

DOUBLE-SIDED MOUNTING BOARD, METHOD OF MANUFACTURING DOUBLE-SIDED
MOUNTING BOARD, AND SEMICONDUCTOR LASER

BACKGROUND OF THE INVENTION

5 1. Field of the Invention

The present invention relates to a double-sided mounting board composed of single-crystal silicon carbide (single-crystal SiC), a method of manufacturing the double-sided mounting board, and a semiconductor laser.

10 2. Description of the Related Art

In recent years, higher speed operation, smaller size and lighter weight (higher density), higher power output, and higher reliability are strongly demanded for electronic devices. Semiconductor devices show a rapid trend toward higher integration,
15 larger size, multiple chips, and higher power output. Electronic circuits show a trend toward more miniaturization, shorter wiring length, and lower resistance. With these trends, how to efficiently remove (dissipate) heat generated in a device has been raised as an important issue.

20 For electronic circuits, besides heat generation, dielectric breakdown of the substrate caused due to higher wiring density and higher electric power has been pointed out as a problem. For materials for substrates, it is required that materials have favorable heat conduction, an excellent electric insulation
25 property, favorable high frequency characteristics, thermal expansion coefficients close to those of Si and GaAs, chemical stability, and high mechanical strength, that circuits can be easily formed with the materials, and that hermetic sealing be possible. In terms of manufacturing, it is required that the materials be
30 inexpensive, that technical perfection for the materials be high, that the raw materials be easily available, that simple, inexpensive manufacturing processes can be applied, and that they do not contain

toxic substances such as pollutants.

Examples of ceramic substrate materials being used include, commonly, polycrystalline alumina (thermal conductivity: approximately 23 W/m·K), polycrystalline aluminum nitride (thermal conductivity: approximately 170 W/m·K), and polycrystalline silicon carbide (thermal conductivity: approximately 300 W/m·K).

However, in recent years, even in the case where polycrystalline silicon carbide having a thermal conductivity of 300 W/m·K is used for the substrate material, the number of cases in which a semiconductor laser shows insufficient heat dissipation characteristics is increasing. In this respect, single-crystal silicon carbide (single-crystal SiC) having a thermal conductivity of approximately 490 W/m·K is drawing attention as a substrate material.

However, use of silicon carbide (SiC) for substrates still involves micropipe defect problems. Japanese Patent No. 3967045 (hereinafter referred to as patent document 1) discloses a method of manufacturing pn junction diodes, by taking measures against concave defects such as micropipes included in the wafer.

SUMMARY OF THE INVENTION

For single-crystal SiC, of all the crystallographic defects included in crystals, hollow through defects (micropipe defects) affect device operation most seriously. In the case where a single-crystal SiC double-sided mounting board has micropipe defects, wiring film material flows into the micropipe defects in the course of forming electrodes on the surfaces, and a short circuit could occur between the front-surface wiring film and the back-surface wiring film.

A problem for the case where single-crystal SiC substrates are used to manufacture double-sided mounting boards will be described with reference to FIG. 6. The problem is that when a first wiring film 2a is formed on the front surface 1a of a single-crystal

SiC substrate 1, and a second wiring film 2b is formed on the back surface 1b, wiring film materials flow into a micropipe 8, causing electrical connection (a short circuit) between the front surface 1a and the back surface 1b of the single-crystal SiC substrate 1.

5 The diameter of the micropipe 8 is approximately 10 to 20 μm , and hence, it is difficult to recognize the micropipe 8 with a stereoscopic microscope.

To address this problem, in the method disclosed in patent document 1, a silicon oxide film (insulating film) is grown to a
10 thickness larger than or equal to the radius of the micropipe by a chemical vapor deposition (CVD) method, and in this process, the micropipe (hole) is filled with the silicon oxide. After that, the insulating film grown on the substrate is removed.

Hence, in this method, the process to remove the insulating
15 film (cutting process) takes time and costs. There is also another problem that because the thermal conductivity of the insulating film is approximately $1 \text{ W/m}\cdot\text{K}$, the heat conduction inside the micropipe is poor, and this affects the performance at the surrounding portions.

