[0006] It is an object of the present invention to provide a kneading apparatus and a method for producing a semiconductor encapsulating resin composition, which are capable of preventing metallic foreign substances from being mixed into a resin composition during the resin composition being kneaded.

[0007] In order to achieve the object, one aspect of the present invention is directed to a kneading apparatus for kneading a composition containing plural kinds of pulverized materials, comprising:

a casing including:

a supply port for supplying the composition;

a kneading section for storing the composition supplied through the supply port to knead the composition; and

a discharge port for discharging the composition thus kneaded, and

at least one screw for kneading the composition stored in the kneading section, the screw rotatably provided in the casing, the screw including:

a screw axis having an outer periphery; and

a screw member provided on the outer periphery of the screw axis, the screw member provided in the kneading section,

wherein the screw member provided in the kneading section has a surface and the kneading section has an inner surface, and

wherein at least the surface of the screw member or at least the inner surface of the kneading section is constituted of a nonmetallic material.

[0008] In order to achieve the object, another aspect of the present invention is directed to a kneading apparatus for kneading a composition containing plural kinds of pulverized materials, comprising:

a casing including:

a supply port for supplying the composition;

a kneading section for storing the composition supplied through the supply port to knead the composition; and

a discharge port for discharging the composition thus kneaded, and

at least one screw for kneading the composition stored in the kneading section, the screw rotatably provided in the casing, the screw including:

a screw axis having an outer periphery;

a screw member provided on the outer periphery of the screw axis, the screw member provided in the kneading section; and

a kneading member provided on the outer periphery of the screw axis, the kneading member provided in the kneading section,

wherein each of the screw member and the kneading member has a surface and the kneading section has an inner surface, and

wherein at least the surface of the screw member, at least the surface of the kneading member and at least the inner surface of the kneading section are constituted of a nonmetallic material.

[0009] In the kneading apparatus of the present invention, it is preferred that a clearance is formed between the inner surface of the kneading section and an outermost portion of the kneading member and the clearance is in the range of 0.5 to 4 mm.

[0010] In the kneading apparatus of the present invention, it is preferred that the kneading member has a core portion having a surface and an outer layer provided on the surface of the core portion, and the outer layer of the kneading member is constituted of a nonmetallic material.

[0011] In the kneading apparatus of the present invention, it is preferred that the screw axis has a core portion having a surface and an outer layer provided on a part of the surface of the core portion, and the outer layer of the screw axis is constituted of a nonmetallic material.

[0012] In the kneading apparatus of the present invention, it is preferred that the screw member has a core portion having a surface and an outer layer provided on the surface of the core portion, and the outer layer of the screw member is constituted of a nonmetallic material.

[0013] In the kneading apparatus of the present invention, it is preferred that a clearance is formed between the inner surface of the kneading section and an outermost portion of the screw member and the clearance is in the range of 0.5 to 4 mm.

[0014] In the kneading apparatus of the present invention, it is preferred that the screw is detachably provided with respect to the casing.

[0015] In the kneading apparatus of the present invention, it is preferred that in the case where a length of the screw axis is defined as L and a diameter of the screw is defined as D, L and D satisfy a relation of $L/D \leq 10$.

[0016] In the kneading apparatus of the present invention, it is preferred that the nonmetallic material is a ceramic material.

[0017] In the kneading apparatus of the present invention, it is preferred that a Vickers hardness Hv of the ceramic material at 500 gf load is equal to or more than 1300.

[0018] In the kneading apparatus of the present invention, it is preferred that a thermal conductivity of the ceramic material is equal to or more than 0.01 cal/(cm·sec·°C).

[0019] In order to achieve the object, another aspect of the present invention is directed to a method for producing a semiconductor encapsulating resin, comprising:

kneading a composition containing plural kinds of pulverized materials using a kneading apparatus of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] Fig. 1 is a process chart showing a producing process of a resin composition.

Fig. 2 is a perspective view schematically showing a kneading apparatus according to a first embodiment of the present invention.

