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(54) **HEAT RADIATING COMPONENT**

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(57) **ABSTRACT**

A heat radiating component provided on a semiconductor package, the heat radiating component coming in contact with a semiconductor element, the heat radiating component includes a heat radiating plate having a concave part; linear high thermal conductivity materials formed on a bottom surface of the concave part so as to stand in a thermal conductive direction; first and second resin layers configured to fill space parts formed by the neighboring linear high thermal conductivity materials, the first and the second resin layers being stacked on the bottom surface of the concave part in order to expose head end parts of the linear high thermal conductivity materials; and a metal layer formed on an upper surface of the second resin layer and at least a portion of a surface of the heat radiating plate where the concave part is formed.

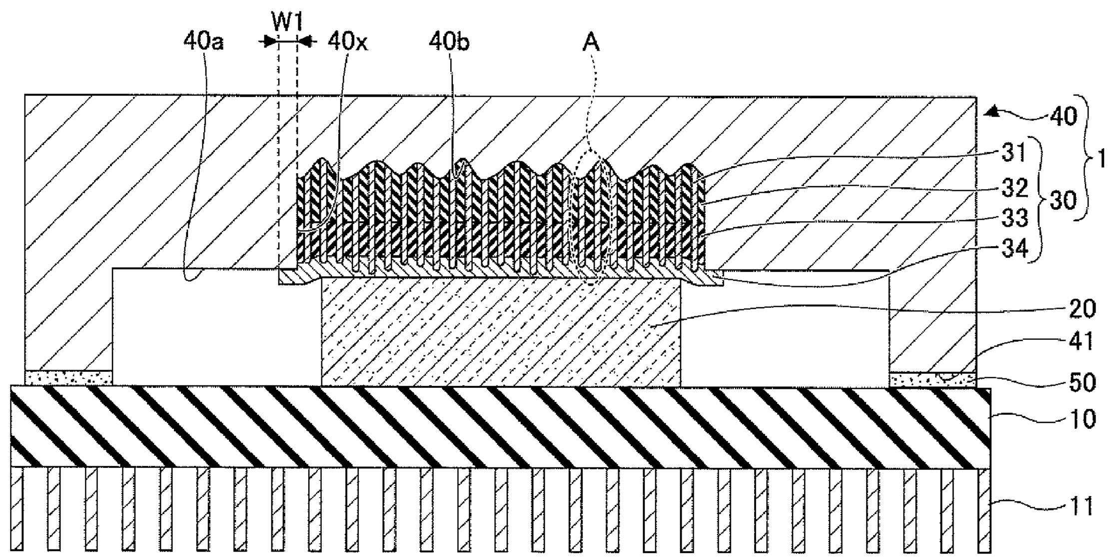
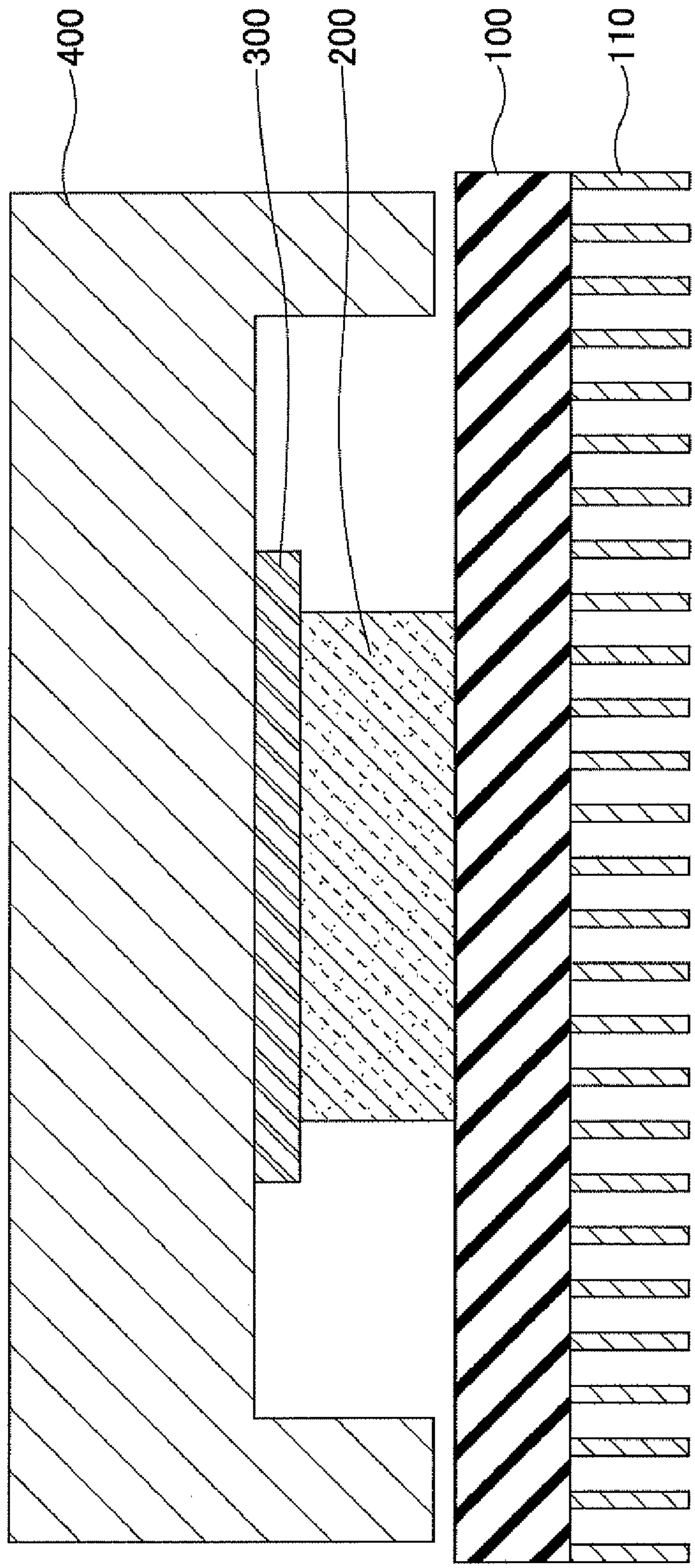


