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(54) **DISPLAY DEVICE**

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(57) **ABSTRACT**

A display device may include a lower electrode; an electroluminescence layer on the lower electrode; an upper electrode on the electroluminescence layer; a cap layer on the upper electrode for improving light extraction efficiency; an absorbent layer on the cap layer, the absorbent layer extending from above and laterally next to the cap layer; and a sealing film on the absorbent layer.

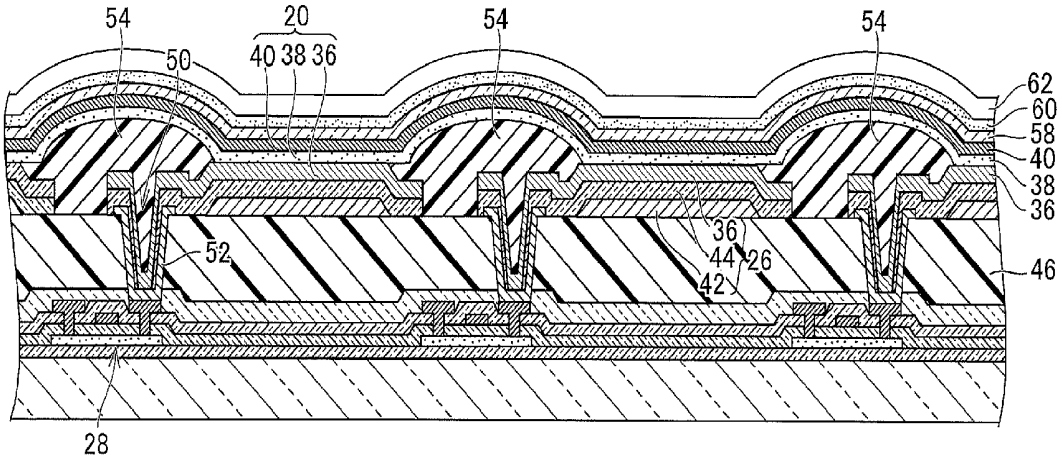


FIG.1

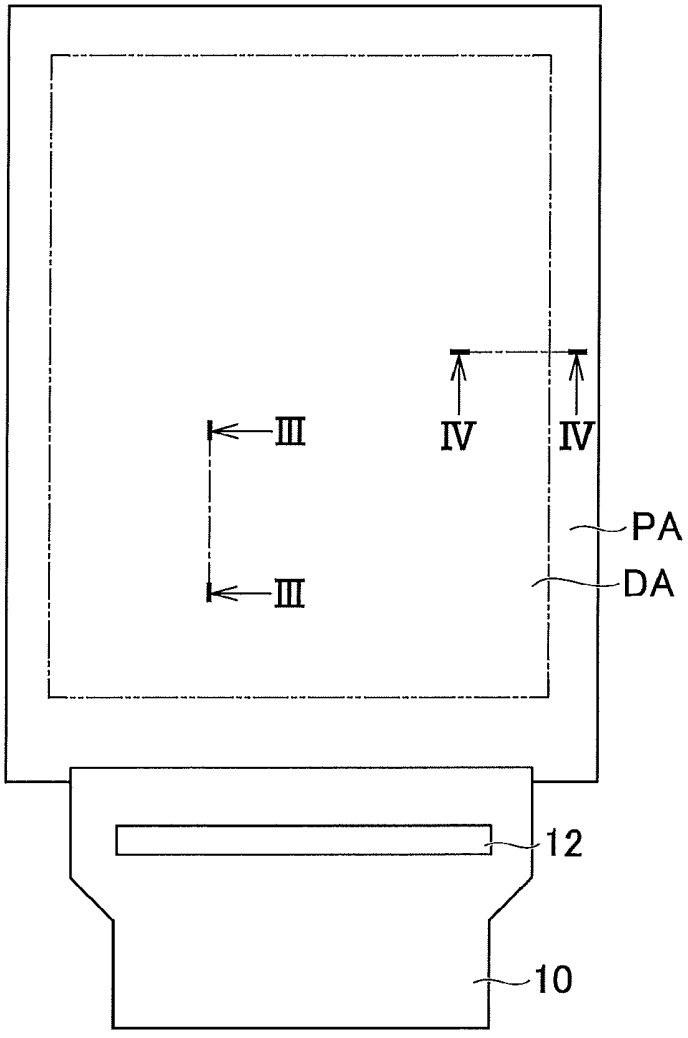


FIG.2

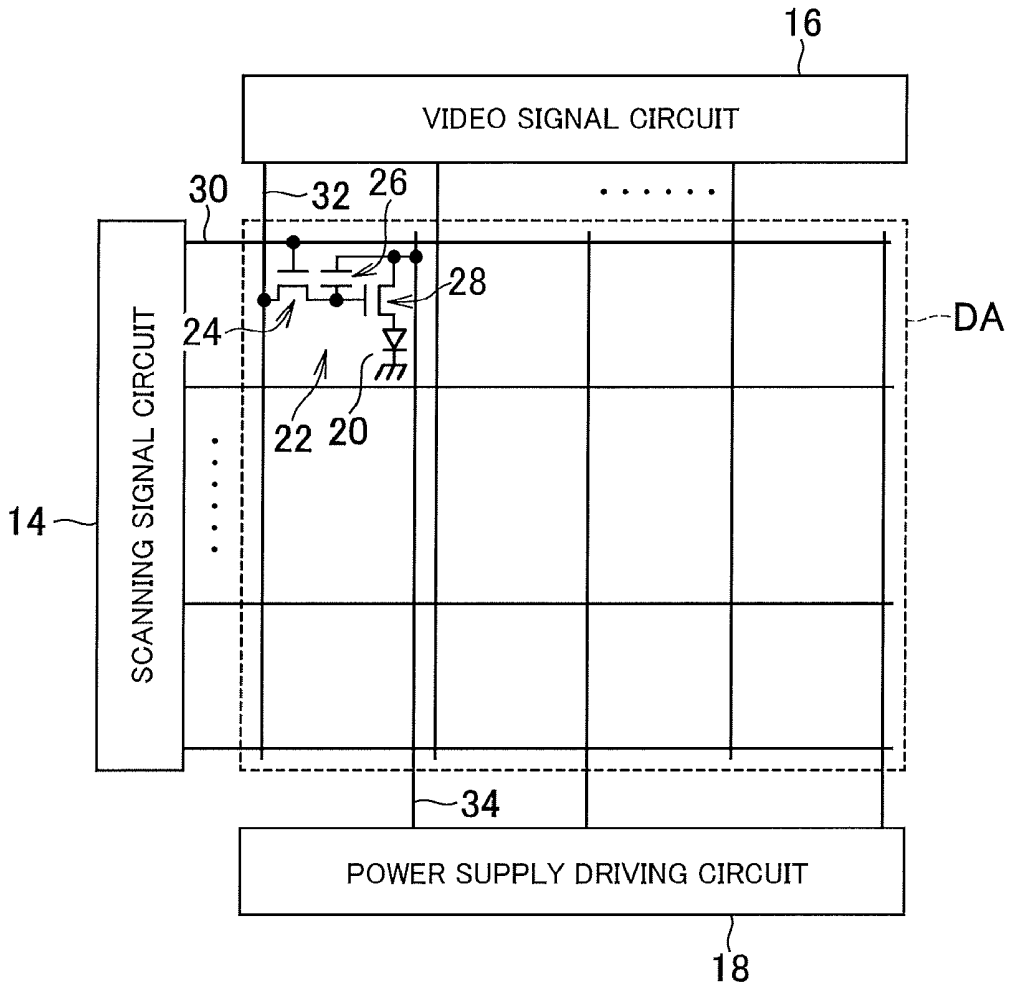

16
VIDEO SIGNAL CIRCUIT
30
32
26
28
24
22
20
DA
14
SCANNING SIGNAL CIRCUIT
34
POWER SUPPLY DRIVING CIRCUIT
18

FIG.3

