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(54) OLED PANEL, METHOD FOR PRODUCING OLED PANEL, AND APPARATUS FOR PRODUCING OLED PANEL

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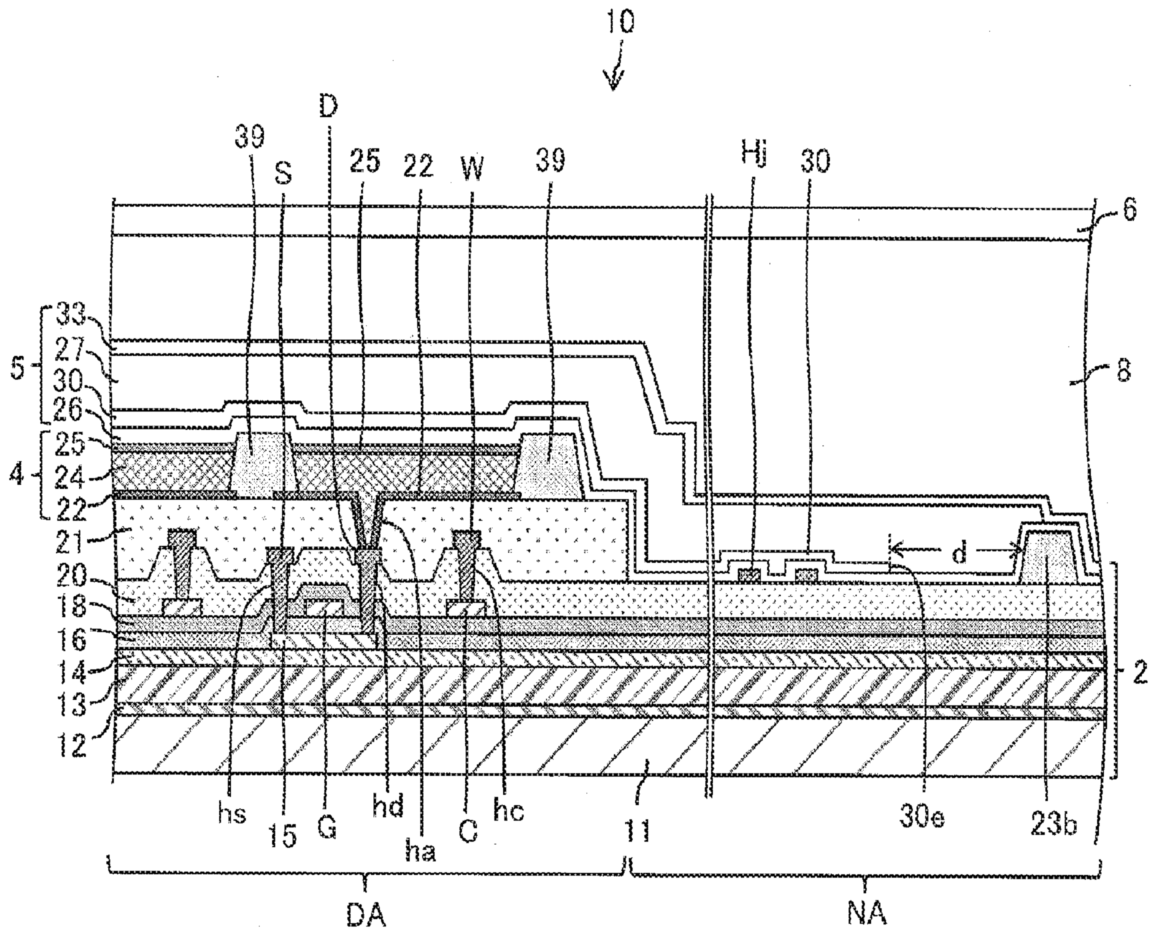
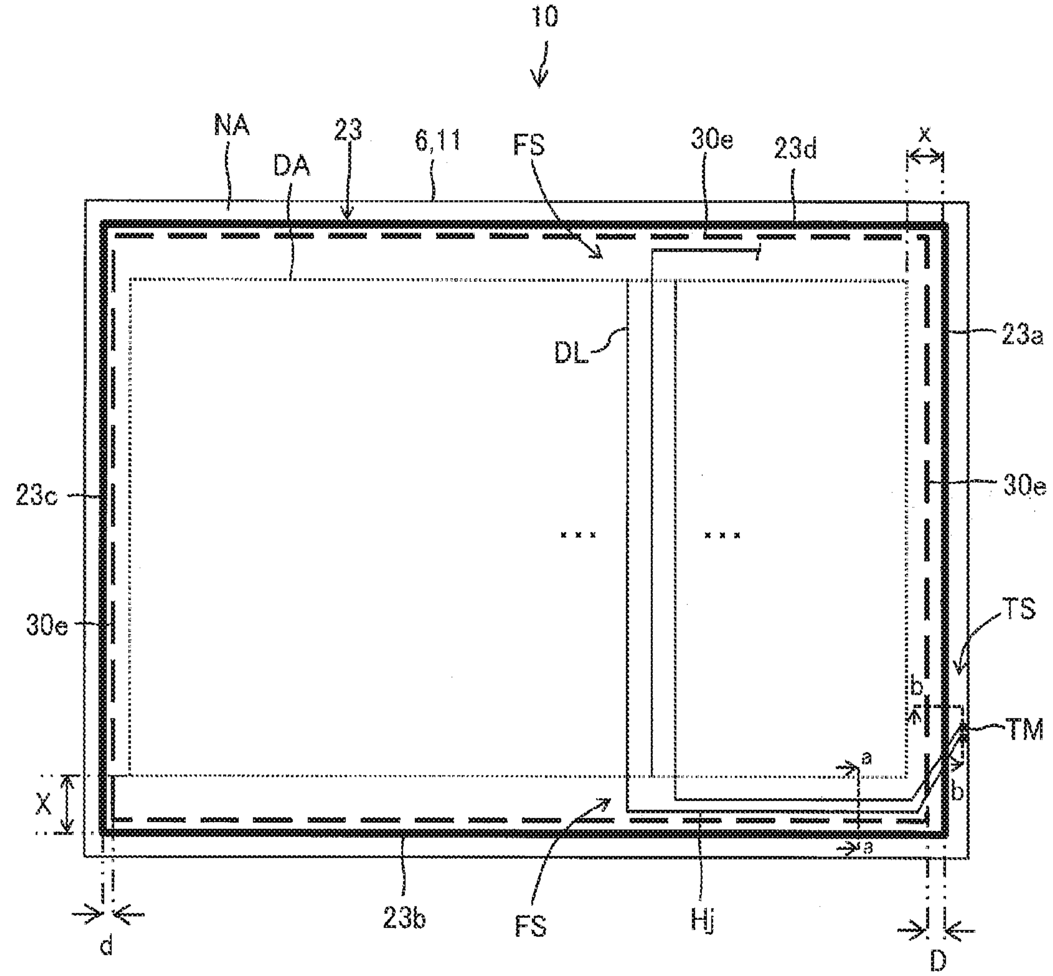
(57) **ABSTRACT**

A base substrate, a OLED element, and a seal portion covering the OLED element are included. The seal portion includes a first sealing film including an inorganic film, a second sealing film including an organic film, a third sealing film including an inorganic film, and a coupling layer formed between the first sealing film and the second sealing film.

