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(54) **ORGANIC EL DISPLAY DEVICE**

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(57) **ABSTRACT**

An organic EL display device according to an embodiment of the present invention includes: a substrate, a plurality of pixels that are disposed on the substrate, a first inorganic insulating layer that covers the plurality of pixels, a conductive layer that is disposed on a side of the first inorganic insulating layer opposite to the plurality of pixels and covers the plurality of pixels, and a second inorganic insulating layer that is disposed on a side of the conductive layer opposite to the first inorganic insulating layer and covers the plurality of pixels.

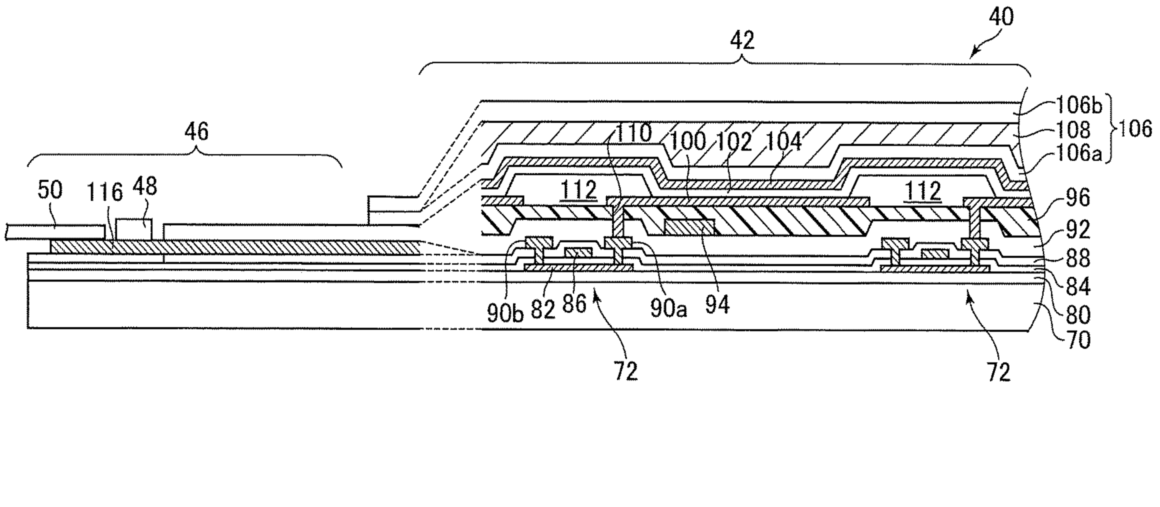
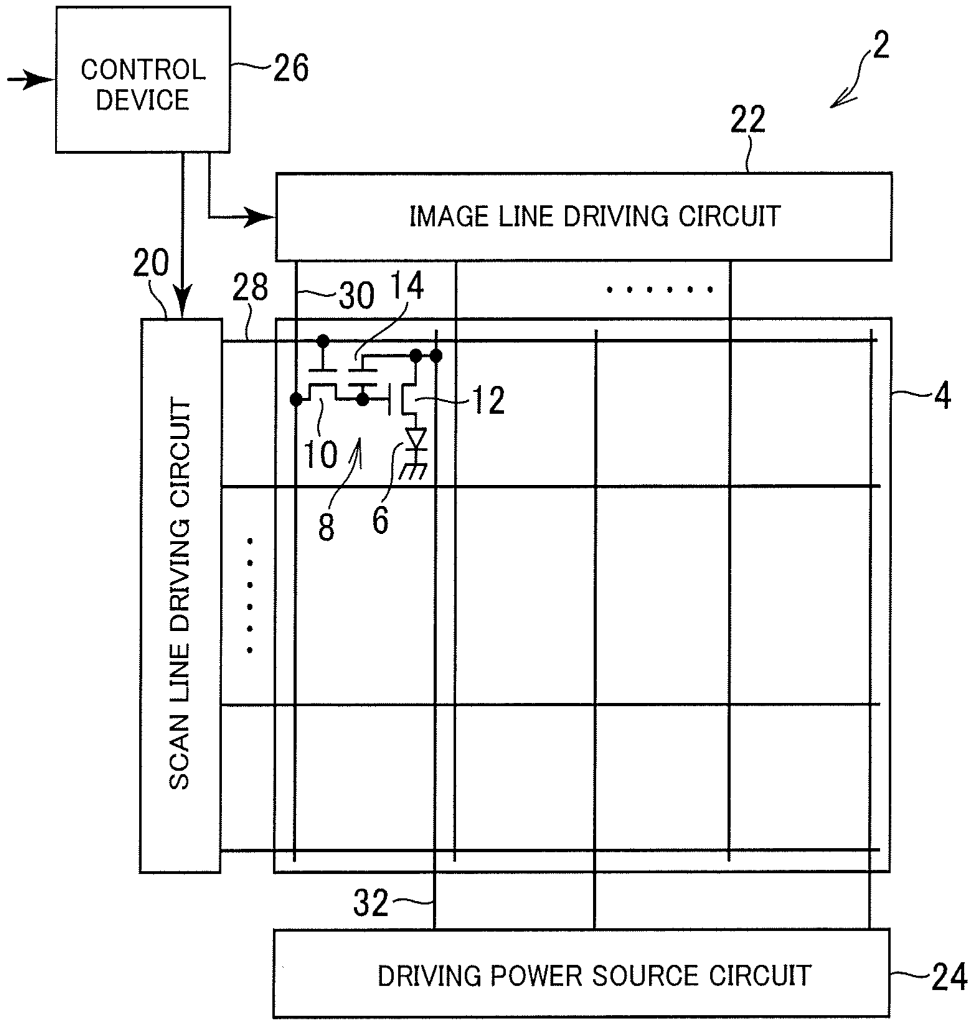
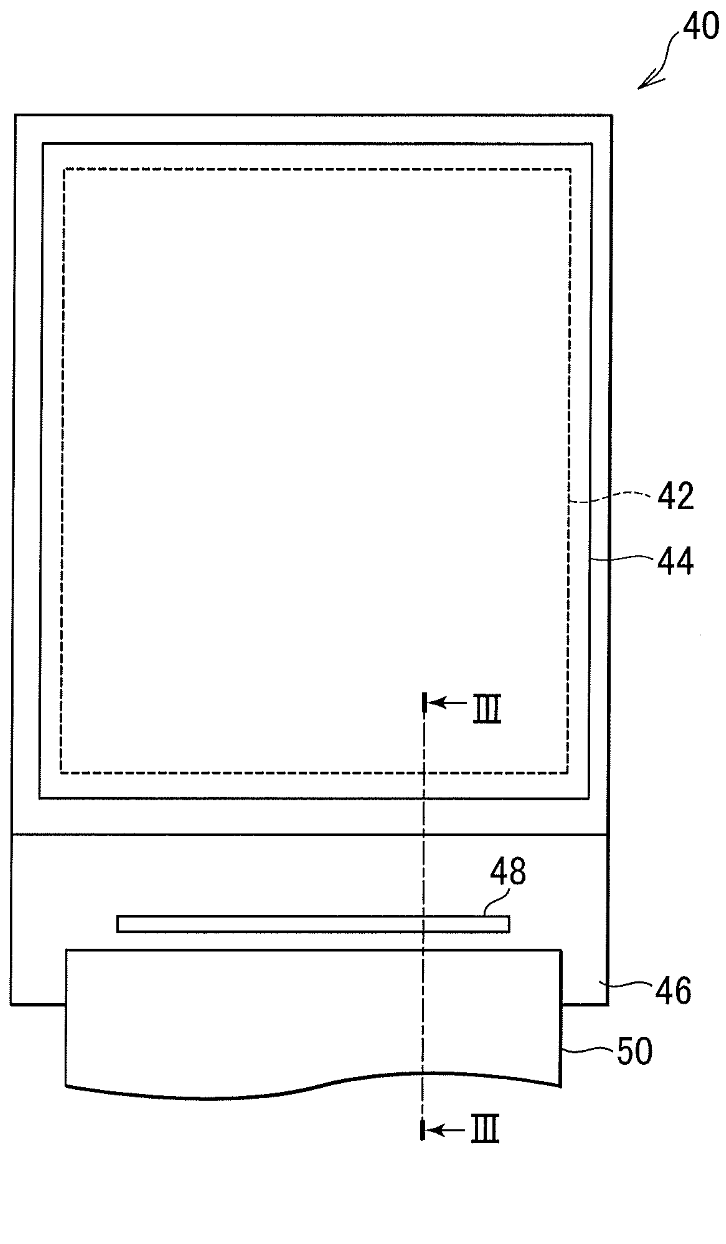


