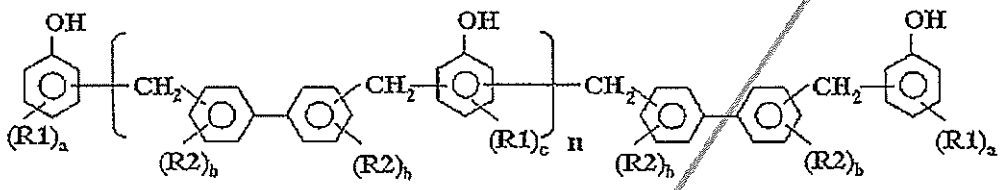
WHAT IS CLAIMED IS:

1. An epoxy resin composition for encapsulating a semiconductor chip comprising

(A) a crystalline epoxy resin,

(B) a phenol resin represented by general formula (1):



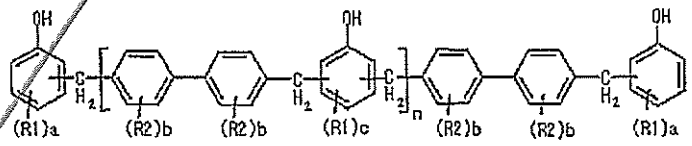
(1)

wherein R1 and R2 are independently hydrogen or alkyl having 1 to 4 carbon atoms and two or more R1s or two or more R2s are the same or different; a is integer of 0 to 4; b is integer of 0 to 4; c is integer of 0 to 3; and n is average and is number of 0 to 10,

(C) a (co)polymer containing butadiene-derived structural unit or its derivative, and

(D) an inorganic filler in the amount of 80 wt% to 95 wt% both inclusive in the total epoxy resin composition.

2. The epoxy resin composition for encapsulating a semiconductor chip as claimed in Claim 1, wherein said phenol resin (B) is represented by general formula (2):



(2)

wherein R1 and R2 are independently hydrogen or alkyl having

1 to 4 carbon atoms and two or more R1s or two or more R2s are the same or different; a is integer of 0 to 4; b is integer of 0 to 4; c is integer of 0 to 3; and n is average and is number of 0 to 10;

said (co)polymer or its derivative (C) is an epoxidized polybutadiene compound (C-1); and

said inorganic filler (D) is contained in the amount of 85 wt% to 95 wt% both inclusive in the total epoxy resin composition.

3. The epoxy resin composition for encapsulating a semiconductor chip as claimed in Claim 2, wherein the number average molecular weight of said epoxidized polybutadiene compound (C-1) is 500 to 4000 both inclusive.

4. The epoxy resin composition for encapsulating a semiconductor chip as claimed in Claim 2, further comprising a curing accelerator (E).

5. A semiconductor device wherein a semiconductor chip is encapsulated with the epoxy resin composition for encapsulating a semiconductor chip as claimed in any one of Claims 2 to 4.

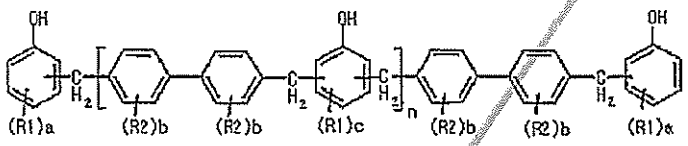
6. The epoxy resin composition for encapsulating a semiconductor chip as claimed in any one of Claims 2 to 4 used for encapsulating an area mounting type semiconductor device,

wherein a semiconductor chip is mounted on one side of the substrate and substantially only the side of the substrate mounting the semiconductor chip is encapsulated.

7. An area mounting type semiconductor device, wherein a semiconductor chip is encapsulated with the area mounting type epoxy resin composition for encapsulating a semiconductor chip as claimed in Claim 6.

