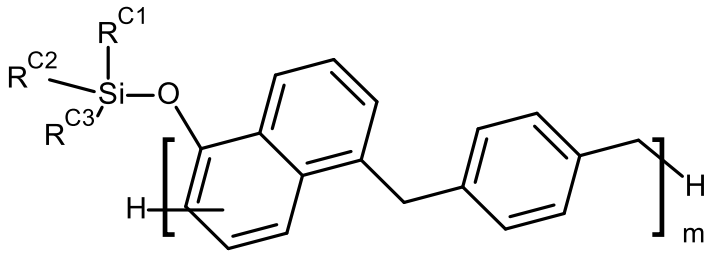
~~2. The resin composition according to claim 1, wherein the siloxane-type curing agent is a compound of formula C22.~~

2~~3~~. The resin composition according to claim 1~~2~~, wherein A^{C1} is selected from a biphenylene group and a naphthylene group, all of which may be unsubstituted or substituted by methyl or ethyl; and A^{C2} is selected from a phenylene group, which may be unsubstituted or substituted by methyl or ethyl.

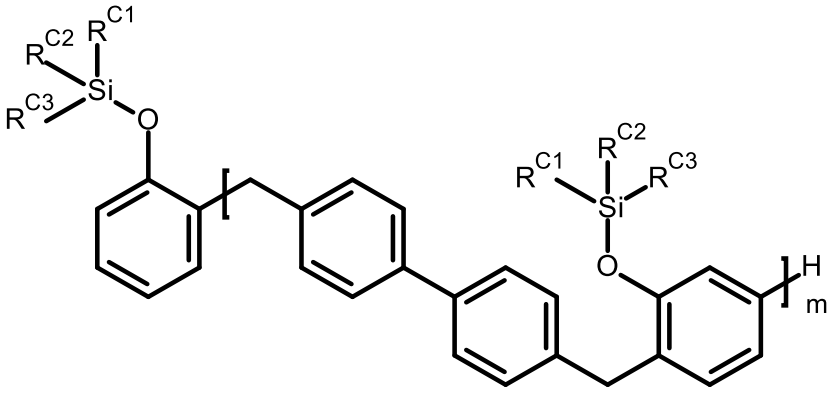
3~~4~~. The resin composition according to claim 1~~2~~ or 2~~3~~, wherein p is 1.

4~~5~~. The resin composition according to claim 1~~2~~ or 2~~3~~, wherein m is from 1.5 to 10.

5~~6~~. The resin composition according to claim 1~~2~~, wherein the siloxane-type curing agent is a compound of formula C22a or C22b



(C22a)



(C22b)

wherein R^{C1}, R^{C2}, R^{C3} are independently selected from methyl, ethyl and 1-propyl, and m is an average number from 2 to 10, particularly 2.5 to 5.

~~7. The resin composition according to claim 1, wherein the siloxane-type curing agent is a compound of formula C31, wherein~~

~~R^{C1}, R^{C2} are independently selected from methyl and ethyl;~~

~~A^{C6} is selected from a divalent group of formula -A^{C61}-[X^{C62}-A^{C62}]$_p$-;;~~

~~A^{C61} is selected from phenylene, biphenylene, naphthylene, 2,2-bis(phenylene)propane, an anthracenylene, a phenantrenylene, a pyrenylene, and a fluorenylene, all of which may be unsubstituted or substituted by C_1 to C_4 alkyl;~~

~~A^{C62} is selected from a phenylene group, which may be unsubstituted or substituted by C_1 to C_4 alkyl;~~

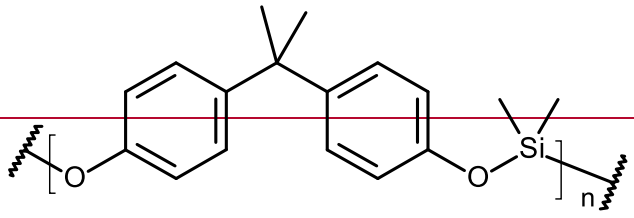
~~p is 0, 1 or 2;~~

~~X^{C51}, X^{C52} are independently selected from a chemical bond and a linear or branched C_1 to C_4 alkanediyl;~~