FIG.1



CONTROL DEVICE
26
2
22
IMAGE LINE DRIVING CIRCUIT
20
28
30
14
12
4
10
8
6
SCAN LINE DRIVING CIRCUIT
32
DRIVING POWER SOURCE CIRCUIT
24

FIG.2



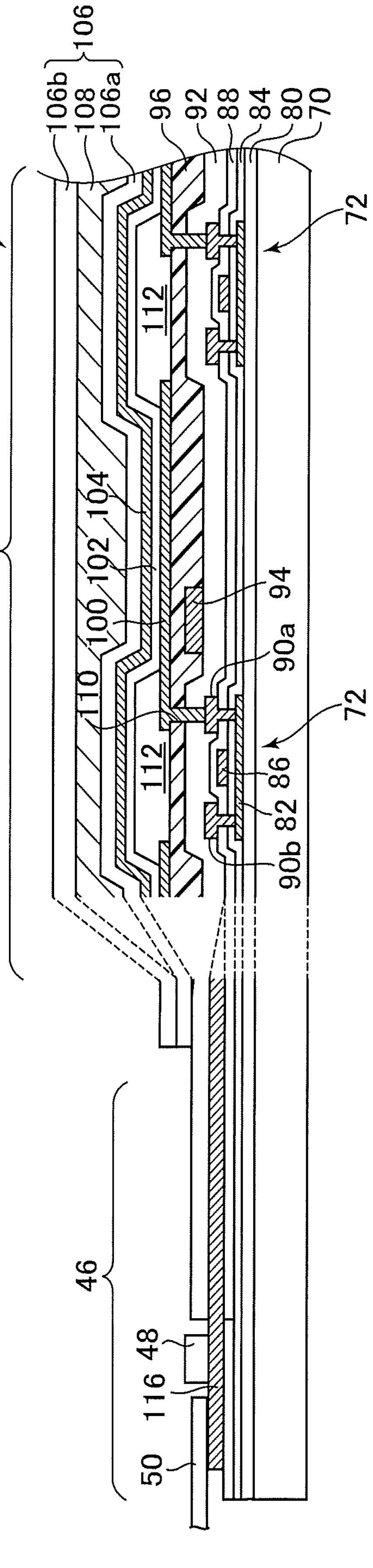
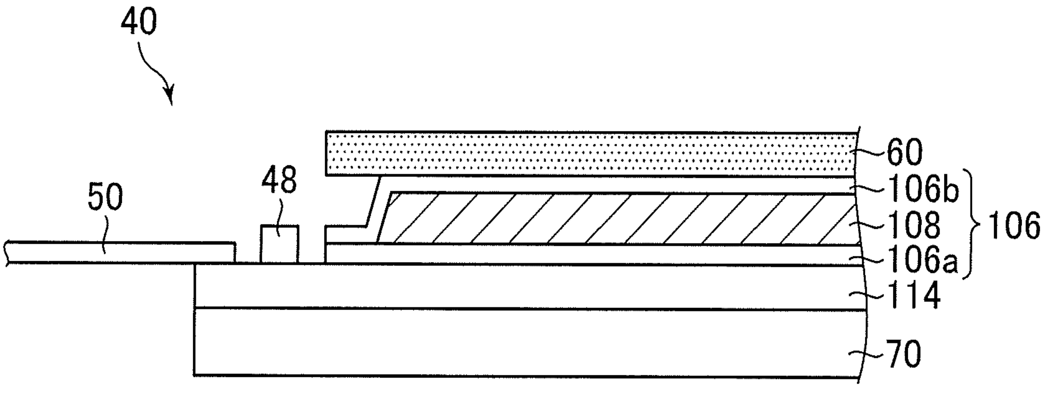

106
106b
108
106a
96
92
88
84
80
70
40
72
112
42
104
102
100
94
90a
110
72
112
86
82
90b
46
48
116
50

FIG.3

FIG.4



ORGANIC EL DISPLAY DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation under 35 U.S.C. 120 of International Application PCT/JP2018/001951 having the International Filing Date of Jan. 23, 2018, and having the benefit of the earlier filing date of Japanese Application No. 2017-078826, filed on Apr. 12, 2017. Each of the identified applications is fully incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] One or more embodiments of the present invention relate to an organic EL display device.