20 The present invention has been made to solve the above problems, and an object thereof is to provide a double-sided mounting board composed of single-crystal SiC in which a short circuit between the front surface side and the back surface side that could be caused due to micropipe defects is prevented, a method of manufacturing
25 the double-sided mounting board, and a semiconductor laser.

To solve the above problems, a double-sided mounting board according to the present invention is composed of single-crystal silicon carbide and includes, at a micropipe defect inner-wall surface portion which is a crystallographic defect that occurs in
30 a manufacturing stage for the double-sided mounting board, a multi-layer film structure including first wiring film material that is inflow from a first wiring film formed as a thin film on a first

component side of the double-sided mounting board, insulating film material that is inflow from an insulating film formed as a thin film on a second component side that is the side opposite to the first component side, and second wiring film material that is inflow
5 from a second wiring film formed as a thin film on the second component side. The other aspects of the present invention will be described in the embodiments described later.

The present invention makes it possible to prevent a short circuit between the front surface side and the back surface side
10 in single-crystal SiC double-sided mounting boards that could be caused due to micropipe defects.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGs. 1A to 1D are cross-sectional diagrams illustrating manufacturing processes for a double-sided mounting board according
15 to a first embodiment.

FIGs. 2A to 2D are cross-sectional diagrams illustrating manufacturing processes for a double-sided mounting board according to a second embodiment.

FIGs. 3A to 3D1 are cross-sectional diagrams illustrating manufacturing processes for a double-sided mounting board according
20 to a third embodiment.

FIG. 4 is a cross-sectional view of a double-sided mounting board according to a fourth embodiment.

FIGs. 5A to 5D are cross-sectional diagrams illustrating manufacturing processes for a double-sided mounting board according
25 to a fourth embodiment.

FIG. 6 is an explanatory diagram illustrating a problem caused by the presence of a micropipe.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Hereinafter, embodiments of the present invention will be described in detail with reference to the drawings.

<<First Embodiment>>

FIGs. 1A to 1D are cross-sectional diagrams illustrating manufacturing processes for a double-sided mounting board 10 according to a first embodiment. Here, wiring films are formed on the front surface 1a and the back surface 1b of a single-crystal SiC substrate 1.

(Process S0) First, a flat-plate-shaped single-crystal SiC substrate 1 to be used is prepared as illustrated in FIG. 1A. The flat-plate-shaped single-crystal SiC substrate 1 to be used has a micropipe 8 inside. Silicon carbide (SiC) is an artificial compound that does not exist in nature and is synthesized from silica sand and carbon. SiC is an excellent heat-resistant material because SiC maintains its strength at high temperatures (up to 1500°C), and it is light and has high corrosion resistance. As described early, single-crystal SiC has a characteristic of high thermal conductivity, and its thermal conductivity is approximately 490 W/m·K.

(Process S1: the first fabrication process, the first step) Then, as illustrated in FIG. 1B, a first wiring film 2a is formed on the first component side on the front surface 1a of the single-crystal SiC substrate 1. Here, the first wiring film 2a is a multi-layer film (Ti/Pt/Au multi-layer film) including a titanium (Ti) layer, a platinum (Pt) layer on the titanium layer, and a gold (Au) layer on the platinum layer, those layers being formed by an electron-beam vapor-deposition film-formation method or a resistance-heating vapor-deposition film-formation method. The same is true of a second wiring film 2b described later.

For the electron-beam vapor deposition, an evaporation material is put in a crucible in a high vacuum atmosphere, and an electron beam is projected to the vapor deposition material in the crucible. The evaporation material in the crucible is heated and evaporated, so that the evaporation material is deposited onto a substrate placed above the evaporation source, forming a thin film. For the resistance-heating vapor-deposition film-formation method,

a vapor deposition material placed in a resistance object is heated and evaporated by energizing the resistance object in a high vacuum atmosphere. The evaporation material is deposited onto a substrate placed above the evaporation source, forming a thin film.

