



US 2004/0150319 A1

(19) **United States**(12) **Patent Application Publication** (10) **Pub. No.: US 2004/0150319 A1**  
(43) **Pub. Date:** **Aug. 5, 2004**  
**Tomimatsu et al.**(54) **DISPLAY APPARATUS AND METHOD OF  
MANUFACTURING THE SAME**(30) **Foreign Application Priority Data**

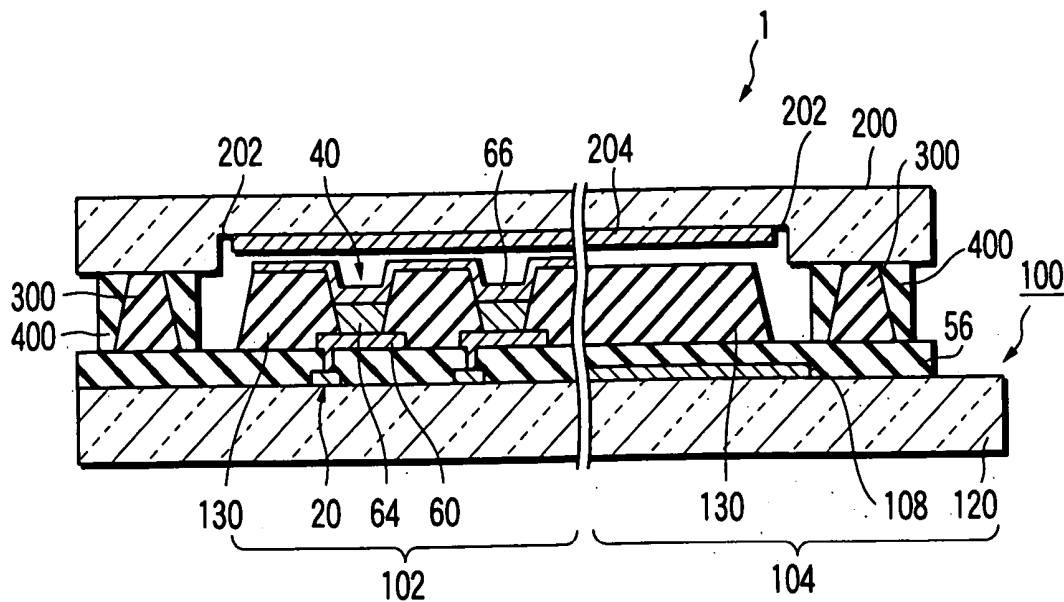
Feb. 4, 2003 (JP) ..... 2002-027123

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(JP)**Publication Classification**(51) **Int. Cl.<sup>7</sup>** ..... **H01J 1/62**(52) **U.S. Cl.** ..... **313/495**

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NEUSTADT, P.C.****1940 DUKE STREET****ALEXANDRIA, VA 22314 (US)**(57) **ABSTRACT**

A display apparatus includes an array substrate including a display area composed of a plurality of pixels arranged in a matrix, and a sealing substrate disposed to be opposed to the array substrate. The display area includes a pixel switch that selects a pixel, a drive control device connected to the pixel switch, and an organic EL device driven by the drive control device. A support section is disposed in a frame shape on an outer peripheral portion of the display area such that a predetermined gap is provided between the array substrate and the sealing substrate.

(21) Appl. No.: **10/683,360**(22) Filed: **Oct. 14, 2003****Related U.S. Application Data**(63) Continuation of application No. PCT/JP03/01017,  
filed on Jan. 31, 2003.

