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(54) **TOP-EMITTING MULTI-PHOTON OLED PANEL**

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H05B 33/00 (2006.01)

(52) **U.S. Cl.** **313/504**; 313/506

(57) **ABSTRACT**

A top-emitting type multi-photon OLED panel comprises: an insulating substrate; a cathode formed on the insulating substrate; a plurality of organic layers laminated on the cathode; and a transparent anode formed on the top layer of the plurality of organic layers, wherein a charge generation layer is sandwiched between each organic layer.

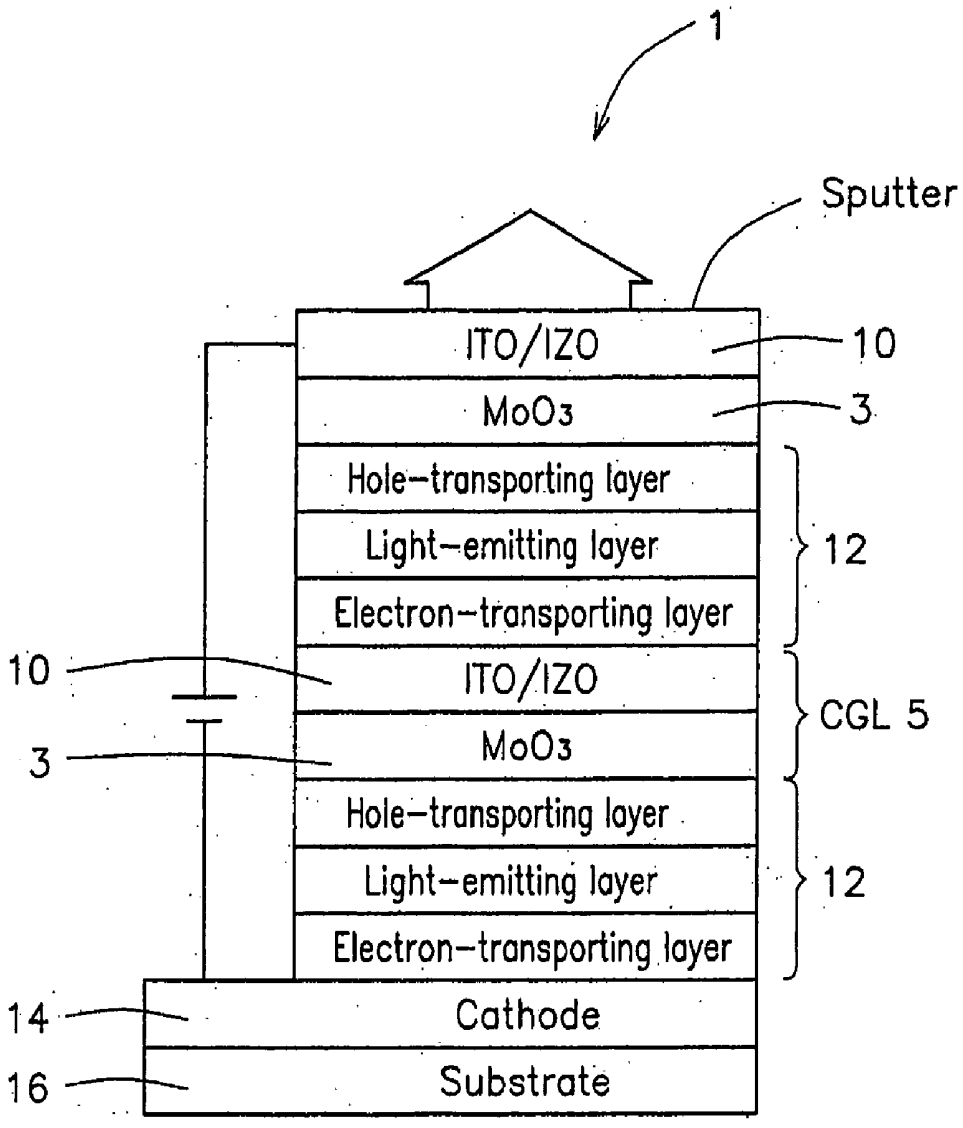


FIG. 1

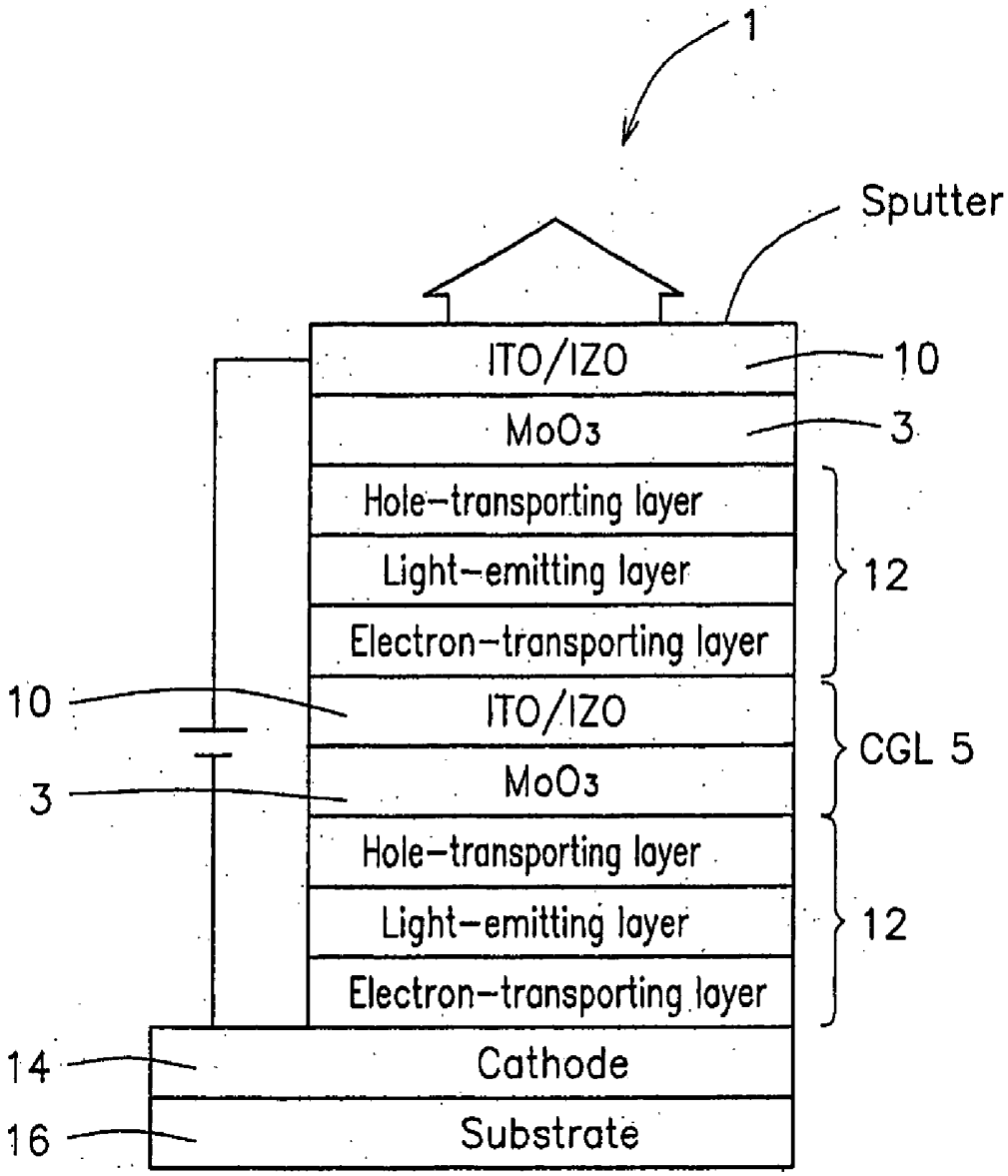

1
Sputter
ITO/IZO
10
MoO3
3
Hole-transporting layer
Light-emitting layer
Electron-transporting layer
12
10
ITO/IZO
CGL 5
3
MoO3
Hole-transporting layer
Light-emitting layer
12
Electron-transporting layer
14
Cathode
16
Substrate

FIG. 2(a)

