Title: PACKAGING STRUCTURE OF MEMS MICROPHONE

Abstract: The present invention relates to a packaging structure of a MEMS microphone comprising: a first case having an open first end and a second end having a sound hole formed therethrough; a flexible printed circuit board including a first region having a hole corresponding to the sound hole, the first region being attached to an inner surface of the first case, a second region having a first electrode for transmitting an electrical signal to an external device, and a connecting portion for connecting the first region and the second region; a transducer and an amplifier disposed in the first region so as to face the sound hole; and a second case sealing the open first end of the first case, the second case including an extension hole for extending the connecting portion and the second region to an outside of the second case.
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Description

PACKAGING STRUCTURE OF MEMS MICROPHONE

Technical Field

[1] The present invention relates to a packaging structure of a MEMS microphone, and more particularly to a packaging structure of a MEMS microphone wherein a distance between a case and a transducer is reduced using a flexible printed circuit board.

Background Art

[2] Recently, a state-of-the-art electronic device requires a high integration and a high precision. Accordingly, a component constituting the state-of-the-art electronic device also requires the high integration and the high precision. Therefore, a size of a microphone mounted in a mobile phone or a radio is drastically reduced for a light weight and a miniaturization. For the miniaturization of the microphone, an intensive development of a MEMS microphone is in progress by a MEMS (Micro Electro Mechanical System) technology to manufacture a microscopic device.

[3] Specifically, the MEMS technology employs a semiconductor manufacturing process, an integrated circuit technology in particular, to manufacture a microscopic sensor, an actuator and an electromechanical structure. The MEMS microphone manufactured by the MEMS technology may be embodied as a microscopic device, and a plurality of MEMS microphones may be manufactured on a single silicon wafer to allow a mass production of the MEMS microphone.

The MEMS microphone comprises a case having a open first end and a second end having a sound hole, a transducer manufactured by the MEMS technology for converting a voice signal to an electrical signal, an amplifier and a printed circuit board having the transducer and the amplifier mounted thereon and sealing the open first end of the case.

The voice signal may be converted more effectively when a distance between the sound hole disposed in the case and the transducer is small. However, since the case consists of a metal and the transducer consists of a silicon, a direct adhesion of the case and the transducer is not possible, and a gap between the case and the transducer is unavoidable. Accordingly, the MEMS microphone has non-uniform characteristic at a low frequency band so that a sensitivity of the MEMS microphone is degraded.

Disclosure of Invention

Technical Problem

[6] It is an object of the present invention to provide a packaging structure of a MEMS microphone wherein a flexible printed circuit board is attached to an inner surface of a case, and a transducer is mounted on the flexible printed circuit board so as to
correspond to a sound hole such that a distance between the sound hole and the transducer is reduced.

[7] It is another object of the present invention to provide a packaging structure of a MEMS microphone wherein the distance between the sound hole and the transducer is reduced to improve an efficiency of conversion of a voice signal passing though the sound hole to an electrical signal.

[8] It is yet another object of the present invention to provide a packaging structure of a MEMS microphone wherein the distance between the sound hole and the transducer is reduced to improve a characteristic of the microphone in a low frequency band.

[9] Finally, it is yet another object of the present invention to provide a packaging structure of a MEMS microphone wherein an opening of a first case is sealed using a second case and an end portion of the second case housing the first case is curled to increase a coupling strength of the first case and the second case.

Technical Solution

[10] In order to achieve the above-described object, there is provided a packaging structure of a MEMS microphone comprising: a first case having an open first end and a second end having a sound hole formed therethrough; a flexible printed circuit board including a first region having a hole corresponding to the sound hole, the first region being attached to an inner surface of the first case, a second region having a first electrode for transmitting an electrical signal to an external device, and a connecting portion for connecting the first region and the second region; a transducer and an amplifier disposed in the first region so as to face the sound hole; and a second case sealing the open first end of the first case, the second case including an extension hole for extending the connecting portion and the second region to an outside of the second case.

[11] The first case comprises a groove corresponding to the extension hole on an outer edge thereof so that a portion of the flexible printed circuit board extends to the outside.