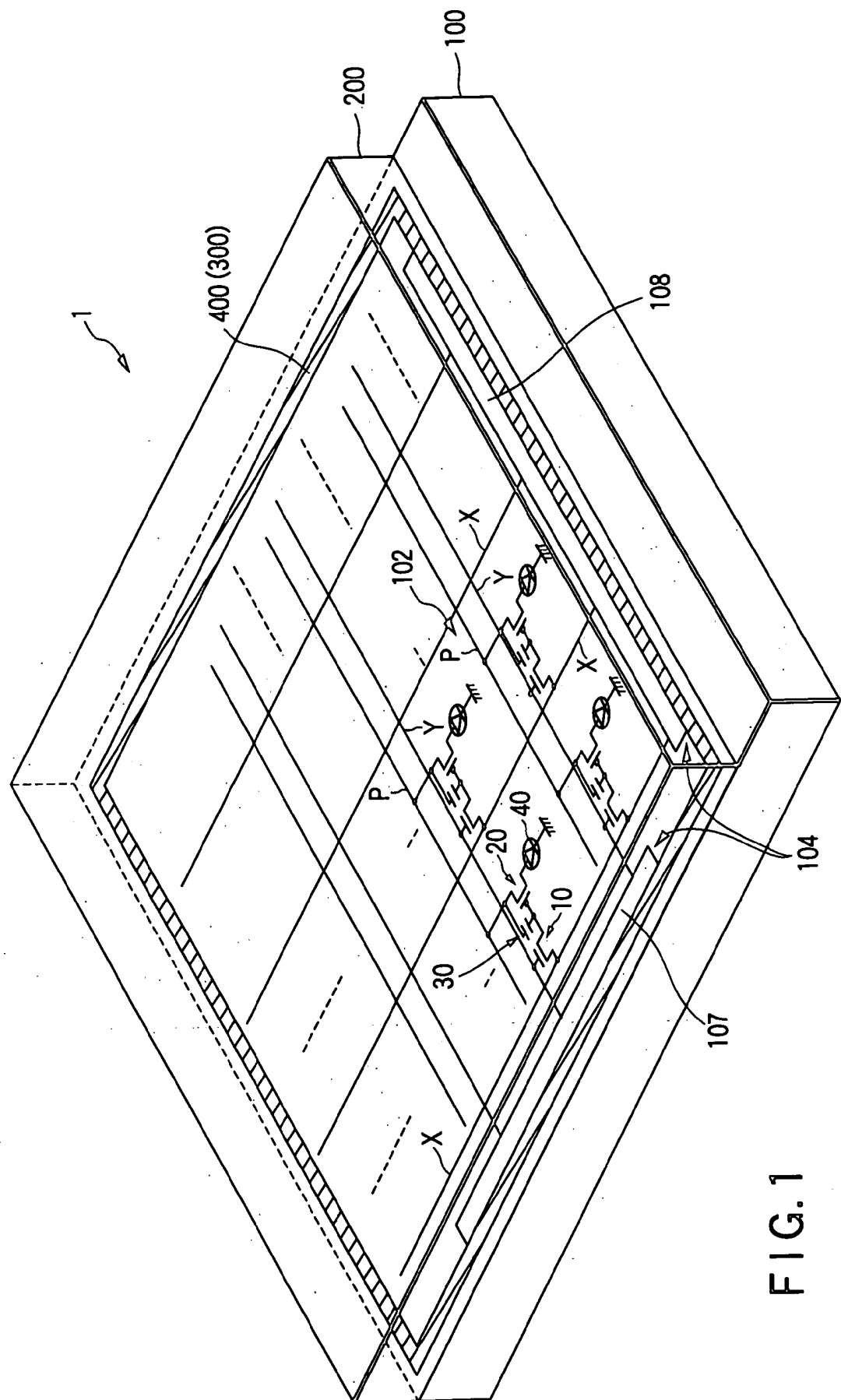


FIG. 1

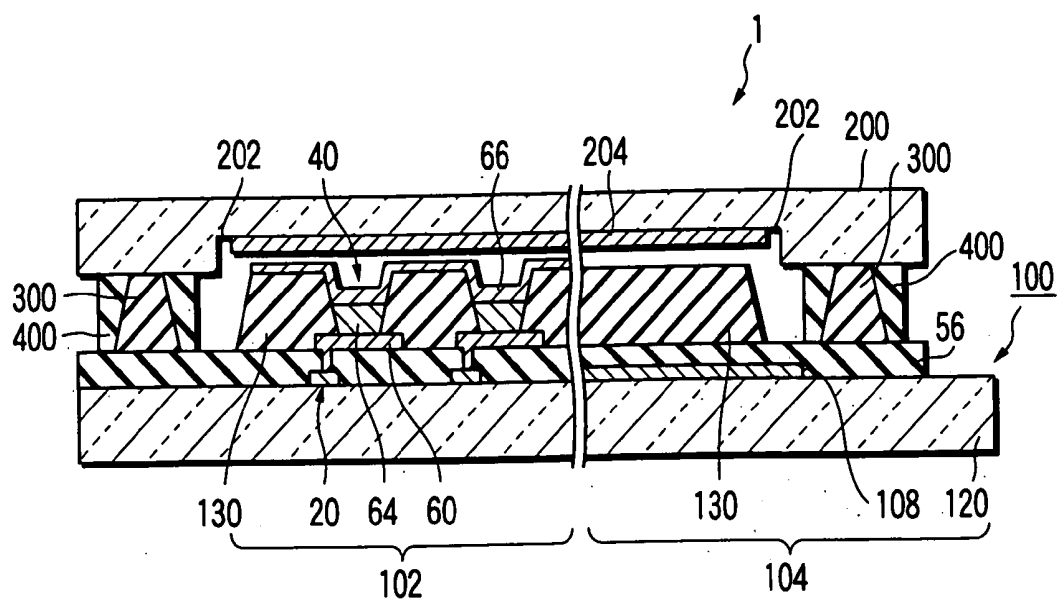


FIG. 2

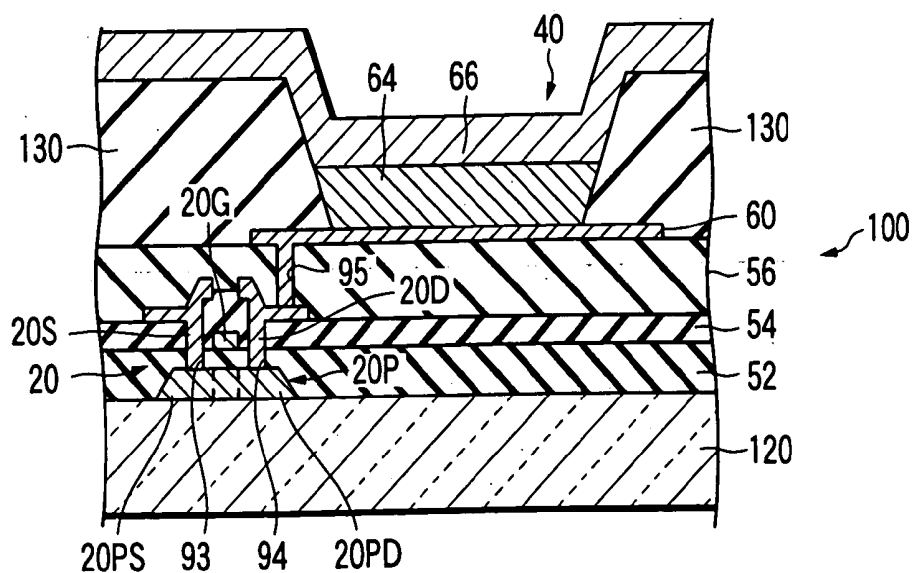


FIG. 3

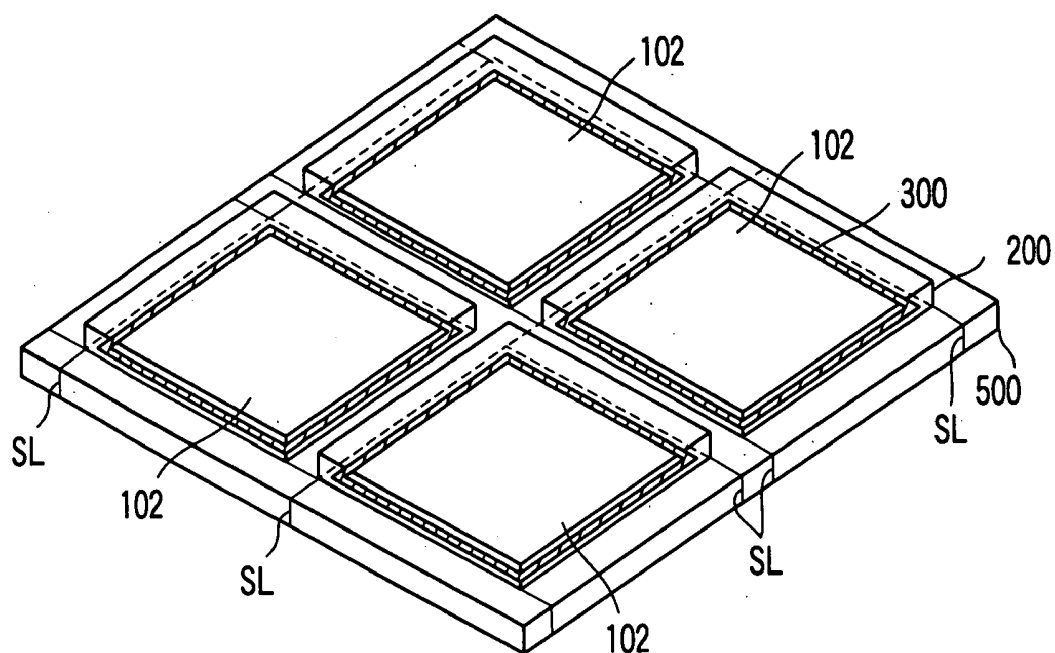


FIG. 4

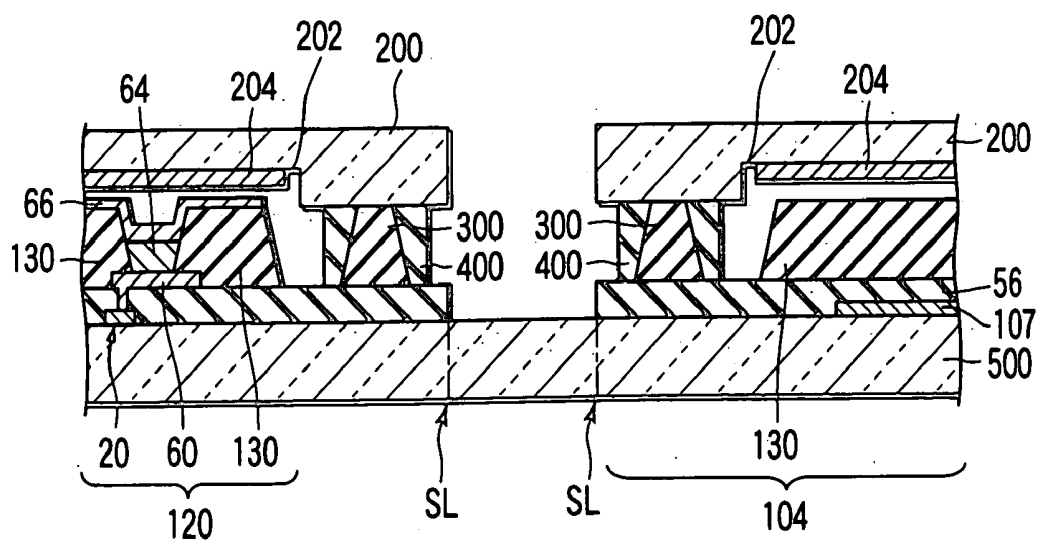


FIG. 5

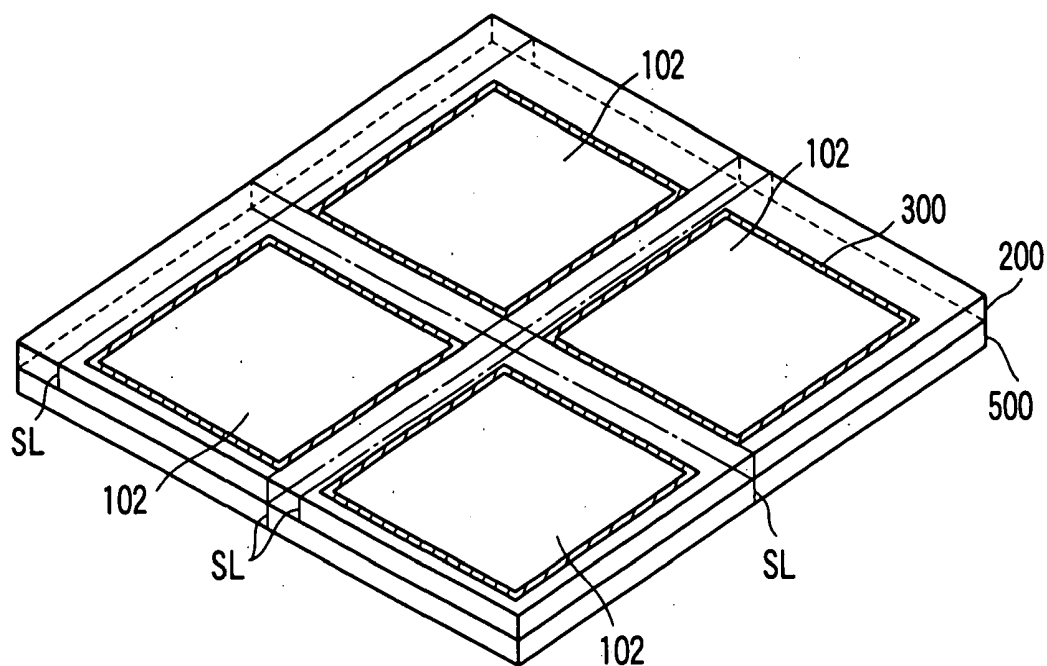


FIG. 6

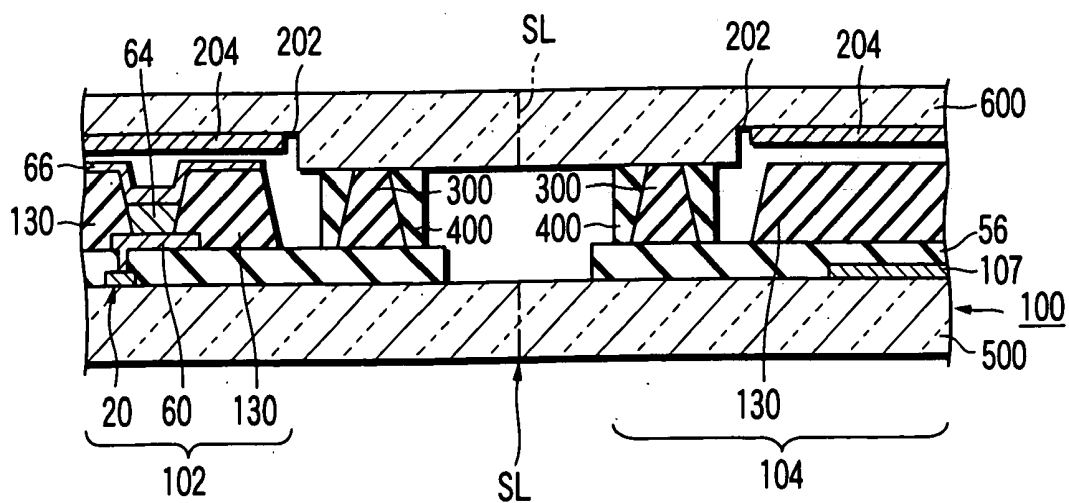


FIG. 7

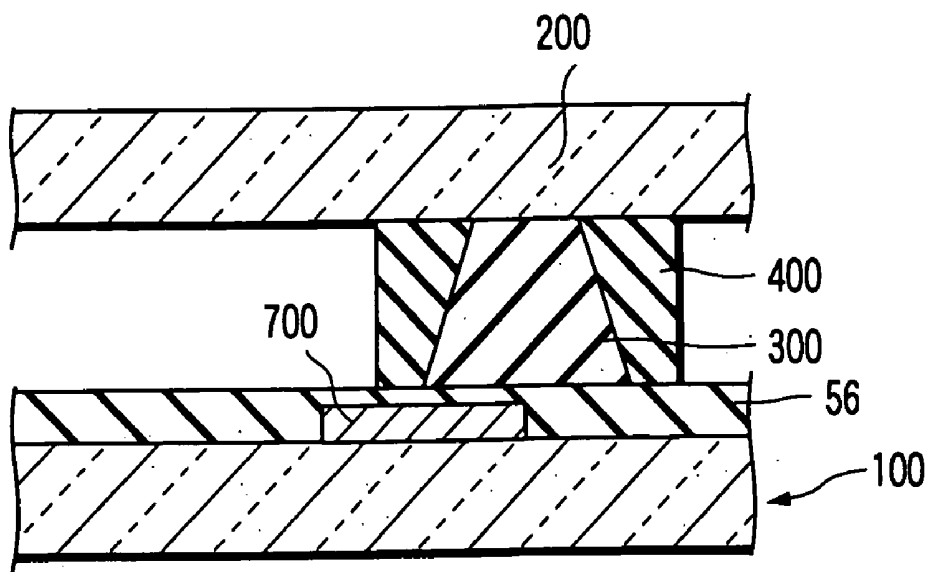


FIG. 8

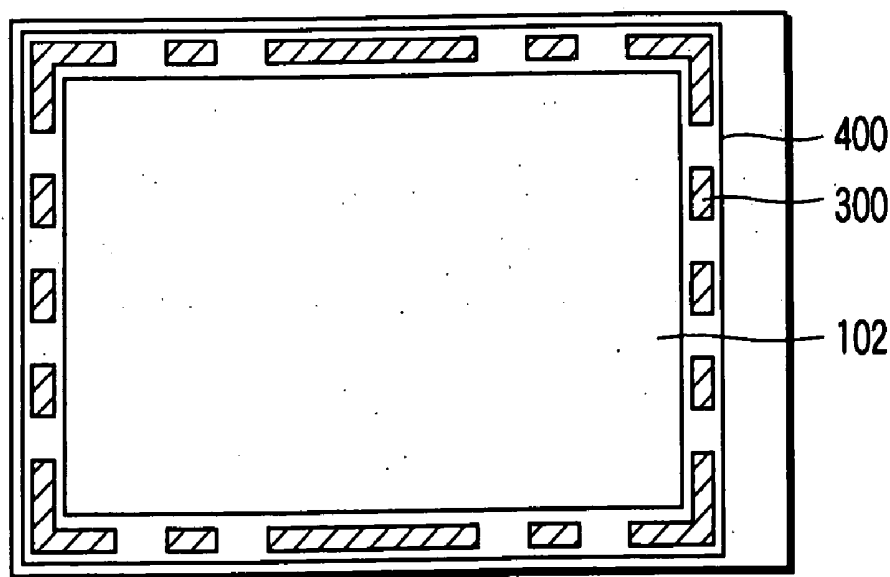


FIG. 9

## DISPLAY APPARATUS AND METHOD OF MANUFACTURING THE SAME

### CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This is a Continuation Application of PCT Application No. PCT/JP03/01017, filed Jan. 31, 2003, which was not published under PCT Article 21(2) in English.

[0002] This application is based upon and claims the benefit of priority from the prior Japanese Patent Application No. 2002-027123, filed Feb. 4, 2002, the entire contents of which are incorporated herein by reference.

