United States Patent Application Publication	20250261339
Kind Code	A1
Publication Date	August 14, 2025
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HEAT DISSIPATING DEVICE

Abstract

A heat dissipating device includes a lower case having a partition wall, a plurality of pillars disposed inside the partition wall, and an upper case installed on the partition wall of the lower case and defining an internal space together with the lower case, wherein the internal space defined by the upper case and the lower case is filled with vapor, and the lower case and the upper case include unevenness portions between the plurality of pillars and formed respectively facing the upper case and the lower case.

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Appl. No.: **18/903078**

Filed: **October 01, 2024**

Foreign Application Priority Data

KR	10-2024-0020120	Feb. 13, 2024

Publication Classification

Int. Cl.: **H05K7/20** (20060101)

U.S. Cl.:

CPC **H05K7/20409** (20130101); **H05K7/2029** (20130101); **H05K7/20436** (20130101);

Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION(S)

[0001] This application claims benefit of and priority to Korean Patent Application No. 10-2024-0020120 filed on Feb. 13, 2024 in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference in its entirety.

BACKGROUND

[0002] The present inventive concepts relate to heat dissipating devices.

[0003] With the advent of the era of artificial intelligence (AI), high-performance computing (HPC), and autonomous vehicles, large-area package products have been produced to mount numerous CPUs and memories in a single package. The large-area package products are mostly high-heat products to which power of 1 kW or higher is applied, and heat solution is a major element of advanced packages.

[0004] Meanwhile, in a package process, an assembly process is generally performed in an environment in which temperatures rise above 200° C., such as thermal interface material (TIM) curing, surface mounting technology (SMT), and the like. However, when thermal expansion mismatch occurs, internal thermal resistance between a chip and a TIM may increase, and internal components of packages may be stressed due to warpage, which reduces mechanical stability and deteriorates product performance.

SUMMARY

[0005] An aspect of the present inventive concepts is to provide a heat dissipating device capable of reducing thermal deformation and contact thermal resistance.

[0006] Another aspect of the present inventive concepts is to provide a heat dissipating device capable of reducing stress applied to electronic components due to thermal deformation.

[0007] According to an aspect of the present inventive concepts, a heat dissipating device includes a lower case having a partition wall, a plurality of pillars inside the partition wall, and an upper case installed on the partition wall of the lower case and defining an internal space together with the lower case, wherein the internal space defined by the upper case and the lower case is filled with vapor, and the lower case and the upper case include unevenness portions between the plurality of pillars and formed respectively facing the upper case and the lower case.

[0008] According to an aspect of the present inventive concepts, a heat dissipating device includes a lower case including a base having a rectangular plate shape and a partition wall extending from an upper surface of the base, a plurality of pillars inside the partition wall and on the upper surface of the base, and an upper case coupled to the lower case to define an internal space with the lower case, wherein the internal space defined by the lower case and the upper case is filled with vapor, the lower case and the upper case include unevenness portions between the plurality of pillars, and a lower surface of the base of the lower case and an upper surface of the upper case are configured to be deformed into a flat planar shape in response thermal deformation.

Description

BRIEF DESCRIPTION OF DRAWINGS

[0009] The above and other aspects, features, and advantages of the present inventive concepts will be more clearly understood from the following detailed description, taken in conjunction with the accompanying drawings, in which:

[0010] FIG. **1** is a configuration diagram illustrating a heat dissipating device according to some example embodiments;

[0011] FIG. **2** is an exploded perspective view illustrating a heat dissipating device according to

