The present invention discloses a thermal module for light source, which comprises a heat-conducting part and a heat-dissipating part engaged therewith. The heat-conducting part is provided with a heat-receiving portion to receive the heat generated by a light source, a joint portion to join with the heat-dissipating part. The heat-dissipating part is provided with a plurality of fin-shaped heat-dissipating sheets for heat dissipation and to join with the joint portion of the heat-conducting part.
THERMAL MODULE FOR LIGHT SOURCE

FIELD OF THE INVENTION

[0001] The present invention is generally related to a heat-dissipating structure for light sources and, more particularly, to a thermal module comprising a heat-conducting part and a heat-dissipating part engaged therewith for providing improved performance of heat-conduction and heat-dissipation.

DESCRIPTION OF THE PRIOR ART

[0002] Light-emitting diodes (LEDs) provide numerous advantages including features of high smoothness, high luminance, and high color reproducibility and comply with the environmental protection policies for not using mercury which is harmful to the earth. Comparing with the conventional illumination or lighting technologies, the LEDs can be made thinner and more compact than the traditional light bulbs, cold cathode fluorescent lamps (CCFLs), or fluorescent tubes. As the LEDs are improved unceasingly in the brightness and luminescent efficiency, they are now developed well in variety of applications. From the basic LED lamps to the outdoor advertisement billboards and the backlight module of displays, it is expected that LEDs are able to replace the various lighting technologies used nowadays and become the main stream in lighting technologies of the next generation.

[0003] As the input efficiency of the high power LED is only 15–20%, the rest of the power will be transformed and released by the form of heat. Consequently, if the heat is not removed in time, it will generate various problems, such as:

[0004] 1. The excesses of waste heat will bring overtemperature around the junction positions of LED dice, and thus decreasing their lighting efficiency and their lifetime.

[0005] 2. The efficiency of phosphor powder for LEDs is lowered under high temperature, and thus decreasing the quality of color of LEDs.

[0006] 3. The plastic materials for packaging LED components, such as epoxy materials, are easily denatured as the temperature rising, and thus causing the light of certain wavelengths to be absorbed and generating color shifting and attenuation of the LEDs.

[0007] 4. When the temperature rises to the glass transition temperature (T_g) of the epoxy materials, the epoxy materials may expand rapidly, and the corresponding thermal stress generated may weaken the joins between the LED dice and the solder, break the circuits of LEDs, and further lose their functionality.

[0008] Therefore, it is needed to design an effective thermal dissipating structure for LED modules on the heat exchanger, to avoid the foregoing problems.

[0009] The thermal dissipating structure of the early “lamp type” LED package dissipates heat only depending on its two wires, which generates quite large thermal resistance for their thin shape. After that, the advanced “surface-mount device” (SMD LED packaging technique is developed, which owns a plastic base plate contacted with the substrate with a larger contact area for thermal dissipation. However, due to the huge amount of heat generated locally by the LED components using nowadays with high brightness, the heat dissipating ability of the conventional heat dissipating structure is no more competent for the white light LED components with the growing power, i.e., the heat dissipating rate is less than the heat generating rate of the white light LED components. Therefore, well designed heat dissipating structures are essential for the LEDs to completely replace the conventional lighting technologies and become the technology of the new generation, otherwise the lowered lighting efficiency and the shortened lifetime will be the chief defects. The bottleneck of heat dissipation for LEDs is the tough problem needed to be overcome in the industries.

[0010] It is considered that LED components are not suitable to install fans thereon based on the considerations of their volume, maintenance, and power consumption, and consequently there are other possible ways for heat dissipation of LED components. For example, the heat dissipating ability may be reinforced by changing the materials of the substrate of the bare LED chips, carrying out the way of flip-chip processes, or embedding heat sinks made of copper under the LED chips. The heat dissipating modules of LEDs are similar to the heat dissipating modules of central processing units (CPUs) which comprise cooling fins and thermal interface materials. The patents related to the improvement of performance of cooling fins for LEDs are almost concentrated on the modifications of cooling fins for enlarging the heat dissipating areas or adding another wire for more uniform heat distribution. For example, the Taiwan Patent Publication “M325445” discloses a LED lighting apparatus with heat dissipating structure, which comprises a plurality of cooling fins set around the light apparatus for heat dissipation. The above patent is characterized by the wave-type cooling fins which increase the heat dissipating area per unit volume, and a heat dissipating vent is formed between the adjacent cooling fins. Although the patent provides improved heat dissipating ability by modifying the cooling fins, the patent failures to provide interfaces between the lighting apparatus and the heat dissipating structures for contacting and heat transferring, and thus the heat generated by the lighting apparatus would not be effectively transferred to the dissipating structure. To overcome the above problem, the idea of forming a thermal interface structure is provided, such as the Taiwan Patent Publication “M297441” discloses a LED projection light source module, which utilizes a thermal interface material with high heat transfer coefficient to improve the heat transfer efficiency. Utilizing the thermal interface material to reinforce the heat transfer efficiency greatly improves the performance of the dissipating module. However, the thermal interface material and heat dissipating structure are almost joined together via the way of soldering in the industry, and the majority of soldering materials, such as tin, do not provide with good heat transfer property. By this way, the solder junction between the thermal interface material and the heat dissipating structure will produce high thermal resistance and weaken the advantages of the design. Therefore, the industries need a novel design of heat dissipating module to overcome the problems exist in the prior arts and provide an effective solution of heat dissipation for LED components.

