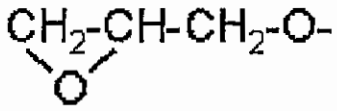
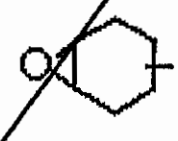
CLAIMS

1. A semiconductor device configured by encapsulating a semiconductor element, partially or entirely covered with a polyimide, using an epoxy resin composition for encapsulating semiconductor device which contains an epoxy resin (A), a phenol resin (B), a curing accelerator (C), an inorganic filler (D), and a silane coupling agent (E) represented by the formula (1):

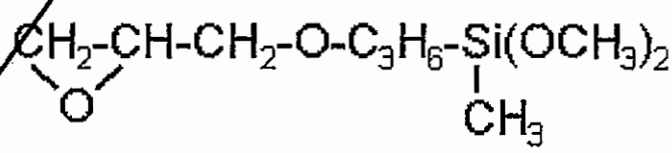
$$Ep\text{-}R^1\text{-}Si\text{-}R^2_n(OR^3)_{3-n} \qquad (1)$$

Ep:  or 

(in the formula (1), each of R^1, R^2 and R^3 represents a C_{1-4} hydrocarbon group, all of them may be the same or different from each other, and n represents an integer from 0 to 2), and/or a hydrolytic condensate thereof.

2. The semiconductor device according to Claim 1,

wherein the silane coupling agent (E) and/or the hydrolytic condensate thereof is a silane coupling agent represented by the formula (2) below:

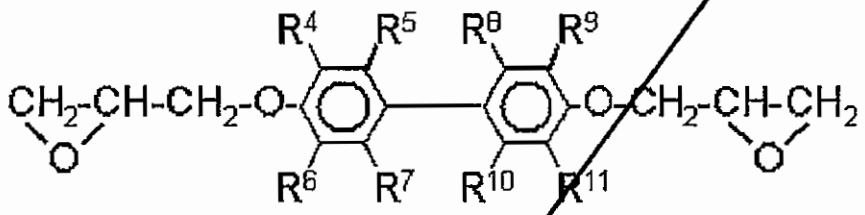


(2)

and/or a hydrolytic condensate thereof.

3. The semiconductor device according to Claim 1, wherein ratio of the silane coupling agent (E) and/or the hydrolytic condensate thereof accounts for 0.01 to 1.0% by mass of the whole epoxy composition for encapsulating semiconductor device.

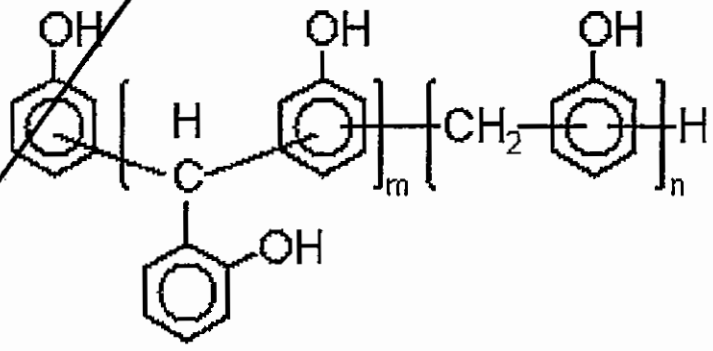
4. The semiconductor device according to Claim 1, wherein the epoxy resin (A) contains an epoxy resin represented by the formula (3) below:



(3)

(in the formula (3), each of R^4 to R^{11} is selected from a hydrogen atom and C_{1-4} alkyl group, all of them may be the same or different from each other).

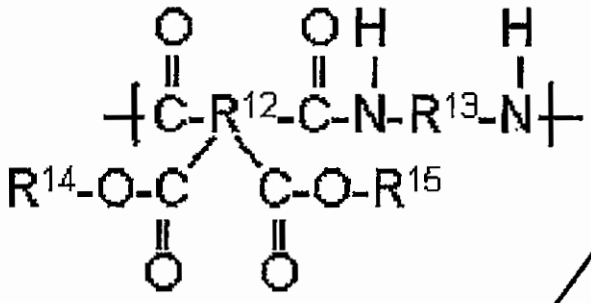
5. The semiconductor device according to Claim 1, wherein the phenol resin (B) contains a phenol resin represented by the formula (4):



(4)

(in the formula (4), m represents an integer from 1 to 5, and n represents an integer from 0 to 5).

