Decision on opposition

Opposition No. 2016-700388

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The case of patent opposition regarding Japanese Patent No. 5807935, entitled "Heat dissipation substrate and semiconductor module using the same", is concluded as follows.

Conclusion

The patent according to claims 1 to 10 of Japanese Patent No. 5807935 is maintained.

Reason

1. History of the procedures

The application of the patent according to claims 1 to 10 of Japanese Patent No. 5807935 was filed on October 9, 2014. The establishment of the patent right was registered on September 18, 2015, and after that, the opposition to the patent was submitted by the opponent, TSUNODA, Akira.

2. The patent invention

The patented invention according to claims 1 to 10 of Japanese Patent No. 5807935 (respectively referred to as "the patent Invention 1" to "the patent Invention 10" below) is the following invention specified by the matters described in claims 1 to 10.

"1. A method for manufacturing a heat dissipation substrate comprising steps of:

performing a plating process on a surface of an alloy composite mainly composed of metal and diamond, to form a metal layer;
performing solid-phase sintering to the alloy composite coated with the metal layer, thereby mending a defect present in the metal layer; and
performing Ni-based plating to which brazing or soldering is applied.

2. A method for manufacturing a heat dissipation substrate, comprising steps of:
mixing powders of main metal, added metal, and diamond;
forming a layer formed of a carbide of the added metal and the main metal on the surface of the diamond by performing a liquid-phase sintering process after compacting the mixed powder;
forming a metal layer on the surface of the alloy composite by plating after the liquid-phase sintering process;
performing solid-phase sintering to the alloy composite coated with the metal layer;
mending a defect present in the surface of the metal layer by the solid-phase sintering; and
performing Ni-based plating to which brazing or soldering is applied.

3. The method for manufacturing a heat dissipation substrate according to claim 2, wherein
a coefficient of linear expansion of the heat dissipation substrate is in a range of a value equal to or higher than 6.5 ppm/K to a value equal to or lower than 15 ppm/K, and
a degree of thermal conductivity is equal to or higher than 420 W/m・K.

4. The method for manufacturing a heat dissipation substrate according to claim 2 or 3, wherein
the main metal is one of Ag, Cu, Al and alloys of these metals, the added metal is at least one substance selected from a group consisting of Ti, Cr, Co, Mn, Ni, Fe, B, Si, Mg, and Zn, with an amount of addition being equal to or higher than 1 vol% and equal to or lower than 15 vol% of an entire alloy composite, and
95% or more of the diamond powders have particle size of 10 μm or larger and 1000 μm or smaller.

5. The method for manufacturing a heat dissipation substrate according to any one of claims 1 to 3, wherein
the surface of the alloy composite is formed of the metal layer made of one of Ag, Cu, Ni, and alloys of these metals, and
a thickness of the metal layer is equal to or larger than 5 μm and equal to or smaller than 200 μm.

6. The method for manufacturing a heat dissipation substrate according to any one of claims 1 to 3, wherein
after grinding or/and polishing the alloy composite, one of Ti, Cr, Au, Pt, and alloys of these metals is deposited, and the metal layer made of one substance selected from a group consisting of Ag, Cu, Ni, and alloys of these metals is formed on its surface, and a total thickness is equal to or larger than 5 μm and equal to or smaller than 200 μm.

7. The method for manufacturing a heat dissipation substrate according to claim 2 or 3, wherein
the solid-phase sintering is performed by the heating and pressuring process performed in an atmosphere selected from a vacuum atmosphere, low-pressure atmosphere, non-oxidizing atmosphere, reducing atmosphere, inert-gas atmosphere, fire-resistant-liquid atmosphere, and non-combustible-liquid atmosphere, at a temperature equal to or lower than a liquid-phase appearance temperature of an alloy of the main metal and the added metal, and at a pressure equal to or higher than 50 MPa and equal to or lower than 500 MPa

8. The method for manufacturing a heat dissipation substrate according to claim 2 or 3, wherein
the solid-phase sintering is performed by the heating and pressuring process performed in an atmosphere selected from a vacuum atmosphere, low-pressure atmosphere, non-oxidizing atmosphere, reducing atmosphere, inert-gas atmosphere, fire-resistant-liquid atmosphere, and non-combustible-liquid atmosphere, at a temperature equal to or lower than a liquid-phase appearance temperature of the main metal or an alloy of the main metal and the added metal, and by hot pressing at a pressure equal to or higher than 50 MPa and equal to or lower than 500 MPa.

9. The method for manufacturing a heat dissipation substrate according to claim 2 or 3, wherein
the solid-phase sintering is performed by the heating and pressuring process performed in the water, at a temperature equal to or lower than a liquid-phase appearance temperature of the main metal or an alloy of the main metal and the added metal, and by performing an electrical sintering process at a pressure equal to or higher than 50 MPa and equal to or lower than 500 MPa.

10. The method for manufacturing a heat dissipation substrate according to claim 2 or 3, wherein
the metal layer is provided after the alloy composite has been densified under a high temperature and high pressure condition, and solid-phase sintering is performed again".

3. Outline of grounds for opposition

The opponent submitted Evidence A No. 1 as primary evidence and Evidence A Nos. 2 to 9 as secondary evidence.

(1) The patent Invention 1 can be easily made by a person skilled in the art based on the invention described in Evidence A No. 1, and the technical matters described in Evidence A Nos. 2 and 3.

(2) The patent Invention 2 can be easily made by a person skilled in the art based on the invention described in Evidence A No. 1 and the technical matters described in Evidence A Nos. 2 to 4.

(3) The patent Inventions 3 to 5, 7, 8, and 10 can be easily made by a person skilled in the art based on the invention described in Evidence A No. 1 and the technical matters described in Evidence A Nos. 2 to 5.

(4) The patent Invention 6 can be easily made by a person skilled in the art based on the invention described in Evidence A No. 1 and the technical matters described in Evidence A Nos. 2 to 6.