SUMMARY OF THE INVENTION

[0011] In view of the defects existed in the prior arts, the present invention provides a thermal module with novel design, which provides good heat dissipating performance and avoids generating high thermal resistance on the interface of materials. The thermal module according to the embodiments of the present invention comprises a heat-conducting...
part and a heat-dissipating part joined therewith, wherein the heat-conducting part comprising a heat-receiving portion to contact with a light source and to receive and transfer the heat generated by the light source; an joint portion extended out from the other side of the heat-receiving portion, and a plurality of engaging slots distributed on the outer periphery of the joint portion for joining with the heat-dissipating part. The heat-dissipating part comprises a plurality of fin-shaped heat-dissipating sheets formed radially extended thereon, and a plurality of engaging slots are formed on the fin-shaped heat-dissipating sheets for joining and fixing with the corresponding engaging slots on the heat-conducting part and receiving the heat transferred from the heat-conducting part.

[0012] In the present invention, the heat-conducting part is made of materials with high heat transfer coefficient for rapidly transferring the heat generated by the light source to the heat-dissipating part. The heat-dissipating part is also made of materials with high heat transfer coefficient, but the heat transfer coefficient of heat-dissipating part materials must be lower than the heat transfer coefficient of heat-conducting part materials, and therefore the heat could be transferred from the heat-conducting part to the heat-dissipating part. The heat-dissipating part according to the embodiments of the present invention provides large dissipating areas for improved dissipating performance.

[0013] In one aspect of the present invention, a thermal module comprising heat-dissipating structure with high heat transfer coefficient is provided for rapidly and uniformly transferring heat to a thermal interface and changing heat with the external cool air.

[0014] In one purpose of the present invention, a solution to the problem of the high thermal resistance existed in the prior arts caused by joining materials by soldering is provided, and thus a better dissipating performance is provided.

[0015] In connection with the following detailed description taken in conjunction with the accompanying drawings, the present invention can be more fully appreciated and understood.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] FIG. 1 illustrates the heat-conducting part and the heat-dissipating part according to the embodiments of the present invention;

[0017] FIG. 2 illustrates the fin-shaped heat-dissipating sheet and the engaging slot formed thereon according to the embodiments of the present invention; and

[0018] FIG. 3 illustrates the whole thermal module according to the embodiments of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0019] The following description provides the detailed embodiments of the present invention for thoroughly understood the embodiments of the present invention. However, skilled in the arts should appreciate that some certain details are not necessary for practicing the present invention. Further, the terms used in the details according to the embodiments of the present invention should be defined with the most widely reasonable ways.

[0020] The thermal module provided by the present invention mainly comprises a heat-conducting part and a heat-dissipating part joined therewith for providing improved heat dissipating performance. In the embodiments of the present invention, the heat-conducting part is utilized to collect the heat generated from the different portions of the light source. Therefore, the heat-conducting part comprises a flat heat-receiving portion for directly contacting with each portion of the light source. The heat-receiving portion can be formed as any flat shapes, such as round shape, rectangular shape, or irregular shapes, depending on the number and layout of the light source. On side of the heat-receiving portion is contacted with the light source, and the other side of the heat-receiving portion comprises a joint portion extended thereon for joining with the heat-dissipating part of the present invention. In the embodiments of the present invention, the joint portion of the heat-conducting part is formed as a hollow structure, which is utilized to join with the corresponding components on the heat-dissipating part for the purpose of transferring heat. To uniformly distribute the heat collected by the heat-receiving portion, it is better to have the same shape of both the cross-section of the joint portion and the plane of the heat-receiving portion contacting with the joint portion, and thus each area of the joint portion contacted with the heat-receiving portion shares the same amount of heat.