5 (Process S2: the second fabrication process, the second step) Next, as illustrated in FIG. 1C, an insulating film 3 is formed on the second component side on the back surface 1b, which is the side opposite to the first component side. The insulating film 3 is an insulating film material of a silicon oxide film, which,
10 specifically, is a thin film composed of silicon dioxide (SiO_2). The insulating film is not limited to an oxide film, but it only needs to be a film that ensures insulation, such as alumina (Al_2O_3), silicon nitride (Si_3N_4), and titanium oxide (TiO_2).

The insulating film 3 is formed by a sputtering film-formation
15 method or an ion-plating film-formation method in which the film material is more likely to flow into the defect inner-wall surface portion of the micropipe 8 than in the electron-beam vapor-deposition film-formation method or the resistance-heating vapor-deposition film-formation method.

20 For the sputtering film-formation method, particles having high energy are collided with the material (target) by means of plasma or the like, and the impact ejects material components. Particles of the material components are deposited onto a substrate, forming a film.

25 The ion-plating film-formation method is based on approximately the same principle as that of the electron-beam vapor-deposition film-formation method. A difference is that evaporation particles pass through plasma to have positive charge and negative charge is applied to the substrate, so that the
30 evaporation particles are attracted by the substrate and deposited onto it, forming a film.

(Process S3: the third fabrication process, the third step) Lastly,

a second wiring film 2b is formed on the second component side as illustrated in FIG. 1D. The second wiring film 2b is a multi-layer film (Ti/Pt/Au multi-layer film) including a titanium (Ti) layer, a platinum (Pt) layer on the titanium layer, and a gold (Au) layer on the platinum layer, those layers being formed by an electron-beam vapor-deposition film-formation method or a resistance-heating vapor-deposition film-formation method.

The double-sided mounting board 10 has a layered structure including, at least, the first wiring film 2a formed on the lowermost surface on the first component side, the insulating film 3 formed on the lowermost surface on the second component side, and the second wiring film 2b formed as an upper layer on the insulating film 3 on the second component side.

The first wiring film 2a and the second wiring film 2b can be constituted of a layered structure including a titanium layer as the lowermost layer, and a platinum layer and a gold layer in this order as upper layers on the titanium layer, those layers being formed by an electron-beam vapor-deposition film-formation method or a resistance-heating vapor-deposition film-formation method.

The present embodiment is characterized in that the wiring films and the insulating film are formed by different methods. The inventors conducted various studies and found that in the case where a wiring film is formed by an electron-beam vapor-deposition film-formation method or a resistance-heating vapor-deposition film-formation method, the wiring film is less likely to flow into the micropipe 8, and that on the other hand, in the case where an insulating film is formed by a sputtering film-formation method or an ion-plating film-formation method, the insulating film is more likely to flow into the micropipe 8.

For this reason, the wiring film is formed on the front surface 1a by an electron-beam vapor-deposition film-formation method or a resistance-heating vapor-deposition film-formation method, the

insulating film is formed on the back surface 1b by a sputtering film-formation method or an ion-plating film-formation method, and then the wiring film is formed on the back surface 1b by an electron-beam vapor-deposition film-formation method or a resistance-heating vapor-deposition film-formation method.

As a result, a double-sided mounting board 10 composed of single-crystal silicon carbide (single-crystal SiC) with a multi-layer film structure can be provided, the multi-layer film structure including first wiring film material 2am which is inflow from the first wiring film 2a formed as a thin film on the first component side, second wiring film material 2bm which is inflow from the second wiring film 2b formed as a thin film on the second component side opposite to the first component side, and insulating film material 3m which is inflow from the insulating film 3 and serves as an intermediate layer, at the defect inner-wall surface portion of the micropipe 8 which is a crystallographic defect that occurs during a manufacturing stage of the double-sided mounting board 10. This provides an advantageous effect of preventing electrical connection (a short circuit) between the front and back surfaces of the single-crystal SiC substrate 1 even if the substrate has a micropipe 8 which has traditionally been a problem.