### BACKGROUND OF THE INVENTION

#### [0003] 1. Field of the Invention

[0004] The present invention relates to a display apparatus and a method of manufacturing the display apparatus, and more particularly to a self-emission type display apparatus such as an organic electro-luminescence (EL) display apparatus and a method of manufacturing the same.

#### [0005] 2. Description of the Related Art

[0006] In recent years, organic EL display apparatuses have attracted attention as flat display apparatuses. The organic EL display apparatus has self-luminescence properties. Thus, it has features: a wide viewing angle is provided, reduction in thickness is achieved without a need for backlight, power consumption can be decreased, and a responsiveness speed is high. The organic EL display apparatus is configured such that a plurality of organic EL devices are arranged on an array substrate in a matrix. Each organic EL device has such a structure that an organic light-emitting layer including an organic compound with a light-emitting function is sandwiched between an anode and a cathode.

[0007] The organic EL device is very susceptible to moisture. Even a small amount of moisture, e.g. about 1 ppm, would destroy the organic EL device, and the organic EL device could no longer maintain a display performance as a display device. It is necessary, therefore, that the organic EL device is configured to be kept out of contact with an external atmosphere. In a general manufacturing process, the array substrate is sealed by a sealing substrate, to which a desiccating material is added, in an inert gas atmosphere of, e.g. nitrogen gas, under dew-point management. In this case, the array substrate and the sealing substrate are bonded to each other via a sealing material mixed with granular spacers each having a size of several-ten  $\mu\text{m}$ . The spacer mixed in the sealing material defines a predetermined gap between the array substrate and the sealing substrate so as to prevent contact between the organic EL devices arranged on the array substrate and the desiccating material.

[0008] When the array substrate and the sealing substrate are to be bonded by the sealing material, the sealing material is cured by ultraviolet irradiation in the state in which both substrates are under pressure. In this case, there is a possibility that the granular spacers mixed in the sealing material may press a drive circuit provided in the vicinity of the sealing material. This may result in damage to the drive circuit. In particular, in display apparatuses used in small-sized mobile terminals, the production of which has increased in recent years, there is little extra area in the

frame size and thus it is difficult to keep a sufficient margin. Consequently, the aforementioned problem tends to occur with the display apparatus for the small-sized mobile terminal, and the reliability may deteriorate.