FIG.1 RELATED ART



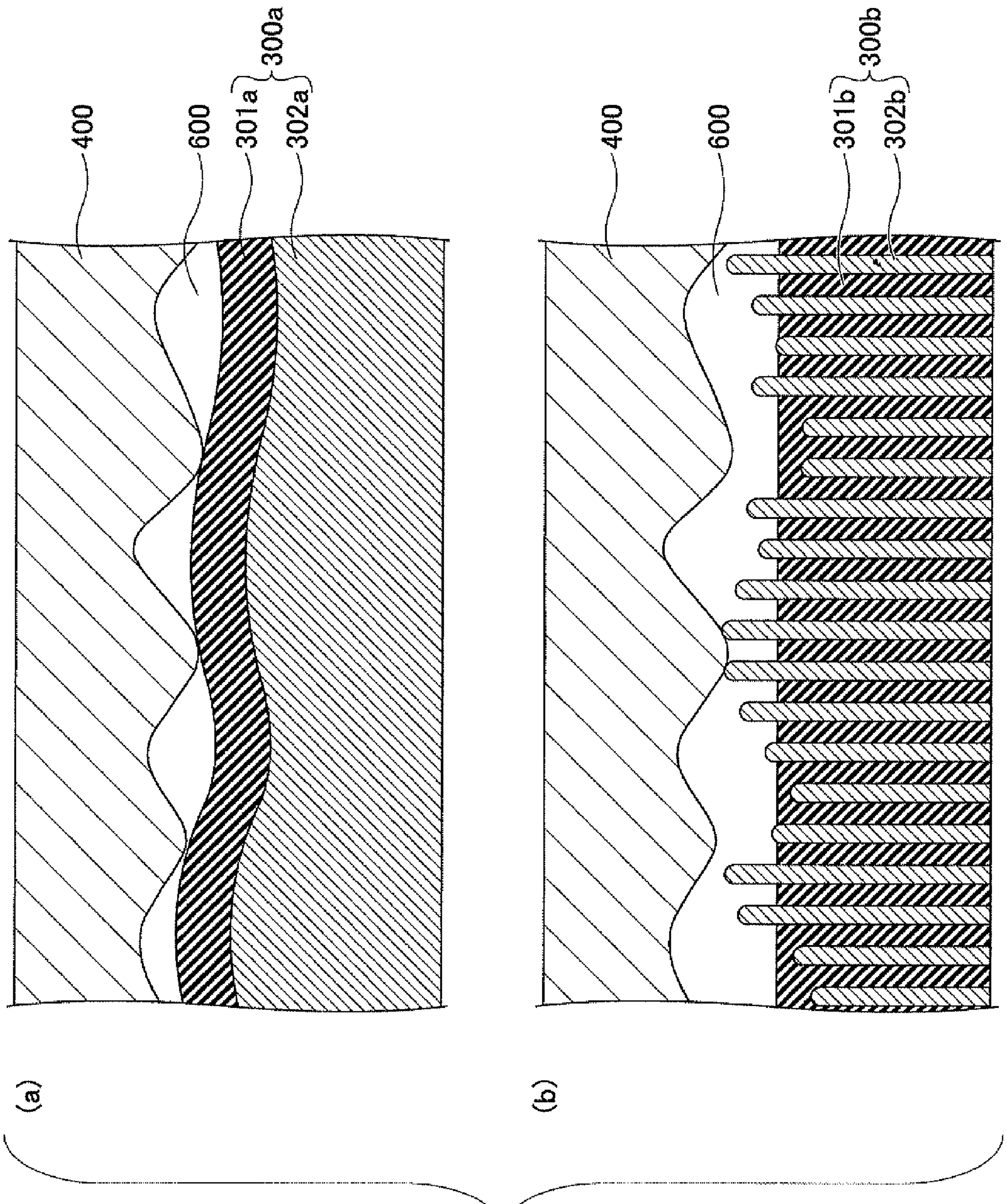
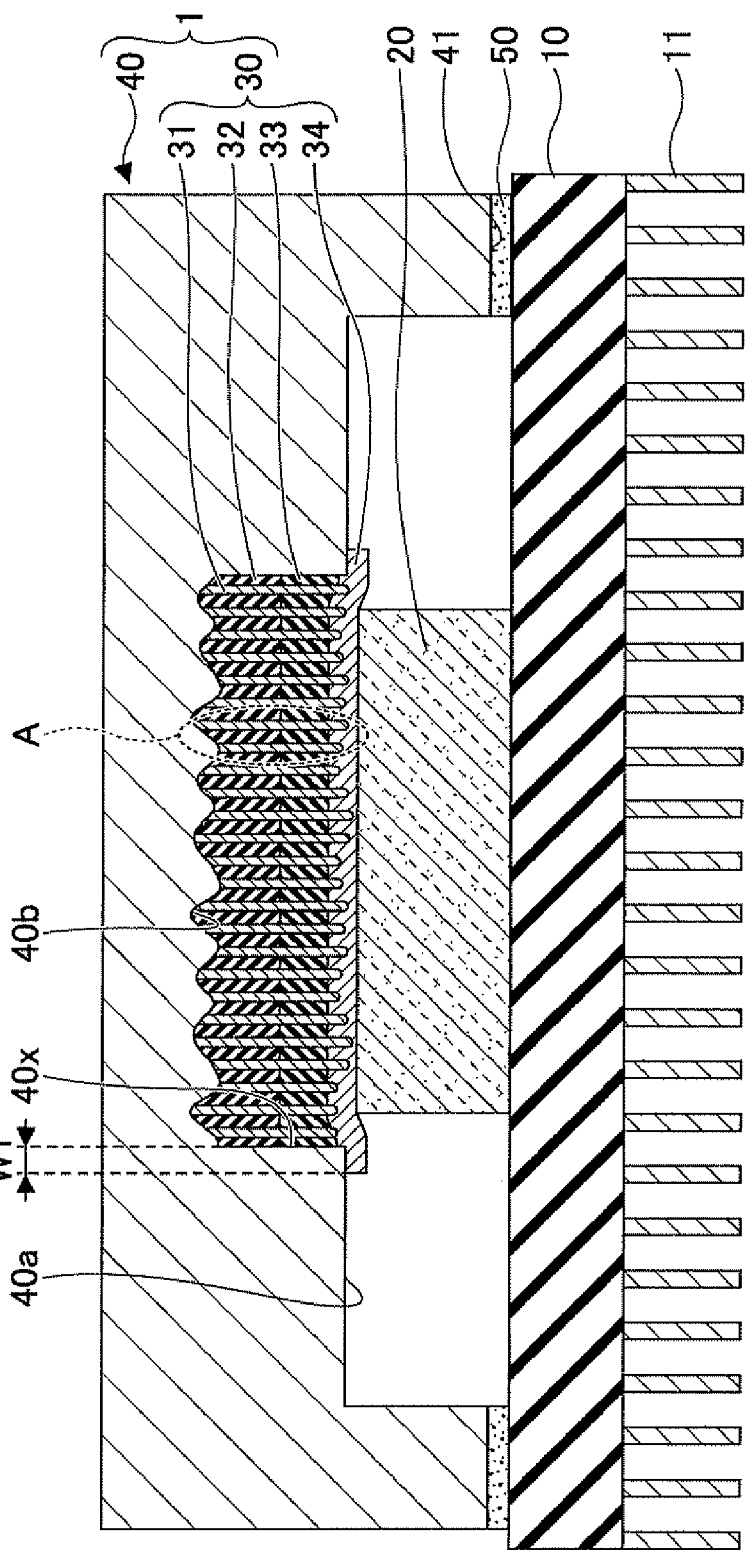