(5) The patent Invention 9 can be easily made by a person skilled in the art based on the invention described in Evidence A No. 1, the technical matters described in Evidence A Nos. 2 to 5, and the technical matters described in Evidence A Nos. 7 to 9.

Therefore, the opponent insists that the patent according to claims 1 to 10 violates the provisions of Article 29(2) of the Patent Act and that the patent according to claims 1 to 10 should be revoked.

[Evidence]

Evidence A No. 1: Japanese Unexamined Patent Application Publication No. 2010-106362

Evidence A No. 2: Japanese Unexamined Patent Application Publication No. 2005-175006

Evidence A No. 3: Japanese Unexamined Patent Application Publication No. 2013-98491

Evidence A No. 4: Japanese Unexamined Patent Application Publication No. H11-67991

Evidence A No. 5: Japanese Unexamined Patent Application Publication No. 2004-197153

Evidence A No. 6: Japanese Patent No. 4251986

Evidence A No. 7: Japanese Unexamined Patent Application Publication No. H10-231175

Evidence A No. 8: Japanese Unexamined Patent Application Publication No.

2008-112893

Evidence A No. 9: Japanese Unexamined Patent Application Publication No. 2009-218541

4. Described matters in Evidence A Nos. 1 to 9 (underlines are applied by the body)

(1) Evidence A No. 1 (Japanese Unexamined Patent Application Publication No. 2010-106362)

A. "[Claim 18]

The method of manufacturing a composite member, comprising:

a metal coating layer forming step of laminating a metal plate on a substrate and pressurizing the laminate with a pressure equal to or higher than 0.5 ton/$cm^2$ while heating the laminate to a temperature equal to or higher than 300°C, wherein

the composite member includes the substrate formed of a composite material obtained by infiltrating molten magnesium or magnesium alloy into SiC aggregate housed in a mold and compounding the magnesium or the magnesium alloy with SiC".

B. "[Claim 21]

The method of manufacturing a composite member according to any one of claims 11 to 20, comprising:

a compression step of pressurizing the substrate or the composite member with a pressure equal to or higher than 1 ton/$cm^2$ while heating the substrate or the composite member to a temperature equal to or higher than 300°C and to a temperature lower than solidus temperatures of a metal component of the substrate and component metal of the metal coating layer".

C. "[0001]

The present invention relates to a composite member including a substrate formed of a composite material obtained by compounding magnesium (so-called pure magnesium) or magnesium alloy with SiC, a method of manufacturing the same, a heat dissipation member formed of the composite member, and a semiconductor device having the heat dissipation member, and especially, to a composite member which is easily plated".

D. "[Problem to be solved by the invention]

[0005]

However, it is difficult to apply nickel plating and the like to a traditional composite material.

[0006]
Since SiC is dotted on the surface, the composite material has many recesses and protrusions on its surface. Therefore, it is difficult to uniformly apply plating. To level the recesses and protrusions, there is considered polishing the surface of the composite material and applying rolling. However, since SiC has high hardness, it is difficult to apply the above processing.
[0007]
In consideration of productivity, electroplating is preferable. However, since SiC existing on the surface of the composite material has high electric insulation, it is hard to realize conduction. Therefore, the electroplating cannot be substantially applied. Although electroless plating is available, it is difficult to uniformly apply plating due to the recesses and protrusions on the surface as described above. In addition, the electroless plating increases cost.
[0008]
A purpose of the present invention is to provide a composite member mainly formed of a Mg-SiC composite material and a composite member to which electroplating is easily applied. Another purpose of the present invention is to provide a method of manufacturing the composite member suitable for manufacturing the above composite member. Still another purpose of the present invention is to provide a heat dissipation member formed of the composite member, and a semiconductor device including the heat dissipation member.
[Solution to Problem]
[0009]
The purpose of the present invention can be achieved by having the metal coating layer on at least one surface of the substrate formed of the composite material. The composite member according to the present invention includes a substrate formed of a composite material obtained by compounding magnesium or magnesium alloy with SiC and the metal coating layer covering at least one surface of the substrate. A volume equal to or larger than 50% of the substrate is SiC.
[0010]
The conduction of the composite member of the present invention is realized by covering one surface of the substrate formed of the composite material with the metal coating layer having conductivity. Therefore, electroplating can be performed. On at least one surface of the substrate including the metal coating layer, the recesses and protrusions caused by SiC are reduced, and it is easy to uniformly apply plating. In addition, the uniform plating increases wettability with a solder of the composite

member according to the present invention and increases a corrosion resistance. Therefore, the composite member according to the present invention can be preferably used for the heat dissipation member.

[0011]

The composite member according to the present invention can be manufactured, for example, by the manufacturing method according to the present invention below. The method of manufacturing the composite member according to the present invention is a method of manufacturing the composite member including the substrate formed of the composite material which is obtained by compounding the magnesium or magnesium alloy with SiC by infiltrating the molten magnesium or magnesium alloy into the SiC aggregate housed in the mold. Especially, in the manufacturing method according to the present invention, a non-filled region, which is not filled with SiC, is provided between the mold and the SiC aggregate, and metal is made present in the non-filled region. The metal coating layer for covering at least one surface of the substrate is formed of the metal. This manufacturing method is referred to below as a composite integration method.

[0012]

The following method is exemplified as another manufacturing method according to the present invention. The method of manufacturing the composite member according to the present invention is a method of manufacturing the composite member including the substrate formed of the composite material which is obtained by compounding the magnesium or magnesium alloy with SiC by infiltrating the molten magnesium or magnesium alloy into the SiC aggregate housed in the mold. Especially, the manufacturing method according to the present invention includes a metal coating layer forming process for laminating a metal plate on the substrate and pressurizing it with a pressure of equal to or higher than 0.5 ton/cm$^2$ while heating the laminate to a temperature equal to or higher than 300°C. This manufacturing method is referred to below as a hot pressing method".

