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(54) **COOLING MODULE AND HELMET HAVING SAME**

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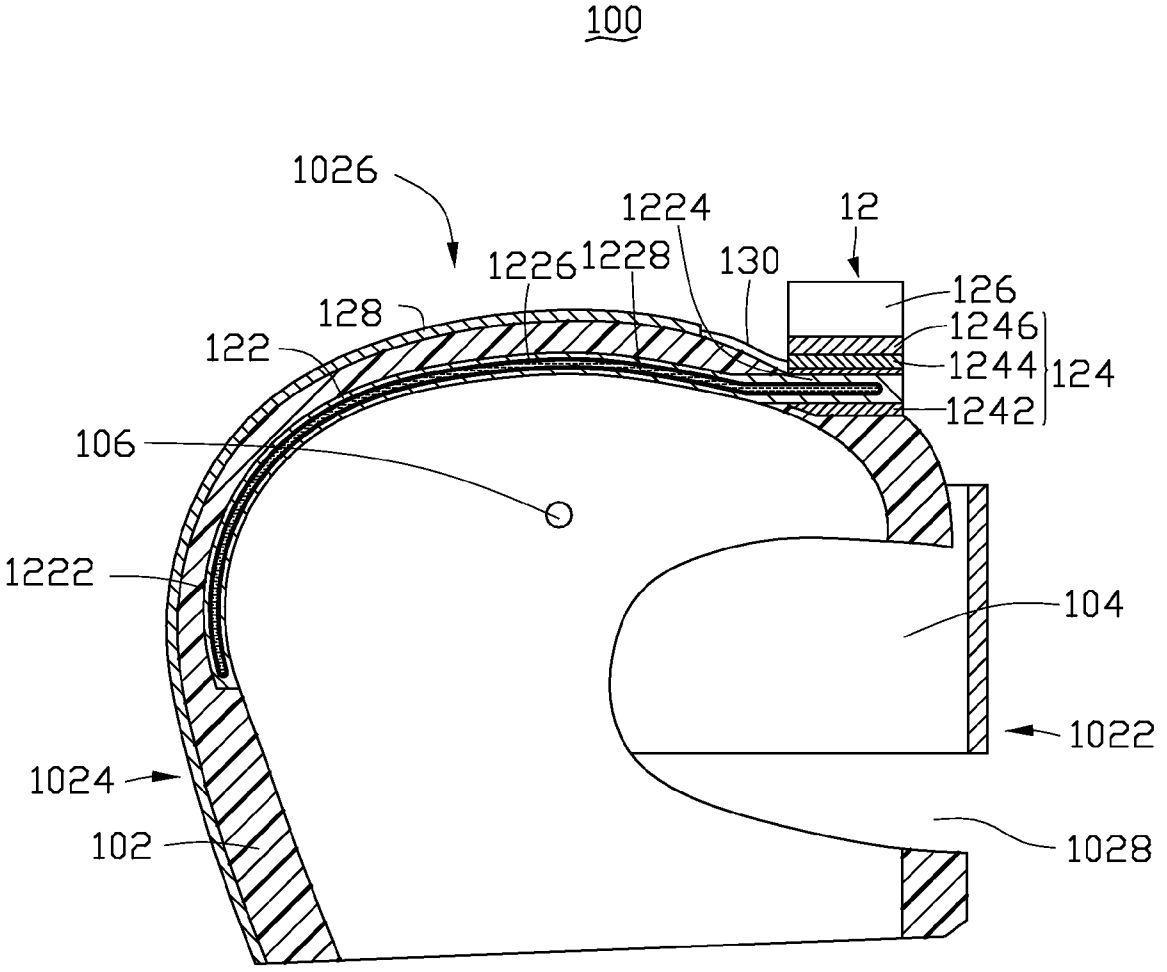
(57) **ABSTRACT**

A helmet includes a shell and a cooling module attached to the shell. The cooling module includes a heat pipe, a thermoelectric cooler, and a film type solar cell. The shell has an outer surface and an inner surface. The heat pipe is embedded in the shell and includes an evaporating section and a condensing section. The thermoelectric cooler includes a cold end brought into contact with the condensing section of the heat pipe, a hot end exposed to the exterior of the shell, and an array of N-type semiconductor elements and an P-type semiconductor elements electrically connected in serial sandwiched between the cold end and the hot end. The film type solar cell is provided on the outer surface of the shell and electrically connected with the thermoelectric cooler and used for supplying electric energy to the thermoelectric cooler. A cooling module is also included in the invention.



