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(54) PACKAGE OF AN IMAGE SENSOR DEVICE

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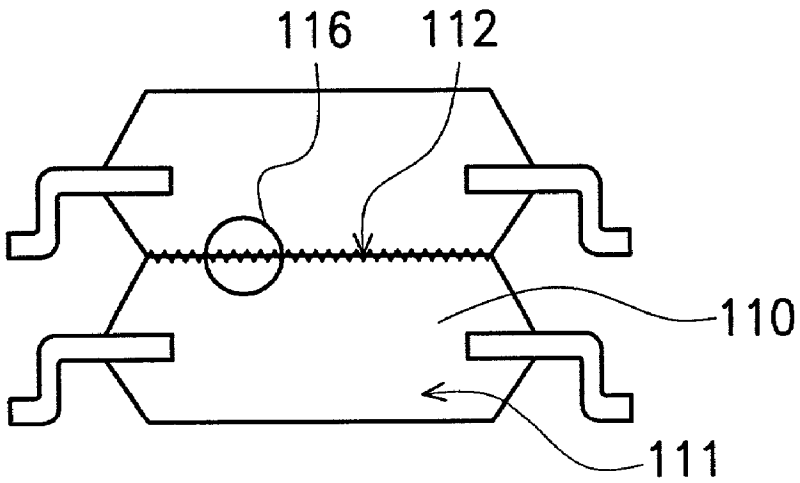
(57) **ABSTRACT**

The present invention provides a package comprising a lead frame, which has a die pad and a plurality of leads located at the peripheral of the die pad. An image sensor chip has an active surface and a corresponding back surface. A plurality of bonding pads are on the active surface. A plurality of leads are electrically connected from the bonding pads to the inner leads. The image sensor chip, the die pads and the inner leads are encapsulated with a transparent molding material. A cavity is formed on a surface of the transparent molding material corresponding to the active surface. The area of the cavity, which is large enough just to cover the chip of the image sensor, has a smooth surface after a polishing process.



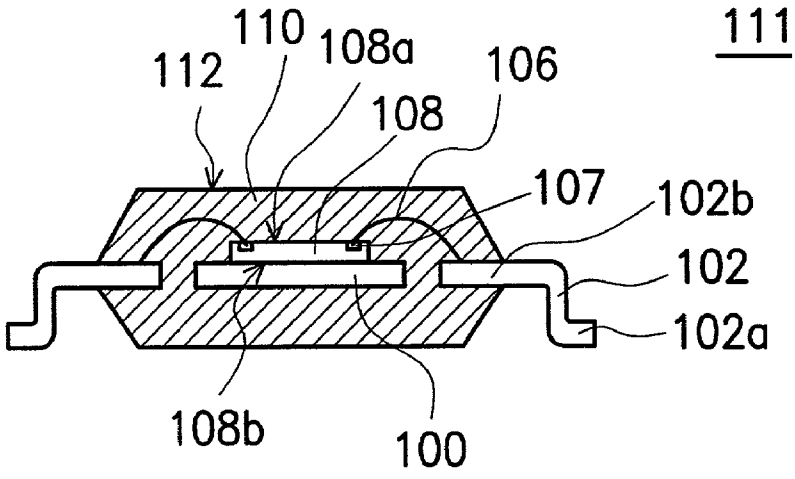


FIG. 1 (PRIOR ART)

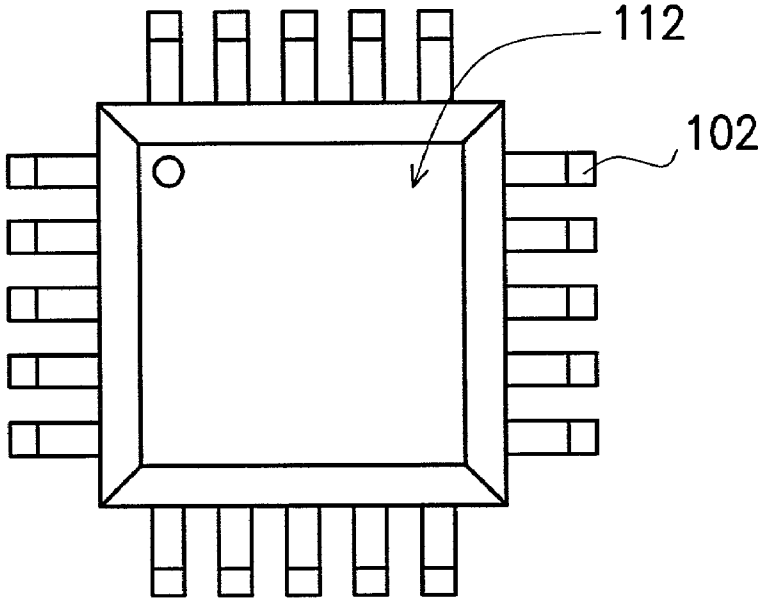


FIG. 2 (PRIOR ART)