WHAT IS CLAIMED IS:

1. A kneading apparatus for kneading a composition containing plural kinds of pulverized materials, comprising:

a casing including:

a supply port for supplying the composition;

a kneading section for storing the composition supplied through the supply port to knead the composition; and

a discharge port for discharging the composition thus kneaded, and

at least one screw for kneading the composition stored in the kneading section, the screw rotatably provided in the casing, the screw including:

a screw axis having an outer periphery; and

a screw member provided on the outer periphery of the screw axis, the screw member provided in the kneading section,

wherein the screw member provided in the kneading section has a surface and the kneading section has an inner surface, and

wherein at least the surface of the screw member or at least the inner surface of the kneading section is constituted of a nonmetallic material.

2. A kneading apparatus for kneading a composition containing plural kinds of pulverized materials, comprising:

a casing including:

a supply port for supplying the composition;

a kneading section for storing the composition supplied through the supply port to knead the composition; and

a discharge port for discharging the composition thus kneaded, and

at least one screw for kneading the composition stored in the kneading section, the screw rotatably provided in the casing, the screw including:

a screw axis having an outer periphery;

a screw member provided on the outer periphery of the screw axis, the screw member provided in the kneading section; and

a kneading member provided on the outer periphery of the screw axis, the kneading member provided in the kneading section,

wherein each of the screw member and the kneading member has a surface and the kneading section has an inner surface, and

wherein at least the surface of the screw member, at least the surface of the kneading member and at least the inner surface of the kneading section are constituted of a nonmetallic material.

3. The kneading apparatus as claimed in claim 2, wherein a clearance is formed between the inner surface of the kneading section and an outermost portion of the kneading member and the clearance is in the range of 0.5 to 4 mm.

4. The kneading apparatus as claimed in claim 2, wherein the kneading member has a core portion having a surface and an outer layer provided on the surface of the core portion, and the outer layer of the kneading member is constituted of a nonmetallic material.

5. The kneading apparatus as claimed in claim 1, wherein the screw axis has a core portion having a surface and an outer layer provided on a part of the surface of the core portion, and the outer layer of the screw axis is constituted of a nonmetallic material.

6. The kneading apparatus as claimed in claim 1, wherein the screw member has a core portion having a surface and an outer layer provided on the surface of the core portion, and the outer layer of the screw member is constituted of a nonmetallic material.

7. The kneading apparatus as claimed in claim 1, wherein a clearance is formed between the inner surface of the kneading section and an outermost portion of the screw member and the clearance is in the range of 0.5 to 4 mm.

8. The kneading apparatus as claimed in claim 1, wherein the screw is detachably provided with respect to the casing.

9. The kneading apparatus as claimed in claim 1, wherein in the case where a length of the screw axis is

defined as L and a diameter of the screw is defined as D, L and D satisfy a relation of $L/D \leq 10$.

10. The kneading apparatus as claimed in claim 1, wherein the nonmetallic material is a ceramic material.

11. The kneading apparatus as claimed in claim 10, wherein a Vickers hardness Hv of the ceramic material at 500 gf load is equal to or more than 1300.

12 The kneading apparatus as claimed in claim 10, wherein a thermal conductivity of the ceramic material is equal to or more than 0.01 cal/(cm·sec·°C).

13. A method for producing a semiconductor encapsulating resin, comprising:

kneading a composition containing plural kinds of pulverized materials using a kneading apparatus defined by claim 1.

[0006] It is an object of the present invention to provide a kneading apparatus and a method for producing a semiconductor encapsulating resin composition, which are capable of preventing metallic foreign substances from being mixed into a resin composition during the resin composition being kneaded.

[0007] The above object is achieved by the following present inventions (1) to (16).

(1) A kneading apparatus for kneading a composition containing plural kinds of pulverized materials, comprising:

a casing including:

a supply port for supplying the composition;

a kneading section for storing the composition supplied through the supply port to knead the composition; and

a discharge port for discharging the composition thus kneaded, and

at least one screw for kneading the composition stored in the kneading section, the screw rotatably provided in the casing, the screw including:

a screw axis having an outer periphery; and

a screw member provided on the outer periphery of the screw axis, the screw member provided in the kneading section,

wherein the screw member provided in the kneading section has a surface and the kneading section has an inner surface,

wherein at least the surface of the screw member or at least the inner surface of the kneading section is constituted of a nonmetallic material, and

wherein the discharge port serves as a connecting portion connected with an inlet port of a degassing device for degassing the composition kneaded by the kneading apparatus.

