US 20040056971A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2004/0056971 A1

Yang et al. (43) Pub. Date: Mar. 25, 2004

(54) THIN TYPE CAMERA MODULE

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(21) Appl. No.: **10/660,649**

(22) Filed: **Sep. 12, 2003**

(30) **Foreign Application Priority Data**

Sep. 23, 2002 (CN) ..... 091215244

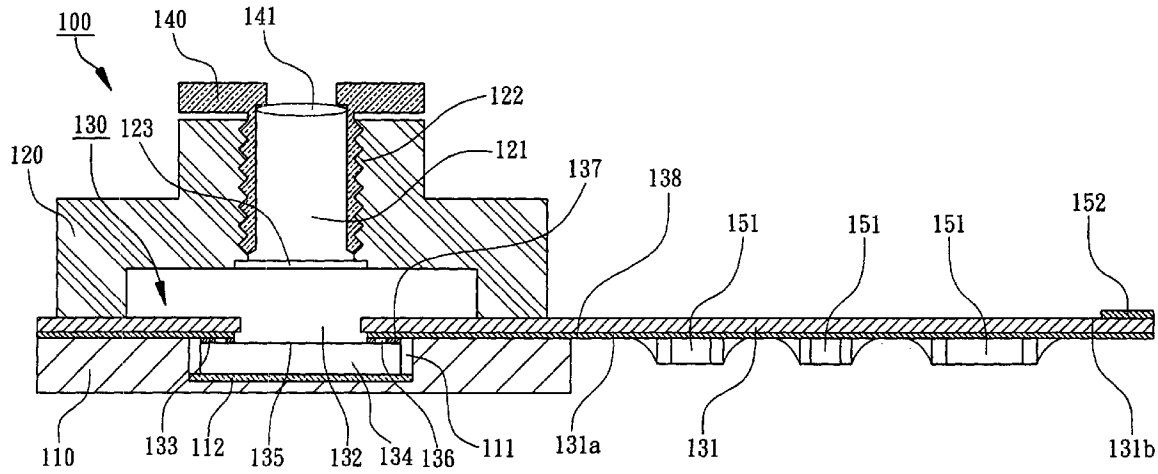
**Publication Classification**

(51) **Int. Cl.**[7] ..... **H04N 5/335**

(52) **U.S. Cl.** ..... **348/294**

(57) **ABSTRACT**

A thin type camera module includes a fixing board, an imaging-sensing semiconductor assembly, and a lens holder. The image-sensing semiconductor assembly is manufacture by a chip-on-film (COF) packaging method. The image-sensing semiconductor assembly comprises an image sensing chip and a COF wiring film, wherein the image sensing chip is flip-chip mounted on the COF wiring film. A photosensitive surface of the image sensing chip is corresponding to a window of the COF wiring film and disposed toward a light-pervious channel of the lens holder. The lens holder is connected with the fixing board to form an airtight space for sealing the image sensing chip. The COF wiring film has a module circuit for mounting an electrical device.



