CLAIMS

1. A semiconductor device comprising:

a substrate;

an adhesive layer; and

a light emitting diode chip,

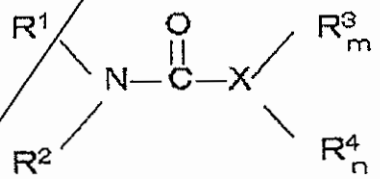
wherein the adhesive layer is a cured product of a die attach material, and

the die attach material contains

at least one resin component (A) selected from the group consisting of a compound (A1) represented by the following formula (1) and an acrylate compound (A2) which has a cycloalkylene group and two or more (meth)acrylic groups and does not have an aromatic ring in one molecule,

at least one silane coupling agent (B) selected from the group consisting of a compound (B1) represented by the following formula (b-1) and a compound (B2) represented by the following formula (b-2), and

an inorganic filler (C).



(1)

(wherein X represents an oxygen atom or a nitrogen atom; m and n each independently represent 0 or 1; when X represents an oxygen atom, m+n=1; when X represents a nitrogen atom, m+n=2; R^1, R^2, R^3, and R^4 each independently represent a hydrogen atom or an organic

group not having an aromatic ring; at least two of R^1, R^2, R^3, and R^4 each independently represent an organic group which has a (meth)acrylic group and does not have an aromatic ring; and at least two substituents of R^1, R^2, R^3, and R^4 may form a ring.)

$$Y-(CH_2)_m-SiR^5R^6R^7 \quad (b-1)$$

$$(S)_n-((CH_2)_p-SiR^5R^6R^7)_2 \quad (b-2)$$

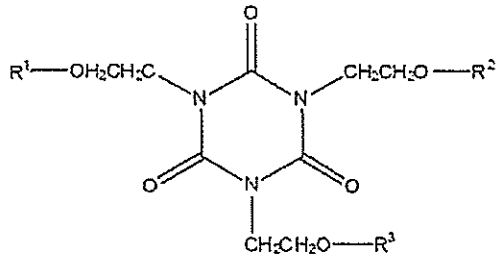
(wherein R^5, R^6, and R^7 each independently represent an alkyl group having 1 to 10 carbon atoms or an alkoxy group having 1 to 10 carbon atoms; at least one of R^5, R^6, and R^7 represents an alkoxy group having 1 to 10 carbon atoms; Y represents any one of an amino group, a glycidyloxy group, a (meth)acryloyloxy group, a mercapto group, and an isocyanate group; m and p each independently represent an integer of 1 to 10; and n represents an integer of 1 or more.)

2. The semiconductor device according to claim 1,

wherein the die attach material is a die attach paste.

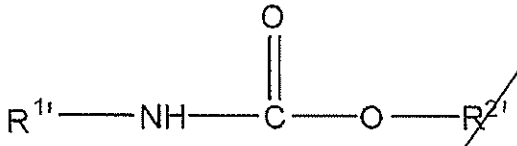
3. The semiconductor device according to claim 1 or 2,

wherein the compound (A1) contains at least one selected from the group consisting of a compound represented by the following formula (a1-1) and a compound represented by the following formula (a1-2).



(a1-1)

(wherein R^1, R^2, and R^3 each independently represent a hydrogen atom or an organic group not having an aromatic ring; and at least two of R^1, R^2, and R^3 represent an organic group which has a (meth)acrylic group and does not have an aromatic ring.)

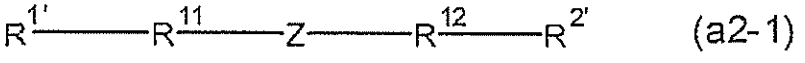


(a1-2)

(wherein $R^{1'}$ and $R^{2'}$ each independently represent an organic group which has a (meth)acrylic group and does not have an aromatic ring.)

4. The semiconductor device according to any one of claims 1 to 3, wherein the compound (A1) is a compound having at least three acrylic groups or (meth)acrylic groups in the molecule.

