

SUMMARY OF INVENTION

Technical Problem

[0004] A semiconductor device which includes a semiconductor substrate including on a surface thereof an interlayer insulating layer provided with a concave portion, and wiring, is increasingly miniaturized. As a sealing composition, any sealing composition which is capable of sealing pores present in the interlayer insulating layer and which does not remain on the wiring made of a material such as copper can be used. However, in the case of using a conventional sealing composition, there is a potential risk that the dissolution of wiring material such as copper cannot be inhibited, thereby resulting in a decrease in the amount of the wiring material. As a result, there is a potential risk of failing to maintain an electrical conductivity of the wiring. In a miniaturized semiconductor device, in particular, a decrease in the amount of wiring material leads to a major problem.

[0005] ~~One embodiment~~ Embodiments of the invention ~~has been made in view of the above problems, and an object thereof is to~~ provide a method of manufacturing a semiconductor device in which polymer (A) contained in a sealing composition can be made less likely to remain on the bottom face of a concave portion of an interlayer insulating layer and on wiring, while maintaining a sealing property provided by the sealing composition at the side face of the concave portion, and in which a decrease in the amount of wiring material such as copper can be reduced to maintain the electrical conductivity of the wiring material, and to provide the sealing composition used in the manufacture of such a semiconductor device.

~~An object of another embodiment~~ Embodiments of the invention ~~is to~~ provide a method of manufacturing a semiconductor device in which polymer (A) contained in a sealing composition can be made less likely to remain on wiring while maintaining the sealing property provided by the sealing composition at a surface of an interlayer insulating layer, and in which a decrease in the amount of wiring material such as copper can be reduced to maintain the electrical conductivity of the wiring material, and to provide the sealing composition used in the manufacture of such a semiconductor device.

Solution to Problem

[0006] Specific means for solving the above mentioned problems are as follows.

~~<1> A~~ According to a first aspect of the present invention, there is provided a sealing composition, comprising:

polymer (A) containing a cationic functional group and having a weight average molecular weight of from 2,000 to 1,000,000; and

a benzotriazole compound;

wherein a content of the polymer (A) is from 0.05 parts by mass to 0.20 parts by mass with respect to 100 parts by mass of the sealing composition;

wherein a content of the benzotriazole compound in the sealing composition is from

3 ppm by mass to 200 ppm by mass; and

wherein the sealing composition has a pH of from 3.0 to 6.5.

[0007] ~~<2>~~ A According to a second aspect of the present invention, there is provided a sealing composition, comprising:

polymer (A) containing a cationic functional group and having a weight average molecular weight of from 2,000 to 1,000,000; and

a benzotriazole compound;

wherein a content of the benzotriazole compound in the sealing composition is from 3 ppm by mass to 200 ppm by mass; and

wherein the sealing composition has a pH of from 3.0 to 6.5.

[0008] ~~<3>~~ The In an embodiment, the sealing composition according to <1> or <2> the first or second aspect, further comprising comprises a monocarboxylic acid compound.

[0009] ~~<4>~~ The In an embodiment of the above sealing composition, according to any one of <1> to <3>, wherein a content of sodium and a content of potassium in the sealing composition are each 10 ppb by mass or less, on an elemental basis.

[0010] ~~<5>~~ A According to a third aspect of the present invention, there is provided a method of manufacturing a semiconductor device,

the semiconductor device comprising a semiconductor substrate including an interlayer insulating layer provided with a concave portion, and wiring containing copper, wherein at least a part of a surface of the wiring is exposed to at least a part of a bottom face of the concave portion; and

the method comprising:

a sealing composition application process in which the sealing composition according to ~~<1>~~ the first aspect is applied at least to the bottom face and a side face of the concave portion of the semiconductor substrate; and

a cleaning process in which at least the side face and the bottom face of the concave portion are cleaned with a rinsing liquid containing a polyvalent carboxylic acid monomer in an amount of from 0.3 millimole/liter to 230 millimole/liter, and which is carried out after the sealing composition application process.

[0011] ~~<6>~~ A According to a fourth aspect of the present invention, there is provided a method of manufacturing a semiconductor device,

the semiconductor device comprising a semiconductor substrate including an interlayer insulating layer, and wiring containing copper; and

the method comprising:

a sealing composition application process in which the sealing composition according to ~~<2>~~ the second aspect is applied at least to surfaces of the interlayer insulating layer and the wiring of the semiconductor substrate; and

a cleaning process in which at least the surfaces of the interlayer insulating

layer and the wiring are cleaned with a rinsing liquid containing a polyvalent carboxylic acid monomer in an amount of from 0.3 millimole/liter to 230 millimole/liter, and which is carried out after the sealing composition application process.

[0012] ~~<7> The~~ In an embodiment of the method of manufacturing a semiconductor device according to <5> or <6> the third or fourth aspect, wherein the polyvalent carboxylic acid monomer satisfies at least one of the following: having two aromatic rings; or having a molecular weight of 342 or more.

[0013] ~~<8> The~~ In an embodiment of the above method of manufacturing a semiconductor device, according to any one of <5> to <7>, wherein the rinsing liquid has a pH of from 4.0 to 7.0.

[0014] ~~<9> The~~ In an embodiment of the above method of manufacturing a semiconductor device, according to any one of <5> to <8>, wherein a content of sodium and a content of potassium in the sealing composition are each 10 ppb by mass or less on an elemental basis.

[0015] ~~<10> The~~ In an embodiment, the above method of manufacturing a semiconductor device according to any one of <5> to <9>, the method comprising comprises a heating process in which the semiconductor substrate is heated at a temperature of from 70°C to 125°C, and which is carried out after the sealing composition application process and before the cleaning process.

[0016] ~~<11> The~~ In an embodiment, the above method of manufacturing a semiconductor device according to any one of <5> to <10>, the method comprising comprises a high temperature heating process in which the semiconductor substrate is heated at a temperature of from 200°C to 425°C, and which is carried out after the cleaning process.

[0017] ~~<12> The~~ In an embodiment of the above method of manufacturing a semiconductor device, according to any one of <5> to <11>, wherein the sealing composition further comprises a monocarboxylic acid.

Advantageous Effects of Invention

[0018] According to ~~one~~ embodiments of the invention, it is possible to provide a method of manufacturing a semiconductor device in which polymer (A) contained in a sealing composition can be made less likely to remain on the bottom face of a concave portion of an interlayer insulating layer, and on wiring, while maintaining the sealing property provided by the sealing composition at the side face of the concave portion, and in which a decrease in the amount of wiring material such as copper can be reduced to maintain the electrical conductivity of the wiring material, and to provide the sealing composition used in the manufacture of such a semiconductor device.

According to ~~another~~ embodiments of the invention, it is possible to provide, ~~as an object,~~ a method of manufacturing a semiconductor device in which polymer (A) contained in a sealing composition can be made less likely to remain on wiring while maintaining the