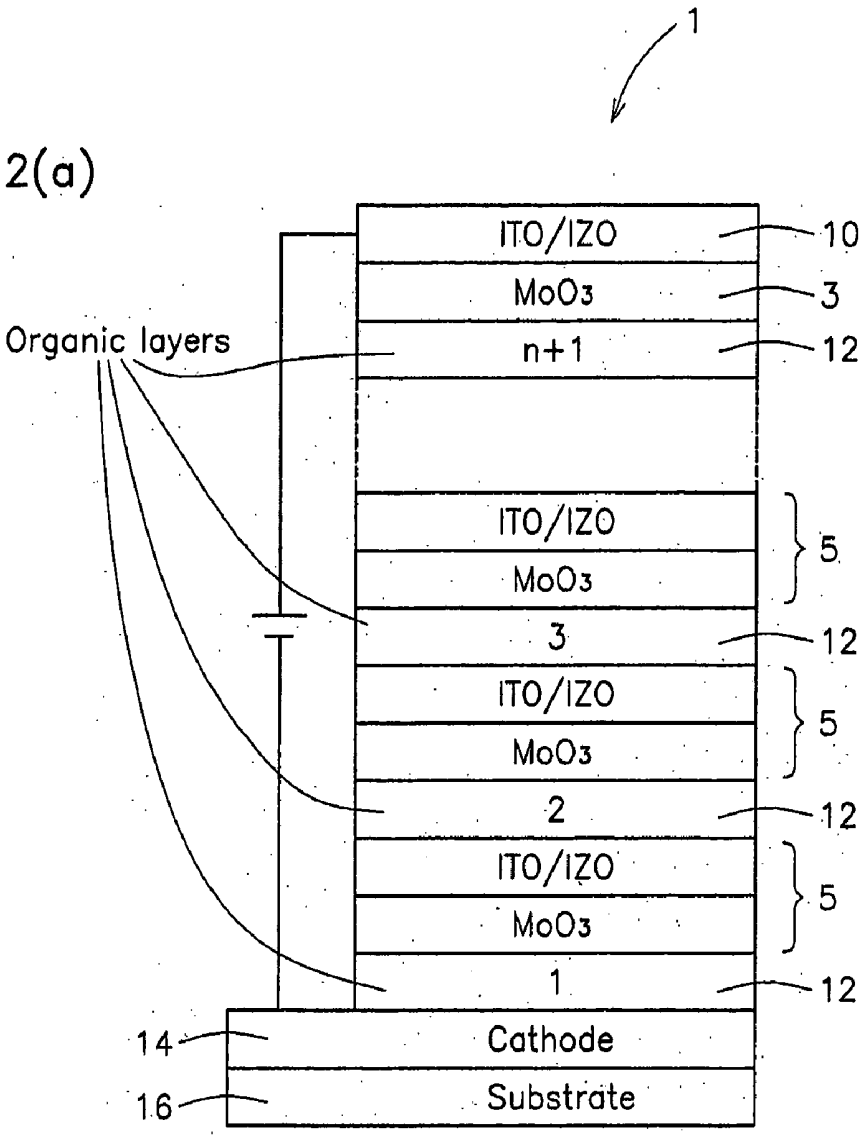

1
ITO/IZO
10
MoO3
3
Organic layers
n+1
12
ITO/IZO
MoO3
5
3
12
ITO/IZO
MoO3
5
2
12
ITO/IZO
MoO3
5
1
12
14
Cathode