some example embodiments;
[0012] FIGS. **3** and **4** are diagrams illustrating an operation of a heat dissipating device according to some example embodiments;
[0013] FIG. **5** is a configuration diagram illustrating a heat dissipating device according to some example embodiments;
[0014] FIG. **6** is an exploded perspective view illustrating a heat dissipating device according to some example embodiments;
[0015] FIGS. **7** to **9** are perspective views illustrating pillars of a heat dissipating device according to some example embodiments; and
[0016] FIG. **10** is a diagram illustrating an unevenness portion provided in a heat dissipating device according to some example embodiments.
DETAILED DESCRIPTION
[0017] It will be understood that elements and/or properties thereof (e.g., structures, surfaces, directions, or the like), which may be referred to as being "perpendicular," "parallel," "coplanar," or the like with regard to other elements and/or properties thereof (e.g., structures, surfaces, directions, or the like) may be "perpendicular," "parallel," "coplanar," or the like or may be "substantially perpendicular," "substantially parallel," "substantially coplanar," respectively, with regard to the other elements and/or properties thereof.
[0018] Elements and/or properties thereof (e.g., structures, surfaces, directions, or the like) that are "substantially perpendicular", "substantially parallel", or "substantially coplanar" with regard to other elements and/or properties thereof will be understood to be "perpendicular", "parallel", or "coplanar", respectively, with regard to the other elements and/or properties thereof within manufacturing tolerances and/or material tolerances and/or have a deviation in magnitude and/or angle from "perpendicular", "parallel", or "coplanar", respectively, with regard to the other elements and/or properties thereof that is equal to or less than 10% (e.g., a. tolerance of ±10%).
[0019] When the terms "about" or "substantially" are used in this specification in connection with a numerical value, it is intended that the associated numerical value includes a manufacturing or operational tolerance (e.g., ±10%) around the stated numerical value. Moreover, when the words "about" and "substantially" are used in connection with geometric shapes, it is intended that precision of the geometric shape is not required but that latitude for the shape is within the scope of the disclosure. Further, regardless of whether numerical values or shapes are modified as "about" or "substantially," it will be understood that these values and shapes should be construed as including a manufacturing or operational tolerance (e.g., ±10%) around the stated numerical values or shapes. When ranges are specified, the range includes all values therebetween such as increments of 0.1%.
[0020] Hereinafter, example embodiments of the present inventive concepts are described with reference to the accompanying drawings.
[0021] FIG. **1** is a configuration diagram illustrating a heat dissipating device according to some example embodiments, and FIG. **2** is an exploded perspective view illustrating the heat dissipating device according to some example embodiments.
[0022] Referring to FIGS. **1** and **2**, a heat dissipating device **100** according to some example embodiments includes a lower case **120**, a pillar **140**, and an upper case **160**.
[0023] The lower case **120** may include a base **122** having a plate shape, for example a square, and a partition wall **124** extending upwardly from an edge of the base **122**. Meanwhile, the lower case **120** may be formed of a metal material. For example, the lower case **120** may be formed of a material including copper. In addition, the base **122** may include a first unevenness portion **126** disposed between the pillars **140** not to interfere with the pillars **140**. The first unevenness portion **126** may be formed to be convex toward the upper case **160**. In other words, the first unevenness portion **126** may be formed to be concave upwardly from a lower surface of the upper case **160**. Meanwhile, a region between the first unevenness portion **126** and the first unevenness portion **126**

may have a planar shape. As an example, the first unevenness portion **126** may have a curved shape. Meanwhile, a depth D of the first unevenness portion **126** may be 20 μm to 200 μm. If the depth D of the first unevenness portion **126** is less than 20 μm, a lower surface of the base **122** may be deformed to be convex downwardly during thermal deformation and may not have a flat shape. For example, in some embodiments the first unevenness portion **126** may face the upper case **160**. In addition, if the depth D of the first unevenness portion **126** is greater than 200 μm, the lower surface of the base **122** may not have a flat planar shape due to thermal deformation and may become convex toward the upper case **160**.

[0024] As an example embodiment, the electronic component **10** (see FIGS. **3** and **4**) may be bonded to the lower surface of the lower case **120** via a TIM **20** (see FIGS. **3** and **4**). Meanwhile, during the process of bonding the heat dissipating device **100** to the electronic component **10** via the TIM **20**, the first unevenness portion **126** may be thermally expanded by thermal deformation and deformed flat. For example, during the process of bonding the heat dissipating device **100** to the electronic component **10** via the TIM **20**, the first unevenness portion **126** may be thermally expanded such that the lower surface of the first unevenness portion **126** is coplanar with the lower surface of the base **122**. Accordingly, the lower surface of the lower case **120** may have a flat planar shape, and thus, contact thermal resistance may be reduced when the lower case **120** comes into contact with the TIM **20**. In addition, since stress applied to the electronic component **10** and the risk of warpage due to thermal expansion may be reduced, mechanical stability may be maintained.