5. The semiconductor device according to claim 1 or 2, wherein the acrylate compound (A2) contains a compound represented by the following formula (a2-1).



(a2-1)

(wherein $R^{1'}$ and $R^{2'}$ each independently represent an organic group

which has a (meth)acrylic group and does not have an aromatic ring; R^{11} and R^{12} each independently represent a linear alkylene group or a single bond; and Z represents a cycloalkylene group.)

6. The semiconductor device according to claim 3,

wherein the resin component (A) contains the compound represented by the formula (a1-1).

7. The semiconductor device according to any one of claims 1 to 6,

wherein the silane coupling agent (B) contains the compound represented by the formula (b-1).

8. The semiconductor device according to any one of claims 1 to 7,

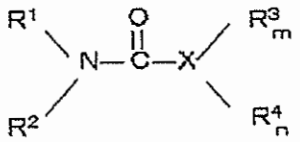
wherein in the formula (b-1), Y represents a glycidyloxy group or a (meth)acryloyloxy group.

9. A die attach material which is used for attaching a substrate and a light emitting diode chip to each other, the material comprising:

at least one resin component (A) selected from the group consisting of a compound (A1) represented by the following formula (1) and an acrylate compound (A2) which has a cycloalkylene group and two or more (meth)acrylic groups and does not have an aromatic ring in one molecule;

at least one silane coupling agent (B) selected from the group consisting of a compound (B1) represented by the following formula (b-1) and a compound (B2) represented by the following formula (b-2); and

an inorganic filler (C).



(1)

(wherein X represents an oxygen atom or a nitrogen atom; m and n each independently represent 0 or 1; when X represents an oxygen atom, m+n=1; when X represents a nitrogen atom, m+n=2; R^1, R^2, R^3, and R^4 each independently represent a hydrogen atom or an organic group not having an aromatic ring; at least two of R^1, R^2, R^3, and R^4 each independently represent an organic group which has a (meth)acrylic group and does not have an aromatic ring; and at least two substituents of R^1, R^2, R^3, and R^4 may form a ring.)

$Y-(CH_2)_m-SiR^5R^6R^7$ (b-1)

$(S)_n-((CH_2)_p-SiR^5R^6R^7)_2$ (b-2)

(wherein R^5, R^6, and R^7 each independently represent an alkyl group having 1 to 10 carbon atoms or an alkoxy group having 1 to 10 carbon atoms; at least one of R^5, R^6, and R^7 represents an alkoxy group having 1 to 10 carbon atoms; Y represents any one of an amino group, a glycidyloxy group, a (meth)acryloyloxy group, a mercapto group, and an isocyanate group; m and p each independently represent an integer of 1 to 10; and n represents an integer of 1 or more.)

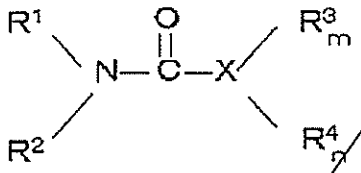
10. A method for manufacturing a semiconductor device, the method comprising:

a step of preparing a die attach material by mixing at least one resin component (A) selected from the group consisting of a

compound (A1) represented by the following formula (1) and an acrylate compound (A2) which has a cycloalkylene group and two or more (meth)acrylic groups and does not have an aromatic ring in one molecule, at least one silane coupling agent (B) selected from the group consisting of a compound (B1) represented by the following formula (b-1) and a compound (B2) represented by the following formula (b-2), and an inorganic filler (C) with each other;

a step of interposing the die attach material between a substrate and a light emitting diode chip; and

a step of attaching the light emitting diode chip to the substrate.