2. Description of the Related Art

[0003] An organic electroluminescence (EL) display device has a display panel where a thin film transistor (TFT), an organic light emitting diode (OLED), and the like are formed on a substrate. A display panel like this generates electromagnetic noise, and may trigger, for example, a malfunction of an attached touch panel. With respect to such a problem, for example, in Japanese Patent Application Laid-Open No. 2003-099193, it is suggested to form an ITO film on a substrate of a touch panel part and a substrate of a display panel part.

SUMMARY OF THE INVENTION

[0004] However, adverse effects of the electromagnetic noise are expected to be more reliably suppressed.

[0005] One or more embodiments of the invention have been made in view of the above, and it is an object thereof to provide an organic EL display device that can more reliably suppress adverse effects of the electromagnetic noise.

[0006] An organic EL display device according to an embodiment of the present invention includes: a substrate, a plurality of pixels that are disposed on the substrate, a first inorganic insulating layer that covers the plurality of pixels, a conductive layer that is disposed on a side of the first inorganic insulating layer opposite to the plurality of pixels and covers the plurality of pixels, and a second inorganic insulating layer that is disposed on a side of the conductive layer opposite to the first inorganic insulating layer and covers the plurality of pixels.

[0007] In one embodiment of the present invention, a touch panel is positioned on a side of the second inorganic insulating layer opposite to the conductive layer.

[0008] In one embodiment of the present invention, sheet resistance of the conductive layer is 500Ω per square or less.

[0009] In one embodiment of the present invention, the conductive layer has a visible light transmittance of 50% or more.

[0010] In one embodiment of the present invention, the conductive layer includes a binder resin.

[0011] In one embodiment of the present invention, the conductive layer includes a nanowire and/or a nanotube.

[0012] In one embodiment of the present invention, the conductive layer includes an ITO.

[0013] In one embodiment of the present invention, the conductive layer includes a resin and a conductive material.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIG. **1** is a schematic view of a schematic configuration of an organic EL display device according to an embodiment of the present invention.

[0015] FIG. **2** is a schematic plan view of an example of a display panel of the organic EL display device illustrated in FIG. **1**.

[0016] FIG. **3** is a view of an example of cross section of FIG. **2**.

[0017] FIG. **4** is a schematic cross sectional view of an example of a state where a touch panel is placed on the display panel illustrated in FIG. **2**.

DETAILED DESCRIPTION OF THE INVENTION

[0018] Below, the respective embodiments of the present invention are explained with reference to the accompanying drawings. Note that the disclosed embodiments are merely examples, and an appropriate variation which a person skilled in the art can easily arrive at without departing from the spirit of the present invention is naturally included in the scope of the present invention. Further, while the width, thickness, shape, and the like of each part in the drawings may be illustrated schematically as compared with the actual embodiments in order to clarify the explanation, these are merely examples, and an interpretation of the present invention should not be limited thereto. Furthermore, in the specification and the respective drawings, the same reference symbols may be applied to elements similar to those which have already been illustrated in another drawing, and a detailed explanation of such elements may be omitted as appropriate.

[0019] FIG. **1** is a schematic view of a schematic configuration of an organic EL display device according to an embodiment of the present invention. An organic EL display device **2** is provided with a pixel array part **4** which displays an image, and a driving part which drives the pixel array part **4**. The organic EL display device **2** has a display panel where a lamination structure of a TFT, an OLED, and the like is formed on a substrate. Note that the schematic view illustrated in FIG. **1** is an example, and the present embodiment is not limited thereto.

[0020] On the pixel array part **4**, OLEDs **6** and pixel circuits **8** are arranged in a matrix form, in correspondence with the respective pixels. The pixel circuit **8** is composed of a plurality of TFTs **10** and **12**, and a capacitor **14**.

[0021] The driving part as described above includes a scan line driving circuit **20**, an image line driving circuit **22**, the driving power source circuit **24**, and the control device **26**, and drives the pixel circuit **8** to control light emission of the OLED **6**.

[0022] The scan line driving circuit **20** is connected to a scan signal line **28** provided for each horizontal line of pixels (pixel row). The scan line driving circuit **20** selects scan signal lines **28** in order according to timing signals input from the control device **26**, and applies an electric voltage for turning on the lighting TFT **10** to the selected scan signal line **28**.