E. "[0047]

In addition, the composite member according to the present invention can be manufactured by joining a metal plate which forms the metal coating layer on the substrate after the substrate has been separately made. For example, the hot pressing method can be used from among the manufacturing methods according to the present invention described above. In this form, since the substrate formed of the composite material can be separately made, the substrate can be manufactured by a basic process without arranging a spacer and a metal plate in the mold and without using a mold having a special structure. Therefore, this form has excellent productivity regarding the substrate. Also, the hot pressing method has various advantages including: (1) Since the hot pressing can be performed at a temperature equal to or lower than the melting point of Mg, a range of selection of the component materials of the metal coating layer is wide, and the composite member in which the metal component of the substrate formed of the composite material is different from the component metal of the metal coating layer can be easily formed; (2) The metal plate plastically deforms along a surface shape of the substrate and is joined to the substrate in close contact. Therefore, the joining strength between the substrate and the metal coating layer is strong; (3) By plastically deforming the metal plate, even when a surface defect (such as external shrinkage cavity) is formed on the substrate, the metal coating layer can be formed. In addition, the defect can be covered. Therefore, the composite member having an excellent surface property can be obtained; (4) Even when gas pockets are included in the substrate, the gas pockets can be reduced by pressurizing them. Since there are fewer gas pockets, heat characteristics of the composite member can be improved; (5) Since an inclusion such as brazing is not needed, the composite member having excellent thermal conductivity can be obtained; and (6) The composite member to which a thin metal plate can be joined and which has a thin metal coating layer can be obtained. In addition, since the metal coating layer is thin, a coefficient of thermal expansion of a whole composite member including the metal coating layer can be reduced. When the substrate is manufactured, various SiC forms described above can be used, and SiC powder can be directly filled in the metal mold.

[0048]

<u>A heating temperature and a pressurizing force of the laminate including the substrate and the metal plate can be appropriately selected based on a composition of the metal component of the substrate and a composition of the metal plate. When the heating temperature is lower than 300°C and the pressurizing force is smaller than 0.5 ton/cm$^2$, it is difficult to sufficiently join the laminate</u>. When the heating temperature increases or the pressurizing force increases, the joining property tends to be more excellent. When the heating temperature is equal to or higher than 500°C, the laminate can be sufficiently joined even when the pressurizing force is small. However, when the heating temperature is too high, the metal component in the substrate and the metal plate are melted, and the substrate and the metal plate are deformed and flow out from a gap of a pressurizing mold. Therefore, <u>it is preferable that the heating temperature be equal to or lower than the solidus temperatures (melting point) of the metal component</u>

of the substrate and the metal plate. When the pressurizing force is too strong, a crack is generated in SiC. Therefore, it is preferable that the pressurizing force be about equal to or less than 9 ton/$cm^2$. When the pressurizing force is stronger than 5 ton/$cm^2$, the deterioration of the pressurizing mold accelerates. Therefore, in consideration of a life-span of the pressurizing mold, it is considered that the pressurizing force is preferably equal to or less than 5 ton/$cm^2$".

F. "[0054]
In addition, as one process of the manufacturing method, a compression process is exemplified for pressurizing the substrate or the composite member including the metal coating layer at a pressure equal to or higher than 1 ton/$cm^2$ while the substrate or the composite member is heated to a temperature equal to or higher than 300°C and a temperature lower than the solidus temperatures (melting point) of the metal component of the substrate and the component metal of the metal coating layer. By performing the hot pressing to the substrate and the composite member, the gas pockets in the substrate are reduced, and a minute substrate and composite member having a low gas pocket rate can be obtained. Also, as described above, variation in characteristics such as the heat characteristics can be reduced. When the heating temperature and the pressurizing force are higher, the gas pocket rate is more easily reduced. It is more preferable that the heating temperature be equal to or higher than 600°C. When the heating temperature is high, the gas pockets can be sufficiently reduced even when the pressurizing force is small".

G. "[0062]
When Ni plating is performed to the composite member by electroplating, even Ni plating can be formed on the metal coating layer. Regarding the composite member having the Ni plating and the composite member to which the Ni plating is not applied, when the corrosion resistance and the wettability with a solder are examined, the composite member having the Ni plating has more excellent corrosion resistance and wettability with the solder".

-"The composite member and the method of manufacturing the same" are described in Evidence A No. 1 (refer to "B.").

According to the described matters in "C.", the "manufacturing method" of the composite member relates to the method of manufacturing the composite member for forming the heat dissipation member, including the substrate formed of the composite material, which is formed by infiltrating the molten magnesium or magnesium alloy into the SiC aggregate, obtained by compounding magnesium or magnesium alloy with SiC.

-With reference to the described matters in [Problem to be solved by the invention] and [Solution to problem] in "D.", since it is difficult to directly apply plating on the Mg-Sic composite material, it can be understood that the metal coating layer is formed on a surface of the substrate formed on the composite material by using the "composite integration method" and the "hot pressing method" which are not plating methods, and electroplating is applied via the metal coating layer.

-According to the described matters in "A." and "E.", the method of manufacturing the composite member includes the metal coating layer forming process. In the metal coating layer forming process, the metal plate is laminated on the substrate formed of the composite material, and the metal coating layer is formed by joining the metal plate by using a so-called hot pressing method for pressurizing the laminate at a pressure equal to or higher than 0.5 ton/cm$^2$ while the laminate is heated to a temperature equal to or higher than 300°C.

-According to the described matters in "B." and "F.", the compression process is included. In the compression process, hot pressing is applied to the composite member on which the metal coating layer has been formed. The hot pressing is to pressurize the composite member at a pressure equal to or higher than 1 ton/cm$^2$ while the composite member is heated to a temperature equal to or higher than 300°C and a temperature lower than the solidus temperatures (melting point) of the metal component of the substrate and the component metal of the metal coating layer. The compression process is performed to reduce the gas pockets in the substrate and to obtain the minute composite member having the low gas pocket rate.