(1)

(wherein X represents an oxygen atom or a nitrogen atom; m and n each independently represent 0 or 1; when X represents an oxygen atom, m+n=1; when X represents a nitrogen atom, m+n=2; R^1, R^2, R^3, and R^4 each independently represent a hydrogen atom or an organic group not having an aromatic ring; at least two of R^1, R^2, R^3, and R^4 each independently represent an organic group which has a (meth)acrylic group and does not have an aromatic ring; and at least two substituents of R^1, R^2, R^3, and R^4 may form a ring.)

$$Y-(CH_2)_m-SiR^5R^6R^7 \quad (b\text{-}1)$$

$$(S)_n-((CH_2)_p-SiR^5R^6R^7)_2 \quad (b\text{-}2)$$

(wherein R^5, R^6, and R^7 each independently represent an alkyl group having 1 to 10 carbon atoms or an alkoxy group having 1 to 10

carbon atoms; at least one of R^5, R^6, and R^7 represents an alkoxy group having 1 to 10 carbon atoms; Y represents any one of an amino group, a glycidyloxy group, a (meth)acryloyloxy group, a mercapto group, and an isocyanate group; m and p each independently represent an integer of 1 to 10; and n represents an integer of 1 or more.)

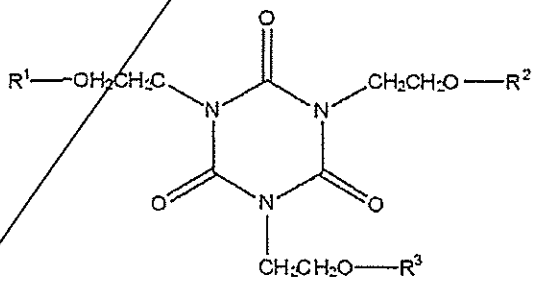
11. The method for manufacturing a semiconductor device according to claim 10,

wherein the die attach material is a die attach paste, and

in the step of interposing the die attach material, the die attach paste is applied to the substrate and the light emitting diode chip.

12. The method for manufacturing a semiconductor device according to claim 10 or 11,

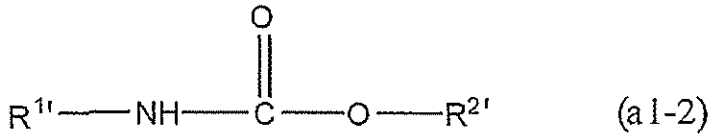
wherein the compound (A1) contains at least one selected from the group consisting of a compound represented by the following formula (a1-1) and a compound represented by the following formula (a1-2).



(a1-1)

(wherein R^1, R^2, and R^3 each independently represent a hydrogen atom or an organic group not having an aromatic ring; and at least two of R^1, R^2, and R^3 represent an organic group which has a

(meth)acrylic group and does not have an aromatic ring.)



(a1-2)

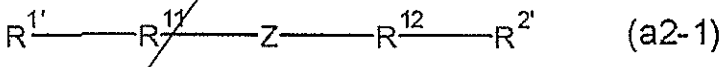
(wherein $R^{1'}$ and $R^{2'}$ each independently represent an organic group which has a (meth)acrylic group and does not have an aromatic ring.)

13. The method for manufacturing a semiconductor device according to any one of claims 10 to 12,

wherein the compound (A1) is a compound having at least three acrylic groups or (meth)acrylic groups in the molecule.

14. The method for manufacturing a semiconductor device according to claim 10 or 11,

wherein the acrylate compound (A2) contains a compound represented by the following formula (a2-1).



(a2-1)

(wherein $R^{1'}$ and $R^{2'}$ each independently represent an organic group which has a (meth)acrylic group and does not have an aromatic ring; R^{11} and R^{12} each independently represent a linear alkylene group or a single bond; and Z represents a cycloalkylene group.)

15. The method for manufacturing a semiconductor device according to claim 12,

wherein the resin component (A) contains the compound represented by the formula (a1-1).

16. The method for manufacturing a semiconductor device according to any one of claims 10 to 15,

wherein the silane coupling agent (B) contains the compound represented by the formula (b-1).

17. The method for manufacturing a semiconductor device according to any one of claims 10 to 16,

wherein in the formula (b-1), Y represents a glycidyloxy group or a (meth)acryloyloxy group.