[0023] The image line driving circuit **22** is connected to an image signal line **30** provided for each vertical line of pixels (pixel column). The image line driving circuit **22** receives an input of an image signal from the control device **26**, and in accordance with a selection of the scan signal line **28** by the scan line driving circuit **20**, outputs an electric voltage according to the image signal for the selected pixel row to each image signal line **30**. That electric voltage is written into the capacitor **14** via the lighting TFT **10** at the selected pixel row. The driving TFT **12** supplies the OLED **6** with an electric current according to the written electric voltage, and thus the OLED **6** of the pixel which corresponds to the selected scan signal line **28** emits light.

[0024] The driving power source circuit **24** is connected to a driving electric power supply line **32** provided for each pixel column, and supplies the OLED **6** with an electric current via the driving electric power supply line **32** and the driving TFT **12** in the selected pixel row.

[0025] Here, a lower electrode of the OLED **6** is connected to the driving TFT **12**. Whereas, an upper electrode of each OLED **6** is composed of an electrode shared in common by the OLEDs **6** of all the pixels. In a case where the lower electrode is configured as an anode, a high electric potential is input thereto, and the upper electrode becomes a cathode and a low electric potential is input thereto. In a case where the lower electrode is configured as a cathode, a low electric potential is input thereto, and the upper electrode becomes an anode and a high electric potential is input thereto.

[0026] FIG. **2** is a schematic plan view of an example of the display panel of the organic display device illustrated in FIG. **1**. The pixel array part **4** illustrated in FIG. **1** is provided in a display area **42** of the display panel **40**, and as described above the OLEDs are arranged on the pixel array part **4**. As described above, an upper electrode **44** which constitutes the OLED **6** is formed so as to be shared in common by the respective pixels and covers the entire display area **42**.

[0027] On one side of the display panel **40** which has a rectangular shape, a component mounting area **46** is provided, and a wiring connected to the display area **42** is disposed thereon. Further, on the component mounting area **46** a driver integrated circuit (IC) **48** which constitutes the driving part is mounted, and an FPC **50** is connected to the component mounting area **46**. The flexible printed circuit (FPC) **50** is connected to the control device **26**, and other circuits **20**, **22**, and **24**, and the like, and an IC is mounted on the FPC **50**.

[0028] FIG. **3** is a view of an example of cross section of FIG. **2**. The display panel **40** has a structure where a circuit layer composed of a TFT **72** and the like, the OLED **6**, a sealing layer **106** which seals the OLED **6**, and the like are laminated on a substrate **70**. The substrate **70** is composed of, for example, a glass board, or a resin film such as polyimide resin. In the present embodiment, the pixel array part **4** is a top emission type pixel array, and light generated in the OLED **6** is emitted to a side opposite from the substrate **70** side (in an upper direction in FIG. **3**) with respect to the OLED **6**. In a case where a colorization method of the organic EL display device **2** is set to the color filter method, the color filter is arranged over the sealing layer **106**, for example. By letting white light generated in the OLED **6** go through this color filter, lights in colors such as red (R), green (G), and blue (B) are generated, for example.

[0029] On the circuit layer of the display area **42**, the pixel circuit **8**, the scan signal line **28**, the image signal line **30**, and the driving electric power supply line **32** which have been described above, and the like are formed. At least a part of the driving part can be formed as a circuit layer in an area adjacent to the display area **42**, on the insulating base material **70**. As described above, the driver IC **48** and the FPC which constitute the driving part can be connected to a wiring **116** of the circuit layer in the component mounting area **46**.

[0030] As illustrated in FIG. **3**, on the substrate **70**, an under-layer **80** which is formed of an inorganic insulating material is arranged. As the inorganic insulating material, for example, silicon nitride (SiN_y), silicon oxide (SiO_x), or a complex of these is used.