-According to the described matters in "G.", the Ni plating having excellent wettability with the solder can be applied to the metal coating layer by electroplating.

Therefore, when the "hot pressing method" is especially considered as a method of molding the metal coating layer and the described matters and the drawings are comprehensively taken into consideration, Evidence A No. 1 discloses the following invention (referred to as "Invention A-1" below).

"A method of manufacturing a composite member for forming a heat dissipation member, comprising:

a metal coating layer forming process for forming a metal coating layer by laminating a metal plate on a substrate formed of the composite material and joining the metal plate to the laminate by a so-called hot pressing method for pressurizing the laminate at a pressure equal to or higher than 0.5 ton/cm$^2$ while the laminate is heated to a temperature equal to or higher than 300°C; and

a compression process for obtaining a minute composite member having a low gas pocket rate by applying hot pressing for pressurizing the composite member on which the metal coating layer has been formed at a pressure equal to or higher than 1 ton/cm$^2$ while the composite member is heated to the temperature equal to or higher than 300°C and lower than solidus temperatures (melting point) of a metal component of the substrate and component metal of the metal coating layer and by reducing gas pockets in the substrate, wherein

the composite member, which forms a heat dissipation member, includes the substrate formed of a composite material formed by infiltrating molten magnesium or magnesium alloy into SiC aggregate and obtained by compounding magnesium or magnesium alloy with SiC, and

Ni plating having excellent wettability with a solder is applied to the metal coating layer by electroplating".

(2) Evidence A No. 2 (Japanese Unexamined Patent Application Publication No. 2005-175006)

A. "[Claim 1]

A heatsink is formed by mixing diamond particles in a metallic base material, wherein heat from a heating element arranged on one surface side of the base material is diffused to the other surface side, and

a metal material layer having coating layers whose materials are the same as the base material are formed on the surfaces of the diamond particles".

B. "[0018]

The heatsink 11 includes a base material 15 formed of Cu, Ag, or preferably Cu having a purity of 99.999% or more and Cu material layers 16 formed of Cu having a purity of 99.999% or more formed on both surfaces of the base material 15. It is preferable to previously form a Ni plating layer to realize an excellent joining property to a solder layer 12 on the surface of the Cu material layer 16".

C. "[0024]

Next, a manufacturing method of the heatsink is described. Diamond particles 17 are mixed to the Cu metal powder. At this time, a compounded amount of the diamond particles 17 is set to be equal to or higher than 10% and equal to or lower than 50% relative to the volume of the base material 15. Then, the mixture is put in a mold and is pressurized (about 20 MPa) and heated in a non-oxidizing atmosphere; for example, in a nitrogen-gas atmosphere which is brought into a vacuum state to form a sintered body. Here, when the coating layer 30 is made of Cu, the sintered body is heated at a temperature equal to or higher than 700°C and equal to or lower than 900°C, and when the coating layer 30 is made of Ag, the sintered body is heated at a temperature equal to or higher than 600°C and equal to or lower than 850°C. After that, Cu plating is performed on both surfaces of the sintered body, and a Cu plating layer is formed. Alternatively, a Cu material layer 16 is formed by joining a plate body made of Cu to form the heatsink 11".

D. "[0027]

Since the Cu material layer 16 which has a smooth surface is formed on the surface of the base material 15, when a semiconductor chip 13 serving as a heating element is joined to the surface, generation of a gap at each joining part can be prevented. Therefore, heat from the semiconductor chip 13 can be properly conducted to the heatsink 11, and the conducted heat can be properly diffused to the outside".

When the described matters and the drawings are comprehensively taken into consideration, the following technical matter is described in Evidence A No. 2.

"A manufacturing method of a heatsink having a structure in which diamond particles are mixed in a metallic base material (Cu),

the diamond particles are mixed in Cu metal powder, a Cu material layer having a smooth surface is formed by applying Cu plating to form a Cu plating layer or by joining a plate body made of Cu to the sintered body, on a surface of a sintered body obtained by pressurizing and heating the mixed powder, and

on the surface of the Cu material layer, an Ni plating layer is previously formed to realize an excellent joining property to a solder layer".

(3) Evidence A No. 3 (Japanese Unexamined Patent Application Publication No. 2013-98491)

A. "[Claim 33]

A method of manufacturing a heatsink comprising:

a process of preparing a metal/diamond complex, having a principal surface with first surface roughness, to be a base of a heatsink;

a process of forming a complex product including a metal film and the metal/diamond complex by forming a metal film on the principal surface of the metal/diamond complex by plating; and
a process of forming a heatsink having a mounting surface to mount a device by processing the complex product, wherein
the metal/diamond complex is a composite of diamond particles and metal,
projections caused by the diamond particles are covered with the metal film,
the principal surface of the metal/diamond complex includes the projections caused by the diamond particles and recesses formed of a surface of the metal, and
the recesses are filled with the metal film, and the mounting surface has roughness smaller than that caused by the projections and the recesses".

B. "[0008]
The heatsink to mount a device according to the present invention includes (a) the base which is formed of the metal/diamond complex formed by compounding diamond particles and metal and which serves as the principal surface on which the diamond particles and the metal exist and (b) a metal region which includes a metal layer provided so as to cover the principal surface of the base and which has the mounting surface to mount the device. The metal layer is formed of metal which is different from a solder material and which has a melting point higher than that of the solder material. The principal surface of the base includes the projections caused by the diamond particles and the recesses positioned between the projections. The recess is filled with the metal region, and the mounting surface has roughness smaller than that caused by the projections and the recesses".