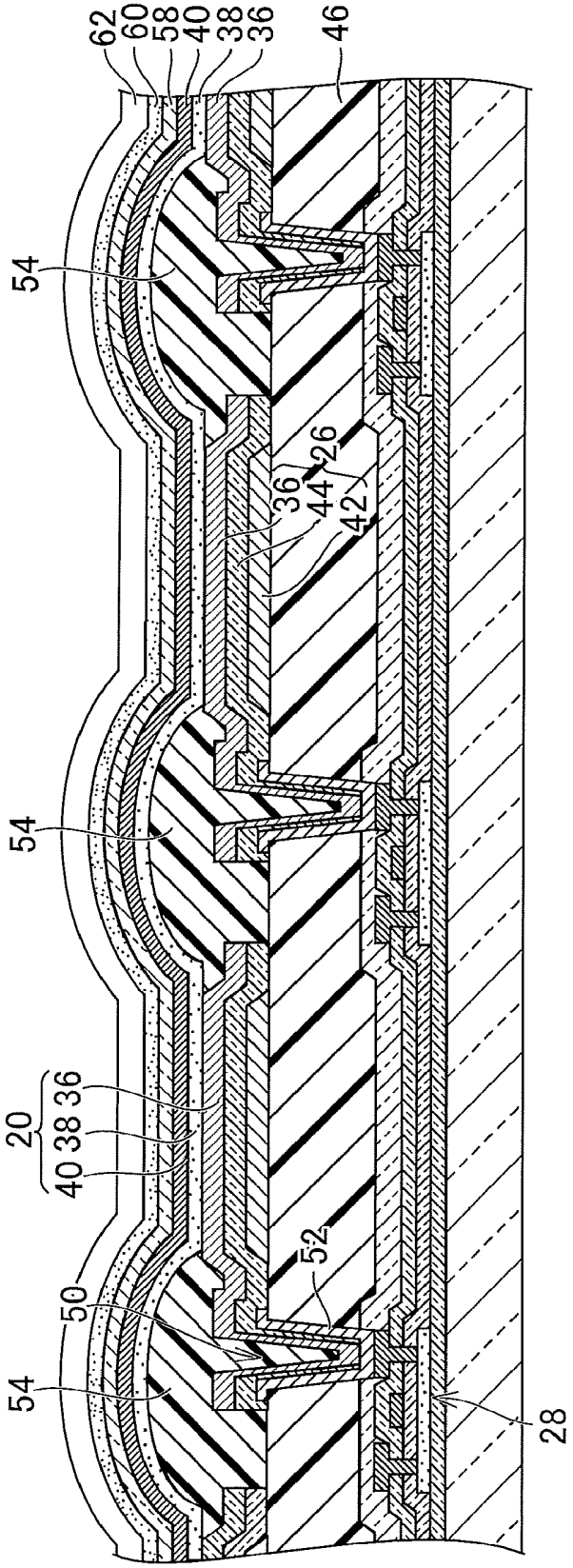
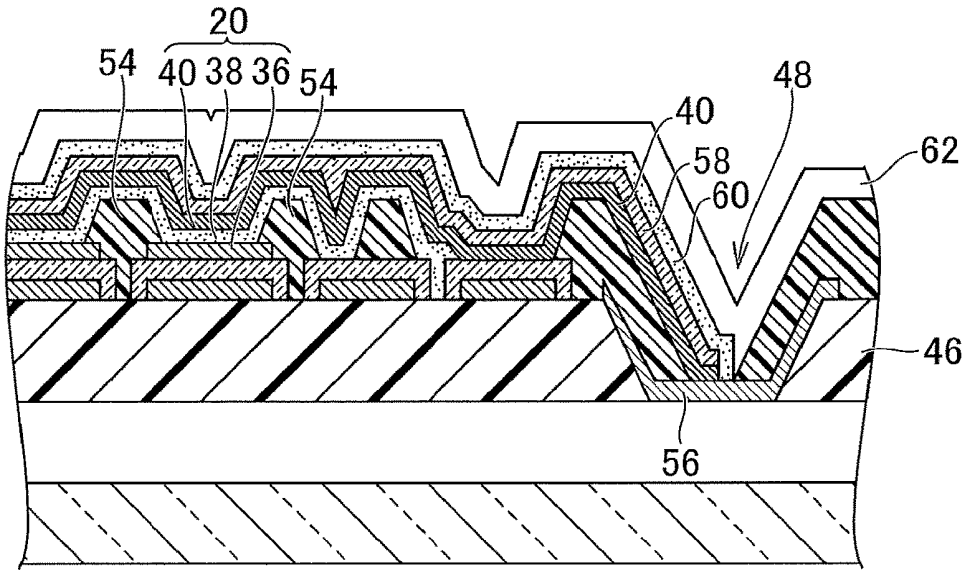


FIG.4



DISPLAY DEVICE

CROSS-REFERENCE TO RELATED APPLICATION

[0001] The present application claims priority from Japanese application JP2017-128824 filed on Jun. 30, 2017, the content of which is hereby incorporated by reference into this application.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] This relates to display devices.