[0031] In the display area **42**, with an interposition of the under-layer **80**, a semiconductor area **82** to be a channel part and the source/drain part of the top gate type TFT **72** is formed on the substrate **70**. The semiconductor area **82** is formed of, for example, polysilicon (p-Si). The semiconductor area **82** is formed by, for example, providing a semiconductor layer (a p-Si film) on the substrate **70**, patterning this semiconductor layer, and selectively leaving parts which are used in the circuit layer. Over the channel part of the TFT **72**, a gate electrode **86** is arranged with an interposition of a gate insulating film **84**. The gate insulating film **84** is typically formed of TEOS. The gate electrode **86** is formed by, for example, patterning a metal film formed by sputtering or the like. On the gate electrode **86**, an interlayer insulating layer **88** is arranged so as to cover the gate electrode **86**. The interlayer insulating layer **88** is formed of, for example, the inorganic insulating material as described above. In the semiconductor area **82** (p-Si) to be the source/drain part of the TFT **72**, impurities are introduced by an ion injection, and further a source electrode **90*a*** and a drain electrode **90*b*** which are electrically connected thereto are formed, and thus the TFT **72** is formed.

[0032] On the TFT **72**, an interlayer insulating film **92** is arranged. On the surface of the interlayer insulating film **92**, a wiring **94** is arranged. The wiring **94** is formed by, for example, patterning a metal film formed by sputtering or the like. With a metal film which constitutes the wiring **94**, and a metal film which is used to form the gate electrode **86**, the source electrode **90*a*** and the drain electrode **90*b***, for example, the wiring **116**, and the scan signal line **28**, the image signal line **30**, and the driving power supply line **32** which are illustrated in FIG. **1** can be formed as a multilayer wiring structure. Thereon, a planarizing film **96** is formed, for example, of a resin material such as an acrylic resin, and in the display area **42**, the OLED **6** is formed on the planarizing film **96**.

[0033] The OLED **6** includes a lower electrode **100**, an organic material layer **102**, and an upper electrode **104**. The organic material layer **102** includes, specifically, a hole transport layer, a light emitting layer, an electron transport layer, and the like. The OLED **6** is typically formed by laminating the lower electrode **100**, the organic material layer **102**, and the upper electrode **104** in this order from the substrate **70** side. In the present embodiment, the lower electrode **100** is an anode of the OLED, and the upper electrode **104** is a cathode.

[0034] If the TFT **72** illustrated in FIG. **3** is the driving TFT **12** having an n-channel, the lower electrode **100** is connected to the source electrode **90*a*** of the TFT **72**. Specifically, after forming the planarizing film **96** as described above, a contact hole **110** for connecting the lower electrode **100** to the TFT **72** is formed, and for example by patterning a conductive body part formed on the surface of the planarizing layer **96** and inside the contact hole **110**, the lower electrode **100** connected to the TFT **72** is formed for each pixel.

[0035] On the structure as described above, a bank **112** which separates pixels is arranged. For example, after forming the lower electrode **100**, the bank **112** is formed on a border of pixels, and in an effective area of a pixel surrounded by the bank **112** (an area where the lower electrode **100** is exposed), the organic material layer **102** and the upper electrode **104** are laminated. The upper electrode **104** is typically formed of a transparent electrode material.

[0036] On the upper electrode **104**, a sealing layer **106** is arranged. The sealing layer **106** can function as, for example, a protection layer which protects the OLED **6** from moisture and the like, and therefore the sealing layer **106** is formed to cover the whole of the display area **42**. Although not shown here, a protection layer can be disposed on the display area **42** so as to ensure mechanical strength of the surface of the display panel **40**, for example. In this case, a protection layer is not typically provided on the component mounting area **46** so as to facilitate connection of the IC and the FPC to the component mounting area **46**. A wiring of the FPC **50** and a terminal of the driver IC **48** are electrically connected to, for example, the wiring **116**.

[0037] As a method of installing a touch panel on the display device, a configuration of externally attaching the touch panel to the display panel (out-cell method), a configuration of providing the touch panel outside the display panel (for example, between the display panel and the polarizing plate arranged outside the display panel) and integrating the display panel and the touch panel (on-cell method), and a configuration of providing the touch panel inside the display panel (in-cell method) are known. In the present embodiment, the out-cell method or the on-cell method are adopted. Specifically, as illustrated in FIG. **4**, the touch panel **60** is arranged on the sealing layer **106** of the display panel **40**, and in this state, the display panel **40** is put inside a housing of the organic EL display device **2**. Note that in FIG. **4**, as the lamination structure of the display panel **40** illustrated in FIG. **3**, a lamination structure from which the sealing layer **106** over the substrate **70** is omitted is illustrated as an upper structure layer **114**, in a simplified manner.