C. "[0160]
Another embodiment is described with reference to Fig. 3 again. In step S101, a metal/diamond complex 43 is prepared, which is for the base of the heatsink and has the principal surface with first surface roughness RMS1. In step S102, a complex product is formed from a metal/diamond complex substrate (refer to reference number 43 in Fig. 4). The complex product includes the metal/diamond complex substrate, and the metal film provided on the principal surface of the metal/diamond complex substrate.
[0161]
In step S107, the metal film is formed by plating. For example, the plating method to form the film can be applied similarly to the embodiment described above with reference to Fig. 6. However, the method is not limited to this. The metal/diamond

complex substrate 43 is arranged in a film forming device 10d. Subsequently, a metal film 47 is formed on a principal surface 43a of the metal/diamond complex substrate 43 by plating, and the complex product including the metal film 47 and the metal/diamond complex substrate 43 is formed. As a result, a plating film is grown on the metal/diamond complex substrate 43. In step S106, one or a plurality of heatsinks 11 having a mounting surface to mount a semiconductor device is formed by separating the complex product by a processing.

[0162]

According to the method of manufacturing the heatsink, since the metal film 47 is formed by plating, the plating film is grown on a metal surface of the principal surface 43a of the metal/diamond complex substrate. Therefore, the plating film grows as filling the recesses. Also, the plating film grows from the metal surface along diamonds and covers the projections caused by diamond particles 41. Finally, the plating film forms the integrated metal film 47. By this growth mechanism, roughness smaller than that caused by the projections and the recesses can be provided on the principal surface 43a of the metal/diamond complex substrate (mounting surface 11a of the heatsink 11)".

When the described matters and the drawings are comprehensively taken into consideration, the following technical matter is described in Evidence A No. 3.

"A method of manufacturing a heatsink

in which a metal film is formed on a principal surface of a metal/diamond complex for a base of the heat sink by plating, and roughness caused by projections and recesses is reduced by covering the projections caused by the diamond particles included in the principal surface and filling the recesses positioned between the projections".

(4) Evidence A No. 4 (Japanese Unexamined Patent Application Publication No. H11-67991)

A. "[Claim 15] A manufacturing method to form a heat sink for semiconductors comprising:

(1) mixing powers of an alloy (C) comprising the metal (A) and the metal (B); powders of the metal (A), which is separately provided, having a higher melting point than the alloy (C); and a plurality of diamond particles;

(2) pressure forming the mixture; and

(3) sintering the formed body at a temperature above the melting point of the separately

provided metal (A) so that the metal (B) reacts with the diamond particles to form the metal carbide (B' ) around the diamond particles.".

B. "[0016] The above is a means called an infiltration method to manufacture the heat sink of the invention. The heat sink of the invention may also be manufactured by another means called a sintering method including the following: ... [0019] Yet a further sintering method to manufacture the heat sink of the invention may include the following:
(1) mixing powders of the alloy (C) comprising the metal (A) and the metal (B); powders of the metal (A), which are separately provided, having a higher melting point than the alloy (C); and a plurality of diamond particles;
(2) pressure forming the mixture; and
(3) sintering the formed body at a temperature above the melting point of the separately provided metal (A) so that the metal (B) included in the alloy (C) reacts with the diamond particles to form the metal carbide (B') around the diamond particles.".

C. "[0042] The heat sink according to the invention can be used alone, can be used in combination with other heat sinks, or can be used with surface plating. When the heat sink is joined with a semiconductor, it is desirable that solder of Au-Sn or Au-Ge alloy be used. ".

When the described matters and the drawings are comprehensively taken into consideration, the following technical matter is described in Evidence A No. 4.

"A manufacturing method to form a heat sink for semiconductors comprising:
(1) mixing powers of an alloy (C) comprising the metal (A) and the metal (B); powders of the metal (A), which is separately provided, having a higher melting point than the alloy (C); and a plurality of diamond particles;
(2) pressure forming the mixture; and
(3) sintering the formed body at a temperature above the melting point of the separately provided metal (A) so that the metal (B) reacts with the diamond particles to form the metal carbide (B' ) around the diamond particles, and
the plating is applied on the surface of the formed heatsink".

(5) Evidence A No. 5 (Japanese Unexamined Patent Application Publication No. 2004-197153)

A. "[Field of the invention]
The present invention relates to a diamond-metal composite material used as a heat dissipation substrate and a manufacturing method thereof".

B. "[0024]
[Description of the embodiments]
A matrix of the diamond-metal composite material according to the present invention is formed of metal 1 made of at least one of metals selected from Ag, Cu, Au, Al, Mg and Zn. The diamond-metal composite material has a structure in which diamond particles whose average particle diameter is less than 60 μm are diffused in the matrix. The diamond particles are not in contact with each other. A reaction layer exists on the surface of the diamond particle, and the reaction layer is mainly formed of a carbide of metal 2 formed of one or more elements selected from group 4a elements, group 5a elements, and group 6a elements. The matrix metal 1 is in close contact with the diamond particles via the reaction layer. According to the above structure, a relative density of the diamond-metal composite material according to the present invention can be equal to or higher than 95%, and a thermal conductivity at room temperature can be in a range of 350 W/mK to 600 W/mK".

C. "[0028]
Therefore, regarding the diamond-metal composite material according to the present invention, it is desirable that the average particle diameter of the diamond particle be equal to or more than 10 μm and less than 60 μm, and it is more desirable that the average particle diameter of the diamond particle be equal to or more than 20 μm and equal to or less than 40 μm. Also, it is desirable that a ratio of the diamond particles in the diamond-metal composite material be 35 to 80 vol% so that the coefficient of thermal expansion of the diamond-metal composite material is the same as that of a semiconductor device when mounted.

When the described matters and the drawings are comprehensively taken into consideration, the following technical matter is described in Evidence A No. 5.

"A diamond-metal composite material used as a heat dissipation substrate has a structure in which diamond particles are diffused in a metal matrix formed of one or more metals selected from Ag, Cu, Au, Al, Mg and Zn. A reaction layer which is mainly formed of a carbide of metal formed of one or more elements selected from group 4a elements, group 5a elements, and group 6a elements is formed on the surface of the diamond particle.

The rate of the diamond particles in the diamond-metal composite material is adjusted so that the coefficient of thermal expansion of the diamond-metal composite material is made to be the same as that of the semiconductor element when mounted".