FIG.2
RELATED
ART

FIG.3



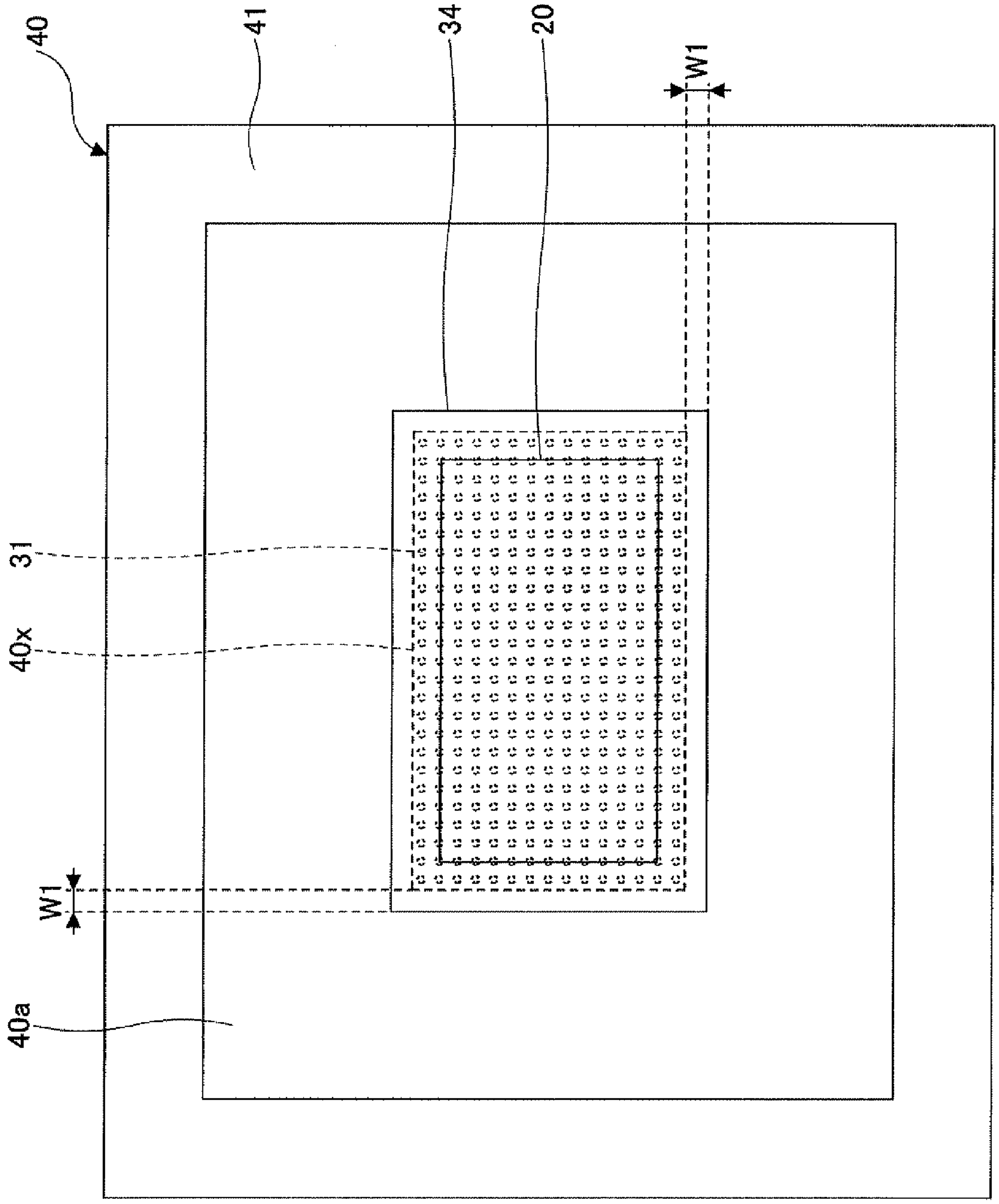


FIG.4

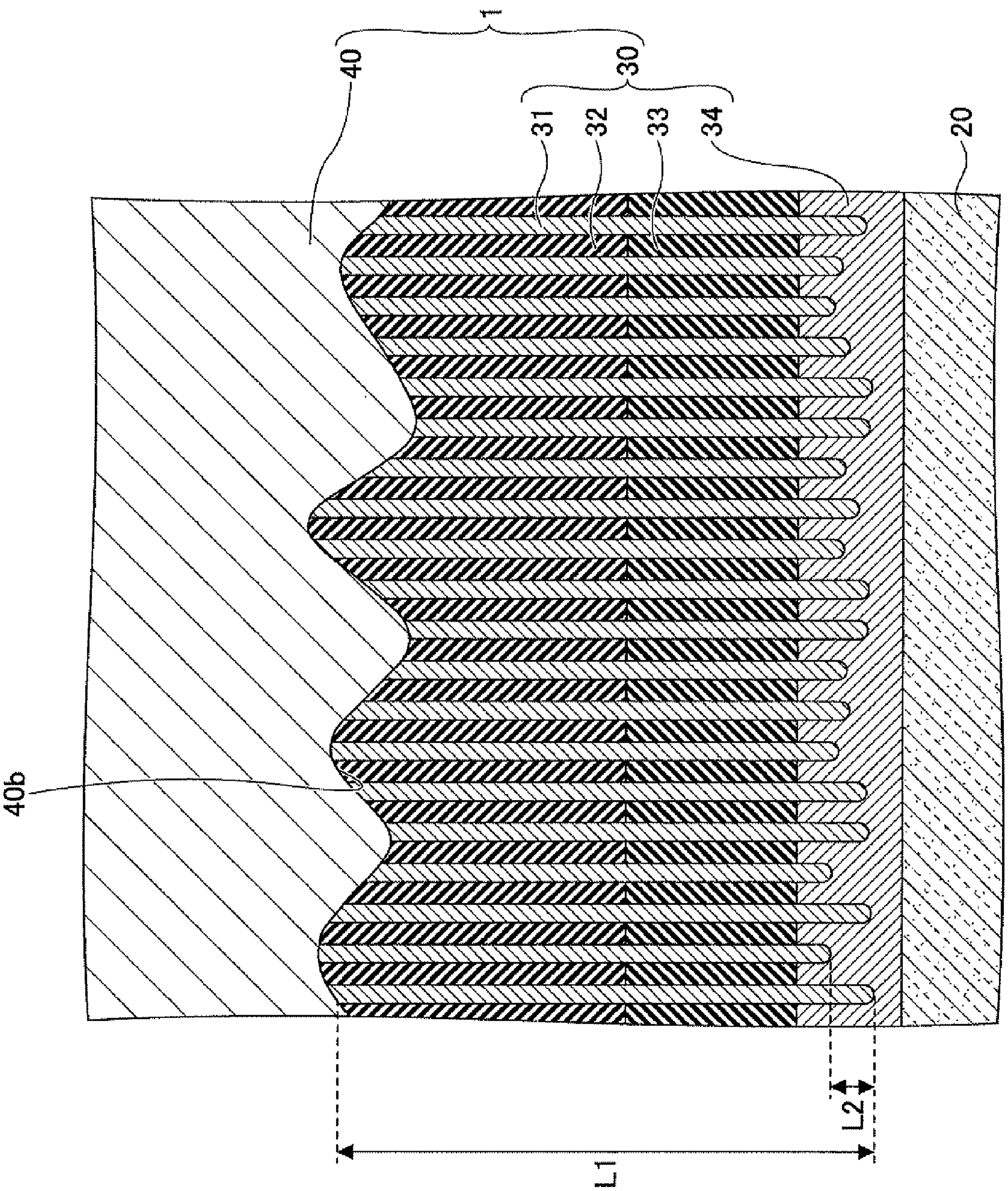


FIG.5

FIG.6

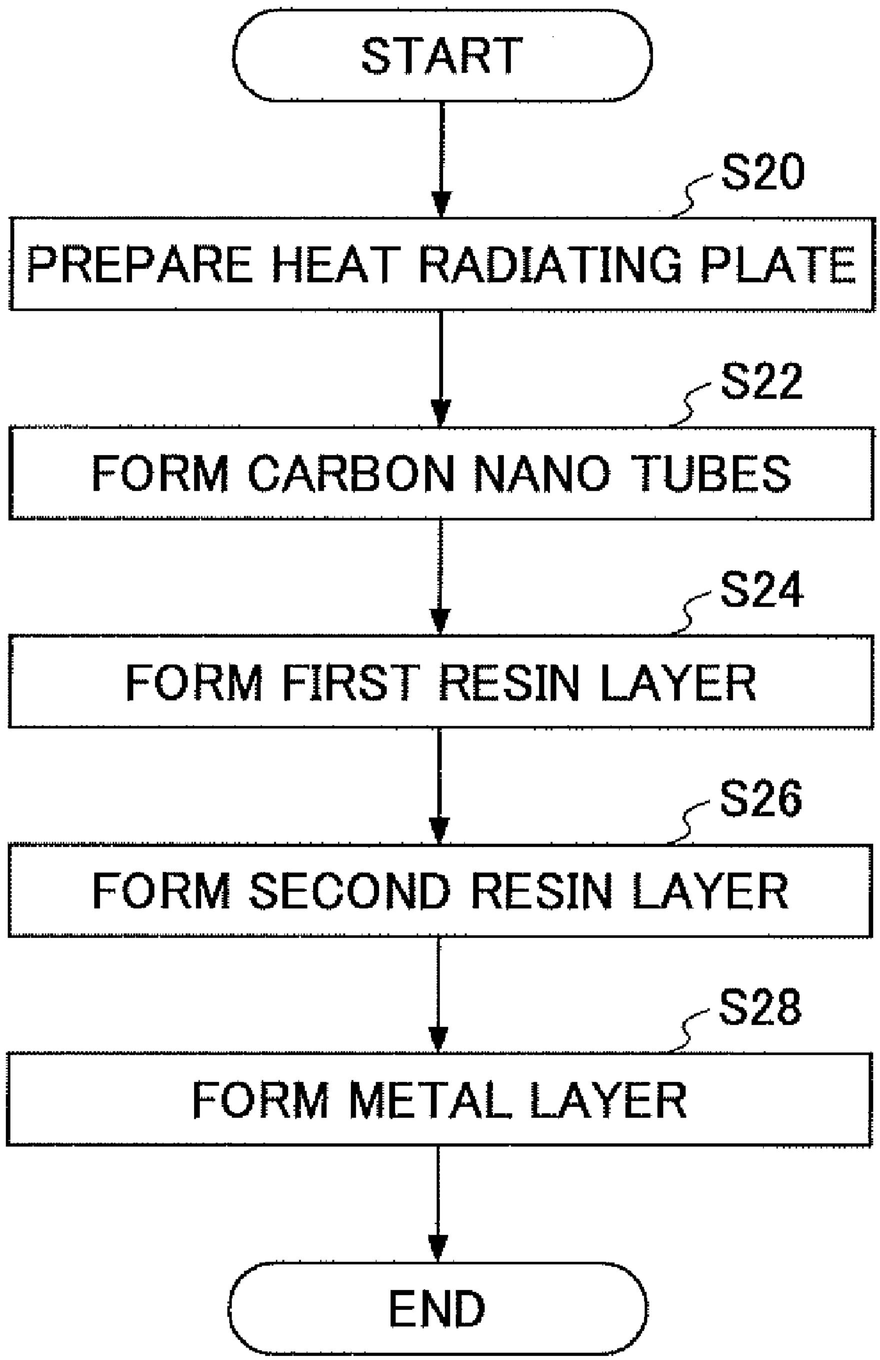
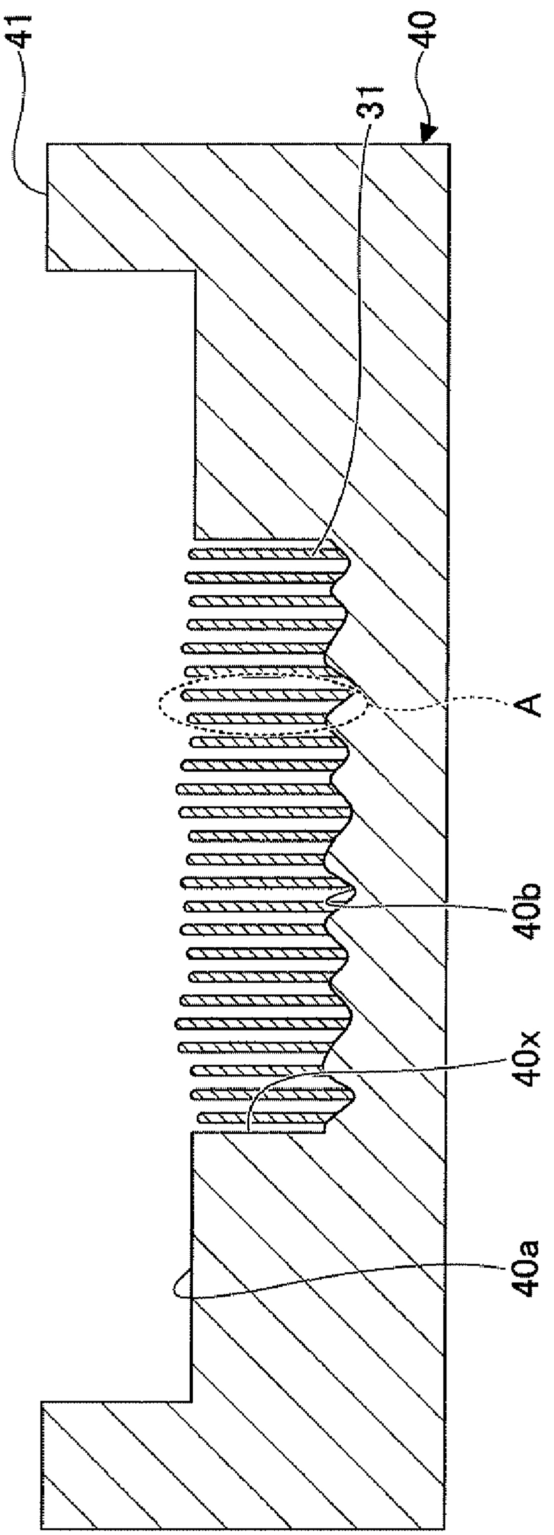