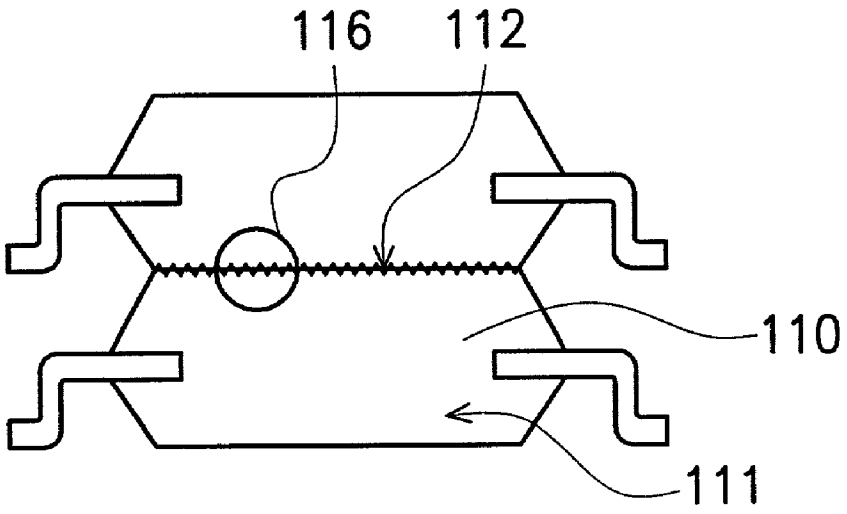


FIG. 3

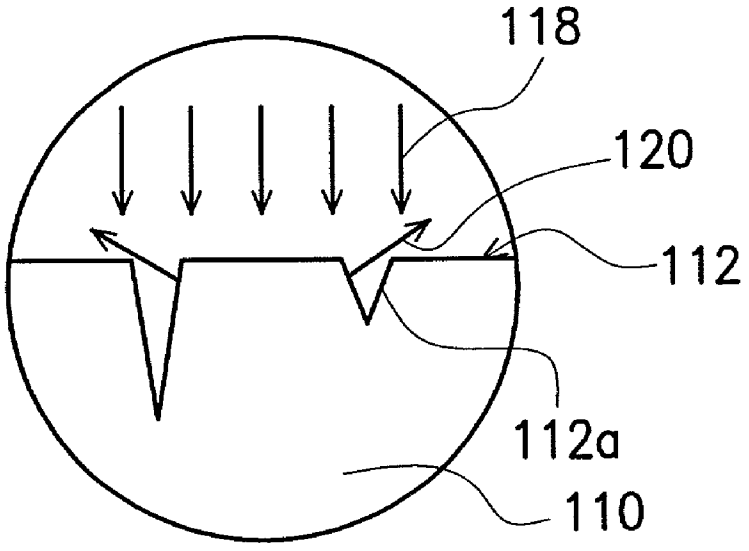


FIG. 4

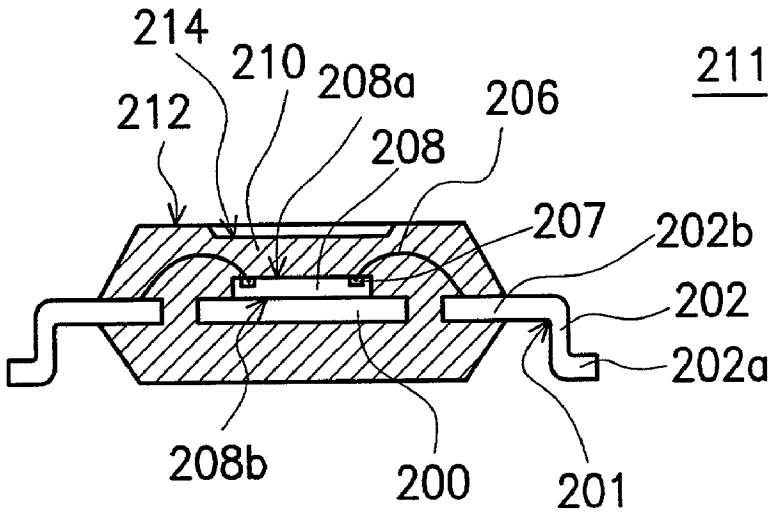

214
210
208a
206
211
212
208
207
202b
202
202a
208b
200
201

FIG. 5

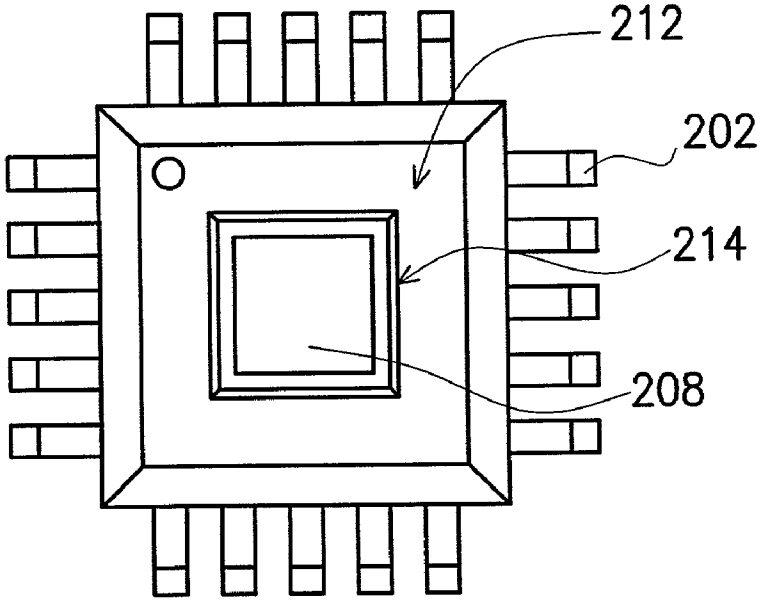

212
202
214
208

FIG. 6

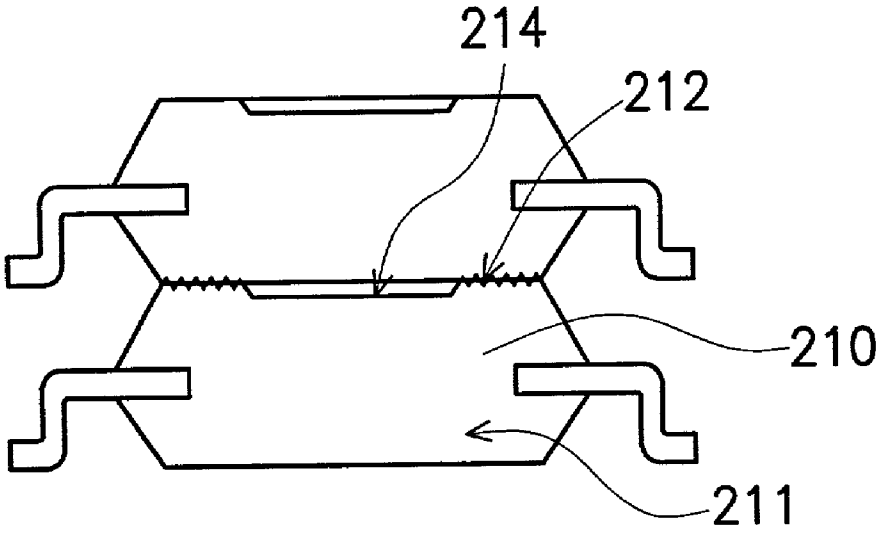


FIG. 7

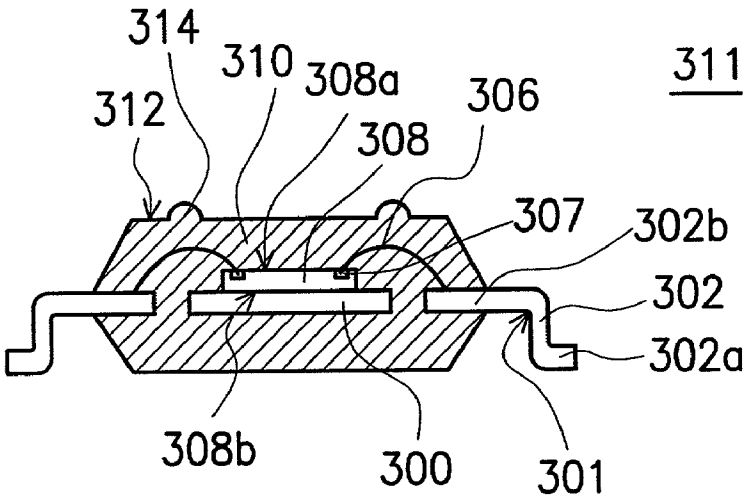

314
310
308a
306
311
312
308
307
302b
302
302a
308b
300
301

FIG. 8

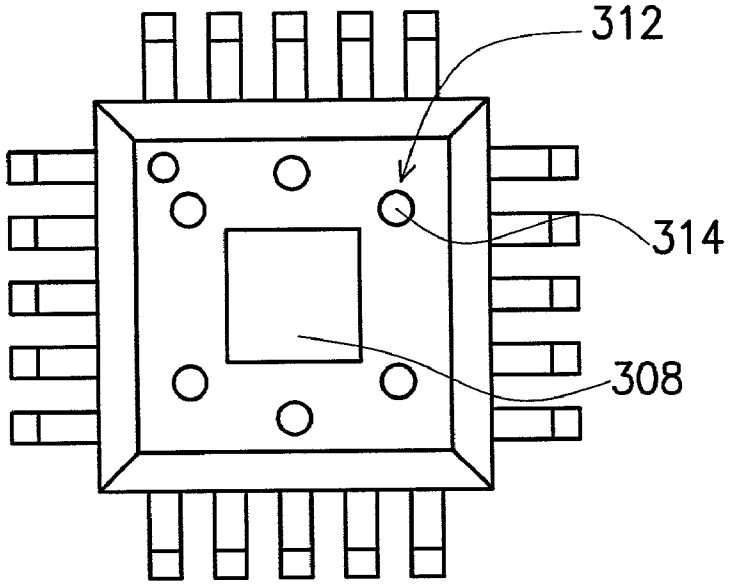

312
314
308

FIG. 9

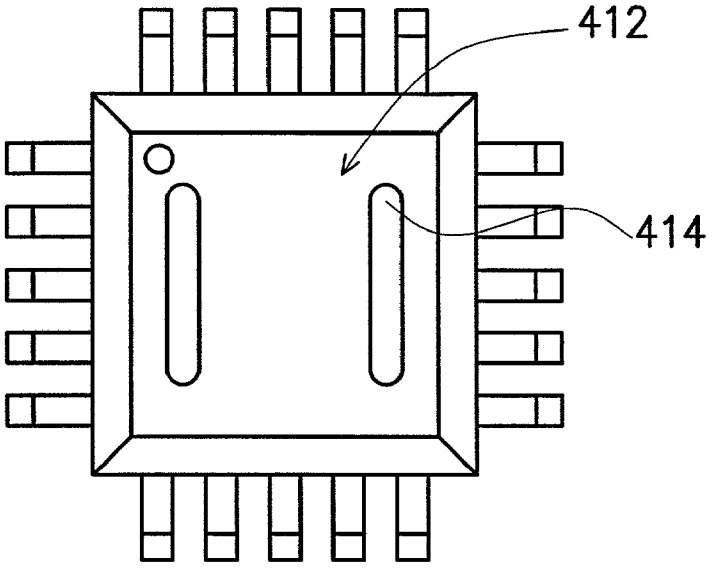


FIG. 10

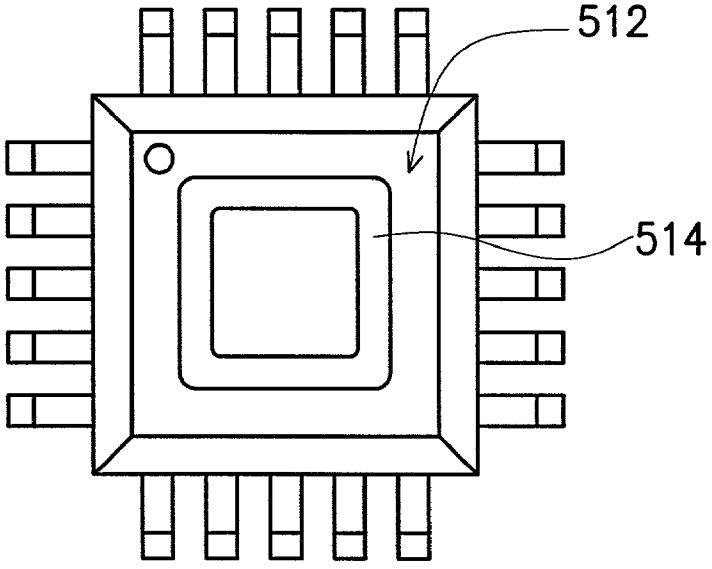


FIG. 11

PACKAGE OF AN IMAGE SENSOR DEVICE

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application claims the priority benefit of Taiwan application Ser. No. 89124358, filed Nov. 17, 2000.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a package of a semiconductor device. More particularly, the present invention relates to a package of an image sensor device.

[0004] 2. Description of the Related Art

[0005] A package process of a semiconductor device is the process after completing the first part of fabricating a semiconductor device. The package process separates each chip of the wafer, and connects the chip to a lead frame by a wire bonding method. A resin material is used to encapsulate the chip and lead frame, and an outer lead