8. The epoxy resin composition for encapsulating a semiconductor chip as claimed in Claim 1,

wherein said phenol resin (B) is represented by general formula (2):

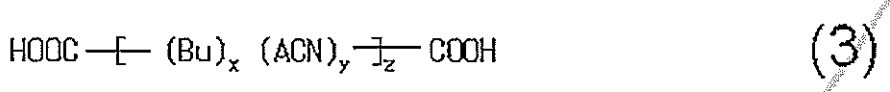


(2)

wherein R1 and R2 are independently hydrogen or alkyl having 1 to 4 carbon atoms and two or more R1s or two or more R2s are the same or different; a is integer of 0 to 4; b is integer of 0 to 4; c is integer of 0 to 3; and n is average and is number of 0 to 10,

wherein said (co)polymer or its derivative (C) is a butadiene-acrylonitrile copolymer (C-2).

9. The epoxy resin composition for encapsulating a semiconductor chip as claimed in Claim 8, wherein said butadiene-acrylonitrile copolymer (C-2) is a carboxyl-terminated butadiene-acrylonitrile copolymer represented by general formula (3):



(3)

wherein Bu represents a butadiene-derived structural unit; ACN represents an acrylonitrile-derived structural unit; x is positive number of less than 1; y is positive number of less than 1; x + y = 1; and z is integer of 50 to 80.

10. The epoxy resin composition for encapsulating a semiconductor chip as claimed in Claim 8, wherein said butadiene-acrylonitrile copolymer (C-2) is contained in the amount of 0.05 wt% to 0.5 wt% both inclusive in the total epoxy resin composition.

11. The epoxy resin composition for encapsulating a semiconductor chip as claimed in Claim 8, wherein said inorganic filler (D) is contained in the amount of 85 wt% to 95 wt% both inclusive in the total epoxy resin composition.

12. The epoxy resin composition for encapsulating a semiconductor chip as claimed in Claim 8, further comprising a curing accelerator (E).

13. A semiconductor device wherein a semiconductor chip is encapsulated with the epoxy resin composition for encapsulating a semiconductor chip as claimed in any one of Claims 8 to 12.

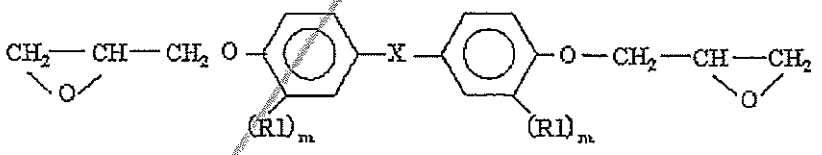
14. The epoxy resin composition for encapsulating a semiconductor chip as claimed in any one of Claims 8 to 12 used for encapsulating an area mounting type semiconductor device,

wherein a semiconductor chip is mounted on one side of the substrate and substantially only the side of the substrate mounting the semiconductor chip is encapsulated.

15. An area mounting type semiconductor device, wherein a semiconductor chip is encapsulated with the area mounting type epoxy resin composition for encapsulating a semiconductor chip as claimed in Claim 14.

16. The epoxy resin composition for encapsulating a semiconductor chip as claimed in Claim 1,

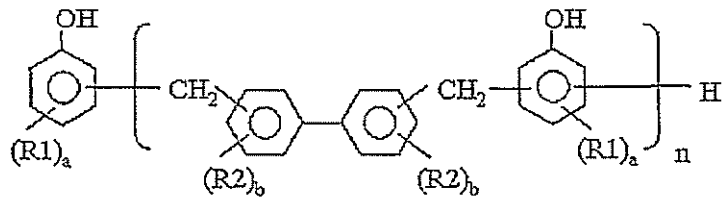
wherein said crystalline epoxy resin (A) is represented by general formula (4):



(4)

wherein X is group selected from single bond, -O-, -S- and $-C(R2)_2-$; R1 is alkyl having 1 to 6 carbon atoms; two or more R1s are the same or different; m is integer of 0 to 4; R2 is hydrogen or alkyl having 1 to 4 carbon atoms; and two or more R2s is the same or different,

said phenol resin (B) is represented by general formula (5):