[0009] In a case where a plurality of organic EL display apparatuses are to be cut out of a single mother substrate, there is no portions serving as fulcra along scribe lines. As a result, defects such as a chip tend to occur at end portions of the substrates of the cut-out organic EL display apparatuses, and it is difficult to cut out the display apparatuses with high precision.

### BRIEF SUMMARY OF THE INVENTION

[0010] The present invention has been made to solve the above problems, and the object of the invention is to provide a display apparatus capable of enhancing reliability and process precision, and a method of manufacturing the display apparatus.

[0011] According to a first aspect of the present invention, there is provided a display apparatus comprising:

[0012] a first substrate including a display area having a plurality of pixels arranged in a matrix; and

[0013] a second substrate disposed to be opposed to the first substrate,

[0014] wherein the first substrate includes

[0015] a separator that separates the pixels in the display area and is disposed to be spaced apart from the second substrate, and

[0016] a support section disposed in a frame shape on an outer peripheral portion of the display area such that a predetermined gap is provided between the first substrate and the second substrate, the support section having a height substantially equal to a height of the separator.

[0017] According to a second aspect of the invention, there is provided a method of manufacturing a display apparatus including a first substrate having a plurality of display pixels arranged in a display area in a matrix and a separator separating the display pixels, a second substrate disposed to be opposed to the first substrate, and a seal material that seals the first substrate and the second substrate, the method comprising:

[0018] a step of forming a support section, which has a height substantially equal to a height of the separator, on a mother substrate having display areas corresponding to a plurality of the display apparatuses, the support section being provided on an outer peripheral portion of each of the display areas;

[0019] a step of sealing using the seal material, in a state in which the second substrate is disposed to be opposed to each display area of the mother substrate, spaced apart from the separator, and put in contact with the support section; and

[0020] a step of cutting the mother substrate in accordance with the respective display areas, and cutting out the first substrate.

[0021] According to a third aspect of the invention, there is provided a method of manufacturing a display apparatus

including a first substrate having a plurality of display pixels arranged in a display area in a matrix and a separator separating the display pixels, a second substrate disposed to be opposed to the first substrate, and a seal material that seals the first substrate and the second substrate, the method comprising:

[0022] a step of forming a support section, which has a height substantially equal to a height of the separator, on a first mother substrate having display areas corresponding to a plurality of the display apparatuses, the support section being provided on an outer peripheral portion of each of the display areas;

[0023] a step of sealing using the seal material, in a state in which a second mother substrate is disposed to be opposed to each display area of the first mother substrate, spaced apart from the separator, and put in contact with the support section; and

[0024] a step of cutting the first mother substrate and the second mother substrate in accordance with the respective display areas, and cutting out the first substrate and the second substrate sealed by the seal material.

#### BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

[0025] FIG. 1 schematically shows the structure of an organic EL display apparatus according to an embodiment of the present invention;

[0026] FIG. 2 is a cross-sectional view schematically showing the structure of the organic EL display apparatus shown in FIG. 1;

[0027] FIG. 3 is a cross-sectional view schematically showing the structures of an organic EL device and a drive control device in the organic EL display apparatus shown in FIG. 1;

[0028] FIG. 4 is a perspective view for describing a method of manufacturing the organic EL display apparatus;

[0029] FIG. 5 is a cross-sectional view for describing the method of manufacturing the organic EL display apparatus;

[0030] FIG. 6 is a perspective view for describing another method of manufacturing the organic EL display apparatus;

[0031] FIG. 7 is a cross-sectional view for describing this another method of manufacturing the organic EL display apparatus;

[0032] FIG. 8 shows an example of the positional relationship between a support section and a drive circuit; and

[0033] FIG. 9 schematically shows the structure of an array substrate in a case where insular support portions are arranged.

#### DETAILED DESCRIPTION OF THE INVENTION

[0034] A display apparatus according to an embodiment of the present invention and a method of manufacturing the display apparatus will now be described with reference to the accompanying drawings.

[0035] In this embodiment, a self-emission type display apparatus, such as an organic EL (electroluminescence) display apparatus, is described as the display apparatus by way of example.

[0036] As is shown in FIG. 1 and FIG. 2, an organic EL display apparatus 1 comprises an array substrate 100 as a first substrate, on which organic EL devices serving as display devices are arranged in a matrix, and a sealing substrate 200 as a second substrate, which is disposed to be opposed to the array substrate 100. A display area 102 of the array substrate 100, which displays an image, comprises three kinds of light-emitting portions, that is, pixels, which emit red, green and blue lights, respectively. Each pixel is separated by separators 130. Each pixel includes an organic EL device 40 serving as a self-emission type display device. The sealing substrate 200 seals the display area 102 of the array substrate 100.

[0037] The organic EL device 40 comprises a first electrode 60, a second electrode 66 and an organic light-emitting layer 64 functioning as a light-emitting layer. The first electrode 60 is formed in an independent insular shape for each pixel, and is electrically insulated. The second electrode 66 is disposed to be opposed to the first electrode 60 and is commonly formed for a plurality of pixels. The organic light-emitting layer 64 is sandwiched between the first electrode 60 and the second electrode 66.