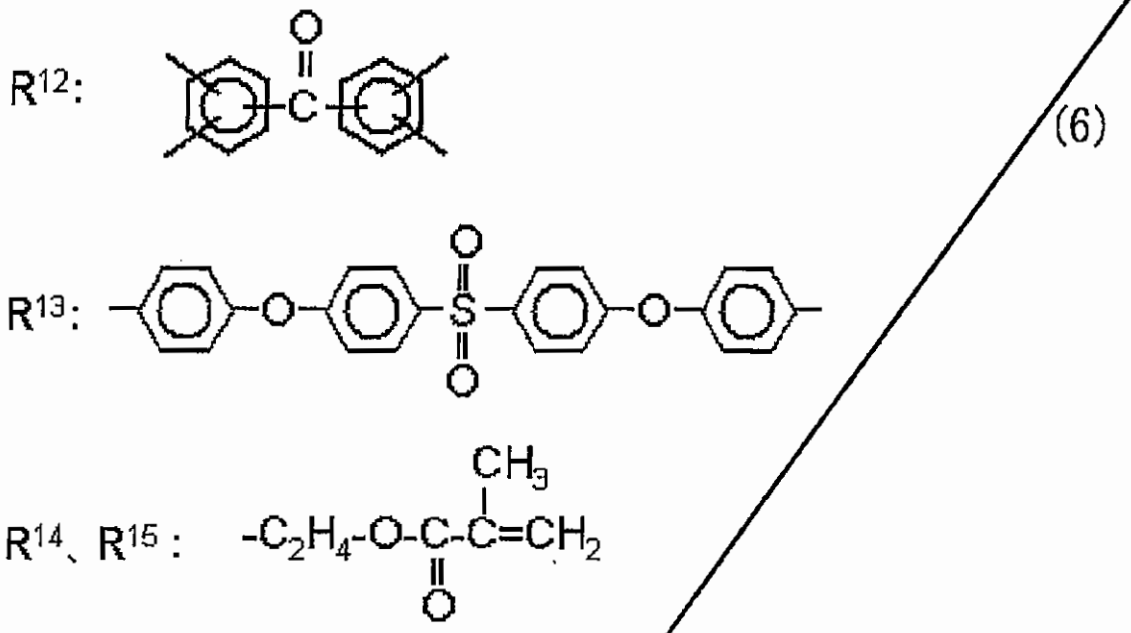
6. The semiconductor device according to Claim 1, wherein the polyimide is obtained by dealcoholization of a polyimide precursor represented by the formula (5):



(5)

(in the formula (5), R^{12} is an organic group having at least two carbon atoms, R^{13} is an organic group having at least two carbon atoms, each of R^{14} and R^{15} is an organic group having at least one double bond, all of them may be the same or different from each other).

7. The semiconductor device according to Claim 6, wherein R^{12}, R^{13}, R^{14} and R^{15} of the polyimide precursor represented by the formula (5) are groups represented by the formula (6) below:



(6)

8. The semiconductor device according to Claim 1 configured as an area mounting-type semiconductor device, having the semiconductor element mounted on one surface of a substrate, and only the surface of the substrate having the semiconductor element mounted thereon being encapsulated with the epoxy resin composition for encapsulating semiconductor device.

9. The semiconductor device according to Claim 1 configured as a board-on-chip type semiconductor device, having the semiconductor element mounted on one surface of a substrate having an opening, and the surface of substrate having the semiconductor element mounted thereon and the opening being encapsulated with the epoxy resin composition for encapsulating semiconductor device.

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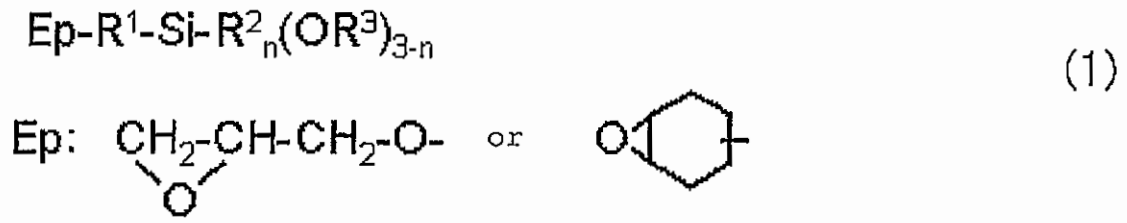

(1)

(in the formula (1), each of R^1, R^2 and R^3 represents a C_{1-4} hydrocarbon group, all of them may be the same or different from each other, and n represents an integer from 0 to 2), and/or a hydrolytic condensate thereof,

wherein the semiconductor device is configured as a board-on-chip type semiconductor device, having the semiconductor element mounted on one surface of a substrate having an opening, and the surface of substrate having the semiconductor element mounted thereon and the opening being encapsulated with the epoxy resin composition for encapsulating semiconductor device.