[0021] On the other hand, the heat-dissipating part is utilized for rapidly changing the heat receiving from the heat-conducting part with the external cool air, and a larger heat-dissipating area contacted with the air is preferred. The structure of the heat-dissipating part according to the embodiments of the present invention comprises a plurality of fin-shaped heat-dissipating sheets radially extended thereon, and a plurality of engaging slots are formed on the fin-shaped heat-dissipating sheets for joining and fixing with the joint portion of the heat-conducting part. Therefore, the heat received by the heat-conducting part can be transferred rapidly and uniformly to each of the fin-shaped heat-dissipating sheets. To control the heat flow direction, the heat transfer coefficient of the heat-conducting part is higher than the heat transfer coefficient of the heat-dissipating part of the present invention, and thus the bulk of the heat flow direction is assured of forwarding to the heat-dissipating part.

[0022] Referring to FIG. 1, it illustrates the heat-conducting part 100 and the heat-dissipating part 110 according to the embodiment of the present invention. As illustrated, the structures of the heat-conducting part 100 and the heat-dissipating 110 are generally provided as cylinders. The heat-conducting part 100 comprises a heat-receiving portion 102 formed as a round plane for contacting with the light source directly and receiving the heat. The position and the size of the area covered by the heat-receiving portion 102 may be depending on the amount and layout of the light source components for minimizing the material cost and optimizing the heat-conducting performance. A joint portion 104 forms a round tube extends out from the other side of the heat-receiving portion 102, and the round tube is a hollow structure for minimizing the material cost and contributing the joint of the heat-conducting part 100 and the heat-dissipating part 110. The joint portion 104 comprises a plurality of engaging slots 106 distributed on the outer periphery of the extension end for joining with the heat-dissipating part 110 and fixing the heat-dissipating part 110 on the outer end of the joint portion 104. The amount of the engaging slots 106 set on the heat-conducting part 100 is depending on the amount of the fin-shaped heat-dissipating sheets 112 set on the heat-dissipating part 110. The more the amount of the engaging slots 106 and fin-shaped heat-dissipating sheets 112, the better the heat transferring performance between the heat-conducting part...
and heat-dissipating part 110, and thus the heat can be transferred more rapidly and uniformly to the heat-dissipating part 110 for heat exchange. As illustrated in FIG. 1, the heat-dissipating part 110 is a cylindrical structure having a plurality of fin-shaped heat-dissipating sheets 112 formed thereon according to the embodiment of the present invention. The fin-shaped heat-dissipating sheets 112 radially extend out from the cylindrical portion 114 set on the core of the heat-dissipating part 110, wherein the distances between every two fin-shaped heat-dissipating sheets are identical for providing uniform heat-dissipating performance. Further, every fin-shaped heat-dissipating sheet 112 comprises an engaging slot 116 formed thereon. The dimension of the engaging slot 116 is designed to be adaptable to join with the corresponding engaging slot 106 on the heat-conducting part 100, and thus the heat-conducting part 100 and the heat-dissipating part 110 can be joined and fixed tightly. Consequently, the heat received by the heat-conducting part 100 from the light source can be then transferred to each of the fin-shaped heat-dissipating sheets 112 for heat dissipation. In the embodiment of the present invention, the more the amount of the fin-shaped heat-dissipating sheets 112 is set, the larger the heat-dissipating area for heat exchange with external cool air is provided. And thus the better heat-dissipating performance is provided.

As illustrated in FIG. 2, it shows one fin-shaped heat-dissipating sheet 112 according to the embodiments of the present invention. There is one engaging slot 116 formed on the fin-shaped heat-dissipating sheet 112 for function of joint, and it is best to set the engaging slot 116 on the middle section of fin-shaped heat-dissipating sheet 112 for uniform distribution of heat on the fin-shaped heat-dissipating sheet 112. In the embodiments of the present invention, the dimension of the width W of the engaging slots 106 and 116 are designed for tight joint, and depth D can be modified on demand. The arrow symbols illustrated represent the heat flow directions on the fin-shaped heat-dissipating part 112, and it should be appropriated that the best uniform heat-dissipating performance is provided when the engaging slot 116 is set on the middle section of the fin-shaped heat-dissipating sheet 112.

For the aspect of manufacturing, the heat-conducting part 100 can be formed integrally by casting, and the materials with high heat transfer coefficient, such as copper, aluminum, silver, gold, or composite materials with high heat transfer coefficient, are utilized for providing improved heat transferring performance. On the other hand, the heat-dissipating part 110 can be formed by way of extrusion, and the materials with high heat transfer coefficient, such as copper, aluminum, silver, gold, or composite materials with high heat transfer coefficient, are also utilized for providing improved heat transferring performance. The engaging slots on the heat-conducting part 100 and heat-dissipating part 110 are formed by cutting machines with certain adequate dimensions. It should be noted that for controlling the heat flow directions, the heat transfer coefficient of the heat-conducting part 100 is higher than the heat transfer coefficient of the heat-dissipating part 110 according to the embodiments of the present invention, and thus the bulk of the heat flow direction is assured of forwarding to the heat-dissipating part.

