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Molded circuit board and camera module, and manufacturing method thereof and electronic device

Abstract

Disclosed are a molded circuit board and a camera module, and a manufacturing method thereof and an electronic device comprising the same. The molded circuit board includes a circuit board main body and a molded structure. The circuit board main body includes at least one circuit layer and at least one substrate layer, wherein the circuit layer and the substrate layer are stacked in a manner of being spaced apart. The molded structure includes a molded layer, wherein the molded layer is stacked on at least one surface of the circuit board main body to cover at least part of the substrate.

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References Cited

U.S. PATENT DOCUMENTS

Patent No.	Issued Date	Patentee Name	U.S. Cl.	CPC
5965944	12/1998	Frankoski et al.	N/A	N/A
11165941	12/2020	Wang et al.	N/A	N/A
2010/0252304	12/2009	Muramatsu et al.	N/A	N/A
2012/0225150	12/2011	Han et al.	N/A	N/A
2017/0064825	12/2016	Ishihara	N/A	H05K 1/0298
2019/0364184	12/2018	Wang et al.	N/A	N/A

FOREIGN PATENT DOCUMENTS

Patent No.	Application Date	Country	CPC
102655098	12/2011	CN	N/A
108243296	12/2017	CN	N/A
108307094	12/2017	CN	N/A
3 570 651	12/2018	EP	N/A
2017-33960	12/2016	JP	N/A
2018/130172	12/2017	WO	N/A

OTHER PUBLICATIONS

International Search Report issued Sep. 30, 2020, in International (PCT) Application No. PCT/CN2020/099767, with English translation. cited by applicant

Extended European Search Report issued Aug. 30, 2022 in European Patent Application No. 20848503.7. cited by applicant

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Background/Summary

FIELD OF THE INVENTION

(1) The present invention relates to the field of electronic information technology, and in particular to a molded circuit board and a camera module, a manufacturing method thereof, and an electronic device comprising the same.

BACKGROUND OF THE INVENTION

(2) As one of the core components of various electronic device, circuit boards can provide mechanical support for fixing and assembling various electronic components such as integrated circuits to realize wiring, electrical connection or electrical insulation between various electronic components. Generally, the circuit board is made into a printed circuit, a printed element or a conductive pattern formed by a combination of the two on an insulating substrate according to a predetermined design. The types of circuit boards usually include single-sided circuit boards, double-sided circuit boards and multi-layer circuit boards. Single-sided circuit boards or double-sided circuit boards are generally formed by etching circuits on copper clad boards with single-sided copper clad or double-sided copper clad (of course, some circuit boards will also use perforation technology). Copper clad boards are formed by compressing the copper foil and the substrate (the substrate is an insulating material) together. Multi-layer circuit boards are usually manufactured by laminating, mainly by compressing multiple circuit layers (currently the circuit layer material is generally copper) and multiple substrates, and then drilling through holes (not shown in the figure) between the circuit layers on the multilayer circuit board to electrically connect each of the circuit layers to form the multilayer circuit board.

(3) At present, whether it is a single-sided circuit board, a double-sided circuit board or a multi-layer circuit board, or a circuit board manufactured by a laminate method or a circuit board manufactured by an additive method, there are usually exposed circuits on the surface, vias, pads and substrates. Therefore, an ink layer is generally provided on the surface of the circuit board by printing, curtaining, spraying or rolling, for solder resisting and insulation (that is, all the circuits and copper surfaces on the circuit board are covered by the ink layer, and the vias and their pads to be soldered on the circuit board are reserved to prevent short circuits when electronic components are soldered, and at the same time to avoid conduction between the circuits) and circuit board protection (that is, all circuits on the circuit board are covered by the ink layer to prevent oxidation of the circuit due to moisture and various dielectrics to harm electrical performance, and to prevent external mechanical damage).

(4) However, as the performance of electronic device becomes higher and higher, the chips mounted on the circuit board will generate more heat, and the ink's heat dissipation performance is relatively poor, which will seriously affect the heat dissipation of the circuit board and the chip. As a result, the performance of electronic device is degraded. Especially for camera modules, the photosensitive chip of the camera module is usually mounted on the circuit board. The existence of the ink layer makes the circuit board's heat dissipation capacity poor, which in turn affects the heat dissipation of the photosensitive chip, which will cause the performance of the camera module severely degraded. In addition, due to the inherent defects in the layout process of the ink layer

(printing, curtaining, spraying or rolling, etc.), that is, the surface of the ink layer is not flat, therefore, for electronic device such as camera modules that require the chip to be directly mounted on the circuit board, the ink layer on the circuit board will cause the chip mounting on the circuit board to have problems such as tilting and bending, causing errors in the assembly of the electronic device, resulting in decreasing in the performance of electronic device.

(5) In addition, due to the lack of plastic deformation ability and toughness of the ink layer, the ink layer on the surface of the circuit board is prone to cracking, which will cause dirt to infringe on the circuits on the circuit board, thereby affecting the performance of electronic devices.

SUMMARY OF THE INVENTION

(6) An object of the present invention is to provide a molded circuit board and a camera module, a manufacturing method thereof, and an electronic device comprising the same, which can improve the performance of the camera module and the electronic device.

(7) Another object of the present invention is to provide a molded circuit board, a camera module, and a manufacturing method thereof, and an electronic device comprising the same, and in an example of the present invention, a molded circuit board has good heat dissipation performance, which helps to improve a relatively poor heat dissipation problem of conventional circuit boards.

(8) Another object of the present invention is to provide a molded circuit board, a camera module, and a manufacturing method thereof, and an electronic device comprising the same, and in an example of the present invention, the molded circuit board uses a molded structure to replace an ink layer on the conventional circuit board, which helps to solve problems caused by the inherent defects of the ink layer.

(9) Another object of the present invention is to provide a molded circuit board, a camera module, and a manufacturing method thereof, and an electronic device comprising the same, and in an example of the present invention, a molded layer of the molded structure of the molded circuit board is cured by a molding material with good heat dissipation performance on a surface of a circuit board main body through a molding process, so that the heat dissipation performance of the molded structure is better than that of the ink layer, which is beneficial to strengthen the heat dissipation of the molded circuit board so as to facilitate the improvement of the performance of the camera module and the electronic device.

(10) Another object of the present invention is to provide a molded circuit board, a camera module, and a manufacturing method thereof, and an electronic device comprising the same, and in an example of the present invention, the molded structure can improve a structural strength of the molded circuit board and reduces a bending degree of the molded circuit board.

(11) Another object of the present invention is to provide a molded circuit board, a camera module, and a manufacturing method thereof, and an electronic device comprising the same, and in an example of the present invention, the manufacturing method of the molded circuit board eliminates the layout of ink on the circuit board main body, so that the molded structure can be directly combined with the circuit board main body, which helps to increase a bonding strength between the two.

(12) Another object of the present invention is to provide a molded circuit board, a camera module, and a manufacturing method thereof, and an electronic device comprising the same, and in an example of the present invention, by eliminating the process for providing the ink, the manufacturing method of the molded circuit board is simplified, which helps to reduce the manufacturing cost.

(13) Another object of the present invention is to provide a molded circuit board, a camera module, and a manufacturing method thereof, and an electronic device comprising the same, and in an example of the present invention, the molded circuit board can provide a flat mounting surface with the molded structure, which helps to improve the performance of the camera module and the electronic device.

(14) Another object of the present invention is to provide a molded circuit board, a camera module,

and a manufacturing method thereof, and an electronic device comprising the same, and in an example of the present invention, the molded circuit board can avoid the problem of dirt caused by the crack of the ink layer as the conventional circuit board, which helps to improve the protection of the circuit board main body.
(15) Another object of the present invention is to provide a molded circuit board, a camera module, and a manufacturing method thereof, and an electronic device comprising the same, and in an example of the present invention, the molded structure of the molded circuit board can provide a mounting surface for the lens assembly to replace a lens holder or a base in the conventional camera module, which helps to simplify the assembly process of the camera module.
(16) Another object of the present invention is to provide a molded circuit board, a camera module, and a manufacturing method thereof, and an electronic device comprising the same, and in an example of the present invention, the molded structure of the molded circuit board can provide a chip attaching surface and/or a mounting surface with good flatness to avoid the problem of tilting and bending of the chip and the optical lens during mounting process, which helps to ensure that the camera module and the electronic device have better performance.
(17) Another object of the present invention is to provide a molded circuit board, a camera module, and a manufacturing method thereof, and an electronic device comprising the same, and in order to achieve the above-mentioned objects, the present invention does not need to use expensive materials or complicated structures. Therefore, the present invention successfully and effectively provides a solution, which not only provides a simple molded circuit board and camera module, and a manufacturing method thereof, and an electronic device comprising the same, but also improve the practicability and reliability of the molded circuit board and the camera module, and the manufacturing method thereof, and the electronic device comprising the same.
(18) In order to achieve at least one of the above-mentioned objects or other objects and advantages, the present invention provides a method for manufacturing a molded circuit board, which comprises the following step of:
(19) providing a circuit board main body and forming a molded layer of a molded structure by curing an insulating molding material on at least one surface of the circuit board main body with a molding die.
(20) According to an example of the present invention, the step of providing a circuit board main body and forming a molded layer of a molded structure by curing an insulating molding material on at least one surface of the circuit board main body with a molding die comprises the following step of: forming a front molded layer of the molded layer of the molded structure by curing the insulating molding material on a front surface of the circuit board main body with an upper die of the molding die, wherein the front molded layer only covers a front conductive circuit of a front circuit layer of the circuit board main body so that a pad of the front circuit layer is exposed to the outside.
(21) According to an example of the present invention, the step of said forming a front molded layer of the molded layer of the molded structure by curing the insulating molding material on a front surface of the circuit board main body with an upper die of the molding die comprises the following steps of:
(22) placing the circuit board main body on the upper die of the molding die so that an inner surface of the upper die is pressed against the pad of the front circuit layer of the circuit board main body, and forming a front molding space between the inner surface of the upper die and a front surface of the circuit board main body; and
injecting the insulating molding material into the front molding space to form the front molded layer after curing.
(23) According to an example of the present invention, the manufacturing method of the molded circuit board, before the step of placing the circuit board main body on the upper die of the molding die, further comprises the following step of:

(24) etching the front conductive circuit of the front circuit layer of the circuit board main body to reduce a height of the front conductive circuit, so that a surface of the front conductive circuit is lower than a surface of the pad.
(25) According to an example of the present invention, before the step of placing the circuit board main body on the upper die of the molding die, there further comprising the following step of: depositing metal on the pad of the front circuit layer of the circuit board main body by a deposition process to increase a height of the pad so that the surface of the front conductive circuit is lower than the surface of the pad.
(26) According to an example of the present invention, a step of said providing a circuit board main body and forming a molded layer of a molded structure by curing an insulating molding material on at least one surface of the circuit board main body with a molding die comprises the following step of:
(27) forming the front molded layer of the molded layer of the molded structure by curing the insulating molding material on the front surface of the circuit board main body with the upper die of the molding die, wherein the front molded layer only covers a surface of a substrate layer of the circuit board main body so that the front conductive circuit and the pad of the front circuit layer is exposed to the outside; and
(28) correspondingly providing an insulating protection layer on the front conductive circuit of the front circuit layer to cover the front conductive circuit.
(29) According to an example of the present invention, a step of said forming a front molded layer of the molded layer of the molded structure by curing the insulating molding material on the front of the circuit board main body with an upper die of the molding die comprises the following step of:
(30) placing the circuit board main body on the upper die of the molding die, so that an inner surface of the upper die is simultaneously pressed against the front conductive circuit and the pad of the front circuit layer of the circuit board main body, thereby a front molding space is formed between the inner surface of the upper die and a front surface of the circuit board main body; and injecting the insulating molding material into the front molding space to form the front molded layer after curing.
(31) According to an example of the present invention, a step of said providing a circuit board main body and forming a molded layer of a molded structure by curing an insulating molding material on at least one surface of the circuit board main body with a molding die further comprises the following step of:
(32) forming a back molded layer of the molded layer of the molded structure by curing the insulating molding material on a back surface of the circuit board main body with a lower die of the molding die, wherein the back molded layer covers a back conductive circuit of a back circuit layer of the circuit board main body.
(33) According to an example of the present invention, the method for manufacturing a molded circuit board, further comprises the following step of:
(34) mounting a set of electronic components on the pad of the front circuit layer of the circuit board main body.
(35) According to an example of the present invention, a step of said providing a circuit board main body and forming a molded layer of a molded structure by curing an insulating molding material on at least one surface of the circuit board main body with a molding die comprises the following steps of: mounting a set of electronic components on the pads on the front circuit layer of the circuit board main body;
(36) forming a front molded layer and a molded package body of the molded structure by curing the insulating molding material on a front surface of the circuit board main body with an upper die of the molding die, wherein the front molded layer covers a front conductive circuit of the front circuit layer and the molded package body covers the electronic components; and forming a back

molded layer of the molded structure by curing the insulating molding material on a back surface of the circuit board main body with a lower die of the molding die, wherein the back molded layer covers a back conductive circuit of a back circuit layer of the circuit board main body to manufacture the molded circuit board.
(37) According to an example of the present invention, the front molded layer only covers the front conductive circuit on the front circuit layer located at an edge area of the circuit board main body.
(38) According to an example of the present invention, heat dissipation efficiency of the insulating molding material is greater than that of the ink material.
(39) According to another aspect of the present invention, the present invention also provides a method for manufacturing a camera module, comprising the following steps of:
(40) manufacturing the molded circuit board according to any one of the above-mentioned methods for manufacturing a molded circuit board;
(41) mounting at least one photosensitive chip to the molded circuit board, and conductively connecting each of the photosensitive chips to the molded circuit board; and
(42) correspondingly providing a lens assembly on the molded circuit board, so that each optical lens of the lens assembly is located in the corresponding photosensitive path of the photosensitive chip.
(43) According to an example of the present invention, the method of manufacturing a camera module, further comprises the follow step of:
(44) correspondingly providing a filter assembly between the molded circuit board and the lens assembly, so that light entering from each of the optical lenses is received by the photosensitive chip after passing through a filter element of the filter assembly.
(45) According to another aspect of the present invention, the present invention also provides a method for manufacturing a camera module, comprising the following steps of:
(46) conductively mounting at least one photosensitive chip on a chip mounting area of a circuit board main body, and conductively mounting a set of electronic components on an edge area of the circuit board main body;
(47) forming a front molded layer of a molded layer and a molded package body of a molded structure by curing an insulating molding material on a front surface of the circuit board main body with a molding die, wherein the front molded layer only covers a front conductive circuit on the front circuit layer of the circuit board main body at the edge area of the circuit board main body, and the molded package body covers the electronic component and a non-photosensitive area of the photosensitive chip;
(48) correspondingly providing at least one filter element of a filter assembly on the molded package body, wherein each of the filter elements is located in a corresponding photosensitive path of the photosensitive chip; and
(49) correspondingly providing a lens assembly on the molded package body of the molded structure, wherein each optical lens of the lens assembly is located in the corresponding photosensitive path of the photosensitive chip, so that light entering from each of the optical lenses is received by the photosensitive chip after passing through the corresponding filter element.
(50) According to an example of the present invention, the method of manufacturing a camera module, further comprises the following step of:
(51) forming a back molded layer of the molded layer of the molded structure by curing the insulating molding material on a back surface of the circuit board main body with the molding die, wherein the back molded layer covers a back conductive circuit of a back circuit layer of the circuit board main body.
(52) According to another aspect of the present invention, the present invention also provides a molded circuit board, comprising:
(53) a circuit board main body, wherein the circuit board main body includes at least one circuit layer and at least one substrate layer, wherein the circuit layer and the substrate layer are stacked at

intervals; and
(54) a molded structure, wherein the molded structure includes a molded layer, and the molded layer is stacked on at least one surface of the circuit board main body to cover at least a part of the substrate layer of the circuit board main body.
(55) According to an example of the present invention, the molded layer of the molded structure includes a front molded layer, wherein the front molded layer is stacked on a front surface of the circuit board main body to cover the substrate layer located on the front surface of the circuit board main body.
(56) According to an example of the present invention, the circuit layer of the circuit board main body includes a front circuit layer stacked on a front surface of the substrate layer, wherein the front circuit layer includes a front conductive circuit and a set of pads conductively connected to the front conduction circuit, and the front molded layer further covers the front conductive circuit of the front circuit layer.
(57) According to an example of the present invention, the front molded layer of the molded structure is provided with a groove corresponding to the pads of the front circuit layer to ensure the pads of the front circuit layer expose to the outside while the molded layer covers the front conductive circuit of the front circuit layer of the circuit board main body.
(58) According to an example of the present invention, the circuit layer of the circuit board main body includes a front circuit layer stacked on a front surface of the substrate layer, wherein the front circuit layer includes a front conductive circuit and a set of pads conductively connected to the front conductive circuit, and the molded structure further includes an insulating protection layer, and the insulating protection layer is stacked on the front molded layer, and corresponds to the front conductive circuit of the front circuit layer of the circuit board main body to cover the front conductive circuit.
(59) According to an example of the present invention, a surface of the front conductive circuit of the front circuit layer of the circuit board main body has a same height as a surface of the pad of the front circuit layer.
(60) According to an example of the present invention, a surface of the front conductive circuit of the front circuit layer of the circuit board main body is lower than a surface of the pad of the front circuit layer.
(61) According to an example of the present invention, the molded layer of the molded structure includes a back molded layer, wherein the back molded layer is stacked on a back surface of the circuit board main body to cover the substrate layer located on the back surface of the circuit board main body.
(62) According to an example of the present invention, the circuit layer of the circuit board main body includes a back circuit layer stacked on a back surface of the substrate layer, wherein the back circuit layer includes a back conductive circuit, and the back molded layer covers the back conductive circuit of the back circuit layer.
(63) According to an example of the present invention, the molded circuit board further includes a set of electronic components, wherein each of the electronic components is mounted on the pad of the front circuit layer of the circuit board main body, and the molded structure further includes a molded package body, and the molded package body integrally extends from the front molded layer to cover the electronic component.
(64) According to an example of the present invention, the front molded layer of the molded structure covers the front conduction circuit of the front circuit layer and the substrate layer located at an edge area of the circuit board main body, so that the front conductive circuit of the front circuit layer and the substrate layer located at a chip mounting area of the circuit board main body are exposed to the outside.
(65) According to an example of the present invention, the molded layer of the molded structure is cured by an insulating molding material on at least one surface of the circuit board main body with

a molding die.
(66) According to an example of the present invention, a heat dissipation efficiency of the insulating molding material is greater than that of the ink material.
(67) According to another aspect of the present invention, the present invention also provides a camera module, comprising:
(68) a molded circuit board, wherein the molded circuit board includes:
(69) a circuit board main body, wherein the circuit board main body includes at least one circuit layer and at least one substrate layer, and the circuit layer and the substrate layer are stacked at intervals; and
(70) a molded structure, wherein the molded structure includes a molded layer, and the molded layer is stacked on at least one surface of the circuit board main body to cover at least a part of the substrate layer of the circuit board main body;
(71) at least one photosensitive chip, wherein each of the photosensitive chips is mounted on the molded circuit board, and each of the photosensitive chips is electrically connected to the molded circuit board; and
(72) a lens assembly, wherein the lens assembly includes at least one optical lens, and the lens assembly is correspondingly provided on the molded circuit board, and each of the optical lenses is located in a corresponding photosensitive path of the photosensitive chip.
(73) According to an example of the present invention, the molded layer of the molded structure includes a front molded layer, wherein the front molded layer is stacked on a front surface of the circuit board main body to cover the substrate layer located on the front surface of the circuit board main body.
(74) According to an example of the present invention, the circuit layer of the circuit board main body includes a front circuit layer stacked on a front surface of the substrate layer, wherein the front circuit layer includes a front conductive circuit and a set of pads conductively connected to the front conductive circuit, and the front molded layer further covers the front conductive circuit of the front circuit layer, and each of the photosensitive chips is mounted on the front molded layer.
(75) According to an example of the present invention, the front molded layer of the molded structure is provided with a groove corresponding to the pads of the front circuit layer to ensure the pads of the front circuit layer expose to the outside while the molded layer covers the front conductive circuit of the front circuit layer of the circuit board main body.
(76) According to an example of the present invention, the circuit layer of the circuit board main body includes a front circuit layer stacked on a front surface of the substrate layer, wherein the front circuit layer includes a front conductive circuit and a set of pads conductively connected to the front conductive circuit, and the molded structure further includes an insulating protection layer, and the insulating protection layer is stacked on the front molded layer, and corresponds to the front conductive circuit of the front circuit layer of the circuit board main body to cover the front conductive circuit, and each of the photosensitive chips is mounted on the insulating protection layer.
(77) According to an example of the present invention, the molded layer of the molded structure includes a back molded layer, wherein the back molded layer is stacked on a back surface of the circuit board main body to cover the substrate layer located on the back surface of the circuit board main body.
(78) According to an example of the present invention, the circuit layer of the circuit board main body includes a back circuit layer stacked on a back surface of the substrate layer, wherein the back circuit layer includes a back conduction circuit, and the back molded layer covers the back conductive circuit of the back circuit layer.
(79) According to an example of the present invention, the front molded layer of the molded structure covers the front conductive circuits of the front circuit layer and the substrate layer located at an edge area of the circuit board main body, so that the front conductive circuit of the

front circuit layer and the substrate layer located at a chip mounting area of the circuit board main body are exposed to the outside, wherein each of the photosensitive chips is mounted on the chip mounting area of the circuit board main body directly by the adhesive.
(80) According to an example of the present invention, the camera module further includes a set of electronic components, wherein each of the electronic components is mounted on the pad of the front circuit layer of the circuit board main body, and the molded structure further includes a molded package body, and the molded package body integrally extends from the front molded layer to cover the electronic component, and the lens assembly is assembled in the molded package body.
(81) According to an example of the present invention, the molded package body of the molded structure further covers a non-photosensitive area of the photosensitive chip.
(82) According to an example of the present invention, the molded layer of the molded structure is formed by curing an insulating molding material on at least one surface of the circuit board main body with a molding die.
(83) According to an example of the present invention, the insulating molding material is epoxy molding compound.
(84) According to an example of the present invention, the lens assembly further includes at least one driver, wherein each of the optical lenses is assembled in the driver, and each of the drivers is mounted on the molded circuit board to driveably keep each of the optical lenses located in the corresponding photosensitive path of the photosensitive chip.
(85) According to an example of the present invention, the lens assembly further includes at least one lens barrel, wherein each of the optical lenses is assembled in the lens barrel, and each of the lens barrels is mounted on the molded circuit board to keep each of the optical lenses located in the corresponding photosensitive path of the photosensitive chip.
(86) According to an example of the present invention, the lens assembly further includes a light turning mechanism, wherein the light turning mechanism is provided on the photosensitive path of the photosensitive chip for turning the light entering the light turning mechanism, so that the turned light is received by the photosensitive element after passing through the optical lens.
(87) According to an example of the present invention, the camera module further includes a filter assembly, wherein the filter assembly is correspondingly provided between the optical lens and the photosensitive chip, so that the light entering through the optical lens is received by the photosensitive chip after passing through the filter assembly.
(88) According to an example of the present invention, the filter assembly includes at least one filter element and a base, wherein each of the filter elements is assembled on the base, and the base is correspondingly provided on the molded structure of the molded circuit board at a position corresponding to an edge area of the circuit board main body, so that each of the filter elements corresponds to the corresponding photosensitive path of the photosensitive element, and the lens assembly is assembled on the base.
(89) According to an example of the present invention, the base is a bracket base manufactured separately or a molded base manufactured by a molding process.
(90) According to another aspect of the present invention, the present invention also provides an electronic device, comprising:
(91) an electronic device body; and
(92) at least one of the above-mentioned camera modules, wherein each of the camera modules is provided on the electronic device main body for acquiring images.
(93) According to another aspect of the present invention, the present invention also provides an electronic device, wherein the electronic device is configured with at least one of the above-mentioned molded circuit boards.
(94) Through the understanding of the following description and the drawings, the further objectives and advantages of the present invention will be fully embodied.

