

substrates are bonded, it is necessary to reliably seal a microstructure to which a sample is introduced without damaging a microstructure such as a flow channel provided in the substrate.

[0005]

For example, Patent Literature 1 discloses “a microchip including an area to which a solution is introduced while maintaining the inner pressure of the area to be negative relative to atmospheric pressure. This microchip is formed by bonding a plurality of substrate layers made of different materials. The microchip composed of such a composite material substrate layer may have insufficient bonding strength between substrate layers.

Citation List

Patent Literature

[0006]

Patent Literature 1: JP 2011-163984A

Summary of Invention

Technical Problem

[0007]

In some case, the bonding strength between substrate layers may be insufficient depending on combination of materials of a substrate layer that constitutes a microchip. Embodiments of the present invention provide a method of manufacturing a microchip for enhancing the bonding strength between substrate layers.

Solution to Problem

[0008]

~~According to a first aspect of the present invention, there is provided a microchip comprising: a plurality of substrate layers; and bonding layers provided at boundary surfaces between the substrate layers and configured to include a silicone compound, wherein at least one of the bonding layers is configured to include an organic silicon compound, wherein the plurality of substrate layers include a substrate layer made of non-silicone resin and a substrate layer made of polydimethylsiloxane, and wherein both surfaces of the substrate layer made of polydimethylsiloxane are bonded to a first substrate layer made of non-silicone resin and a second substrate layer made of non-silicone resin through the bonding layer.~~

According to a first aspect of the present invention, there is provided a sealed microchip comprising: a plurality of substrate layers comprising: a first substrate layer having a groove formed therein, a second substrate layer having no groove formed therein, and a third substrate layer between the first and second substrate layers, wherein the third substrate layer is made of polydimethylsiloxane and has a self-sealing ability due to elastic deformation; and bonding layers provided at boundary surfaces of the first and second substrate layers and configured to include a silicon compound, wherein an inner space is defined by the groove and a bonding layer at a bonding surface of the third substrate layer, the inner space having a negative pressure relative to atmospheric pressure, wherein at least one of the bonding layers is configured to include an organic silicon compound, wherein the first and second substrate layers are made of non-silicone resin, and wherein both surfaces of the third substrate layer made of polydimethylsiloxane are bonded to the first substrate layer made of non-silicone resin and the second substrate layer made of non-silicone resin through the bonding layers.

~~The first substrate layer made of non-silicone resin may have a groove on a bonding surface bonded to the substrate layer made of polydimethylsiloxane. The second substrate layer made of non-silicone resin and the substrate layer made of polydimethylsiloxane may be bonded through the bonding layer made of an organic silicon compound, the second substrate layer made of non-silicone resin has no groove on a bonding surface bonded to the substrate layer made of polydimethylsiloxane.~~

Further, the substrate layer made of polydimethylsiloxane may be bonded to the first substrate layer made of non-silicone resin through a bonding layer made of an inorganic silicon compound.

~~In addition, the substrate layer made of polydimethylsiloxane may have a groove on a bonding surface bonded to the first substrate layer made of non-silicone resin. The first substrate layer made of non-silicone resin and the second substrate layer made of non-silicone resin may have each bonded to the substrate layer made of polydimethylsiloxane through the bonding layer made of an organic silicon compound.~~

The first substrate layer made of non-silicone resin and the second substrate layer made of non-silicone resin may be composed of acrylic resin or polycarbonate, and may be impermeable to gas.

~~Further, the substrate layer made of polydimethylsiloxane may have a self-sealing ability due to elastic deformation. The groove may have an inner space which is negative pressure relative to atmospheric pressure.~~

According to a second aspect of the present invention, there is provided a sealed microchip comprising: a plurality of substrate layers comprising: a first substrate layer having no groove formed therein, a second substrate having no groove formed therein, and a third substrate layer between the first and second substrate layers, the third substrate layer having a groove formed therein, wherein the third substrate layer is made of polydimethylsiloxane and has a self-sealing ability due to elastic deformation; and bonding layers provided at boundary surfaces of the first and second substrate layers and configured to include a silicon compound, wherein the inner space is defined by the groove and a bonding layer at a bonding surface of the first substrate layer, the inner space having a negative pressure relative to atmospheric pressure, wherein at least one of the bonding layers is configured to include an organic silicon compound, wherein the first and second substrate layers are made of non-silicone resin, and wherein both surfaces of the third substrate layer made of polydimethylsiloxane are bonded to the first substrate layer made of non-silicone resin and the second substrate layer made of non-silicone resin through the bonding layers.

