PRIOR ART DOCUMENTS

PATENT DOCUMENTS

[0005]

Patent Document 1: Japanese Patent Laid-open Publication No. 5-117621

Patent Document 2: Japanese Patent Laid-open Publication No. 2008-266378

Patent Document 3: Japanese Patent Laid-open Publication No. 2011-151280

SUMMARY

PROBLEMS TO BE SOLVED

[0006]

From the viewpoint of lowering the thermal resistance at the contact interface between the heater and the focus ring and at the contact interface between the semiconductor module and the heat sink, these thermally conductive sheets are required to have a low elastic modulus so that they can adhere to the base material according to the shape of the base material in contact with the sheets. In addition, the thermally conductive sheets are required to have heat resistance of 250°C or more because the surface temperature of the focus ring during plasma processing reaches 250°C or more and the operating temperature reaches 250°C or more

due to the shift of the material of the element of the power semiconductor from Si to SiC, which achieves less energy loss.

[0007]

However, when the compositions described in Patent Documents 1 and 2 are applied to a thermally conductive sheet, the sheet has insufficient adhesiveness to a base material due to a high elastic modulus, and has a problem in thermal responsiveness. Meanwhile, the composition described in Patent Document 3 has a problem of insufficient heat resistance.

[0008]

Therefore, it is an object of the embodiments disclosed herein to provide a resin composition capable of providing a sheet that is excellent in heat resistance and thermal conductivity, has a low elastic modulus, and is excellent in thermal responsiveness.

SOLUTIONS TO THE PROBLEMS

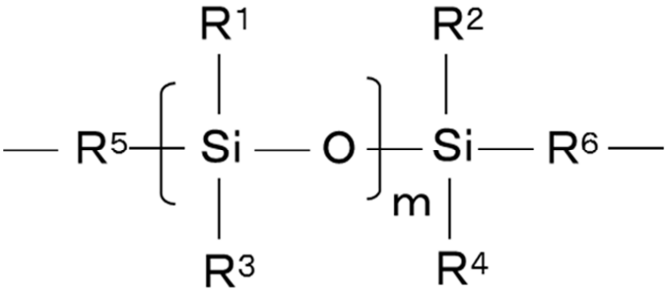
[0009]

The present disclosure is related to a resin composition including (A) a polyimide resin containing 60 mol% or more of a diamine residue having a structure represented by General Formula (1) below in all diamine residues; (B) a thermosetting resin; and (C) a thermally conductive filler,

wherein the resin composition contains 60 parts by volume or more of the thermally conductive filler (C) in 100 parts by volume of a total of the polyimide resin (A), the thermosetting resin (B), and the thermally conductive filler (C).

[0010]

[Chemical Formula 1]



(1)

[0011]

In General Formula (1), R^1 to R^4 may each be same or different and represent an alkyl group having 1 to 30 carbon atoms, a phenyl group, or a phenoxy group. The phenyl group and the phenoxy group may be substituted with an alkyl group having 1 to 30 carbon atoms. m R^1s and R^3s may each be same or different. R^5 and R^6 may each be same or different and represent an alkylene group having 1 to 30 carbon atoms or an arylene group. The arylene group may be substituted with an alkyl group having 1 to 30 carbon atoms. m represents a range of 10 or more.

[0011a]

In an aspect, there is provided a resin composition comprising:

(A) a polyimide resin containing 60 mol% or more of a diamine residue having a structure represented by General Formula (1) below in all diamine residues;

(B) a thermosetting resin; and

(C) a thermally conductive filler,

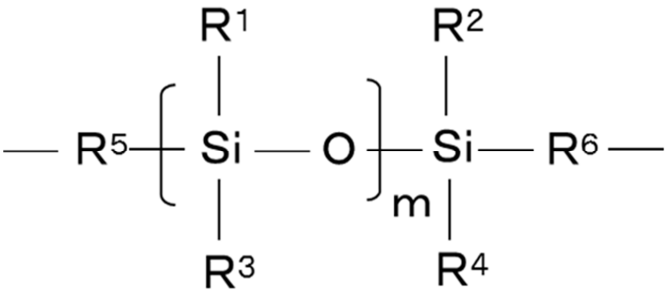
wherein

the resin composition contains:

0.1 to 15 parts by weight of the thermosetting resin (B) relative to 100 parts by weight of the polymer resin (A); and

60 parts by volume or more of the thermally conductive filler (C) in 100 parts by volume of a total of the polyimide resin (A), thermosetting resin (B), and the thermally conductive filler (C):

[Chemical Formula 1]



(1)

wherein R^1 to R^4 may each be same or different and represent an alkyl group having 1 to 30 carbon atoms, a phenyl group, or a phenoxy group, and the phenyl group and the phenoxy group may be substituted with an alkyl group having 1 to 30 carbon atoms; m R^1s and R^3s may each be same or different; R^5 and R^6 may each be same or different and represent an alkylene group having 1 to 30 carbon atoms or an arylene group, and the arylene group may be substituted with an alkyl group having 1 to 30 carbon atoms; and m represents a range of 10 or more.

