US 20070199681A1

(19) **United States**
(12) **Patent Application Publication**
**Hwang et al.**
(10) **Pub. No.: US 2007/0199681 A1**
(43) **Pub. Date: Aug. 30, 2007**

(54) **DISSIPATION HEAT PIPE STRUCTURE AND MANUFACTURING METHOD THEREOF**

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(21) Appl. No.: **11/307,827**

(22) Filed: **Feb. 24, 2006**

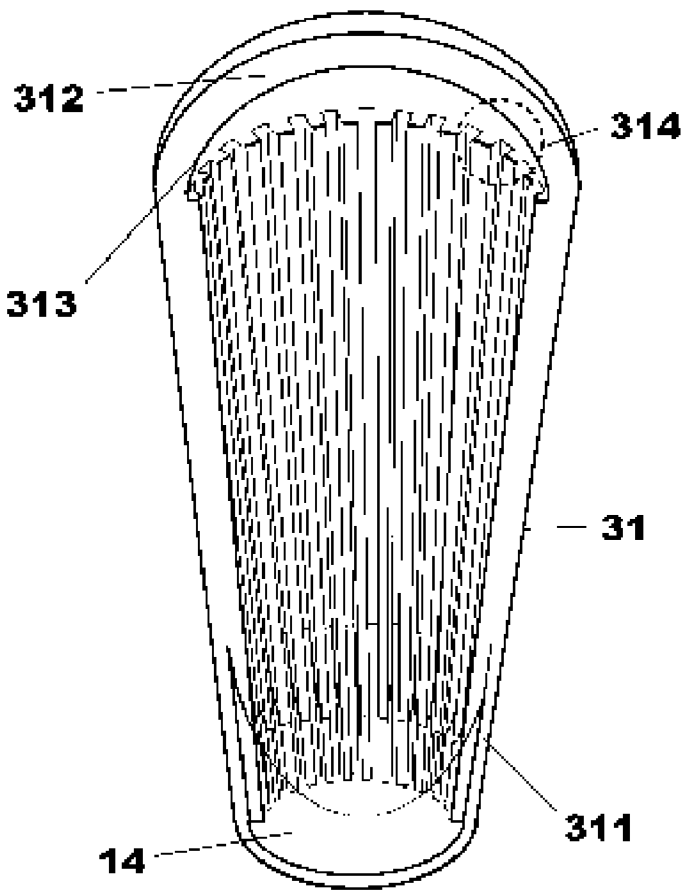
**Publication Classification**

(51) **Int. Cl.**
*F28D 15/00* (2006.01)

(52) **U.S. Cl.** ........................................ **165/104.26**

(57) **ABSTRACT**

This invention discloses a manufacturing method and the structure for a dissipation heat pipe. This dissipation heat pipe includes a hollow closed pipe, a type of fluid and a wick structure. The dissipation heat pipe is often used in conducting the heat from a chip. The dissipation heat pipe can be made of a special thermal conduction material, including the metal and a bracket structure of carbon element which have high thermal conductivity, so as to improve the heat conduction efficiency. The corresponding manufacturing method for this heat conduction material can be made by chemical vapor deposition, physical vapor deposition, electroplating or the other materials preparation method. The bracket structure of carbon element can coat on the metal surface and can also be mixed into the metal.