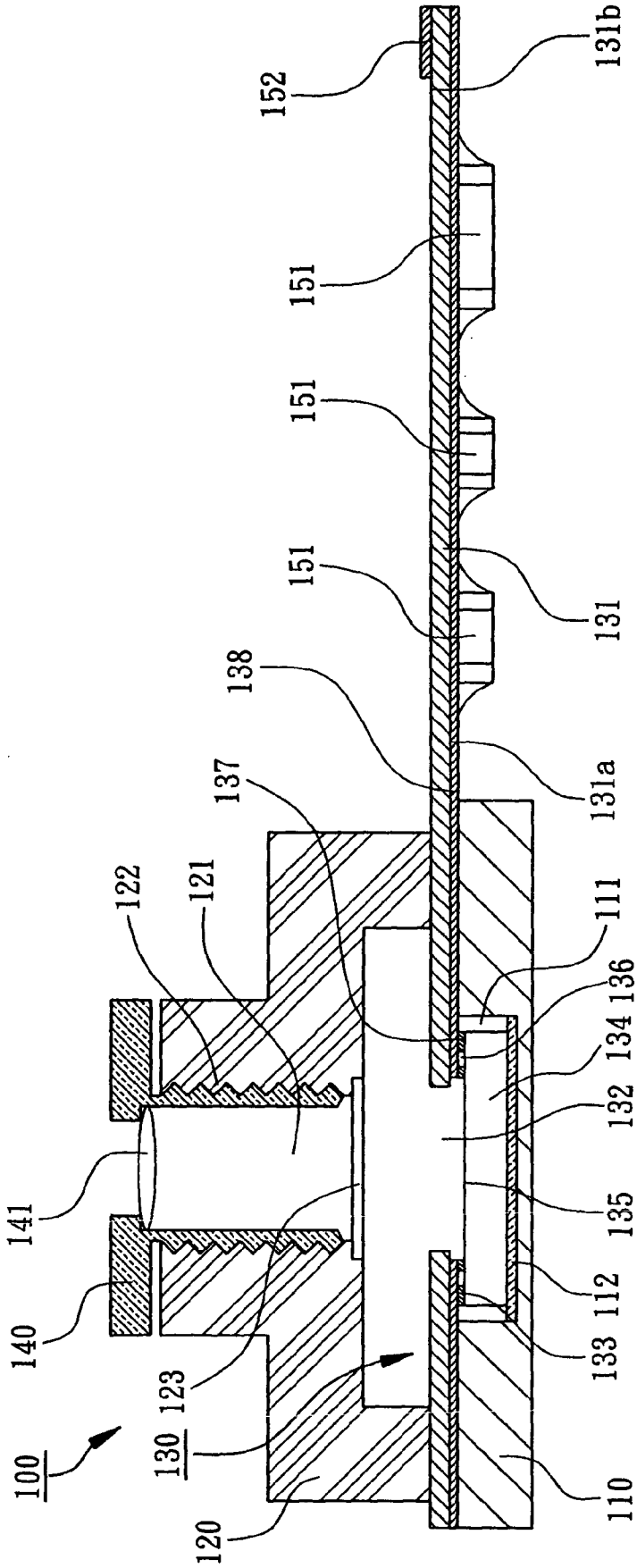

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FIG. 1

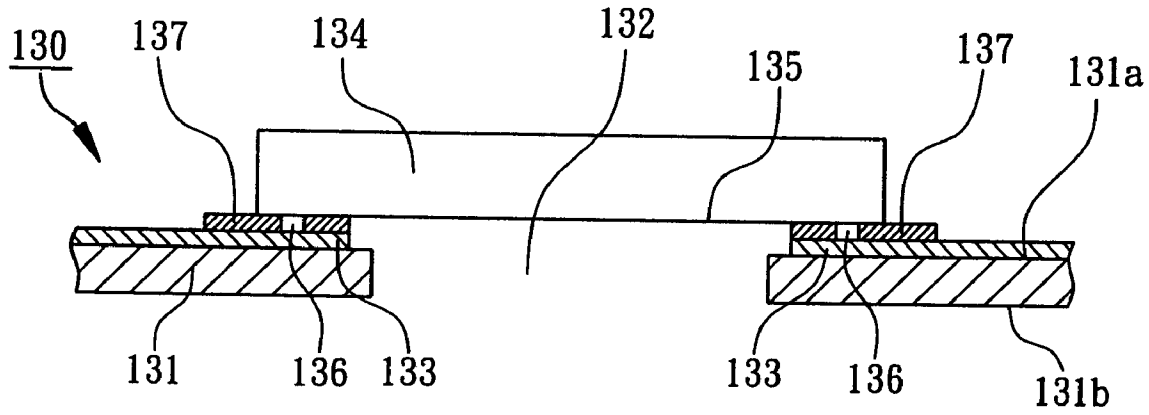



FIG. 2

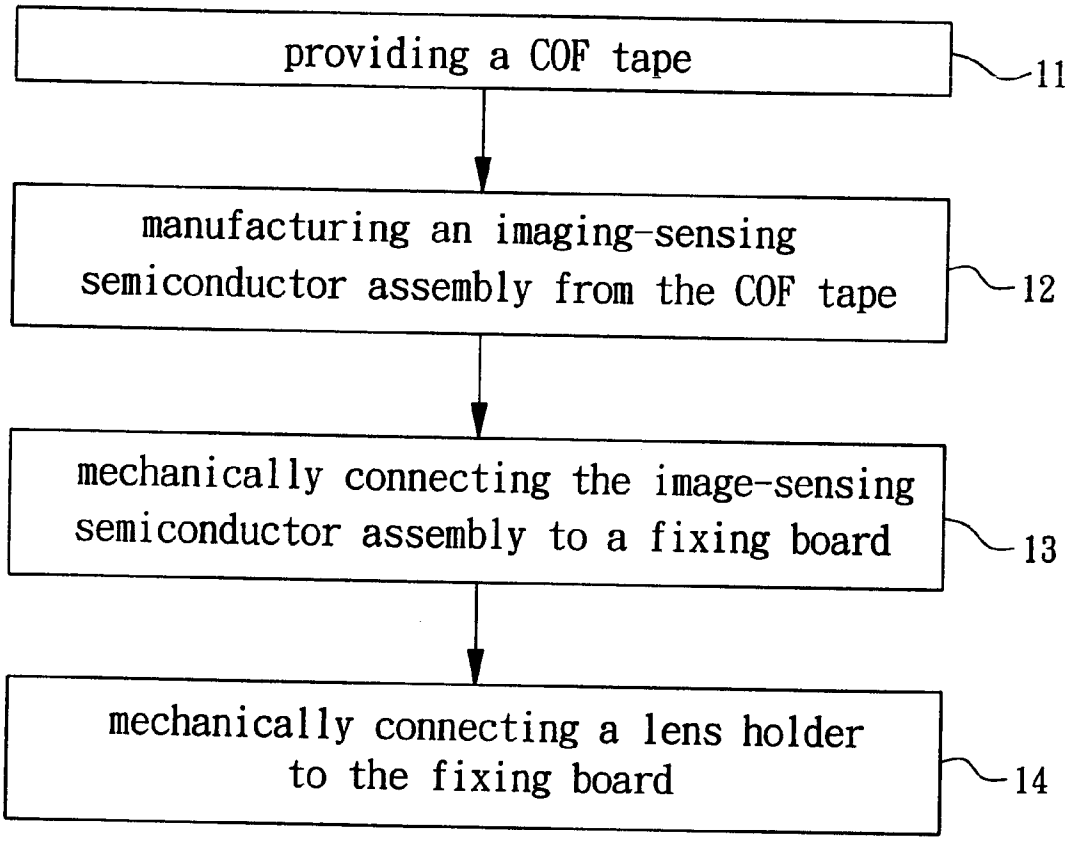
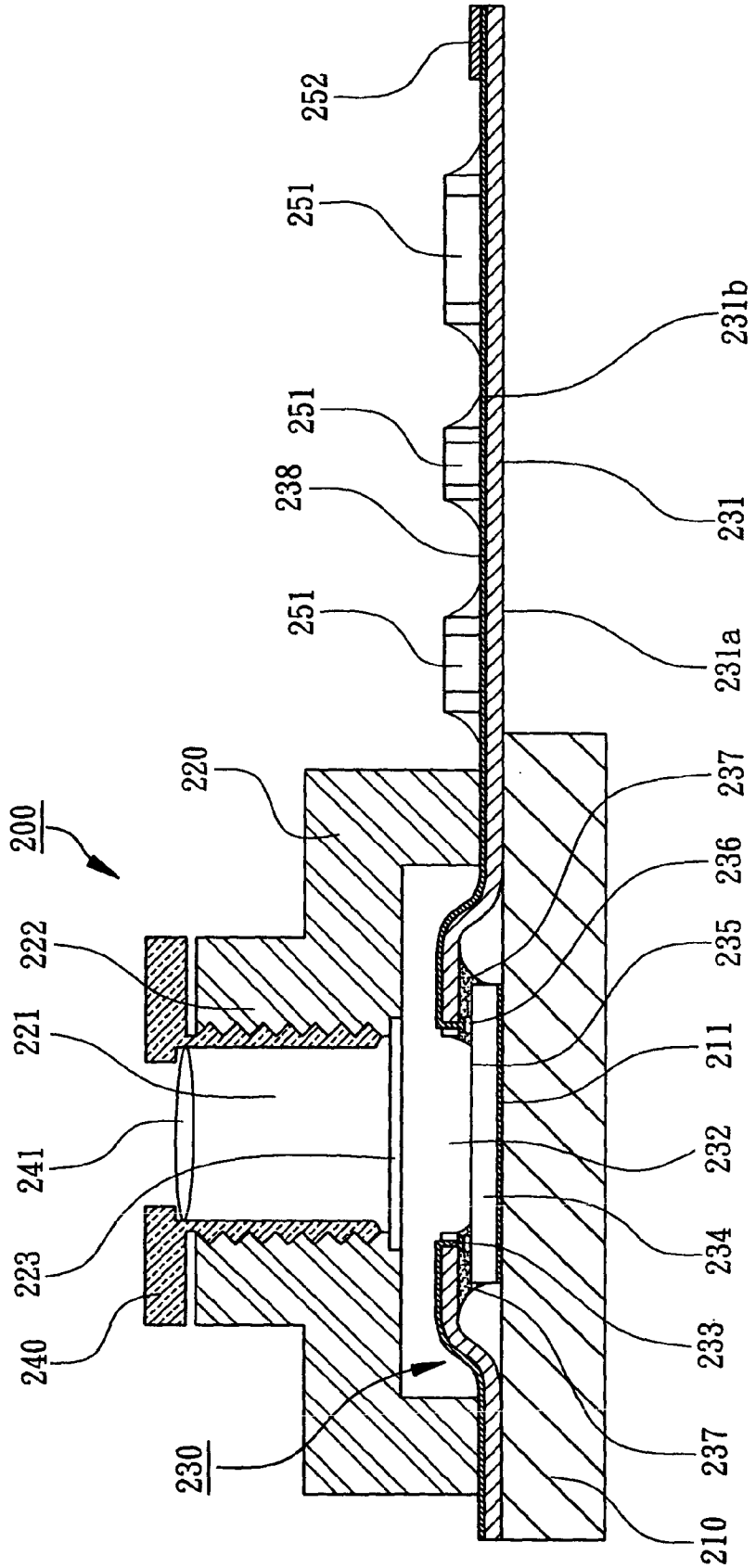

providing a COF tape
11
manufacturing an imaging-sensing semiconductor assembly from the COF tape
12
mechanically connecting the image-sensing semiconductor assembly to a fixing board
13
mechanically connecting a lens holder to the fixing board
14