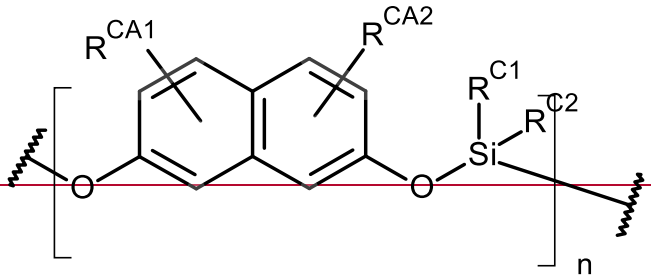
~~n is an average number of repeating units and is from 2 to 100.~~

~~8. The resin composition according to claim 7, wherein p is 0 or 1.~~

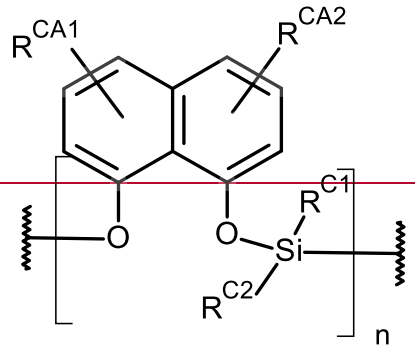
~~9. The resin composition according to claim 7, wherein the siloxane-type curing agent is selected from a compound of formula C31a, C31b, and C31c~~



~~(C31a)~~



~~(C31b)~~



~~(C31c)~~

~~wherein~~

~~R^{CA1}, R^{CA2} are independently selected from H and a linear or branched C_1 to C_4 alkyl, preferably H, methyl and ethyl;~~

~~n is an average number of repeating units and is from 1.05 to 1000, preferably from 1.5 to 500, most preferably from 2 to 100.~~

~~10. The resin composition according to claim 8, wherein R^{CA1} and R^{CA2} are independently selected from H and methyl.~~

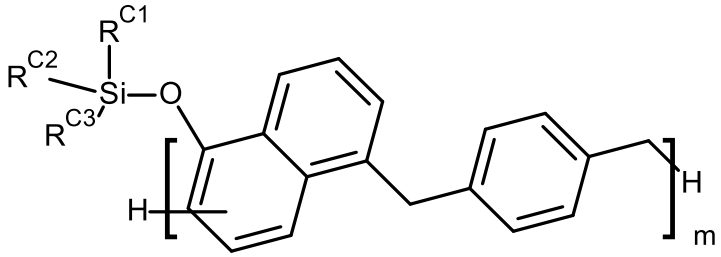
6~~11~~. The resin composition according to anyone of the preceding claims, wherein R^{C1}, R^{C2} and, if applicable, R^{C3} are methyl;

7~~12~~. The resin composition according to anyone of the preceding claims, further comprising an inorganic filler.

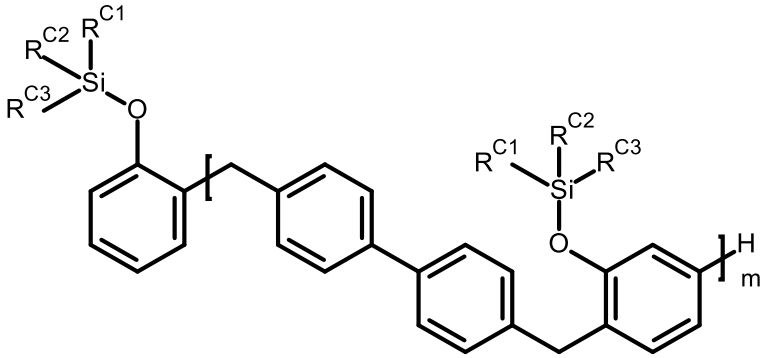
8~~13~~. Use of a resin composition according to claim 7~~13~~ for depositing an insulating film on a circuit substrate, particularly for manufacturing a printed wiring board.