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NA
23
6,11
DA
FS
30e
23d
x
23a
DL
30e
23c
30e
TS
b
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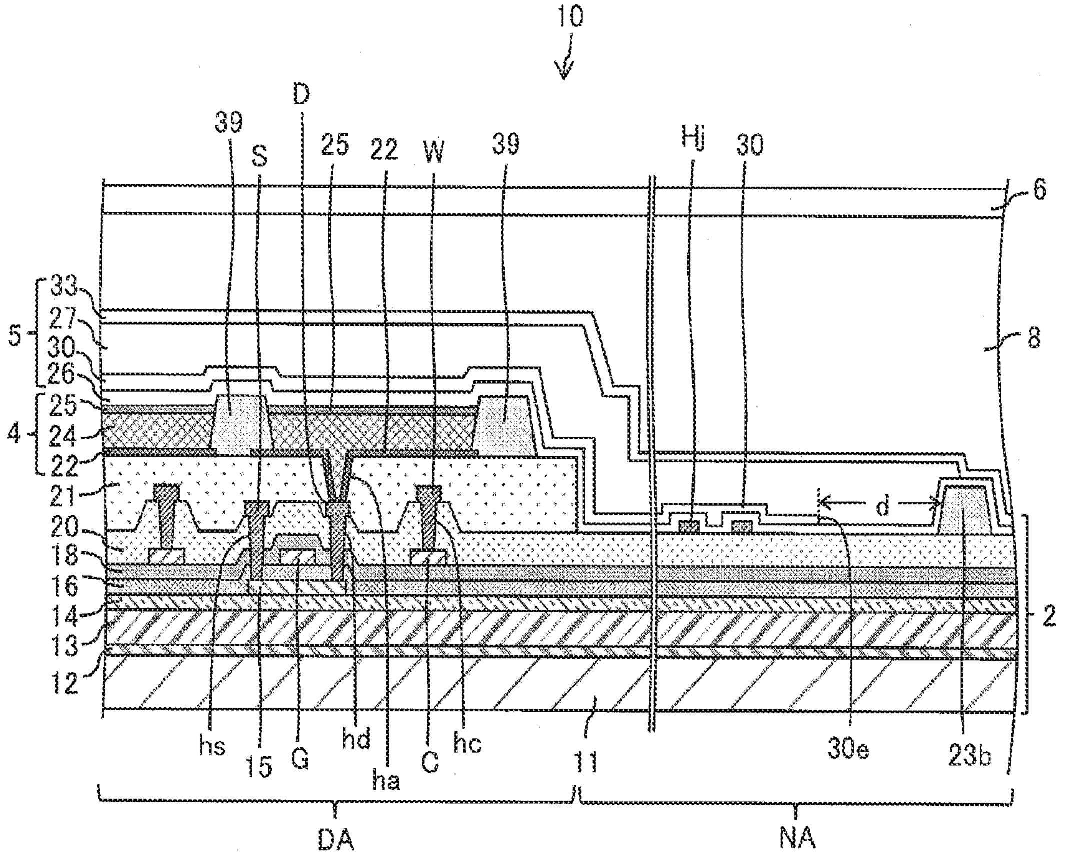
X
a
23b
FS
Hj
d
D

FIG. 1


10
D
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S
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Hj
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6
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21
20
18
16
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NA

FIG. 2

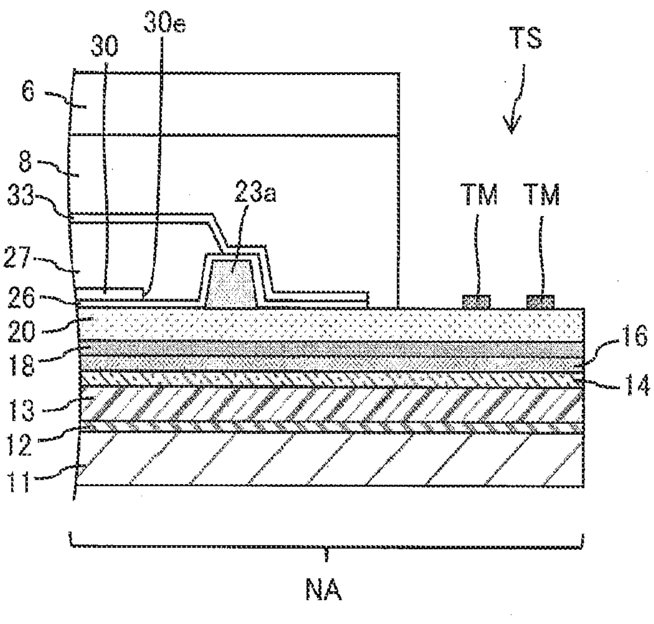


FIG. 3

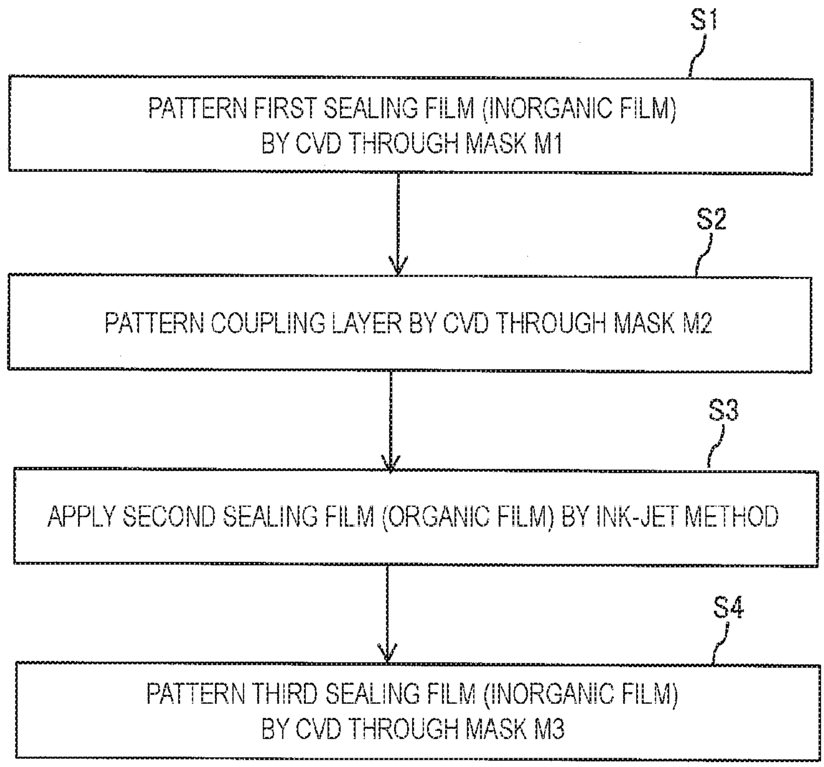

S1
PATTERN FIRST SEALING FILM (INORGANIC FILM) BY CVD THROUGH MASK M1
S2
PATTERN COUPLING LAYER BY CVD THROUGH MASK M2
S3
APPLY SECOND SEALING FILM (ORGANIC FILM) BY INK-JET METHOD
S4
PATTERN THIRD SEALING FILM (INORGANIC FILM) BY CVD THROUGH MASK M3