[0025] A plurality of pillars **140** may be provided inside the partition wall **124**. For example, the plurality of pillars **140** may be arranged to be spaced apart from each other in an internal space formed by the lower case **120** and the upper case **160**. Meanwhile, the pillar **140** may have a pillar shape, for example a cylindrical shape. Thus, since the pillar **140** has a cylindrical shape, a region on which stress is concentrated may not be formed in the pillar **140**. In addition, the pillar **140** may be formed of the same material as that of the lower case **120**. Also, the pillar **140** may be formed of a metal material. For example, the lower case **120** may be formed of a material including copper. For example, the pillar **140** may be formed of a material including copper.

[0026] The upper case **160** may have a plate shape, for example a rectangular shape. As an example, the upper case **160** may be installed on an upper surface of the partition wall **124** of the lower case **120**. Meanwhile, the internal space formed by the upper case **160** and the lower case **120** may be filled with vapor V. For example, the internal space formed by the upper case **160** and the lower case **120** serves as a vapor chamber. Meanwhile, the upper case **160** may be formed of a metal material. For example, the upper case **160** may be formed of a material including copper. In some example embodiments, the upper case **160**, the pillar **140**, and the lower case **120** may be formed of the same material. In addition, the upper case **160** may include a second unevenness portion **162** disposed between the pillars **140** not to interfere with the pillars **140**. The second unevenness portion **162** may be formed to be convex toward the lower case **120**. Meanwhile, a region between the second unevenness portion **162** and the second unevenness portion **162** may have a planar shape. As an example, the second unevenness portion **162** may have a curved shape. For example, in some example embodiments, the second unevenness portion **162** may face the lower case **120**. Meanwhile, the depth D of the second unevenness portion **162** may be 20 μm to 200 μm. Meanwhile, during the process of installing components, such as a heat sink (not shown), on top of the heat dissipating device **100** via the TIM **20**, the second unevenness portion **162** may thermally expand due to thermal deformation to be deformed flat. For example, during the process of installing components, such as a heat sink (not shown), on top of the heat dissipating device **100** via the TIM **20**, the second unevenness portion **162** may be thermally expanded such that an upper surface of the second unevenness portion **162** is coplanar with an upper surface of the upper case **160**. Accordingly, the upper surface of the upper case **160** may have a flat planar shape, and thus, contact thermal resistance may be reduced when the upper case **160** comes into contact with the TIM **20**. In addition, since the stress applied to other components and the risk of warpage due to thermal expansion may be reduced, mechanical stability may be maintained.

[0027] FIGS. **3** and **4** are diagrams illustrating an operation of a heat dissipating device according to some example embodiments.

[0028] First, referring to FIG. **3**, before the heat dissipating device **100** is bonded to the electronic component **10**, the first and second unevenness portions **126** and **162** are provided in the lower case **120** and the upper case **160** of the heat dissipating device **100**, respectively. Meanwhile, the first unevenness portion **126** of the lower case **120** may be disposed between the pillars **140** not to interfere with the pillars **140**. In addition, the first unevenness portion **126** may be formed to be convex toward the upper case **160**. In addition, the first unevenness portion **126** may have a curved shape. In addition, the second unevenness portion **162** of the upper case **160** may also be disposed between the pillars **140** not to interfere with the pillars **140**. In addition, the second unevenness portion **162** of the upper case **160** may be formed to be convex toward the lower case **120**. In addition, the second unevenness portion **162** may have a curved shape.

