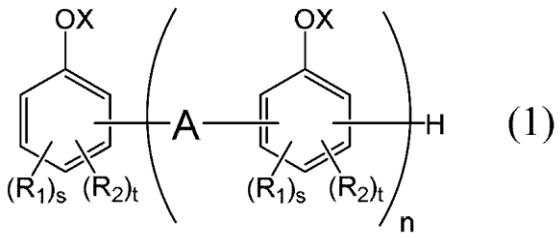
Claims

[Claim 1] A curable resin represented by the following formula (1):

[Chem. 1]



(1)

in formula (1), A represents any one of the following formulas (1-a), (1-c) or (1-d),

each of the multiple Xs independently represents any one of the following formulas (1-e) to (1-g),

each of the multiple R_1s independently represents a residue obtained by removing one hydrogen atom from a C9 petroleum resin,

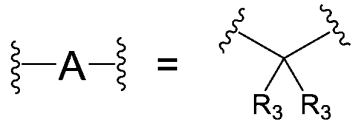
each of the multiple R_2 independently represents a hydrogen atom, a hydrocarbon group having 1 to 10 carbon atoms, an alkoxy group having 1 to 6 carbon atoms, an amino group, or a hydroxy group,

each of the multiple s and t independently represents an integer of 0 to 3, and the sum of s and t is an integer of 0 to 3, s being the number of R_1s bonded to the same aromatic ring, t being the number of R_2 bonded to the same aromatic ring,

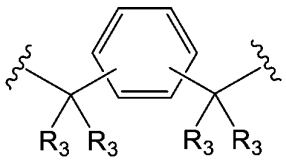
the average value s_{ave} of s is $0 < s_{ave} \leqq 3$, and the average value t_{ave} of t is $0 \leqq t_{ave} \leqq 2$,

n is the number of repetitions, and the average value n_{ave} of n is $0.1 \leqq n_{ave} \leqq 5$,

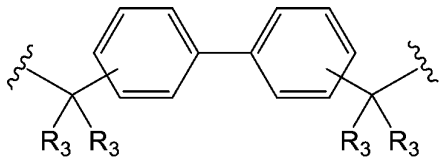
[Chem. 2]



(1-a)



(1-c)

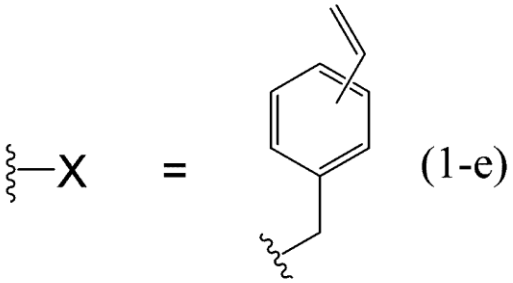


(1-d)

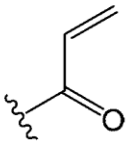
in formulas (1-a), (1-c) or (1-d), each of the multiple R_3s independently represents a hydrogen atom or a hydrocarbon group having 1 to 10 carbon atoms,

the wavy line represents a bonding site to the aromatic ring in formula (1),

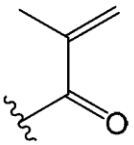
[Chem. 3]



(1-e)



(1-f)

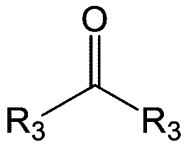


(1-g)

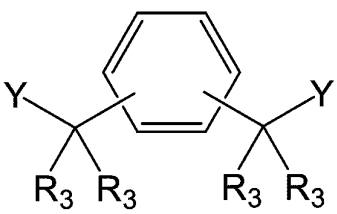
in formulas (1-e) to (1-g), the wavy lines represent the bonding sites to the oxygen atom in formula (1).

[Claim 2] A curable resin obtained by reacting a phenolic resin obtained by reacting a phenolic resin (P3) containing a C9 petroleum resin (P2) having a phenolic hydroxy group with any of the compounds represented by the following formulas (4-a), (4-c) or (4-d), and a compound represented by any of the following formulas (2-a) to (2-c):

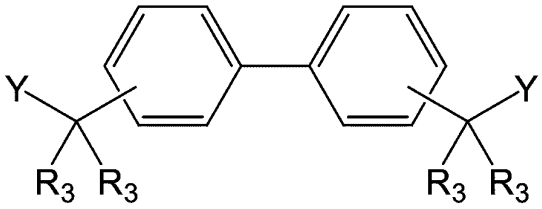
[Chem. 4]



(4-a)



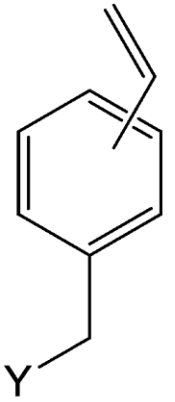
(4-c)



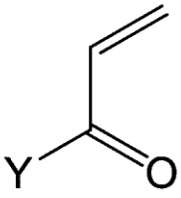
(4-d)

in formulas (4-a) to (4-d), each of the multiple R_3 independently represents a hydrogen atom or a hydrocarbon group having 1 to 10 carbon atoms. Each of the multiple Y independently represents a hydrogen atom, a fluorine atom, a chlorine atom, a bromine atom, an iodine atom, a hydroxy group, or an alkoxy group having 1 to 6 carbon atoms,

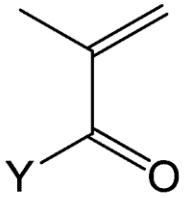
[Chem. 5]



(2-a)



(2-b)



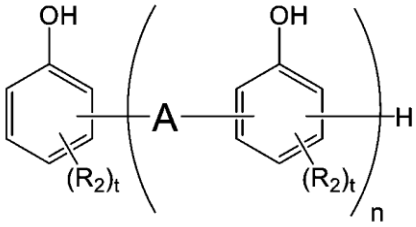
(2-c)

in formulas (2-a) to (2-c), a plurality of Y each independently represent a hydrogen atom, a fluorine atom, a chlorine atom, a bromine atom, an iodine atom, a hydroxy group, or an alkoxy group having 1 to 6 carbon atoms.