is exposed for an outer connection. In view of different functional requirements, during the first part of the process of fabricating a semiconductor device, the surface of each layer of the chip will have different circuit pattern designs and a different number of bonding pads.

[0006] In view of the requirements of photology, the image sensor device has to use a transparent molding method. The molding surface that corresponds to an active surface of the chip needs to be polished in order to prevent the light that passes through the molding surface from deflecting on the active surface of the chip.

[0007] In the conventional method, the polished surface of the package of the image sensor chip is not well protected. Therefore after the molding process and during any step of the fabrication, if the polished surface comes into contact with anything, it will be damaged and abraded, and its transparency will be affected. Therefore, the conventional package has the disadvantage of abrading the polished surface and less light will be able to transmit through the device.

[0008] Referring to **FIG. 1** and **FIG. 2**, **FIG. 1** is a schematic diagram of a conventional package of an image sensor device, and **FIG. 2** is a schematic top view of the conventional package of the image sensor device of **FIG. 1**. Some parts of the device and some reference numbers of **FIG. 1** are not shown in **FIG. 2**, so that the main structure of the device can be seen easily. A back surface **108***b* of a chip **108** of the image sensor device is adhered on a die pad **100** of a lead frame **102**. A bonding pad **107** of the image sensor chip **108** is connected to an inner lead **102***b* of the lead frame **102** by conductive wires **106**. The image sensor chip **108**, the die pad **100**, and the inner lead **102***b* are encapsulated with a transparent molding material **110** to complete a package body of the image sensor **111**. Due to the requirements of photology, a molding surface **112** corresponding to an active surface **108***a* of the image sensor chip **108** must be polished. The polishing process prevents the light that passes through the molding surface **112** from deflecting on the active surface **108***a*.

[0009] **FIG. 3** is a schematic diagram of an image sensor chip for a post mold cure (PMC) process after completing a molding process. **FIG. 4** is a schematic magnified diagram of a region **116** of **FIG. 3**. During the PMC process, the package of the image sensor chip **111** is stacked up with each other to save space. This method will cause the polished surface **112** to have some abraded defects. **FIG. 4** shows a magnified portion of the contact part of the region **116**. Some abraded defects **112***a* occur on the molding surface **112**. When an incident light **118** radiates onto the abraded defect **112***a*, a refracted light **120** will be produced and the light transmitted to the active surface **108***a* of the chip **108** will be reduced.

SUMMARY OF THE INVENTION

[0010] The present invention of a package of an image sensor device provides a solution to the above-mentioned problem of the prior art. The package of the present invention comprises a lead frame, at least one die pad and a plurality of leads that are located at the peripheral of the die pad. Each lead has an inner lead and an outer lead. An image sensor chip has an active surface and a corresponding back surface. A plurality of bonding pads are on the active surface. The back surface of the chip is adhered on the die pad. A plurality of conductive wires are electrically connected from the bonding pads to the inner leads. The image sensor chip, the die pads and the inner leads are encapsulated with a transparent molding material. A cavity is formed on a surface of the transparent molding material corresponding to the active surface. The area of the cavity is large enough just to cover the chip of the image sensor, and a bottom surface of the cavity is a smooth surface after a polishing process.

