CLAIMS

1. An epoxy resin composition for semiconductor encapsulation, comprising an epoxy resin (A) and a curing agent (B), used for encapsulating a copper wire and a semiconductor element connected to the copper wire,

wherein a cured product of the epoxy resin composition for semiconductor encapsulation is heated for 10 hours at 200°C, the amount of generation of a first corrosive gas that is a sulfur compound having corrosiveness to the copper wire is less than or equal to 70 ppm.

2. The epoxy resin composition for semiconductor encapsulation according to claim 1, wherein the first corrosive gas is sulfurous acid gas.

3. The epoxy resin composition for semiconductor encapsulation according to claim 1 or 2, wherein a second corrosive gas that is a halogen compound, and a third corrosive gas that is an organic acid are corrosive to the copper wire, and the total amount of generation of the first, second and third corrosive gases generated when the cured product of the epoxy resin composition for semiconductor encapsulation is heated for 10 hours at 200°C is less than or equal to 230 ppm.

4. The epoxy resin composition for semiconductor encapsulation according to claim 3, wherein the second

corrosive gas is hydrogen chloride gas.

5. The epoxy resin composition for semiconductor encapsulation according to claim 3 or 4, wherein the third corrosive gas includes two or more kinds of different organic acids.

6. The epoxy resin composition for semiconductor encapsulation according to any one of claims 3 to 5, wherein the third corrosive gas includes formic acid and/or acetic acid.

7. The epoxy resin composition for semiconductor encapsulation according to any one of claims 1 to 6, further comprising hydrotalcite.

8. The epoxy resin composition for semiconductor encapsulation according to claim 7, wherein the hydrotalcite is a compound represented by the following formula (1):

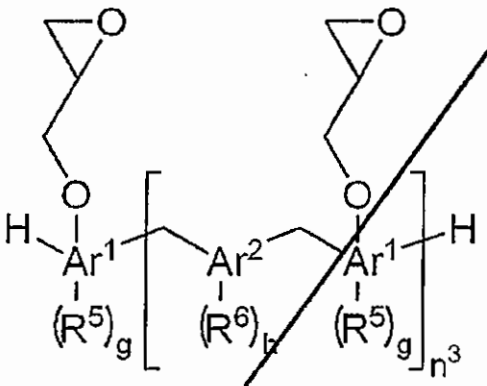
$$M_aAl_b(OH)_{2a+3b-2c}(CO_3)_c \cdot mH_2O \qquad (1)$$

wherein in the formula (1), M represents a metal element including at least Mg; a, b and c are respectively numbers that satisfy the relations: $2 \leq a \leq 8$, $1 \leq b \leq 3$, and $0.5 \leq c \leq 2$; and m represents an integer of equal to or larger than 0.

9. The epoxy resin composition for semiconductor

encapsulation according to any one of claims 1 to 8, wherein the epoxy resin (A) includes at least one selected from the group consisting of an epoxy resin represented by the following formula (2), an epoxy resin represented by the following formula (3), and an epoxy resin represented by the following formula (4):

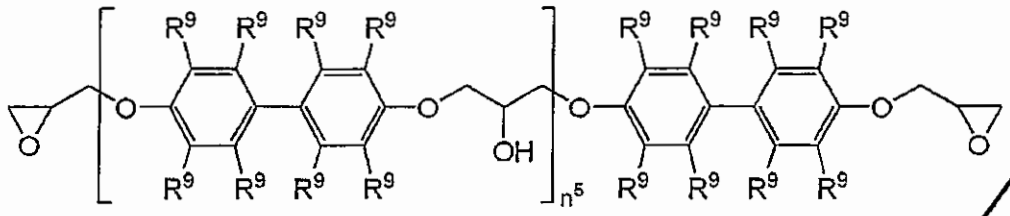
[Chemical Formula 1]



(2)

wherein in the formula (2), Ar^1 represents a phenylene group or a naphthylene group; when Ar^1 is a naphthylene group, the glycidyl ether group may be bonded to any of the α-position and the β-position; Ar^2 represents any one group among a phenylene group, a biphenylene group and a naphthylene group; R^5 and R^6 each independently represent a hydrocarbon group having 1 to 10 carbon atoms; g represents an integer of 0 to 5; h represents an integer of 0 to 8; n^3 represents the degree of polymerization, and the average value is a positive number of 1 to 3;