FIG. 4

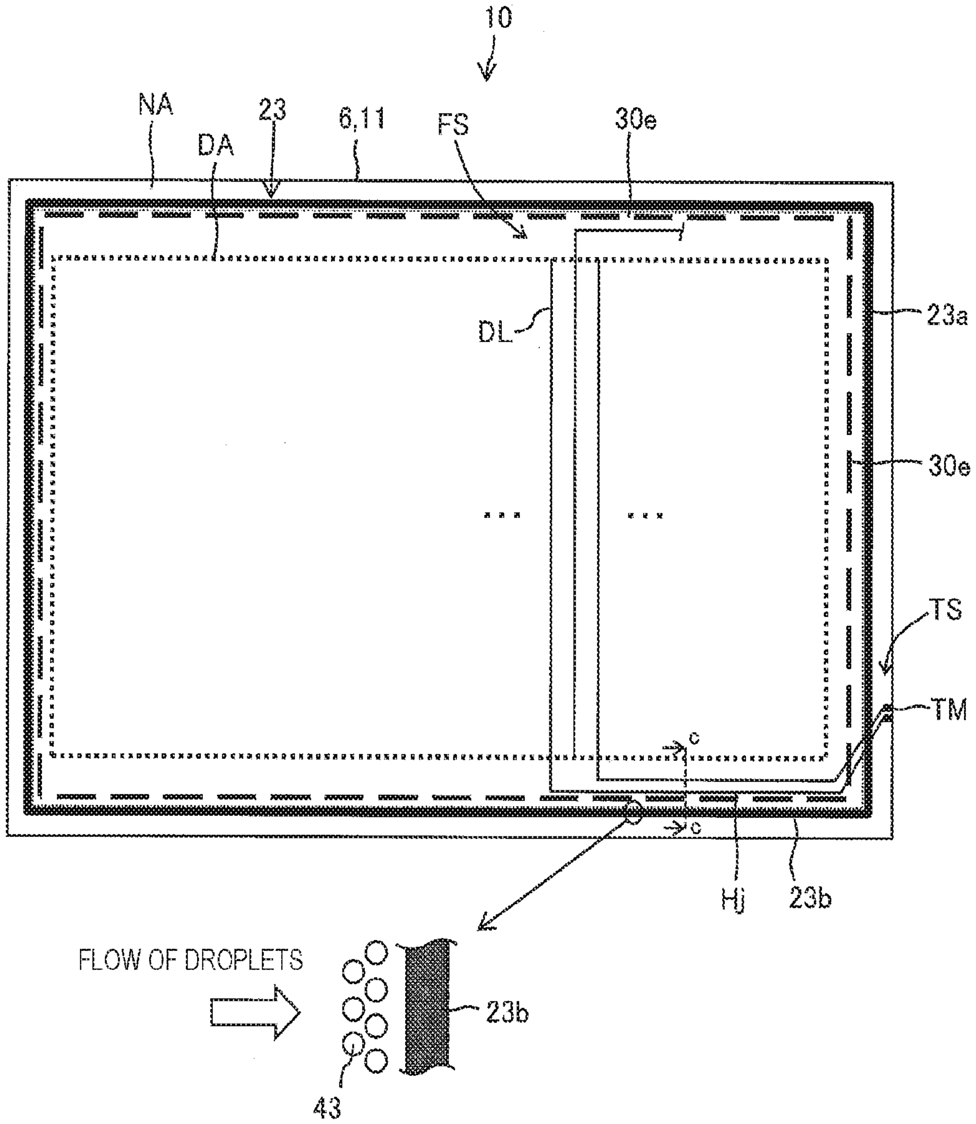
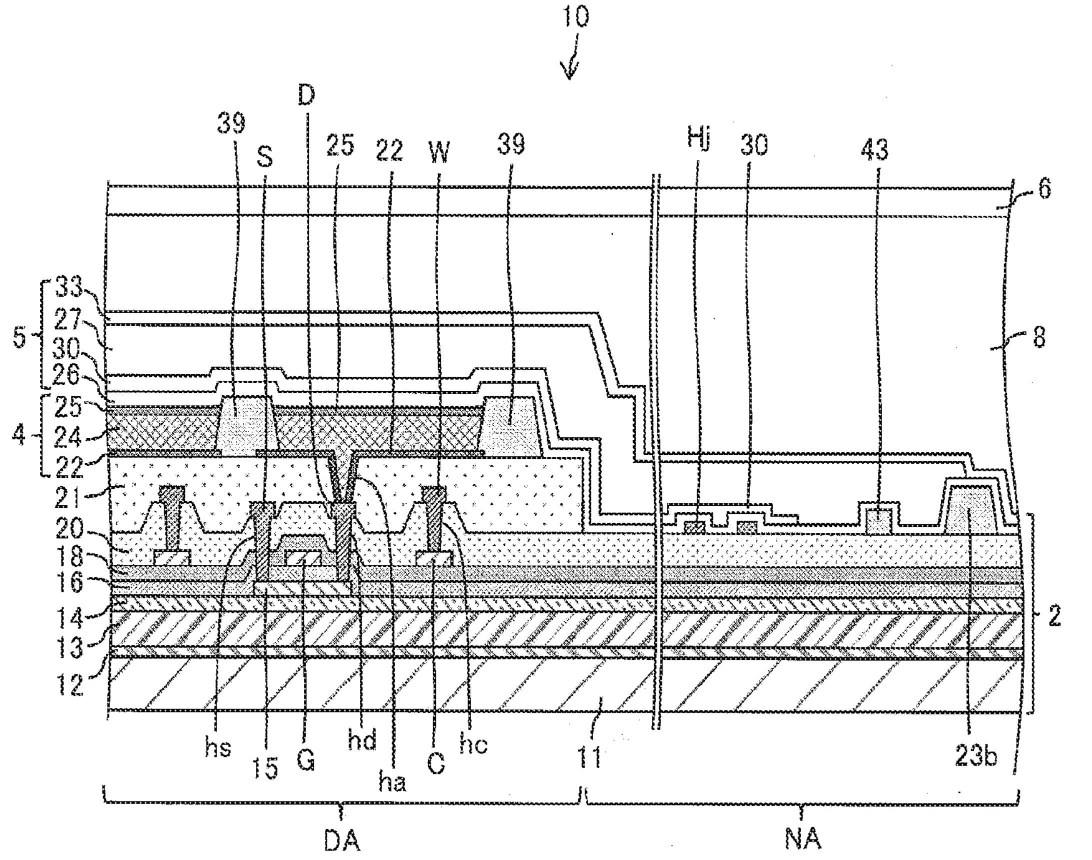

10
NA
23
6,11
FS
30e
DA
23a
DL
30e
TS
TM
c
c
Hj
23b
FLOW OF DROPLETS
23b
43

FIG. 5


10
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43
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27
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23b
DA
NA