[0011] The present invention also provides another package of an image sensor device that comprises a lead frame, at least one die pad and a plurality of leads located at the peripheral of the die pad. Each lead has an inner lead and an outer lead. An image sensor chip has an active surface and a corresponding back surface. A plurality of bonding pads are on the active surface. The back surface of the chip is adhered on the die pad. A plurality of conductive wires are electrically connected from the bonding pads to the inner leads. The image sensor chip, the die pads and the inner leads are encapsulated with a transparent molding material. A smooth surface that has been polished is formed on a surface of the transparent molding material corresponding to the active surface. The smooth surface partially covers the chip of the image sensor and a protrusion is installed at the periphery of the smooth surface.

[0012] The characteristic of the present invention is to use a cavity surface or a protrusion of a transparent molding surface to prevent coming into direct contact with the polished surface of the molding surface. When the polished surface is defected, less light will be transmitted to the active surface of the chip, and light transmission therefore will be reduced.

[0013] It is to be understood that both the foregoing general description and the following detailed description are exemplary, and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The accompanying drawings are included to provide a further understanding of the invention, and are incorporated in and constitute a part of this specification. The drawings illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention. In the drawings,

[0015] **FIG. 1** is a schematic diagram of a package of an image sensor device of the prior art;

[0016] **FIG. 2** is a schematic top view of **FIG. 1**;

[0017] **FIG. 3** is a schematic diagram of a package of an image sensor device for a post mold cure (PMC) process after completing a molding process;

[0018] **FIG. 4** is a schematic magnified diagram of region **116** of **FIG. 3**;

[0019] **FIG. 5** is a schematic diagram of a package of an image sensor device according to a first preferred embodiment of the present invention;

[0020] **FIG. 6** is a schematic top view of **FIG. 5**;

[0021] **FIG. 7** is a schematic diagram of a package of an image sensor device for a post mold cure (PMC) process after completing a molding process according to a first preferred embodiment of the present invention;

[0022] **FIG. 8** is a schematic diagram of a package of an image sensor device according to a second preferred embodiment of the present invention;

[0023] **FIG. 9** is a schematic top view of **FIG. 8**;

[0024] **FIG. 10** is a schematic diagram of a strip-shaped protrusion on the transparent molding surface of a package of an image sensor device; and

[0025] **FIG. 11** is a schematic diagram of a ring-shaped protrusion on the transparent molding surface of a package of an image sensor device.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0026] First Preferred Embodiment

[0027] Referring to **FIG. 5** and **FIG. 6**. **FIG. 5** is a schematic diagram of a package of an image sensor device of a first preferred embodiment according to the present invention. **FIG. 6** is a schematic top view of **FIG. 5**. Some parts of the device and reference numbers are not shown in **FIG. 6**, so that the main structure of the device can be seen easily. At least one die pad **200** is in a lead frame **201**, a plurality of leads **202** are located at periphery of the die pad **200**. Each lead **202** has an inner lead **202***b* and an outer lead **202***a*. An image sensor chip **208** has an active surface **208***a* and a corresponding back surface **208***b*. The back surface **208***b* of the chip is adhered on the die pad **200**. The chip of the image sensor device **208** is a complementary metal-oxide semiconductor (CMOS), for example.

[0028] A plurality of bonding pads **207** are formed on the active surface **208***a* of the image sensor chip **208**. The bonding pads **207** are electrically connected to the inner lead **202***b* of the lead **202** by conductive wires **206**. The image sensor chip **208**, the die pad **200** and the inner lead **202***b* of the leads **202** are encapsulated by a transparent material **210**, for example a transparent resin. The package of the image sensor device is thus completed. The surface **212** of the transparent material **210** that corresponds to the active surface **208***a* of the chip **208** has a cavity **214**. The area of the cavity **214** is big enough to cover the image sensor device **208** (shown in **FIG. 6**). The surface of the cavity **214** is a smooth surface that has been polished.

[0029] **FIG. 7** is a schematic diagram of package of an image sensor device for a post mold cure (PMC) process after completing a molding process according to a first preferred embodiment of the present invention. During the PMC process, the image sensor devices can be stacked up to save space. The characteristic of the present invention is that the cavity surface **214** of the molding surface **212** can reduce abraded damage on the molding surface **212** during the packaging process of the image sensor device **211**. Therefore the chance of light being reflected away from the active surface **208***a* of the chip can be reduced (See **FIG. 5**). Furthermore, the preferred embodiment of the present invention is not limited to the lead frame, various types of carriers can be utilized, and a plurality of conductive pins can be formed on the carrier.