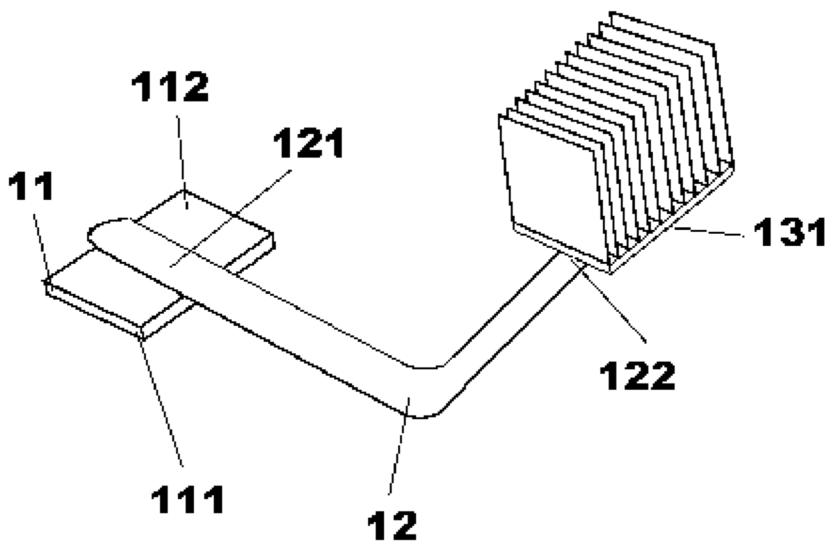



Fig. 1

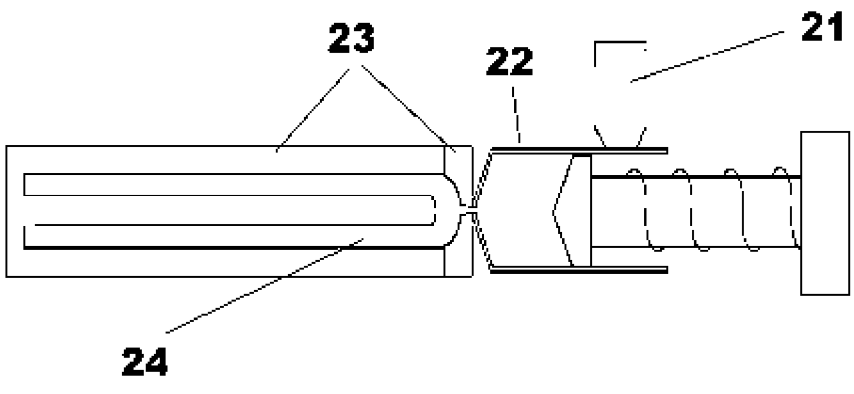



Fig. 2

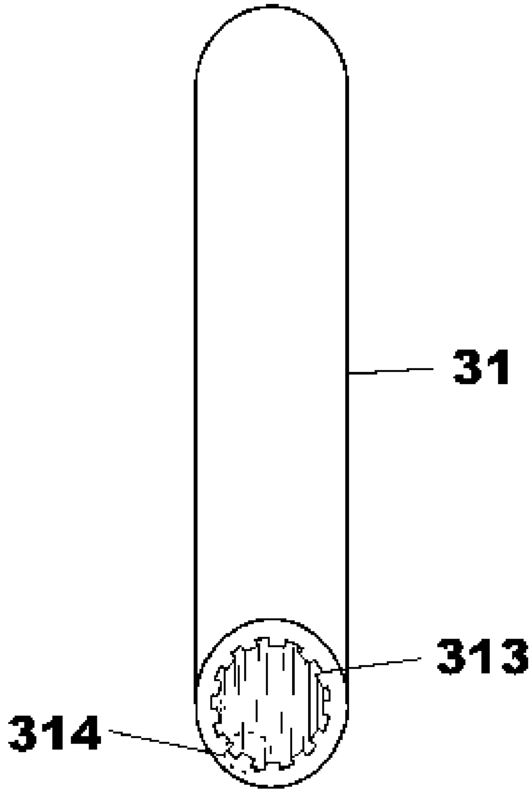



Fig. 3

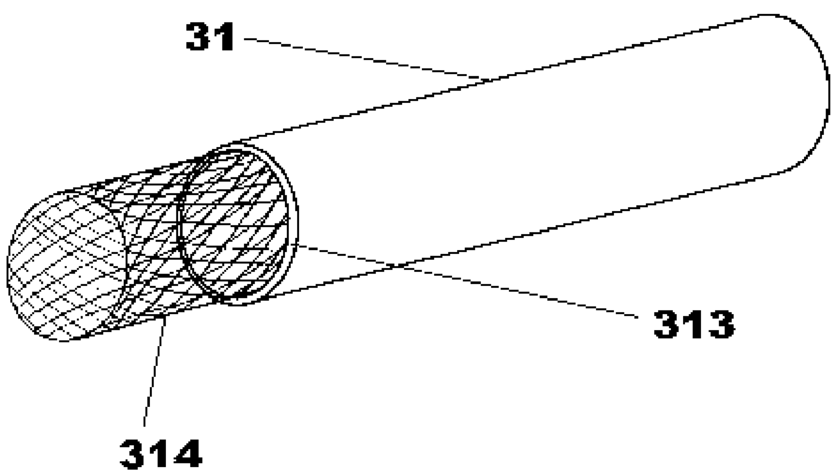



Fig. 4

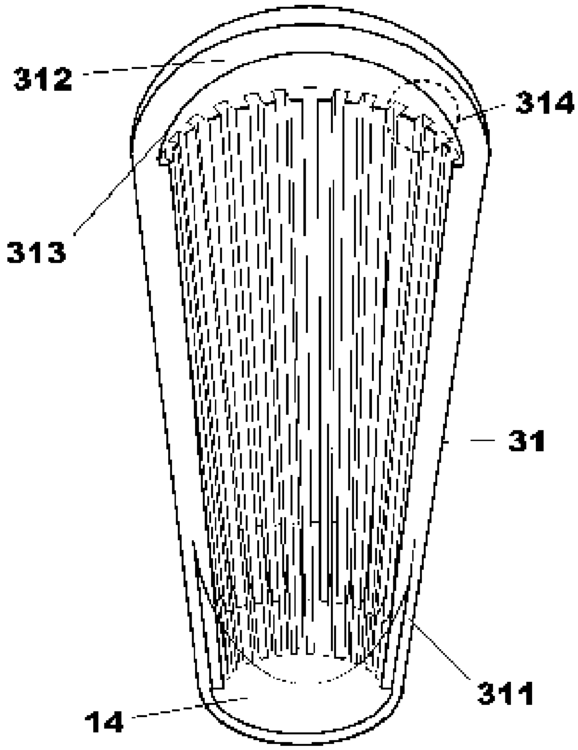



Fig. 5

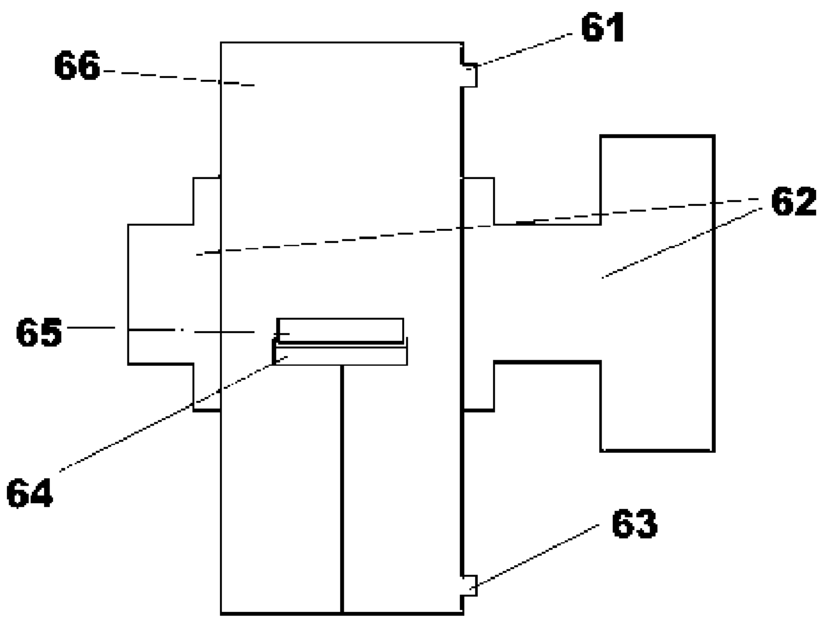



Fig. 6

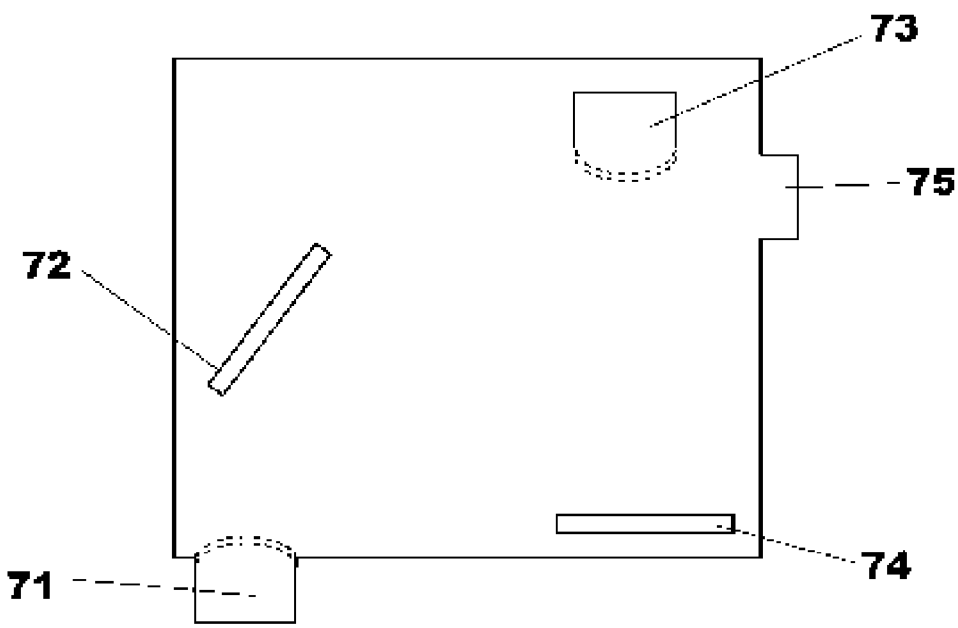



Fig. 7

# DISSIPATION HEAT PIPE STRUCTURE AND MANUFACTURING METHOD THEREOF

## FIELD OF THE INVENTION

[0001] The present invention relates to a dissipation heat pipe structure and corresponding manufacturing method and, more particularly, to the manufacturing method for manufacturing a heat conduction material combining a metal with a bracket structure of carbon element.

## BACKGROUND OF THE INVENTION

[0002] In recent years, the pace of high technology industry development is extremely fast, the development of electronic components is toward small volumes and high densities. The efficiency requirements