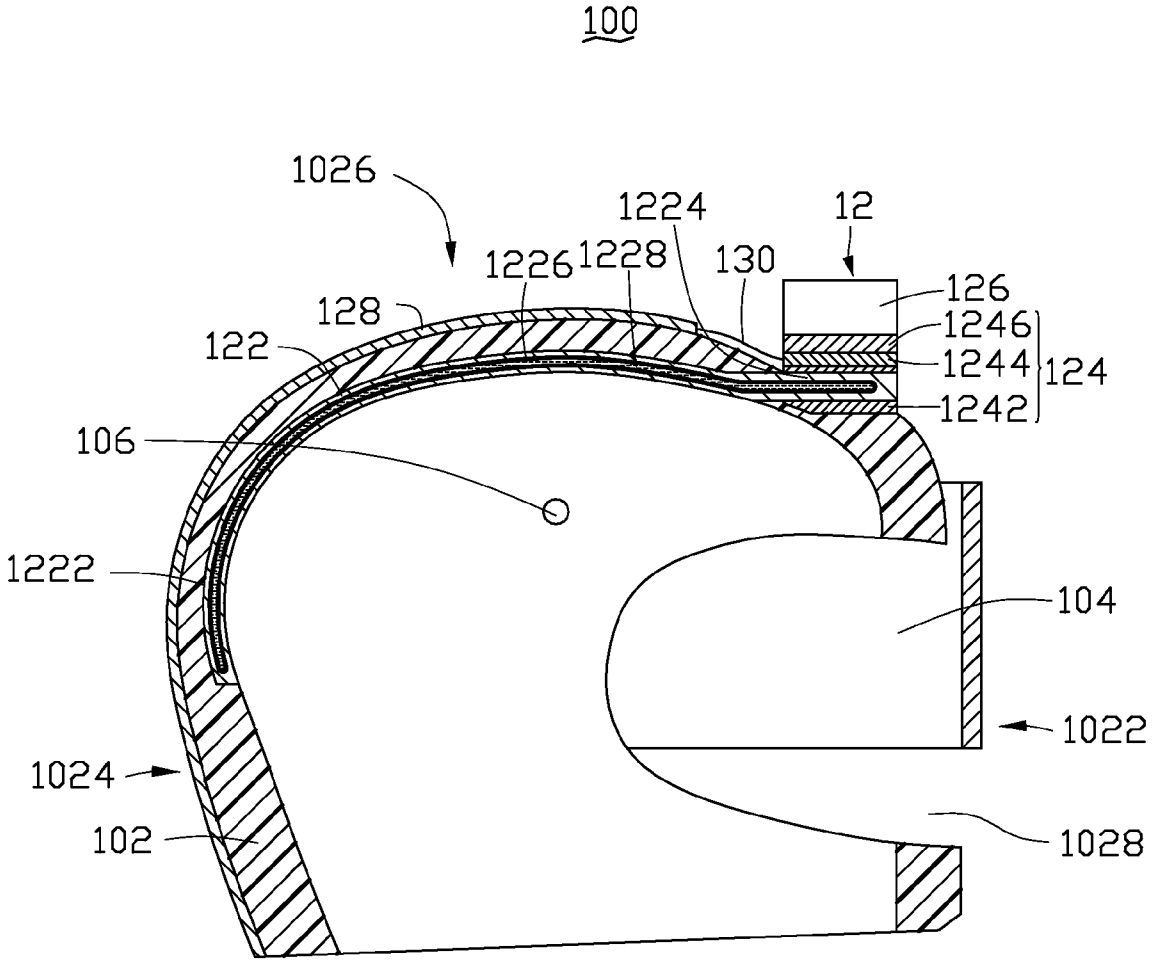

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FIG. 1

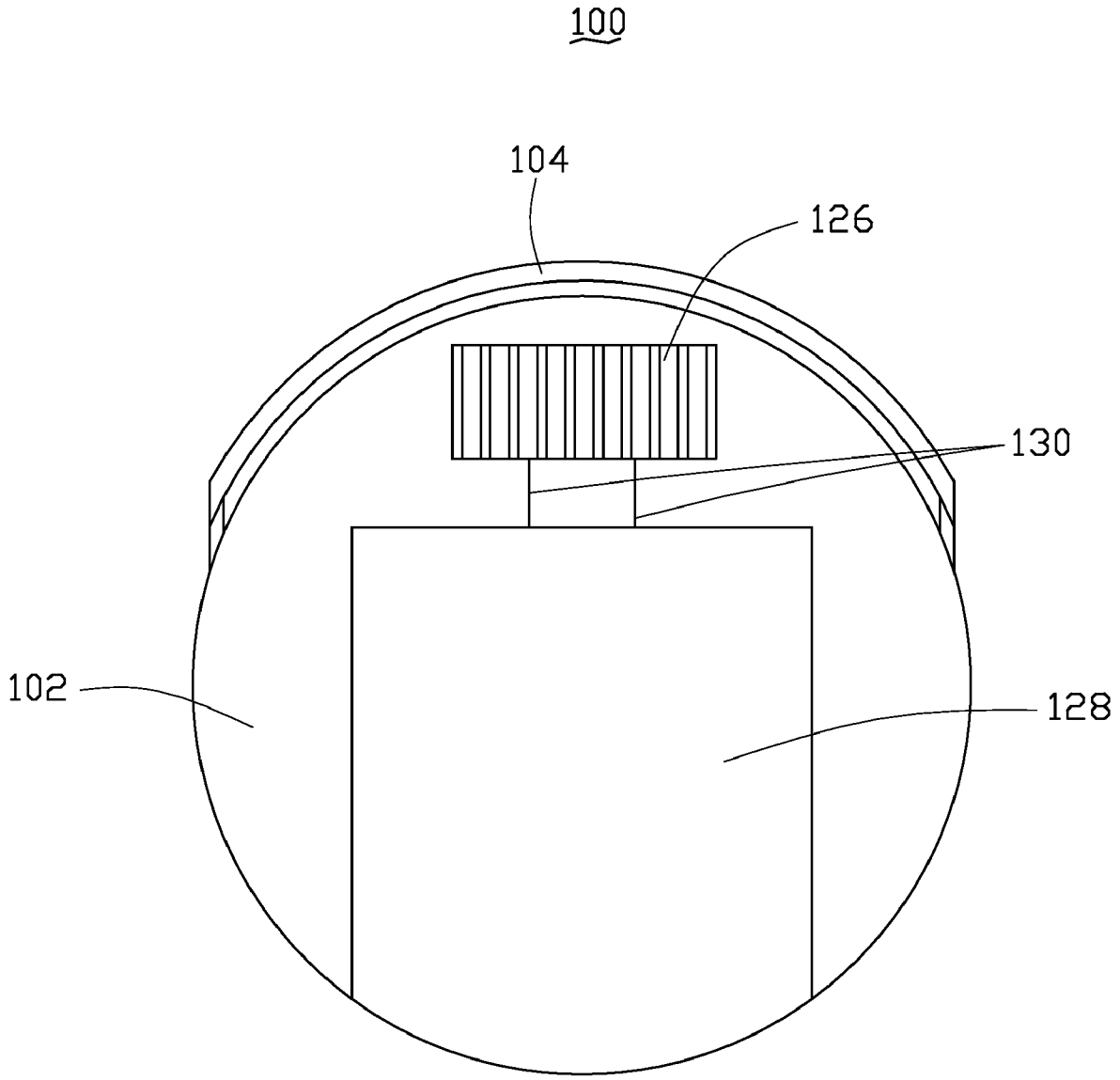

FIG. 2

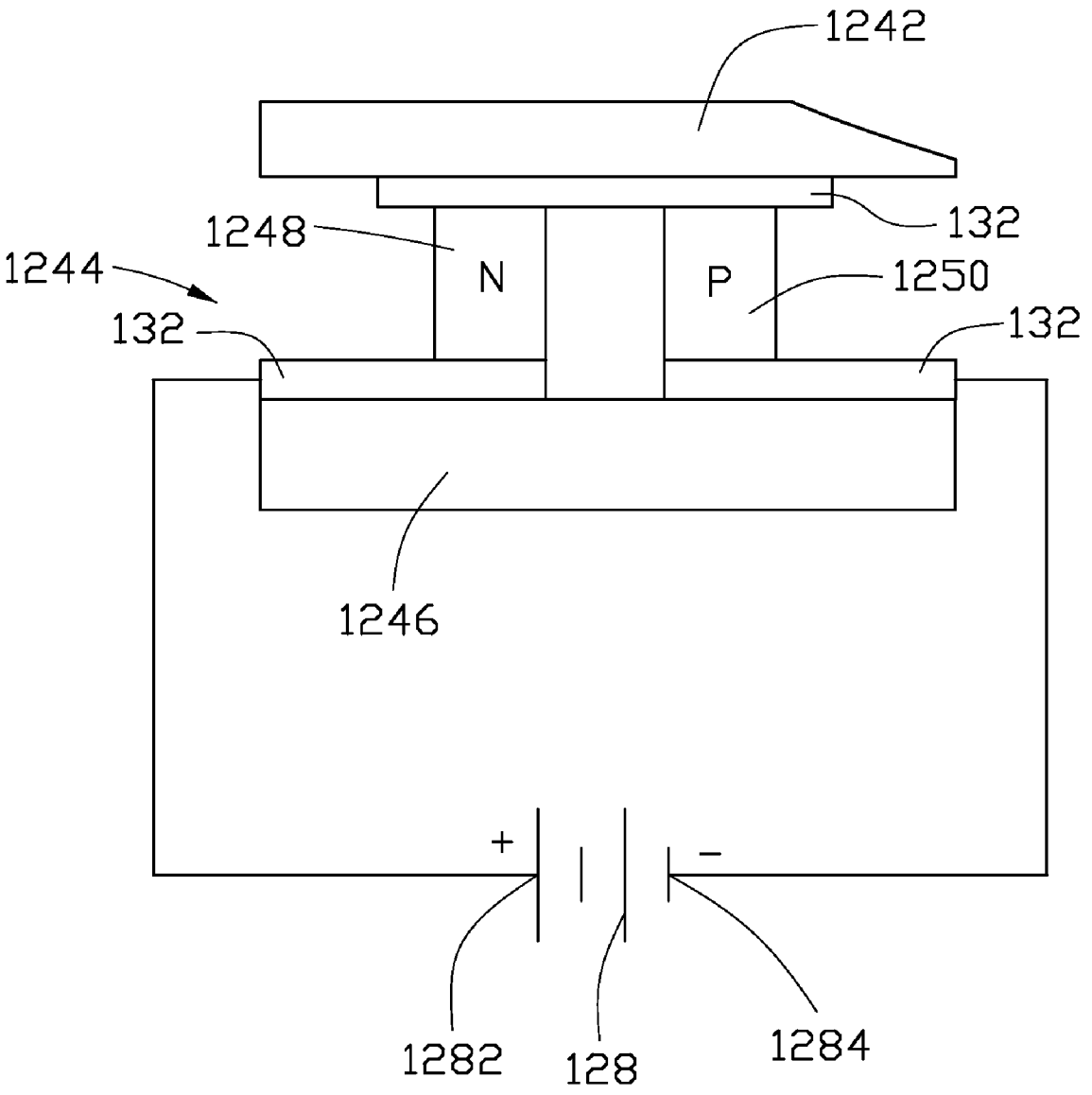

FIG. 3

COOLING MODULE AND HELMET HAVING SAME

BACKGROUND

[0001] 1. Field of the Invention

[0002] The present invention relates to helmets and, more particularly, to a helmet having a cooling module.

[0003] 2. Description of Related Art

[0004] Helmets are worn by competitors in various forms of athletic contents such as football, hockey, and vehicle racing. They are also worn for protection by individuals engaged in the construction field and also in other dangerous fields of work such as the military. During such athletic competition or construction work considerable body heat is generated which reflects itself in discomfort to the wearer of the helmet and not uncommonly results in a physical condition, sometimes fatal, known as hyperthermia. The performance of such activities in an environment where elevated temperatures prevail is known to cause or aggravate this condition.

[0005] What is needed, therefore, is a helmet having a cooling module.

SUMMARY

[0006] In a first preferred embodiment of the present invention, a helmet includes a shell and a cooling module attached to the shell. The cooling module includes at least a heat pipe, at least thermoelectric cooler, and a film type solar cell. The shell has an outer surface and an inner surface. The heat pipe is embedded in the shell and includes an evaporating section and a condensing section. The at least the thermoelectric cooler includes a cold end brought into contact with the condensing section of at least the heat pipe, a hot end exposed to the exterior of the shell, and an array of N-type semiconductor elements and an P-type semiconductor elements electrically connected in serial sandwiched between the cold end and the hot end. The film type solar cell is provided on the outer surface of the shell and electrically connected with the at least one thermoelectric cooler and used for supplying electric energy to the at least one thermoelectric cooler.