[0009]

~~According to a second aspect of the present invention, there is provided a method for manufacturing a microchip, the method comprising: a deposition process of coating a groove forming surface of a first substrate layer made of non-silicone resin with a cross-linkable composition containing a silicon compound, the groove forming surface of the first substrate layer being provided with a groove; and a coating process of coating a surface of a second substrate layer made of non-silicone resin with a cross-linkable composition containing an organic silicon compound, the surface of the second substrate layer being provided with no groove, and a bonding process of bonding each of the groove forming surface of the first substrate layer made of non-silicone resin and the surface of the second substrate layer made of non-silicone resin to a substrate layer made of polydimethylsiloxane.~~

According to a third aspect of the present invention, there is provided a method for manufacturing a sealed microchip, the method comprising: a deposition process of coating a groove forming surface of a first substrate layer made of non-silicone resin with a cross-linkable composition containing a silicon compound, the groove forming surface of the first substrate layer having a groove formed therein; a coating process of coating a surface of a second substrate layer made of non-silicone resin with a cross-linkable composition containing an organic silicon compound, the surface of the second substrate layer having no groove formed therein, and a bonding process of bonding each of the groove forming surface of the first substrate layer made of non-silicone resin and the surface of the second substrate layer made of

4a

non-silicone resin to a third substrate layer made of polydimethylsiloxane, wherein the third substrate layer is made of polydimethylsiloxane and has a self-sealing ability due to elastic deformation, wherein the inner space is defined by the groove and a bonding layer at a bonding surface of the first substrate layer, the inner space having a negative pressure relative to atmospheric pressure, and wherein both surfaces of the third substrate layer made of polydimethylsiloxane are bonded to the first substrate layer made of non-silicone resin and the second substrate layer made of non-silicone resin through the bonding layers.

Advantageous Effects of Invention

[0010]

According to embodiments of the present invention, there is provided a microchip having enhanced bonding strength between substrate layers.

Brief Description of Drawings

[0011]

[FIG. 1] FIGS. 1A and 1B are schematic diagrams for describing the configuration of a microchip 1a according to a first embodiment of the present technology.

[FIG. 2] FIG. 2 is a flowchart for describing a method for manufacturing the microchip 1a.

[FIG. 3] FIGS. 3A to 3F are schematic diagrams for describing a method for manufacturing the microchip 1a.

[FIG. 4] FIG. 4 is a schematic diagram for describing the configuration of a microchip 1b according to a second embodiment of the present technology.

[FIG. 5] FIG. 5 is a flowchart for describing a method for manufacturing the microchip 1b.

[FIG. 6] FIG. 6A to 6F are schematic diagrams for describing a method for

CLAIMS

1. A sealed microchip comprising:

a plurality of substrate layers comprising:

a first substrate layer having a groove formed therein,

a second substrate layer having no groove formed therein, and

a third substrate layer between the first and second substrate layers,

wherein the third substrate layer is made of polydimethylsiloxane and has a self-sealing ability due to elastic deformation; and

bonding layers provided at boundary surfaces between of the first and second substrate layers and configured to include a silicon compound,

wherein an inner space is defined by the groove and a bonding layer at a bonding surface of the third substrate layer, the inner space having a negative pressure relative to atmospheric pressure,

wherein at least one of the bonding layers is configured to include an organic silicon compound,

wherein the plurality of first and second substrate layers ~~include a substrate layer~~ are made of non-silicone resin and ~~a substrate layer made of polydimethylsiloxane,~~ and

wherein both surfaces of the third substrate layer made of polydimethylsiloxane are bonded to ~~a~~ the first substrate layer made of non-silicone resin and ~~a~~ the second substrate layer made of non-silicone resin through the bonding layers.