16
Substrate

FIG. 2(b)

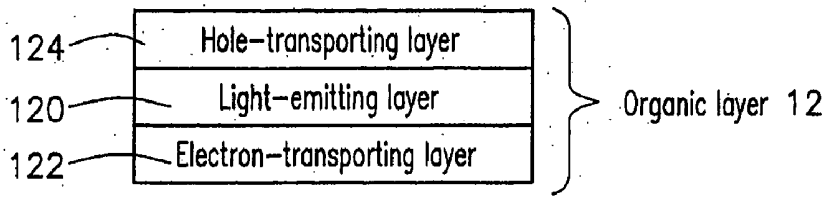
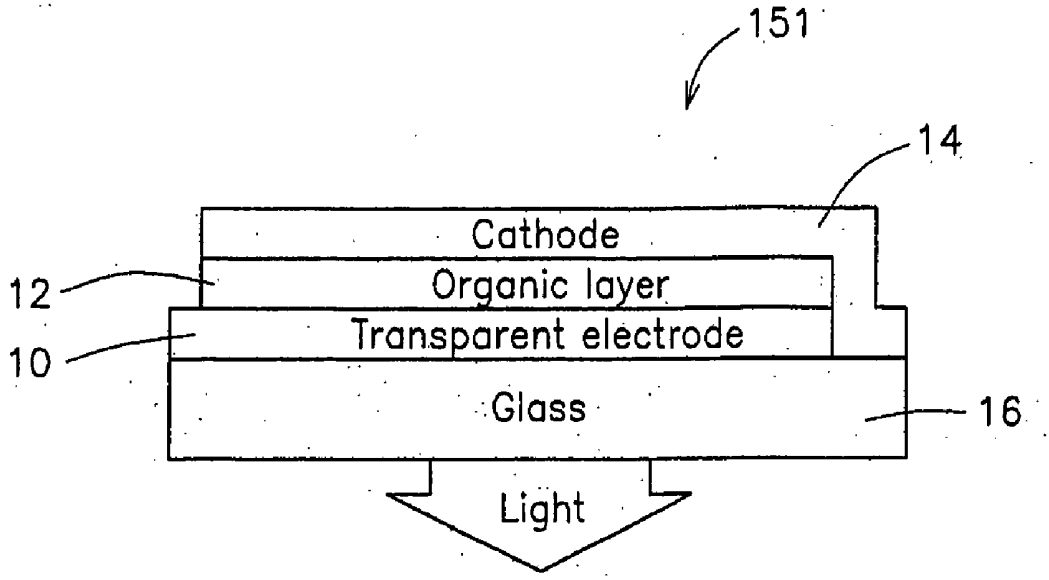
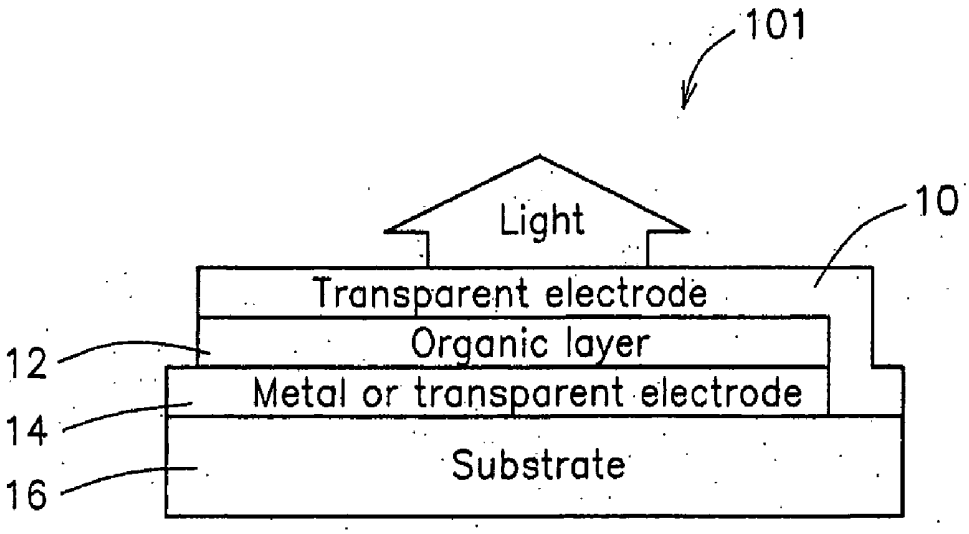