(95) These and other objectives, features and advantages of the present invention are fully embodied by the following detailed description, drawings and claims.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) FIG. **1** is a three-dimensional schematic diagram of a camera module according to a first example of the present invention.

(2) FIG. **2** shows a schematic cross-sectional view of the camera module according to the above-mentioned first example of the present invention.

(3) FIG. **3**A shows a schematic diagram of one manufacturing processes of the molded circuit board according to the above-mentioned first example of the present invention.

(4) FIG. **3**B shows a schematic diagram of the other manufacturing process of the molded circuit board according to the above-mentioned first example of the present invention.

(5) FIG. **4**A shows a first modified implementation of the molded circuit board according to the above-mentioned first example of the present invention.

(6) FIG. **4**B shows a second modified implementation of the molded circuit board according to the above-mentioned first example of the present invention.

(7) FIG. **4**C shows a third modified implementation of the molded circuit board according to the above-mentioned first example of the present invention.

(8) FIG. **4**D shows a fourth modified implementation of the molded circuit board according to the above-mentioned first example of the present invention.

(9) FIG. **4**E shows a fifth modified implementation of the molded circuit board according to the above-mentioned first example of the present invention.

(10) FIG. **5**A shows a first modified implementation of the camera module according to the above-mentioned first example of the present invention.

(11) FIG. **5**B shows a second modified implementation of the camera module according to the above-mentioned first example of the present invention.

(12) FIG. **5**C shows a first modified implementation of the camera module according to the above-mentioned first example of the present invention.

(13) FIG. **5**D shows a second modified implementation of the camera module according to the above-mentioned first example of the present invention.

(14) FIG. **6** shows a schematic cross-sectional view of a camera module according to a second example of the present invention.

(15) FIG. **7** shows a schematic diagram of the manufacturing process of the molded circuit board of the camera module according to the above-mentioned second example of the present invention.

(16) FIG. **8**A shows a first modified implementation of the camera module according to the above-mentioned second example of the present invention.

(17) FIG. **8**B shows a second modified implementation of the camera module according to the above-mentioned second example of the present invention.

(18) FIG. **9** is a schematic flowchart of a method for manufacturing a camera module according to an example of the present invention.

(19) FIG. **10**A shows a first implementation of manufacturing a molded circuit board in the method of manufacturing the camera module according to the above-mentioned example of the present invention.

(20) FIG. **10**B shows a second implementation of manufacturing a molded circuit board in the method of manufacturing the camera module according to the above-mentioned example of the present invention.

(21) FIG. **10**C shows a third implementation of manufacturing a molded circuit board in the

method of manufacturing the camera module according to the above-mentioned example of the present invention.
(22) FIG. **11** shows a modified implementation of the manufacturing method of the camera module according to the above-mentioned example of the present invention.
(23) FIG. **12** shows a three-dimensional schematic diagram of an electronic device according to an example of the present invention.

DETAIL DESCRIPTION OF THE INVENTION

(24) The following description is used to disclose the present invention so that those skilled in the art can implement the present invention. The preferred examples in the following description are only examples, and those skilled in the art can think of other obvious variations. The basic principles of the present invention defined in the following description can be applied to other examples, modifications, improvements, equivalents, and other technical solutions that do not depart from the spirit and scope of the present invention.
(25) Those skilled in the art should understand that, in the disclosure of the present invention, the orientation or positional relationship indicated by the terms “longitudinal”, “lateral”, “upper”, “lower”, “front”, “rear”, “left”, “right”, “vertical”, “horizontal”, “top”, “bottom”, “inner”, “outer”, etc., are based on the orientation or positional relationship shown in the drawings, which is only for the convenience of describing the present invention and simplifying the description, rather than indicating or implying that the device or element referred to must have a specific orientation, be constructed and operated in a specific orientation, and therefore the above-mentioned terms should not be construed as limiting the present invention.
(26) In the present invention, the term “a” in the claims and specification should be understood as “one or more”, that is, in one example, the number of an element may be one, and in another example, the number of the element can be more than one. Unless it is clearly stated in the disclosure of the present invention that the number of the element is only one, the term “one” cannot be understood as unique or singular, and the term “one” cannot be understood as a limitation on the number. In the description of the present invention, it should be understood that “first”, “second”, etc. are only used for descriptive purposes, and cannot be understood as indicating or implying relative importance. In the description of the present invention, it should be noted that unless otherwise clearly specified and limited, the terms “connected” and “connection” should be understood in a broad sense. For example, it can be a fixed connection, a detachable connection or an integral connection; it can be a mechanical connection or an electrical connection; it can be a direct connection or an indirect connection through a medium. For those of ordinary skilled in the art, the specific meanings of the above-mentioned terms in the present invention can be understood according to specific circumstances.
(27) In the description of this specification, descriptions with reference to the terms “one example”, “some examples”, “examples”, “specific examples”, or “several examples” etc. mean specific features, structures, materials or characteristics described in conjunction with the example or examples are included in at least one example or examples of the present invention. In this specification, the schematic representations of the above terms do not necessarily refer to the same example or examples. Moreover, the described specific features, structures, materials or characteristics can be combined in any one or more example or examples in a suitable manner. In addition, those skilled in the art can conjunct and combine the different example or examples and the features of the different example or examples described in this specification without contradicting each other.
(28) As an indispensable part of electronic device, circuit boards mainly provide mechanical support for fixing and assembling various electronic components such as integrated circuits. Circuit boards usually include single-sided circuit boards, double-sided circuit boards, and multi-layer circuit boards. Since the surfaces of various circuit boards usually have exposed circuits, vias, pads and substrates, in the prior art, an ink layer is usually provided on the surface of the circuit board

by printing, curtaining, spraying or rolling. For example, a layer of ink is first set up by spraying, and then the photosensitive reaction of the photosensitive resist is used to transfer the conductive pattern on the film to the ink on the circuit board, and then ultraviolet rays are irradiated. Because the transparent part except the conductive pattern on the film transmits ultraviolet rays, the corresponding ink on the surface of the circuit board is photopolymerized and changed from monomer to polymer. Finally, the unphotopolymerized ink on the surface of the circuit board is removed by a weak alkali solution so that the copper surface is exposed. Its purpose is to prevent soldering and insulation and protect the circuit board.

(29) However, as the performance of electronic device becomes higher and higher, the chips or other components mounted on the circuit board will generate more heat, and the relatively poor heat dissipation performance of the ink will seriously affect the heat dissipation of the circuit board. As a result, the performance of electronic device is degraded. Especially for camera modules, the photosensitive chip of the camera module is usually directly mounted on the circuit board. Due to the existence of the ink layer, the heat dissipation capacity of the circuit board is poor, which in turn affects the heat dissipation of the photosensitive chip, which will lead to the performance of the camera module being severely degraded. In addition, due to the inherent defects in the layout process of the ink layer (printing, curtaining, spraying or rolling, etc.), that is, the surface of the ink layer is not flat, so for the electronic devices that is necessary to directly mount the chip on the circuit board like a camera module, the ink layer on the circuit board may cause problems such as tilting and bending of the chip mounting on the circuit board, causing errors in the assembly of the electronic device, and reducing the performance of the electronic device. Therefore, in order to solve the above-mentioned problems, the present invention provides a molded circuit board and a manufacturing method thereof, which can improve the heat dissipation performance and/or flatness of the circuit board, and help to improve the performance of the various electronic devices equipped with the molded circuit board.

(30) It is worth mentioning that although the circuit board of the camera module is taken as an example in FIGS. **1** to **8**B and the following description to illustrate the features and advantages of the molded circuit board of the present invention, those skilled in the art can understood that the molded circuit board disclosed in FIGS. **1** to **8**B and the following description is only an example, and does not constitute a limitation to the content and scope of the present invention. For example, in other examples of the molded circuit board, the molded circuit board can also be used for other electronic devices such as e-books, AR glasses, robots, computers, etc., which will not be described in the present invention.

(31) As shown in FIGS. **1** to **3**B of the accompanying drawings of the specification, a molded circuit board, a manufacturing method thereof, and a camera module according to an example of the present invention are illustrated. Specifically, as shown in FIGS. **1** and **2**, the camera module **1** includes a lens assembly **10**, at least one photosensitive chip **20**, and a molded circuit board **30**, wherein each of the photosensitive chips **20** is mounted on the molded circuit board **30**, and each of the photosensitive chips **20** is electrically connected to the molded circuit board **30**. And, the lens assembly **10** includes at least one optical lens **11**, wherein the lens assembly **10** is correspondingly provided on the molded circuit board **30**, and each of optical lenses **11** is located in the corresponding photosensitive path of the photosensitive chip **20** to be assembled into the camera module **1**.

(32) In particular, as shown in FIGS. **2** and **3**A, the molded circuit board **30** includes a circuit board main body **31** and a molded structure **32**, wherein the circuit board main body **31** includes at least one circuit layer **310** and at least one substrate layer **314**, and the circuit layer **310** and the substrate layer **314** are stacked at intervals. And, the molded structure **32** includes a molded layer **321**, wherein the molded layer **321** is stacked on at least one surface of the circuit board main body **31** to cover at least a part of the substrate layer **314** of the circuit board main body **31**. It is understandable that the substrate layer **314** of the circuit board main body **31** can be, but not limited

to, made of polyimide film (PI film for short) or polypropylene (PP for short).
(33) Specifically, the molded layer **321** of the molded structure **32** is formed by curing the insulating molding material **320** on at least one surface of the circuit board main body **31** with a molding die. It is understandable that since the molded structure **32** is directly integrally formed on the surface of the circuit board main body **31** through a molding process, the molded structure **32** can not only improve the flatness of the circuit board main body **31**, in order to provide a higher flatness of the chip mounting surface, and but also can be directly combined with the circuit board main body **31**, increase a bonding strength between the two, prevent the molded structure **32** from loosening or falling off, and help to extend the service life of the molded structure **32**.
(34) It is worth noting that, in the invention, the thickness of the molded layer **321** of the molded structure **32** is between 10 μm and 100 μm. Preferably, the thickness of the molded layer **321** of the molded structure **32** is between 10 μm and 50 μm. It is understandable that the thickness of the circuit layer **310** of the circuit board main body **31** is usually between 10 μm and 50 μm (generally about 25 μm), and the thickness of an ink layer in a conventional circuit board is also about 25 μm.
(35) Preferably, the heat dissipation efficiency of the insulating molding material **320** is greater than the heat dissipation efficiency of an ink material, so that the heat dissipation performance of the molded circuit board **30** is better than that of the circuit board provided with the ink layer, which helps to improve the overall heat dissipation performance of the camera module **1**.
(36) More preferably, the insulating molding material **320** is implemented as epoxy molding compound (abbreviation: EMC), which enables the molded circuit board **30** to avoid the problem of dirt caused by the crack of the ink layer as in the conventional circuit board, which helps to improve the protection of the circuit board main body. It is understandable that, since the heat dissipation efficiency of EMC is usually 1 W to 3 W, and the heat dissipation efficiency of ink materials is usually only 0.2 W, compared with conventional ink circuit boards, the heat dissipation performance of the molded circuit board **30** of the present invention is better, which is conducive to meeting the current high-performance development needs of electronic device. Of course, in other examples of the present invention, the insulating molding material **320** can also be implemented as other insulating molding materials with good heat dissipation performance, as long as its heat dissipation efficiency is better than that of the ink material, the present invention will not describe it here.
(37) It is worth mentioning that although in FIGS. **1** to **5**D and the following description, taking the camera module **1** including only one optical lens **11** and one photosensitive chip **20** as an example, the features and advantages of the camera module **1** of the present invention are described, those skilled in the art can understand that the camera module **1** disclosed in FIGS. **1** to **5**D and the following description is only an example, which does not constitute a limitation to the content and scope of the present invention. For example, in other examples of the camera module, the number of the optical lens **11** and the photosensitive chip **20** may be multiple respectively to form an array camera module. In addition, the type of the optical lens **10** can be adjusted accordingly according to the requirements of the camera module. For example, the optical lens **10** can be implemented as an integrated optical lens, a split optical lens, a bare lens, or an optical lens with a lens barrel, etc., the present invention does not limit thereto. The type of the circuit board main body **31** of the molded circuit board **30** can be adjusted accordingly according to the requirements of the camera module.
(38) For example, in this example of the present invention, the circuit board main body **31** can be implemented as multi-layer circuit board. In other examples of the present invention, the circuit board main body **31** may also be implemented as other types of circuit boards such as single-sided circuit boards or double-sided circuit boards.
(39) Exemplarily, as shown in FIGS. **2** and **3**A, in this example of the present invention, the circuit layer **310** of the circuit board main body **31** of the molded circuit board **30** includes a front circuit layer **311**, at least one middle circuit layer **312** and a back circuit layer **313**, wherein all of the substrate layers **314** are stacked and provided, and the front circuit layer **311** and the back circuit

layer **312** are respectively stacked on the outermost side of the substrate layer **314**, and each of the middle circuit layers **312** is respectively stacked between the adjacent substrate layers **314** to form the circuit board main body **31** by pressing. It can be understood that, the front circuit layer **311**, the middle circuit layer **312**, and the back circuit layer **313** may be electrically connected to each other through vias (not shown in the figure) provided on the circuit board main body **31**, but they are not limited thereto.