FIG. 6

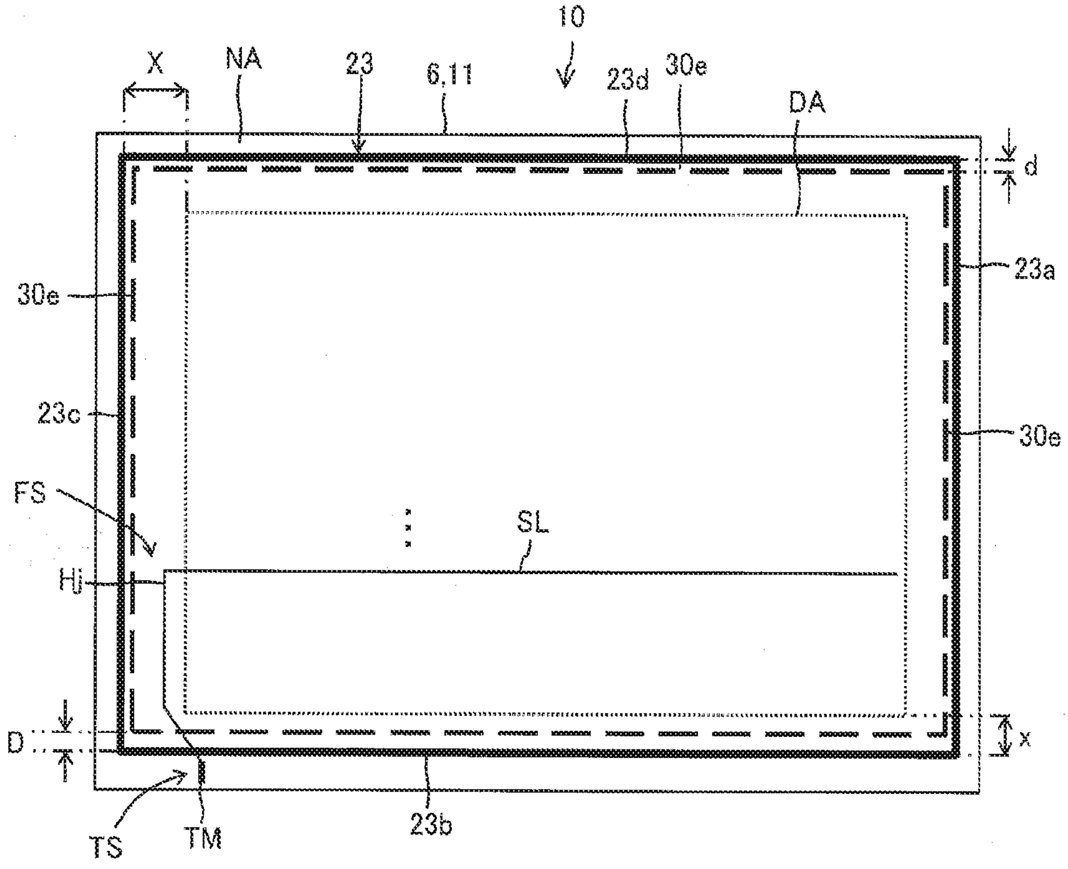


FIG. 7

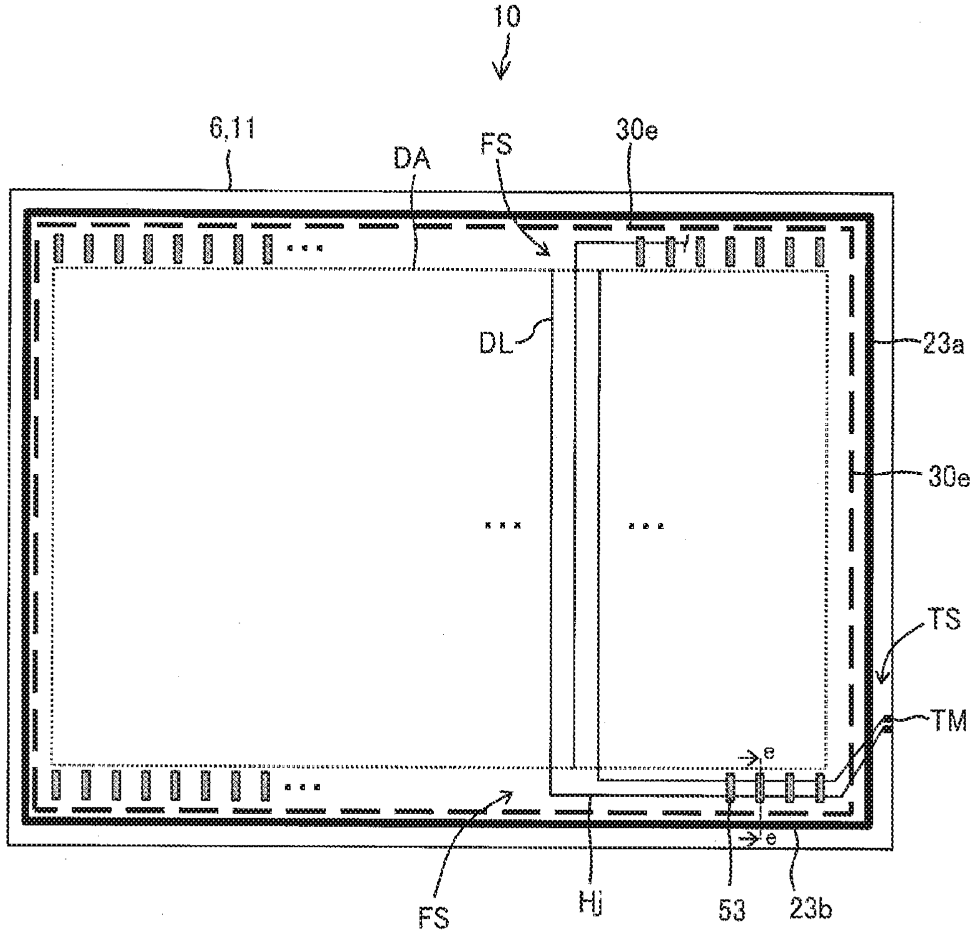
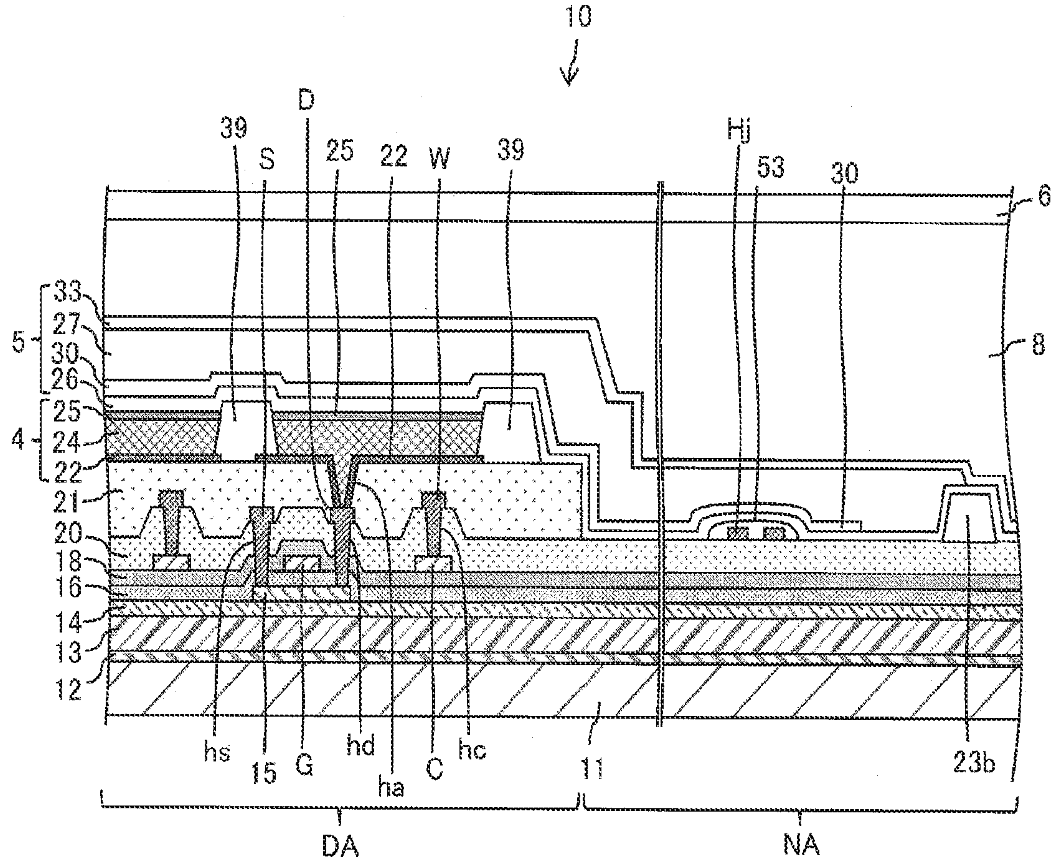


FIG. 8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G
hd
ha
C
hc
11
23b
DA
NA