<<Second Embodiment>>

FIGS. 2A to 2D are cross-sectional diagrams illustrating manufacturing processes for a double-sided mounting board 10 according to a second embodiment. In the second embodiment, wiring films are formed on the front surface 1a and the back surface 1b of a single-crystal SiC substrate 1 in the same way as in the first embodiment. The second embodiment is different from the first embodiment in that a wiring film is formed first on the back surface 1b. In FIGS. 2A to 2D, the constituents that are the same as those in FIGS. 1A to 1D are denoted by the same symbols, and description thereof is omitted. In FIGS. 2A to 2D, the back surface 1b is a

first component side, and the front surface 1a is a second component side.

(Process S0) First, as illustrated in FIG. 2A, a flat-plate-shaped single-crystal SiC substrate 1 to be used has a micropipe 8 inside.

5 (Process S1A: the first fabrication process, the first step) Then, as illustrated in FIG. 2B, a second wiring film 2b is formed on the first component side, which is the back surface 1b of the single-crystal SiC substrate 1. Here, the second wiring film 2b is a multi-layer film (Ti/Pt/Au multi-layer film) including a
10 titanium (Ti) layer, a platinum (Pt) layer on the titanium layer, and a gold (Au) layer on the platinum layer, those layers being formed by an electron-beam vapor-deposition film-formation method or a resistance-heating vapor-deposition film-formation method. The same is true of a second wiring film 2b described later.

15 (Process S2A: the second fabrication process, the second step) Next, as illustrated in FIG. 2C, an insulating film 3 is formed on the second component side on the front surface 1a which is the side opposite to the first component side. The insulating film 3 is a silicon oxide film which is an insulating film material.

20 The insulating film 3 is formed by a sputtering film-formation method or an ion-plating film-formation method in which the film material is more likely to flow into the defect inner-wall surface portion of the micropipe 8 than in the electron-beam vapor-deposition film-formation method or the resistance-heating
25 vapor-deposition film-formation method.

(Process S3A: the third fabrication process, the third step) Lastly, a first wiring film 2a is formed on the second component side as illustrated in FIG. 2D. The first wiring film 2a is a multi-layer film (Ti/Pt/Au multi-layer film) including a titanium (Ti) layer,
30 a platinum (Pt) layer on the titanium layer, and a gold (Au) layer on the platinum layer, those layers being formed by an electron-beam vapor-deposition film-formation method or a resistance-heating

vapor-deposition film-formation method.

The double-sided mounting board 10 has a layered structure including, at least, the second wiring film 2b formed on the lowermost surface on the first component side, the insulating film 3 formed on the lowermost surface on the second component side, and the first wiring film 2a formed as an upper layer on the insulating film 3 on the second component side.

As a result, a double-sided mounting board 10 composed of single-crystal silicon carbide (single-crystal SiC) with a multi-layer film structure can be provided, the multi-layer film structure including second wiring film material 2bm which is inflow from the second wiring film 2b formed as a thin film on the first component side, first wiring film material 2am which is inflow from the first wiring film 2a formed as a thin film on the second component side opposite to the first component side, and insulating film material 3m which is inflow from the insulating film 3 and serves as an intermediate layer, at the defect inner-wall surface portion of the micropipe 8 which is a crystallographic defect that occurs during a manufacturing stage of the double-sided mounting board 10. This provides an advantageous effect of preventing electrical connection (a short circuit) between the front and back surfaces of the single-crystal SiC substrate 1 even if the substrate has a micropipe 8 which has traditionally been a problem.

<<Third Embodiment>>

FIGs. 3A to 3D1 are cross-sectional diagrams illustrating manufacturing processes for a double-sided mounting board 10 according to a third embodiment. In the third embodiment, wiring films are formed on the front surface 1a and the back surface 1b of a single-crystal SiC substrate 1 in the same way as in the first embodiment. The third embodiment is different from the first embodiment in that an insulating film 3a is formed first on the front surface 1a. In FIGs. 3A to 3D1, the constituents that are the same

as those in FIGs. 1A to 1D are denoted by the same symbols, and description thereof is omitted.

(Process S0) First, as illustrated in FIG. 3A, a flat-plate-shaped single-crystal SiC substrate 1 to be used has a micropipe 8 inside.