(40) Of course, the circuit board main body **31** can also be formed by superimposing one front circuit layer **311** and one substrate layer **314** on each other to serve as a single-sided circuit board; or, the circuit board main body **31** can also be formed by superimposing one front circuit layer **311**, one substrate layer **314**, and one back circuit layer **313** on each other to serve as a double-sided circuit board.

(41) It is worth noting that the present invention defines the front circuit layer **311**, the middle circuit layer **312**, and the back circuit layer **313** according to different positions of the circuit layer **310** in the circuit board main body **31**, for example, the circuit layer **310** located on the front surface of the circuit board main body **31** is defined as the front circuit layer **311**, the circuit layer **310** located in the middle of the circuit board main body **31** is defined as the middle circuit layer **312**, and the circuit layer **310** on the back surface of the circuit board main body **31** is defined as the back circuit layer **313**. It can be understood that, in the present invention, the surface of the circuit board main body **31** for attaching the photosensitive chip **20** is defined as the front surface of the circuit board main body **31** (the upper surface of the circuit board main body **31** in FIG. **2**); and the surface of the circuit board main body **31** opposite to the surface on which the photosensitive chip **20** is attached is defined as the back surface of the circuit board main body **31** (as shown in FIG. **2**, the lower surface of the circuit board main body **31**).

(42) Further, in this example of the present invention, as shown in FIGS. **2** and **3**A, the front circuit layer **311** of the circuit board main body **31** of the molded circuit board **30** includes a front conductive circuit **3111** and a set of pads **3112**, wherein each of the pads **3112** is conductively connected to the front conductive circuit **3111**; the back circuit layer **313** only includes a back conductive circuit **3131**, and does not include any pads. In other words, in this example of the present invention, all the pads are concentrated on the front surface of the circuit board main body **31**, so that various electronic components and the photosensitive chip **20** can only be provided on the front surface of the circuit board main body **31**, which is beneficial to reduce the height of the molded circuit board **30**, thereby reducing the overall height of the camera module **1**. Of course, in other examples of the present invention, the back circuit layer **313** may also include pads for soldering various electronic components, which will not be described in the present invention.

(43) It is worth noting that, as shown in FIG. **2**, the circuit board main body **31** has a chip mounting area **3101** and an edge area **3102**, wherein the edge area **3102** is located around the chip mounting area **3101**, and the pad **3112** is located in the edge area **3102** of the circuit board main body **31**. In this way, when the photosensitive chip **20** is mounted on the chip mounting area **3101** of the circuit board main body **31** of the molded circuit board **30**, the photosensitive chip **20** can be electrically connected to the pad **3112** through wires, so as to conduct the photosensitive chip **20** and the molded circuit board **30**. Of course, in other examples of the present invention, when the pad of the photosensitive chip **20** is located on the non-photosensitive surface of the photosensitive chip **20** (for example, the back surface of the photosensitive chip **20**), the pad **3112** of the front circuit layer **311** may also be located in the chip mounting area **3101** of the circuit board main body **31**, which will not be described in the present invention.

(44) Preferably, the surface of the front conductive circuit **3111** of the front circuit layer **311** is flush with the surface of the pad **3112** of the front circuit layer **311**. For example, the front conductive circuits **3111** and the pads **3112** of the front circuit layer **311** of the circuit board main body **31** are etched through a complete piece of copper foil to ensure the surface of the front conductive circuits **3111** has a same height as the surface of the pad **3112**. Of course, in other examples of the present

invention, the front conductive circuit **3111** and the pad **3112** can also be manufactured by other processes, and the present invention will not describe it here.

(45) According to the above-mentioned example of the present invention, as shown in FIG. **3**A, the molded layer **321** of the molded structure **32** of the molded circuit board **30** includes a front molded layer **3211**, wherein the front molded layer **3211** is stacked on the front surface of the circuit board main body **31** to cover the substrate layer **314** on the front surface of the circuit board main body **31**. In particular, the front molded layer **3211** can simultaneously cover the surface of the front conductive circuit **3111** of the front circuit layer **311** (that is, the front molded layer **3211** simultaneously covers the conductive circuits **3111** of the chip mounting area **3101** and the edge area **3102** of the circuit board main body **31**) and the surface of the substrate layer **314** on the front surface of the circuit board main body **31**, and the front molded layer **3211** does not cover the surface of the pad **3112** of the front circuit layer **311**.

(46) In other words, the molded layer **321** of the molded structure **32** of the molded circuit board **30** includes the front molded layer **3211** formed by curing the insulating molding material **320** on the front surface of the circuit board main body **31** through a molding process, wherein the surface of the pad **3112** of the front circuit layer **311** is exposed because it is not covered by the front molded layer **3211**, and the surface of the front conductive circuit **3111** of the front circuit layer **311** and the surface of the substrate layer **314** on the front surface of the circuit board main body **31** are protected by being covered by the front molded layer **3211**. It is understandable that it is precisely because the pad **3112** is exposed to the outside and the front conductive circuit **3111** is covered by the front molded layer **3211**, the front molded layer **3211** of the molded structure **32** can perfectly replace the ink layer to prevent soldering and insulation and protect the circuit board. At the same time, since the heat dissipation efficiency of the insulating molding material **320** used in the molding process of the front molded layer **3211** is greater than that of the ink material, the front molded layer **3211** can also improve the heat dissipation performance of the molded circuit board **30**.

(47) At the time of manufacturing the molded circuit board **30**, one of the circuit board main bodies **31** can be put into a molding die **50** for a molding process, so that the front molded layer **3211** of the molded structure **32** is formed by curing the insulating molding material **320** on the front surface of the circuit board main body **31**, wherein the front molded layer **3211** covers the surface of the front conductive circuit **3111** of the front circuit layer **311** and the surface of the substrate layer **314** located on the front surface of the circuit board main body **31**, and the pad **3112** is exposed to the outside, and is electrically connected to various electronic components and chips.

(48) Specifically, as shown in FIG. **3**A, the molding die **50** includes an upper die **51**, wherein the upper die **51** can be moved to perform clamping and drafting operations, and when the molding die **50** is in a mold clamping state, a front molding space **510** is formed between the upper die **51** and the front surface of the circuit board main body **31**, wherein the front molded layer **3211** of the molded structure **32** is formed by adding the insulating molding material into the front molding space **510** and curing it. It can be understood that the height of the front molding space **510** of the molding die **50** is between 10 micrometers and 100 micrometers. Preferably, the height of the front molding space **510** of the molding die **50** is between 10 μm and 50 μm, so as to mold the front molded layer **321** that meets the thickness requirement.

(49) More specifically, as shown in FIG. **3**A, the upper die **51** of the molding die **50** has a pressing surface **511** and an upper molded surface **512**, wherein the pressing surfaces **511** of the upper die **51** correspond to the pad **3112** of the front circuit layer **311** of the circuit board main body **31**, and the pressing surface **511** of the upper die **51** is lower than the upper molded surface **512** of the upper die **51** (that is, the upper die **51** has a stepped inner surface), so that when the pressing surface **511** of the upper die **51** is pressed against the corresponding pad **3112**, there is still a gap between the upper molded surface **512** of the upper die **51** and the front conductive circuit **3111** to ensure that the insulating molding material **320** can enter the gap between the upper molded surface **512** of the

upper die **51** and the front conductive circuit **3111**, which enables the cured front molded layer **3211** to cover the front conductive circuit **3111** to protect the front conductive circuit **3111**.

(50) Exemplarily, as shown in FIG. **3**A, after placing the circuit board main body **31** on the upper die **51**, the upper die **51** is operated for clamping, so that the pressing surface **511** of the upper die **51** is pressed on the surface of the pad **3112**, and the front molding space **510** is formed between the upper molded surface **512** of the upper die **51** and the surfaces of the front conductive circuit **3111** of the front circuit layer **311** and the substrate layer **314**; then, the insulating molding material **320** is injected into the front molding space **510** to form, after curing, the front molded layer **3211** that simultaneously covers the front conductive circuit **3111** and the substrate layer **314**, thereby making the molded circuit board **30** (or semi-finished molded circuit board); finally, after the insulating molding material **320** is cured to form the front molded layer **3211**, the upper die **51** is operated for drafting, and the molded circuit board **30** (or semi-finished molded circuit board) is taken out from the molding die **50**.

(51) It is worth noting that, as shown in FIG. **3**A, it is precisely because the pressing surface **511** of the upper die **51** presses the surface of the pad **3112** during the molding process, the insulating molding material **320** cannot cover the surface of the pad **3112**, a groove **3210** is formed on the front molded layer **3211** formed by curing the insulating molding material **320** at a position corresponding to the pad **3112**, so that the surface of the pad **3112** is exposed, so that various electronic components are electrically connected to the molded circuit board **30**. In particular, when electronic components are soldered to the pad **3112** to be electrically connected to the molded circuit board **30**, since there is the groove **3210** on the front molded layer **3211** at the position corresponding to the pad **3112**, it can effectively prevent the molten solder from flowing out. Therefore, the molded structure **32** can avoid the waste of resources due to the molten solder flowing out while improve the structural strength and heat dissipation performance of the molded circuit board **30**. It also helps to improve the soldering performance at the pad **3112**.

(52) In addition, since the front molded layer **3211** is integrally formed by a molding process, the front molded layer **3211** can provide a flat chip mounting surface for mounting the photosensitive chip **20** in order to reduce the possibility of tilting or bending of the mounting of the photosensitive chip **20**, which helps to reduce mounting errors and improve the performance of the camera module **1**. Even for a large-sized photosensitive chip, the front molded layer **3211** can control the mounting error of the chip within a controllable range, so as to ensure that the camera module **1** has a higher performance.

(53) FIG. **4**A shows a first modified implementation of the molded circuit board **30** of the camera module **1** according to the above-mentioned example of the present invention. Compared with the above-mentioned example according to the present invention, the molded circuit board **30** according to the first modified implementation e of the present invention is different in that: the front molded layer **3211** of the molded structure **32** only covers the surface of the substrate layer **314** of the circuit board main body **31**, and does not cover the front conductive circuit **3111** and the pad **3112** of the front circuit layer **311**, that is, the front conductive circuit **3111** and the pad **3112** of the circuit layer **311** are both exposed to the outside.