2. Description of the Related Art

[0003] Recently, displays equipped with illuminants such as organic electroluminescence have been developing (JP H09-304796A and JP 2000-030857A). Organic electroluminescence elements, which are vulnerable to moisture, are configured to be covered with a sealing film (JP 2000-030857A). To improve barrier properties, a kind of sealing film is known to have a structure where an organic layer is interposed between a pair of inorganic films.

[0004] A cap layer is technically used for gradually changing refractive indexes to improve light extraction efficiency. With a defect in the sealing film, water enters there and diffuses into the cap layer, changing the refractive index in the material of the cap layer. Then, the light extraction efficiency cannot improve.

[0005] This is to aim at curbing deterioration of the cap layer.

SUMMARY OF THE INVENTION

[0006] A display device may include a lower electrode; an electroluminescence layer on the lower electrode; an upper electrode on the electroluminescence layer; a cap layer on the upper electrode for improving light extraction efficiency; an absorbent layer on the cap layer, the absorbent layer extending from above and laterally next to the cap layer; and a sealing film on the absorbent layer.

[0007] The cap layer is prevented from deterioration by the absorbent layer provided not only above it but also laterally next to it.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. **1** is a plan view of a display device in accordance with an embodiment.

[0009] FIG. **2** is a circuit diagram of the display device in FIG. **1**.

[0010] FIG. **3** is an enlarged view of a portion of line cross section of the display device in FIG. **1**.

[0011] FIG. **4** is an enlarged view of a portion of IV-IV line cross section of the display device in FIG. **1**.

DETAILED DESCRIPTION OF THE INVENTION

[0012] Hereinafter, some embodiments will be described with reference to the drawings. Here, the invention can be embodied according to various aspects within the scope of the invention without departing from the gist of the invention and is not construed as being limited to the content described in the embodiments exemplified below.

[0013] The drawings are further schematically illustrated in widths, thickness, shapes, and the like of units than actual forms to further clarify description in some cases but are merely examples and do not limit interpretation of the invention. In the present specification and the drawings, the same reference numerals are given to elements having the same functions described in the previously described drawings and the repeated description will be omitted.

[0014] Further, in the detailed description, "on" or "under" in definition of positional relations of certain constituents and other constituents includes not only a case in which a constituent is located just on or just under a certain constituent but also a case in which another constituent is interposed between constituents unless otherwise mentioned.

[0015] FIG. **1** is a plan view of a display device in accordance with an embodiment. The display device is an organic electroluminescence display device. The display device is configured to display a full-color image in full-color pixels, each of which consists of combination of unit pixels (subpixels) of colors such as red, green, and blue. The display device includes a display area DA and a peripheral area PA around the display area DA. A flexible printed circuit board **10** is connected to the peripheral area PA. On the flexible printed circuit board **10** is mounted an integrated circuit chip **12** for driving elements to display the image.

[0016] FIG. **2** is a circuit diagram of the display device in FIG. **1**. The display device is equipped with a scanning signal circuit **14**, a video signal circuit **16**, and a power supply driving circuit **18**. In the display area DA, display elements **20** and pixel circuits **22** are provided in a matrix, for respective pixels. The pixel circuit **22** includes a thin film transistor **24**, a capacitor **26**, and a thin film transistor **28**. The scanning signal circuit **14**, the video signal circuit **16**, and the power supply driving circuit **18** are to drive the pixel circuit **22** and control light emission of the display element **20**.

[0017] The scanning signal circuit **14** is connected to a scanning signal line **30** provided for each of horizontal rows (pixel rows) of pixels and is configured for outputting a scanning signal to the selected one of the scanning signal lines **30**. The scanning signal controls the thin film transistor **24**.