CLAIMS

1. A semiconductor device comprising:

a substrate;

an adhesive layer; and

a light emitting diode chip,

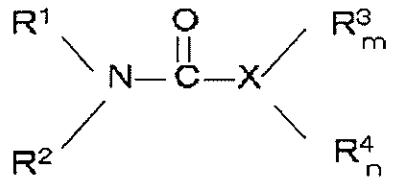
wherein the adhesive layer is a cured product of a die attach material, and

the die attach material contains

at least one resin component (A) selected from the group consisting of a compound (A1) represented by the following formula (1) and an acrylate compound (A2) which has a cycloalkylene group and two or more (meth)acrylic groups and does not have an aromatic ring in one molecule,

at least one silane coupling agent (B) selected from the group consisting of a compound (B1) represented by the following formula (b-1) and a compound (B2) represented by the following formula (b-2), and

an inorganic filler (C).



(1)

(wherein X represents an oxygen atom or a nitrogen atom; m and n each independently represent 0 or 1; when X represents an oxygen atom, m+n=1; when X represents a nitrogen atom, m+n=2; R^1, R^2, R^3, and R^4 each independently represent a hydrogen atom or an organic group not having an aromatic ring; at least two of R^1, R^2, R^3, and R^4 each independently represent an organic group which has a (meth)acrylic group and does not have an aromatic ring; and at least two substituents of R^1, R^2, R^3, and R^4 may form a ring.)

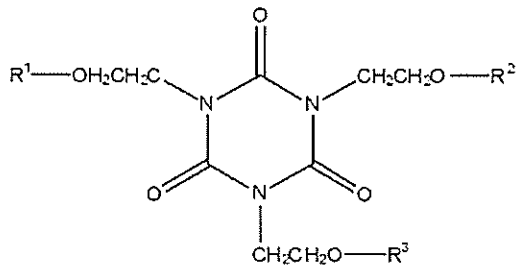
$Y-(CH_2)_m-SiR^5R^6R^7$ (b-1)

$(S)_n-((CH_2)_p-SiR^5R^6R^7)_2$ (b-2)

(wherein R^5, R^6, and R^7 each independently represent an alkyl group having 1 to 10 carbon atoms or an alkoxy group having 1 to 10 carbon atoms; at least one of R^5, R^6, and R^7 represents an alkoxy group having 1 to 10 carbon atoms; Y represents any one of an amino group, a glycidyloxy group, a (meth)acryloyloxy group, a mercapto group, and an isocyanate group; m and p each independently represent an integer of 1 to 10; and n represents an integer of 1 or more.)

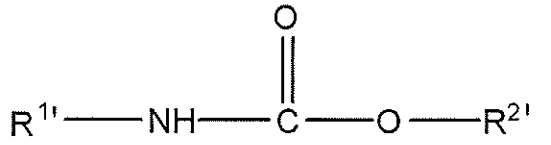
2. The semiconductor device according to claim 1, wherein the die attach material is a die attach paste.

3. The semiconductor device according to claim 1, wherein the compound (A1) contains at least one selected from the group consisting of a compound represented by the following formula (a1-1) and a compound represented by the following formula (a1-2).



(a1-1)

(wherein R^1, R^2, and R^3 each independently represent a hydrogen atom or an organic group not having an aromatic ring; and at least two of R^1, R^2, and R^3 represent an organic group which has a (meth)acrylic group and does not have an aromatic ring.)



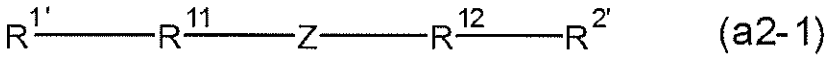
(a1-2)

(wherein $R^{1'}$ and $R^{2'}$ each independently represent an organic

group which has a (meth)acrylic group and does not have an aromatic ring.)

4. The semiconductor device according to claim 1,
wherein the compound (A1) is a compound having at least three acrylic groups or (meth)acrylic groups in the molecule.

5. The semiconductor device according to claim 1,
wherein the acrylate compound (A2) contains a compound represented by the following formula (a2-1).