[12] The connecting portion and the second region are extended through a path formed by the extension hole and the groove.

[13] There is also provided a packaging structure of a MEMS microphone comprising: a first case having an open first end and a second end having a sound hole formed therethrough; a first printed circuit board including a first region having a hole corresponding to the sound hole, the first region being attached to an inner surface of the first case and a second region connected to the first region, the second region being attached to a second printed circuit board; a transducer and an amplifier disposed in the first region so as to face the sound hole; and a second flexible printed circuit board.
sealing the open first end of the first case, wherein the second printed circuit board includes a second electrode for transmitting an electrical signal to an external device.

Advantageous Effects

[14] As described above, in accordance with the packaging structure of the MEMS microphone according to the embodiment of the present invention, the flexible printed circuit board is attached to the inner surface of the case and the transducer is mounted on the flexible printed circuit board so as to correspond to the sound hole such that the distance between the sound hole and the transducer is reduced.

[15] In accordance with the packaging structure of the MEMS microphone according to the embodiment of the present invention, the distance between the sound hole and the transducer is reduced to improve an efficiency of converting a voice signal passed through the sound hole to an electrical signal.

[16] In accordance with the packaging structure of the MEMS microphone according to the embodiment of the present invention, the distance between the sound hole and the transducer is reduced to improve a characteristic of the microphone in a low frequency band.

[17] In accordance with the packaging structure of the MEMS microphone according to the embodiment of the present invention, an opening of a first case is sealed using a second case and an end portion of the second case housing the first case is curled to increase a coupling strength of the first case and the second case.

[18] While the present invention has been particularly shown and described with reference to the preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and details may be effected therein without departing from the spirit and scope of the invention.

Brief Description of the Drawings

[19] Fig. 1 is a perspective view illustrating a disassembled packaging structure of a MEMS microphone in accordance with an embodiment of the present invention.

[20] Fig. 2 is a perspective view illustrating an assembled packaging structure of a MEMS microphone in accordance with an embodiment of the present invention.

[21] Fig. 3 is a cross-sectional view illustrating an assembled packaging structure of a MEMS microphone in accordance with an embodiment of the present invention.

[22] Fig. 4 is a diagram illustrating a flexible printed circuit board shown in Fig. 1.

[23] Fig. 5 is a perspective view illustrating a disassembled packaging structure of a MEMS microphone in accordance with another embodiment of the present invention.

[24] Fig. 6 is a perspective view illustrating an assembled packaging structure of a MEMS microphone in accordance with another embodiment of the present invention.

[25] Fig. 7 is a cross-sectional view illustrating an assembled packaging structure of a
MEMS microphone in accordance with another embodiment of the present invention.

Fig. 8 is a diagram exemplifying various forms in accordance with an embodiment of the present invention.

Mode for the Invention

The above-described objects and other objects and characteristics and advantages of the present invention will now be described in detail with reference to the accompanied drawings.

Fig. 1 is a perspective view illustrating a disassembled packaging structure of a MEMS microphone in accordance with an embodiment of the present invention, Fig. 2 is a perspective view illustrating an assembled packaging structure of a MEMS microphone in accordance with an embodiment of the present invention, and Fig. 3 is a cross-sectional view illustrating an assembled packaging structure of a MEMS microphone in accordance with an embodiment of the present invention.

Referring to Figs. 1 through 3, the packaging structure of the MEMS microphone in accordance with the embodiment of the present invention comprises a first case 100A having an open first end and a second end having a sound hole 110A formed therethrough, a flexible printed circuit board (FPCB) 120A having a first region 122A attached to at least one inner surface of the first case 100A including a surface having the sound hole 110A formed therethrough, a transducer 140 and an amplifier 150 disposed on the flexible printed circuit board 120A so as to face the sound hole 110A, and a second case 160 for sealing the open first end of the first case 100A.