[0029] Thereafter, during the process of bonding the heat dissipating device **100** to the electronic component **10** via the TIM **20**, a process temperature may be approximately 150° C. to 250° C. Accordingly, the vapor V filling the internal space formed by the lower case **120** and the upper case **160** is vaporized and the first and second unevenness portions **126** and **162** are thermally deformed. Accordingly, the first and second unevenness portions **126** and **162** may expand and become flat (e.g., coplanar with the bottom surface of the base **122** and the top surface of the upper case **160**, respectively). Accordingly, the lower surface of the lower case **120** and the upper surface of the upper case **160** may have a flat planar shape. Accordingly, contact thermal resistance may be reduced when the lower case **120** comes into contact with the TIM **20**. In addition, stress applied to the electronic component **10** due to thermal expansion of the lower case **120** and the risk of warpage of the lower case **120** may be reduced, thereby maintaining mechanical stability.

[0030] FIG. **5** is a configuration diagram illustrating a heat dissipating device according to some example embodiments, and FIG. **6** is an exploded perspective view illustrating a heat dissipating device according to some example embodiments.

[0031] Referring to FIGS. **5** and **6**, a heat dissipating device **200** according to some example embodiments include a lower case **220**, a pillar **240**, and an upper case **260**.

[0032] Meanwhile, the pillar **240** may include the same component as the pillar **140** described above, and thus, a detailed description thereof is omitted here and replaced with the above description.

[0033] The lower case **220** may include a base **222** having a plate shape, for example a square, and a partition wall **224** extending upwardly from an inner edge of the base **222**. Meanwhile, the lower case **220** may be formed of a metal material. For example, the lower case **220** may be formed of a material including copper. In addition, the base **222** may include a first unevenness portion **226** disposed between the pillars **240** not to interfere with the pillars **240**. The first unevenness portion **226** may be formed to be convex toward the upper case **260**. In other words, the first unevenness portion **226** may be formed to be concave from a lower surface of the upper case **260** upwardly. As an example, the first unevenness portion **226** may have a curved shape. Meanwhile, the depth D of the first unevenness portion **226** may be 20 μm to 200 μm. If the depth D of the first unevenness portion **226** is less than 20 μm, the first unevenness portion **226** may be deformed to be convex downwardly during thermal deformation and the lower surface of the base **222** may not have a flat shape. In addition, when the depth D of the first unevenness portion **226** is greater than 200 μm, the lower surface of the base **222** may not have a flat planar shape due to thermal deformation but may be convex toward the upper case.

[0034] As an example, the electronic component **10** (see FIGS. **3** and **4**) may be bonded to a lower surface of the lower case **220** via the TIM **20** (see FIGS. **3** and **4**). Meanwhile, during the process of bonding the heat dissipating device **200** to the electronic component **10** via the TIM **20**, the first unevenness portion **226** may be thermally expanded by thermal deformation and deformed flat