[0038] In each pixel of the display area 102, the array substrate 100 includes a pixel switch 10 composed of, e.g. an N-type thin-film transistor, a drive control device 20 composed of, e.g. a P-type thin-film transistor, a capacitor element 30, and the organic EL device 40. The organic EL device 40 is selected via the pixel switch 10. An excitation power for the organic EL device 40 is controlled by the drive control device 20.

[0039] The array substrate 100 includes a plurality of scan lines Y arranged in the row direction of the organic EL devices 40, a plurality of signal lines X arranged in the column direction of the organic EL devices 40, and power supply lines P for supplying power to a first electrode of each organic EL device 40. In a peripheral area 104 surrounding the display area 102, the array substrate 100 further includes a scan line drive circuit 107 for supplying drive signals to the scan lines Y and a signal line drive circuit 108 for supplying drive signals to the signal lines X.

[0040] The scan lines Y are connected to the scan line drive circuit 107. The signal lines X are connected to the signal line drive circuit 108. The pixel switch 10 is provided near an intersection between the scan line Y and signal line X. The drive control device 20 is connected in series with the organic EL device 40. The capacitance element 30 is connected in series with the pixel switch 10 and in parallel with the drive control device 20. Both electrodes of the capacitance element 30 are connected to the gate electrode and source electrode of the drive control device 20, respectively.

[0041] The power supply line P is connected to a first electrode power supply line (not shown) arranged on the peripheral area 104. A second electrode of the organic EL device 40 is connected to a second electrode power supply line (not shown) which is arranged on the peripheral area 104 and supplies a common potential.

[0042] More specifically, the pixel switch 10 in this embodiment is composed of an N-type thin-film transistor.



In the pixel switch **10**, the gate electrode is connected to the scan line **Y**, the source electrode is connected to the signal line **X**, and the drain electrode is connected to one electrode of the capacitance element **30** and to the gate electrode of the drive control device **20**. In the drive control device **20**, the source electrode is connected to the power supply line **P**, and the drain electrode is connected to the first electrode **60** of the organic EL device **40**. The other electrode of the capacitance element **30** is connected to the power supply line **P**.

[0043] When the pixel switch **10** is selected via the associated scan line **Y**, the pixel switch **10** writes a drive signal of the associated signal line **X** in the capacitance element **30**, and controls the operation of the drive control device **20**. The gate voltage of the drive control device **20** is adjusted on the basis of the drive signal. The drive control device **20** supplies a desired drive current from the power supply line **P** to the organic EL device **40**.

[0044] FIG. 3 is a schematic cross-sectional view showing the drive control device **20** and organic EL device **40** of the array substrate **100**.

[0045] The drive control device **20** includes a polysilicon semiconductor layer **20P** disposed on an insulating support substrate **120** formed of, e.g. glass. In the drive control device **20**, a gate electrode **20G** is provided on the polysilicon semiconductor layer **20P** via a gate insulation film **52**. A source electrode **20S** is put in contact with a source region **20PS** of the polysilicon semiconductor layer **20P** via a contact hole **93** that penetrates the gate insulation film **52** and an interlayer insulation film **54**. A drain electrode **20D** is put in contact with a drain region **20PD** of the polysilicon semiconductor layer **20P** via a contact hole **94** that penetrates the gate insulation film **52** and interlayer insulation film **54**.

[0046] The organic EL device **40** is disposed on an insulation film **56** provided on the interlayer insulation film **54**. The organic EL device **40** for one pixel is partitioned by the separators **130** arranged within the display area in a matrix. The separator **130** comprises, for example, a hydrophilic film such as a silicon oxide film (SiO) and a hydrophobic film such as a resin resist. In each pixel, the first electrode **60** is electrically insulated from adjacent pixels by the separators **130**. The separators **130** are so arranged as to overlap peripheral portions of the first electrode **60**. Thus, the electrode portion, which is exposed from the hydrophilic film of the separator **130**, functions substantially as the first electrode.

[0047] In the organic EL device **40**, the lower-side first electrode **60** functions as an anode, and the first electrode **60** is provided on the insulation film **56**. The first electrode **60** is connected to the drain electrode **20D** of the drive control device **20** via a contact hole **95** that penetrates the insulation film **56**. The first electrode **60** is formed of a light-transmissive electrically-conductive material such as ITO (Indium Tin Oxide) or IZO (Indium Zinc Oxide).

[0048] The organic light-emitting layer **64** sandwiched between the first electrode **60** and second electrode **66** may have a three-layer stacked structure comprising a hole transporting layer and an electron transporting layer, which are commonly formed for respective colors, and a light-emitting layer formed individually for each color. Alternatively, the organic light-emitting layer **64** may have a

two-layer structure or a single layer structure having an integrated function of the three layers. For example, the hole transporting layer is interposed between the anode and the light-emitting layer and is formed of a thin film of an aromatic amine derivative, a polythiophene derivative, polyaniline derivative, etc. The light-emitting layer is interposed between the hole transporting layer and the cathode and is formed of an organic compound that emits red, green or blue light. When the light-emitting layer is formed by using, for instance, a high-polymer material, it has a stacked structure of PPV (poly-para-phenylenevinylene), a polyfluorene derivative or a precursor thereof, etc.