[0018] The video signal circuit **16** is connected to a video signal line **32** provided for each of vertical columns (pixel columns) of pixels and is configured for outputting a video signal. The scanning signal circuit selects one of the scanning signal lines **30** to turn on the corresponding thin film transistor **24** and writes on the capacitor **26** the video signal output to the video signal line **32**.

[0019] The thin film transistor **28** is controlled in accordance with the voltage written on the capacitor **26**. The thin film transistor **28** controls a current to be supplied to the display element **20** from a driving power line **34** provided for each pixel column and connected to the power supply driving circuit **18**. The display element **20** has its brightness controlled by the current control. The display element **20** is grounded on a side opposite to the thin film transistor **28**.

[0020] FIG. **3** is an enlarged view of a portion of line cross section of the display device in FIG. **1**. The display element **20** includes a lower electrode **36** (pixel electrode or anode), an organic electroluminescence layer **38**, and an upper electrode **40** (common electrode or cathode).

[0021] Under the lower electrode **36** are a capacitance electrode **42** and a capacitive insulation layer **44**, which constitute a capacitor **26**. The capacitive insulation layer **44** is made from inorganic insulation material such as silicon nitride (SiNx). Under the display element **20** and the capacitor **26** is a planarization film **46** made from an organic insulation film such as an acrylic resin or a polyimide resin.

[0022] FIG. **4** is an enlarged view of a portion of IV-IV line cross section of the display device in FIG. **1**. The planarization film **46** is disunited in the peripheral area PA. Specifically, the planarization film **46** has a continuous portion from the display area DA to the peripheral area PA, the continuous portion surrounded by another portion in the peripheral area PA. Disuniting the planarization film **46** as such forms a trench **48**. The trench **48** exposes an inorganic insulation film or a metal layer but excludes an organic material such as the planarization film **46**. Or, the trench **48** disunites the organic material and prevents moisture from permeating the organic material. This prevents moisture from entering into the organic electroluminescence layer **38**.

[0023] The lower electrode **36**, which is made from metal with light reflectivity such as aluminum, extends to a bottom of the contact hole **50** in FIG. **3** and is connected to a conducting layer **52** made from a transparent conductive film. The lower electrode **36** has continuity with one of the source electrode and the drain electrode of the thin film transistor **28** under the planarization film **46**, through the conducting layer **52**. To separate the pixels, a bank layer **54** made from an organic insulation film (resin) is provided. The bank layer **54** is configured to be on a periphery of the lower electrode **36**.

[0024] The organic electroluminescence layer **38**, which is between the upper electrode **40** and the lower electrode **36**, includes a hole transport layer, a hole transport layer, a light emitting layer, an electron transport layer, and an electron injection layer. Some layers except for the light emitting layer continuously overlap with a plurality of lower electrode **36**, whereas the light emitting layer is individually disposed for each lower electrode **36**. The light emitting layer generates light due to recombination of holes injected from the lower electrode **36** and electrons injected from the upper electrode **40**.

[0025] The upper electrode **40** is formed from a transparent conductive film such as indium tin oxide (ITO), in a widely spread shape to be a common one layer for the plurality of pixels in the display area DA. As shown in FIG. **4**, the upper electrode **40** is connected to a cathode contact **56** in the peripheral area PA. The cathode contact **56** is illustrated in the trench **48**.

[0026] The display device includes a cap layer **58**. The cap layer **58** is on the upper electrode **40** entirely in the display area DA to improve light extraction efficiency. The cap layer **58** further extends to the peripheral area PA. The cap layer **58** has its thickness and its refractive index selected in accordance with emission intensity and emission wavelength of light from the organic electroluminescence layer **38**. The cap layer serves as a protective layer for the organic electroluminescence layer **38** including the upper electrode **40**. The cap layer **58** is formed from publicly known inorganic material. The material of the cap layer **58** preferably has a refractive index of 1.0 or more. The best method of forming the cap layer **58** is selected in accordance with the material thereof. The cap layer **58** generally has its thickness of 5 nm to 100 nm preferably for effective emission of light although it is not limited.