124
Hole-transporting layer
120
Light-emitting layer
122
Electron-transporting layer
Organic layer 12

FIG. 3



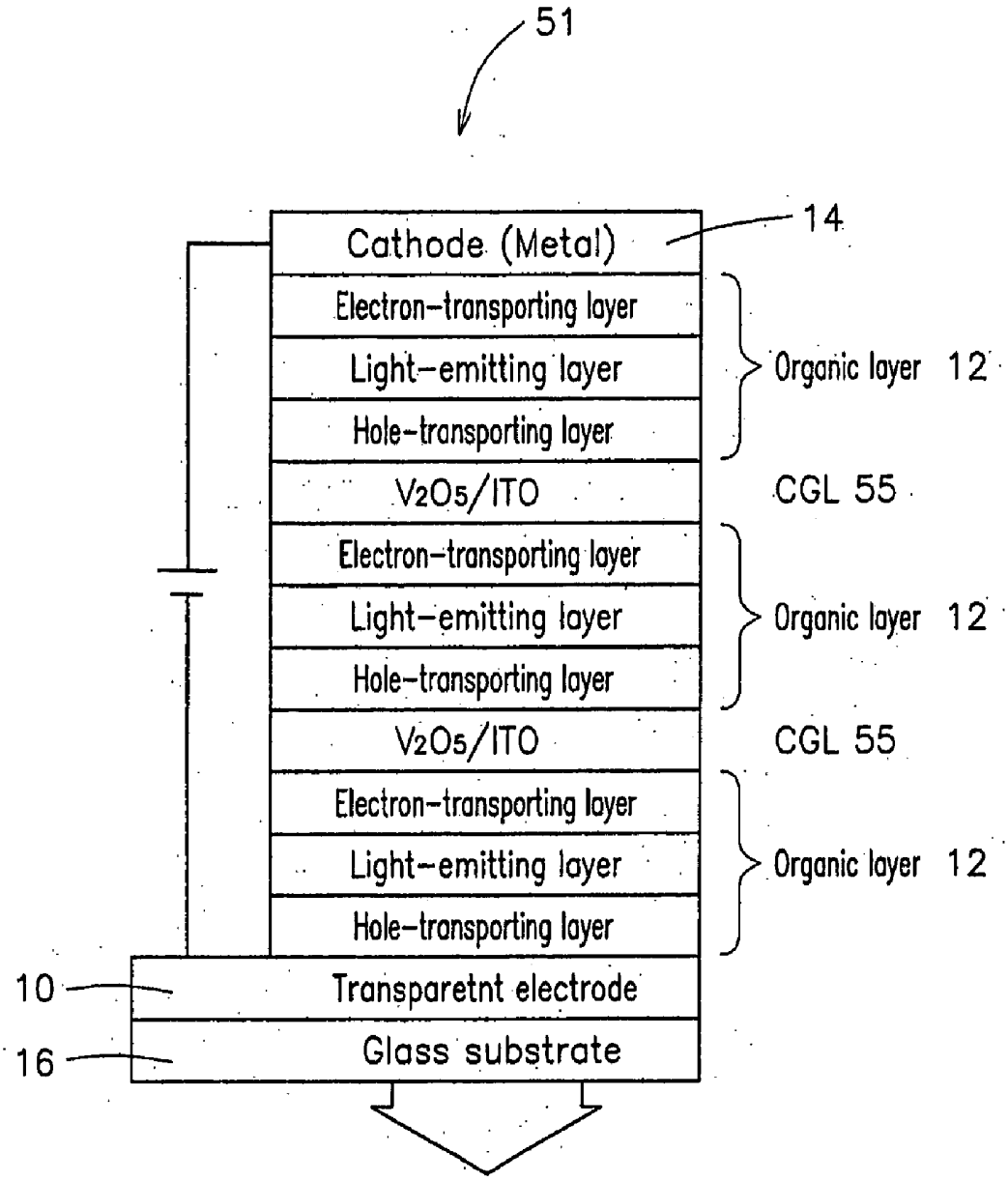
PRIOR ART

FIG. 4



PRIOR ART

FIG. 5



PRIOR ART

TOP-EMITTING MULTI-PHOTON OLED PANEL

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to an organic electroluminescence panel (hereinafter referred to as OLED panel), in particular to a top-emitting type multi-photon OLED panel.

[0003] 2. Description of Related Art

[0004] In an OLED panel, OLED elements are arranged on a substrate, such as a glass substrate to emit the OLED elements. The OLED panel is superior in electric power consumption, reaction speed, view field, and luminance. The OLED panel is expected as an epoch-making display and a flat-type lighting or the like.

[0005] Organic electroluminescent elements are configured by sandwiching an organic layer between an anode and a cathode. The organic layer may comprise a plurality of layers, such as an electron-injecting layer and/or a hole-injecting layer and an electron-transporting layer and/or a hole-transporting layer. Its emitting principle is similar to that of the emitting mechanism of light emitting diodes (LED). More specifically, a hole and an electron are fed into a light-emitting layer by the application of a direct current voltage between the anode and the cathode. The electronic state of organic molecules included in the light-emitting layer is shifted to the excited state by energy generated by a recombination of the hole and electron in the light-emitting layer. Energy is emitted as light when this quite unstable electronic state falls to a ground state so that the organic electroluminescent elements can emit light. Accordingly, organic electroluminescence is referred to also as organic light emitting device (OLED).

[0006] A method of taking out luminance of an OLED panel has two systems: bottom-emitting system and top-emitting system. As shown in **FIG. 3**, the bottom-emitting system takes out light from a glass substrate **16** side of an OLED panel **151** by laminating a transparent electrode **10**, an organic layer **12**, and a metal cathode **14** on the glass substrate **16**. As shown in **FIG. 4**, the top-emitting system takes out light from a top surface electrode layer side **10** of an OLED panel **101** by laminating a metal electrode **14**, an organic layer **12**, and a transparent electrode **10**.

[0007] While a single organic layer, such as the above-mentioned organic layer is sandwiched between an anode and a cathode in a conventional OLED panel, a multi-photon OLED panel for increasing light-emitting luminance of an OLED panel by the lamination of a plurality of organic layers has been developed. As shown in **FIG. 5**, a multi-photon OLED panel is formed by laminating a plurality of organic layers **12** between an Indium Tin Oxide (ITO) transparent electrode **10** formed on a glass substrate and a cathode **14** made of Al and sandwiching a charge generation layer (hereinafter referred to as CGL) **55** between each organic layer. The CGL layer **55** is formed by sputtering ITO on the organic layer or depositing a V_2O_5 layer.

[0008] However, there was a problem that a special chamber for deposition was needed, which resulted in an additional cost because the deposition of V_2O_5 layers had low reproducibility and needed to be performed at high temperatures. Further, there was another problem that the organic layers **12** were damaged by particles generated by sputtering when ITO was sputtered on the organic layers **12** as CGL layers **55**.

[0009] Moreover, the above-mentioned multi-photon OLED panel **51** takes out light from the transparent electrode **10** side, such as ITO and the glass substrate **16** side because of being a bottom-emitting system. Accordingly, the luminous efficiency of light emitted from the organic layers **12** is deteriorated when transmitting the glass substrate **16** due to reflection and light attenuation.

[0010] Thus, it is an object of the present invention to provide a top-emitting type multi-photon OLED panel having high luminous efficiency at low production costs.