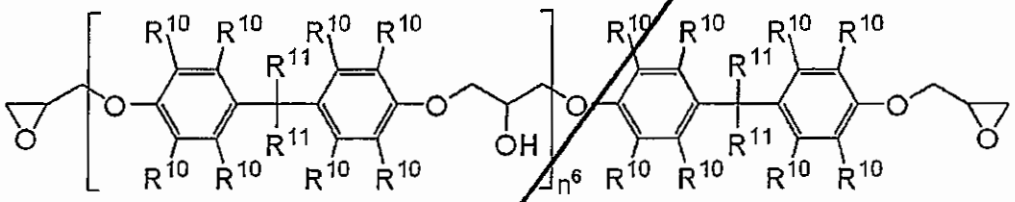
[Chemical Formula 2]



(3)

wherein in the formula (3), a plurality of R^9s each independently represent a hydrogen atom or a hydrocarbon group having 1 to 4 carbon atoms; and n^5 represents the degree of polymerization, and the average value thereof is a positive number of 0 to 4; and

[Chemical Formula 3]

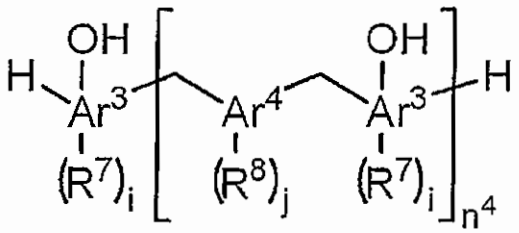


(4)

wherein in the formula (4), a plurality of R^{10}s and R^{11}s each independently represent a hydrogen atom or a hydrocarbon group having 1 to 4 carbon atoms; and n^6 represents the degree of polymerization, and the average value thereof is a positive number of 0 to 4.

10. The epoxy resin composition for semiconductor encapsulation according to any one of claims 1 to 9, wherein the epoxy resin composition comprises at least one curing agent selected from the group consisting of compounds represented by the following formula (5):

[Chemical Formula 4]



(5)

wherein in the formula (5), Ar^3 represents a phenylene group or a naphthylene group; when Ar^3 is a naphthylene group, the hydroxyl group may be bonded to any of the α-position and the β-position; Ar^4 represents any one group among a phenylene group, a biphenylene group and a naphthylene group; R^7 and R^8 each independently represent a hydrocarbon group having 1 to 10 carbon atoms; i represents an integer of 0 to 5; j represents an integer of 0 to 8; n^4 represents the degree of polymerization, and the average value is a positive number of 1 to 3.

11. The epoxy resin composition for semiconductor encapsulation according to any one of claims 1 to 10, wherein the copper purity of the copper wire is more than or equal to 99.99% by mass.

12. A cured product of the epoxy resin composition for semiconductor encapsulation according to any one of claims 1 to 11.

13. A semiconductor device comprising:

a lead frame having a die pad unit;

a semiconductor element mounted on the die pad unit;

a copper wire that electrically connects the lead frame and the semiconductor element; and

an encapsulating resin that is formed from a cured product of an epoxy resin composition and encapsulates the semiconductor element and the copper wire,

wherein when the encapsulating resin is heated for 10 hours at 200°C, the amount of generation of a first corrosive gas that is a sulfur compound having corrosiveness to the copper wire is less than or equal to 70 ppm.

14. The semiconductor device according to claim 13, wherein the second corrosive gas that is a halogen compound, and a third corrosive gas that is an organic acid have corrosiveness to the copper wire, and when the encapsulating resin is heated for 10 hours at 200°C, the total amount of generation of the first, second and third corrosive gases is less than or equal to 230 ppm.

15. The semiconductor device according to claim 13 or 14, wherein the copper wire is bonded to an electrode pad formed on the semiconductor element, and the electrode pad contains aluminum as a main component.