START
S20
PREPARE HEAT RADIATING PLATE
S22
FORM CARBON NANO TUBES
S24
FORM FIRST RESIN LAYER
S26
FORM SECOND RESIN LAYER
S28
FORM METAL LAYER
END

FIG.7



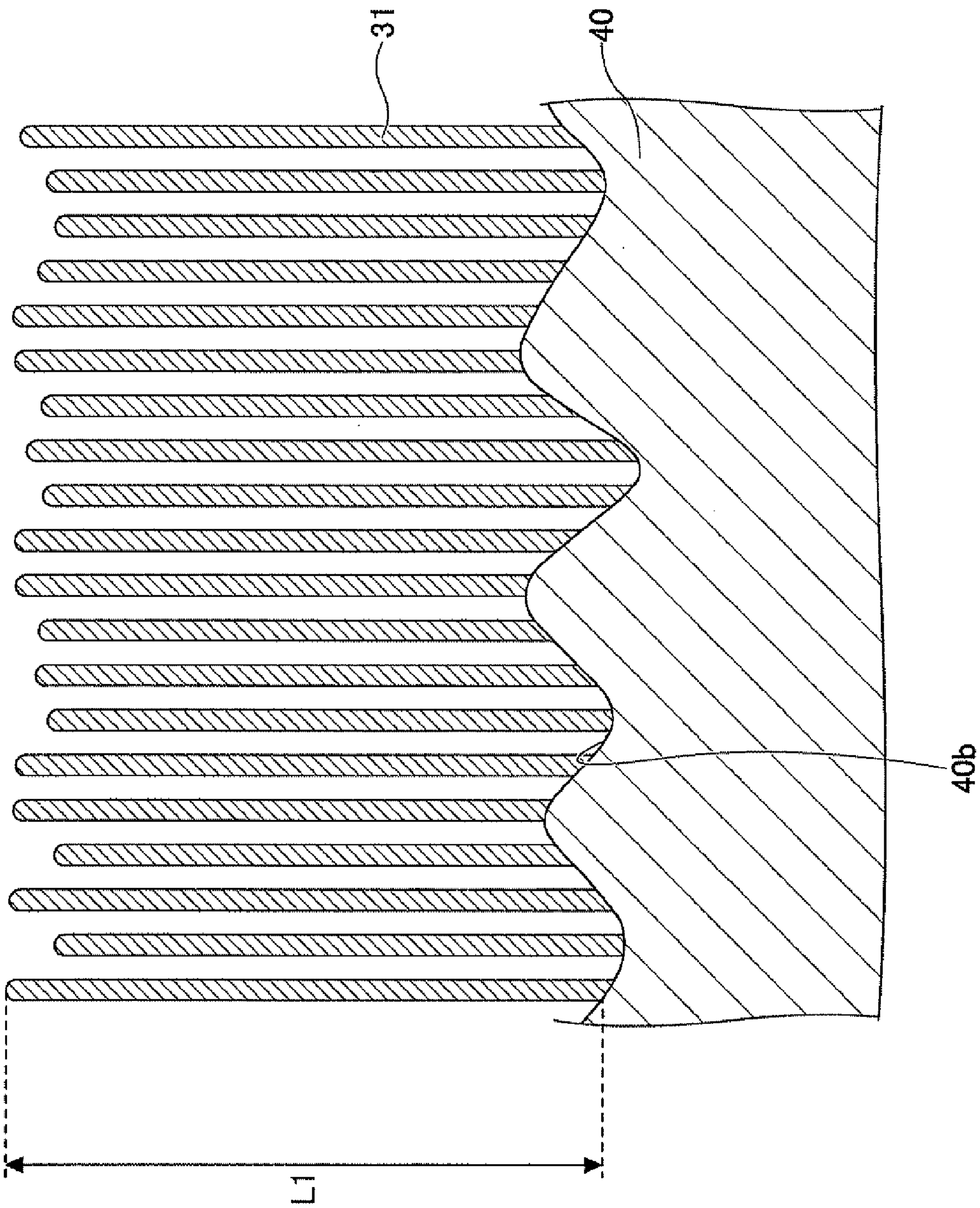
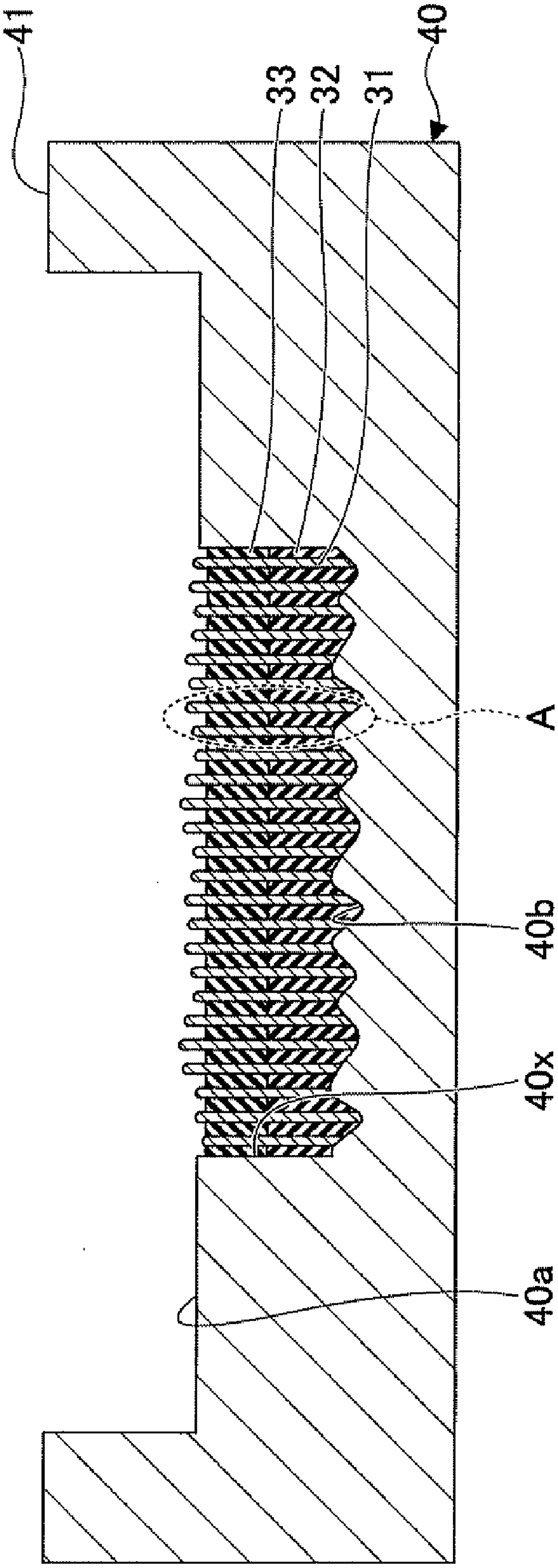