FIG. 9

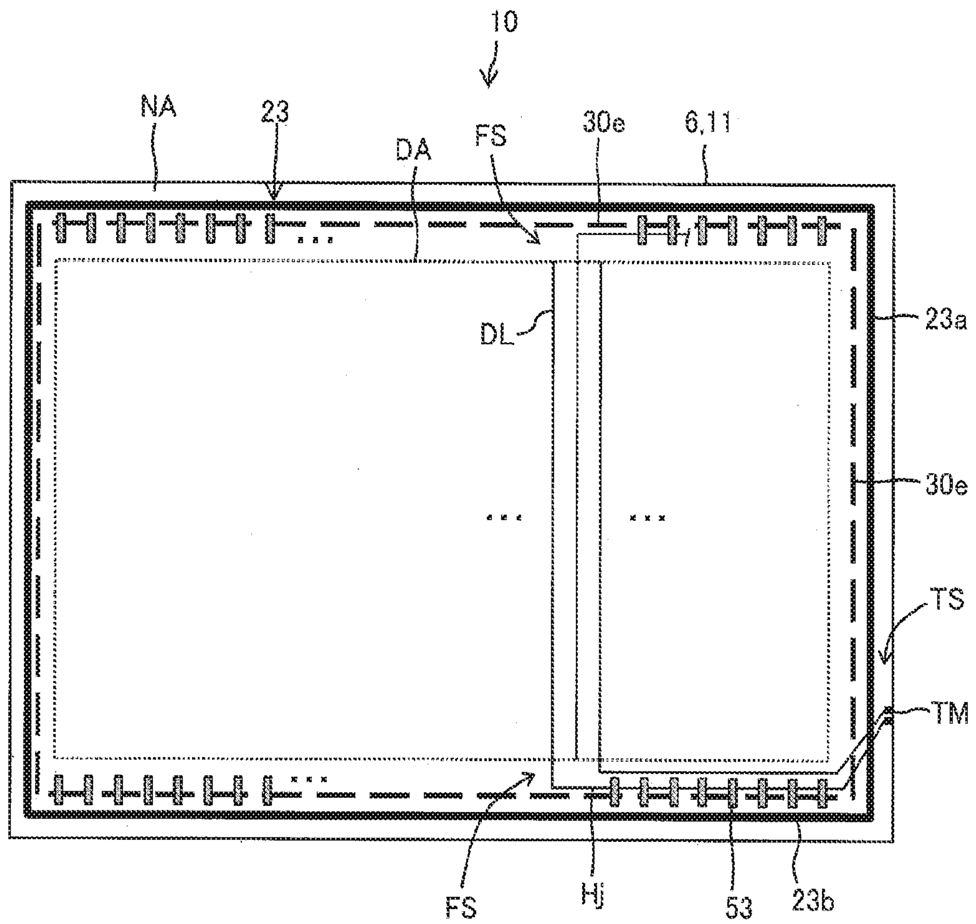

FIG. 10

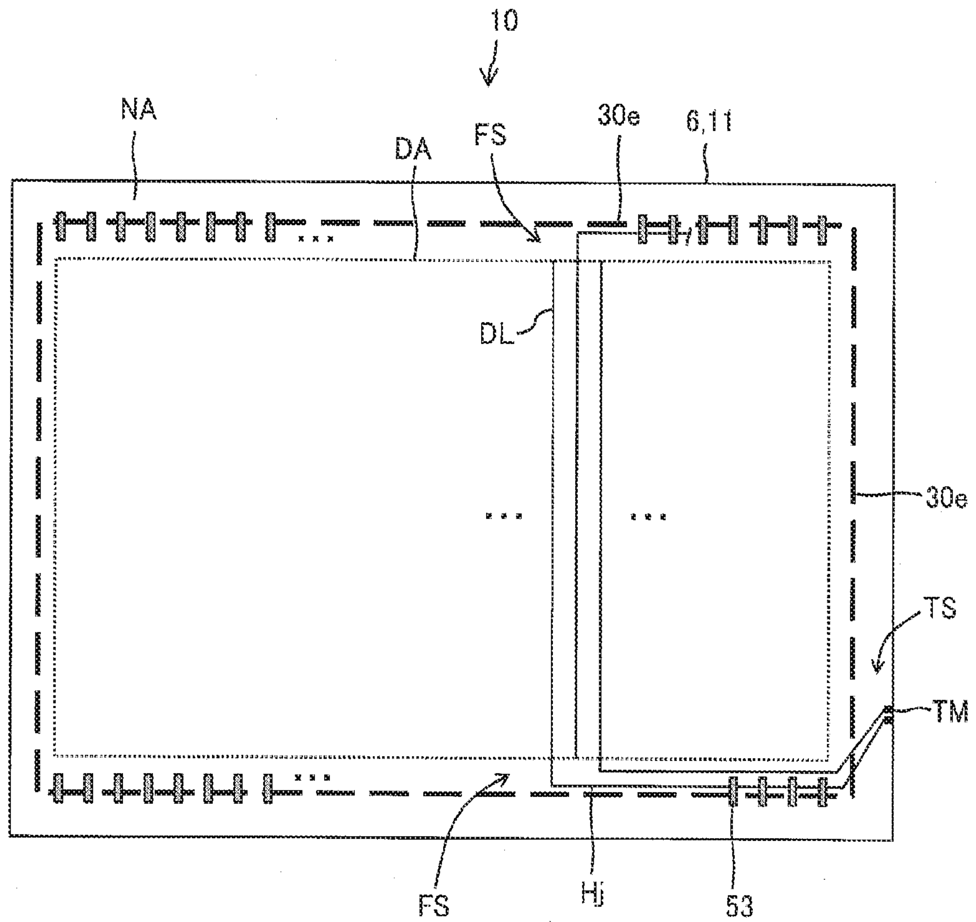

FIG. 11

OLED PANEL, METHOD FOR PRODUCING OLED PANEL, AND APPARATUS FOR PRODUCING OLED PANEL

TECHNICAL FIELD

[0001] The disclosure relates to an organic light emitting diode (OLED) panel.

BACKGROUND ART

[0002] PTL 1 discloses a structure in which OLED elements are surrounded by inorganic films and an organic film formed on the inorganic film so that penetration of moisture and oxygen into the OLED elements can be prevented.

CITATION LIST

Patent Literature

[0003] PTL 1: JP 2016-54144 A (published on Apr. 14, 2016)

SUMMARY

Technical Problem

[0004] One problem with the structure disclosed in PTL 1 is that forming the organic film to a desired shape (e.g., thickness and area) is difficult.

Solution to Problem

[0005] According to an embodiment of the disclosure, an OLED panel includes a base substrate, an OLED element, and a seal portion covering the OLED element. The seal portion includes a first sealing film including an inorganic film, a second sealing film including an organic film, a third sealing film including an inorganic film, and a coupling layer formed between the first sealing film and the second sealing film.

[0006] According to an embodiment of the disclosure, a method for producing an OLED panel is provided. The OLED panel includes a base substrate, an OLED element, and a seal portion. The seal portion includes a first sealing film including an inorganic film, and a second sealing film including an organic film. The method includes forming a coupling layer on the first sealing film and forming, by an ink-jet method, a second sealing film on the coupling layer.

Advantageous Effects of Disclosure

[0007] The coupling layer, included in the seal portion, makes it easier to form the second sealing film, which is an organic film, to a desired shape (e.g., thickness and area).

BRIEF DESCRIPTION OF DRAWINGS

[0008] FIG. **1** is a plan view illustrating a configuration of a display device according to the present embodiment.

[0009] FIG. **2** is a cross-sectional view of the display device of FIG. **1** taken along line a-a and viewed in the direction of the arrows.

[0010] FIG. **3** is a cross-sectional view of the display device of FIG. **1** taken along line b-b and viewed in the direction of the arrows.

[0011] FIG. **4** is a flowchart illustrating a process of forming a seal portion.

[0012] FIG. **5** is a plan view illustrating another configuration of the display device according to the present embodiment.

[0013] FIG. **6** is a cross-sectional view of the display device of FIG. **5** taken along line c-c and viewed in the direction of the arrows.

[0014] FIG. **7** is a plan view illustrating a modified example of the display device of FIG. **1**.

[0015] FIG. **8** is a plan view illustrating still another configuration of the display device according to the present embodiment.

[0016] FIG. **9** is a cross-sectional view of the display device of FIG. **8** taken along line e-e and viewed in the direction of the arrows.

[0017] FIG. **10** is a plan view illustrating a modified example of the display device illustrated in FIGS. **8** and **9**.

[0018] FIG. **11** is a plan view illustrating still another configuration of the display device according to the present embodiment.

DESCRIPTION OF EMBODIMENTS

[0019] Embodiments of the disclosure will be described below with reference to FIGS. **1** to **11**. These embodiments are merely illustrative.

[0020] FIG. **1** is a plan view illustrating a configuration of a display device according to the present embodiment. FIG. **2** is a cross-sectional view of the display device of FIG. **1** taken along line a-a and viewed in the direction of the arrows. FIG. **3** is a cross-sectional view of the display device of FIG. **1** taken along line b-b and viewed in the direction of the arrows.

[0021] As illustrated in FIGS. **1** and **2**, the display device **10** includes an OLED panel **2**, which includes a base substrate **11** and OLED elements **4**, and a functional film **6** bonded to the upper surface of the OLED panel **2** via an adhesive layer **8**. The OLED panel **2** includes a display area DA and a non-display area NA. Pixels including the organic light emitting diode (OLED) elements **4** are provided in the display are DA. The non-display area NA surrounds the display area DA. The following descriptions are provided assuming that the direction from the base substrate **11** toward the OLED elements **4** is the upward direction. Furthermore, areas at or relatively near the display area DA in plan view may be referred to as inside, and areas at or relatively near the edge of the panel in plan view may be referred to as outside.

[0022] The OLED panel **2** includes a base substrate **11**, an adhesive layer **12**, a resin layer **13**, a moisture-proof layer **14**, semiconductor films **15**, a gate insulator film **16**, gate electrodes G, a first interlayer insulating film **18**, capacitive electrodes C, a second interlayer insulating film **20**, source electrodes S, drain electrodes D, wires W, a flattering film **21**, anode electrodes **22**, a partition **39**, a bank **23** (**23***a* to **23***d*), organic EL (organic electroluminescent) layers **24**, cathode electrodes **25**, a first sealing film **26**, a coupling layer **30**, a second sealing film **27**, and a third sealing film **33**. The resin layer **13** is bonded to the base substrate **11** via the adhesive layer **12**. The moisture-proof layer **14** is formed on the resin layer **13**. The semiconductor films **15** are formed on the moisture-proof layer **14**. The gate insulator film **16** is formed on the semiconductor films **15**. The gate electrodes G are formed on the gate insulator film **16**. The first interlayer insulating film **18** covers the gate electrodes G. The capacitive electrodes C are formed on the first interlayer insulating film **18**. The second interlayer insulating film **20** covers the capacitive electrodes C. The source electrodes S, the drain electrodes D, and the wires W are formed on the second interlayer insulating film **20**. The flattering film **21** covers the source electrode S, the drain electrodes D, and the wires W. The anode electrodes **22** are formed on the flattering film **21**. The partition **39** defines pixels for the colors. The bank **23** (**23**_a_ to **23**_d_) is formed in the non-display area NA. The organic EL layers **24** are formed on the anode electrodes **22**. The cathode electrodes **25** are formed on the organic EL layers **24**. The first sealing film **26** covers the partition **39** and the cathode electrodes **25**. The coupling layer **30** is formed on the first sealing film **26**. The second sealing film **27** covers the coupling layer **30**. The third sealing film **33** covers the second sealing film **27**. The coupling layer **30** is light-transmissive, for example.

