

INTERPOSER AND MANUFACTURING METHOD FOR THE SAME

TECHNICAL FIELD

5 The present invention relates to an interposer and a manufacturing method for the same, and more particularly, relates to an interposer and a manufacturing method for the same in which a void is not generated in a through hole.

BACKGROUND ART

10 Fig. 4 is a cross sectional view to show a silicon substrate 60 explaining a problem in the prior art technology when an interposer is manufactured by arranging a conducting hole on the silicon substrate 60. Referring to Fig. 4, in the prior art technology, firstly a through hole 71 is formed on the silicon substrate 60. At this point, the through hole 71 becomes a cylindrical shape whose center portion is concave as shown in Fig. 15 4 rather than straight.

For the through hole 71, seed layers 63, 64 are formed by sputtering around the through hole 71 from both of a front surface 61 and a back surface 62. Then, conducting layers 65, 66 are formed by electroplated coating and the like utilizing the seed layers 63, 64 as a seed.

20 The interposer in the prior art technology is constituted as described above. When the through hole is formed on the silicon substrate, because the center portion of the through hole has the concave shape and diameter of the through hole becomes larger as it goes inside from the front surface or the back surface, the seed layer cannot be formed well inside even when the seed layer is intended to be formed inside of the through hole. As a result, even when the conducting layer is grown from the seed layer by the electroplated coating and the like, because the conducting layer is not grown enough, so called "void" 72 is formed inside of the through hole 71, in which the conducting layer does not exist.

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DISCLOSURE OF THE INVENTION

The present invention is made to solve the above described problems and it is an object of the present invention to provide an interposer and manufacturing method for the same in which the manufacturing process is simple and the void is not generated inside of the through hole.

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In accordance with one aspect of the present invention an interposer

includes: a substrate which has one surface and another surface opposed to the one surface; a through hole being formed from the one surface to the another surface; a seed layer which is formed at an opening portion of the through hole on the one surface side of the substrate; an electrode layer for electroplated coating which is formed by covering the seed layer; and an electroplated coating layer which extends from the electrode layer for electroplated coating to the another surface side to fill the through hole.

Because the interposer according to the present invention includes the seed layer which is formed at the opening portion of the through hole on the one surface side of the substrate, the electrode layer for electroplated coating which is formed by covering the seed layer, and the electroplated coating layer which extends from the electrode layer for electroplated coating to the another surface side to fill the through hole, the electroplated coating layer can be surely formed from the seed layer on the one surface side of the substrate to the another surface side.

As a result, an interposer can be provided in which the manufacturing process is simple and the void is not generated inside of the through hole.

The through hole may have a shape whose center portion is concave. Further, the seed layer, the electrode layer for electroplated coating and the electroplated coating layer may be made out of the same material, or may be different materials.

In accordance with another aspect of the present invention, a manufacturing method for interposer includes steps of: preparing a substrate which has one surface and another surface; forming a through hole on the substrate; forming a seed layer at an opening portion of the through hole on the one surface side; and filling the through hole by forming an electroplated coating layer from the seed layer on the one surface side to the another surface side.

The manufacturing method for the interposer according to the present invention includes steps of forming a seed layer at an opening portion of the through hole on the one surface side and filling the through hole by forming an electroplated coating layer from the seed layer on the one surface side to the another surface side. Because the conducting layer is surely formed by the electroplating from the one surface side of the

through hole on the substrate to another surface side, the void is not generated inside of the through hole.

As a result, a method for manufacturing the interposer can be provided that is simple and the void is not generated inside of the through hole.

Preferably, the step of filling the through hole by forming an electroplated coating layer from the seed layer on the one surface side to the another surface side includes steps of forming an electrode layer for electroplated coating to close the through hole at the one surface side, and forming the electroplated coating layer utilizing the electrode layer.

More preferably, the step of forming the through hole includes a step of forming a through hole whose center portion becomes concave.