9~~14~~. An insulating layer comprising the resin composition according to claim 7~~13~~, after curing said resin composition to form an insulating layer, wherein the insulating layer has a dielectric resistance D_k of 3 or below and a loss tangent D_f of 0.02 or below, particularly 0.01 or below.

105. A compound of formula C22a or C22b

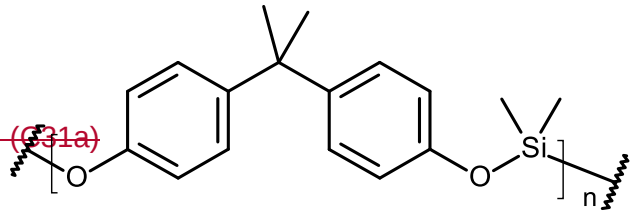


(C22a)

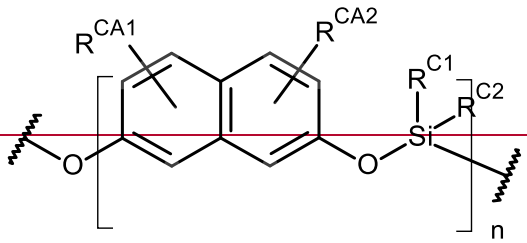


(22b)

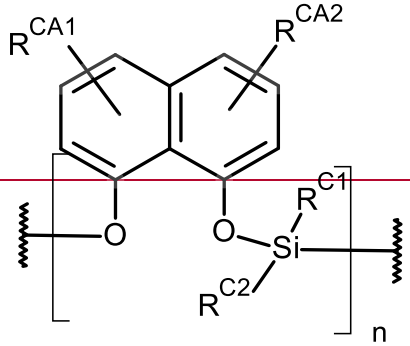
~~or of formula C31a, C31b, and C31c~~



~~(C31a)~~



~~(C31b)~~



~~(C31c)~~

wherein

R^{C1}, R^{C2}, R^{C3} are independently selected from methyl, ethyl and 1-propyl, most preferably methyl;

m is an average number of repeating units and is from 1.05 to 20, particularly 2 to 10;

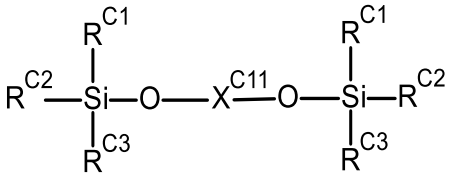
~~n is an average number of repeating units and is from 1.05 to 1000, preferably from 1.5 to 500, most preferably from 2 to 100.~~

~~R^{CA1}, R^{CA2} are independently selected from H and C_1 to C_4 alkyl, preferably H, methyl and ethyl, most preferably H.~~

116. A resin composition, comprising

(a) an epoxy resin,

(b) a siloxane-type curing agent formula C11:



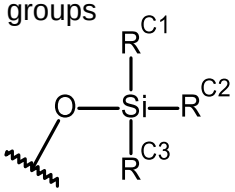
(C11)

wherein

R^{C1} is selected from methyl and ethyl;

R^{C2}, R^{C3} are independently selected from a linear or branched C_1 to C_3 alkyl and a linear C_4 to C_6 alkyl group, preferably methyl and ethyl;

X^{C11} is a divalent group selected from X^{C11} comprises or consists of a naphthyl group, a bipyridyl group, a group -A^{C1}-X^{C32}-A^{C2}-, or a group -X^{C41}-A^{C3}-X^{C42}, which may be unsubstituted or substituted by C_1 to C_6 alkyl, and which A^{C1}, A^{C2} or A^{C3} groups may be substituted by one or more groups



;