[0007] In a second preferred embodiment of the present invention, a cooling module includes at least a heat pipe, at least thermoelectric cooler, and a film type solar cell. The shell has an outer surface and an inner surface. The heat pipe includes an evaporating section and a condensing section. The at least thermoelectric cooler includes a cold end brought into contact with the condensing section of at least the heat pipe, a hot end, and an array of N-type semiconductor elements and an array P-type semiconductor elements electrically connected in serial sandwiched between the cold end and the hot end. The film type solar cell is electrically connected with the at least one thermoelectric cooler and used for supplying electric energy to the at least one thermoelectric cooler.

[0008] Advantages and novel features will become more apparent from the following detailed description of the present helmet and cooling module, when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Many aspects of the present cooling module and helmet having the same can be better understood with reference to the following drawings. The components in the drawings are not necessarily drawn to scale, the emphasis instead being placed upon clearly illustrating the principles of the present cooling module and helmet having the same. Moreover, in the drawings, like reference numerals designate corresponding parts throughout the several views.

[0010] FIG. **1** is a schematic, cross-sectional view of a helmet in accordance with a preferred embodiment, wherein the helmet includes a thermoelectric cooler;

[0011] FIG. **2** is a schematic, plan view of the helmet in FIG. **1**; and

[0012] FIG. **3** is a schematic, cross-sectional view of the thermoelectric cooler of the helmet in FIG. **1**.

DETAILED DESCRIPTION OF THE EMBODIMENT

[0013] Reference will now be made to the drawings to describe preferred embodiments of the present molding apparatus.

[0014] FIGS. **1** to **2** illustrate a helmet **100** in accordance with a preferred embodiment. The helmet **100** is useful for athletes, drivers, workers, etc. The helmet **100** includes a shell **102**, a visor **104** and a cooling module **12**.

[0015] The shell **102** has a front side **1022**, a rear side **1024** and a top side **1026** corresponding to a wearer's face, rear side of head and top side of head, respectively. The front side **1022** of the shell **102** has a view window **1028**, which exposes at least a portion of the wearer's face. The visor **104** is attached to the shell **102** by at least a screw **106** and configured for protecting eyes and face from blowing.

[0016] The cooling module **12** includes a heat pipe **122**, a thermoelectric cooler **124**, a heat sink **126** and a solar cell **128**. The heat pipe **122** is embedded in the shell **102**. The heat pipe **122** has a condensing section **1224** which extends from the top side **1026** to the rear side **1024** and an evaporating section **1222** which connects with the evaporating section **1222** at the top side **1026** and extends throughout the shell **102**. The heat pipe **122** can be selected from the group consisting of tube-type heat pipe, flat heat pipe etc. The heat pipe **122** has a hollow cavity **1226** formed therein and a work fluid **1228** is filled with the hollow cavity **1226**. The hollow cavity **1226** extends from the evaporating section **1222** to the condensing section **1224**.

[0017] The thermoelectric cooler **124** includes a cold end **1242**, a hot end **1246** and thermoelectric elements **1244** sandwiched therebetween. The cold end **1242** is brought into contact with the condensing section **1224** of the heat pipe **122**. In the preferred embodiment, the condensing section **1224** is inserted in the cold end **1242**. The heat sink **126** is fixed on the hot end **1246** and exposed to an exterior of the shell **102**. The heat sink **126** is configured for dissipating heat emitted from the hot end **1246**. The solar cell **128** has two electrodes (see anode **1282** and cathode **1284** in FIG. **3**) and the two electrodes are electrically connected with the thermoelectric cooler **124** by two conductors **130**, and thus form an electric current loop. The solar cell **128** is configured for supplying electric energy to the thermoelectric cooler **124**. The solar cell **128** is a semiconductor device that can transform light into electric energy. In the preferred embodiment, the solar cell **128** is a film type solar cell, for example Amorphous Si solar cell, poly-Si solar cell, $CuInSe_2$ solar cell, GeCd solar cell and TiO_2 solar cell etc. The film type solar cell is light and bendable so that the solar cell **128** can be fixed on the outer surface of the shell **102** by adhesive or with a bolt.