[0023] The base substrate **11** is formed of an insulating flexible material, for example. The resin layer **13** is formed of polyimide, for example. The moisture-proof layer **14** is formed of silicon oxide (SiOx), silicon nitride (SiNx), or composed of layered films of these materials, for example. The semiconductor film **15** is formed of amorphous silicon, polysilicon, or an oxide semiconductor, for example. The gate insulator film **16** is formed of silicon oxide (SiOx), silicon nitride (SiNx), or composed of layered films of these materials, for example. The gate electrode G, the source electrode S, the drain electrode D, the capacitive electrode C, and the wire W, are each composed of a single layer metal film or a layered metal film, for example. The metal is at least one metal selected from aluminum (Al), tungsten (W), molybdenum (Mo), tantalum (Ta), chromium (Cr), titanium (Ti), and copper (Cu), for example.

[0024] The first interlayer insulating film **18** and the second interlayer insulating film **20** may each be formed of, for example, silicon oxide (SiOx) or silicon nitride (SiNx). The flattering film **21** may be formed of a coatable photosensitive organic material, such as a polyimide material or an acrylic material. The anode electrode **22** is formed by, for example, layering an Indium Tin Oxide (ITO) layer and a Ag alloy layer. The anode electrode **22** is light-reflective.

[0025] The semiconductor film **15**, the gate insulator film **16**, the gate electrode G, the first interlayer insulating film **18**, the second interlayer insulating film **20**, the source electrode S, and the drain electrode D form a thin film transistor (TFT). The semiconductor film **15** and the source electrode S are connected to each other via a contact hole hs extending through the gate insulator film **16**, the first interlayer insulating film **18**, and the second interlayer insulating film **20**. The source electrode S is connected to a power source line (not illustrated), for example. The semiconductor film **15** and the drain electrode D are connected to each other via a contact hole hd extending through the gate insulator film **16**, the first interlayer insulating film **18**, and the second interlayer insulating film **20**. The drain electrode D and the anode electrode **22** are connected to each other via a contact hole ha extending through the flattering film **21**. The wire W and the capacitive electrode C are connected to each other via a contact hole he extending through the second interlayer insulating film **20**.

[0026] The bank **23** and the partition **39** can be formed in the same step, for example, from a coatable photosensitive organic material, such as a polyimide material or an acrylic material. The flattering film **21** and the partition **39** are formed in the display area DA (not formed in the non-display area NA).

[0027] The bank **23** defines the edge of the second sealing film **27**, and is formed on an upper side of the second interlayer insulating film **20**, in the non-display area NA. The bank **23** has a shape of a single-walled rectangular frame and surrounds the display area DA. The bank **23** includes a first side **23**_a_ extending along the column direction (vertical direction in the drawing), a second side **23**_b_ extending along the row direction (lateral direction in the drawing), a third side **23**_c_ extending along the column direction (vertical direction in the drawing), and a fourth side **23**_d_ extending along the row direction. The length relationship is as follows: first side **23**_a_=third side **23**_c_<second side **23**_b_=fourth side **23**_d_. Another possible configuration of the bank is a frame shape formed by a plurality of independent islands (projections) arranged to surround the display area DA.

[0028] The organic EL layer **24** is formed in each of the regions surrounded by the partition **39** (subpixel regions), by a vapor deposition method or an ink-jet method. For example, the organic EL layer **24** is formed by layering, for example, a hole injecting layer, a hole transport layer, a light emitting layer, an electron transport layer, and an electron injecting layer in this order, with the hole injecting layer being the bottom layer. The cathode electrode **25** may be formed of transparent metal, such as Indium Tin Oxide (ITO) or Indium Zincum Oxide (IZO).

[0029] The anode electrode **22**, the cathode electrode **25**, and the organic EL layer **24**, which is sandwiched therebetween, form the organic light emitting diode (OLED) element **4**. In the OLED element **4**, when a drive current flows between the anode electrode **22** and the cathode electrode **25**, holes and electrons recombine in the light emitting layer to form excitons, and when the excitons fall to their ground state, light is emitted.

[0030] The first sealing film **26** and the third sealing film **33** are light-transmitting inorganic insulating films. The second sealing film **27** is a light-transmitting organic insulating film and is thicker than the first sealing film **26** and the third sealing film **33**. The coupling layer **30** has an affinity for inorganic films and organic films. The first sealing film **26**, the coupling layer **30**, the second sealing film **27**, and the third sealing film **33** are layered in this order, with the first sealing film **26** being closest to the OLED elements **4**, to form a seal portion **5**. The seal portion **5** covers the OLED elements **4** to prevent penetration of foreign matter, such as moisture and oxygen, into the OLED elements **4**.

[0031] FIG. **4** is a flowchart illustrating a process of forming the seal portion. An apparatus for producing the OLED panel performs the following steps.

[0032] The first sealing film **26** may be formed of, for example, silicon oxide (SiOx), silicon nitride (SiNx), silicon oxynitride (SiON), or formed by layering films formed of these materials. The first sealing film **26** is patterned by performing chemical vapor deposition (CVD) film forming through a mask M1 (e.g., metal mask) (FIG. **4**: step S1). The mask M1 is a separate member from the substrate on which the OLED elements **4** are formed. This process eliminates the need for photolithography processing, and thus reduces the possibility of degradation of the OLED elements **4** due to, for example, moisture and oxygen. The first sealing film **26** is formed to extend outside the bank **23***b* (toward the edge of the substrate).

[0033] The coupling layer **30** may be formed of, for example, an organosilicon compound, such as hexamethyldisiloxane or silicon carbon nitride (SiCN). The coupling layer **30** is also patterned by performing CVD film forming through a mask M**2** (e.g., metal mask) (FIG. **4**: step S**2**). The mask M**2** is a separate member from the substrate on which the OLED elements **4** are formed. This process eliminates the need for photolithography processing, and thus reduces the possibility of degradation of the OLED elements **4** due to, for example, moisture and oxygen.

[0034] In step S**2**, the coupling layer **30** is formed to extend outside the display area DA (into the non-display area NA). An edge **30***e* of the coupling layer **30** is located inside the bank **23** so that a predetermined distance d can be provided between the edge of the coupling layer **30** and the bank **23**. In the steps S**1** and S**2**, the first sealing film **26** and the coupling layer **30** are successively formed by CVD. Since the patterns of the two films are different from each other as described above, the masks for use are to be changed (M**1**→M**2**).

[0035] In the display area, a plurality of data lines DL extend in the column direction (vertical direction in the drawing). A wiring section FS are provided to route the data lines DL. The wiring section FS is located outside the display area and inside the second side **23***b* of the bank **23**. The coupling layer **30** overlaps the wiring section FS. The wiring section FS includes wiring section wires Hj, which are connected to the data lines DL. The coupling layer **30** covers the wiring section wires Hj via the first sealing film **26**. It is also possible to provide the wiring section FS outside the second side **23***b* of the bank **23**.

[0036] The second sealing film **27** is formed by, for example, applying ink including an organic photosensitive material, such as an acrylic material or an epoxy material, by an ink-jet method and curing the ink with UV light (FIG. **4**: step S**3**). The flow of the ink can be stopped by the bank **23**, so that the second sealing film **27** will not extend outside the bank **23**. The use of an ink-jet method to apply the second sealing film **27** eliminates the need for photolithography processing to pattern the organic film. This reduces the possibility of degradation of the OLED elements **4** due to, for example, moisture and oxygen.

[0037] The third sealing film **33** may be formed of, for example, silicon oxide (SiOx), silicon nitride (SiNx), silicon oxynitride (SiON), or formed by layering films formed of these materials. The third sealing film **33** is patterned by performing CVD film forming through a mask M**3** (e.g., metal mask) (FIG. **4**: step S**4**). The mask M**3** is a separate member from the substrate including the OLED elements **4**. The mask M**3** may have the same pattern as the mask M**1**.

[0038] As illustrated in FIG. **3**, a terminal section TS, which includes a plurality of terminals TM for connection to external circuits, is provided outside the first side **23***a* of the bank **23**. At least the terminals TM of the terminal section TS are free of the seal portion **5** (first sealing film **26**, coupling layer **30**, second sealing film **27**, and third sealing film **33**).

[0039] In the present embodiment, a distance D, which is between the first side **23***a* (side adjacent to the terminal section TS) of the bank **23** and the edge **30***e* of the coupling layer **30**, is greater than a distance d, which is between the third side **23***c* (side free of the terminal section TS) of the bank **23** and the edge **30***e* of the coupling layer **30**.