(54) Specifically, as shown in FIG. **4**A, the upper die **51** of the molding die **50** only has a pressing surface **511** (that is, the upper die **51** has a flat inner surface), so that, when the pressing surface **511** of the upper die **51** is pressed against the pad **3112**, there is no gap between the pressing surface **511** of the upper die **51** and the front conductive circuit **3111**, so that the cured front molded layer **3211** only covers the surface of the substrate layer **314** of the circuit board main body **31**, thereby the front conductive circuit **3111** and the pad **3112** of the front circuit layer **311** are both exposed to the outside.

(55) Illustratively, as shown in FIG. **4**A, after placing the circuit board main body **31** on the upper die **51**, the upper die **51** is operated for clamping, so that the pressing surface **511** of the upper die **51** simultaneously press on the surface of the pad **3112** and the surface of the front conductive

circuit **3111**, and the front molding space **510** is formed between on the pressing surface **511** of the upper die **51** and the surface of the substrate layer **314** of the circuit board main body **31**; then, the insulating molding material **320** is injected into the front molding space **510** to form the front molded layer covering only the surface of the substrate layer **314** after curing; finally, after the insulating molding material **320** is cured to form the front molded layer **3211**, the upper die **51** is operated for drafting; the molded circuit board **30** is taken out from the molding die **50**.

(56) It is worth noting that in this first modified implementation of the present invention, since the front conductive circuit **3111** of the front circuit layer **311** of the circuit board main body **31** is still exposed outside the front molded layer **3211**, there is still the risk of mechanical damage and short circuit to the front conductive circuit **3111**. Therefore, in order to solve this problem, the present invention further provides the second modified implementation of the molded circuit board **30** on the basis of the above-mentioned first modified implementation. Specifically, as shown in FIG. **4**B, the molded structure **32** further includes an insulating protective layer **322**, wherein the insulating protective layer **322** is correspondingly provided on the surface of the front conductive circuit **3111** of the front circuit layer **311** to cover the front conductive circuit **3111**, so as to prevent the front conductive circuit **3111** from being mechanically damaged or short-circuited.

(57) Preferably, the insulating protection layer **322** of the molded structure **32** is formed by curing an insulating molding material on the exposed surface of the front conductive circuit **311** through a molding process after the front molded layer **3211** is formed, to further cover the exposed surface of the front conductive circuit **311** by the insulating protective layer **322**. Of course, in other examples of the present invention, the insulating protection layer **322** may also be provided on the exposed surface of the front conductive circuit **311** by means such as pasting, gluing, or applying.

(58) FIG. **4**C shows a third modified implementation of the molded circuit board **30** of the camera module **1** according to the above-mentioned example of the present invention. Compared with the above-mentioned example according to the present invention, the molded circuit board **30** according to the third modified implementation of the present invention is different in that: when manufacturing the molded circuit board **30**, the upper die **51** of the molding die **50** only has an upper molded surface **512** (that is, the upper die **51** has a flat inner surface), and when the molding die **50** is in a clamp state, the upper molded surface **512** of the upper die **51** does not contact the front conductive circuit **3111** and the pad **3112** of the front circuit layer **311**, so that the cured front molded layer **3211** simultaneously covers the surface of the substrate layer **314** of the circuit board main body **31** and the front conductive circuit **3111** and the pad **3112** of the front circuit layer **311**.

(59) After that, the front molded layer **3211** is thinned by grinding or the like, so that the front molded layer **3211** forms the groove **3210** at a position corresponding to the pad **3112**, so that the pad **3112** of the front circuit layer **311** is exposed to the outside.

(60) Illustratively, as shown in FIG. **4**C, first, after placing the circuit board main body **31** on the upper die **51**, the upper die **51** is operated for clamping, so that the upper molded surface **512** of the upper die **51** does not press against the front conductive circuit **3111** and the pad **3112** of the front circuit layer **311**, so that the front molding space **510** is formed between the inner surface of the upper die **51** and the front surface of the circuit board main body **31**; then, the insulating molding material **320** is injected into the front molding space **510** to form the front molded layer **3211** covering the front conductive circuit **3111** and the pad **3112** of the front circuit layer **311** of the circuit board main body **31** after curing to made into the semi-finished molded circuit board; then, after the insulating molding material **320** is cured to form the front molded layer **3211**, the upper die **51** is operated for drafting, and the semi-finished molded circuit board is taken out from the molding die **50**; finally, the groove **3210** is formed on the front molded layer **3211** at a position corresponding to the pad **3112** by grinding, so that the molded circuit board **30** is manufactured. Of course, in other examples of the present invention, the front molded layer **3211** may also be thinned by grinding, so that the front conductive circuits **3111** and the pads **3112** of the front circuit layer **311** are exposed to the outside.

(61) It is worth noting that the inner surface of the upper die **51** does not press against the front conductive circuit **3111** and the pad **3112** of the front circuit layer **311**, so that a distance between an inner surface of the upper die **51** and the front surface of the circuit board main body **31** is increased, so the front molding space **510** becomes larger, so that the insulating molding material **320** can flow more easily to fill the front molding space **510**, which helps to complete the molding process.

(62) FIG. **4**D shows a fourth modified implementation of the molded circuit board **30** of the camera module **1** according to the above-mentioned example of the present invention. Compared with the above-mentioned example according to the present invention, the molded circuit board **30** according to the fourth modified implementation of the present invention is different in that: the surface of the front conductive circuit **3111** of the front circuit layer **311** of the circuit board main body **31** is lower than the surface of the pad **3112** of the front circuit layer **311**, that is, the height of the front conductive circuit **3111** is smaller than that of the height of the pad **3112**, so that when the front conductive circuit **3111** of the front circuit layer **311** is covered by the front molded layer **3211**, the pad **3112** of the front circuit layer **311** can still be exposed to the outside.

(63) Specifically, as shown in FIG. **4**D, at the time of manufacturing the molded circuit board **30**, the front conductive circuit **3111** of the front circuit layer **311** is etched first through an etching process, so as to reduce the height of the front conductive circuit **3111** of the front circuit layer **311**, so that the height of the front conductive circuit **3111** is smaller than the height of the pad **3112**; then, the front molded layer **3211** is formed on the front surface of the circuit board main body **31** with the molding die **50** through a molding process, so that the front conductive circuit **3111** of the front circuit layer **311** is covered by the front molded layer **3211**, and the pad **3112** of the front circuit layer **311** can still be exposed to the outside. Of course, in other examples of the present invention, when the molded circuit board **30** is manufactured, metal can also be deposited on the pad **3112** of the front circuit layer **311** through a deposition process to increase the height of the pad **3112** of the front circuit layer **311**, so that the height of the pad **3112** is greater than the height of the front conductive circuit **3111**; and then, the front molded layer **3211** is formed on the front surface of the circuit board main body **31** by a molding process with a molding die, so that the front conductive circuit **3111** of the front circuit layer **311** is covered by the front molded layer **3211**, and the pad **3112** of the front circuit layer **311** can still be exposed to the outside.

(64) Exemplarily, as shown in FIG. **4**D, first, the front conductive circuit **3111** of the front circuit layer **311** of the circuit board main body **31** is etched to reduce the height of the front conductive circuit **3111**, so that the surface of the front conductive circuit **3111** is lower than the surface of the pad **3112**; then, after placing the etched circuit board main body **31** on the upper die **51**, the upper die **51** is operated for clamping, so that the pressing surface **511** of the upper die **51** is pressed against the surface of the pad **3112**, and there is still a gap between the pressing surface **511** of the upper die **51** and the surface of the front conductive circuit **3111** to form the molding space **510** between the pressing surface **511** of the upper die **51** and the surface of the substrate layer **314** of the circuit board main body **31** and the surface of the front conductive circuit **3111**; next, the insulating molding material **320** is injected into the front molding space **510** to form the front molded layer **3211** covering only the surface of the substrate layer **314** and the surface of the front conductive circuit **3111** after curing to manufacture the molded circuit board **30**; finally, after the insulating molding material **320** is cured to form the front molded layer **3211**, the upper die **51** is operated for drafting, the molded circuit board **30** is taken out from the molding die **50**.

(65) FIG. **4**E shows a fifth modified implementation of the molded circuit board **30** of the camera module **1** according to the above-mentioned example of the present invention. Compared with the above-mentioned example according to the present invention, the molded circuit board **30** according to the fifth modified implementation of the present invention is different in that: by adopting a splicing process, a plurality of the circuit board main bodies **31** are simultaneously put into a molding die to mold the plurality of circuit board main bodies **31**, thereby forming a plurality

of the molded structures **32** at a time. It is worth noting that since a plurality of the circuit board main bodies **31** are simultaneously molded to form corresponding molded structures **32** on the plurality of circuit board main bodies **31**, therefore, while the manufacturing efficiency of the molded circuit board **30** is improved, it also helps to ensure that the molded circuit board **30** can provide a flat chip mounting surface.

(66) Exemplarily, as shown in FIG. **4**E, after placing the two combined circuit board main bodies **31** on the corresponding upper die **51**, the upper die **51** is operated for clamping, so that the pressing surface **511** of the upper die **51** is pressed against the surface of the pad **3112**, and an indenter **513** of the upper die **51** is pressed against a joint positon of the circuit board main body **31**, wherein a front molding space **510** is formed between the upper molded surface **512** of the upper die **51** and the front conductive circuit **3111** of the front circuit layer **311** and the surface of the substrate layer **314** of each circuit board main body **31**; next, the insulating molding material **320** is injected into each of the front molding spaces **510** to form, after curing, the front molded layer **3211** that simultaneously covers the front conductive circuit **3111** and the substrate layer **314**, thereby making a semi-finished molded circuit board; finally, after the upper die **51** is operated for drafting to take out the semi-finished molded circuit board, the semi-finished molded circuit board is then cut along the junction positon of the two circuit board main bodies **31** to obtain two of the molded circuit boards **30**. It can be understood that, in this example of the present invention, since the indenter **513** of the upper die **51** is directly pressed against the circuit board main body **31**, at least a part of the circuit board main body **31** of the molded circuit board **30** (such as at least one side of the circuit board main body **31**) is exposed to the outside because it is not covered by the front molded layer **3211**, that is, there is at least one exposed part on the circuit board main body **31** of the molded circuit board **30**. Of course, in other examples of the present invention, the exposed part of the circuit board main body **31** of the molded circuit board **30** may be subsequently covered with other insulating materials, or the exposed part of the circuit board main body **31** of the molded circuit board **30** can also be cut off directly.

(67) It is worth mentioning that, in the above-mentioned example of the present invention, as shown in FIGS. **2** and **3**B, the molded layer **321** of the molded structure **32** of the molded circuit board **30** may further include the back molded layer **3212** formed by curing the insulating molding material **320** on the back surface of the circuit board main body **31** by the molding process, wherein the back molded layer **3212** covers the surface of the back conductive circuit **3131** of the back circuit layer **313** and the surface of the substrate layer **314** located on the back surface of the circuit board main body **31** to protect the back conductive circuit **3131**. It is understandable that, in this example of the present invention, since the back circuit layer **313** of the circuit board main body **31** only includes the back conductive circuit **3131**, and does not includes the pad, therefore, during the molding process of molding the back molded layer **3212**, it is not necessary to consider whether the pads are exposed or not, and the molding is directly performed by the molding die **50**. Of course, in other examples of the present invention, the molded structure **32** of the molded circuit board **30** may also only includes the back molded layer **3212** or the front molded layer **3211**, and the surface of the circuit board main body **31** without providing the molded layer may be provided with the ink layer.

(68) Specifically, as shown in FIG. **3**B, the molding die **50** further includes a lower die **52**, wherein the lower die **52** can be moved for clamping and drafting, and when the molding die **50** is in a clamping state, a back molding space **520** is formed between the lower die **52** and the back surface of the circuit board main body **31**, wherein the back molded layer **3212** of the module structure **32** is formed by adding the insulating molding material to the back molding space **520** and curing.