(6) Evidence A No. 6 (Japanese Patent No. 4251986)

A. "[0027]The present invention is a heat sink for mounting a semiconductor chip. The heat sink is characterized in that at least one pair of two opposite faces are coated with at least one metal selected from nickel, chromium, titanium and tantalum or their alloys, and further one or more outer layer is coated with at least one metal selected from molybdenum, platinum, gold, silver, tin, lead, germanium and indium, or their alloys. It is preferable that the outermost coating layer of the heat sink is a metal of good solderability with semiconductor material. To this end, at least one metal of high affinity for diamond, a metal containing at least one element selected from the group of nickel, chromium, titanium and tantalum is coated onto the heat sink surface with the result that the coated layer has high adhesiveness to the heat sink. Furthermore, the surface of the heat sink contacting with semiconductor chip should be coated with at least one layer or multi-layer of at least one metal selected from the group of molybdenum, platinum, gold, silver, tin, lead, germanium and indium or their alloys which have good solderability so as to make a strong bonding between the semiconductor chip and the heat sink. ".

B. "[0031]

Furthermore, in order to prepare the heatsink for mounting a semiconductor utilizing the above described high thermal conductivity sintered compact, it is necessary to machine the sintered compact material into a required shape and size, then the shaped compact should be coated with metals to bond with the semiconductor chip.
In the usual case, the sintered compact material is machined and polished to the required thickness and surface roughness, and after that, the sintered compact material is cut into the shape and size required as a heatsink. The cut material is coated with metal layers and then used as a heatsink for mounting a semiconductor chips. The expression "required" herein is used to mean "required as a product" or "object required in a product".

[0032]

For example, in the process of coating a surface of the diamond-copper composite

sintered compact with metal layers, the compact body is rinsed to remove the oxidized layer on the surface with weak acid and then being coated with metal layers with method of electroplating, electroless plating, sputtering, ion plating, and vapor depositing individually or in combination. The sintered compact can be cut with the use of the wire electric discharge machining or the laser cutting.
As a method of finishing the sintered compact material into the required thickness and surface roughness, either method of dry polishing using a polishing machine fitted with a resin bonded diamond grinding wheel or a wet grinding process using a surface grinder fitted with a resin bonded or vitrified bonded diamond grinding wheel.
[0033]
In a case of surface finishing by the above method, it is desirable that the back side of the grinding wheel be cooled with water so that the surface temperature of the grinding wheel is controlled in order to prevent the copper in the sintered compact from being oxidized. At least 70% area of the finished surface by this method consists of flat diamond surface. Since coating of a metal film with sufficient adhesion strength cannot be achieved by the ordinary electroplating on such a surface, as diamond particles are exposed on the most part of the surface, a metal of the first layer is preferably coated by a sputtering method. The layers of second and the following can be coated by any methods of plating, sputtering or ion plating. ".

When the described matters and the drawings are comprehensively taken into consideration, the following technical matter is described in Evidence A No. 6.

"A method of preparing a heatsink for mounting a semiconductor chip utilizing a diamond-copper composite sintered compact (high thermal conductivity diamond sintered compact) includes:
a process of finishing a surface of a sintered compact material into the required thickness and surface roughness by polishing it; and
a process of coating the polished surface with a metal layer.

In the process of coating the surface with the metal layers, a metal layer formed of at least one kind of metal selected from nickel, chromium, titanium, and tantalum, which have high affinity for diamond, and their alloys is formed preferably by sputtering, and further, the outer surface is coated with one or a plurality of metal layers formed of at least one metal selected from molybdenum, platinum, gold, silver, tin, lead, germanium, and indium, and their alloys having good solderability by any one of plating, sputtering, and ion plating".

(7) Evidence A No. 7 (Japanese Unexamined Patent Application Publication No. H10-231175)

A. "[Claim 3] A method of manufacturing a low thermal expansion and highly heat conductive heat dissipation material, wherein
SiC powder obtained by adding 0.1 to 5 wt.% (outer percentage) of X (X is one or not less than two kinds of Li, B, Mg, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Se, Te, Y, Th, and a rare earth element) to the composition comprising 54 to 78 wt.% of SiC and a balance Al, Al powder, and X powder are mixed, and the mixed powder is sintered".

B. "[Claim 7] The method of manufacturing a low thermal expansion and highly heat conductive heat dissipation material according to any one of claims 3 to 6, wherein
the mixed powder is sintered by a direct electric sintering method".

C. "[0030] The sintering method of the composite material according to the present invention is a method to obtain a sufficient material by performing normal pressure sintering after a normal green compact has been created. The method is not limited to pressure-sintering such as HIP and HP. However, it is desirable to perform HIP and HP, because the sintered body can be more surely manufactured by pressure-sintering. However, since the sintering method takes a long time, a reaction phase such as Al3C4 is generated by the slight reaction of SiC with Al alloy. This may slightly decrease a thermal conductivity κ. Therefore, the direct electric sintering method, in which sintering can be performed in a short time, is further desirable. The direct electric sintering method is a method for directly energizing a powder layer and a metal mold while powders filled in a metal mold such as HP is pressurized and uniformly heating the powders to the inside in a short time by resistance heating".

When the described matters and the drawings are comprehensively taken into consideration, the following technical matter is described in Evidence A No. 7.
"A method of manufacturing a low thermal expansion and highly heat conductive heat dissipation material is a method of mixing SiC powder, Al powder, and X (one or not less than two kinds of Li, B, Mg, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Se, Te, Y, Th, and a rare earth element) powder and sintering the obtained mixed powder.

The mixed powder is desirably sintered by a pressure-sintering method such as

HP, and more desirably by a direct electric sintering method".