[0038] The sealing layer **106** includes a first sealing layer **106***a*, a conductive layer **108**, and a second sealing layer **106***b* in this order from the substrate **70** side. As shown, the conductive layer **108** is not provided on the edge of the sealing layer **106** outside the display area **42**, and the first sealing layer **106***a* is in direct contact with the second sealing layer **106***b*. The sealing layer **106** includes the conductive layer in this manner, thereby shielding the electromagnetic noise at a position closer to the sources of the noise (display part). This can suppress the adverse effects of electromagnetic noise more reliably. For example, it is possible to more reliably suppress a malfunction of a touch panel. Further, a conductive layer can be formed in the step of forming a sealing layer, and this serves to improve manufacturing efficiency.

[0039] The first sealing layer (inorganic insulating layer) **106***a* and the second sealing layer (inorganic insulating layer) **106***b* are each formed by, for example, forming a film of inorganic insulating material, such as SiN_y, to have a thickness of several μm or so using a chemical vapor deposition (CVD) method. By inserting the conductive layer **108** between such sealing layers, in other words, covering the entire conductive layer **108** with the first sealing layer **106***a* and the second sealing layer **106***b*, adverse effects of the conductive layer **108** on the other members can be suppressed. The conductive layer **108** is formed so as to cover the display area **42**. The conductive layer **108** is preferably formed such that the sheet resistance is 500Ω per square or less in order to achieve, for example, satisfactory effects of shielding electromagnetic noise generated on the display part (the structure layer **114** below the sealing layer **106**). Further, the conductive layer **108** is preferably formed so as to ensure transparency (e.g., having a visible light transmittance of 50% or more).

[0040] The conductive layer **108** includes conductive material. For example, following materials are used as the conductive material: metals such as silver, gold, copper, nickel, and alloys of these metals (e.g., Cu—Ni); carbon; metal oxide such as indium tin oxide (ITO); and electroconductive polymer.

[0041] The conductive layer **108** includes, for example, a binder resin such as an acrylic resin and the conductive material described above. In this case, the thickness of the conductive layer **108** is 10 μm to 50 μm, for example. The conductive material used in combination with the binder resin may be formed appropriately, although a nanowire (typically, metal nanowire) and/or a nanotube (typically, carbon nanotube) are preferably used. The metal nanowire is particularly preferred between them. The metal nanowire can satisfactorily achieve, for example, the conductivity and transparency described above. Here, the nanowire is a fiber-like conductive substance with a solid structure having a diameter of nanometer size, and the nanotube is a fiber-like conductive substance with a hollow structure having a diameter of nanometer size. Thicknesses of the nanowire and the nanotube are, for example, 5 nm to 500 nm, and are preferably 5 nm to nm. Lengths of the nanowire and the nanotube are, for example, 1 μm to 1000 μm, and are preferably 10 μm to 1000 μm. The conductive layer **108** is formed by, for example, applying an application material containing the binder resin and the conductive material to the first sealing layer **106***a* (e.g., by using the inkjet method), and subjecting the application material to a post-treatment (e.g., heat curing treatment and light curing treatment) as appropriate according to a type of the binder resin. The conductive layer **108** can also function as a flattening layer of the sealing layer **106**.

[0042] The present invention is not limited to the embodiments as have been described above, and various kinds of variations are acceptable. For example, the configurations explained as to the above embodiments can be replaced with a configuration which is substantially the same as the ones which have been explained regarding the embodiments described above, a configuration which exhibits the same technical effect, or a configuration which can achieve the same objective. Specifically, the conductive layer **108** may be formed of an ITO film, for example.

[0043] It is understood that without departing from the spirit of the present invention, those skilled in the art can arrive at various kinds of variations and modifications, and such variations and modifications belong to the scope of the present invention. For example, each of the embodiments as described above to which addition, deletion, or design change of components, or addition, omission, or condition change of processes is suitably applied by those skilled in the art are also encompassed within the scope of the present invention as long as they fall within the spirit of the present invention.

What is claimed is:

1. An organic EL display device, comprising:
a substrate,
a plurality of pixels that are disposed on the substrate,
a first inorganic insulating layer that covers the plurality of pixels,
a conductive layer that is disposed on a side of the first inorganic insulating layer opposite to the plurality of pixels and covers the plurality of pixels, and
a second inorganic insulating layer that is disposed on a side of the conductive layer opposite to the first inorganic insulating layer and covers the plurality of pixels.