FIG.8

FIG.9



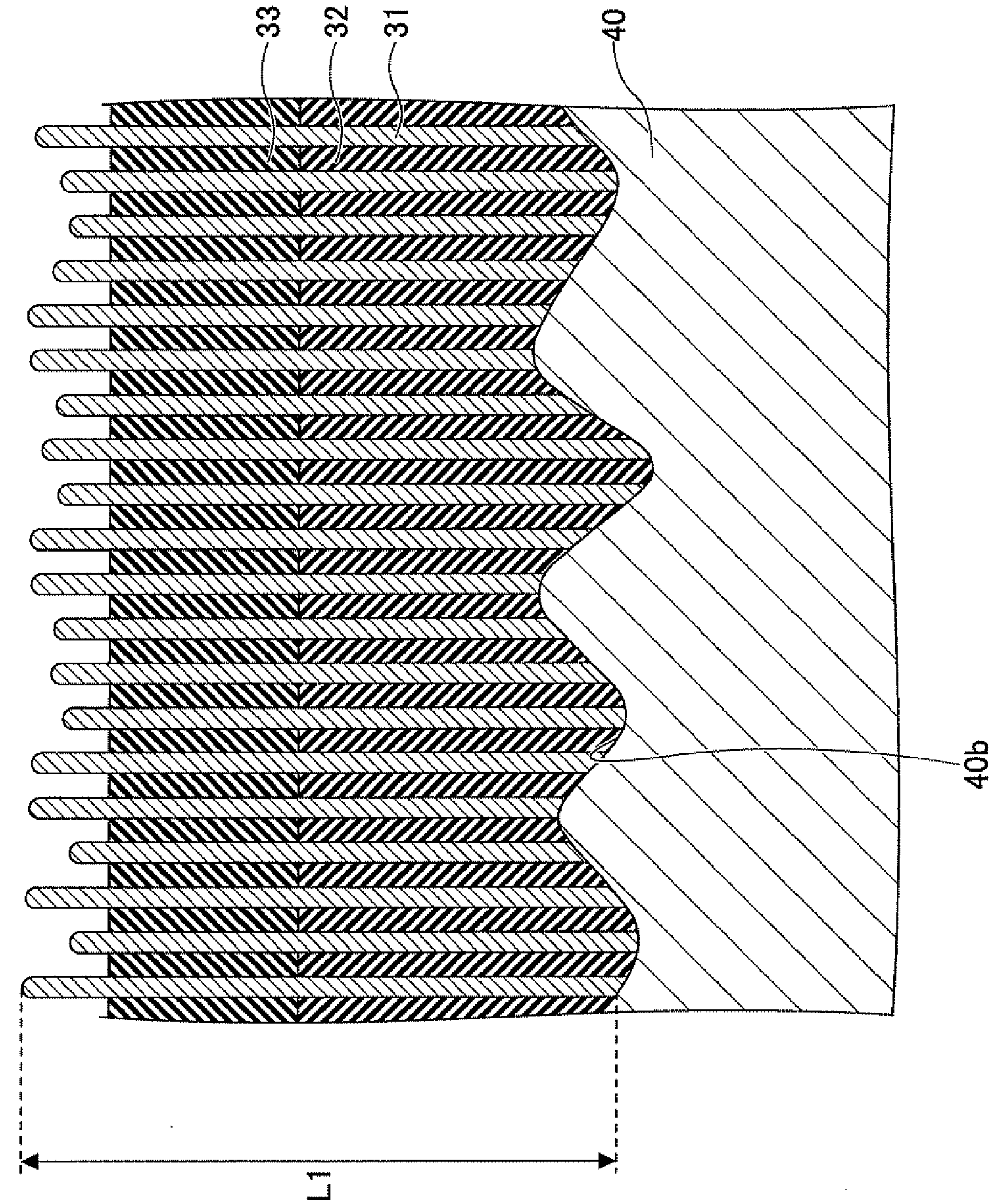
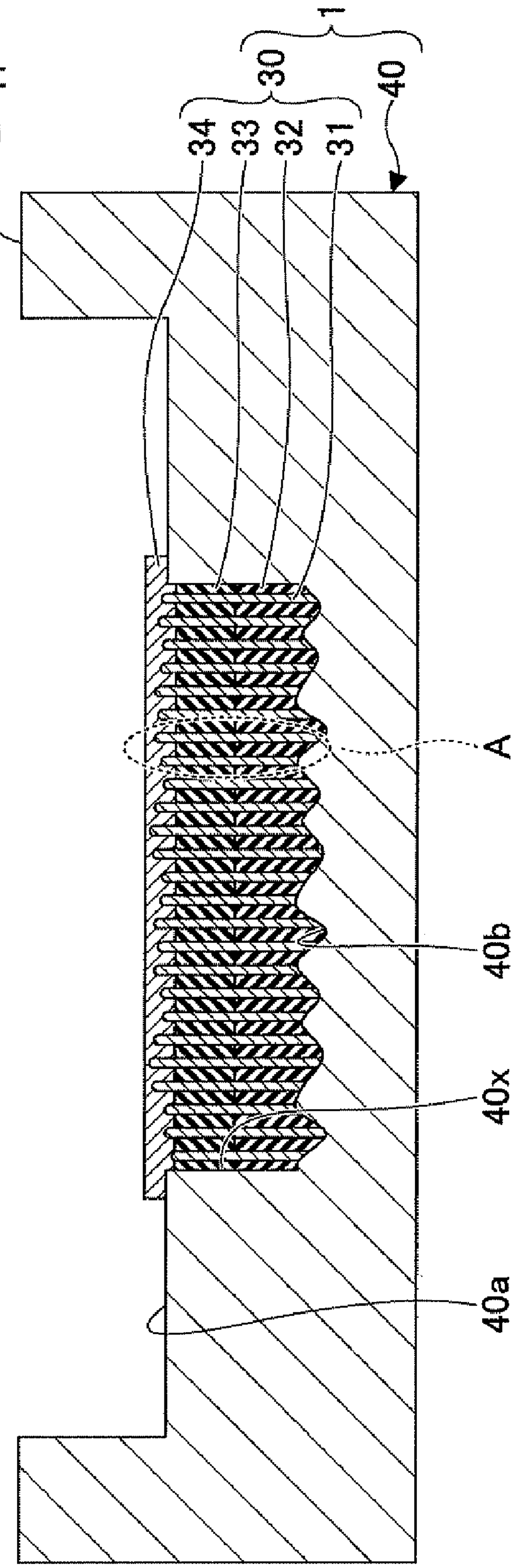


FIG.10

FIG.11



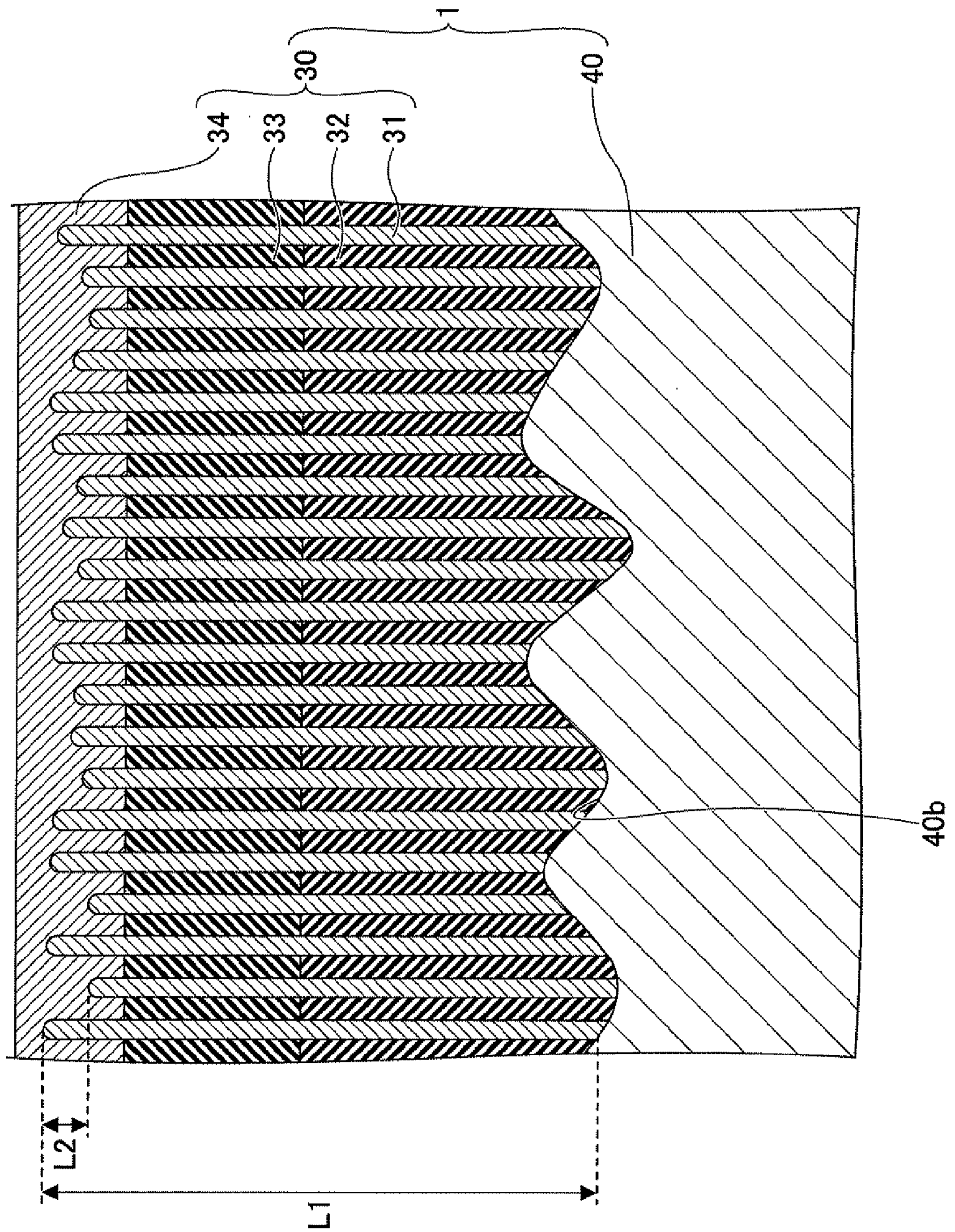
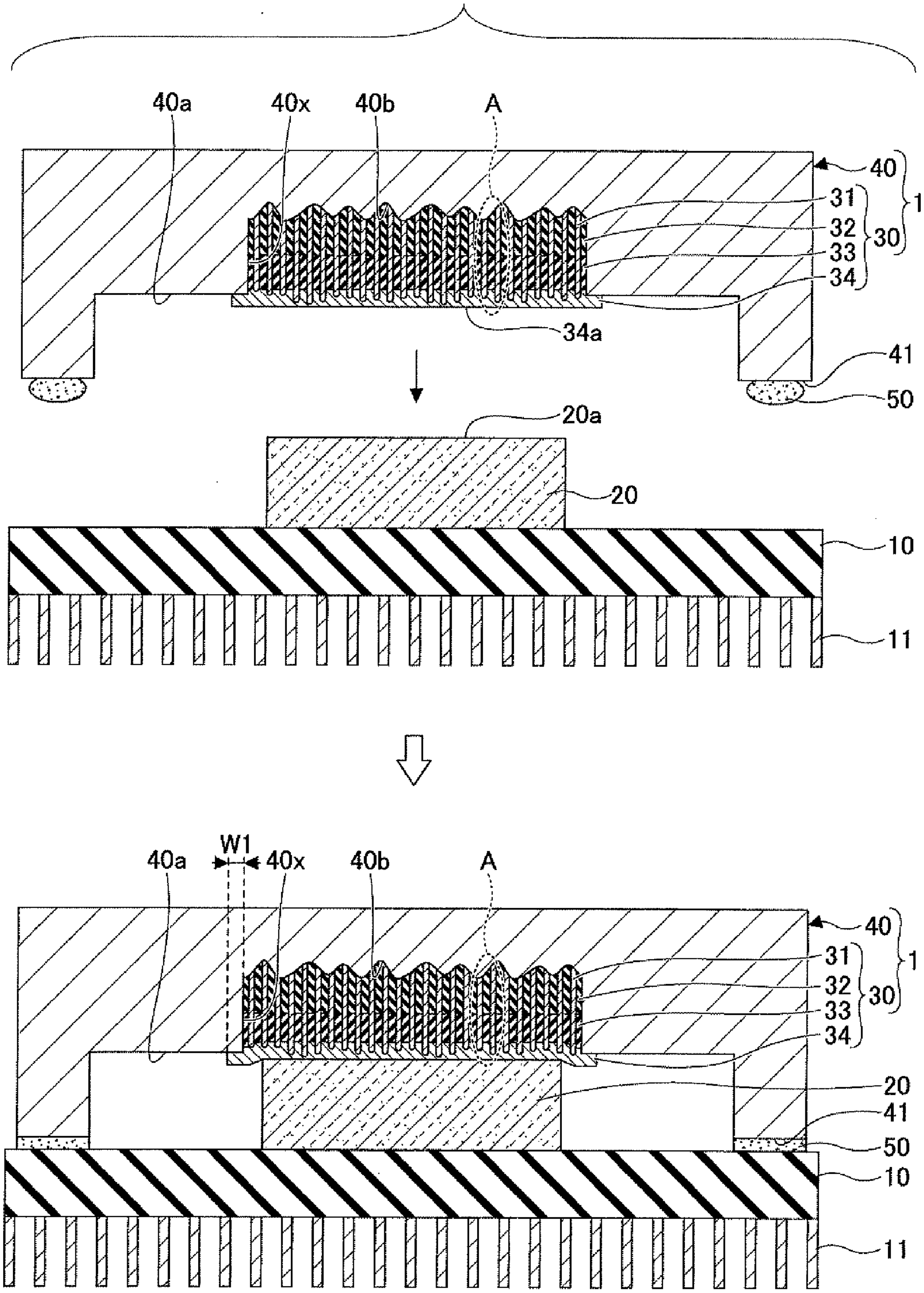


