Title: MANUFACTURING METHOD OF RADIANT HEAT CIRCUIT BOARD

Abstract: Provided is a method of manufacturing a heat dissipation circuit board used at vehicle and electric and electronic parts in order to improve the efficiency of dissipating heat. In the method, a substrate is formed by sequentially stacking a lower metal layer, an insulating layer, and an upper metal layer. Then, a space for mounting a part is formed on the substrate by removing the upper metal layer and the insulating layer, and a lower part of the lower metal layer is removed corresponding to the formed space in consideration of heat-resistance property, flexibility, and thickness at a predetermined depth. After forming the space, a top of the formed space is pressed. In the step of forming the substrate, surfaces of the lower and upper metal layers are roughed and stacked on the insulating layer.
Description

MANUFACTURING METHOD OF RADIANT HEAT CIRCUIT BOARD

Technical Field
[1] The present invention relates to a method of manufacturing a heat dissipation circuit board and, more particularly, to a method of manufacturing a heat dissipation circuit board used in vehicle and electric and electronic parts in order to improve the efficiency of dissipating heat.

Background Art
[2] In general, a printed circuit board (PCB) is a dielectric substrate with circuit line patterns which are made of conductive material such as copper. That is, the PCB is a circuit line pattern formed substrate without electric parts mounted.
[3] Heat generating elements, for example, semiconductor devices or light emitting diodes (LED), are mounted on the PCB. Particularly, the LED generates a significant amount of heat.
[4] The heat generated from heat generating elements must be processed within the PCB. If not, the heat generated from the heat generating element rises the overall temperature of the PCB, malfunction of the heat generating elements, and causes the heat generating elements to generate an error. Thus, the reliability of a related product is degraded. In order to overcome such an overheat program, various heat dissipating structures have been employed.
[5] FIG. 1 is a cross-sectional view of a conventional heat dissipation circuit board.
[6] As shown, the conventional heat dissipation circuit board 100 is formed by sequentially stacking a lower copper layer 110, an insulating layer 120, and an upper copper layer 130, and forming a circuit pattern on the upper copper layer 130.
[7] Then, electronic part 140 is mounted on the circuit pattern formed upper copper layer 130.
[8] In the conventional heat dissipation circuit board 100, the insulating layer 120 interferes in transferring heat generated from heat generating elements 140 to the lower metal layer 110 which is used to dissipate the heat. Since the conventional heat dissipation circuit board 100 cannot effectively dissipate heat, an inferior circuit board may be manufactured and an electric part 140 may generate an error.
[9] In a case that an electronic parts 140 emitting light such as a light emitting diode (LED) is mounted on the conventional heat dissipation circuit board 100, the conventional heat dissipation circuit board 100 does not effectively reflect the light emitted from the electronic part 140, and absorbs the predetermined portion of the light
therefrom. Therefore, the concentration of the light is degraded.

Furthermore, if the thicknesses of the copper layers 110 and 130 become thicker than a predetermined thickness, the reliability in depositing the copper layers 110 and 130 and the insulating layer 120 is degraded.

Disclosure of Invention

Technical Problem

It is, therefore, an object of the present invention to provide a method of manufacturing a heat dissipation circuit board having an improved structure for preventing heat dissipation problem from being arisen by effectively dissipating heat generated from electronic parts and for improving the concentration of the light if a light radiating electronic part such as a light emitting diode (LED) is mounted.

Technical Solution

In accordance with one aspect of the present invention, there is a method of manufacturing a heat dissipation circuit board. In the method, a substrate is formed by sequentially stacking a lower metal layer, an insulating layer, and an upper metal layer. Then, a space for mounting a part is formed on the substrate by removing the upper metal layer and the insulating layer, and a lower part of the lower metal layer is removed corresponding to the formed space in consideration of heat-resistance property, flexibility, and thickness at a predetermined depth. After forming the space, a top of the formed space is pressed. In the step of forming the substrate, surfaces of the lower or upper metal layers are roughed and stacked on the insulating layer

Advantageous Effects

Since a heat generating element is directly mounted on a lower metal layer in a method of manufacturing a heat dissipation circuit board according to an embodiment of the present invention, the heat generated from the heat generating element is directly transferred to the lower metal layer without blocking the heat by an insulating layer. Therefore, the heat dissipating function of the heat dissipation circuit board is significantly improved.

Since the insulating layer is stacked on the lower and upper metal layers through hot-press pressurizing after roughing the surfaces of the lower and upper metal layers, it is possible to stack thick metal layers without having the limitation in the thickness of the lower or upper metal layer.

Furthermore, the method of manufacturing a heat dissipation circuit board according to the present invention allows a high brightness LED chip to mount if a mold for a press operation is designed to be suitable to the object of a designer, and the light concentration may be improved due to a concave shape formed through the press operation.
Moreover, since additional heat dissipating plates are not needed, parts can be further miniaturized.