The flexible printed circuit board 120A includes a first region 122A being attached to the inner surface of the first case 100A, and having the PCB substrate 140 and the chamber case 150 mounted thereon so as to face the sound hole 110A. The flexible printed circuit board 120A also comprises a second region 126A attached to the second case 160 and having a first electrode 135 for transmitting an electrical signal to an external device, and comprises a connecting portion 124A for connecting the first region 122A and the second region 126A. A detailed description of the flexible printed circuit board 120A will be described in a later part of description.

The first case 100A includes the open first end and the second end opposing the first end and having the sound hole 110A formed therethrough. The first case 100A includes a groove 115A on one surface thereof. The groove 115A provides a path such that the connecting portion 124A may reach an extension hole 165 disposed on the second case 160. The first case 100A may be manufactured using a conductive material having a superior noise shielding characteristic such as a nickel, a copper, an aluminum, or alloys thereof.

The transducer 140 is stacked over a hole 125A formed in the first region 122A to
face the sound hole 110A so as to convert an voice signal passed through the sound hole 110A to an electrical signal. The transducer 140 may be manufactured on a silicon wafer by the MEMS technology wherein a microscopic electrical mechanical structure having a size in the unit of μm is manufactured by the semiconductor manufacturing process, the micromachining technology employing the integrated circuit technology. The transducer 140 manufactured by the MEMS technology typically includes a silicon membrane referred to as a vibrating plate and a back electret having a semi-permanent charge.

The amplifier 150 is mounted on the first region 122A to receive the electrical signal generated by the transducer 140 and to apply an amplified electrical signal to a first circuit pattern 131A disposed in the first region 122A.

The second case 160 has an open first end and includes the extension hole 165 on an outer edge so as to correspond to the groove 115A disposed on the first case 100A. The first region 122A of the flexible printed circuit board 120A, the transducer 140, the amplifier 150 and the first case 100A are housed in the second case 160, and the open first end thereof is then curled to prevent a generation of a gap between the first case 100A and the second case 160, thereby inducing a electrical adherence, protecting the first region 122A having the transducer 140 and the amplifier 150 mounted thereon and shielding an external electrical noise.

In addition, the connecting portion 124A is disposed at the extension hole 165, and the extension hole 165 is sealed by an epoxy except a region where the connecting portion 124A is disposed to block a dust and a noise flowing in through the extension hole 165. Similar to the first case 100A, the second case 160 may be manufactured using the conductive material having the superior noise shielding characteristic such as the nickel, the copper, the aluminum, or the alloys thereof.

Fig. 4 is a diagram illustrating the flexible printed circuit board 120A shown in Fig. 1.

Referring to Fig. 4, the flexible printed circuit board 120A comprises the first region 122A, the second region 126A and the connecting portion 124A. In addition, the transducer 140 and the amplifier 150 are mounted on a surface of the first region 122A by SMT (Surface Mount Technology).

Specifically, the first region 122A is attached to the at least one inner surface of the first case 100A including the surface having the sound hole 110A formed therethrough. The hole 125A and the first circuit pattern 131A are disposed in the first region 122A, and the transducer 140 is disposed at the hole 125A to correspond to the sound hole 110A. The first circuit pattern 131A transmits the electrical signal generated in the transducer 140 to the amplifier 150 disposed at one side of the transducer 140, and the
electrical signal passed through the amplifier 150 is transmitted to a second circuit pattern 132A disposed in the connecting portion 124A.

The connecting portion 124A is disposed at the groove 115A disposed at the first case IOOA and the extension hole 165 disposed at the second case 160, i.e. in the path. The second circuit pattern 132A is disposed at the connecting portion 124A to receive the electrical signal the first circuit pattern 131A and transmit the same to a third circuit pattern 133A of the second region 126A.

The second region 126A is attached to a back side of the second case 160 sealing the open first end of the first case IOOA. The third circuit pattern 133A and the first electrode 135 are disposed in the second region 126A, wherein the third circuit pattern 133A transmits the electrical signal received from the second circuit pattern 132A to the first electrode 135, and the first electrode 135 transmits the electrical signal received from the third circuit pattern 133A to the external device.