[0011] (Non-Patent Cited Document 1)

[0012] SID 03 DIGEST (Page 979 to 981)

[0013] (Non-Patent Cited Document 2)

[0014] Academic Lecture of The 64th Applied Physics Society Lecture Draft (Page 1,178)

SUMMARY OF THE INVENTION

[0015] A top-emitting type multi-photon OLED panel according to the present invention is so formed that a cathode is formed on an insulating substrate and a plurality of organic layers and CGL layers are alternately laminated on the cathode. More particularly, the top-emitting type multi-photon OLED panel comprises: an insulating substrate; a cathode formed on the insulating substrate; a plurality of organic layers laminated on the cathode; and a transparent anode formed on the top layer of the plurality of organic layers, wherein a CGL layer is sandwiched between each organic layer.

BRIEF DESCRIPTION OF THE DRAWING

[0016] **FIG. 1** is a cross-sectional view showing one embodiment of a top-emitting type multi-photon OLED panel according to the present invention.

[0017] FIGS. **2**(*a*) and **2**(*b*) are respectively a cross-sectional view of a top-emitting type multi-photon OLED panel according to the present invention.

[0018] **FIG. 3** is a cross-sectional view of a conventional bottom-emitting OLED panel.

[0019] **FIG. 4** is a cross-sectional view of a conventional top-emitting OLED panel.

[0020] **FIG. 5** is a cross-sectional view of a conventional bottom-emitting type multi-photon OLED panel.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0021] Embodiments of the top-emitting type multi-photon OLED panel of the present invention will be now described with reference to the accompanying drawings. The same reference characters are used in common elements.

[0022] As shown in **FIG. 1**, in one embodiment of the present invention, an OLED panel **1** is a top-emitting type multi-photon OLED panel which comprises: an insulating

substrate **16**; a cathode **14** formed on the insulating substrate **16**; a plurality of organic layers **12** laminated on the cathode **14**; a transparent anode **10** formed on the top layer of the plurality of organic layers **12**, wherein a CGL layer **5** is sandwiched between each organic layer **12**.

[**0023**] First, the transparent anode **10** is formed by depositing a MoO_3 layer **3** on the top layer of the organic layers **12** and sputtering an ITO layer or an IZO (Indium Zinc Oxide) layer on the MoO_3 layer **3** (See Non-patent Cited Document 2). The MoO_3 layer **3** was deposited on the top layer of the organic layers **12** to protect the organic layers **12** from particles caused by sputtering when the ITO layer or the IZO layer is formed by sputtering. Unlike the deposition of the above-mentioned V_2O_5 layer, the deposition of the MoO_3 layer **3** has high reproducibility and needs no special chamber because there is no need to perform the deposition at high temperatures, which results in costs lower than that of the V_2O_5 layer.

[**0024**] The cathode **14** is made from a metal, such as Cr, Ti, Ta, Ni, Ag, and Al, but the kind of metal is not particularly limited. Alternatively, the cathode **14** may be made from a transparent electrode, such as ITO and IZO. Although an insulator, such as glass is generally used for the insulating substrate **16**, a non-transparent metal substrate may be used in which an insulating layer is sandwiched between the cathode **14** and the insulating substrate **16** to prevent light from being radiated from the substrate **16** side when the cathode **14** is made from a transparent electrode, such as ITO.

[**0025**] As shown in **FIG. 2**(*b*), the organic layer **12** may include a light-emitting layer **120**. The light-emitting layer **120** may be sandwiched between an electron-transporting layer **122** on the cathode side and a hole-transporting layer **124** on the anode side. Alternatively, the organic layer **12** may comprise an electron-injecting layer on the cathode side of the electron-transporting layer **122** and a hole-injecting layer on the anode side of the hole-transporting layer **124**.

[**0026**] As mentioned above, the OLED panel **1** for emitting light upward outside from the insulating substrate **16** toward the transparent anode **10** in the embodiment of the present invention is a top-emitting OLED panel. The OLED panel **1** is a multi-photon type, in which light emitted by the plurality of organic layers **12** is strengthened under certain conditions to be emitted from the transparent anode **10**. Unlike the above-mentioned bottom-emitting OLED panel **51**, the OLED panel **1** according to this embodiment can obtain high luminous efficiency because light emitted from the transparent anode **10** is not needed to transmit the glass substrate.

[**0027**] Further, in the OLED panel **1** according to this embodiment, the CGL layer **5** may be formed of the MoO_3 layer **3** deposited on each organic layer **12** and the ITO layer or the IZO layer of the transparent anode sputtered on the MoO_3 layer **3**. The organic layers **12** can be protected from particles caused by sputtering when the ITO layer **10** or the IZO layer **10** is formed by sputtering because the MoO_3 layer **3** is deposited on each organic layer **12**.