A^{C1} is selected from a phenylene group, biphenylene group, a naphthylene group, an anthracenylene group, a phenantrenylene group, a pyrenylene group, and a fluorenylene group, all of which may be unsubstituted or substituted by C_1 to C_4 alkyl;

A^{C2} is selected from a phenylene group or a naphthylene group, which may be unsubstituted or substituted by C_1 to C_4 alkyl;

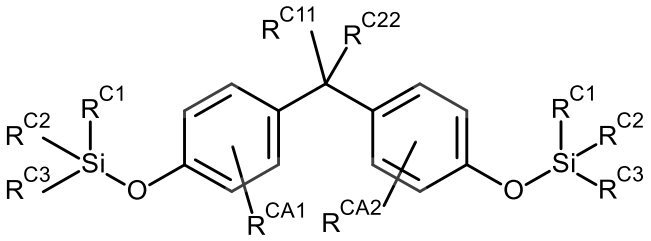
A^{C3} is selected from methanediyl that is substituted by a C_6 to C_{20} aryl group, which may be unsubstituted or substituted by C_1 to C_4 alkyl;

X^{C32} is a chemical bond or C_1 to C_4 alkanediyl, preferably a chemical bond or methanediyl.

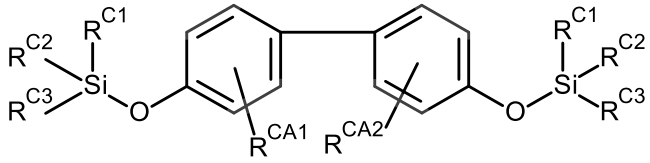
X^{C41}, X^{C42} are independently selected from a C_1 to C_6 alkanediyl.

and wherein the resin composition does essentially not contain any fluoride or bromide.

127. The resin composition according to claim 16, wherein the siloxane-type curing agent is a compound of formula C12a and C12b



(C12a)



(C12b)

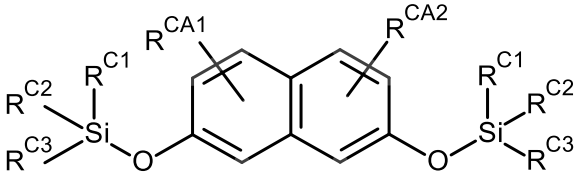
wherein

R^{C1}, R^{C2}, R^{C3} are independently selected from methyl, ethyl and 1-propyl, preferably methyl;

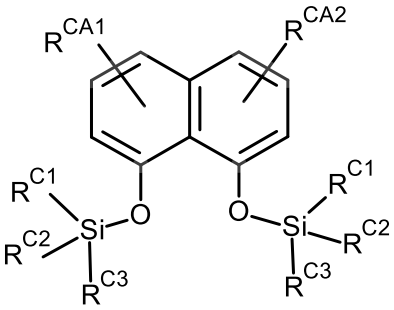
R^{C11}, R^{C12} are independently selected from methyl, ethyl and 1-propyl, preferably methyl;

R^{CA1}, R^{CA2} are independently selected from H and a linear or branched C_1 to C_4 alkyl preferably H, methyl and ethyl.

138. The resin composition according to claim 116, wherein the siloxane-type curing agent is a compound of formula C13a and C13b



(C13a)



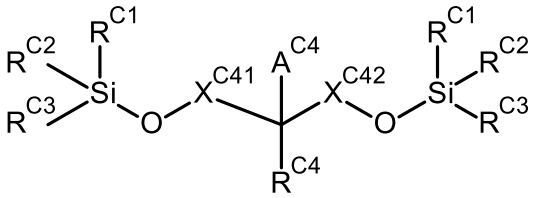
(C13b)

wherein

R^{C1}, R^{C2}, R^{C3} are independently selected from methyl, ethyl and 1-propyl, preferably methyl;

R^{CA1}, R^{CA2} are independently selected from H and a linear or branched C_1 to C_4 alkyl, preferably H, methyl and ethyl.