The flexible printed circuit board 120A comprises a CCL (Copper Clad Laminate). The CCL is a thin stacked film wherein a Cu having a flexibility and a tension-resistance is coated on both surfaces of an insulating material such as a polyimide film and a polyester film having a flexibility and a heat-resistance. A cover layer may be formed to protect a copper pattern after forming the Cu. It is preferable that the flexible printed circuit board 120A is attached to the first case IOOA and the second case 160 by an adhesive, a melting or a sealing.

Fig. 5 is a perspective view illustrating a disassembled packaging structure of a MEMS microphone in accordance with another embodiment of the present invention, Fig. 6 is a perspective view illustrating an assembled packaging structure of a MEMS microphone in accordance with another embodiment of the present invention, and Fig. 7 is a cross-sectional view illustrating an assembled packaging structure of a MEMS microphone in accordance with another embodiment of the present invention.

Referring to Figs. 5 through 7, a packaging structure of a MEMS microphone in accordance with another embodiment of the present invention comprises a first case IOOB having an open first end and a second end having a sound hole HOB formed therethrough, a flexible printed circuit board 120B attached to at least one inner surface of the first case IOOB including a surface having the sound hole HOB formed therethrough, a transducer 140 and an amplifier 150 mounted on the flexible printed circuit board 120B, and a PCB (Printed Circuit Board) 170 for sealing the open first end of the first case IOOB.

The packaging structure of the MEMS microphone in accordance with another embodiment of the present invention is identical to the packaging structure of the MEMS microphone in accordance with the embodiment of the present invention except the first case IOOB, the flexible printed circuit board 120B and the PCB 170.
Therefore, a detailed description of a constitution except the first case 10OB, the flexible printed circuit board 120B and the PCB 170 is omitted.

[46] The first case 10OB includes the open first end and the second end opposing the first end and having the sound ole HOB formed therethrough. At least one inner surface of the first case 10OB including a surface having the sound hole HOB formed therethrough is attached to a first region 122B. The first case 10OB may be manufactured using a conductive material having a superior noise shielding characteristic such as a nickel, a copper, an aluminum, or alloys thereof.

[47] The flexible printed circuit board 120B comprises the first region 122B and a second region 126B. The transducer 140 and the amplifier 150 are mounted in the first region 122B using the SMT technology.

[48] Specifically, the first region 122B is attached to the at least one inner surface of the first case 10OB including the surface having the sound hole HOB formed therethrough. The hole 125B and the first circuit pattern 131B are disposed in the first region 122B, and the transducer 140 is disposed at the hole 125B to correspond to the sound hole HOB. The amplifier 150 is disposed at one side of the transducer 140. The first circuit pattern 131B transmits the electrical signal generated in the transducer 140 to the amplifier 150 disposed at one side of the transducer 140, and the electrical signal passed through the amplifier 150 is transmitted to a fourth circuit pattern 133B disposed in the second region 126B. The second region 126B is attached to a back side of the PCB 170 sealing the open first end of the first case 10OB. The fourth circuit pattern 133B is disposed in the second region 126B wherein the fourth circuit pattern 133B transmits the electrical signal received from the first circuit pattern 131B to a fifth circuit pattern 173 disposed in the PCB 170.

[49] The flexible printed circuit board 120B comprises a CCL (Copper Clad Laminate). The CCL is a thin stacked film wherein a Cu having a flexibility and a tension-resistance is coated on both surfaces of an insulating material such as a polyimide film and a polyester film having a flexibility and a heat-resistance. A cover layer may be formed to protect a copper pattern after forming the Cu. It is preferable that the flexible printed circuit board 120B is attached to the first case 10OB by an adhesive, a melting or a sealing.

[50] the PCB 170 comprises the fifth circuit pattern 173 transmitting the electrical signal applied from the fourth circuit pattern 133B disposed in the second region 126B of the flexible printed circuit board 120B to a second electrode 180, and the second electrode 180 transmitting the electrical signal transmitted from the fifth circuit pattern 173 to an external device.

[51] the PCB 170 comprises a solder 190 disposed at an end portion thereof that is in contact with the second region 126B in order to seal the open first end of the first case
IOOB and to maintain a stable electrical connection to the second region 126B. By sealing the first case IOOB with the PCB 170 using laser welding, a dust and a noise from an outside is blocked.