(69) More specifically, as shown in FIG. **3**B, the lower die **52** of the molding die **50** has a flat lower molded surface **521**, so that when the circuit board main body **31** is placed on the lower die **52**, the back molding space **520** is formed between the lower molded surface **521** of the lower die **52** and the back surface of the circuit board main body **31**, so that the insulating molding material **320** is

cured in the back molding space **520** to form a molded layer **3212** that simultaneously covers the back conductive circuit **3131** of the back circuit layer **313** and the back molded layer **3212** of the substrate layer **314**. Of course, in other examples of the present invention, the back molded layer **3212** may also only cover the substrate layer **314** on the back surface of the circuit board main body **31**, and not cover the back conductive circuit **3131** of the back circuit layer **313**, that allows the back conductive circuit **3131** to be exposed to the outside.

(70) Exemplarily, as shown in FIG. **3**B, after the circuit board main body **31** is placed on the lower die **52**, the lower die **52** is operated for clamping, so that the back molding space **520** is formed between the lower molded surface **521** of the lower die **52** and the back surface of the circuit board main body **31**; then, the insulating molding material **320** is injected into the back molding space **520** to form, after curing, the back molded layer **3212** that simultaneously covers the back conductive circuit **3131** and the substrate layer **314**; finally, after the insulating molding material **320** is cured to form the back molded layer **3212**, the lower die **52** is operated for drafting, the molded circuit board **30** is taken out from the molding die **50**.

(71) It is worth noting that the back molded layer **3212** and the front molded layer **3211** of the molded layer **321** of the molded structure **32** can be molded together by the molding die **50** through a molding process. Alternatively, the back molded layer **3212** and the front molded layer **3211** of the molded structure **32** can also be separately molded by a molding process. Of course, the back molded layer **3212** may be molded by the lower die **52** of the molding die **50** after the front molded layer **3211** is molded; or it may be molded by the lower die **52** of the molding die **50** before the front molded layer **3211** is molded, which is not further limited in the present invention.

(72) In addition, in order to further enhance the heat dissipation capability of the molded circuit board **30**, the circuit board main body **31** of the molded circuit board **30** may further include a copper clad layer (not shown in the figure), wherein the copper clad layer and the back circuit layer **313** are provided on the back surface of the circuit board main body **31** at intervals, so that the copper clad layer does not contact the back conductive circuit **3131** of the back circuit layer **313**, which facilitates to enhance the heat dissipation performance of the molded circuit board **30** with the copper clad layer.

(73) Further, the back molded layer **3212** can have a similar molding manner as the front molded layer **3211**, so that the back molded layer **3212** only covers the back conductive circuit **3131** of the back circuit layer **313**, without covering the copper clad layer, so that the copper clad layer is exposed to the outside, so as to maximize the heat dissipation performance of the molded circuit board **30**. In other words, during the process of molding the back molded layer **3212**, the copper clad layer can achieve the purpose of being exposed outside the back molded layer **3212** in a same way that the pad **3112** is exposed outside the front molded layer **3211** in the above example, and the present invention will not describe it.

(74) According to the above-mentioned example of the present invention, as shown in FIG. **2**, the molded circuit board **30** further includes a set of electronic components **33**, and each of the electronic components **33** can be mounted on the pad **3112** of the front circuit layer **311** of the circuit board main body **31** by a process such as SMT (Surface Mount Technology). It is worth mentioning that in this example of the present invention, the photosensitive chip **20** and each of the electronic components **33** can be mounted after the front molded layer **3211** of the molded circuit board **30** is formed, and the photosensitive chip **20** is mounted on the chip mounting surface of the front molded layer **3211** to correspond to the chip mounting area **3101** of the circuit board main body **31**, and each of the electronic components **33** are respectively mounted on the pads **3112** to correspond to the edge areas **3102** of the circuit board main body **31**. It should be understood that, in the camera module of the present invention, the type of the electronic component **33** may not be limited. For example, the electronic component **33** can be implemented as a resistor, a capacitor, a driving device, and the like.

(75) In addition, after the photosensitive chip **20** is mounted on the front molded layer **3211** of the

molded structure **32** of the molded circuit board **30**, the photosensitive chip **20** can be electrically connected to the pad **3112** of the front circuit layer **311** by a gold wire process to conduct the photosensitive chip **20** and the molded circuit board **30**.

(76) It is worth mentioning that, as shown in FIG. **2**, in the above-mentioned first example of the present invention, the camera module **1** further includes a filter assembly **40**, wherein the filter assembly **30** is correspondingly provided between the the optical lens **11** of the lens assembly **10** and the photosensitive chip **20**, so that the light entering through the optical lens **11** is received by the photosensitive chip **20** after passing through the filter assembly **40**, thereby improving the imaging quality of the camera module **1**.

(77) Specifically, the filter assembly **40** includes a filter element **41** and a base **42**, wherein the filter element **41** is assembled on the base **42**, and the base **42** is correspondingly provided on the position of the front molded layer **3211** of the molded structure **32** of the molded circuit board **30** corresponding to the edge area **3102** of the circuit board main body **31**, so that while the filter element **41** is located between the photosensitive chip **20** and the optical lens **11**, the filter element **41** also corresponds to the photosensitive path of the photosensitive chip **20**, wherein the size of the filter element **31** is larger than that of the photosensitive area of the photosensitive chip **20** to ensure that the light entering the interior of the camera module **1** from the optical lens **11** is filtered by the filter element **41** before being received by the photosensitive chip **20** for photoelectric conversion, thereby the imaging quality of the camera module **1** is improved, for example, the filter element **41** can filter the infrared part of the light entering the interior of the camera module **1** from the optical lens **11**.

(78) Preferably, the base **42** is implemented as a separately manufactured bracket base **421**, wherein the bracket base **421** is bonded to the front molded layer **3211**, therefore, while the filter element **41** assembled on the holder base **421** is held in the photosensitive path of the photosensitive chip **20**, the bracket base **421** can also serve as a lens holder for mounting the lens assembly **10**.

(79) Further, as shown in FIG. **2**, the lens assembly **10** of the camera module **1** may further include a driver **12**, wherein the optical lens **11** is driveably assembled to the driver **12**, and the driver **12** is assembled on the top surface of the bracket base **421** so that the optical lens **11** is held in the photosensitive path of the photosensitive chip **20**. In addition, when the camera module **1** is used, the driver **12** can drive the optical lens **11** to move back and forth along the photosensitive path of the photosensitive chip **20** to adjust the focal length of the camera module **1** by adjusting the distance between the optical lens **11** and the photosensitive chip **20**, so that the camera module **1** is implemented as a zoom camera module. The type of the driver **12** of the camera module **1** of the present invention is not limited. The driver **2** can be implemented as a voice coil motor, which can be electrically connected to the molded circuit board **30** to be in the working state after receive power and the control signal, the optical lens **11** is driven to move back and forth along the photosensitive path of the photosensitive chip **20**. Nevertheless, those skilled in the art can understand that the type of the driver **12** is not limited, as long as it can drive the optical lens **11** to move back and forth along the photosensitive path of the photosensitive chip **20**.

(80) It is worth mentioning that, FIG. **5**A shows a first modified implementation of the camera module **1** according to the above-mentioned first example of the present invention. Specifically, compared with the above-mentioned first example according to the present invention, the camera module **1** according to the first modified implementation of the present invention is implemented as a fixed-focus camera module, that is, in this modified implementation of the present invention, the lens assembly **10** of the camera module **1** may not have the driver **12**. Specifically, the lens assembly **10** includes a lens barrel **12′**, wherein the lens barrel **12′** is assembled on the top surface of the bracket base **421**, and the optical lens **11** is fixedly assembled on the the lens barrel **12′**, so that the optical lens **11** is held in the photosensitive path of the photosensitive chip **20** by the lens barrel **12′**. In addition, in the process of assembling the lens barrel **12′** on the top surface of the bracket base **421**, the angle at which the lens barrel **12′** is assembled on the top surface of the

bracket base **421** can be adjusted by a calibration device, so that the optical axis of the optical lens **11** can be perpendicular to the photosensitive surface of the photosensitive chip **20** to ensure the imaging quality of the camera module **1**. It can be understood that the lens barrel **12′** can be manufactured separately, so that the lens barrel **12′** can be provided with thread or not, and the present invention is not limited in this respect.

(81) FIG. **5**B shows a second modified implementation of the camera module **1** according to the above-mentioned first example of the present invention. Specifically, compared with the first modified implementation according to the present invention, the base **42** of the filter assembly **40** of the camera module **1** according to the second modified implementation of the present invention is implemented as a molded base **422**, wherein the molded base **422** is cured at the position on the front molded layer **3211** of the molded circuit board **30** corresponding to the edge area **3102** of the circuit board main body **31** by the molding material through a molding process, wherein the lens barrel **12′** is assembled on the top surface of the molded base **422** to hold the optical lens **11** in the photosensitive path of the photosensitive chip **20** by the lens barrel **12′**. That is, in this modified implementation of the present invention, the molded base **422** is first manufactured by a molding process, and then the separately manufactured lens barrel **12′** is assembled on the top surface of the molded base **422**, so that the angle at which the lens barrel **12′** is assembled on the top surface of the molded base **422** can be adjusted by a calibration device, so that the optical axis of the optical lens **11** can be perpendicular to the photosensitive surface of the photosensitive chip **20** to ensure the imaging quality of the camera module **1**. Of course, in other examples of the present invention, the lens barrel **12′** may also extend integrally on the top surface of the molded base **422**, that is, the lens barrel **12′** and the molded base **422** can be integrally cured by the molding material through a module process, thereby enhancing the stability and reliability of the camera module **1**.

(82) Preferably, in this modified implementation of the present invention, as shown in FIG. **5**B, the molded base **422** covers the electronic components **33** on the molded circuit board **30** after being molded, and is mounted on the periphery of the photosensitive chip **20** of the molded circuit board **30** to isolate the adjacent electronic components **33** and isolate the electronic components **33** from the photosensitive chip **20** by the molded base **422**.

(83) FIG. **5**C shows a third modified implementation of the camera module **1** according to the above-mentioned first example of the present invention. Specifically, compared with the above-mentioned second modified implementation according to the present invention, the camera module **1** according to the third modified implementation of the present invention is different in that: the molded base **422** covers the electronic components **33** on the molded circuit board **30** and the non-photosensitive area of the photosensitive chip **20** after being molded to securely mount the photosensitive chip **20** on the molded circuit board **30**, thereby realizing a compact structure, and reducing the influence of dirt on the electronic components and the circuit board main body on the photosensitive chip **20**.

(84) Preferably, as shown in FIG. **5**C, the module base **422** has a stepped structure to provide a lower mounting surface for the filter element **41** and a higher mounting surface for the lens barrel **12′**, in order to reduce the distance between the filter element **41** and the photosensitive chip **20**, which helps to reduce the overall height of the camera module **1**. It is understandable that since the molded base **422** is integrally formed on the molded circuit board **30** through a molding die, the molded base **422** can provide a relatively flat mounting surface, so that the filter element **41** can be substantially parallel to the photosensitive chip **20** with a small tilt.

(85) FIG. **5**D shows a fourth modified implementation of the camera module **1** according to the above-mentioned first example of the present invention. Specifically, compared with the above-mentioned first example according to the present invention, the camera module **1** according to the fourth modified implementation of the present invention is implemented as a periscope camera module, that is, the camera module **1** further includes a light turning mechanism **13**, wherein the light turning mechanism **13** is provided on the photosensitive path of the photosensitive chip **20** for

turning the light entering the light turning mechanism **13**, so that the light turned by the light turning mechanism **13** is received by the photosensitive chip **20** after passing through the optical lens **11**. It is understandable that since the periscope camera module can be mounted to various electronic device main bodies in a “horizontal” installation manner, the height of the periscope array module can be reduced, so that after the periscope camera module is mounted on the electronic device main body, the thickness of the electronic device main body is not increased, thereby conforming to the development trend of thinning and lightening of the electronic device.