FIG. 3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234
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233
230
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210

FIG. 4

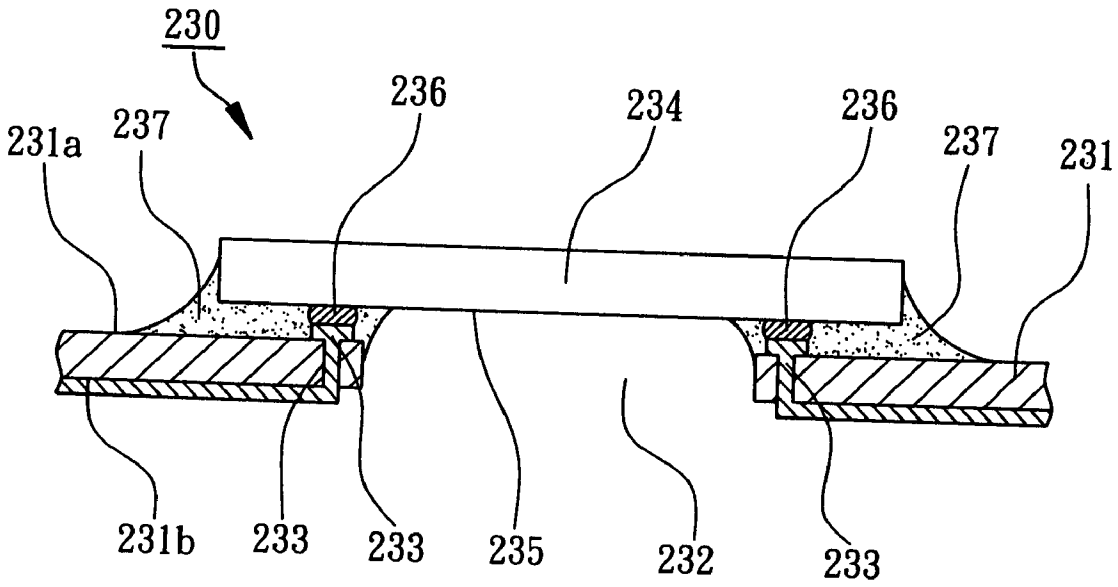


FIG. 5

# THIN TYPE CAMERA MODULE

## FIELD OF THE INVENTION

[0001] The present invention is relating to a camera module, particularly to a thin type camera module comprises an image-sensing semiconductor assembly manufactured by Chip-On-Film technology.

## BACKGROUND OF THE INVENTION

[0002] Application fields of a camera module are wide, such as digital camera, video telephone, video conference system. Normally the camera module includes a package having an image sensing chip (such as CMOS) inside an optical device for capturing image information. The camera module is converting the image information to the digital signal and transporting to a circuit board for identifying or storing the image information.

[0003] A conventional CCD image sensing module was disclosed in R.O.C. Taiwan Patent No. 492593 entitled "CCD and CMOS image capturing module". The CCD and CMOS image capturing module comprises a image sensing device which is electrically connecting to a circuit board. A lens holder is mounted on the circuit board and seals the image sensing device. Because that the circuit board forms a module circuit which is for connecting to the image sensing device, the process flow of the CCD and CMOS image capturing module is that firstly connecting the image sensing device to the circuit board, then fixing the lens holder and the circuit board. The CCD and CMOS image capturing module would cause the lens holder and the image sensing device misalignment, and capturing angle of the image sensing device is easy to deviate. Another improved structure of the CCD and CMOS image capturing module which is similar to the foregoing CCD and CMOS image capturing module are brought from the known patent. But the lens holder is connecting onto mold body of the image sensing device (CMOS or CCD). Besides, the lens holder is attached and sealed the top edge of the mold body of the image sensing device. However, the lens holder is connecting on the image sensing device, the image sensing device has to sustain the weight of the whole lens holder. The stability between the image sensing device and circuit board would be poor.

[0004] Another conventional electric camera lens module was disclosed in R.O.C Taiwan. Patent No. 372079 entitled "electric camera lens module". The electric camera lens module comprises a lens holder and a photosensitive module, wherein a plane of the lens holder disposes a hollow pillar which is set an adjustable cone, another plane of the lens holder disposes a trough which is linking the hollow pillar. The photosensitive module is installed in the trough, which comprises a filter, a hard substrate with pins and a photosensitive chip, wherein the substrate has a through hole at corresponding the hollow pillar for setting the filter. The photosensitive chip has a photosensitive surface corresponding to the through hole and the pillar, and has a plurality of contact ends contacted with pins of the substrate through the signal circuit of the substrate. When the pins electrically contact with an exterior electronic device, the electric camera lens module will start to capture image. Because of the photosensitive module is assembled by the filter, the hard substrate and the photosensitive chip, wherein the photosensitive chip is disposed at the bottom of the substrate in bare-chip configuration, so that protection of the photosensitive chip is poor. The whole thickness of the electric camera lens module is thicker, because the thickness of the photosensitive module has to consider the thickness of the filter, the hard substrate and the photosensitive chip, and the length of the pins of the hard substrate.