[0040] Furthermore, a distance X, which is between the second side **23***b* (side adjacent to the wiring section FS) of the bank **23** and the display area DA is greater than a distance x, which is between the first side **23***a* (side adjacent to the terminal section TS) of the bank **23** and the display area DA.

[0041] An apparatus for producing an OLED panel performs, for example, the following steps to produce the OLED panel **2**, which is flexible (see FIGS. **1** to **4**).

[0042] First, a backplane is formed. The backplane includes, on a glass substrate, the resin layer **13**, the moisture-proof layer **14**, the semiconductor films **15**, the gate insulator film **16**, a first metal layer including the gate electrodes G, the first interlayer insulating film **18**, a second metal layer including the capacitive electrodes C, the second interlayer insulating film **20**, a third metal layer including the source electrodes S, the drain electrodes D, and the wires W, the flattering film **21**, and the anode electrodes **22**. Next, the organic EL layers **24** and the cathode electrodes **25** are formed on the backplane. Next, the seal portion **5**, which includes the coupling layer **30**, is formed to cover the OLED elements **4** (see FIG. **4** for details). Next, a protective film is applied to the seal portion **5**, and the glass substrate is removed by, for example, laser irradiation. The flexible base substrate **11** is applied to the resin layer **13** via the adhesive layer **12**. Thus, the flexible OLED panel **2** is obtained. The protective film on the seal portion **5** can be removed, and the functional panel **6** can be attached to the seal portion **5** of the OLED panel **2** via the adhesive layer **8**. In this manner, the display device **10** can be obtained.

[0043] In the present embodiment, the coupling layer **30**, which has an affinity for organic films and inorganic films, is formed on the first sealing film **26**, which is an inorganic film, and the second sealing film **27**, which is an organic film, is formed by applying ink including an organic photosensitive material to the coupling layer **30** by an ink-jet method and curing the ink with UV light.

[0044] As a result of applying ink droplets to the coupling layer **30** as described above, the wettability of the droplets increases. Consequently, the second sealing film **27** can be easily formed to a desired shape (e.g., thickness and area). Also, the bond between the first sealing film **26** and the second sealing film **27** increases via the coupling layer **30**. Accordingly, the sealing performance can be enhanced.

[0045] The coupling layer **30** is formed to extend outside the display area DA (into the non-display area), but the edge **30***e* of the coupling layer **30** is located inside the bank **23** so that a predetermined distance d is provided between the edge of the coupling layer **30** and the bank **23**. As a result, while the wettability of the droplets increases on the coupling layer **30**, the wettability of the droplets does not increase on the area between the edge of the coupling layer **30** and the bank **23**. Thus, the possibility that the droplets will spread beyond the bank **23** is reduced. Consequently, the distance between the edge of the panel and the bank **23** can be reduced, the distance between the terminal section TS and the bank **23** (first side **23***a* thereof) can be reduced, and the bank **23** can be of a single-walled construction (not double- or more than double-walled construction). As a result, frame narrowing is achieved.

[0046] The distance D between the first side **23***a* (side adjacent to the terminal section TS) of the bank **23** and the edge **30***e* of the coupling layer **30** is greater than the distance d between the third side **23***c* (side free of the terminal section TS) of the bank **23** and the edge **30***e* of the coupling layer **30**. This configuration reduces the possibility that the droplets will spread beyond the bank **23** and enter into the terminal section TS (possibility that the second sealing film **27** will be formed on the terminal section TS).

[0047] In the present embodiment, the first sealing film **26** is patterned by performing CVD film forming through a mask (e.g., metal mask). Furthermore, the coupling layer **30** is also patterned by performing CVD film forming through a mask (e.g., metal mask). The use of CVD film forming results in increased coverage, and as a result, can reduce convex and recess due to, for example, wires in a lower layer.

[0048] For example, since the coupling layer **30** overlaps the wiring section FS (the coupling layer **30** covers the wiring section wires Hj via the first sealing film **26**), convex and recess attributable to the wiring section wires Hj can be reduced. As a result of this, in combination with the liquid-philic behavior of the coupling layer **30**, the droplets will spread sufficiently over the area on the wiring section FS, too.

[0049] The flattering film **21** is not present on the wiring section FS. Thus, in a case where the coupling layer **30** is not present, the droplets may travel within narrow grooves formed by the wiring section wires Hj in the surface of the first sealing film **26** and may spread beyond the bank. However, the presence of the coupling layer **30** reduces the possibility.

[0050] FIG. **5** is a plan view illustrating another configuration of the display device according to the present embodiment. FIG. **6** is a cross-sectional view of the display device of FIG. **5** taken along line c-c and viewed in the direction of the arrows.

[0051] As illustrated in FIGS. **5** and **6**, a plurality of buffers **43** may be provided in a staggered arrangement in front of the bank **23** (particularly, first side **23***a*, which is adjacent to the terminal section TS). Here, the term “in front of” means the side closer to the display area. This configuration inhibits the flow of the droplets and thus reduces the possibility that the droplets will spread beyond the bank **23** (particularly, enter into the terminal section TS).

[0052] In FIGS. **1** and **5**, the terminal section TS is provided outside the first side **23***a* (short side) of the bank **23**, and the wiring section FS is provided inside the second side **23***b* (long side) of the bank **23**. However, this is merely illustrative. As illustrated in FIG. **7**, the terminal section TS may be provided outside the second side **23***b* (long side) of the bank **23**, and a wiring section FS for routing scanning lines SL may be provided inside the third side **23***c* (short side) of the bank **23**.

[0053] In the configuration of FIG. **7**, too, the distance D between the second side **23***b* (side adjacent to the terminal section TS) of the bank **23** and the edge **30***e* of the coupling layer **30** is greater than the distance d between the fourth side **23***d* (side free of the terminal section TS) of the bank **23** and the edge **30***e* of the coupling layer **30**.

[0054] Furthermore, a distance X between the third side **23***c* (side adjacent to the wiring section FS) of the bank **23** and the display area DA is greater than a distance x between the second side **23***b* (side adjacent to the terminal section TS) of the bank **23** and the display area DA.

[0055] FIG. **8** is a plan view illustrating still another configuration of the display device according to the present embodiment. FIG. **9** is a cross-sectional view of the display device of FIG. **8** taken along line e-e and viewed in the direction of the arrows.

[0056] As illustrated in FIGS. **8** and **9**, a plurality of ribs **53**, each extending in the column direction, may be provided on the wiring section FS, along the second side **23***b* of the bank **23**. The coupling layer **30** may be formed to overlap all the ribs **53**. That is, the coupling layer **30** covers the ribs **53** via the first sealing film **26**. As a result of this configuration, the coupling layer **30** has, in the wiring section FS, an irregular surface portion due to the ribs **53**. Thus, the surface tension of the irregular surface portion, in combination with the liquid-philic behavior of the coupling layer **30**, facilitates spreading of the droplets.

[0057] As illustrated in FIG. **10**, the edge **30***e* of the coupling layer **30** may overlap the ribs **53**. That is, the coupling layer **30** may be formed to overlap a portion (inner portion) of each of the ribs **53** and not to overlap the remaining portion (outer portion). This configuration facilitates spreading of the droplets in the portion, of the irregular surface portion, that overlaps the coupling layer **30** (inner side) and impedes spreading of the droplets in the portion, of the irregular surface portion, that does not overlap the coupling layer **30** (outer side). As a result, the formation position for the second sealing film **27** (position of the edge **30***e*) can be controlled with high accuracy. Consequently, frame narrowing is achieved.

[0058] Furthermore, as illustrated in FIG. **11**, the bank may be eliminated (may not be formed). This configuration is possible because the edge **30***e* of the coupling layer **30** is disposed so as to overlap the ribs **53** and thus the formation position for the second sealing film **27** (position of the edge **30***e*) is controlled with high accuracy.

Supplement

[0059] In a first aspect, an OLED panel includes a base substrate, an OLED element and a seal portion covering the OLED element. The seal portion includes a first sealing film including an inorganic film, a second sealing film including an organic film, a third sealing film including an inorganic film, and a coupling layer formed between the first sealing film and the second sealing film. The OLED panel is not limited to use in display devices, and is applicable to electronic devices (e.g., detection devices) that use OLEDs as photodiodes or temperature sensors, for example.

[0060] In a second aspect, the second sealing film includes an organic material coatable by an ink-jet method.

[0061] In a third aspect, a bank is provided outside a display area including the OLED element. The bank defines an edge of the second sealing film. The coupling layer includes an edge, and the edge is located outside the display area and inside the bank. A predetermined distance is provided between the edge of the coupling layer and the bank.