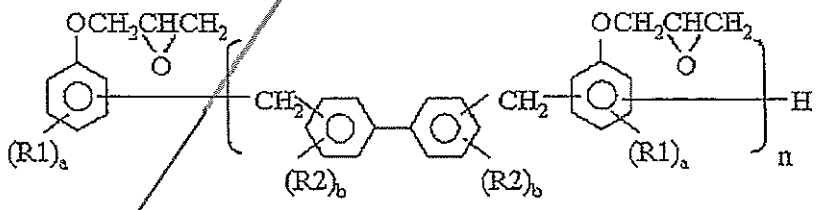
(5)

wherein R1 and R2 are independently hydrogen or alkyl having 1 to 4 carbon atoms; two or more R1s or two or more R2s are the same or different; a is integer of 0 to 3; b is integer of 0 to 4; n is average and is positive number of 1 to 5,

said (co)polymer or its derivative (C) is a polybutadiene having the intramolecular oxirane structure (C-3) with the oxirane-oxygen content of 3 % to 10 % both inclusive, and

said inorganic filler (D) is contained in the amount of 85 wt% to 95 wt% both inclusive in the total epoxy resin composition; and

further comprising an epoxy resin (F) represented by general formula (6):



(6)

wherein R1 and R2 are independently hydrogen or alkyl having 1 to 4 carbon atoms; two or more R1s or two or more R2s are the same or different; a is integer of 0 to 3 , b is integer of 0 to 4; and n is average and is positive number of 1 to 5.

17. The epoxy resin composition for encapsulating a semiconductor chip as claimed in Claim 16, wherein said polybutadiene

having the intramolecular oxirane structure (C-3) has a viscosity of 20 Pa·s to 700 Pa·s both inclusive at 25 °C.

18. The epoxy resin composition for encapsulating a semiconductor chip as claimed in Claim 16, further comprising a curing accelerator (E).

19. A semiconductor device wherein a semiconductor chip is encapsulated with the epoxy resin composition for encapsulating a semiconductor chip as claimed in any one of Claims 16 to 18.

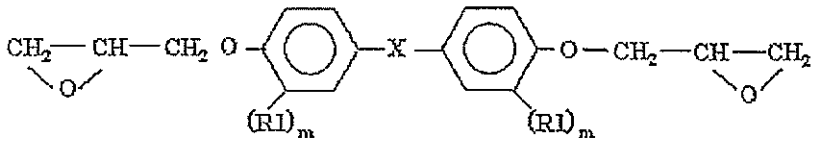
20. The epoxy resin composition for encapsulating a semiconductor chip as claimed in any one of Claims 16 to 18 used for encapsulating an area mounting type semiconductor device,

wherein a semiconductor chip is mounted on one side of the substrate and substantially only the side of the substrate mounting the semiconductor chip is encapsulated.

21. An area mounting type semiconductor device, wherein a semiconductor chip is encapsulated with the area mounting type epoxy resin composition for encapsulating a semiconductor chip as claimed in Claim 20.

22. The epoxy resin composition for encapsulating a semiconductor chip as claimed in Claim 1,

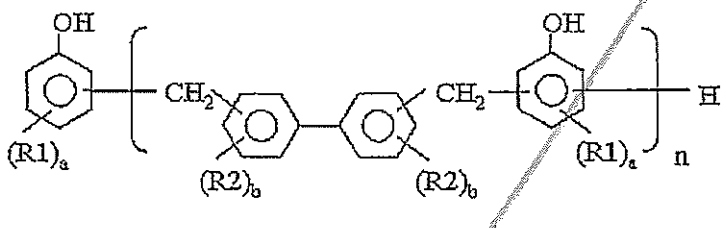
wherein said crystalline epoxy resin (A) is represented by general formula (4):



(4)

wherein X is group selected from single bond, -O-, -S- and $-C(R2)_2-$; R1 is alkyl having 1 to 6 carbon atoms; two or more R1s are the same or different; m is integer of 0 to 4; R2 is hydrogen or alkyl having 1 to 4 carbon atoms; and two or more R2s is the same or different,

said phenol resin (B) is represented by general formula (5):