[0027] The display device has an absorbent layer **60**, which may include calcium or calcium oxide. The absorbent layer **60** is on the cap layer **58**. The absorbent layer **60** spreads all over the display area DA and further extends to the peripheral area PA. The absorbent layer **60** continuously extends from above and laterally next to the cap layer **58**. As shown in FIG. **4**, the cap layer **58** is illustrated to have its tip surface of the periphery covered with and in contact with the absorbent layer **60**, in the trench **48**. The periphery (e.g. whole periphery) of the absorbent layer **60** is at a lower position than the cap layer **58**. The absorbent layer **60** entirely surrounds the cap layer **58**. Specifically, the absorbent layer **60** extends beyond a whole periphery of the cap layer **58** and covers a whole surface of the cap layer **58** except for its bottom surface. In accordance with the embodiment, the cap layer **58** is prevented from deterioration due to the absorbent layer **60** not only above it but also laterally next to it.

[0028] The absorbent layer **60** further covers the upper electrode **40** at its periphery from its side and is in contact with the upper electrode **40** at its periphery. The absorbent layer **60** entirely surrounds the upper electrode **40** and is also in contact with a layer (cathode contact **56**) under the periphery of the upper electrode **40**.

[0029] The absorbent layer **60** extends from above and laterally next to the organic electroluminescence layer **38**. As shown in FIG. **4**, the absorbent layer **60** is illustrated to have its periphery at a position lower than a periphery of the organic electroluminescence layer **38**. The absorbent layer **60** entirely surrounds the organic electroluminescence layer **38**.

[0030] The display device has a sealing film **62**. The display element **20** is covered with the sealing film **62** for its protection. The sealing film **62** has a structure where an organic film is interposed between inorganic layers over and under it; the inorganic layer may be made from silicon nitride or silicon oxide. The sealing film **62** is on the absorbent layer **60**. The sealing film extends from above and laterally next to each of the absorbent layer **60**, the cap layer **58**, and the organic electroluminescence layer **38**. The sealing film **62** entirely surrounds each of the absorbent layer **60**, the cap layer **58**, and the organic electroluminescence layer **38**.

[0031] The display device is not limited to the organic electroluminescence display device but may be a display device with a light-emitting element disposed in each pixel, such as a quantum-dot light-emitting diode (QLED).

[0032] While there have been described what are at present considered to be certain embodiments, it will be understood that various modifications may be made thereto, and it is intended that the appended claims cover all such modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. A display device comprising:

a lower electrode;

an electroluminescence layer on the lower electrode;

an upper electrode on the electroluminescence layer;

a cap layer on the upper electrode for improving light extraction efficiency;

an absorbent layer on the cap layer, the absorbent layer extending from above and laterally next to the cap layer; and

a sealing film on the absorbent layer.

2. The display device according to claim **1**, wherein the absorbent layer entirely surrounds the cap layer.

3. The display device according to claim **1**, wherein the absorbent layer extends from above and laterally next to the electroluminescence layer.

4. The display device according to claim **3**, wherein the absorbent layer entirely surrounds the electroluminescence layer.

5. The display device according to claim **1**, wherein the sealing film extends from above and laterally next to each of the absorbent layer, the cap layer, and the electroluminescence layer.

6. The display device according to claim **5**, wherein the sealing film entirely surrounds each of the absorbent layer, the cap layer, and the electroluminescence layer.

* * * * *

专利名称(译)	显示设备		
公开(公告)号	US20190006621A1	公开(公告)日	2019-01-03
申请号	US16/008155	申请日	2018-06-14
[标]申请(专利权)人(译)	株式会社日本显示器		
申请(专利权)人(译)	日本展示INC.		
当前申请(专利权)人(译)	日本展示INC.		
[标]发明人	KATO KENGO		
发明人	KATO, KENGO		
IPC分类号	H01L51/52		
CPC分类号	H01L51/5253 H01L51/5275 H01L27/3248 H01L27/3258 H01L27/3265 H01L27/3276 H01L51/5237 H01L51/5259		
优先权	2017128824 2017-06-30 JP		
外部链接	Espacenet USPTO		

摘要(译)

显示装置可包括下电极;下电极上的电致发光层;电致发光层上的上电极;上电极上的盖层用于提高光提取效率;在盖层上的吸收层，吸收层从盖层上方和侧面延伸;和吸收层上的密封膜。