5 (Process S1B1) Then, as illustrated in FIG. 3B1, an insulating film 3a is formed on the first component side on the front surface 1a of the single-crystal SiC substrate 1. The insulating film 3a is a silicon oxide film which is an insulating film material. The insulating film 3a is formed by a sputtering film-formation method or an ion-plating film-formation method in which the film material
10 is more likely to flow into the defect inner-wall surface portion of the micropipe 8 than in the electron-beam vapor-deposition film-formation method or the resistance-heating vapor-deposition film-formation method.

15 (Process S1B2) Then, as illustrated in FIG. 3B2, a first wiring film 2a is formed on the first component side of the front surface 1a. Here, the first wiring film 2a is a multi-layer film (Ti/Pt/Au multi-layer film) including a titanium (Ti) layer, a platinum (Pt) layer on the titanium layer, and a gold (Au) layer on the platinum
20 layer, those layers being formed by an electron-beam vapor-deposition film-formation method or a resistance-heating vapor-deposition film-formation method.

(Process S2B) Next, as illustrated in FIG. 3C1, an insulating film 3b is formed on the second component side on the back surface 1b
25 which is the side opposite to the first component side. The insulating film 3b is a silicon oxide film which is an insulating film material.

(Process S3B) Lastly, a second wiring film 2b is formed on the second component side as illustrated in FIG. 3D1. The second wiring film
30 2b is a multi-layer film (Ti/Pt/Au multi-layer film) including a titanium (Ti) layer, a platinum (Pt) layer on the titanium layer, and a gold (Au) layer on the platinum layer, those layers being formed

by an electron-beam vapor-deposition film-formation method or a resistance-heating vapor-deposition film-formation method.

In the third embodiment, first, the diameter of the micropipe 8 in the flat-plate-shaped single-crystal SiC substrate 1 to be used is made narrower than in the case of the first embodiment to reduce the amount of inflow from the first wiring film 2a.

As a result, a double-sided mounting board 10 composed of single-crystal silicon carbide (single-crystal SiC) with a multi-layer film structure can be provided, the multi-layer film structure including first wiring film material 2am which is inflow from the first wiring film 2a formed as a thin film on the first component side, second wiring film material 2bm which is inflow from the second wiring film 2b formed as a thin film on the second component side opposite to the first component side, and insulating film material 3m which is inflow from the insulating film 3 and serves as an intermediate layer, at the defect inner-wall surface portion of the micropipe 8 which is a crystallographic defect that occurs during a manufacturing stage of the double-sided mounting board 10. This provides an advantageous effect of preventing electrical connection between the front and back surfaces of the single-crystal SiC substrate 1 even if the substrate has a micropipe 8 which has traditionally been a problem.

<<Fourth Embodiment>>

FIG. 4 is a cross-sectional view of a double-sided mounting board 10 according to a fourth embodiment. The double-sided mounting board 10 has, on each of the front surface 1a and the back surface 1b, a thin-film seed layer 20 (a first wiring film 20a, a second wiring film 20b), a thick-film electrolytic plating layer 22 (electrolytic plating layers 22a, 22b), and a wiring layer 24 (wiring layers 24a, 24b) in this order from the bottom. The seed layer 20 is a multi-layer film composed of titanium and copper (Ti/Cu multi-layer film), and the electrolytic plating layer 22 is composed

of copper.

Specifically, the first wiring film 20a and the second wiring film 20b are constituted of a layered structure including a titanium layer as the lowermost layer and a copper layer as an upper layer on it, formed by an electron-beam vapor-deposition film-formation method or a resistance-heating vapor-deposition film-formation method.

The wiring layer 24 is a multi-layer film composed of nickel and gold (Ni/Au multi-layer film). The base of the double-sided mounting board 10 in FIG. 4 is a single-crystal SiC substrate 1, and hence, it could include micropipes illustrated in the first embodiment. An application example of the invention of the present application for this case will be described with reference to FIGs. 5A to 5D.