for the aforesaid components also increase that generates much waste heat. The efficiency of the electronic components will be decreased and destroyed if the waste heat is unable to eliminate appropriately. Therefore, various heat conduction materials are provided to improve the efficiency of heat dissipation.

[0003] In the prior art, the material applying in the heat dissipation structure usually includes copper or aluminum to be the tendency of current heat dissipation technology. Traditionally, aluminum applying in the heat dissipation material is restricted to cause a bottleneck because of high temperature conduction is produced by the efficiency upgrade of central processors. Copper applying in the heat dissipation technology is then provided. However, copper has a higher specific gravity that has disadvantage to shape and the application is restricted. Although both copper and aluminum are used for air cooling to implement heat dissipation, the air cooling incorporating the aforesaid copper and aluminum will be unable to satisfy the demand for heat dissipating when the heat release of chips achieves 50 $W/cm^2$. Therefore, the high efficiency of heat dissipation materials needs to improve.

[0004] In addition, to satisfy the demand for the heat dissipation and the space restriction, a dissipation heat pipe is in widespread use for conducting heat. The dissipation heat pipe can be used in a small and narrow space by using a fluid within the dissipation heat pipe to absorb and release heat to generate a phase change for conducting heat. A greater heat transfer can be generated by the dissipation heat pipe at a slight temperature difference and there is a reputation of "heat superconductor" for the dissipation heat pipe. Therefore, a conventional heat dissipation module is developed and comprises at least one dissipation heat pipe, at least one heat dissipation slip, and a plurality of heat sink fins.