FIG.12

FIG.13


40a
40x
40b
A
40
1
31
32
30
33
34
34a
41
50
20a
20
10
11
W1
40a
40x
40b
A
40
1
31
32
30
33
34
20
41
50
10
11

HEAT RADIATING COMPONENT

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This patent application is based upon and claims the benefit of priority of Japanese Patent Application No. 2009-236989 filed on Oct. 14, 2009, the entire contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention generally relates to heat radiating components. More specifically, the present invention relates to a heat radiating component provided on a semiconductor package, the heat radiating component coming in contact with a semiconductor device.

[0004] 2. Description of the Related Art

[0005] A semiconductor element used for a CPU (Central Processing Unit) or the like is electrically connected and fixed onto a semiconductor package. Since the semiconductor package has a high temperature at the time of operating, if the temperature of the semiconductor element is not decreased forcibly, full play is not given to the semiconductor ability so that the semiconductor element may be broken. Therefore, by providing a heat radiating plate (heat sink) or a heat radiating fin (or heat pipe) on the semiconductor element, heat generated by the semiconductor element is effectively radiated to an outside. The following structure has been suggested. That is, a TIM (Thermal Interface Material) is sandwiched between the semiconductor element and the heat radiating plate or the like, so that contact heat resistance is reduced due to the TIM following concave and convex surfaces of each of the semiconductor element and the heat radiating plate and thermal conductivity is thereby increased.

[0006] FIG. **1** is a cross-sectional view showing an example of a related art heat radiating component provided on a semiconductor package. In a semiconductor package, heat is generated by a semiconductor element **200** provided on a board **100** having external connection terminals **110**. The heat is transferred to a heat radiating plate **400** via a thermal conductive member **300** provided on the semiconductor element **200**. Thus, the thermal conductive member **300** is used as a part configured to thermally connect the semiconductor element **200** and the heat radiating plate **400** to each other without the semiconductor element **200** and the heat radiating plate **400** directly contacting each other.

[0007] Indium having a good thermal conductivity is frequently used as a material of the thermal conductive member **300**. However, since indium is rare metal and expensive, there will be a future supplying problem. In addition, since a thermal process such as a reflow process for bonding the thermal conductive member **300** to the heat radiating plate **400** is required, a manufacturing process may be complex.

[0008] Because of this, as another example of the thermal conductive member **300**, silicon grease, an organic resin binder including a metal filler or graphite as a high thermal conductive material, or the like is used. A resin molded sheet where carbon nanotubes are arranged in a thermal conductive direction has been known as the thermal conductive member **300**. See Japanese Patent Application Publication No. 2008-205273 and Published Japanese Translation of PCT Application No. 2007-532335.

[0009] However, the thermal conductive member **300** made of the organic resin binder including the metal filler or graphite using resin as a binder may have a heat radiating capability problem because the thermal conductivity of the resin is not high. In addition, in the carbon nanotubes arranged in a thermal conductive direction, a contact heat resistance between carbon nanotube end surfaces and the heat radiating component is large so that expected capabilities may not be realized. This is because short carbon nanotubes cannot reach the surface of the heat radiating component.

[0010] For example, FIG. **2** is a cross-sectional view showing an example of a contact surface of a thermal conductive member including a high thermal conductivity material and the related art heat radiating component. As shown in FIG. **2**(*a*) and FIG. **2**(*b*), the contact surface between the thermal conductive member **300***a* and the heat radiating plate **400** is rough in a microscopic view, and a space **600** is formed between the contact surfaces of the thermal conductive member **300***a* and the heat radiating plate **400**.

[0011] In an example shown in FIG. **2**(*a*), the thermal conductive member **300***a* has a structure where a most outer surface of a high thermal conductivity material **302***a* is covered with a low thermal conductivity material layer **301***a* whose resin ratio is high. In this case, there is no physical contact between the heat radiating plate **400** and the high thermal conductivity material **302***a* such as metal filler or graphite, and the contact thermal resistance between the heat radiating plate **400** and the high thermal conductivity material **302***a* is large. Hence, the thermal conductivity may be low and the heat transfer may not be good.

[0012] In an example shown in FIG. **2**(*b*), a thermal conductive member **300***b* has a structure where carbon nanotubes as high thermal conductivity materials **302***b* are fixed by a low thermal conductivity material layer **301***b* such as a resin binder. In this case, since there is great unevenness of the lengths of the high thermal conductivity materials **302***b*, short high thermal conductivity materials **302***b* do not reach the surface of the heat radiating plate **400**. Hence, in this case, as well as the case shown in FIG. **2**(*a*), the contact thermal resistance between the heat radiating plate **400** and the high thermal conductivity materials **302***b* is large. Hence, the thermal conductivity may be low and the heat transfer may not be good.

SUMMARY OF THE INVENTION

[0013] Accordingly, embodiments of the present invention may provide a novel and useful heat radiating component solving one or more of the problems discussed above.

[0014] More specifically, the embodiments of the present invention may provide a heat radiating component having a high thermal conductivity and good heat radiating capability.

[0015] Another aspect of the embodiments of the present invention may be to provide a heat radiating component provided on a semiconductor package, the heat radiating component coming in contact with a semiconductor element, the heat radiating component including:

[0016] a heat radiating plate having a concave part;

[0017] linear high thermal conductivity materials formed on a bottom surface of the concave part so as to stand in a thermal conductive direction;

[0018] first and second resin layers configured to fill space parts formed by the neighboring linear high thermal conductivity materials, the first and the second resin layers being stacked on the bottom surface of the concave part in order to expose head end parts of the linear high thermal conductivity materials; and

[0019] a metal layer formed on an upper surface of the second resin layer and at least a portion of a surface of the heat radiating plate where the concave part is formed so as to cover the head end parts of the linear high thermal conductivity materials;

[0020] wherein a surface opposite to a surface of the metal layer coming in contact with the upper surface of the second resin layer comes in contact with the semiconductor element;

[0021] a softening point of the first resin layer is equal to or higher than a maximum temperature of a heat generation range of the semiconductor element; and

[0022] a softening point of the second resin layer is equal to or less than a minimum temperature of the heat generation range of the semiconductor element.