(86) Referring to FIGS. **6** and **7** of the accompanying drawings of the specification, a camera module **1**A according to a second example of the present invention is illustrated. Compared with the first example according to the present invention, the second example according to the present invention is different in that: a molded structure **32**A of a molded circuit board **30**A of the camera module **1**A further includes a molded package body **323**A, wherein the molded package body **323**A integrally extends from a front molded layer **3211** to replace the base in the filter assembly **40**, so that the filter element **41** and the lens assembly **10** can be directly assembled to the molded package body **323**A of the molded circuit board **30**A, so as to keep the filter element **41** and the optical lens **11** of the lens assembly **10** located in the photosensitive path of the photosensitive chip **20**. Preferably, the molded package body **323**A covers the electronic components **33** of the molded circuit board **30**A, so that the molded package body **323**A isolates the adjacent electronic components **33**, and isolates the electronic components **33** and the photosensitive chip **20**, so as to reduce the contamination of the photosensitive chip **20** caused by the dirt carried on the electronic components **33**.

(87) Further, as shown in FIG. **7**, the molded package body **323**A of the molded structure **32**A and the front molded layer **3211** are cured together by the insulating molding material **320** on the front surface of the circuit board main body **31** by the molding process, so as to cover the electronic components **33** of the molded circuit board **30**A by the molded package body **323**A, and the surface of the front conductive circuit **3111** of the front circuit layer **311** and the surface of the substrate layer **314** on the front surface of the circuit board main body **31** are covered by the front molded layer **3211**, so that the surface of the pad **3112** of the front circuit layer **311** is exposed to the outside. In other words, at the time of manufacturing the molded circuit board **30**A, the electronic component **33** may be mounted on the pad **3112** of the front circuit layer **311** of the circuit board main body **31** first by soldering through solder; place the circuit board main body **31** into a molding die **50**A for a molding process, to form the front molded layer **3211** and the molded package body **323**A of the molded structure **32**A by curing the insulating molding material **320** on the front surface of the circuit board main body **31**, wherein the front molded layer **3211** covers the surface of the front conductive circuit **3111** of the front circuit layer **311** and the substrate layer **314** of the front surface of the circuit board main body **31**, and a part of the pad **3112** is exposed to the outside, and is electrically connected to the photosensitive chip **20**. It is worth noting that, since the molded package body **323**A and the front molded layer **3211** are integrally formed by the molding die **50**A, the mounting surface provided by the molded package body **323**A can maintain good parallelism with the chip mounting surface provided by the front molded layer **3211**, which not only helps to ensure that the photosensitive chip **20** and the filter element **41** are parallel to each other, but also helps to ensure that the optical axis of the optical lens **11** is perpendicular to the photosensitive surface of the photosensitive chip **20**.

(88) Specifically, as shown in FIG. **7**, the molding die **50**A includes an upper die **51**A, wherein the upper die **51**A can be moved for clamping and drafting operations, and when the molding die **50**A is in a clamping state, a front molding space **510**A is formed between the upper die **51**A and the front surface of the circuit board main body **31**, wherein the front molded layer **3211** and the molded package body **323**A of the molded structure **32**A are formed by adding the insulating molding material **320** to the front molding space **510**A and curing.

(89) More specifically, as shown in FIG. **7**, the upper die **51**A of the molding die **50**A has a

pressing surface **511**A, a first upper molded surface **512**A, and a second upper molded surface **513**A, wherein the pressing surface **511**A of the upper die **51**A corresponds to the pad **3112** of the front circuit layer **311** of the circuit board main body **31**, and the second upper molded surface **513**A of the upper die **51**A is located around the first upper molded surface **512**A of the upper die **51**A, and the second upper molded surface **513**A of the upper die **51**A corresponds to the electronic component **33**. The pressing surface **511**A of the upper die **51**A is lower than the first upper molded surface **512**A of the upper die MA, and the first upper molded surface **512**A of the upper die MA is lower than the second upper molded surface **513**A of the upper die MA (that is, the upper die MA has a stepped inner surface), when the pressing surface **511**A of the upper die **51**A is pressed against the corresponding pad **3112**, there is still a gap between the first upper molded surface **512**A of the upper die **51**A and the front conductive circuit **3111**, there is a gap between the second upper molded surface **513**A of the upper die **51**A and the top surface of the electronic component **33** to ensure that the insulating molding material **320** can enter the gap between the first upper molded surface **512**A and the front conductive circuit **3111** and the gap between the second upper molded surface **513**A and the electronic component **33**, which enables the cured front molded layer **3211** to cover the front conductive circuit **3111**, and the cured molded package body **323**A can cover the electronic component **33** to protect the front conductive circuit **3111** and the electronic component **33**.

(90) Exemplarily, as shown in FIG. **7**, the electronic component **33** is first mounted on the part of the pad **3112** on the front circuit layer **311** of the circuit board main body **31**; and after placing the circuit board main body **31** on the upper die **51**A, the upper die **51**A is operated for clamping, so that the pressing surface **511**A of the upper die **51**A is pressed against the surface of the remaining pads **3112** on the front circuit layer **311**, and the front molding space **510**A is formed between the first and second upper molded surfaces **512**A, **513**A of the upper die **51**A and the front conductive circuit **3111** of the front circuit layer **311**, the substrate layer **314**, and the surfaces of the electronic components **33**; then, the insulating molding material **320** is injected into the front molding space **510**A to form, after curing, the front molded layer **3211** that simultaneously covers the front conductive line **3111**A and the substrate layer **314**A, and to form the molded package body **323**A covering the electronic component **33** to manufacture the molded circuit board **30**A; finally, after the insulating molding material **320** is cured to form the front molded layer **3211** and the molded package body **323**A, the upper die **51**A is operated for drafting, and the molded circuit board **30**A is taken out from the molding die **50**A. Of course, in this example of the present invention, after the back molded layer **3212** is molded on the back surface of the circuit board main body **31**, the photosensitive chip **20**, the filter element **41**, and the lens assembly **10** can be mounted on the molded circuit board **30**A in sequence, the lens assembly **10** can be assembled into the camera module **1**A.

(91) It is worth noting that, in the above-mentioned example of the present invention, the front molded layer **3211** of the molded structure **32**A covers the chip mounting area **3101** and the edge area **3102** of the circuit board main body **31**, so that the photosensitive chip **20** is mounted on the front molded layer **3211** of the molded structure **32**A of the molded circuit board **30**A, in order to reduce the adverse effect of the circuit board main body **31** on the mounting accuracy of the photosensitive chip **20** through the front molded layer **3211**. Of course, in other examples of the present invention, the photosensitive chip **20** may also be directly mounted on the chip mounting area **3101** of the circuit board main body **31** through an adhesive.

(92) Illustratively, FIG. **8**A shows a first modified implementation of the camera module **1**A according to the above-mentioned second example of the present invention. Specifically, compared to the above-mentioned second example of the present invention, the camera module **1**A according to the first modified implementation of the present invention is different in that: the photosensitive chip **20** is directly mounted on the chip mounting area **3101** of the circuit board main body **31** of the molded circuit board **30**A through an adhesive **60**; the front molded layer **3211**A of the molded

layer **321**A of the molded structure **32**A only covers the front conductive circuit **3111** of the front circuit layer **311** and the substrate layer **314** located at the edge area **3102** of the circuit board main body **31**, so that the front conductive circuit **3111** of the front circuit layer **311** located at the chip mounting area **3101** of the circuit board main body **31** is exposed to the outside because it is not covered. In this way, when the photosensitive chip **20** is mounted through the adhesive **60**, the adhesive **60** can enter into the gap of the front circuit layer **311**, which helps to increase the contact area between the adhesive **60** and the molded circuit boards **30**A, which further enhances the mounting strength of the photosensitive chip **20**. In addition, in this modified implementation of the present invention, the molded package body **323**A of the molded structure **32**A only covers the electronic component **33** to prevent the adjacent electronic components **33** from interacting with each other.

(93) It is worth noting that, as shown in FIG. **8**A, since the photosensitive chip **20** is directly mounted on the chip mounting area **3101** of the circuit board main body **31**, the front molded layer **3211**A of the molded structure **32**A only covers the edge area **3102** of the circuit board main body **31**. Therefore, in the present invention, the molded structure **32**A can be molded on the circuit board main body **31** through a molding process, and then the photosensitive chip **20** is mounted on the chip mounting area **3101** of the circuit board main body **31**; or, in the present invention, it can also first mount the photosensitive chip **20** on the chip mounting area **3101** of the circuit board main body **31**, then the molded structure **32**A is molded on the circuit board main body **31** through a molding process, which is not further limited by the present invention.

(94) FIG. **8**B shows a second modified implementation of the camera module **1**A according to the above-mentioned second example of the present invention, specifically, compared with the first modified implementation of the above-mentioned second example of the present invention, the camera module **1**A according to the second modified implementation of the present invention is different in that: the molded package body **323**A of the molded structure **32**A simultaneously covers the electronic component **33** and the non-photosensitive area of the photosensitive chip **20** to further strengthen the bonding strength between the photosensitive chip **20** and the molded circuit board **32**A, and also helps to avoid contamination of the photosensitive chip **20** caused by dirt on the circuit board main body **31**. It is worth noting that, since the molded package body **323**A of the molded structure **32**A covers the non-photosensitive area of the photosensitive chip **20**, before the molded structure **32**A is molded on the circuit board main body **31** through a molding process, the photosensitive chip **20** needs to be attached to the chip mounting area **3101** of the circuit board main body **31** through the adhesive **60**, and the photosensitive chip **20** is electrically connected to the circuit board main body **31**.

(95) It is worth noting that in the second example of the present invention and its modified implementations, in addition to the above-mentioned structure, other structures of the camera module **1**A is the same as the structures of the camera module **1** according to the first example of the present invention, and the camera module **1**A also has modified implementations similar to or the same as the various modified implementations of the camera module **1** of the first example, which will not be repeated here.

(96) According to another aspect of the present invention, an example of the present invention further provides a method for manufacturing a camera module. Specifically, referring to FIG. **9**, the method for manufacturing the camera module comprises the steps of:

(97) S**100**: providing a circuit board main body **31** and forming a molded layer **321**(**321**A) of a molded structure **32**(**32**A) by curing an insulating molding material **320** on at least one surface of the circuit board main body **31** with a molding die **50**(**50**A); S**200**: mounting at least one photosensitive chip **20** on the molded circuit board **30** (**30**A), and conductively connecting each of the photosensitive chips **20** to the molded circuit board **30** (**30**A);