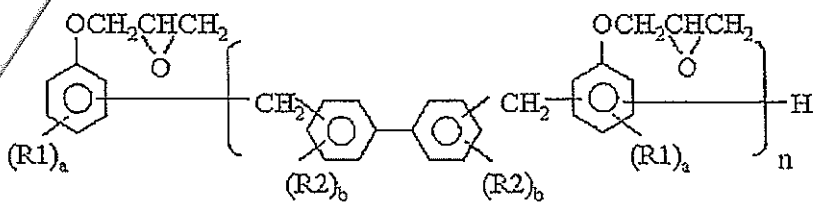
(5)

wherein R1 and R2 are independently hydrogen or alkyl having 1 to 4 carbon atoms; two or more R1s or two or more R2s are the same or different; a is integer of 0 to 3; b is integer of 0 to 4; n is average and is positive number of 1 to 5, and

said (co)polymer or its derivative (C) is an epoxidized polybutadiene compound (C-1),

said inorganic filler (D) is contained in the amount of 80 wt% to 94 wt% both inclusive in the total epoxy resin composition;

further comprising an epoxy resin (F) represented by general formula (6):



(6)

wherein R1 and R2 are independently hydrogen or alkyl having 1 to 4 carbon atoms; two or more R1s or two or more R2s are the same or different; a is integer of 0 to 3 , b is integer of 0 to 4; and n is average and is positive number of 1 to 5; and

wherein the weight ratio [(F)/(A)] of said epoxy resin (F) to said crystalline epoxy resin (A) represented by general formula (4) is 10/90 to 90/10 both inclusive.

23. The epoxy resin composition for encapsulating a semiconductor chip as claimed in Claim 22, wherein said epoxidized polybutadiene compound (C-1) has the number average molecular weight of 500 to 4000 both inclusive.

24. The epoxy resin composition for encapsulating a semiconductor chip as claimed in Claim 22, further comprising a curing accelerator (E).

25. A semiconductor device wherein a semiconductor chip is encapsulated with the epoxy resin composition for encapsulating a semiconductor chip as claimed in any one of Claims 22 to 24.

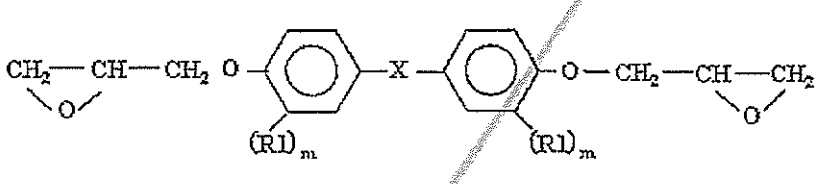
26. The epoxy resin composition for encapsulating a semiconductor chip as claimed in any one of Claims 22 to 24 used for encapsulating an area mounting type semiconductor device,

wherein a semiconductor chip is mounted on one side of the substrate and substantially only the side of the substrate mounting the semiconductor chip is encapsulated.

27. An area mounting type semiconductor device, wherein a semiconductor chip is encapsulated with the area mounting type epoxy resin composition for encapsulating a semiconductor chip as claimed in Claim 26.

28. The epoxy resin composition for encapsulating a semiconductor chip as claimed in Claim 1,

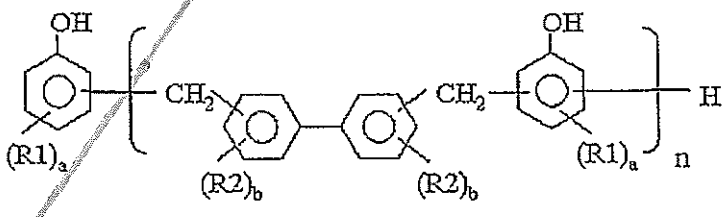
wherein said crystalline epoxy resin (A) is represented by general formula (4):



(4)

wherein X is group selected from single bond, -O-, -S- and $-C(R2)_2-$; R1 is alkyl having 1 to 6 carbon atoms; two or more R1s are the same or different; m is integer of 0 to 4; R2 is hydrogen or alkyl having 1 to 4 carbon atoms; and two or more R2s is the same or different,

said phenol resin (B) is represented by general formula (5):