The joint between the metal components are usually implemented by soldering techniques in the prior arts. However, if the soldering material, such as tin, is utilized in the embodiments of the present invention, the interfacial heat resistance between the heat-conducting part 100 and the heat-dissipating part 110 will increase apparently, and the heat transferring performance will be reduced. Therefore, instead of using tin materials, the joint processes are implemented by the mutual engagement between the engaging slots with physically joint in the embodiments of the present invention. During the joint processes, the heat-conducting part 100 or the heat-dissipating part 110 will first be put in the heating furnace for achieving a certain temperature. As the metals get expanded apparently when heating, the width W of engaging slots 106 or 116 will become wider and be suitable for carrying out engagement with the corresponding engaging slots. The structure of heat-conducting part 100 and heat-dissipating part 110 after joining is illustrated as FIG. 3. The whole thermal module 300 is illustrated according to an embodiment of the present invention. When the thermal module 300 is cooled to the room temperature, the width W of the engaging slots will contract back the original width and provide the effect of tight joint. Therefore, the structure of the present invention provides good joint effect without using soldering materials and provides good heat transferring properties. As illustrated in FIG. 3, the joined thermal module 300 first receives the heat generated by the light sources via the heat receiving portion, and then the heat will be transferred to the tube-shaped joint portion 104. The heat on the joint portion 104 can be effectively and uniformly transferred to each of the fin-shaped heat-dissipating sheets 112 joined with the joint portion 104. The fin-shaped heat-dissipating sheets 112 provide wide and separated heat-dissipating areas, and the heat flow channels formed between the fin-shaped heat-dissipating sheets 112 facilitate the heat exchange between the heat-dissipating sheets 112 and the external cool air for dissipating the heat generated by the light sources. Furthermore, the heat-conducting part and the heat-dissipating part are formed as cylinders, rectangular cylinders, or other symmetrical forms, and they are joined together by coaxial alignment.

The present invention is not limited to the specific details described herein. Under the spirit and scope of the present invention, different modifications based on the descriptions and illustrations are possible. Therefore, the present invention should be defined by the following claims and all the possible modifications and variations but not by the above description.

What is claimed is:
1. A thermal module for light source, comprising:
   a heat-conducting part comprising a heat-receiving portion, to receive heat generated by a light source;
   a joint portion extended out from one side of said heat-receiving portion, and said joint portion comprises a plurality of first engaging slots distributed on outer periphery of said joint portion; and
   a heat-dissipating part comprising a plurality of fin-shaped heat-dissipating sheets formed radially extended thereon, and said fin-shaped heat-dissipating sheets comprising a plurality of second engaging slots formed therein, wherein said second engaging slots are corresponding to said first engaging slots for engaging mutually, fixing said heat-dissipating part on outer periphery of said joint portion, and receiving said heat from said heat-conducting part;
   wherein heat transfer coefficient of said heat-conducting part is higher than heat transfer coefficient of said heat-dissipating part.
2. The thermal module for light source of claim 1, wherein said heat-conducting part and said heat-dissipating part are formed as symmetrical forms, and said heat-conducting part and said heat-dissipating part are joined together by coaxial alignment.

3. The thermal module for light source of claim 2, wherein said symmetrical forms are cylinders, rectangular cylinders, or a combination thereof.

4. The thermal module for light source of claim 1, wherein said first engaging slots and said second engaging slots are tightly joined together by thermal expansion and contraction.

5. The thermal module for light source of claim 1, wherein said heat-conducting part is formed by casting.

6. The thermal module for light source of claim 1, wherein said heat-dissipating part is formed by extrusion.

7. The thermal module for light source of claim 1, wherein said heat-conducting part is made of copper, aluminum, silver, gold, or composite materials with high heat transfer coefficient.

8. The thermal module for light source of claim 1, wherein said fin-shaped heat-dissipating sheets are formed as wavy-shaped shape for improving heat transferring performance.

9. The thermal module for light source of claim 1, wherein said second engaging slots are formed on middle section of said fin-shaped heat-dissipating sheets for uniformly heat distribution on said fin-shaped heat dissipating sheets.

10. The thermal module for light source of claim 1, wherein said light source is light-emitting diode (LED).