14~~9~~. The resin composition according to claim 11~~6~~, wherein the siloxane-type curing agent is a compound of formula C14



(C14)

wherein

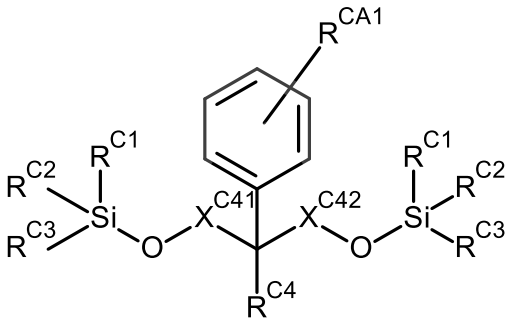
A^{C4} is selected from a C_6 to C_{20} aryl, which may be unsubstituted or substituted by linear or branched C_1 to C_6 alkyl, preferably a C_6 to C_{12} aryl, which may be unsubstituted or substituted by linear or branched C_1 to C_4 alkyl;

R^{C1}, R^{C2}, R^{C3} are independently selected from methyl, ethyl and 1-propyl, preferably methyl;

X^{C41}, X^{C42} are independently selected from C_1 to C_6 alkanediyl, preferably C_1 to C_4 alkanediyl, most preferably methanediyl and ethanediyl;

R^{C4} is selected from H and linear or branched C_1 to C_6 alkyl, preferably H and C_1 to C_4 alkyl, most preferably H, methyl and ethyl.

15~~20~~. The resin composition according to claim 1~~47~~, wherein ~~Particular preferred~~ the bifunctional siloxane-type curing agents are those of formula C14a



(C14a)

wherein

R^{C1}, R^{C2}, R^{C3} are independently selected from methyl, ethyl and 1-propyl, preferably methyl;

X^{C41}, X^{C42} are independently selected from C_1 to C_6 alkanediyl, preferably C_1 to C_4 alkanediyl, most preferably methanediyl and ethanediyl;

R^{C4} is selected from H and C_1 to C_4 alkyl, preferably H, methyl or ethyl, most preferably H or methyl;

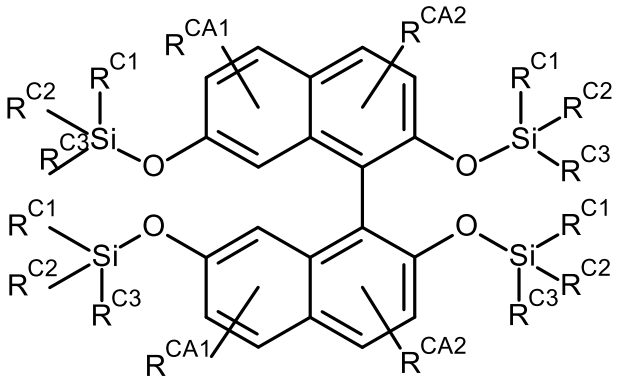
R^{CA1} is selected from H and C_1 to C_4 alkyl, preferably H, methyl and ethyl, most preferably H.

16~~21~~. The resin composition according to anyone of claims 1~~16~~ to 15~~20~~, further comprising an inorganic filler.

17~~22~~. Use of a resin composition according to claim 16~~21~~ for depositing an insulating film on a circuit substrate, particularly for manufacturing a printed wiring board.

18~~23~~. An insulating layer comprising the resin composition according to claim 16~~21~~, after curing said resin composition to form an insulating layer, wherein the insulating layer has a dielectric resistance D_k of 3 or below and a loss tangent D_f of 0.02 or below, particularly 0.01 or below.

~~24. A compound of formula C15:~~



~~(C15)~~

~~wherein~~

~~R^{C1}, R^{C2}, R^{C3} are independently selected from methyl, ethyl and 1-propyl, most preferably methyl;~~

~~R^{CA1}, R^{CA2} are independently selected from H and C_1 to C_4 alkyl, preferably H, methyl and ethyl, most preferably H.~~