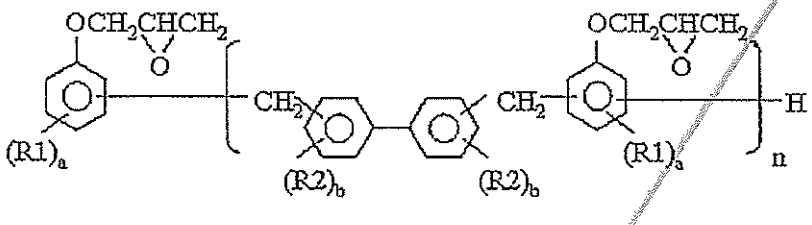


(5)

wherein R1 and R2 are independently hydrogen or alkyl having 1 to 4 carbon atoms; two or more R1s or two or more R2s are the same or different; a is integer of 0 to 3; b is integer of 0 to 4; n is average and is positive number of 1 to 5, and

said (co)polymer or its derivative (C) is a butadiene-acrylonitrile copolymer (C-2); and

further comprising an epoxy resin (F) represented by general formula (6):

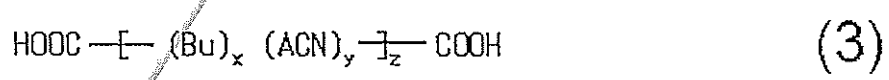


(6)

wherein R1 and R2 are independently hydrogen or alkyl having 1 to 4 carbon atoms; two or more R1s or two or more R2s are the same or different; a is integer of 0 to 3, b is integer of 0 to 4; and n is average and is positive number of 1 to 5.

29. The epoxy resin composition for encapsulating a semiconductor chip as claimed in Claim 28,

wherein said butadiene-acrylonitrile copolymer (C-2) is a carboxyl-terminated butadiene-acrylonitrile copolymer represented by general formula (3):



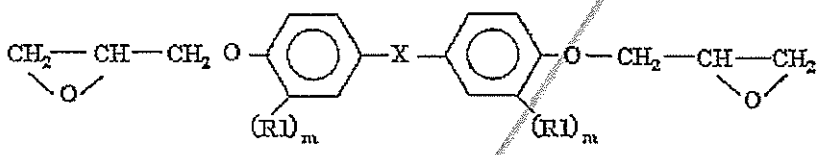
(3)

wherein Bu represents a butadiene-derived structural unit; ACN represents an acrylonitrile-derived structural unit; x is positive number of less than 1; y is positive number of less than 1; x + y = 1; and z is integer of 50 to 80.

30. The epoxy resin composition for encapsulating a semiconductor chip as claimed in Claim 28,

wherein said butadiene-acrylonitrile copolymer (C-2) is contained in the amount of 0.05 wt% to 0.5 wt% both inclusive in the total epoxy resin composition.

31. The epoxy resin composition for encapsulating a semiconductor chip as claimed in Claim 28, wherein the weight ratio [(F)/(A)] of the epoxy resin (F) to the crystalline epoxy resin (A) represented by general formula (4) is 10/90 to 90/10 both inclusive.



(4)

32. The epoxy resin composition for encapsulating a semiconductor chip as claimed in Claim 28, further comprising a curing accelerator (E).

33. A semiconductor device wherein a semiconductor chip is encapsulated with the epoxy resin composition for encapsulating a semiconductor chip as claimed in any one of Claims 28 to 32.

34. The epoxy resin composition for encapsulating a semiconductor chip as claimed in any one of Claims 28 to 32 used for encapsulating an area mounting type semiconductor device,

wherein a semiconductor chip is mounted on one side of the

substrate and substantially only the side of the substrate mounting the semiconductor chip is encapsulated.