(8) Evidence A No. 8 (Japanese Unexamined Patent Application Publication No. 2008-112893)

A. "[Claim 1]

A manufacturing method of a high thermal conduction composite material comprising: coating a surface of a carbon fiber bundle with core forming high thermal conduction metal of a thermal conductivity 100 W/mK or higher or depositing core forming high thermal conduction metal of a thermal conductivity of 100 W/mK or higher on the surface of a carbon fiber bundle;
after that, cutting the carbon fiber bundle to a prescribed length;
performing pressure sintering to the cut pieces in a laminated state;
obtaining a core material;
arranging housing forming high thermal conduction metal of a thermal conductivity 100 W/mK or higher around the entire core material; and
performing the pressure sintering".

B. "[Claim 5]

The manufacturing method of a high thermal conduction composite material according to any one of claims 1 to 4, wherein
the pressure sintering is performed by a pulse current sintering method".

C. "[0010]

The present invention is especially effective when applied to a case where the pressure sintering is applied in a state where the cut pieces are laminated while the longitudinal directions of the carbon fibers of the cut pieces are aligned.
As the pressure sintering, hot pressing, hot isostatic pressing, and the like can be used. However, it is preferable to apply the pulse current sintering method from the viewpoint of productivity".

When the described matters and the drawings are comprehensively taken into consideration, the following technical matter is described in Evidence A No. 8.

"A manufacturing method of a high thermal conduction composite material including a process of: coating the surface of a carbon fiber bundle with core forming high thermal conduction metal or depositing core forming high thermal conduction metal on the surface of a carbon fiber bundle; cutting the carbon fiber bundle to a prescribed length

to be cut pieces; performing pressure sintering of the cut pieces in a laminated state; obtaining a core material, arranging housing forming high thermal conduction metal around the entire core material; and further performing the pressure sintering, and
the pressure sintering is performed by pulse current sintering method".

(9) Evidence A No. 9 (Japanese Unexamined Patent Application Publication No. 2009-218541)

A. "[Claim 1]
A production method of a sintered body, comprising a step of sintering, at a temperature within the range of from 900°C to 1200°C, a mixture of a manganese-based oxide and copper oxide wherein the ratio of the molar amount of copper to one mol of manganese in the mixture is in the range of from 0.001 to 0.05.".

B. "[0028]
In sintering, it is also possible to carry out pressure sintering using a hot press, a pulse current sintering method and the like, in addition to normal pressure sintering. ".

When the described matters and the drawings are comprehensively taken into consideration, the following technical matter is described in Evidence A No. 9.
"_A production method of a sintered body, including a step of sintering, a mixture of a manganese-based oxide and copper oxide, and
in sintering, it is also possible to carry out pressure sintering using hot pressing, a pulse current sintering method, and the like, in addition to normal pressure sintering".

5. Judgment by the body
5-1. The patent Invention 1
(1) Comparison

When the patent Invention 1 is compared with Invention A-1,

A. According to "a method of manufacturing a composite member for forming a heat dissipation member, which includes the substrate formed of the composite material which is obtained by compounding the magnesium or magnesium alloy with SiC by infiltrating the molten magnesium or magnesium alloy into the SiC aggregate includes a metal coating layer forming process for forming a metal coating layer by laminating a metal plate on the substrate formed of the composite material and joining the metal plate to the laminate by a so-called hot pressing method for pressurizing the laminate at a pressure equal to or higher than 0.5 ton/cm$^2$ while the laminate is heated to a temperature equal to or higher than 300°C" in Invention A-1,

"the substrate formed of the composite material" and "the metal coating layer" in Invention A-1 respectively correspond to the "alloy composite" and "the metal layer" in the patent Invention 1.

"The substrate formed of the composite material" in Invention A-1 and "the alloy composite" in the patent Invention 1 are common to each other in that the main component is formed of metal and an inorganic material other than metal.

Therefore, the patent Invention 1 and Invention A-1 are common to each other in that "the metal layer is formed on the surface of the alloy composite mainly formed of metal and an inorganic material other than metal".

However, the inorganic material other than metal is "diamond" in the patent Invention 1, whereas, the inorganic material other than metal is SiC in Invention A-1. The patent Invention and Invention A-1 are different from each other in this point. In the patent Invention 1, the metal layer is formed "by plating", whereas, in Invention A-1, the metal layer is formed by joining a metal plate by the hot pressing method. The patent Invention and Invention A-1 are also different from each other in these points.

B. According to "Ni plating having excellent wettability with a solder is applied to the metal coating layer by electroplating" in Invention A-1,

"the Ni plating" having excellent wettability with a solder in Invention A-1 corresponds to "Ni-based plating to which brazing or soldering is applied " in the patent Invention 1.

The patent Invention 1 corresponds to Invention A-1 in the point that "Ni-based plating to which brazing or soldering is applied is formed".

C. "The composite member for forming a heat dissipation member" in Invention A-1 includes the substrate formed of the composite material for heat dissipation. Therefore, the above composite member for forming a heat dissipation member corresponds to "the heat dissipation substrate" in the patent Invention 1.

Therefore, the patent Invention 1 corresponds to Invention A-1 in that "they are the methods of manufacturing the heat dissipation substrate in which the metal layer is formed on the surface of the alloy composite mainly formed of metal and an inorganic material other than metal, and Ni-based plating to which brazing or soldering is applied is formed".

The patent Invention 1 and Invention A-1 are different from each other in the following points.

[The different feature 1]

The inorganic material other than metal which is one of the main components of the alloy composite is "diamond" in the patent Invention 1 and is SiC in Invention A-1.

[The different feature 2]

The metal layer is formed by "plating". In the patent Invention 1, this point is specified. On the other hand, the metal layer is formed by joining the metal plate by the hot pressing method in Invention A-1.

[The different feature 3]

In the patent Invention 1, a point is specified that "solid-phase sintering is performed to the alloy composite coated with the metal layer, and a defect present in the surface of the metal layer is mended by the solid-phase sintering". On the other hand, this point is not specified in Invention A-1.

(2) Judgment

[The different feature 2] is discussed first.