(a2-1)

(wherein $R^{1'}$ and $R^{2'}$ each independently represent an organic group which has a (meth)acrylic group and does not have an aromatic ring; R^{11} and R^{12} each independently represent a linear alkylene group or a single bond; and Z represents a cycloalkylene group.)

6. The semiconductor device according to claim 3,
wherein the resin component (A) contains the compound represented by the formula (a1-1).

7. The semiconductor device according to claim 1,
wherein the silane coupling agent (B) contains the compound represented by the formula (b-1).

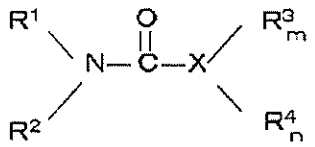
8. The semiconductor device according to claim 1,
wherein in the formula (b-1), Y represents a glycidyloxy group or a (meth)acryloyloxy group.

9. A die attach material which is used for attaching a substrate and a light emitting diode chip to each other, the material comprising:
at least one resin component (A) selected from the group consisting of a compound (A1) represented by the following

formula (1) and an acrylate compound (A2) which has a cycloalkylene group and two or more (meth)acrylic groups and does not have an aromatic ring in one molecule;

at least one silane coupling agent (B) selected from the group consisting of a compound (B1) represented by the following formula (b-1) and a compound (B2) represented by the following formula (b-2); and

an inorganic filler (C).



(1)

(wherein X represents an oxygen atom or a nitrogen atom; m and n each independently represent 0 or 1; when X represents an oxygen atom, m+n=1; when X represents a nitrogen atom, m+n=2; R^1, R^2, R^3, and R^4 each independently represent a hydrogen atom or an organic group not having an aromatic ring; at least two of R^1, R^2, R^3, and R^4 each independently represent an organic group which has a (meth)acrylic group and does not have an aromatic ring; and at least two substituents of R^1, R^2, R^3, and R^4 may form a ring.)

$$Y\text{-}(CH_2)_m\text{-}SiR^5R^6R^7 \quad (b\text{-}1)$$

$$(S)_n\text{-}((CH_2)_p\text{-}SiR^5R^6R^7)_2 \quad (b\text{-}2)$$

(wherein R^5, R^6, and R^7 each independently represent an alkyl group having 1 to 10 carbon atoms or an alkoxy group having 1 to 10 carbon atoms; at least one of R^5, R^6, and R^7 represents an alkoxy group having 1 to 10 carbon atoms; Y represents any one of an amino group, a glycidyloxy group, a (meth)acryloyloxy group, a mercapto group, and an isocyanate group; m and p each independently represent an integer of 1 to 10; and n represents an integer of 1 or more.)

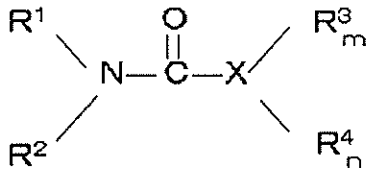
10. A method for manufacturing a semiconductor device, the method comprising:

a step of preparing a die attach material by mixing at least

one resin component (A) selected from the group consisting of a compound (A1) represented by the following formula (1) and an acrylate compound (A2) which has a cycloalkylene group and two or more (meth)acrylic groups and does not have an aromatic ring in one molecule, at least one silane coupling agent (B) selected from the group consisting of a compound (B1) represented by the following formula (b-1) and a compound (B2) represented by the following formula (b-2), and an inorganic filler (C) with each other;

a step of interposing the die attach material between a substrate and a light emitting diode chip; and

a step of attaching the light emitting diode chip to the substrate.