(e.g., coplanar). For example, during the process of bonding the heat dissipating device **200** to the electronic component **10** via the TIM **20**, the first unevenness portion **226** may be thermally expanded such that the lower surface of the first unevenness portion **226** is coplanar with the lower surface of the base **222**. Accordingly, the lower surface of the lower case **220** has a flat planar shape, and thus, contact thermal resistance may be reduced when the lower case **220** comes into contact with the TIM **20**. In addition, since stress applied to the electronic component **10** and the risk of warpage due to thermal expansion may be reduced, mechanical stability may be maintained.
[0035] The upper case **260** may have a plate shape, for example a rectangular shape. In some example embodiments, the upper case **260** may be smaller than the lower case **220**. As an example embodiment, the upper case **260** may be installed on an upper surface of the partition wall **224** of the lower case **220**. Meanwhile, an internal space formed by the upper case **260** and the lower case **220** may be filled with vapor V. For example, the internal space formed by the upper case **260** and the lower case **220** serves as a vapor chamber. Meanwhile, the upper case **260** may be formed of a metal material. For example, the upper case **260** may be formed of a material including copper. In addition, the upper case **260** may include a second unevenness portion **262** disposed between the pillars **140** not to interfere with the pillars **140**. The second unevenness portion **262** may be formed to be convex toward the lower case **220**.
[0036] As an example, the second unevenness portion **262** may have a curved shape. Meanwhile, the depth D of the second unevenness portion **262** may be 20 μm to 200 μm. Meanwhile, during a process of installing a component, such as a heat sink (not shown), on top of the heat dissipating device **200** via the TIM **20**, the second unevenness portion **262** expands due to thermal deformation to be deformed to be flat. For example, during the process of installing components, such as a heat sink (not shown), on top of the heat dissipating device **200** via the TIM **20**, the second unevenness portion **262** may be thermally expanded such that an upper surface of the second unevenness portion **262** is coplanar with an upper surface of the upper case **160**. Accordingly, the upper surface of the upper case **260** may have a flat planar shape, and thus, contact thermal resistance may be reduced when the upper case **260** comes into contact with the TIM **20**. In addition, since stress applied to other components and the risk of warpage due to thermal expansion may be reduced, mechanical stability may be maintained.
[0037] FIGS. **7** to **9** are perspective views illustrating pillars of a heat dissipating device according to some example embodiments.
[0038] Referring to FIGS. **7** to **9**, a plurality of pillars **340**, **440**, and **540** may be provided inside the partition wall **124**. For example, the plurality of pillars **340**, **440**, and **540** may be arranged to be spaced apart from each other in the internal space formed by the lower case **120** and the upper case **160**. Meanwhile, the pillars **340**, **440**, and **540** may have a polygonal pillar shape. For example, the pillar **340** shown in FIG. **7** may have a square pillar shape, the pillar **440** shown in FIG. **8** may have a hexagonal pillar shape, and the pillar **540** shown in FIG. **9** may have an octagonal pillar shape. However, the shapes of the pillars are not limited thereto and may vary. Meanwhile, the pillars **340**, **440**, and **540** may be formed of the same material as that of the lower case **120**. The pillars **340**, **440**, and **540** may be formed of a metal material. For example, the pillars **340**, **440**, and **540** may be formed of a material including copper.
[0039] Meanwhile, the lower case **120** and the upper case **160** are substantially the same as the components described above, and thus, a detailed description thereof is omitted here and replaced with the above description.
[0040] FIG. **10** is a diagram illustrating an unevenness portion provided in a heat dissipating device according to some example embodiments.
[0041] Referring to FIG. **10**, first and second unevenness portions **626** and **662** provided in a lower case **620** and an upper case **660** may have a trapezoidal cross-section. However, the cross-sectional shape of the first and second unevenness portions **626** and **662** are not limited to the trapezoidal shape may vary. For example, the cross-sectional shape of the unevenness portions may be a

triangular or square shape. The first and second unevenness portions **626** and **662** may be formed to be convex toward the upper case **660** and lower case **620**, respectively. Meanwhile, the depth D of the first and second unevenness portions **626** and **662** may be 20 μm to 200 μm. In addition, a region between the first unevenness portion **626** and the first unevenness portion **626** may have a planar shape, and a region between the second unevenness portion **662** and the second unevenness portion **662** may also have a planar shape.

[0042] Meanwhile, the pillar **140** is substantially the same as the component described above, and thus, a detailed description thereof is omitted here and replaced with the above description.

[0043] The heat dissipating device capable of reducing thermal deformation and reducing contact thermal resistance may be provided. As an example, the electronic component **10** (see FIGS. **3** and **4**) may be bonded to a lower surface of the lower case **620** via the TIM **20** (see FIGS. **3** and **4**). Meanwhile, during the process of bonding the heat dissipating device **600** to the electronic component **10** via the TIM **20**, the first unevenness portion **626** may be thermally expanded by thermal deformation and deformed flat (e.g., coplanar). For example, during the process of bonding the heat dissipating device **600** to the electronic component **10** via the TIM **20**, the first unevenness portion **626** may be thermally expanded such that the lower surface of the first unevenness portion **626** is coplanar with the lower surface of the base **622**. Accordingly, the lower surface of the lower case **620** may have a flat planar shape, and thus, contact thermal resistance may be reduced when the lower case **620** comes into contact with the TIM **20**. In addition, since stress applied to the electronic component **10** and the risk of warpage due to thermal expansion may be reduced, mechanical stability may be maintained.