[0005] Referring to FIG. **1**, a schematic diagram illustrates a conventional heat dissipation module and a heat conduction process. The heat dissipation module as shown in FIG. **1** comprises a heat dissipation slip **11**, a dissipation heat pipe **12** and a plurality of heat sink fins **13**. The heat dissipation slip **11** includes a lower surface **111** and an upper surface **112** which is corresponded to the lower surface **111**. The heat conduction process is that the lower surface **111** of the heat dissipation slip **11** is contacted to a waste heat generated by a heat source first of all. The waste heat is then conducted to the upper surface **112** of the heat dissipation slip **11**. The dissipation heat pipe **12** comprises a heat source end **121** and a heat dissipation end **122**. The heat source end **121** is coupled to the upper surface **112** of the heat dissipation slip **11**. The waste heat is conducted to the heat dissipation end **122** of the dissipation heat pipe **12** from the heat source end **121** of the dissipation heat pipe **12**. A bottom **131** is formed by the plurality of heat sink fins **13**. Specifically the bottom **131** is composed of each edge of each fin. The heat dissipation end **122** of the dissipation heat pipe **12** is contacted to the bottom **131** to conduct the waste heat to the plurality of heat sink fins **13**. Lastly, the waste heat is discharged through the convection and the radiating.

[0006] Besides, diamonds are well known and have characteristics with the highest hardness, the fastest heat conduction, and the widest refraction range in current materials. Diamonds, therefore, are always one of more important materials in engineering due to the excellent characteristics. The thermal conductivity of diamonds at the normal atmospheric temperature is five times more than copper. Moreover, the thermal expansion factor of diamonds at high temperature is very small that shows the excellent efficiency for heat dissipating. The feature may help people to differentiate the adulteration of diamonds. In the prior art, many technologies and manufacture procedures have been developed to make diamonds. The direct decomposition for hydrocarbons is the most familiar method like Microwave Plasma Enhance Chemical Vapor Deposition (MPCVD) and Hot Filament CVD (HFCVD). By the aforesaid methods, polycrystalline diamond films can be deposited. The characteristic of the polycrystalline diamond films is same as the single crystal diamonds.

## SUMMARY OF THE INVENTION

[0007] Briefly, to eliminate the waste heat generated by electronic components efficiently and to face the development tendency of electronic components with small volumes and high densities, the object of the present invention is to provide a heat conduction material which is applied for a dissipation heat pipe to improve the efficiency of heat dissipation for a chip. The waste heat caused by the high temperature, which is generated from the operation of the chip, can be reduced. In addition, the heat conduction material provided by the present invention is not only restricted for the heat dissipation of the chip, but is also applied for other heat conduction apparatuses.

[0008] The heat conduction material provided by the present invention is applied for a dissipation heat pipe and the heat conduction material comprises combining a metal with a bracket structure of carbon element. The metal can be copper or aluminum or other metals with high thermal conductivity. The bracket structure of carbon element is diamonds and can also be used for coating on the metal surface or for encapsulating in materials. The bracket structure of carbon element can be further used in combining the metal with the materials.

[0009] The heat conduction material can be made by chemical vapor deposition, physical vapor deposition, melting, electroplating or other manufacturing methods. Other features and advantages of the present invention and variations thereof will become apparent from the following description, drawings, and claims.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. **1** is schematic diagram illustrating a conventional heat dissipation module;

[0011] FIG. **2** is a schematic diagram illustrating a die for manufacturing a dissipation heat pipe which has an end without sealing according to an embodiment of the present invention;

[0012] FIG. **3** is a schematic diagram illustrating setting a wick structure into the dissipation heat pipe according to an embodiment of the present invention;

[0013] FIG. **4** is a schematic diagram illustrating setting a wick structure into the dissipation heat pipe according to another embodiment of the present invention;

[0014] FIG. **5** is a perspective drawing illustrating the dissipation heat pipe according to an embodiment of the present invention;

[0015] FIG. **6** is a schematic diagram illustrating microwave plasma enhanced chemical vapor deposition for manufacturing a heat dissipation structure according to an embodiment of the present invention; and

[0016] FIG. **7** is a schematic diagram illustrating ion beam sputtering for manufacturing a heat dissipation structure according to another embodiment of the present invention.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0017] Referring to FIG. **2**, a schematic diagram illustrates a die for manufacturing a dissipation heat pipe which has an end without sealing according to an embodiment of the present invention. The die comprises a mold material supplier **21**, a mold material injector **22** and a mold **23**. A mold material is injected by the mold material injector **22** to a cavity **24** of the mold **23** for molding. The shape is a hollow closed pipe which has an end without sealing. The mold material can be a metal material or a melt material which combines a metal with a bracket structure of carbon element. The metal is copper or aluminum or silver or other metals with high thermal conductivity or other material combinations. The melting point of the bracket structure of carbon element is higher than any metal of the mentioned above. Therefore, the bracket structure of carbon element can be mixed with those metals to form a mold material.