[**0028**] Alternatively, like a conventional method, the CGL layer **5** may be formed by depositing the V_2O_5 layer on each organic layer **12**. In this case, the CGL layer **5** is formed only by the deposition of the V_2O_5 layer, so that the sputtering is not performed on the V_2O_5 layer, which leads to no need to laminate a protective layer, such as the MoO_3 layer **3** on each organic layer **12**. In the case of forming the CGL layer **5** by the V_2O_5 layer, high luminous efficiency can be obtained without the necessity of light emitted from the transparent anode **10** transmitting the glass substrate as well because the OLED panel **1** is a top-emitting system.

[**0029**] As mentioned above, the deposition of the MoO_3 layer **3** has reproducibility higher than the V_2O_5 layer and needs no special chamber, which results in costs lower than that of the V_2O_5 layer.

[**0030**] In the top-emitting type multi-photon OLED panel **1** according to the present invention, the cathode **14** may be formed on the insulating substrate **16**, and a plurality of organic layers **12** and CGL layers **5** may be alternately laminated on the cathode **14**. More specifically, the top-emitting type multi-photon OLED panel **1** can be produced by forming a film with a general sputtering apparatus or a deposition apparatus using the steps below.

[**0031**] (1) Preparing the insulating substrate **16**. (2) depositing the cathode **14** on the insulating substrate **16**. (3) depositing the organic layer **12** on the cathode **14**. (4) laminating the CGL layer **5** on the organic layer **12**. More specifically, the MoO_3 layer **3** is deposited on the organic layer **12** and an ITO layer or an IZO layer is laminated on the MoO_3 layer **3** by sputtering. (5) alternately repeating at least n times ($n \geqq 1$) the step of depositing the organic layer **12** on the CGL layer **5** and the step of laminating the CGL layer **5**.

[**0032**] The top-emitting type multi-photon OLED panel **1** can be obtained from the above-mentioned steps, in which n+1 ($n \geqq 1$) layers of the organic layers **12** are with the CGL layer **5** sandwiched between each organic layer **12**, and an anode made from ITO or IZO with the MoO_3 layer **3** sandwiched on the top layer of the organic layers **12**. The CGL layer **5** comprises the MoO_3 layer **3** deposited on a plurality of organic layers **12**, and the ITO layer or the IZO layer sputtered on the MoO_3 layer **3** from the step (4), but the CGL layer **5** may be formed by depositing the V_2O_5 layer on each organic layer **12**.

[**0033**] The top-emitting type multi-photon OLED panel of the present invention can obtain high luminance because light emitted by the plurality of organic layers is strengthened under certain conditions to be emitted from the top transparent anode. Further, unlike the bottom-emitting type OLED panel, the top-emitting type multi-photon OLED panel of the present invention can obtain high luminous efficiency because light emitted from the transparent anode **10** is not needed to transmit the glass substrate.

[**0034**] Moreover, in the top-emitting type multi-photon OLED panel of the present invention, the CGL layer comprises the MoO_3 layer deposited on each organic layer, and the ITO layer or the IZO layer sputtered on the MoO_3 layer. The organic layers **12** can be protected from particles caused by sputtering when the ITO layer or the IZO layer is formed by sputtering because the MoO_3 layer is deposited on the organic layer.

[**0035**] The deposition of the MoO_3 layer has reproducibility higher than the V_2O_5 layer, which enables mass production. In addition, the deposition needs no special chamber because of no need to perform the deposition of the

MoO_3 layer at high temperatures, which results in costs lower than that of the V_2O_5 layer.

[0036] The embodiments of the present invention have been described so far, but the top-emitting type multi-photon OLED panel **1** of the present invention is not limited to the above-mentioned embodiments. The organic layers **12** are three layers in **FIG. 1**, but as shown in **FIG. 2**(*a*), the top-emitting type multi-photon OLED panel **1** may comprise an arbitrary number of organic layers **12**.

[0037] In addition, the organic layers **12** may be arbitrary well-known organic layers and their components, material, thickness, and size or the like are not particularly limited. The anode **10** is not particularly limited to ITO or IZO and an arbitrary transparent electrode may be used. Each components, material, thickness, and size of the substrate **16** and the cathode **14** are not particularly limited.

[0038] There has thus been shown and described a novel top-emitting type multi-photon OLED panel which fulfills all the objects and advantages sought therefor. Many changes, modifications, variations, combinations, and other uses and applications of the subject invention will, however, become apparent to those skilled in the art after considering this specification and accompanying drawings which disclose the preferred embodiments thereof. All such changes, modifications, variations and other uses and applications which do not depart from the spirit and scope of the invention are deemed to be covered by the invention, Which is to be limited only by the claims which follow. This application claims priority from Japanese Patent Application No. 2005-088883, which is incorporated herein by reference.