[0008] (2) A kneading apparatus for kneading a composition containing plural kinds of pulverized materials, comprising:

a casing including:

a supply port for supplying the composition;

a kneading section for storing the composition supplied through the supply port to knead the composition; and

a discharge port for discharging the composition thus kneaded, and

at least one screw for kneading the composition stored in the kneading section, the screw rotatably provided in the casing, the screw including:

a screw axis having an outer periphery;

a screw member provided on the outer periphery of the screw axis, the screw member provided in the kneading section; and

a kneading member provided on the outer periphery of the screw axis, the kneading member provided in the kneading section,

wherein each of the screw member and the kneading member has a surface and the kneading section has an inner surface,

wherein at least the surface of the screw member, at least the surface of the kneading member and at least the inner surface of the kneading section are constituted of a nonmetallic material, and

wherein the discharge port serves as a connecting portion connected with an inlet port of a degassing device for degassing the composition kneaded by the kneading apparatus.

[0009] (3) The kneading apparatus as described in the above (2), wherein a clearance is formed between the inner surface of the kneading section and an outermost portion of the kneading member and the clearance is in the range of 0.5 to 4 mm.

[0010] (4) The kneading apparatus as described in the above (2) or (3), wherein the kneading member has a core portion having a surface and an outer layer provided on the surface of the core portion, and the outer layer of the kneading member is constituted of a nonmetallic material.

[0011] (5) The kneading apparatus as described in any one of the above (1) to (4), wherein the screw axis has a core portion having a surface and an outer layer provided on a

part of the surface of the core portion, and the outer layer of the screw axis is constituted of a nonmetallic material.

[0012] (6) The kneading apparatus as described in any one of the above (1) to (5), wherein the screw member has a core portion having a surface and an outer layer provided on the surface of the core portion, and the outer layer of the screw member is constituted of a nonmetallic material.

[0013] (7) The kneading apparatus as described in any one of the above (1) to (6), wherein a clearance is formed between the inner surface of the kneading section and an outermost portion of the screw member and the clearance is in the range of 0.5 to 4 mm.

[0014] (8) The kneading apparatus as described in any one of the above (1) to (7), wherein the screw is detachably provided with respect to the casing.

[0015] (9) The kneading apparatus as described in any one of the above (1) to (8), wherein in the case where a length of the screw axis is defined as L and a diameter of the screw is defined as D, L and D satisfy a relation of $L/D \leq 10$.

[0016] (10) The kneading apparatus as described in any one of the above (1) to (9), wherein the nonmetallic material is a ceramic material.

[0017] (11) The kneading apparatus as described in the above (10), wherein a Vickers hardness Hv of the ceramic material at 500 gf load is equal to or more than 1300.

[0018] (12) The kneading apparatus as described in the above (10) or (11), wherein a thermal conductivity of the ceramic material is equal to or more than 0.01 cal/(cm·sec·°C).

[0019] (13) The kneading apparatus as described in any one of the above (1) to (12), further comprising two of the screws arranged in parallel with each other in a direction perpendicular to the screw axis,

wherein the supply port is provided so as to bridge over the screw members of the two screws in plan view, and

wherein the discharge port is provided so as to bridge over the screw members of the two screws in plan view.

(14) The kneading apparatus as described in the above (13), further comprising at least a first screw member and a second screw member oppositely oriented to the first screw member as the screw member,

wherein the supply port is provided so as to bridge over the first screw members of the two screws in plan view, and

wherein the discharge port is provided so as to bridge over the second screw members of the two screws in plan view.

(15) The kneading apparatus as described in any one of the above (1) to (12), further comprising at least a first screw member and a second screw member oppositely oriented to the first screw member as the screw member.

(16) A method for producing a semiconductor encapsulating resin, comprising:

kneading a composition containing plural kinds of pulverized materials using a kneading apparatus by any one of claims 1 to 15.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] Fig. 1 is a process chart showing a producing process of a resin composition.

Fig. 2 is a perspective view schematically showing a kneading apparatus according to a first embodiment of the present invention.