[0062] In a fourth aspect, the bank has a frame shape, and a terminal section is provided outside a first side of the bank.

[0063] In a fifth aspect, a wiring section is provided to route wires. The wiring section is located outside the display area and inside a second side of the bank. The coupling layer overlaps the wiring section.

[0064] In a sixth aspect, a distance between the second side of the bank and the display area is greater than a distance between the first side of the bank and the display area.

[0065] In a seventh aspect, a plurality of ribs are disposed side by side on the wiring section, and the coupling layer overlaps the plurality of ribs.

[0066] In an eighth aspect, the coupling layer overlaps a portion of each of the plurality of ribs and does not overlap a remaining portion of each of the plurality of ribs.

[0067] In a ninth aspect, a distance between the first side of the bank and the edge of the coupling layer is greater than a distance between a third side of the bank and the edge of the coupling layer, the third side being free of the terminal section.

[0068] In a tenth aspect, the bank has a single-walled frame shape.

[0069] In an eleventh aspect, the coupling layer includes a material formable into the coupling layer by CVD.

[0070] In a twelfth aspect, the material includes an organosilicon compound.

[0071] In a thirteenth aspect, the organosilicon compound includes hexamethyldisiloxane or silicon carbon nitride.

[0072] In a fourteenth aspect, the base substrate is flexible.

[0073] In a fifteenth aspect, a plurality of ribs are disposed side by side in a non-display area, the non-display area being free of the OLED elements, and the coupling layer overlaps the plurality of ribs.

[0074] In a sixteenth aspect, the coupling layer has an affinity for an inorganic film and an organic film.

[0075] In a seventeenth aspect, a method for producing an OLED panel is provided. The OLED panel includes a base substrate, an OLED element, and a seal portion. The seal portion includes a first sealing film including an inorganic film and a second sealing film including an organic film. The method includes forming a coupling layer on the first sealing film, and forming, by an ink-jet method, the second sealing film on the coupling layer.

[0076] In an eighteenth aspect, the coupling layer is formed including an edge, and the edge is located outside a display area and inside a bank. The display area includes the OLED element. The bank defines an edge of the second sealing film. A predetermined distance is provided between the edge of the coupling layer and the bank.

[0077] In a nineteenth aspect, the coupling layer is patterned by CVD through a mask.

[0078] In a twentieth aspect, the first sealing film is patterned by CVD through a mask.

[0079] In a twenty-first aspect, the coupling layer includes an organosilicon compound.

[0080] In a twenty-second aspect, the organosilicon compound is hexamethyldisiloxane or silicon carbon nitride.

[0081] In a twenty-third aspect, an apparatus for producing an OLED panel is provided. The OLED panel includes a base substrate, an OLED element, and a seal portion. The seal portion includes a first sealing film including an inorganic film and a second sealing film including an organic film. The apparatus is configured to form a coupling layer on the first sealing film and form, by an ink-jet method, the second sealing film on the coupling layer.

Remarks

[0082] The disclosure is not limited to the embodiments described above, and includes embodiments that can be implemented by combining techniques disclosed in different embodiments and includes embodiments that can be implemented by combining techniques disclosed in different drawings (any combination of the techniques disclosed in the drawings, FIGS. **1** to **11**).

REFERENCE SIGNS LIST

[0083] **2** OLED panel
[0084] **4** OLED element
[0085] **5** Seal portion
[0086] **23** Bank
[0087] **26** First sealing film
[0088] **27** Second sealing film
[0089] **30** Coupling layer
[0090] **33** Third sealing film
[0091] **39** Partition
[0092] **43** Buffer
[0093] **53** Rib
[0094] FS Wiring section
[0095] TS Terminal section
[0096] DA Display area
[0097] NA Non-display area
[0098] Hj Wiring section wire

1. An OLED panel comprising:
a base substrate;
an OLED element; and
a seal portion covering the OLED element, the seal portion including:
a first sealing film including an inorganic film;
a second sealing film including an organic film;
a third sealing film including an inorganic film; and
a coupling layer formed between the first sealing film and the second sealing film,
wherein a bank is provided outside a display area including the OLED element, the bank defining an edge of the second sealing film,
the coupling layer includes an edge, and the edge is formed outside the display area and inside the bank, and
a predetermined distance is provided between the edge of the coupling layer and the bank.

2. The OLED panel according to claim **1**,
wherein the second sealing film includes an organic material coatable by an ink-jet method.

3. (canceled)

4. The OLED panel according to claim **1**,
wherein the bank has a frame shape, and a terminal section is provided outside a first side of the bank.

5. The OLED panel according to claim **4**,
wherein a wiring section is provided to route wires,
the wiring section is located outside the display area and inside a second side of the bank, and
the coupling layer overlaps the wiring section.

6. The OLED panel according to claim **5**,
wherein a distance between the second side of the bank and the display area is greater than a distance between the first side of the bank and the display area.

7. The OLED panel according to claim **5**,
wherein a plurality of ribs are disposed side by side on the wiring section, and the coupling layer overlaps the plurality of ribs.

8. The OLED panel according to claim **7**,

wherein the coupling layer overlaps a portion of each of the plurality of ribs and does not overlap a remaining portion of each of the plurality of ribs.

9. The OLED panel according to claim **5**,

wherein a distance between the first side of the bank and the edge of the coupling layer is greater than a distance between a third side of the bank and the edge of the coupling layer, the third side being free of the terminal section.

10. The OLED panel according to claim **1**,

wherein the bank has a single-walled frame shape.

11. The OLED panel according to claim **1**,

wherein the coupling layer includes a material formable into the coupling layer by CVD.

12. The OLED panel according to claim **11**,

wherein the material includes an organosilicon compound.

13. The OLED panel according to claim **12**,

wherein the organosilicon compound includes hexamethyldisiloxane or silicon carbon nitride.

14. The OLED panel according to claim **1**,

wherein the base substrate is flexible.

15. The OLED panel according to claim **1**,

wherein a plurality of ribs are disposed side by side in a non-display area, the non-display area being free of the OLED element, and

the coupling layer overlaps the plurality of ribs.

16. The OLED panel according to claim **15**,

wherein wiring section wires are provided to route wires of the display area, the display area including the OLED element, and

the wiring section wires overlap the plurality of ribs.

17. The OLED panel according to claim **1**,

wherein the coupling layer has an affinity for an inorganic film and an organic film.

18. A method for producing an OLED panel, the OLED panel including a base substrate, an OLED element, and a seal portion, the seal portion including a first sealing film including an inorganic film and a second sealing film including an organic film, the method comprising: forming a coupling layer on the first sealing film; and

forming the second sealing film on the coupling layer by an ink-jet method,

wherein the coupling layer is formed including an edge, and the edge is located outside a display area and inside a bank, the display area including the OLED elements, the bank defining an edge of the second sealing film, and

a predetermined distance is provided between the edge of the coupling layer and the bank.

19. (canceled)

20. The method for producing an OLED panel according to claim **18**,

wherein the coupling layer is patterned by CVD through a mask.

21. The method for producing an OLED panel according to any one of claims **18**,

wherein the first sealing film is patterned by CVD through a mask.

22. The method for producing an OLED panel according to claim **20**,

wherein the coupling layer includes an organosilicon compound.

23-24. (canceled)

* * * * *

专利名称(译)	OLED面板，OLED面板的制造方法以及OLED面板的制造装置		
公开(公告)号	US20190363145A1	公开(公告)日	2019-11-28
申请号	US16/064072	申请日	2017-01-26
[标]申请(专利权)人(译)	夏普株式会社		
申请(专利权)人(译)	夏普株式会社		
当前申请(专利权)人(译)	夏普株式会社		
[标]发明人	OHTA YOSHIFUMI SONODA TOHRU		
发明人	OHTA, YOSHIFUMI SONODA, TOHRU		
IPC分类号	H01L27/32 H01L51/52 H01L51/00 H01L51/56		
CPC分类号	H01L27/3246 H01L51/5246 H01L51/5253 H01L51/5256 H05B33/04 H05B33/06 H05B33/10 H01L27/3276 H01L51/0097 H01L51/56		
外部链接	Espacenet USPTO		

摘要(译)

包括基础基板，OLED元件和覆盖OLED元件的密封部分。密封部包括：第一密封膜，其包括无机膜；第二密封膜，其包括有机膜；第三密封膜，其包括无机膜；以及形成在第一密封膜和第二密封膜之间的结合层。