The invention claimed is:

1. An epoxy resin composition for semiconductor encapsulation, comprising an epoxy resin and a curing agent, said composition used for encapsulating a copper wire and a semiconductor element connected to the copper wire,

wherein a cured product of the epoxy resin composition for semiconductor encapsulation is heated for 10 hours at 200° C., the amount of generation of a first corrosive gas that is a sulfur compound having corrosiveness to the copper wire is less than or equal to 70 ppm, and

wherein the first corrosive gas is sulfurous acid gas.

2. The epoxy resin composition for semiconductor encapsulation according to claim 1, wherein a second corrosive gas that is a halogen compound, and a third corrosive gas that is an organic acid are corrosive to the copper wire, and the total amount of generation of the first, second and third corrosive gases generated when the cured product of the epoxy resin composition for semiconductor encapsulation is heated for 10 hours at 200° C. is less than or equal to 230 ppm.

3. The epoxy resin composition for semiconductor encapsulation according to claim 2, wherein the second corrosive gas is hydrogen chloride gas.

4. The epoxy resin composition for semiconductor encapsulation according to claim 2, wherein the third corrosive gas includes two or more kinds of different organic acids.

5. The epoxy resin composition for semiconductor encapsulation according to claim 2, wherein the third corrosive gas includes formic acid and/or acetic acid.

6. The epoxy resin composition for semiconductor encapsulation according to claim 1, further comprising hydrotalcite.

7. The epoxy resin composition for semiconductor encapsulation according to claim 6, wherein the hydrotalcite is a compound represented by the following formula (1):

$$M_aAl_b(OH)_{2a+3b-2c}(CO_3)_c \cdot mH_2O \quad (1)$$

wherein in the formula (1), M represents a metal element including at least Mg; a, b and c are respectively numbers that satisfy the relations: $2 \leq a \leq 8$, $1 \leq b \leq 3$, and $0.5 \leq c \leq 2$; and m represents an integer of equal to or larger than 0.

8. The epoxy resin composition for semiconductor encapsulation according to claim 1, wherein the copper purity of the copper wire is more than or equal to 99.99% by mass.

9. A cured product of the epoxy resin composition for semiconductor encapsulation according to claim 1.

10. A semiconductor device comprising:

a lead frame having a die pad unit;

a semiconductor element mounted on the die pad unit;

a copper wire that electrically connects the lead frame and the semiconductor element; and

an encapsulating resin that is formed from a cured product of an epoxy resin composition and encapsulates the semiconductor element and the copper wire,

wherein when the encapsulating resin is heated for 10 hours at 200° C., the amount of generation of a first corrosive gas that is a sulfur compound having corrosiveness to the copper wire is less than or equal to 70 ppm, and

wherein the first corrosive gas is sulfurous acid gas.

11. The semiconductor device according to claim 10, wherein the second corrosive gas that is a halogen compound, and a third corrosive gas that is an organic acid have corrosiveness to the copper wire, and when the encapsulating resin is heated for 10 hours at 200° C., the total amount of generation of the first, second and third corrosive gases is less than or equal to 230 ppm.

12. The semiconductor device according to claim 10, wherein the copper wire is bonded to an electrode pad formed on the semiconductor element, and the electrode pad contains aluminum as a main component.

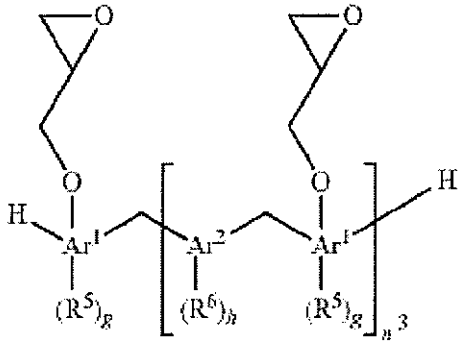
13. An epoxy resin composition for semiconductor encapsulation, comprising an epoxy resin and a curing agent, said composition used for encapsulating a copper wire and a semiconductor element connected to the copper wire,

wherein a cured product of the epoxy resin composition for semiconductor encapsulation is heated for 10 hours at 200° C.,

wherein the amount of generation of a first corrosive gas that is a sulfur compound having corrosiveness to the copper wire is less than or equal to 70 ppm, and