[0018] Referring to FIGS. **1** to **3**, the thermoelectric cooler **124** is a solid-state heat pump that operates on the Peltier

effect. The thermoelectric elements **1244** include an array of N-type semiconductors element **1248** and an array of P-type semiconductor elements **1250** electrically connected in series by electric bars **132** and thermally connected in parallel. The array of N-type semiconductor elements **1248** and the array of P-type semiconductor elements **1250** are then affixed to the cold end **1242** and the hot end **1246**. The solar cell **128** is electrically connected with the two ends of the array of N-type semiconductor elements **1248** and the array of P-type semiconductor elements **1250** in series. Thus, a series circuit is achieved between the solar cell **128**, the array of N-type semiconductor elements **1248** and the array of P-type semiconductor elements **1250**. The array of N-type semiconductor elements **1248** and the array of P-type semiconductor elements **1250** form a thermocouple. The thermocouple can transfer heat from the cold end **1242** to the hot end **1246**, so that heat emitted from the condensing section **1224** of the heat pipe **122** that is inserted in the cold end **1242** can be dissipated in time. Generally, a material of the cold end **1242** and the hot end **1246** can be ceramics.

[0019] The helmet **100** can emit heat produced by the wearer's body efficiently so that make the wearer feel comfortable based on the cooling module **12** including the heat pipe **122**, the thermoelectric cooler **124** and the heat sink **126**. Also, the electric energy that the thermoelectric cooler **124** needed is supplied by the film type solar cell **128**, which is cheap and environmentally friendly.

[0020] It is to be understood that any number of the heat pipe **122** can be present (e.g., two, three etc). Also, when the heat pipe **122** can be a tube-type heat pipe or a plurality of tube-type heat pipes arranged side by side. The number of the thermoelectric cooler **124** and the heat sink **126** can be more than one, and still be within the scope of the preferred embodiment.

[0021] It is to be understood, however, that even though numerous characteristics and advantages of the present invention have been set forth in the foregoing description, together with details of the structure and function of the invention, the disclosure is illustrative only, and changes may be made in detail, especially in matters of shape, size, and arrangement of parts within the principles of the invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

What is claimed is:

1. A helmet comprising:

a shell having an outer surface and an inner surface and

a cooling module attached to the shell, the cooling module comprising:

at least one heat pipe embedded in the shell, the at least one heat pipe comprising an evaporating section and a condensing section;

at least one thermoelectric cooler comprising a cold end brought into contact with the condensing section of the at least a heat pipe, a hot end exposed to an exterior of the shell, and an array of N-type semiconductor elements and an array of P-type semiconductor elements electrically connected in serial sandwiched between the cold end and the hot end; and

a film type solar cell provided on the outer surface of the shell and electrically connected with the at least one thermoelectric cooler, for supplying electric energy to the at least one thermoelectric cooler.

2. The helmet as described in claim **1**, wherein the at least one heat pipe is selected from the group consisting of a tube-type heat pipe, and a flat heat pipe.

3. The helmet as described in claim **1**, wherein at least one of the hot end and the cold end is comprised of ceramics.

4. The helmet as described in claim **1**, wherein the solar cell is selected from the group consisting of Amorphous Si solar cell, poly-Si solar cell, $CuInSe_2$ solar cell, GeCd solar cell and TiO_2 solar cell.

5. The helmet as described in claim **1**, wherein the at least one heat pipe is inserted in the cold end of the at least one thermoelectric cooler.

6. A cooling module for use in a helmet, comprising:

at least one heat pipe embedded in the shell, the at least one heat pipe comprising an evaporating section and a condensing section;

at least one thermoelectric cooler comprising a cold end brought into contact with the condensing section of the at least a heat pipe, a hot end, and an array of N-type semiconductor elements and an array of P-type semiconductor elements electrically connected in serial sandwiched between the cold end and the hot end; and

a film type solar cell electrically connected with the at least one thermoelectric cooler, for supplying electric energy to the at least one thermoelectric cooler.

7. The cooling module as described in claim **6**, wherein the at least one heat pipe is selected from the group consisting of a tube-type heat pipe, and a flat heat pipe.

8. The cooling module as described in claim **6**, wherein at least one of the hot end and the cold end is comprised of ceramics.

9. The cooling module as described in claim **6**, wherein the solar cell is selected from the group consisting of Amorphous Si solar cell, poly-Si solar cell, $CuInSe_2$ solar cell, GeCd solar cell and TiO_2 solar cell.

10. The cooling module as described in claim **6**, wherein the at least one heat pipe is inserted in the cold end of the at least one thermoelectric cooler.

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