**Brief Description of the Drawings**

The above and other objects and features of the present invention will become apparent from the following description of the preferred embodiments given in conjunction with the accompanying drawings, in which:

- FIG. 1 is a cross-sectional view of a conventional heat dissipation circuit board;
- FIG. 2 is a flowchart illustrating a method of manufacturing a heat dissipation circuit board according to an embodiment of the present invention;
- FIG. 3 through FIG. 7 are cross-sectional views for sequentially showing the manufacturing processes of a heat dissipation circuit board shown in FIG. 2 according to an embodiment of the present invention; and
- FIG. 8 through FIG. 10 are cross-sectional views for sequentially showing the manufacturing processes of a heat dissipation circuit board shown in FIG. 2 according to another embodiment of the present invention.

**Best Mode for Carrying Out the Invention**

Other objects and aspects of the invention will become apparent from the following description of the embodiments with reference to the accompanying drawings, which is set forth hereinafter.

Hereinafter, a method of manufacturing a heat dissipation circuit board according to an embodiment of the present invention will be described with accompanying drawings.

Words or terms used through the specification and claims are not limited by definitions defined in a dictionary. In order to clearly describe the present invention, the definitions of the words or terms are properly defined and used to be suitable to the spirit and scope of the present invention.

Embodiments described in the specification and structures shown in the accompanying drawings are only embodiments of the present invention. The present invention may be embodied in many different forms and should not be constructed as being limited to the embodiments set forth therein.

FIG. 2 is a flowchart illustrating a method of manufacturing a heat dissipation circuit board according to an embodiment of the present invention, and FIG. 3 through FIG. 7 are cross-sectional views for sequentially showing the manufacturing processes of a heat dissipation circuit board shown in FIG. 2.

As shown in FIG. 2, the method of manufacturing the heat dissipation circuit board 300 according to the present embodiment includes a substrate stacking step S200, a space forming step S210, a lower metal layer removing step S220, and a pressing step...
Referring to FIG. 3 through FIG. 7, a lower metal layer 310, an insulating layer 320, and an upper metal layer 330 are sequentially stacked on a substrate 300 at step S200. It is preferable to use copper to form the lower metal layer 310 and the upper metal layer 330. However, the lower and upper metal layers 310 and 330 may be formed of aluminum or the alloy thereof.

A roughing process is performed to form nodule 315 or 335 on the lower or upper metal layers 310 or 330 in order to closely contact the lower or upper metal layers 310 or 330 to the insulating layer 320. As a result, fine nodule 315 or 335 is formed on the surface of the lower or upper metal layers 310 or 330. The nodule functions as anchor to hold the insulating layer 320 and enhance the adhesive force when the lower or upper metal layers 310 or 330 is adhered to the insulating layer 320 at high temperature and high pressure.

After the roughing process is performed to form the nodules 315 or 335, the lower and upper metal layers 310 and 330 are stacked on the insulating layer 320 through hot-press pressurizing.

According to the present embodiment, the heat dissipation circuit board can be formed to have a proper thickness to dissipate heat according to the part 350 by forming a circuit pattern without having the limitation in thicknesses of the lower and upper metal layers 310 and 330.

At step S210, a space 340 for mounting the part 350 is formed by removing the upper metal layer 330 and the insulating layer 320 from the substrate formed at the substrate stacking step S200.

The lower and upper metal layers 310 and 330 can be removed through etching process. The insulating layer 320 can be removed using thrill. However, the present invention is not limited thereto. For example, ultraviolet (UV) laser or a carbon dioxide (CO₂) laser can be used to remove them.

At step S220, the lower part 360 of the lower metal layer 310 is removed at a predetermined depth corresponding to the spaces 340 formed at the space forming step S210. Herein, the predetermined depth denotes a reference value defined to prevent a metal layer have been crowded out when the upper part of the space is pressed through a press. That is, the predetermined depth denotes a reference value decided according to heat-resisting property and flexibility, or the thickness of the heat dissipation circuit board.

It is preferable to form the space 340 to have a wider area than an actual area for mounting the part 350. A wire bonding of the part 350 or an electrode is connected to the surface of the upper metal layer 330, the top of the substrate 300.

Then, the top of the space 340 formed at the space forming step S210 is pressed at
step S230. After pressing, the substrate has about a concave shape, and the part 350 is directly mounted on the lower metal layer 310. As a result, the heat generated from the part 350 is directly transferred to the lower metal layer 310 without being blocked by the insulating layer 320. After pressing the top of the space 340, the inner side of the space 340 is plated to improve the light concentration.

Meanwhile, FIG. 8 through FIG. 10 are cross-sectional views for sequentially showing the manufacturing processes of a heat dissipation circuit board shown in FIG. 2 according to another embodiment of the present invention.

As shown, the lower metal layer 410, the insulating layer 420, and the upper metal layer 430 are sequentially stacked on the substrate 400, and the surface of the lower or upper metal layer 410 or 430 is roughed to form nodule 415 or 435. Then, the upper metal layer 430 and the insulating layer 420 are removed to form a space 440 for mounting a part 450. It is preferable to form the space 440 to have an area identical to an actual area for mounting the part 450.