[0023] Additional objects and advantages of the embodiments are set forth in part in the description which follows, and in part will become obvious from the description, or may be learned by practice of the invention. The object and advantages of the invention will be realized and attained by means of the elements and combinations particularly pointed out in the appended claims. It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are not restrictive of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] FIG. **1** is a cross-sectional view showing an example of a related art heat radiating component provided on a semiconductor package;

[0025] FIG. **2** is a cross-sectional view showing an example of a contact surface of a thermal conductive member including a high thermal conductivity material and the related art heat radiating component;

[0026] FIG. **3** is a cross-sectional view showing an example of a heat radiating component of an embodiment of the present invention provided on a semiconductor package;

[0027] FIG. **4** is a bottom view of an example of the semiconductor package shown in FIG. **3**;

[0028] FIG. **5** is an expanded cross-sectional view of a portion A shown in FIG. **3**;

[0029] FIG. **6** is a flowchart showing an example of a manufacturing process of the heat radiating component;

[0030] FIG. **7** is a first view showing the example of the manufacturing process of the heat radiating component;

[0031] FIG. **8** is a second view showing the example of the manufacturing process of the heat radiating component;

[0032] FIG. **9** is a third view showing the example of the manufacturing process of the heat radiating component;

[0033] FIG. **10** is a fourth view showing the example of the manufacturing process of the heat radiating component;

[0034] FIG. **11** is a fifth view showing the example of the manufacturing process of the heat radiating component;

[0035] FIG. **12** is a sixth view showing the example of the manufacturing process of the heat radiating component; and

[0036] FIG. **13** is a view showing an example of a manufacturing process of the semiconductor package.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0037] A description is given below, with reference to the FIG. **3** through FIG. **13** of embodiments of the present invention.

(Structure of Heat Radiating Component)

[0038] FIG. **3** is a cross-sectional view showing an example of a heat radiating component of an embodiment of the present invention provided on a semiconductor package. FIG. **4** is a bottom view of an example of the semiconductor package shown in FIG. **3**. In FIG. **4**, illustrations of a board **10**, external terminals **11** and an adhesive **50** illustrated in FIG. **3** are omitted.

[0039] As shown in FIG. **3** and FIG. **4**, a heat radiating component **1** of the embodiment of the present invention includes a TIM (Thermal Interface Material) **30** as a thermal conductive member and a heat radiating plate **40**. The heat radiating component **1** is provided on an upper surface of a semiconductor element **20** provided on a board **10** having external connection terminals **11**. The TIM **30** is provided between the semiconductor element **20** and the heat radiating plate **40** so that the semiconductor element **20** and the heat radiating plate **40** are thermally connected to each other.

[0040] When the semiconductor element **20** is operated, it is heated to approximately 100° C. through approximately 110° C. The heat generated by the semiconductor element **20** is transferred to the heat radiating plate **40** of the heat radiating component **1** via the TIM **30** of the heat radiating component **1** provided on the semiconductor element **20**. The semiconductor element **20** and the heat radiating plate **40** do not directly contact each other but the TIM **30** thermally connects the semiconductor element **20** and the heat radiating plate **40** to each other.

[0041] A heat sink, for example, can be used as the heat radiating plate **40**. The heat radiating plate **40** is made of, for example, a material having high thermal conductivity such as aluminum or oxygen free copper where nickel plating is applied. The heat radiating plate **40** is configured to transfer and diffuse heat generated by the semiconductor element **20** to an outside. The heat radiating plate **40** has a square-shaped configuration for which one side is, for example, approximately 10 mm through approximately 40 mm. A most thick part of the heat radiating plate **40** has a thickness of, for example, approximately 20 mm through approximately 30 mm. An external edge part **41** of the heat radiating plate **40** is fixed onto the board **10** by an adhesive **50** or the like.

[0042] The TIM **30** is formed in a concave part **40***x* of the heat radiating plate **40** and on at least a part of a surface **40***a* of the heat radiating plate **40**. The TIM **30** includes a large number of carbon nanotubes **31**, first resin layer **32**, second resin layer **33**, and a metal layer **34**. The carbon nanotubes **31** are formed on a bottom surface **40***b* of the concave part **40***x* of the heat radiating plate **40**. The first resin layer **32** are formed on the bottom surface **40***b* of the concave part **40***x* of the heat radiating plate **40** so as to fill spaces formed by the neighboring carbon nanotubes **31**. The second resin layer **33** are formed on the first resin layer **32** so as to fill the spaces formed by the neighboring carbon nanotubes **31**. The metal layer **34** is formed on the second resin layer **32** and at least a part of the surface **40***a* of the heat radiating plate **40**.

[0043] A width W1 of a portion of the surface **40***a* of the heat radiating plate **40** where the metal layer **34** is formed can be, for example, approximately 1 mm. However, the metal layer **34** may be formed on an entire surface of the surface **40***a*. The semiconductor element **20** has a square-shaped configuration for which one side is, for example, approximately 10 mm. The semiconductor element **20** has a thickness of, for example, approximately 0.3 mm through approximately 0.8 mm.

[0044] FIG. **5** is an expanded cross-sectional view of a portion A shown in FIG. **3**. Details of the heat radiating component **1** are further discussed with reference to FIG. **5**. The carbon nanotubes **31** stand (bristle) in a thermal conductive direction (a direction substantially perpendicular to the bottom surface **40***b*) on the bottom surface **40***b* of the concave part **40***x* of the heat radiating plate **40**. The carbon nanotube **31** is a substantially cylindrical-shaped carbon crystal having a diameter of approximately 0.7 nm through approximately 70 nm. The carbon nanotube **31** has a high thermal conductivity. The thermal conductivity of the carbon nanotube **31** is, for example, 3000 W/(m·K). In other words, the carbon nanotube **31** is a linear high thermal conductivity material.

[0045] A length L1 between the bottom surface **40***b* of the concave part **40***x* of the heat radiating plate **40** and a head end part of the carbon nanotube **31** can be, for example, approximately 100 μm. Positions of the head end parts of the carbon nanotubes **31** are scattered. A length L2 between a position of a head end part of the shortest carbon nanotube **31** and a position of a head end part of the longest carbon nanotube **31** is approximately 10 μm.

[0046] The first resin layer **32** is configured to reinforce the strength of the carbon nanotubes **31**. For example, a hot melt resin, a thermosetting resin, or the like can be used as the first resin layer **32**. The thickness of the first resin layer **32** can be, for example, approximately 50 μm. The hot melt resin is in a solid state at a normal temperature. The hot melt resin is melted by heating at a temperature exceeding a designated softening point so as to become in a fluidized or liquid state. The softening point of the hot melt resin can be adjusted. It is possible to easily obtain the hot melt resin having various kinds of the softening points commercially.

[0047] In a case where the hot melt resin is used as the first resin layer **32**, it may be necessary to select hot melt resin having a softening point that is equal to or higher than a maximum temperature in a heat generation range of the semiconductor element **20**. For example, if the heat generation range of the semiconductor element **20** is between approximately 100° C. and approximately 110° C., it may be necessary to select the hot melt resin for which the softening temperature is equal to or higher than approximately 110° C. as the first resin layer **32** because the maximum temperature of the heat generation range of the semiconductor element **20** is approximately 110° C. This is because it is not possible to reinforce the strength of the carbon nanotubes **31** if the first resin layer **32** is softened so as to become a fluidized or liquid state by heat generation of the semiconductor element **20**.

[0048] The second resin layer **33** is configured to follow bending generated by the heating of the semiconductor element **20**. For example, a hot melt resin or the like can be used as the second resin layer **33**. The thickness of the second resin layer **33** can be, for example, approximately 40 μm. In a case where the hot melt resin is used as the second resin layer **33**, it may be necessary to select the hot melt resin for which the softening point is equal to or less than a minimum temperature of the heat generation range of the semiconductor element **20**. For example, if the heat generation range of the semiconductor element **20** is between approximately 100° C. and approximately 110° C., it may be necessary to select the hot melt resin for which the softening temperature is equal to or lower than approximately 100° C. as the second resin layer **33** because the minimum temperature of the heat generation range of the semiconductor element **20** is approximately 100° C. This is because when the semiconductor element **20** generates heat, the second resin layer **33** is softened and becomes in a fluidized or liquid state so as to follow the bending generated by the heating of the semiconductor element **20**.

[0049] The metal layer **34** is provided so that a large number of the carbon nanotubes **31** are connected to each other in a horizontal direction (a direction substantially parallel with the bottom surface **40***b* of the concave part **40***x*) so as to be unified. In other words, the metal layer **23** is formed on the second resin layer **33** and at least a portion of the surface **40***a* of the surface **40***a* of the heat radiating plate **40**, so as to cover the head ends of a large number of the carbon nanotubes **31**.

[0050] The metal layer **34** connects a large number of the carbon nanotubes **31** and the surface **40***a* of the heat radiating plate **40** in the horizontal direction so as to be unified. By connecting a large number of the carbon nanotubes **31** and the surface **40***a* of the heat radiating plate **40** to each other so that the carbon nanotubes **31** and the surface **40***a* are unified, it is possible to improve the thermal conductivity in the horizontal direction.

[0051] One of surfaces of the metal layer **34** comes in contact with one of surfaces of the semiconductor element **20**. Thus, the surfaces of the metal layer **34** and the semiconductor element **20** are in contact so that the heat resistance between the metal layer **34** and the semiconductor element **20** can be decreased. In addition, since the metal layer **34** is formed on at least a portion of the surface **40***a* of the heat radiating plate **40**, it is possible to directly transfer the heat generated by the semiconductor element **20** to the heat radiating plate **40**.

[0052] A metal having a high thermal conductivity such as Au, Ni, or Cu can be used as a material of the metal layer **34**. The thickness of the metal layer **34** can be, for example, approximately 20 μm. In order to cancel scattering of the lengths of the carbon nanotubes **31**, the thickness of the metal layer **34** can be greater than the length L2 between the position of the head end part of the shortest carbon nanotube **31** and the position of the head end part of the longest carbon nanotube **31**.