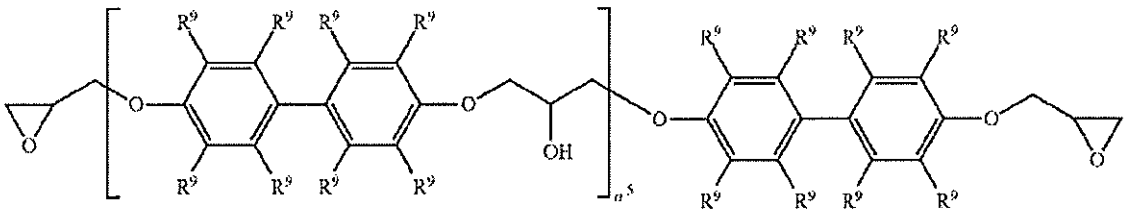
wherein the epoxy resin includes at least one selected from the group consisting of an epoxy resin represented by the following formula (2), an epoxy resin represented by the following formula (3), and an epoxy resin represented by the following formula (4):

(2)



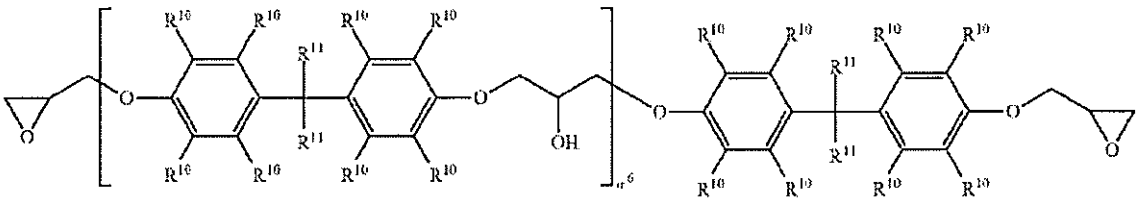
wherein in the formula (2), Ar^1 represents a phenylene group or a naphthylene group; when Ar^1 is a naphthylene group, the glycidyl ether group may be bonded to any of the α-position and the β-position; Ar^2 represents any one group among a phenylene group, a biphenylene group and a naphthylene group; R^5 and R^6 each independently represent a hydrocarbon group having 1 to 10 carbon atoms; g represents an integer of 0 to 5; h represents an integer of 0 to 8; n^3 represents the degree of polymerization, and the average value is a positive number of 1 to 3;

(3)



wherein in the formula (3), a plurality of R^9 s each independently represent a hydrogen atom or a hydrocarbon group having 1 to 4 carbon atoms; and n^5 represents the degree of polymerization, and the average value thereof is a positive number of 0 to 4; and

(4)



wherein in the formula (4), a plurality of R^{10}s and R^{11}s each independently represent a hydrogen atom or a hydrocarbon group having 1 to 4 carbon atoms; and n^6 represents the degree of polymerization, and the average value thereof is a positive number of 0 to 4.

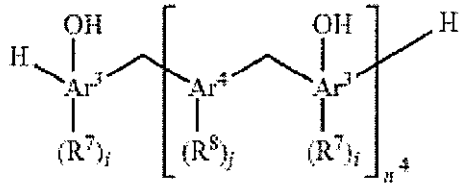
14. An epoxy resin composition for semiconductor encapsulation, comprising an epoxy resin and a curing agent, said composition used for encapsulating a copper wire and a semiconductor element connected to the copper wire,

wherein a cured product of the epoxy resin composition for semiconductor encapsulation is heated for 10 hours at 200° C.,

wherein the amount of generation of a first corrosive gas that is a sulfur compound having corrosiveness to the copper wire is less than or equal to 70 ppm, and

wherein the epoxy resin composition comprises at least one curing agent selected from the group consisting of compounds represented by the following formula (5):

(5)



wherein in the formula (5), Ar^3 represents a phenylene group or a naphthylene group;

when Ar^3 is a naphthylene group, the hydroxyl group may be bonded to any of the α-position and the β-position; Ar^4 represents any one group among a phenylene group, a biphenylene group and a naphthylene group; R^7 and R^8 each independently represent a hydrocarbon group having 1 to 10 carbon atoms; i represents an integer of 0 to 5; j represents an integer of 0 to 8; n^4 represents the degree of polymerization, and the average value is a positive number of 1 to 3.