[Claim 3] A curable resin obtained by reacting a phenolic resin obtained by reacting a polyhydroxy resin represented by the following formula (3) with a C9 petroleum resin (P1)

having a double bond, with a compound represented by any one of the following formulas (2-a) to (2-c):

[Chem. 6]



(3)

in formula (3), A represents any one of the following formulas (1-a), (1-c) or (1-d),

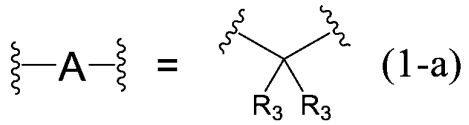
each of the multiple R_2s independently represents a hydrogen atom, a hydrocarbon group having 1 to 10 carbon atoms, an alkoxy group having 1 to 6 carbon atoms, an amino group, or a hydroxy group,

each of the multiple ts independently represents an integer of 0 to 3,

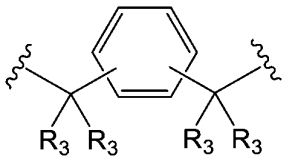
the average value t_{ave} of t is $0 \leqq t_{ave} \leqq 2$,

n is the number of repetitions, and the average value n_{ave} of n is $0.1 \leqq n_{ave} \leqq 5$,

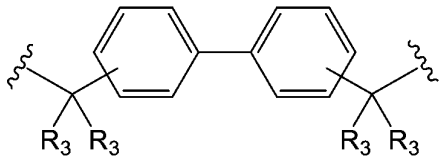
[Chem. 7]



(1-a)



(1-c)

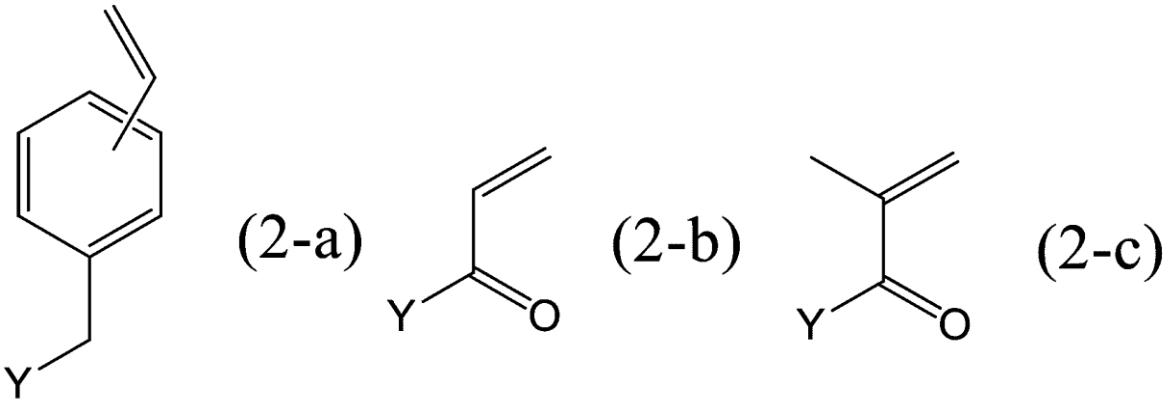


(1-d)

in formulas (1-a), (1-c) or (1-d), each of the multiple R_3s independently represents a hydrogen atom or a hydrocarbon group having 1 to 10 carbon atoms,

the wavy line represents a bonding site to the aromatic ring in formula (3),

[Chem. 8]



in formulas (2-a) to (2-c), a plurality of Y each independently represent a hydrogen atom, a fluorine atom, a chlorine atom, a bromine atom, an iodine atom, a hydroxy group, or an alkoxy group having 1 to 6 carbon atoms.

[Claim 4] A curable resin composition comprising the curable resin according to any one of claims 1 to 3.

[Claim 5] The curable resin composition according to claim 4, further comprising a polyphenylene ether resin.

[Claim 6] The curable resin composition according to claim 4, further comprising a maleimide resin.

[Claim 7] The curable resin composition according to claim 4, further comprising a polyolefin resin or a polystyrene resin.

[Claim 8] The curable resin composition according to claim 4, further comprising an inorganic filler.

[Claim 9] The curable resin composition according to claim 4, further comprising a curing accelerator.

[Claim 10] The curable resin composition according to claim 4, further comprising a polymerization initiator.

[Claim 11] A cured product of the curable resin composition according to claim 4.

[Claim 12] A prepreg obtained by using the curable resin composition according to claim 4.

[Claim 13] A laminate obtained by curing the curable resin composition according to claim 4.

[Claim 14] A semiconductor substrate comprising the laminate according to claim 13.