2. ~~The microchip according to claim 1,~~

~~wherein the first substrate layer made of non-silicone resin has a groove on a bonding surface bonded to the substrate layer made of polydimethylsiloxane,~~

~~wherein the second substrate layer made of non-silicone resin and the substrate layer made of polydimethylsiloxane are bonded through the bonding layer made of an organic silicon compound, the second substrate layer made of non-silicone resin has no groove on a bonding surface bonded to the substrate layer made of polydimethylsiloxane.~~

32. The microchip according to claim 21, wherein the third substrate layer made of polydimethylsiloxane is bonded to the first substrate layer made of non-silicone resin through a bonding layer made of an inorganic silicon compound.

~~4 The microchip according to claim 1, wherein the substrate layer made of polydimethylsiloxane has a groove on a bonding surface bonded to the first substrate layer made of non-silicone resin,~~

~~wherein the first substrate layer made of non-silicone resin and the second substrate layer made of non-silicone resin are each bonded to the substrate layer made of polydimethylsiloxane through the bonding layer made of an organic silicon compound.~~

3. A sealed microchip comprising:

a plurality of substrate layers comprising:

a first substrate layer having no groove formed therein,

a second substrate having no groove formed therein, and

a third substrate layer between the first and second substrate layers, the third substrate layer having a groove formed therein,

wherein the third substrate layer is made of polydimethylsiloxane and has a self-sealing ability due to elastic deformation; and

bonding layers provided at boundary surfaces of the first and second substrate layers and configured to include a silicon compound,

wherein the inner space is defined by the groove and a bonding layer at a bonding surface of the first substrate layer, the inner space having a negative pressure relative to atmospheric pressure,

wherein at least one of the bonding layers is configured to include an organic silicon compound,

wherein the first and second substrate layers are made of non-silicone resin, and

wherein both surfaces of the third substrate layer made of polydimethylsiloxane are bonded to the first substrate layer made of non-silicone resin and the second substrate layer

made of non-silicone resin through the bonding layers.

4. The microchip according to claim 3, wherein the third substrate layer made of polydimethylsiloxane is bonded to the first substrate layer made of non-silicone resin through a bonding layer made of an organic silicon compound.

5. The microchip according to claim ~~3~~2 or 4, wherein the first substrate layer made of non-silicone resin and the second substrate layer made of non-silicone resin are composed of acrylic resin or polycarbonate.

6. The microchip according to claim 5, wherein the first substrate layer made of non-silicone resin and the second substrate layer made of non-silicone resin are impermeable to gas.

~~7. The microchip according to claim 6,
— wherein the substrate layer made of polydimethylsiloxane has a self-sealing ability due to elastic deformation,
— wherein the groove has an inner space which is negative pressure relative to atmospheric pressure.~~

~~8~~7. A method for manufacturing a sealed microchip, the method comprising:

a deposition process of coating a groove forming surface of a first substrate layer made of non-silicone resin with a cross-linkable composition containing a silicon compound, the groove forming surface of the first substrate layer ~~being provided with~~ having a groove formed therein;

a coating process of coating a surface of a second substrate layer made of non-silicone resin with a cross-linkable composition containing an organic silicon compound, the surface of the second substrate layer ~~being provided with~~ having no groove formed therein, and

a bonding process of bonding each of the groove forming surface of the first substrate

layer made of non-silicone resin and the surface of the second substrate layer made of non-silicone resin to a third substrate layer made of polydimethylsiloxane,

wherein the third substrate layer is made of polydimethylsiloxane and has a self-sealing ability due to elastic deformation,

wherein the inner space is defined by the groove and a bonding layer at a bonding surface of the first substrate layer, the inner space having a negative pressure relative to atmospheric pressure, and

wherein both surfaces of the third substrate layer made of polydimethylsiloxane are bonded to the first substrate layer made of non-silicone resin and the second substrate layer made of non-silicone resin through the bonding layers.