## SUMMARY

[0005] The primary object of the present invention is to provide a thin type camera module comprises an image-sensing semiconductor assembly which is manufacture by a chip-on-film (COF) packaging method, so the thin type camera module is thinner. Besides, a fixing board forms a recession for holding an image sensing chip in order to achieve more thinner thin type camera module.

[0006] The second object of the present invention is to provide a thin type camera module comprises an image-sensing semiconductor assembly which is manufacture by a COF packaging method. An image sensing chip is flip-chip mounted on a COF wiring film, so the reliability is better. And the COF wiring film is suited for continue mass production the image-sensing semiconductor assembly to reduce the thin type camera module running cost.

[0007] The third object of the present invention is to provide a thin type camera module comprises an image-sensing semiconductor assembly with a COF wiring film. The COF wiring film possesses all circuit design including module circuit for the thin type camera module to integrate a module circuit of the thin type camera module in the image-sensing semiconductor assembly so that an extra circuit substrate is not necessary. The COF wiring film with module circuit has input/output terminals directly to let image-sensing semiconductor assembly enables mounting of passive element. The image-sensing semiconductor assembly could be connected to a fixing board or a lens holder firstly for variedly process flow.

[0008] According to the thin type camera module of the present invention, which comprises a fixing board, an image-sensing semiconductor assembly and a lens holder. The image-sensing semiconductor assembly comprises a COF wiring film and an image sensing chip. The the COF wiring film forms a plurality of connecting ends around a window of the COF wiring film for flip-chip connecting. The connecting ends is disposed on a surface of the COF wiring film. The image sensing chip has a photosensitive surface with a plurality of bumps. The image sensing chip is flip-chip mounted to the COF wiring film by electrically connecting the bumps and the connecting ends, and the photosensitive surface of the image sensing chip is corresponding to the window of the COF wiring film. Preferably, the COF wiring film includes a module circuit for connecting passive element what the thin type camera module need. The lens holder is mounted on the fixing board to form an airtight space. The image sensing chip locates inside the airtight space and the photosensitive surface of the image sensing chip is toward a light-pervious channel of the lens holder for capturing image.

## DESCRIPTION OF THE DRAWINGS

[0009] **FIG. 1** is a cross-sectional view illustrating a thin type camera module of a first embodiment of the present invention.

[0010] **FIG. 2** is a cross-sectional view illustrating an image-sensing semiconductor assembly of the thin type camera module of the first embodiment of the present invention.

[0011] **FIG. 3** is a process flow chart of the thin type camera module of the first embodiment of the present invention.

[0012] **FIG. 4** is a cross-sectional view illustrating a thin type camera module of a second embodiment of the present invention.

[0013] **FIG. 5** is a cross-sectional view illustrating an image-sensing semiconductor assembly of the thin type camera module of the second embodiment of the present invention.

## DEATAILED DESCRIPTION OF THE PRESENT INVENTION

[0014] Referring to the drawings attached, the present invention will be described by means of the embodiments below.

[0015] As showed in **FIG. 1, a** thin type camera module **100** of a first embodiment of the present invention comprises a fixing board **110**, a lens holder **120** and an imaging-sensing semiconductor assembly **130**, wherein the fixing board **110** is a kind of hard material without electrical transmitting function, such as BT substrate, FR-4 substrate, ceramic substrate or metal plate. The lens holder **120** is mounted on the fixing board **110** to form an airtight space to fix the imaging-sensing semiconductor assembly **130**. The lens holder **120** has a light-pervious channel **121** which forms a connecting portion **122**, such as inner thread of a screw, at a opening of the light-pervious channel **121** for connecting a camera lens **140**. The camera lens **140** has a lens **141** and its shape is like a cylindrical. The camera lens **140** is fixed or connected to the lens holder **120** in adjustable type.