(98) S**300**: correspondingly providing a lens assembly **10** on the molded circuit board **30** (**30**A), so that each optical lens **11** of the lens assembly **10** is located in the corresponding photosensitive path

of the photosensitive chip **20**.
(99) Further, as shown in FIG. **9**, the method for manufacturing the camera module further comprises the steps of:
(100) S**400**: correspondingly providing a filter assembly **40** between the molded circuit board **30** (**30**A) and the lens assembly **10**, so that the light entering from each of the optical lenses **11** is received by the photosensitive chip **20** after passing through the filter element **41** of the filter assembly **40**.
(101) It is worth noting that in the first implementation of the present invention, as shown in FIG. **10**A, the step S**100** in the method for manufacturing the camera module, that is, the method for manufacturing the molded circuit board **30** (**30**A), can comprise the steps of:
(102) S**110**: forming the front molded layer **3211** of the molded layer **321** of the molded structure **32** by curing the insulating molding material **320** on the front surface of the circuit board main body **31** with an upper die **51** of the molding die **50**, wherein the front molded layer **3211** only covers the front conductive circuits **3111** of the front circuit layer **311** of the circuit board main body **31**, so that the pads **3112** of the front circuit layer **311** are exposed to the outside.
(103) Further, as shown in FIG. **10**A, the method for manufacturing the molded circuit board **30** (**30**A) may comprise the following steps of:
(104) S**120**: forming the back molded layer **3212** of the molded structure **32** by curing the insulating molding material **320** on the back surface of the circuit board main body **31** with the lower die **52** of the molding die **50**, wherein the back molded layer **3212** covers the back conductive circuit **3131** of the back circuit layer **313** of the circuit board main body **31**.
(105) Furthermore, as shown in FIG. **10**A, the method for manufacturing the molded circuit board **30** (**30**A) may further comprise the following steps of:
(106) S**130**: mounting a set of electronic components **33** on the pad **3112** of the front circuit layer **311** of the circuit board main body **31**.
(107) It is worth mentioning that, according to the above-mentioned first implementation of the present invention, as shown in FIG. **10**A, the step S**110** may comprise the steps of:
(108) S**112**: placing the circuit board main body **31** on the upper die **51** of the molding die **50** so that the inner surface of the upper die **51** is pressed against the pad **3112** of the front circuit layer **311** of the circuit board main body **31**, and a front molding space **510** is formed between the inner surface of the upper die **51** and the front surface of the circuit board main body **31**; and
(109) S**113**: injecting the insulating molding material **320** into the front molding space **510** to form the front molded layer **3211** after curing.
(110) It is worth noting that the inner surface of the upper die **51** of the molding die **50** can be designed as required to mold the front molded layer **3211** that meets the requirements. For example, the surface of the front conductive circuit **3111** of the front circuit layer **311** is usually flush with the surface of the pad **3112** of the front circuit layer **311**. At this time, it can be designed so that the inner surface of the upper die **51** forms a pressing surface **511** and a molded surface **512**, wherein the pressing surface **511** is lower than the molded surface **512**, so that the upper die **51** has a stepped inner surface. Of course, the upper die **51** may also have a flat inner surface. At this time, the front molded layer **3211** that simultaneously covers the front conductive circuit **3111** and the pad **3112** of the front circuit layer **311** can be molded first, and then grind to expose the pad **3112** to the outside; or the front circuit layer **311** of the circuit board main body **31** can be pre-processed to make the surface of the front conductive circuit **3111** of the front circuit layer **311** to be lower than the surface of the pad **3112**.
(111) Exemplarily, as shown in FIG. **10**A, in the above-mentioned first implementation of the present invention, before the step S**112**, the step S**110** may further comprises the steps of:
(112) S**111**: etching the front conductive circuit **3111** of the front circuit layer **311** of the circuit board main body **31** to reduce the height of the front conductive circuit **3111** so that the surface of the front conductive circuit **3111** is lower than the surface of the pad **3112**.

(113) Of course, in other implementations of the present invention, before the step S**112**, the step S**110** may further comprise the step of: depositing metal on the pad **3112** of the front circuit layer **311** of the circuit board main body **31** through a deposition process to increase the height of the pad **3112**, so that the surface of the front conductive circuit **3111** is lower than the surface of the pad **3112**. In a second implementation of the present invention, as shown in FIG. **10**B, the step S**100**, that is, the method for manufacturing the molded circuit board **30** (**30**A), may also comprise the steps of:
(114) S**110**′: forming the front molded layer **3211** of the molded structure **32** by curing the insulating molding material **320** with an upper die **51** of the molding die **50**, wherein the front molded layer **3211** only covers the surface of the substrate layer **314** of the circuit board main body **31**, so that the front conductive circuits **3111** and the pads **3112** of the front circuit layer **311** are exposed to the outside;
(115) S**120**′: correspondingly providing an insulating protection layer **322** on the front conductive circuit **3111** of the front circuit layer **311** to cover the front conductive circuit **3111**;
(116) S**130**′: forming the back molded layer **3212** of the molded structure **32** by curing the insulating molding material **320** on the back surface of the circuit board main body **31** with the lower die **52** of the molding die **50**, wherein the back molded layer **3212** covers the back conductive circuit **3131** of the back circuit layer **313** of the circuit board main body **31**; and
(117) S**140**′: mounting a set of electronic components **33** on the pads **3112** of the front circuit layer **311** of the circuit board main body **31** to manufacture the molded circuit board **30**.
(118) It is worth noting that, in this second implementation of the present invention, the insulating protection layer **322** may be provided by means such as molding, adhesion, etc., to cover the front conduction circuit **3111** of the front circuit layer **311**.
(119) According to the above-mentioned second implementation of the present invention, as shown in FIG. **10**B, the step S**110**′ further comprises the steps of:
(120) S**111**′: placing the circuit board main body **31** on the upper die **51** of the molding die **50** so that the inner surface of the upper die **51** is simultaneously pressed against the front conductive circuit **3111** and the pad **3112** of the front circuit layer **311** of the circuit board main body **31** to form a front molding space **510** between the inner surface of the upper die **51** and the front surface of the circuit board main body **31**; and
(121) S**112**′: injecting the insulating molding material **320** into the front molding space **510** to form the front molded layer **3211** after curing.
(122) In a third implementation of the present invention, as shown in FIG. **10**C, the step S**100**, that is, the method for manufacturing the molded circuit board **30** (**30**A), may comprise the steps of:
(123) S**110**″: mounting a set of electronic components **33** on the pads **3112** of the front circuit layer **311** of the circuit board main body **31**;
(124) S**120**″: forming the front molded layer **3211**A and the molded package body **323**A of the molded structure **32**A by curing the insulating molding material **320** on the front surface of the circuit board main body **31** with an upper die **51**A of the molding die **50**A, wherein the front molded layer **3211**A covers the front conductive circuit **3111** of the front circuit layer **311**, and the molded package body **323**A covers the electronic component **33**; and
(125) S**130**″: forming the back molded layer **3212** of the molded structure **32**A by curing the insulating molding material **320** on the back surface of the circuit board main body **31** with the lower die **52** of the molding die **50**, wherein the back molded layer **3212** covers the back conductive circuit **3131** of the back circuit layer **313** of the circuit board main body **31** to manufacture the molded circuit board **30**A.
(126) It is worth noting that, in some examples of the present invention, the front molded layer **3211**A only covers the front conductive circuits **3111** of the front circuit layer **311** located at the edge area **3101** of the circuit board main body **31**.
(127) It is worth mentioning that the present invention further provides a modified implementation

of the method for manufacturing the camera module according to the above-mentioned example of the present invention. The step S**100** may further comprises the steps of: firstly the electronic component **33** and the photosensitive chip **20** are mounted on the front surface of the circuit board main body **31**, and the photosensitive chip **20** is electrically connected to the circuit board main body **31**; then, the front molded layer **3211**A and the molded package body **323**A of the molded structure **32**A is formed by curing the insulation molding material **320** on the front surface of the circuit board main body **31** with the molding die **50**A, wherein the molded package body **323**A covers the electronic component **33** and the non-photosensitive area of the photosensitive chip **20**.

(128) Exemplarily, as shown in FIG. **11**, in this modified implementation of the present invention, the method for manufacturing the camera module comprises the steps of:

(129) S**100**′: conductively mounting at least one photosensitive chip **20** on the chip mounting area **3101** of the circuit board main body **31**, and conductively mounting a set of electronic components **33** on the edge area **3102** of the circuit board main body **31**;

(130) S**200**′: forming the front molded layer **3211**A of the molded layer **321**A and the molded package body **323**A of the molded structure **32**A by curing the insulating molding material **320** on the front surface of the circuit board main body **31** with the molding die **50** (**50**A), wherein the front molded layer **3211**A only covers the front conductive circuit **3111** on the front circuit layer **311** of the circuit board main body **31** located at the edge area **3101** of the circuit board main body **31**, and the molded package body **323**A covers the electronic component **33** and the non-photosensitive area of the photosensitive chip **20**;

(131) S**300**′: correspondingly providing at least one filter element **41** of the filter assembly **40** on the molded package body **323**A, wherein each of the filter elements **41** is located in the corresponding photosensitive path of the photosensitive chip **20**; and

(132) S**400**′: correspondingly providing the lens assembly **10** on the molded package body **323**A of the molded structure **32**A, wherein each optical lens **11** of the lens assembly **10** is located in corresponding the photosensitive path of the photosensitive chip **20**, so that the light entering from each of the optical lenses **11** is received by the photosensitive chip **20** after passing through the corresponding filter element **41**.

(133) Further, as shown in FIG. **11**, the method for manufacturing the camera module further comprises the steps of:

(134) S**500**′: forming the back molded layer **3212** of the molded layer **321**A of the molded structure **32**A by curing the insulating molding material **320** on the back surface of the circuit board main body **31** with the molding die **50** (**50**A), wherein the back molded layer **3212** covers the back conductive circuit **3131** of the back circuit layer **313** of the circuit board main body **31**.

(135) It is worth mentioning that according to another aspect of the present invention, the present invention further provides an electronic device, wherein the electronic device is configured with at least one of the molded circuit boards **30** (**30**A) for providing mechanical support for fixing and assembling various electronic components such as integrated circuits, etc. For example, in the above-mentioned example of the present invention, the electronic device can be, but is not limited to, implemented as the camera module **1** (**1**A) configured with the molded circuit board **30** (**30**A). In other examples of the present invention, the electronic device may also be implemented as various electronic devices such as computers, robots, AR glasses, etc., configured with the molded circuit board **30** (**30**A). In addition, referring to FIG. **12**, according to another aspect of the present invention, the present invention further provides an electronic device, wherein the electronic device includes an electronic device main body **70** and at least one camera module **1** (**1**A), wherein each of the camera modules **1** (**1**A) are respectively provided on the electronic device body **70** for capturing images. It is worth mentioning that the type of the electronic device main body **70** is not limited. For example, the electronic device main body **70** can be any electronic device that can be configured with the camera module **1** such as a smart phone, a tablet computer, a notebook computer, an e-book, a personal digital assistant, a camera, etc. Those skilled in the art can

understand that, although in FIG. **12**, the electronic device main body **70** being implemented as a smart phone is taking as an example, it does not constitute a limitation to the content and scope of the present invention.

(136) It is worth noting that the orientation or positional relationship indicated by “upper”, “lower”, “inner”, “outer” etc. mentioned in the present invention is based on the orientation or positional relationship shown in the drawings, which is only for the convenience of describing the present invention and simplifying the description, rather than indicating or implying that the device or element referred to must have a specific orientation, be configured and operated in a specific orientation.

(137) Those skilled in the art should understand that the above description and the examples of the present invention shown in the accompanying drawings are only examples and do not limit the present invention. The purpose of the present invention has been completely and effectively achieved. The functions and structural principles of the present invention have been shown and explained in the examples. Without departing from the principles, the examples of the present invention may have any deformation or modification.

Claims

1. A molded circuit board, characterized in that it comprises: a circuit board main body, wherein the circuit board main body includes at least one circuit layer and at least one substrate layer, wherein the circuit layer and the substrate layer are stacked at intervals, and adjacent circuit layers or adjacent substrate layers are not in contact with each other; and a molded structure, wherein the molded structure includes a molded layer, wherein the molded layer is stacked on at least one surface of the circuit board main body to cover at least a part of the substrate layer of the circuit board main body, and a material of the molded layer is different from that of the substrate layer: wherein a front molded layer of the molded structure is provided with a groove corresponding to a set of pads of a front circuit layer of the circuit board main body to ensure the pads of the front circuit layer expose to the outside.

2. The molded circuit board of claim 1, wherein the front molded layer is stacked on a front surface of the circuit board main body to cover the substrate layer located on the front surface of the circuit board main body.

3. The molded circuit board of claim 2, wherein the front circuit layer is stacked on a front surface of the substrate layer, and the front circuit layer includes a front conductor circuit and the pads conductively connected to the front conductive circuit, and the front molded layer further covers the front conductive circuit of the front circuit layer.

4. The molded circuit board of claim 3, wherein the molded layer covers the front conductive circuit of the front circuit layer of the circuit board main body.

5. The molded circuit board of claim 2, wherein the front circuit layer is stacked on a front surface of the substrate layer, and the front circuit layer includes a front conductive circuit and the pads conductively connected to the front conductive circuit, and the molded structure further includes an insulating protective layer, and the insulating protective layer is stacked on the front molded layer, and corresponds to the front conductive circuit of the front circuit layer of the circuit board main body to cover the front conductive circuit.

6. The molded circuit board of claim 5, wherein a surface of the front conductive circuit of the front circuit layer of the circuit board main body is flush with or lower than a surface of the pad of the front circuit layer.