[52] On the other hand, while a description of the packaging structure of the MEMS microphone in accordance with the embodiment of the present invention is mainly focused on a cubic shape, a scope of the present invention is not limited to the square shape. The packaging structure of the MEMS microphone in accordance with the embodiment of the present invention may have various shapes such as an elliptical pillar or a polygonal pillar according to a shape of an external device in which the microphone is mounted.

[53] In accordance with the packaging structure of the MEMS microphone according to the embodiment of the present invention, each component of a MEMS microphone package may be subjected to various modifications and substitutions of materials. Therefore, each component is not limited to the packaging structure of the MEMS microphone according to the embodiment of the present invention.

Industrial Applicability

[54] In accordance with the packaging structure of the MEMS microphone according to the embodiment of the present invention, the flexible printed circuit board is attached to the inner surface of the case and the transducer is mounted on the flexible printed circuit board so as to correspond to the sound hole such that the distance between the sound hole and the transducer is reduced.
Claims

[1] A packaging structure of a MEMS microphone comprising:
a first case having an open first end and a second end having a sound hole
formed therethrough;
a flexible printed circuit board including a first region having a hole corre-
responding to the sound hole, the first region being attached to an inner surface
of the first case, a second region having a first electrode for transmitting an
electrical signal to an external device, and a connecting portion for connecting
the first region and the second region;
a transducer and an amplifier disposed in the first region so as to face the sound
hole; and
a second case sealing the open first end of the first case, the second case
including an extension hole for extending the connecting portion and the second
region to an outside of the second case.

[2] The structure in accordance with claim 1, wherein the first case comprises a
groove corresponding to the extension hole on an outer edge thereof so that a
portion of the flexible printed circuit board extends to the outside.

[3] The structure in accordance with one of claims 1 and 2, wherein the connecting
portion and the second region are extended through a path formed by the
extension hole and the groove.

[4] The structure in accordance with claim 1, wherein the first region is bonded to
the first case by a melting or an adhesive layer disposed therebetween.

[5] The structure in accordance with claim 1, wherein the second region is disposed
on a back surface of the second case being in contact with the first case.

[6] The structure in accordance with claim 5, wherein the second region is bonded to
the second case by a melting or an adhesive layer disposed therebetween.

[7] The structure in accordance with claim 1, further comprising a sealing portion for
sealing the extension hole while maintaining the connecting portion open.

[8] A packaging structure of a MEMS microphone comprising:
a first case having an open first end and a second end having a sound hole
formed therethrough;
a first printed circuit board including a first region having a hole corresponding
to the sound hole, the first region being attached to an inner surface of the first
case and a second region connected to the first region, the second region being
attached to a second printed circuit board;
a transducer and an amplifier disposed in the first region so as to face the sound
hole; and
a second flexible printed circuit board sealing the open first end of the first case, wherein the second printed circuit board includes a second electrode for transmitting an electrical signal to an external device.

[9] The structure in accordance with claim 8, wherein the first region is bonded to the first case by a melting or an adhesive layer disposed therebetween.

[10] 10. The structure in accordance with claim 8, wherein the second flexible printed circuit board comprises a solder for an electrical connection to the second region.
[Fig. 6]

(a)

110B
100B
170

[b]

100B
180 175 170

[Fig. 7]

110B
100B
140 125B 150
180 170 190
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION OF SUBJECT MATTER**

**H04R 19/04(2006.01)**

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 8 H04R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean patents and applications for inventions since 1975

Korean utility models and applications for utility models since 1975

Japanese utility models and applications for utility models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKIPASS "MICROPHONE", "MEMS", "PACKAGING", "FPCB"

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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<td>US 6324907 B1 (MICROTURIC A/S) 04 DECEMBER 2001 see the whole document, Fig 4.</td>
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* Further documents are listed in the continuation of Box C

**Date of the actual completion of the international search**

18 JANUARY 2007 (18 01 2007)

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**Telephone No** 82-42-481-5753

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