FIGs. 5A to 5D are cross-sectional diagrams illustrating manufacturing processes for a double-sided mounting board 10 according to a fourth embodiment.

(Process S10)

First, as illustrated in FIG. 5A, a seed layer 20 is formed using the process in the first embodiment. Description will be made with reference to FIGs. 1A to 1D as appropriate.

(Process S1) Then, as illustrated in FIG. 1B, a first wiring film 20a which is a Ti/Cu multi-layer film and corresponds to the first wiring film 2a is formed on the front surface 1a of the single-crystal SiC substrate 1. Here, the first wiring film 20a is a multi-layer film (Ti/Cu multi-layer film) including a titanium (Ti) layer and a copper (Cu) on it, formed by an electron-beam vapor-deposition film-formation method or a resistance-heating vapor-deposition film-formation method. The same is true of a second wiring film 20b described later.

(Process S2) Next as illustrated in FIG. 1C, an insulating film 3 is formed on the back surface 1b which is the surface opposite to

the front surface 1a. The insulating film 3 is a silicon oxide film which is an insulating film material. The insulating film 3 is formed by a sputtering film-formation method or an ion-plating film-formation method in which the film material is more likely to
5 flow into the defect inner-wall surface portion of the micropipe 8 than in the electron-beam vapor-deposition film-formation method or the resistance-heating vapor-deposition film-formation method. (Process S3) Lastly, a second wiring film 20b which is a Ti/Cu multi-layer film and corresponds to the second wiring film 2b is
10 formed as illustrated in FIG. 1D. The second wiring film 20b is a multi-layer film (Ti/Cu multi-layer film) including a titanium (Ti) layer and a copper (Cu) layer on it, formed by an electron-beam vapor-deposition film-formation method or a resistance-heating vapor-deposition film-formation method.

15 Returning to FIG. 5B, resist patterns 21 are formed on the front surface 1a and the back surface 1b of the single-crystal SiC substrate 1, and then, thick-film Cu layers (electrolytic plating layers 22) are formed on the front surface 1a side and the back surface 1b side of the single-crystal SiC substrate 1, as illustrated
20 in FIG. 5B.

Then, as illustrated in FIG. 5C, after the resist patterns 21 are removed, the surfaces of the thick-film Cu layers (electrolytic plating layers 22) are polished. After that, as illustrated in FIG. 5D, wiring layers 24 which are Ni/Au multi-layer
25 films are formed. The Ni/Au multi-layer film is formed by performing Ni plating treatment, cleaning, and then, Au plating treatment. The Ni/Au multi-layer film can be formed not only by the plating method, but by the vapor deposition the same as or a similar to the one for forming the seed layer. In FIG. 5D, a
30 multi-layer film structure is formed inside the micropipe 8, including first wiring film material 20am, the insulating film material 3m, and second wiring film material 20bm, and this provides

a significant effect of preventing the first wiring film 20a and the second wiring film 20b from electrically connecting to each other (making a short circuit).

5 The fourth embodiment provides a double-sided mounting board
10 composed of single-crystal silicon carbide (single-crystal SiC) with a multi-layer film structure including the first wiring film material 20am which is inflow from the first wiring film 20a formed as a thin film on the first component side, the second wiring film material 20bm which is inflow from the second wiring film 20b formed
10 as a thin film on the second component side opposite to the first component side, and the insulating film material 3m, which is inflow from the insulating film 3 and serves as an intermediate layer, at the defect inner-wall surface portion of the micropipe 8 which is a crystallographic defect that occurs during a manufacturing stage
15 of the double-sided mounting board 10. This provides an advantageous effect of preventing electrical connection between the front and back surfaces of the single-crystal SiC substrate 1 even if the substrate has a micropipe 8 which has traditionally been a problem.

20 As an application example of the double-sided mounting board 10, a semiconductor laser may be configured to include a double-sided mounting board 10 illustrated in the first to fourth embodiments and a semiconductor laser device disposed on the double-sided mounting board 10.