[0018] The hollow closed pipe of a dissipation heat pipe **31** has an end without sealing according to FIG. **2**. A wick structure **314** is formed around an interior wall **313** of the hollow closed pipe as shown in FIG. **3**. The wick structure **314** which possesses groove shapes is etched by microstructure manufacturing from the interior wall **313**. As shown in FIG. **4**, the wick structure **314** of the interior wall **313** can also be made by sintering via a metal mesh around the interior wall **313**.

[0019] Lastly, referring to FIG. **5**, a perspective drawing illustrates the dissipation heat pipe **31** which has the end with sealing after filling a type of fluid **14** according to FIG. **3** or FIG. **4**. The heat conduction process for the dissipation heat pipe **31** is that a heat source end **311** of the dissipation heat pipe **31** is connected to the upper surface **112** of the heat dissipation slip **11** as shown in FIG. **1**. The waste heat which is distributed on the upper surface **112** is conducted to the liquid fluid **14** within the hollow closed pipe from the heat source end **311**. The waste heat is then absorbed by the liquid fluid **14** to implement a phase change for vaporizing the liquid fluid **14** to be the gaseous fluid **14**. The waste heat carried by the gaseous fluid **14** is conducted onto the bottom **131** of the plurality of heat sink fins **13** as shown in FIG. **1** through the heat dissipation end **312** when the gaseous fluid **14** is diffused to a heat dissipation end **312** of the dissipation heat pipe **31** and is then contacted to the interior wall **313** of the heat dissipation end **312**. The gaseous fluid **14** is implemented via the phase change again and is then condensed to the liquid fluid **14**. The liquid fluid **14** further returns to the heat source end **311** through the forcing of the wick structure **314** of the interior wall **313**. The aforesaid circulation process may help to discharge much heat. The heat is absorbed or released by the dissipation heat pipe **31** via the vaporization and the condensation of the type of liquid. Therefore, the dissipation heat pipe **31** possesses the outstanding heat conduction efficiency. The type of fluid **14** within the dissipation heat pipe **31** can be composed of water or liquids having heat conduction capacity.

[0020] In addition, the heat conduction material having the bracket structure of carbon element can be formed on a metal surface by using CVD or PVD. Referring to FIG. **6**, a schematic diagram illustrates microwave plasma enhanced chemical vapor deposition for manufacturing a heat dissipation structure according to an embodiment of the present invention. In the embodiment, the reaction procedure is that a mixed gas for desired reaction is delivered to a gas reaction room **66** from a gas entrance **61**. At the same time, a microwave is generated by a microwave generation system **62** to activate the mixed gas in order to provide reactive ions for reacting. A surface of a metal material **65** on a carrier **64** is absorbed to form diamond films. The metal material **65** is the dissipation heat pipe **31** as shown in FIG. **5** and can be copper or aluminum or other metals with high heat conductivity or other material combinations. Remaining gas is discharged via a waste gas exit **63**. By the way mentioned above, a heat conduction material coating diamond particles can be acquired.

[0021] Referring to FIG. **7**, a schematic diagram illustrates ion beam sputtering for manufacturing a heat dissipation structure according to another embodiment of the present invention. In the embodiment, the manufacturing procedure is that a target **72** is molded by diamond materials first of all. The placement angle of the target **72** and the shooting direction of ion beam of a first ion gun **71** are approximately forty five degrees. The diamond particles fired by the first ion gun **71** fly to the front of a second ion gun **73**. The diamond particles is then sputtered to the surface of a metal material **74** to form uniform diamond films by providing enough kinetic energy from the first ion gun **71**. The metal material **74** is the dissipation heat pipe **31** as shown in FIG. **5** and can be copper or aluminum or other metals with high heat conductivity or other material combinations. The remaining diamond particles are discharged by a waste gas exit **75**. By the way mentioned above, a heat conduction material coating diamond particles can be acquired.