[0016] Referring to **FIGS. 1 and 2**, the imaging-sensing semiconductor assembly **130** comprises a COF (chip-on film) wiring film **131** and an image sensing chip **134**, wherein the COF wiring film **131** is flexible, such as polyimide (PI). The COF wiring film **131** has a first surface **131***a*, a second surface **131***b* and a window **132**. The window **132** is passing through the first surface **131***a* and the second surface **131***b*. In this embodiment, the COF wiring film **131** has a plurality of metal wires forming on the first surface **131***a*. The metal wires has a plurality of connecting ends **133** which are disposed around the window **132** on the first surface **131***a* of the COF wiring film **131**. The image sensing chip **134** is optical sensing chip, CCD (charge coupled device), CMOS (complementary metal oxide semiconductor) or photodiode, which is having a photosensitive surface **135**. A plurality of bumps **136**, such as gold bumps, are formed on peripherals of the photosensitive surface **135** for output terminals of the image sensing chip **134**. The image sensing chip **134** is flip-chip mounted on the COF wiring film **131**, and its photosensitive surface **135** is corresponding to the window **132** and the bumps **136** are electrically connected with the connecting ends **133**. Preferably, a sealant layer **137**, such as ACF (anisotropic conductive film), NCF (non-conductive film), UV past or thermosetting filling past, is disposed around the window **132** of the COF wiring film **131** between the first surface **131***a* of the COF wiring film **131** and the photosensitive surface **135** of the image sensing chip **134**. The sealant layer **137** encloses the bumps **136** of the image sensing chip **134** and combines the COF wiring film **131** with the image sensing chip **134** for improving reliability of electrically connecting of the connecting ends **133** and the bumps **136**.

[0017] The image sensing chip **134** is disposed inside the airtight space which is formed by the lens holder **120** and the fixing board **110**. Inside the airtight space, it can be vacuum state or inert gas filled, such as Nitrogen or Argon gas, for avoiding moisture invading and effecting the image sensing chip **134** capturing image. In this embodiment, the fixing board **110** forms a recession **111**. The image sensing chip **134** is attaching on the recession by an adhesive layer **112** (such as past or tape) which is formed at bottom surface of the image sensing chip **134**. The recession **111** assists the image sensing chip **134** in locating for aligning with the photosensitive surface **135** and the light-pervious channel **121** of the lens holder **120**. Perfectly, the lens holder **120** disposes a filter **123** which is also aligning with the light-pervious channel **121** and corresponding to the photosensitive surface **135** of the image sensing chip **134**. The filter **123** is used for filtering out the infrared in order to avoid causing noise or false color. Besides, the COF wiring film **131** includes a module circuit **138** which is formed on extending surface which is not covered by the lens holder **120**. The module circuit **138** is electrically connecting at least an electric device **151**, such as a passive component (selected from resistant, inductance and capacitance) or a active component. A plurality of connection fingers **152** are connected with the module circuit **138** of the COF wiring film **131** and the image sensing chip **134**, which are used for input/output terminals of the whole thin type camera module **100** for electrically connecting to exterior electrical device.

[0018] The imaging-sensing semiconductor assembly **130** of the thin type camera module **100** of the present invention is manufactured by a Chip-On-Film (COF) packaging method. The thin type camera module is thinner and suited for continuously mass producing the image-sensing semiconductor assemblies to reduce the thin type camera module running cost. The image sensing chip **134** is flip-chip mounted on the COF wiring film **131**. The connecting ends **133** of the COF wiring film **131**, which are disposed surrounding the window **132** on the first surface **131***a* for better stability of the image sensing chip **134**. And, the fixing board **110** forms the recession **111** for installing the image sensing chip **134** and achieve forming a thinner thin type camera module **100**. In addition, the COF wiring film **131** of imaging-sensing semiconductor assembly **130** can provide all circuit design of the thin type camera module **100** to integrating the module circuit **138** of the image-sensing semiconductor assembly **130**. And the COF wiring film **131** is formed input/output terminals directly, so the hard circuit substrate is not necessary. The COF wiring film **131** with the module circuit **138**, which is flexible and exposing out of the lens holder **120**, so process flow of the thin type of camera module **100** is various. The image-sensing semiconductor assembly **130** could be connected to the fixing board **110** or the lens holder **120** at first base on process flow design to achieve elastic process flow because that the image-sensing semiconductor assembly **130** is not necessary to electrically connect to the lens holder **120** and the fixing board **110**.

[0019] One of manufacturing process flows for the thin type camera module **100** of above description is shown in **FIG. 3**. The detailed description of the process flow of the thin type camera module **100** is as following:

[0020] Firstly, a COF tape is provided in a step **11** of "providing a COF tape". The COF tape is rolled in the reel, which comprises a plurality of mentioned-above COF wiring films **131**. Each first surface **131***a* of the COF wiring film **131** forms a plurality of metal wires which include a plurality of connecting ends **133** disposed around the window **132** on the first surface **131***a*. Preferably, the metal wires are connecting with the module circuit **138**.