2. The organic EL display device according to claim **1**, wherein
a display area including the plurality of pixels is positioned on the substrate,
the first inorganic insulating layer, the conductive layer, and the second inorganic insulating layer cover the display area,
a part of the first inorganic insulating layer is positioned on outside of the display area,
a part of the second inorganic insulating layer is positioned on the outside, and
an edge of the first inorganic insulating layer overlaps an edge of the second inorganic insulating layer in a plan view on the outside.

3. The organic EL display device according to claim **2**, wherein
a part of the conductive layer is positioned on the outside, and
an edge of the part of the conductive layer is positioned between the edge of the first inorganic insulating layer and the display area.

4. The organic EL display device according to claim **1**, wherein
the first inorganic insulating layer includes an area that is in direct contact with the second inorganic insulating layer, and
all of the conductive layer is covered by the first inorganic insulating layer and the second inorganic insulating layer.

5. The organic EL display device according to claim **1**, wherein
each of the plurality of pixels includes a lower electrode, a light emitting layer on the lower electrode, and an upper electrode on the light emitting layer,
the first inorganic insulating layer is positioned on the upper electrode, and
the first inorganic insulating layer and the second inorganic insulating layer are sealing layers that seal the light emitting layer.

6. The organic EL display device according to claim **1**, wherein
a touch panel is positioned on a side of the second inorganic insulating layer opposite to the conductive layer.

7. The organic EL display device according to claim **1**, wherein
the conductive layer includes a binder resin.

8. The organic EL display device according to claim **1**, wherein
the conductive layer includes a nanowire and/or a nanotube.

9. The organic EL display device according to claim **1**, wherein
the conductive layer includes an ITO.

10. The organic EL display device according to claim **1**, wherein
the conductive layer includes a resin and a conductive material.

11. The organic EL display device according to claim **1**, wherein
sheet resistance of the conductive layer is 500Ω per square or less.

12. The organic EL display device according to claim **1**, wherein
the conductive layer has a visible light transmittance of 50% or more.

13. An organic EL display device comprising:
a plurality of pixels each including a lower electrode, a light emitting layer on the lower electrode, and an upper electrode on the light emitting layer,
a first sealing layer that is positioned on the upper electrode and covers the plurality of pixels,
a conductive layer that is positioned on a side of the first sealing layer opposite to the plurality of pixels and covers the plurality of pixels,
a second sealing layer that is positioned on a side of the conductive layer opposite to the first sealing layer and covers the plurality of pixels, and
a touch panel that is positioned on a side of the second sealing layer opposite to the conductive layer.

14. The organic EL display device according to claim **13**, wherein
the first sealing layer includes an area that is in direct contact with the second sealing layer, and
all of the conductive layer is covered by the first sealing layer and the second sealing layer.

15. The organic EL display device according to claim **13**, wherein
the first sealing layer, the conductive layer, and the second sealing layer are provided across the display area and outside of the display area, the display area including the plurality of pixels, and
an edge of the first sealing layer overlaps an edge of the second sealing layer in a plan view on the outside.

16. The organic EL display device according to claim **15**, wherein
an edge of the conductive layer on the outside is positioned between the edge of the first sealing layer and the display area.

17. The organic EL display device according to claim **13**, wherein
the conductive layer includes a binder resin.

18. The organic EL display device according to claim **13**, wherein
the conductive layer includes a nanowire and/or a nanotube.

* * * * *

专利名称(译)	有机EL显示装置		
公开(公告)号	US20200044005A1	公开(公告)日	2020-02-06
申请号	US16/596883	申请日	2019-10-09
[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	KOKAME HIRAAKI KAMIYA AKINORI		
发明人	KOKAME, HIRAAKI KAMIYA, AKINORI		
IPC分类号	H01L27/32 H01L51/52 G06F3/041		
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优先权	2017078826 2017-04-12 JP		
外部链接	Espacenet USPTO		

摘要(译)

根据本发明实施例的有机EL显示装置包括：基板；布置在基板上的多个像素；覆盖多个像素的第一无机绝缘层；布置在侧面的导电层。 第一无机绝缘层与第二无机绝缘层相对并覆盖多个像素，第二无机绝缘层位于导电层的与第一无机绝缘层相反的一侧并覆盖多个像素。