[0022] Moreover, the heat conduction material having a metal and a bracket structure of carbon element can be further made by electroplating, melting except CVD and PVD of the above embodiments.

[0023] Although the features and advantages of the embodiments according to the preferred invention are disclosed, it is not limited to the embodiments described above, but encompasses any and all modifications and changes within the spirit and scope of the following claims.

What is claimed is:

1. A dissipation heat pipe structure, applied in conducting and dissipating a heat source generated by a chip, comprising:

a hollow closed pipe having a heat source end for contacting said heat source and a heat dissipation end which being corresponded to said heat source end for contacting a heat dissipation device, a temperature of said heat dissipation device being lower than said heat source;

a type of fluid, set at said heat source end within said hollow closed pipe, after said heat source being contacted to said heat source end to vaporize said type of fluid to be a vapor, said vapor being then contacted to said heat dissipation end to form said type of fluid; and

a wick structure, set at an interior wall of said hollow closed pipe for conducting said type of fluid to said heat source end from said heat dissipation end;

wherein said hollow closed pipe is combined a metal with a bracket structure of carbon element to form a heat conduction material.

2. The dissipation heat pipe structure of claim 1, wherein said heat source generated by said chip can be conducted by a heat dissipation slip to said heat source end.

3. The dissipation heat pipe structure of claim 1, wherein said hollow closed pipe can be any long column.

4. The dissipation heat pipe structure of claim 1, wherein said hollow closed pipe can be any flat column.

5. The dissipation heat pipe structure of claim 1, wherein said heat dissipation device is composed of a plurality of heat sink fins.

6. The dissipation heat pipe structure of claim 1, wherein said metal is copper.

7. The dissipation heat pipe structure of claim 1, wherein said metal is aluminum.

8. The dissipation heat pipe structure of claim 1, wherein said metal is silver.

9. The dissipation heat pipe structure of claim 1, wherein said metal is a metal material with high thermal conductivity.

10. The dissipation heat pipe structure of claim 1, wherein said bracket structure of carbon element is a diamond.

11. The dissipation heat pipe structure of claim 1, wherein said heat conduction material can be formed by chemical vapor deposition (CVD).

12. The dissipation heat pipe structure of claim 1, wherein said heat conduction material can be formed by physical vapor deposition (PVD).

13. The dissipation heat pipe structure of claim 1, wherein said heat conduction material can be formed by melting.

14. The dissipation heat pipe structure of claim 1, wherein said heat conduction material can be formed by electroplating.

15. A method for manufacturing a dissipation heat pipe structure, applied in conducting and dissipating a heat source generated by a chip, comprising:

employing a manufacturing to form a heat conduction material having a metal and a bracket structure of carbon element;

employing a die to form a hollow closed pipe;

forming a wick structure in an interior wall of said hollow closed pipe;

forming a type of fluid, set at an end within said hollow closed pipe; and sealing said hollow closed pipe.

16. The method for manufacturing a dissipation heat pipe structure of claim 15, further comprising providing copper to be said metal.

17. The method for manufacturing a dissipation heat pipe structure of claim 15, further comprising providing aluminum to be said metal.

18. The method for manufacturing a dissipation heat pipe structure of claim 15, further comprising providing silver to be said metal.

19. The method for manufacturing a dissipation heat pipe structure of claim 15, further comprising providing a metal material having high thermal conductivity to be said metal.

20. The method for manufacturing a dissipation heat pipe structure of claim 15, further comprising providing diamonds to be said bracket structure of carbon element.

21. The method for manufacturing a dissipation heat pipe structure of claim 15, further comprising providing CVD to form said heat conduction material.

22. The method for manufacturing a dissipation heat pipe structure of claim 15, further comprising providing PVD to form said heat conduction material.

23. The method for manufacturing a dissipation heat pipe structure of claim 15, further comprising providing melting to form said heat conduction material.

24. The method for manufacturing a dissipation heat pipe structure of claim 15, further comprising providing electroplating to form said heat conduction material.

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