[0021] Then, the imaging-sensing semiconductor assembly **130** is manufactured by a COF packaging method in a step **12** of "manufacturing an imaging-sensing semiconductor assembly from the COF tape". Peripherals of the photosensitive surface **135** of the image sensing chip **134** are a plurality bumps **136** which are non-reflowable conductive bumps such as gold, copper, aluminum or its alloy, or solder bumps. In this embodiment, the bumps **136** are gold bumps for flip-chip mounted to the COF tape. Then, he image sensing chips **134** are flip-chip mounted to the COF tape. Preferably, prior to the flip-chip mounting step, a sealant layer **137** such as an ACF or a NCF is coated. The photosensitive surface **135** of the image sensing chip **134** is corresponding the window **132** and face down, and the face surface **131***a* of the COF wiring film **131** is face up for flip-chip mounting the image sensing chip **134** on the COF wiring film **131**. In one embodiment, the sealant layer **137** is an ACF, the bumps **136** could not be necessary to bond with the connecting ends **133** actually. The bumps **136** are electrically connected to the connecting ends **133** vertically by conductive particles of the ACF sealant layer **137**. The sealant layer **137** encloses the bumps **136** for protecting the bumps and improving reliability of electrically connecting of the connecting ends **133** and the bumps **136**. Perfectly, at least an electric device **151** is surface-mounted to the module circuit **138** of the COF wiring film **131** for constuting whole module circuit **138** and electrical functions in the imaging-sensing semiconductor assembly **130**. So the COF tape can package the pluralities of image-sensing semiconductor assemblies **130** continuously, then the COF tape is singulated to get image-sensing semiconductor assemblies **130** for next step of process flow of the thin type camera module **100**.

[0022] Then, the image-sensing semiconductor assembly **130** is fixed to the fixing board **110** in a step **13**"mechanically connecting the image-sensing semiconductor assembly to a fixing board". The fixing board **110** has a recession **111**. The adhesive layer **112** is prepared in the recession **111** for adhering the image sensing chip **134**. The recession **111** assists the image sensing chip **134** in fixing the image sensing chip **134** and the capturing angle in position, meanwhile, providing a thinner module.

[0023] Then, the lens holder **120** is connecting to the fixing board **110** to form an airtight space in a step **14** of "mechanically connecting a lens holder to the fixing board". The image sensing chip **134** is located inside the airtight space for avoiding dust invading it. The lens holder **120** has a light-pervious channel **121** which is connecting a camera lens **140** at a opening of the light-pervious channel **121**. Preferably, the lens holder **120** includes a filter **123** which is aligning with the light-pervious channel **121**. The photosensitive surface **135** of the image sensing chip **134**, the filter **123** of the lens holder **120** and the lens **141** of the camera lens **140** are forming on the light-pervious channel **121** and corresponding each other for capturing image. In the process flow of the thin type camera module **100** of above description, the image-sensing semiconductor assembly **130** is located on the fixing board **110** and the recession **111** of the fixing board **110** assists the image sensing chip **134** in locating for the photosensitive surface **135** of the image sensing chip **134** corresponding to the filter **123** and lens **141** in order to align correctly and get right capturing angle.

[0024] As showed in **FIG. 4, a** thin type camera module **200** of a second embodiment of the present invention comprises a fixing board **210**, a lens holder **220** and an imaging-sensing semiconductor assembly **230**, wherein the fixing board **210** is a kind of hard substrate without electrical function. The lens holder **220** is mounted on the fixing board **210** to form an airtight space. The lens holder **220** has a light-pervious channel **221** which forms a connecting portion **222** for connecting a camera lens **240**. The imaging-sensing semiconductor assembly **230** comprises a COF wiring film **231** and an image sensing chip **134**. The image sensing chip **134** is disposed insides the airtight space. The COF wiring film **231** has a first surface **231***a*, a second surface **231***b*, a window **232** which passes through the first surface **231***a* and the second surface **231***b*, and at least a conductive via **239** disposed around the window **232**. In this embodiment, the COF wiring film **231** has a plurality of metal wires forming on the second surface **231***b*. The metal wires includes a plurality of connecting ends **233** disposed on the first surface **231***a* around the window **232**. The conductive vias **239** electrically connect the connecting ends **233**. Surrounding the photosensitive surface **235** of the image sensing chip **234** are a plurality of bumps **236**. In this embodiment, the bumps **236** are reflowable solder bumps. **FIG. 5** is a cross-section view illustrating of the imaging-sensing semiconductor assembly **230** after manufactured by a chip-on-film packaging method. The photosensitive surface **235** of the image sensing chip **234** is face-down and corresponding to the window **232** of the COF wiring film **231** during flip-chip mounting step. The first surface **231***a* of the COF wiring film **231** is face-up and the image sensing chip **234** is flip-chip mounted on the COF wiring film **231**. The bumps **236** electrically connect the connecting ends **233**. Preferably, a sealant layer **237** is formed surrounding the windows **232** of the COF wiring film **231** after flip-chip mounting. In this embodiment, the sealant layer **237** is a thermosetting compound such as UV past, transparent thermosetting liquid compoundt or underfilling material. The sealant layer **237** fills the surrounding of the photosensitive surface **235** of the image sensing chip **234** by capillarity, but it is not covering the active area of the photosensitive surface **235**. The sealant layer **237** encloses the bumps **236** for fixing the image sensing chip **234** and the COF wiring film **231** and for improving reliability of electrically connecting of the connecting ends **233** and the bumps **236**.