Then, the lower part 460 of the lower metal layer 410 is removed at a predetermined depth corresponding to the space 440. Herein, the predetermined depth denotes a reference value set to prevent a metal layer have been crowded out when the top of the space is pressed through a press. That is, the predetermined depth denotes a reference value decided according to heat resisting property and flexibility, or thickness of the heat dissipation circuit board.

Then, the top of the space 440 is pressed. After pressing, the substrate has a concave shape, and the part 450 is directly mounted on the lower metal layer 410. As a result the heat generated from the part 450 is directly transferred to the insulating layer 420 without being blocked by the insulating layer 420.

As shown in FIG. 10, since the upper metal layer 430 and the insulating layer 420 are remained in the space 440 for mounting the part 450, the wire bonding of the part 450 and an electrode become connected to the inner side of the space 440, thereby helping the part to be miniaturized.

After pressing the space, it is preferable to plate the inner side of the space for reflecting the light. The plated inner side of the space 440 improves the light concentration.

Meanwhile, the present invention also relate to a heat dissipation circuit board manufactured by a method of manufacturing a heat dissipation circuit board according to the present embodiment.

While the present invention has been described with respect to certain preferred embodiments, it will be apparent to those skilled in the art that various changes and modifications may be made without departing from the scope of the invention as defined in
the following claims.
Claims

[1] A method of manufacturing a heat dissipation circuit board comprising:
forming a substrate by sequentially stacking a lower metal layer, an insulating layer, and an upper metal layer;
forming a space for mounting a part on the substrate by removing the upper metal layer and the insulating layer;
removing a lower part of the lower metal layer corresponding to the formed space in consideration of heat-resistance property, flexibility, and thickness at a predetermined depth; and
pressing a top of the formed space,
wherein in the step of forming the substrate, surfaces of the lower or upper metal layers are roughed and stacked on the insulating layer.

[2] The method of claim 1, wherein in the step of forming the substrate, the lower metal layer or the upper metal layer is stacked on the insulating layer through pressurizing using a hot-press.

[3] The method of claim 1, wherein the space for mounting the part is formed to have a wider area than an actual area for mounting the part.

[4] The method of claim 1, wherein the space for mounting the part is formed to have an area identical to an actual area for mounting the part.

[5] The method of claim 1, wherein the lower metal layer and the upper metal layer are removed through an etching process and the insulating layer is removed using a thrill or a laser.

[6] The method of claim 1, wherein the step of pressing the top of the formed space, an inner side of the formed space is plated for reflecting light.

[7] A heat dissipation circuit board manufactured by a method of manufacturing a heat dissipation circuit board, which is claimed in one of claims 1 to 6.
INTERNATIONAL SEARCH REPORT

PCT/KR2007/001168

A. CLASSIFICATION OF SUBJECT MATTER

H05K 7/20(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 8 HOIL 33/00 HOIL 29/22

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

KOREAN UTILITY MODELS AND APPLICATIONS FOR UTILITY MODEL SINCE 1975

JAPANESE UTILITY MODELS AND APPLICATIONS FOR UTILITY MODEL SINCE 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKIPASS (KIPO internal) "PRINTED" "CIRCUIT" "BOARD" "HEAT" "LED"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>JP 2003-304000 A (CITIZEN ELECTRONICS CO) 24 OCTOBER 2003 see the whole document</td>
<td>1</td>
</tr>
<tr>
<td>A</td>
<td>US 2005/0199899 A1 (LIN et al ) 15 SEPTEMBER 2005 see the whole document</td>
<td>1</td>
</tr>
</tbody>
</table>

Further documents are listed in the continuation of Box C

See patent family annex

* Special categories of cited documents
  "A" document defining the general state of the art which is not considered to be of particular relevance
  "E" earlier application or patent but published on or after the international filing date
  "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)
  "O" document referring to an oral disclosure, use, exhibition or other means
  "P" document published prior to the international filing date but later than the priority date claimed

T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

& document member of the same patent family

Date of the actual completion of the international search

15 JUNE 2007 (15 06 2007)

Date of mailing of the international search report

18 JUNE 2007 (18.06.2007)

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
920 Dunsan-dong, Seo-gu, Daejeon 302-701, Republic of Korea
Facsimile No 82-42-472-7140

Authorized officer

SEO, Hawthorne

Telephone No 82-42-481-5670

Form PCT/ISA/210 (second sheet) (April 2007)
<table>
<thead>
<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>JP2003304000A2</td>
<td>24.10.2003</td>
</tr>
<tr>
<td>US2005199899AA</td>
<td>15.09.2005</td>
<td>NONE</td>
<td></td>
</tr>
</tbody>
</table>

Form PCT/ISA/210 (patent family annex) (April 2007)