At this point, the seed layer, the electrode layer for electroplated coating and the electroplated coating layer may be made out of the same material, or different materials.

BRIEF DESCRIPTION OF DRAWINGS

Fig. 1A is a diagram showing a manufacturing process of an interposer according to the first embodiment of the present invention step by step;

Fig. 1B is a diagram showing a manufacturing process of the interposer according to the first embodiment of the present invention step by step;

Fig. 1C is a diagram showing a manufacturing process of the interposer according to the first embodiment of the present invention step by step;

Fig. 1D is a diagram showing a manufacturing process of the interposer according to the first embodiment of the present invention step by step;

Fig. 2 is a diagram showing a manufacturing process of an interposer according to the second embodiment of the present invention;

Fig. 3A is a diagram to show a shape of a through hole to which the third embodiment of the present invention is applied;

Fig. 3B is a diagram showing a shape of the through hole to which the third embodiment of the present invention is applied; and

Fig. 4 is a diagram to explain a problem of an interposer in the prior art technology.

BEST MODE FOR CARRYING OUT THE INVENTION

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Hereinafter, the first embodiment according to the present invention will be described with reference to the accompanying drawings. Fig. 1A - Fig. 1D are diagrams to show step by step a manufacturing process of an interposer according to the first embodiment of the present invention. Referring to Fig. 1A - Fig. 1D, firstly a silicon substrate 10 having a front surface 11 and a back surface 12 is prepared, and a through hole 13 is opened on the substrate (Fig. 1A). At this point, the through hole 13 may be formed having a shape whose center portion is concave as shown in Fig. 1A as the interposer in the prior art. In this state, then, an insulating film which is not shown in the drawing, is formed on the substrate 10 including inside of the through hole 13. This insulating film may be made of SiO₂, SiN and the like and is formed by sputtering, CVD or oxidization.

Next, Ti layer (not shown) as a barrier layer is formed by sputtering and the like around the through hole 13 where the insulating layer is formed on the back surface 12 of the substrate 10. Then, a seed layer 14 (a base layer for an electrode to flow current for electroplating) made out of Cu is formed on the barrier layer by sputtering and the like (Fig. 1B). An electroplated coating is performed from the back surface 12 based on the Cu seed layer 14. This electroplated coating is performed till an edge surface of the electroplating meets to close the through hole 13 at the back surface 12 so as to form an electrode layer for the electroplated coating of the electroplated coating layer 15 made out of Cu (Fig. 1C).

Next, an electroplated coating of Cu is performed to the front surface 11 utilizing the electroplated coating layer 15 of Cu as an electrode. By these steps, an electroplated coating layer of Cu grows in a direction shown by an arrow in Fig. 1D, and an electroplated coating layer 16 is prepared (Fig. 1D).

As described above, according to this embodiment, the through hole 13 can be made as the conducting layer of Cu without generating the void inside of the through hole even when the concave shaped hole is formed

inside of the through hole 13.

At this point in the embodiment described above, though Ti is utilized as the barrier layer, this layer can be omitted.

5 Next, an explanation will be given on the second embodiment. Fig. 2 is a diagram to show a manufacturing process of an interposer according to the second embodiment corresponding to Fig. 1D of the first embodiment, and the interposer has basically the same structure as shown in Fig. 1. Referring to Fig. 2, in this second embodiment, a through hole 23 is formed
10 on a silicon substrate 20, and the through hole 23 is filled with a seed layer 24, an electrode layer 25 for electroplated coating and electroplated coating layer 26.

 Though in the first embodiment, the seed layer and the electroplated coating layer made out of Cu are formed on the silicon
15 substrate, in this embodiment the seed layer 24, the electrode layer 25 for electroplating and the electroplated coating layer 26 are made out of not only Cu but any material such as Ni, Cr, Au, Ag and the like as far as the electroplated coating can be performed. The material for the seed layer 24, the electrode layer 25 for electroplated coating and the electroplated coating
20 layer 26 may be different from one another. For example, the seed layer may be made out of Cu and the electroplating of Au may be performed utilizing the seed layer as the electrode layer for electroplated coating.