[0030] A Second Preferred Embodiment

[0031] **FIG. 8** is a schematic diagram of a package of an image sensor device of a second preferred embodiment according to the present invention, and **FIG. 9** is a schematic top view of **FIG. 8**. Some parts of the device and reference numbers are not shown on **FIG. 9**, so that the main structure of the device can be seen easily. At least one die pad **300** is in a lead frame **301**, a plurality of leads **302** are located at the periphery of the die pad **300**. Each lead **302** has an inner lead **302***b* and an outer lead **302***a*. An image sensor chip **308** has an active surface **308***a* and a corresponding back surface **308***b*. The back surface **308***b* of the chip is adhered on the die pad **300**. The image sensor chip **308** is a complementary metal-oxide semiconductor (CMOS), for example.

[0032] A plurality of bonding pads **307** are formed on the active surface **308***a* of the image sensor chip **308**. The bonding pads **307** are electrically connected to the inner lead **302***b* of the lead **302** by conductive wires **306**. The image sensor chip **308**, the die pad **300** and the inner lead **302***b* of the leads **302** are encapsulated by a transparent molding compound **310**, for example a transparent resin. A package of an image sensor device **311** is thus completed. A surface of the transparent molding compound **310** that corresponds to the active surface **308***a* has been polished in order to form a smooth surface **312**.

[0033] Referring to **FIG. 9**, the area of the smooth surface **312** is large enough to cover the chip **308** of the image sensor device. A protrusion **314** is formed at the periphery of the smooth surface **312**. The protrusion **314** can be, for example, a plurality of node-shaped protrusions, wherein these node-shaped protrusions are located around the periphery of the smooth surface **312**. The protrusions **314** of the smooth surface **312** can prevent the damage of abrasion on the smooth surface **312** during the packaging process of the image sensor device **311**. Therefore, the light reflection of the active surface **308***a* of the chip can be reduced.

[0034] According to the characteristics of the second preferred embodiment of the present invention, the protrusions **314** in **FIG. 9** can be made into strip-shaped protru-

sions that are shown in **FIG. 10**. The strip-shaped protrusions **414** are located around the periphery of the smooth surface **412** of the molding compound. The protrusions **314** in **FIG. 9** also can be made into ring-shaped protrusions that are shown in **FIG. 11**. The ring-shaped protrusions **514** are located around the periphery of the smooth surface **512** of the molding compound. The second preferred embodiment of the present invention is not limited to the use of the lead frame, various types of carriers can be utilized, and a plurality of connective pins can be formed in the carrier.

[**0035**] The above-mentioned ring-shaped protrusions that are around the periphery of the smooth surface can prevent the abraded damage during the packaging process of the image sensor device in order to reduce the light reflection of the active surface of the chip.

[**0036**] From the preferred embodiments of the present invention, the advantages of the invention are as follows:

[**0037**] 1. The present invention provides a packaging comprising a cavity surface of a transparent molding compound in order to prevent abraded damage on a smooth surface during a packaging process of an image sensor device. Furthermore, the light reflection of an active surface of a chip can be reduced.

[**0038**] 2. The present invention also provides a packaging comprising a protrusion on the smooth surface of the transparent molding compound in order to prevent the abraded damage on the smooth surface of the molding compound during the packaging process of the image sensor device. Furthermore, the light reflection of the active surface of the chip can be reduced.

[**0039**] The present invention uses a PMC process as an example to explain the abraded damage on the smooth surface during the packaging process of the image sensor device. However, the present invention can also prevent other factors that cause the damage on the smooth surface from contact during packaging.

[**0040**] It will be apparent to those skilled in the art that various modifications and variations can be made to the structure of the present invention without departing from the scope or spirit of the invention. In view of the foregoing, it is intended that the present invention covers modifications and variations of this invention provided they fall within the scope of the following claims and their equivalents.