As described in "4. (1)", in Invention A-1, it is difficult to directly apply plating on the Mg-SiC composite material. Therefore, a technical feature of Invention A-1 is a point that the metal coating layer is formed by joining the metal plate on one surface of the substrate formed of the composite material by the hot pressing method, <u>not plating</u>. Therefore, even when the point that the metal layer is formed on the surface of the alloy composite by "plating" is a known technical matter as described in Evidence A No. 2 (refer to "4. (2)") and Evidence A No. 3 (refer to "4. (3)"), application of the technical matter to Invention A-1; that is, employment of plating instead of the hot pressing method to join the metal plate, causes a disincentive.

Therefore, the configuration according to the different feature 2 cannot be derived by applying the technical matter described in Evidence A No. 2 or Evidence A No. 3 to Invention A-1

Also, regarding [the different feature 3], it can be understood that " solid-phase sintering is performed to the alloy composite on which the metal layer has been formed <u>by plating</u>, and the defect present in the surface of the metal layer <u>formed by plating</u> is mended by the solid-phase sintering" in the patent Invention 1.  That is, it can be said that [the different feature 3] is discussed based on the configuration according to the different feature 2. Therefore, Invention A-1 includes "a compression process for obtaining a minute composite member having a low gas pocket rate by applying hot pressing for pressurizing the composite member on which the metal coating layer has been formed at a pressure equal to or higher than 1 ton/$cm^2$ while the composite member is heated to a temperature equal to or higher than 300°C and lower than solidus temperatures (melting point) of a metal component of the substrate and component metal of the metal coating layer and by reducing gas pockets in the substrate" (however, this process is not performed to mend the defects present in the surface of the metal layer formed by plating).  However, similar to the different feature 2, the employment of plating instead of the hot pressing method, which is not the plating, to join the metal plate causes a disincentive in Invention A-1.  Therefore, the configuration according to the different feature 3 cannot be derived by applying the technical matter described in Evidence A No. 2 or Evidence A No. 3 to Invention A-1.

The configuration according to the different feature 3 is not described or indicated in Evidence A Nos. 2 and 3.

Therefore, without examining [the different feature 1], the patent Invention 1 cannot be easily made by a person skilled in the art based on Invention A-1 and the technical matters described in Evidence A Nos. 2 and 3.

5-2. The patent Invention 2

(1) Comparison

The patent Invention 2 is compared with Invention A-1.

The patent Invention 2 corresponds to Invention A-1 in a point that "the manufacturing method of a heat dissipation substrate in which the metal layer is formed on the surface of the alloy composite including at least metal and the inorganic material other than metal, and Ni-based plating to which brazing or soldering is applied is formed".

The patent Invention 2 and Invention A-1 are different from each other in the following points.

[The different feature 1]

Regarding the alloy composite including at least metal and the inorganic material other than metal, the patent Invention 2 specifies that "mixing powders of main metal, added metal, and diamond and compacting the mixed powders, and after that, forming a layer formed of a carbide of the added metal and the main metal on the surface of the diamond by performing a liquid-phase sintering process". Whereas, in Invention A-1, the alloy composite is "formed of the composite material formed by infiltrating molten magnesium or magnesium alloy into SiC aggregate and obtained by compounding magnesium or magnesium alloy with SiC".

[The different feature 2]

It is specified in the patent Invention 2 that the metal layer is formed "by plating". Whereas, the metal layer is formed by joining the metal plate by the hot pressing method in Invention A-1.

[The different feature 3]

It is specified in the patent Invention 2 that "solid-phase sintering is performed to the alloy composite on which the metal layer has been formed, and the defects present in the surface of the metal layer are mended by the solid-phase sintering". Whereas, the Invention A-1 does not specify that point.

(2) Judgment

[The different feature 2] and [the different feature 3] are the same as those discussed in "5-1. (2)".

Therefore, according to the reason similar to that in the judgment on [the different feature 2] and [the different feature 3] discussed in "5-1. (2)", the configurations according to the different features 2 and 3 cannot be derived from the technical matters described in Invention A-1 and Evidence A Nos. 2 to 4.

The configuration according to the different feature 3 is not described and indicated in Evidence A No. 4 (refer to "4. (4)").

Therefore, without examining [the different feature 1], the patent Invention 2 cannot be easily made by a person skilled in the art based on Invention A-1 and the technical matters described in Evidence A Nos. 2 to 4.

5-3. The patent Inventions 3 to 10

Claims 3 to 10 depend on claim 1 or 2, and the patent Inventions 3 to 10 include all the matters specifying the invention of the patent Invention 1 or 2 and further limit the invention by adding matters specifying the patent Invention 1 or 2. Therefore, according to the reason similar to that in the judgment on the patent Invention 1 or 2 (refer to "5-1. (2)" and "5-2. (2)"),

the patent Inventions 3 to 5, 7, 8, and 10 cannot be easily made by a person skilled in the art based on Invention A-1 and the technical matters described in Evidence A Nos. 2 to 5,

the patent Invention 6 cannot be easily made by a person skilled in the art based on Invention A-1 and the technical matters described in Evidence A Nos. 2 to 6, and

the patent Invention 9 cannot be easily made by a person skilled in the art based on Invention A-1, the technical matters described in Evidence A Nos. 2 to 5, and the technical matters described in Evidence A Nos. 7 to 9.

5-5. Summary

As described above, the patent Inventions 1 to 10 cannot be easily made by a person skilled in the art based on Invention A-1 and the technical matters described in Evidence A Nos. 2 to 9.

6. Closing

Therefore, according to the reasons and proof of the opposition to the patent, the patent according to claims 1 to 10 cannot be revoked.

Also, no other reason for revoking the patent according to claims 1 to 10 is found.

Therefore, the decision shall be made as described in the conclusion.

August 5, 2016

Chief administrative judge: MORIKAWA, Yukitoshi
Administrative judge: INOUE, Shinichi
Administrative judge: SAKAI, Tomohiro