[0044] Meanwhile, during a process of installing a component, such as a heat sink (not shown), on top of the heat dissipating device **600** via the TIM **20**, the second unevenness portion **662** expands due to thermal deformation to be deformed to be flat. For example, during the process of installing components, such as a heat sink (not shown), on top of the heat dissipating device **600** via the TIM **20**, the second unevenness portion **662** may be thermally expanded such that an upper surface of the second unevenness portion **662** is coplanar with an upper surface of the upper case **660**. Accordingly, the upper surface of the upper case **660** may have a flat planar shape, and thus, contact thermal resistance may be reduced when the upper case **660** comes into contact with the TIM **20**. In addition, since stress applied to other components and the risk of warpage due to thermal expansion may be reduced, mechanical stability may be maintained.

[0045] The heat dissipating device capable of reducing stress applied to electronic components due to thermal deformation may be provided.

[0046] While example embodiments have been shown and described above, it will be apparent to those skilled in the art that modifications and variations could be made without departing from the scope of the present inventive concept as defined by the appended claims.

Claims

1. A heat dissipating device comprising: a lower case having a partition wall; a plurality of pillars inside the partition wall; and an upper case installed on the partition wall of the lower case and defining an internal space together with the lower case, wherein the internal space defined by the upper case and the lower case is filled with vapor, and the lower case and the upper case include unevenness portions between the plurality of pillars and the unevenness portions facing the upper case and the lower case, respectively.

2. The heat dissipating device of claim 1, wherein the unevenness portion is concavely indented from a lower surface of the lower case toward the upper case.

3. The heat dissipating device of claim 1, wherein the unevenness portion provided in the upper case is convex from a lower surface of the upper case toward the lower case.

4. The heat dissipating device of claim 1, wherein an electronic component is bonded to a lower

surface of the lower case via a thermal interface material (TIM).
5. The heat dissipating device of claim 4, wherein the unevenness portion is configured to be deformed by thermal deformation, during a bonding process of the electronic component and the lower case, such that the lower surface of the lower case forms a flat plane in response to the thermal deformation.
6. The heat dissipating device of claim 1, wherein the lower case, the plurality of pillars, and the upper case include a metal material and include a same material.
7. The heat dissipating device of claim 6, wherein the lower case, the plurality of pillars, and the upper case include copper.
8. The heat dissipating device of claim 1, wherein the upper case is smaller than the lower case.
9. The heat dissipating device of claim 1, wherein the plurality of pillars have a cylindrical shape.
10. The heat dissipating device of claim 1, wherein the plurality of pillars have a polygonal pillar shape.
11. The heat dissipating device of claim 1, wherein a depth of the unevenness portion is 20 μm to 200 μm.
12. The heat dissipating device of claim 1, wherein the unevenness portion has a curved cross-section.
13. A heat dissipating device comprising: a lower case including a base having a plate shape and a partition wall extending from an upper surface of the base; a plurality of pillars inside the partition wall and on the upper surface of the base; and an upper case coupled to the lower case to define an internal space with the lower case, wherein the internal space defined by the lower case and the upper case is filled with vapor, the lower case and the upper case include unevenness portions between the plurality of pillars, and a lower surface of the base of the lower case and an upper surface of the upper case are configured to be deformed into a flat planar shape in response to thermal deformation.
14. The heat dissipating device of claim 13, wherein the unevenness portion provided in the lower case is convex toward the upper case.
15. The heat dissipating device of claim 13, wherein the unevenness portion provided in the upper case is convex toward the lower case.
16. The heat dissipating device of claim 13, wherein a depth of the unevenness portion is 20 μm to 200 μm.
17. The heat dissipating device of claim 13, wherein the unevenness portion has a curved cross-section.
18. The heat dissipating device of claim 13, wherein the lower case, the plurality of pillars, and the upper case include a metal material and include a same material.
19. The heat dissipating device of claim 18, wherein the lower case, the plurality of pillars, and the upper case include copper.
20. The heat dissipating device of claim 13, wherein the upper case is smaller than the lower case.