25 The present invention is not limited to the above embodiments but includes various modifications. For example, the above embodiments have been described in detail to make the description of the present invention easier to understand, and hence, the present invention is not limited to ones including all the constituents
30 described above. Some of the constituents of an embodiment can be replaced with constituents of another embodiment, constituents of an embodiment can be combined with constituents of another

embodiment. Some of the constituents of each embodiment can be deleted, added to, or replaced with constituents of another embodiment.

What is claimed is:

1. A double-sided mounting board comprising a single-crystal silicon carbide substrate, comprising,

5 at a micropipe defect inner-wall surface portion which is a crystallographic defect that occurs in a manufacturing stage for the double-sided mounting board,

a multi-layer film structure including

10 first wiring film material that is inflow from a first wiring film formed as a thin film on a first component side of the single-crystal silicon carbide substrate,

second wiring film material that is inflow from a second wiring film formed as a thin film on a second component side that is the side opposite to the first component side, and

15 insulating film material that is inflow from an insulating film formed as a thin film on the second component side, the insulating film material serving as an intermediate layer between the first wiring film material and the second wiring film material to prevent electrical connection between the first wiring
20 film material and the second wiring film material.

2. The double-sided mounting board according to claim 1, comprising

a layered structure including, at least,

25 the first wiring film formed on the lowermost surface on the first component side,

the insulating film formed on the lowermost surface on the second component side, and

30 the second wiring film formed as an upper layer on the insulating film on the second component side.

3. The double-sided mounting board according to claim 1, wherein

each of the first wiring film and the second wiring film is constituted of a layered structure including a titanium layer as a lowermost layer and a platinum layer and a gold layer in this order as upper layers on the titanium layer, the titanium, platinum, and gold layers being formed by an electron-beam vapor-deposition film-formation method or a resistance-heating vapor-deposition film-formation method.

4. The double-sided mounting board according to claim 1, wherein each of the first wiring film and the second wiring film is constituted of a layered structure including a titanium layer as a lowermost layer and a copper layer as an upper layer on the titanium layer, the titanium and copper layers being formed by an electron-beam vapor-deposition film-formation method or a resistance-heating vapor-deposition film-formation method.

5. The double-sided mounting board according to claim 1, wherein the insulating film material is a silicon oxide and is formed by a sputtering film-formation method or an ion-plating film-formation method in which the insulating film material is more likely to flow into the micropipe defect inner-wall surface portion than in an electron-beam vapor-deposition film-formation method or a resistance-heating vapor-deposition film-formation method.

6. A method of manufacturing a double-sided mounting board comprising a single-crystal silicon carbide substrate, comprising:
a first step of forming a first wiring film on a first component side of the single-crystal silicon carbide substrate;
a second step of forming an insulating film on a second component side that is the side opposite to the first component side;
and

a third step of forming a second wiring film on the second component side, wherein

at a micropipe defect inner-wall surface portion which is a crystallographic defect that occurs in a manufacturing stage for the double-sided mounting board,

insulating film material that is inflow from the insulating film serves as an intermediate layer between first wiring film material that is inflow from the first wiring film formed on the first component side and second wiring film material that is inflow from the second wiring film formed on the second component side, so that the insulating film material prevents electrical connection between the first wiring film material and the second wiring film material.

7. The method of manufacturing a double-sided mounting board according to claim 6, wherein

each of the first wiring film and the second wiring film is a multi-layer film including a titanium layer, a platinum layer on the titanium layer, and a gold layer on the platinum layer, the titanium, platinum, and gold layers being formed by an electron-beam vapor-deposition film-formation method or a resistance-heating vapor-deposition film-formation method.

8. The method of manufacturing a double-sided mounting board according to claim 6, wherein,

the insulating film material is a silicon oxide, and the insulating film is formed by a sputtering film-formation method or an ion-plating film-formation method in which the insulating film material is more likely to flow into the micropipe defect inner-wall surface portion than in an electron-beam vapor-deposition film-formation method or a resistance-heating vapor-deposition film-formation method.

9. A semiconductor laser comprising:

the double-sided mounting board according to any one of claims
1 to 5; and

5 a semiconductor laser device disposed on the double-sided
mounting board.