[0025] In this embodiment, thickness of the image sensing chip **234** is thinner by grinding bottom surface of the image sensing chip **234** for providing a thinner module and a better horizontal plane corresponding to the photosensitive surface **235**. When the image sensing chip **234** of the imaging-sensing semiconductor assembly **230** is disposed inside the airtight space which is formed by the lens holder **220** and the

fixing board **210**, an adhesive layer **211** (such as past or tape) is formed between the bottom surface of the image sensing chip **234** and the fixing board **210** for fixing the image sensing chip **234** on the fixing board **210**. The image sensing chip **234** is steadier and having a steady capturing angle. The photosensitive surface **235** of image sensing chip **234** is aligning with the light-pervious channel **221** of the lens holder **220**. The lens holder **220** comprises a filter **223** which is also aligning with the light-pervious channel **221** and corresponding to the photosensitive surface **235** of the image sensing chip **234**. The photosensitive surface **235** of the image sensing chip **234**, the filter **223** of the lens holder **220** and the lens **241** of the camera lens **240** are forming in the light-pervious channel **221** and corresponding each other for capturing image. In addition, the metal wires of the COF wiring film **231** includes a module circuit **238** for electrically mounting at least a passive component **251** of the thin type camera module **200** in the imaging-sensing semiconductor assembly **230**. The module circuit **238** is formed on an extended surface of the fixing board **210** which is not covered by the lens holder **220** for electrically connecting the electric device **251**. Connection fingers **252** are connected with the module circuit **238** of the COF wiring film **231** and the image sensing chip **234**, which are used for input/output terminals of the whole thin type camera module **200**.

[**0026**] Therefore, thickness of the thin type camera module **200** is thinner. The imaging-sensing semiconductor assembly **230** of the thin type camera module **200** is suited for continuously mass production to reduce the thin type camera module running cost.

[**0027**] The whole circuit patterns of the thin type camera module **200** are integrated in the imaging-sensing semiconductor assembly **230** with module circuit **238**, so the extra module substrate is not necessary. The COF wiring film **231** with module circuit **238** is flexible and partially exposed out of the lens holder **220**. The image-sensing semiconductor assembly **230** could be mechanically connected to the fixing board **210** or the lens holder **220** elastically for varieous process flow of the thin type camera module **200**.

[**0028**] The above description of embodiments of this invention is intended to be illustrated and not limiting. Other embodiments of this invention will be obvious to those skilled in the art in view of the above disclosure.

What is claimed is:

**1**. A thin type camera module comprising:

a fixing board;

an imaging-sensing semiconductor assembly comprising a COF (chip-on film) wiring film and an image sensing chip, wherein the COF wiring film has a surface, a window and a plurality of connecting ends disposed on the surface of the COF wiring film around the window, the image sensing chip has a photosensitive surface corresponding to the window, and a plurality of bumps are formed on peripherals of the photosensitive surface, the image sensing chip is flip-chip mounted on the COF wiring film to electrically connect the bumps with the connecting ends; and

a lens holder for connecting a camera lens, wherein the lens holder has a light-pervious channel and is connected with the fixing board to form a airtight space for sealing the image sensing chip, and the photosensitive surface of the image sensing chip is corresponding to the light-pervious channel for capturing image.

**2**. The thin type camera module in accordance with claim 1, further comprising at least an electric device electrically connected with the COF wiring film.

**3**. The thin type camera module in accordance with claim 2, wherein the electric device is a passive component.

**4**. The thin type camera module in accordance with claim 2, wherein the COF wiring film formed a module circuit electrically connecting the electric device.

**5**. The thin type camera module in accordance with claim 4, wherein the module circuit is formed on an extending surface of the COF wiring film without being covered by the lens holder.

**6**. The thin type camera module in accordance with claim 1, further comporising a sealant layer is formed around the window of the COF wiring film for enclosing the bumps of the image sensing chip.

**7**. The thin type camera module in accordance with claim 6, wherein the sealant layer is an anisotropic conductive film (ACF).

**8**. The thin type camera module in accordance with claim 6, wherein the sealant layer is a non-conductive film (NCF).

**9**. The thin type camera module in accordance with claim 6, wherein the sealant layer is transparent thermosetting compound.

**10**. The thin type camera module in accordance with claim 1, wherein the COF wiring film has at least a conductive via electrically connecting the connecting ends.

**11**. The thin type camera module in accordance with claim 1, wherein the lens holder comprises a filter aligning with the light-pervious channel.

**12**. The thin type camera module in accordance with claim 1, further comprising a camera lens connected with the lens holder.

**13**. The thin type camera module in accordance with claim 1, wherein the fixing board has a recession for locating the image sensing chip.

**14**. The thin type camera module in accordance with claim 1, wherein the airtight space is in vacuum state.

**15**. The thin type camera module in accordance with claim 1, wherein the airtight space filled with inert gas.

* * * * *