[0012]

In another aspect, there is provided a power semiconductor device including a heat sink; and a power semiconductor module, wherein a sheet including a cured product of the resin composition is provided between the heat sink and the power semiconductor module.

[0013]

In another aspect, there is provided a sheet including a cured product of the resin composition.

[0014]

In another aspect, there is provided a laminate including a base material selected from a metal substrate and a ceramic substrate; and the sheet laminated on the base material.

[0015]

In another aspect, there is provided a laminate including a heating element; and the sheet laminated on the heating element.

[0016]

In another aspect, there is provided a plasma processing apparatus including a plasma source; a mounting table having a temperature regulation mechanism; and a temperature control plate, wherein the sheet is provided between the mounting table

having a temperature regulation mechanism and the temperature control plate.

[0017]

In another aspect, there is provided a method of producing

a semiconductor including the step of performing dry etching using the plasma processing apparatus.

EFFECTS

[0018]

The resin composition of the present disclosure provides a sheet that is excellent in heat resistance and thermal conductivity, has a low elastic modulus, and is excellent in thermal responsiveness.

EMBODIMENTS OF THE INVENTION

[0019]

The resin composition of the present invention contains (A) a polyimide resin containing 60 mol% or more of a diamine residue having a structure represented by General Formula (1) below in all diamine residues (hereinafter may be referred to as "(A) a polyimide resin"); (B) a thermosetting resin; and (C) a thermally conductive filler.

[0020]

[Chemical Formula 2]

CLAIMS

1. A resin composition comprising:

(A) a polyimide resin containing 60 mol% or more of a diamine residue having a structure represented by General Formula (1) below in all diamine residues;

(B) a thermosetting resin; and

(C) a thermally conductive filler,

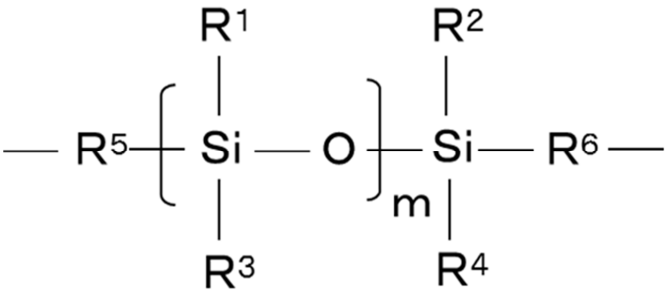
wherein

the resin composition contains:

0.1 to 15 parts by weight of the thermosetting resin (B) relative to 100 parts by weight of the polymer resin (A); and

60 parts by volume or more of the thermally conductive filler (C) in 100 parts by volume of a total of the polyimide resin (A), the thermosetting resin (B), and the thermally conductive filler (C):

[Chemical Formula 1]



(1)

wherein R^1 to R^4 may each be same or different and

represent an alkyl group having 1 to 30 carbon atoms, a phenyl group, or a phenoxy group, and the phenyl group and the phenoxy group may be substituted with an alkyl group having 1 to 30 carbon atoms; m R^1s and R^3s may each be same or different; R^5 and R^6 may each be same or different and represent an alkylene group having 1 to 30 carbon atoms or an arylene group, and the arylene group may be substituted with an alkyl group having 1 to 30 carbon atoms; and m represents a range of 10 or more.

2. The resin composition according to claim 1, wherein the thermosetting resin (B) has a group selected from an epoxy group, an isocyanate group, and a methylol group.

3. The resin composition according to claim 2, wherein the thermosetting resin (B) is an epoxy resin having a siloxane skeleton.

4. The resin composition according to claim 2, wherein the thermosetting resin (B) is an epoxy resin having a triazine skeleton.

5. A power semiconductor device comprising:

a heat sink; and

a power semiconductor module,

wherein

a sheet including a cured product of the resin composition according to any one of claims 1 to 4 is provided between the heat sink and the power semiconductor module.

6. A sheet comprising a cured product of the resin composition according to any one of claims 1 to 4.

7. The sheet according to claim 6, having a thickness of 100 to 400 μm.

8. A laminate comprising:

a base material selected from a metal substrate and a ceramic substrate; and

the sheet according to claim 6 laminated on the base material.

9. A laminate comprising:

a heating element; and

the sheet according to claim 6 laminated on the heating element.

10. A plasma processing apparatus comprising:

a plasma source;

a mounting table having a temperature regulation mechanism; and

a temperature control plate,

wherein

the sheet according to claim 6 is provided between the mounting table having a temperature regulation mechanism and the temperature control plate.

11. The plasma processing apparatus according to claim 10, wherein the temperature control plate is a focus ring.

12. A method of producing a semiconductor, comprising the step of performing dry etching using the plasma processing apparatus according to claim 10 or 11.