(1)

(wherein X represents an oxygen atom or a nitrogen atom; m and n each independently represent 0 or 1; when X represents an oxygen atom, m+n=1; when X represents a nitrogen atom, m+n=2; R^1, R^2, R^3, and R^4 each independently represent a hydrogen atom or an organic group not having an aromatic ring; at least two of R^1, R^2, R^3, and R^4 each independently represent an organic group which has a (meth)acrylic group and does not have an aromatic ring; and at least two substituents of R^1, R^2, R^3, and R^4 may form a ring.)

$$Y\text{-}(CH_2)_m\text{-}SiR^5R^6R^7 \quad (b\text{-}1)$$

$$(S)_n\text{-}((CH_2)_p\text{-}SiR^5R^6R^7)_2 \quad (b\text{-}2)$$

(wherein R^5, R^6, and R^7 each independently represent an alkyl group having 1 to 10 carbon atoms or an alkoxy group having 1 to 10 carbon atoms; at least one of R^5, R^6, and R^7 represents an alkoxy group having 1 to 10 carbon atoms; Y represents any one of an amino group, a glycidyloxy group, a (meth)acryloyloxy group, a mercapto group, and an isocyanate group; m and p each

independently represent an integer of 1 to 10; and n represents an integer of 1 or more.)

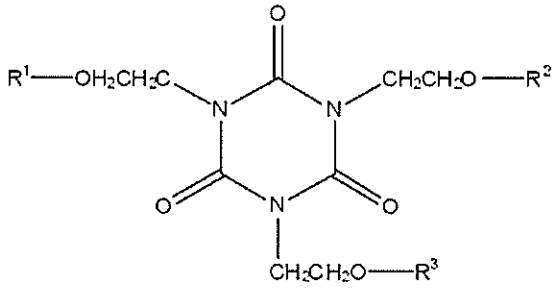
11. The method for manufacturing a semiconductor device according to claim 10,

wherein the die attach material is a die attach paste, and

in the step of interposing the die attach material, the die attach paste is applied to the substrate and the light emitting diode chip.

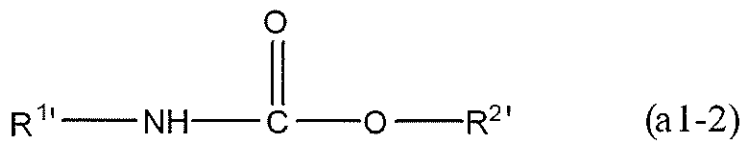
12. The method for manufacturing a semiconductor device according to claim 10,

wherein the compound (A1) contains at least one selected from the group consisting of a compound represented by the following formula (a1-1) and a compound represented by the following formula (a1-2).



(a1-1)

(wherein R^1, R^2, and R^3 each independently represent a hydrogen atom or an organic group not having an aromatic ring; and at least two of R^1, R^2, and R^3 represent an organic group which has a (meth)acrylic group and does not have an aromatic ring.)



(a1-2)

(wherein $R^{1'}$ and $R^{2'}$ each independently represent an organic group which has a (meth)acrylic group and does not have an

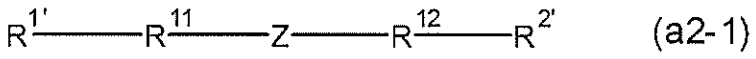
aromatic ring.)

13. The method for manufacturing a semiconductor device according to claim 10,

wherein the compound (A1) is a compound having at least three acrylic groups or (meth)acrylic groups in the molecule.

14. The method for manufacturing a semiconductor device according to claim 10,

wherein the acrylate compound (A2) contains a compound represented by the following formula (a2-1).



(a2-1)

(wherein $R^{1'}$ and $R^{2'}$ each independently represent an organic group which has a (meth)acrylic group and does not have an aromatic ring; R^{11} and R^{12} each independently represent a linear alkylene group or a single bond; and Z represents a cycloalkylene group.)

15. The method for manufacturing a semiconductor device according to claim 12,

wherein the resin component (A) contains the compound represented by the formula (a1-1).

16. The method for manufacturing a semiconductor device according to claim 10,

wherein the silane coupling agent (B) contains the compound represented by the formula (b-1).

17. The method for manufacturing a semiconductor device according to claim 10,

wherein in the formula (b-1), Y represents a glycidyloxy group or a (meth)acryloyloxy group.