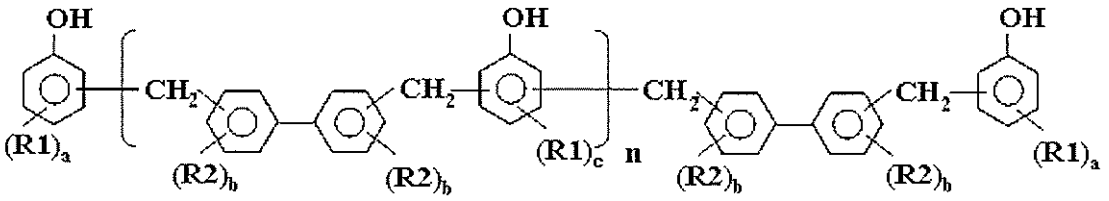
35. An area mounting type semiconductor device, wherein a semiconductor chip is encapsulated with the area mounting type epoxy resin composition for encapsulating a semiconductor chip as claimed in Claim 34.

CLAIMS:

1. An epoxy resin composition for encapsulating a semiconductor chip comprising

(A) a crystalline epoxy resin,

(B) a phenol resin represented by general formula (1):



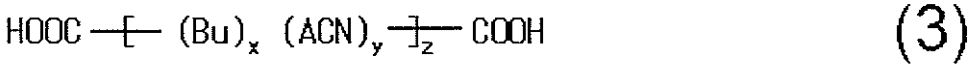
(1)

wherein R1 and R2 are independently hydrogen or alkyl having 1 to 4 carbon atoms and two or more R1s or two or more R2s are the same or different; a is integer of 0 to 4; b is integer of 0 to 4; c is integer of 0 to 3; and n is average and is number of 0 to 10,

(C-2) a carboxyl-terminated butadiene-acrylonitrile copolymer in the amount of 0.05 wt% to 0.5 wt% both inclusive in the total epoxy resin composition, and

(D) an inorganic filler in the amount of 80 wt% to 95 wt% both inclusive in the total epoxy resin composition,

wherein the carboxyl-terminated butadiene-acrylonitrile copolymer is represented by general formula (3):



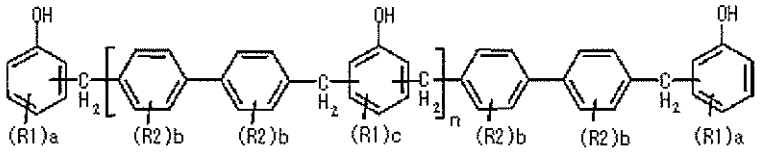
(3)

and wherein Bu represents a butadiene-derived structural unit; ACN represents an acrylonitrile-derived structural unit; x is positive

number of less than 1; y is positive number of less than 1; x + y = 1; and z is integer of 50 to 62.

2. The epoxy resin composition for encapsulating a semiconductor chip as claimed in Claim 1,

wherein said phenol resin (B) is represented by general formula (2):



(2)

wherein R1 and R2 are independently hydrogen or alkyl having 1 to 4 carbon atoms and two or more R1s or two or more R2s are the same or different; a is integer of 0 to 4; b is integer of 0 to 4; c is integer of 0 to 3; and n is average and is number of 0 to 10.

3. The epoxy resin composition for encapsulating a semiconductor chip as claimed in Claim 2, wherein said inorganic filler (D) is contained in the amount of 85 wt% to 95 wt% both inclusive in the total epoxy resin composition.

4. The epoxy resin composition for encapsulating a semiconductor chip as claimed in Claim 2, further comprising a curing accelerator (E).

5. A semiconductor device wherein a semiconductor chip is encapsulated with the epoxy resin composition for encapsulating a semiconductor chip as claimed in Claim 2, 3 or 4.

6. The epoxy resin composition for encapsulating a semiconductor chip as claimed in Claim 2, 3 or 4 used for encapsulating an area mounting type semiconductor device,

wherein a semiconductor chip is mounted on one side of the substrate and substantially only the side of the substrate mounting the semiconductor chip is encapsulated.

7. An area mounting type semiconductor device, wherein a semiconductor chip is encapsulated with the area mounting type epoxy resin composition for encapsulating a semiconductor chip as claimed in Claim 6.