WHAT IS CLAIMED IS:

1. A kneading apparatus for kneading a composition containing plural kinds of pulverized materials, comprising:

a casing including:

a supply port for supplying the composition;

a kneading section for storing the composition supplied through the supply port to knead the composition; and

a discharge port for discharging the composition thus kneaded, and

at least one screw for kneading the composition stored in the kneading section, the screw rotatably provided in the casing, the screw including:

a screw axis having an outer periphery; and

a screw member provided on the outer periphery of the screw axis, the screw member provided in the kneading section,

wherein the screw member provided in the kneading section has a surface and the kneading section has an inner surface,

wherein at least the surface of the screw member or at least the inner surface of the kneading section is constituted of a nonmetallic material, and

wherein the discharge port serves as a connecting portion connected with an inlet port of a degassing device for degassing the composition kneaded by the kneading apparatus.

2. A kneading apparatus for kneading a composition containing plural kinds of pulverized materials, comprising:

a casing including:

a supply port for supplying the composition;

a kneading section for storing the composition supplied through the supply port to knead the composition; and

a discharge port for discharging the composition thus kneaded, and

at least one screw for kneading the composition stored in the kneading section, the screw rotatably provided in the casing, the screw including:

a screw axis having an outer periphery;

a screw member provided on the outer periphery of the screw axis, the screw member provided in the kneading section; and

a kneading member provided on the outer periphery of the screw axis, the kneading member provided in the kneading section,

wherein each of the screw member and the kneading member has a surface and the kneading section has an inner surface,

wherein at least the surface of the screw member, at least the surface of the kneading member and at least the inner surface of the kneading section are constituted of a nonmetallic material, and

wherein the discharge port serves as a connecting portion connected with an inlet port of a degassing device for degassing the composition kneaded by the kneading apparatus.

3. The kneading apparatus as claimed in claim 2, wherein a clearance is formed between the inner surface of the kneading section and an outermost portion of the kneading member and the clearance is in the range of 0.5 to 4 mm.

4. The kneading apparatus as claimed in claim 2 or 3, wherein the kneading member has a core portion having a surface and an outer layer provided on the surface of the core portion, and the outer layer of the kneading member is constituted of a nonmetallic material.

5. The kneading apparatus as claimed in any one of claims 1 to 4, wherein the screw axis has a core portion having a surface and an outer layer provided on a part of the surface of the core portion, and the outer layer of the screw axis is constituted of a nonmetallic material.

6. The kneading apparatus as claimed in any one of claims 1 to 5, wherein the screw member has a core portion having a surface and an outer layer provided on the surface of the core portion, and the outer layer of the screw member is constituted of a nonmetallic material.

7. The kneading apparatus as claimed in any one of claims 1 to 6, wherein a clearance is formed between the inner surface of the kneading section and an outermost portion of the screw member and the clearance is in the range of 0.5 to 4 mm.

8. The kneading apparatus as claimed in any one of claims 1 to 7, wherein the screw is detachably provided with respect to the casing.

9. The kneading apparatus as claimed in any one of claims 1 to 8, wherein in the case where a length of the screw axis is defined as L and a diameter of the screw is defined as D, L and D satisfy a relation of $L/D \leq 10$.

10. The kneading apparatus as claimed in any one of claims 1 to 9, wherein the nonmetallic material is a ceramic material.

11. The kneading apparatus as claimed in claim 10, wherein a Vickers hardness Hv of the ceramic material at 500 gf load is equal to or more than 1300.

12. The kneading apparatus as claimed in claim 10 or 11, wherein a thermal conductivity of the ceramic material is equal to or more than 0.01 cal/(cm·sec·°C).

13. The kneading apparatus as claimed in any one of claims 1 to 12, further comprising two of the screws arranged in parallel with each other in a direction perpendicular to the screw axis,

wherein the supply port is provided so as to bridge over the screw members of the two screws in plan view, and

wherein the discharge port is provided so as to bridge over the screw members of the two screws in plan view.

14. The kneading apparatus as claimed in claim 13, further comprising at least a first screw member and a second screw member oppositely oriented to the first screw member as the screw member,

wherein the supply port is provided so as to bridge over the first screw members of the two screws in plan view, and

wherein the discharge port is provided so as to bridge over the second screw members of the two screws in plan view.

15. The kneading apparatus as claimed in any one of claims 1 to 12, further comprising at least a first screw member and a second screw member oppositely oriented to the first screw member as the screw member.

16. A method for producing a semiconductor encapsulating resin, comprising:

kneading a composition containing plural kinds of pulverized materials using a kneading apparatus defined by any one of claims 1 to 15.