What is claimed is:

1. A top-emitting type multi-photon OLED panel so formed that a cathode is formed on an insulating substrate and a plurality of organic layers and charge generation layers are alternately laminated on the cathode.

2. A top-emitting type multi-photon OLED panel comprising:

an insulating substrate;

a cathode formed on the insulating substrate;

a plurality of organic layers laminated on the cathode; and

a transparent anode formed on the top layer of the plurality of organic layers,

wherein a charge generation layer is sandwiched between each organic layer.

3. The OLED panel according to claim 1, wherein the charge generation layer comprises a MoO_3 layer deposited on each organic layer, and an Indium Tin Oxide layer or an Indium Zinc Oxide layer sputtered on the MoO_3 layer.

4. The OLED panel according to claim 1, wherein the charge generation layer is formed by depositing a V_2O_5 layer on each organic layer.

5. The OLED panel according to claim 2, wherein the transparent anode is formed of a MoO_3 layer deposited on the top layer of the organic layers and an Indium Tin Oxide layer or an Indium Zinc Oxide layer sputtered on the MoO_3 layer.

6. The OLED panel according to claim 1, wherein the organic layer comprises a light-emitting layer.

7. The OLED panel according to claim 1, wherein the organic layer comprises an electron-transporting layer and/or a hole-transporting layer.

8. The OLED panel according to claim 1, wherein the cathode is made of a metal either of Cr, Ti, Ta, Ni, Ag or Al.

9. The OLED panel according to claim 1, wherein the cathode is made of Indium Tin Oxide or Indium Zinc Oxide.

10. A method for manufacturing a top-emitting type multi-photon OLED panel comprising the steps of:

preparing an insulating substrate;

forming a cathode on the insulating substrate;

depositing an organic layer on the cathode;

laminating a charge generation layer on the organic layer; and

alternately repeating at least once the step of depositing the organic layer on the charge generation layer and the step of laminating the charge generation layer.

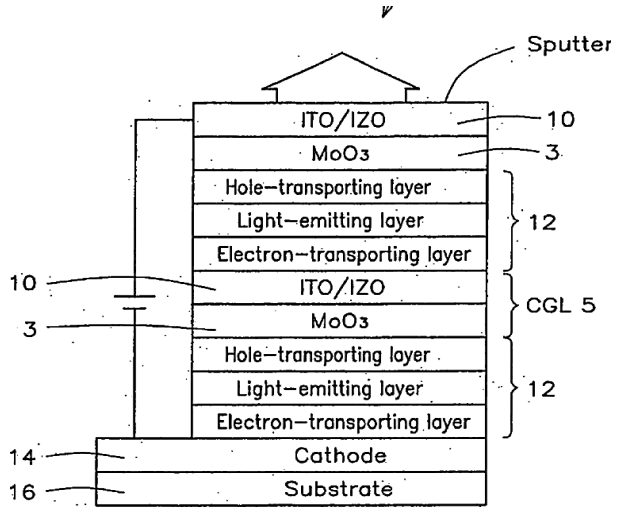
11. The method according to claim 10, wherein the charge generation layer is formed by depositing a MoO_3 layer on a plurality of organic layers and sputtering an Indium Tin Oxide layer or an Indium Zinc Oxide layer on the MoO_3 layer.

* * * * *

专利名称(译)	顶部发射多光子OLED面板		
公开(公告)号	US20060214565A1	公开(公告)日	2006-09-28
申请号	US11/378795	申请日	2006-03-16
[标]申请(专利权)人(译)	罗永春 永井NAOMI 三浦伸 筒井长则 NAKA茂树 冈田HIROYUKI ONNAGAWA博义		
申请(专利权)人(译)	罗永春 永井NAOMI 三浦伸 筒井长则 NAKA茂树 冈田HIROYUKI ONNAGAWA博义		
当前申请(专利权)人(译)	Kaneka公司		
[标]发明人	LUO YONGCHUN NAGAI NAOMI MIURA NOBUHITO TSUTSUI NAGANORI NAKA SHIGEKI OKADA HIROYUKI ONNAGAWA HIROYOSHI		
发明人	LUO, YONGCHUN NAGAI, NAOMI MIURA, NOBUHITO TSUTSUI, NAGANORI NAKA, SHIGEKI OKADA, HIROYUKI ONNAGAWA, HIROYOSHI		
IPC分类号	H05B33/00		
CPC分类号	H01L51/5278 H01L2251/308 H01L2251/5315		
优先权	2005088883 2005-03-25 JP		
外部链接	Espacenet USPTO		

摘要(译)

顶部发射型多光子OLED面板包括：绝缘基板;形成在绝缘基板上的阴极;层叠在阴极上的多个有机层;形成在多个有机层的顶层上的透明阳极，其中电荷产生层夹在每个有机层之间。


Sputter
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