 Next, an explanation will be given on the third embodiment of the
25 present invention. Fig. 3 is a diagram to show a shape of the through hole to which an interposer according to the third embodiment of the present invention is applied. Though in the first and the second embodiments, the present invention is applied to the through holes having the shape whose center portion becomes concave, the present invention can be applied to the
30 substrate 30 with the through hole 31 having a cylindrical shape (Fig. 3A) and the through hole 32 having a diameter which becomes smaller in succession as the hole goes from the front surface to the back surface (Fig. 3B).

Though in the above described embodiments, the explanation is made on the embodiments utilizing the silicon substrate as a material for the substrate, these embodiments should not be considered as the restricted
5 examples, and the present invention is applicable to the insulating substrate made out of such as glass and sapphire. In these cases, forming of the insulating layer described above is not necessary.

Though in the embodiments described above, the explanation is made on the cases in which filling of the conducting material into the
10 through hole is performed by electroplated coating, the present invention should not be restricted to these examples, the filling may be performed by electroless plated coating.

INDUSTRIAL APPLICABILITY

15 The manufacturing method of the interposer in accordance with the present invention can be utilized advantageously as a manufacturing method of the interposer in which the void is not generated in the through hole because the conducting layer by the electroplated coating is surely formed at the through hole from one side of the substrate to another side.

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WHAT IS CLAIMED IS:

1. An interposer comprising:
 - a substrate which has one surface, another surface opposed to said
 - 5 one surface, and a through hole passing through from said one surface to said another surface;
 - a seed layer which is formed by sputtering at an opening portion of said through hole on said one surface side of said substrate;
 - an electrode layer for electroplated coating which is formed by
 - 10 covering said seed layer to close said opening portion ; and
 - an electroplated coating layer which extends from said electrode layer for electroplated coating to said another surface side to fill said through hole.
- 15 2. The interposer according to claim 1, wherein said through hole has a shape whose center portion is concave.
3. The interposer according to claim 1 or 2, wherein said seed layer, said electrode layer for electroplated coating and said electroplated coating layer
- 20 are made out of the same material.
4. The interposer according to claim 1 or 2, wherein said seed layer, said electrode layer for electroplated coating and said electroplated coating layer
- 25 are made out of different materials.
5. A method for manufacturing an interposer comprising steps of:
 - preparing a substrate which has one surface and another surface
 - opposed to said one surface;
 - forming a through hole on said substrate;
 - 30 forming a seed layer at an opening portion of said through hole on said one surface side; and
 - filling said through hole by forming an electroplated coating layer from said seed layer on said one surface side to said another surface side to close said through hole.
- 35 6. The method for manufacturing an interposer according to claim 5,

wherein said step of filling said through hole by forming an electroplated coating layer from said seed layer on said one surface side to said another surface side includes steps of:

5 forming an electrode layer for electroplated coating to close said through hole at said one surface side; and
 forming said electroplated coating layer utilizing said electrode layer.

10 7. The method for manufacturing an interposer according to claim 5 or 6, wherein said step of forming the through hole includes a step of forming a through hole whose center portion becomes concave.

15 8. The method for manufacturing an interposer according to claim 6, wherein said seed layer, said electrode layer for electroplated coating and said electroplated coating layer are made out of the same material.

20 9. The method for manufacturing an interposer according to claim 6, wherein at least two of said seed layer, said electrode layer for electroplated coating and said electroplated coating layer are made out of different materials.

25 10. The interposer according to claim 1, wherein:
 said through hole has a first opening area at said surface of one side, and said first opening area becomes smaller in succession as the hole goes from said surface of said one side to said surface of said another side.

30 11. The method for manufacturing an interposer according to claim 5, wherein said through hole is formed by performing an etching such that an opening area of said through hole becomes smaller in succession as the hole goes from said surface of said one side and from said surface of said another side to inside.