(Manufacturing Method of the Heat Radiating Component)

[0053] Next, a manufacturing method of the heat radiating component **1** is discussed with reference to FIG. **6** through FIG. **12**. Here, FIG. **6** is a flowchart showing an example of a manufacturing process of the heat radiating component. FIG. **7** through FIG. **12** are views showing the example of the manufacturing process of the heat radiating component. FIG. **8**, FIG. **10** and FIG. **12** are expanded cross-sectional views of the portion A shown in FIG. **7**, FIG. **9**, and FIG. **11**.

[0054] First, as shown in FIG. **6** through FIG. **8**, a large number of the carbon nanotubes **31** are formed on the bottom surface **40***b* of the concave part **40***x* of the heat radiating plate **40** in step S**20** through step S**22**. In step S**20**, for example, the heat radiating plate **40** where nickel plating is applied to oxygen free copper is prepared. The concave part **40***x* and the external edge part **41** are formed in the heat radiating plate **40** by, for example, pressing. See FIG. **3** and FIG. **4**. A material of the heat radiating plate **40** is not limited to oxygen free copper. However, by using a material whose main ingredient is oxygen free copper as the material of the heat radiating plate **40**, it is possible to grow the carbon nanotubes **31** well.

[0055] Next, in step S**22**, the carbon nanotubes **31** are formed on the bottom surface **40***b* of the concave part **40***x* of the heat radiating plate **40** by a CVD (Chemical Vapor Deposition) method or the like so as to stand (bristle) in the thermal conductive direction (the direction substantially perpendicular to the bottom surface **40***b*).

[0056] More specifically, first, a metal catalyst layer is formed on the bottom surface **40***b* of the concave part **40***x* of the heat radiating plate **40** by a sputtering method or the like. As the metal catalyst layer, for example, Fe, Co, Ni and other metals can be used. The thickness of the metal catalyst layer can be, for example, approximately several nm.

[0057] Next, the heat radiating plate **40** where the metal catalyst layer is formed is put into a heating furnace whose pressure and temperature are adjusted. By applying a CVD (Chemical Vapor Deposition) method, the carbon nanotubes **31** are formed on the metal catalyst layer. The pressure and temperature of the heating furnace can be, for example, approximately 100 Pa and approximately 600° C. In addition, as process gas, for example, acetylene gas can be used. As carrier gas, for example, argon gas or hydrogen gas can be used. Although the carbon nanotubes **31** are formed on the metal catalyst in a direction perpendicular to the bottom surface **40***b* of the concave part **40***x* of the heat radiating plate **40**, the length L**1** between the bottom surfaces **40***b* and the head end parts of the carbon nanotubes **31** can be controlled by a growing time of the carbon nanotubes **31**.

[0058] Next, as shown in step S**24** through step S**26** in FIG. **6** and shown in FIG. **9** and FIG. **10**, the first resin layer **32** is formed on the bottom surface **40***b* of the concave part **40***x* by a reflow process so that the space parts formed by the neighboring carbon nanotubes **31** are filled by the first resin layer **32**. For example, a hot melt resin, a thermosetting resin, or the like can be used as the first resin layer **32**. In this case, the softening point of the hot melt resin is equal to or higher than a maximum temperature in the heat generation range of the semiconductor element **20**. The thickness of the first resin layer **32** can be, for example, approximately 50 μm. In addition, the second resin layer **33** is formed on the first resin layer **32** so as to fill in the space formed by the neighboring carbon nanotubes **31**. For example, a hot melt resin can be used as the second resin layer **33**. In this case, the softening point of the hot melt resin is equal to or less than a minimum temperature in the heat generation range of the semiconductor element **20**. The thickness of the second resin layer **33** can be, for example, approximately 40 μm.

[0059] Next, as shown in step S**28** in FIG. **6** and shown in FIG. **11** and FIG. **12**, the metal layer **23** is formed on the second resin layer **33** and at least a portion of the surface **40***a* of the heat radiating plate **40** so as to cover the head ends of the carbon nanotubes **31**. The metal layer **34** is formed by, for example, a sputtering method or a plating method. Metal having a high thermal conductivity such as Au, Ni, or Cu can be used as a material of the metal layer **34**. The thickness of the metal layer **34** can be, for example, approximately 20 μm. In order to cancel scattering of the lengths of the carbon nanotubes **31**, the thickness of the metal layer **34** can be greater than the length L**2** between the position of the head end part of the shortest carbon nanotube **31** and the position of the head end part of the longest carbon nanotube **31**. By this step, a large number of the carbon nanotubes **31** and the surface **40***a* of the heat radiating plate **40** are connected to each other and unified, so that manufacturing of the heat radiating component is completed.

[0060] Next, a manufacturing method of a semiconductor package is discussed with reference to FIG. **13**. FIG. **13** is a view showing an example of a manufacturing process of the semiconductor package. As shown in FIG. **13**, the adhesive **50** is applied on the external edge part **41** of the completed heat radiating component **1** (see FIG. **11** and FIG. **12**). Then, the surface **34***a* of the metal layer **34** of the heat radiating component **1** is made to come in contact with the surface **20***a* of the semiconductor element **20** provided on the board **10** and is pressed. Then, the adhesive **50** is cured. As a result, the heat radiating component **1** is fixed onto the semiconductor element **20** provided on the board **10** so that the semiconductor package is completed.

[0061] Thus, in this embodiment, the carbon nanotubes which are linear high thermal conductivity materials are formed in the concave part of the heat radiating plate so as to stand (bristle) in the thermal conductive direction. Then, the first and second resin layers are stacked in the concave part of the heat radiating plate so that the space formed by the neighboring carbon nanotubes is filled by the first resin layer and the second resin layer. Here, the softening point of the first resin layer is equal to or higher than a maximum temperature of a heat generation range of the semiconductor element. The softening point of the second resin layer is equal to or less than a minimum temperature of the heat generation range of the semiconductor element. In addition, a metal layer is formed on the second resin layer and at least a portion of a surface of the heat radiating plate so as to cover the head ends of a large number of the carbon nanotubes and thereby a large number of the carbon nanotubes and the surface of the heat radiating plate are connected to each other in the horizontal direction and unified.

[0062] As a result of this, first ends of the carbon nanotubes are directly formed on the heat radiating plate so that the heat radiating plate and the carbon nanotubes are adhered to each other. In addition, second ends of the carbon nanotubes are unified with the surface of the heat radiating plate in the horizontal direction by the metal layer. The surface of the metal layer comes in contact with the surface of the semiconductor element. Therefore, the carbon nanotubes and the semiconductor element are adhered to each other. In other words, the heat radiating plate and the semiconductor element are adhered to each other via the TIM including the carbon nanotubes and the metal layer. Therefore, it is possible to reduce the contact heat resistance between the heat radiating plate and the semiconductor element so that the thermal conductivity can be improved.

[0063] Furthermore, the softening point of the second resin layer is equal to or less than a minimum temperature of the heat generation range of the semiconductor element. Therefore, when the semiconductor element generates heat, the second resin layer may be softened and may become in a fluidized or liquid state. In this case, since the carbon nanotubes having flexibility and the metal layer being extremely thin can be deformed at a certain degree, the TIM can follow the bending generated by the heating of the semiconductor element. In other words, since the TIM is adhered to the semiconductor element even if the semiconductor element is bent, it is possible to reduce the contact heat resistance between the TIM and the semiconductor element and the thermal conductivity can be improved.

[0064] All examples and conditional language recited herein are intended for pedagogical purposes to aid the reader in understanding the invention and the concepts contributed by the inventor to furthering the art, and are to be construed as being without limitation to such specifically recited examples and conditions, nor does the organization of such examples in the specification relate to a showing of the superiority or inferiority of the invention. Although the embodiments of the present invention have been described in detail, it should be understood that the various changes, substitutions, and alterations could be made hereto without departing from the spirit and scope of the invention.

What is claimed is:

1. A heat radiating component provided on a semiconductor package, the heat radiating component coming in contact with a semiconductor element, the heat radiating component comprising:

a heat radiating plate having a concave part;

linear high thermal conductivity materials formed on a bottom surface of the concave part so as to stand in a thermal conductive direction;

first and second resin layers configured to fill space parts formed by the neighboring linear high thermal conductivity materials, the first and the second resin layers being stacked on the bottom surface of the concave part in order to expose head end parts of the linear high thermal conductivity materials; and

a metal layer formed on an upper surface of the second resin layer and at least a portion of a surface of the heat radiating plate where the concave part is formed so as to cover the head end parts of the linear high thermal conductivity materials;

wherein a surface opposite to a surface of the metal layer coming in contact with the upper surface of the second resin layer comes in contact with the semiconductor element;

a softening point of the first resin layer is equal to or higher than a maximum temperature of a heat generation range of the semiconductor element; and

a softening point of the second resin layer is equal to or less than a minimum temperature of the heat generation range of the semiconductor element.

2. The heat radiating component as claimed in claim **1**, wherein a material of the second resin layer is hot melt resin.

3. The heat radiating component as claimed in claim **1**, wherein the linear high thermal conductivity materials are carbon nanotubes.

4. The heat radiating component as claimed in claim **1**, wherein a thickness of the metal layer is greater than a length between a position of a head end part of a shortest linear high thermal conductivity material among the linear high thermal conductivity materials and a position of a head end part of a longest linear high thermal conductivity material among the linear high thermal conductivity materials.

5. The heat radiating component as claimed in claim **1**, wherein the heat radiating plate is made of a material whose main ingredient is oxygen free copper.

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