What is claimed is:

1. A package of an image sensor device, the package comprising

a lead frame, comprising a die pad, and a plurality of leads located at the periphery of the die pad, wherein each lead has an inner lead and an outer lead;

a chip of the image sensor having an active surface and a corresponding back surface, wherein a plurality of bonding pads are formed on the active surface, and the back surface of the chip is adhered on the die pad;

a plurality of conductive wires electrically connecting from the bonding pads to the inner leads; and

a transparent molding compound encapsulating the image sensor chip, the die pad and the inner leads, wherein a cavity surface is formed on the transparent molding compound surface that corresponds to the active surface, an area of the cavity is large enough to cover the chip of the image sensor and the cavity surface is polished in order to have a smooth surface.

2. The package of the image sensor device of claim 1,wherein the chip of the image sensor device is a complementary metal-oxide semiconductor.

3. The package of the image sensor device of claim 1, wherein the transparent molding compound is a transparent resin.

4. A package of an image sensor device comprises:

a lead frame, comprising a die pad, and a plurality of leads located at the periphery of the die pad, wherein each lead has an inner lead and an outer lead;

a chip of an image sensor having an active surface and a corresponding back surface, wherein a plurality of bonding pads are formed on the active surface, and the back surface of the chip is adhered on the die pad;

a plurality of conductive wires electrically connecting from the bonding pads to the inner leads; and

a transparent molding compound encapsulating the image sensor chip, the die pad and the inner leads, wherein a surface of the transparent molding compound that corresponds to the active surface is polished to form a smooth surface, an area of the smooth surface is large enough to cover the chip of the image sensor device, and a protrusion is formed at the periphery of the smooth surface.

5. The package of the image sensor device of claim 4, wherein the protrusion is formed by a plurality of node-shaped protrusions located at the periphery of the smooth surface.

6. The package of the image sensor device of claim 4, wherein the protrusion is formed by a plurality of strip-shaped protrusions located at the periphery of the smooth surface.

7. The package of the image sensor device of claim 4, wherein the protrusion can be formed by a plurality of ring-shaped protrusions and they are located at the peripheral of the smooth surface.

8. The package of the image sensor device of claim 4, wherein the chip of the image sensor device is a complementary metal-oxide semiconductor.

9. The package of the image sensor device of claim 4, wherein the transparent molding compound is a transparent resin.

10. A package of an image sensor device, the package comprising:

a carrier having a plurality of conductive pins;

a chip of the image sensor having an active surface and a corresponding back surface, wherein a plurality of bonding pads are formed on the active surface, and the back surface of the chip is adhered on the surface of the carrier;

a plurality of conductive wires electrically connecting from the bonding pads to the conductive pins; and

a transparent molding compound encapsulating the chip of the image sensor, the conductive wires and the conductive pins, wherein a cavity surface is formed on the surface of the transparent molding compound that corresponds to the active surface, an area of the cavity

surface is large enough to cover the chip of the image sensor device and the cavity surface is polished to have a smooth surface.

11. The package of the image sensor device of claim 10, wherein the chip of the image sensor device is a complementary metal-oxide semiconductor.

12. The package of the image sensor device of claim 10, wherein the transparent molding compound is a transparent resin.

13. A package of an image sensor device comprises:

a carrier having a plurality of conductive pins;

a chip of the image sensor having an active surface and a corresponding back surface, wherein a plurality of bonding pads are formed on the active surface, and the back surface of the chip is adhered on the surface of the carrier;

a plurality of conductive wires electrically connecting from the bonding pads to the conductive pins; and

a transparent molding compound encapsulating the chip of the image sensor, the conductive wires and the conductive pins, wherein a polished smooth surface is formed on the surface of the transparent molding compound that corresponds to the active surface, an area of the smooth surface is large enough to cover the chip of the image sensor device and a protrusion is formed at the periphery of the smooth surface.

14. The package of the image sensor device of claim 13, wherein the protrusion can be a plurality of node-shaped protrusions, and these node-shaped protrusions are located around the periphery of the smooth surface.

15. The package of the image sensor device of claim 13, wherein the protrusion can be a plurality of strip-shaped protrusions that are located at the periphery of the smooth surface.

16. The package of the image sensor device of claim 13, wherein the protrusion can be a plurality of ring-shaped protrusions that are located at the periphery of the smooth surface.

17. The package of the image sensor device of claim 13, wherein the chip of the image sensor device is a complementary metal-oxide semiconductor.

18. The package of the image sensor device of claim 13, wherein the transparent molding compound is a transparent resin.

* * * * *