[0049] In the organic EL device **40**, the upper-side second electrode **66** functions as a cathode. The second electrode **66** is commonly provided on the organic light-emitting layers **64** of the respective organic EL devices **40**. The second electrode **66** is formed of a light-shield metal film of, e.g. Ca (calcium), Al (aluminum), Ba (barium), Ag (silver), etc.

[0050] The sealing substrate **200** includes a recess portion **202** that extends over at least a region corresponding to the display area **102**. The sealing substrate **200** having this structure has a desiccating agent **204** disposed in the recess portion **202**. The desiccating agent **204** absorbs moisture evaporated from the organic EL device **40**, etc.

[0051] The array substrate **100** further includes a support section **300** arranged in a frame shape surrounding the outer periphery of the display area **102**. The support section **300** has such a height as to provide a predetermined gap between the array substrate **100** and sealing substrate **200** in the display area **102**. The height of the support section **300** is substantially equal to the height of the separator **130**. When the support section **300** supports the sealing substrate **200** in the peripheral area **104**, the separator **130** on the array substrate **100** is spaced apart from the sealing substrate **200** in the display area **102**. Specifically, the sealing substrate **200** has the recess portion **202** opposed to the display area **102**. Thus, even if the height of the separator **130** is substantially equal to that of the support section **300**, the separator **130** does not contact the desiccating agent **204** provided on the sealing substrate **200**.

[0052] As is shown in FIG. 1, for example, the support section **300** has a continuous loop shape surrounding the display area **102**. Thereby, when the sealing substrate **200** is supported by the support section **300** on the array substrate **100** in the peripheral area **104**, the display area **102** is sealed.

[0053] The support section **300** is formed of, e.g. resin resist. The support section **300** and the separators **130** arranged on the display area **102** may be formed of the same material. In this case, the support section **300** and the separators **130** may be formed in the same fabrication step. In particular, the water-repellent film of the separator **130** and the support section **300** may be formed of the same material in the same fabrication step. This fabrication method does not require an increase in number of fabrication steps for forming the support section **300**, and can prevent a decrease in yield.

[0054] Since the display area **102** of the array substrate **100** is sealed by the support section **300** and sealing substrate **200**, external moisture is prevented from entering the sealed space. This prevents degradation of the organic EL device **40**. In particular, when the separator **130** and support

section **300** are formed by the same fabrication steps, entrance of moisture can more effectively be prevented.

[0055] The array substrate **100** and sealing substrate **200** are sealed by a seal material **400**. The seal material **400** is formed of a photosensitive resin, e.g. an ultraviolet curing resin. Additionally, the seal material may be formed of a photosensitive resin mixed with a desiccating agent. If this seal material **400** is used, entrance of external moisture can be prevented by arranging the seal material **400** on both sides of the support section **300**. Moreover, moisture within the sealed space can effectively be eliminated. In the case where the desiccating agent is mixed in the seal material **400**, it is not necessary to dispose the desiccating agent **204** in the recess portion **202** of the sealing substrate **200**.

[0056] The gap between the array substrate **100** and the sealing substrate **200** is kept constant by the support section **300**. Moreover, since the support section **300** is arranged on the outer peripheral part of the display area **102**, the mechanical strength of the entire display apparatus is increased.

[0057] An insert gas such as nitrogen gas is filled in the sealed space defined by the support section **300** in the predetermined gap between the array substrate **100** and sealing substrate **200**. The humidity in the sealed space is maintained at such a low level as not to adversely affect the organic EL device **40**.

[0058] In the organic EL device **40** with the above-described structure, electrons and holes are injected in the organic light-emitting layer **64** sandwiched between the first electrode **62** and second electrode **66**. The electron and hole are recombined to form an exciton, and light is produced by photo-emission of a predetermined wavelength which occurs when the exciton is deactivated. The EL light is emitted from the lower surface side of the array substrate **100**, that is, from the first electrode **60** side.

[0059] A method of manufacturing the organic EL device having the above-described structure will now be described. In the method to be described here, array substrates corresponding to a plurality of EL display apparatuses are cut out of a single mother substrate.

[0060] As is shown in FIGS. 4 and 5, display areas corresponding to a plurality of organic EL display apparatuses are formed on a mother substrate **500** for array substrates. Specifically, processes of forming a semiconductor layer, a metal layer and an insulation layer on the mother substrate **500** and patterning these layers are repeated. Thereby, for each display area **102**, the processes are carried out to form polysilicon semiconductor layers of TFTs that make up pixel switches **10**, drive control devices **20**, drive circuits **107** and **108**, etc., as well as gate electrodes, capacitance elements **30**, gate insulation films **52**, interlayer insulation films **54**, etc.

[0061] Subsequently, source electrodes and drain electrodes of the TFTs are formed. In this case, the source electrode of the pixel switch **10** is formed integral with the signal line X. Thereafter, the insulation film **56** is formed on the TFTs, and then first electrodes **60** are formed in independent insular shapes at positions corresponding to the respective display devices **40** on the insulation film **56**. In this case, the drain electrode **20D** of the drive control device **20** is electrically connected to the first electrode **60**.

[0062] Next, separators **130** for electrically insulating each display device **40** are formed on the display area **102**. To begin with, a film of a hydrophilic material is formed. A part of this film is selectively removed, thereby forming a hydrophilic film having an opening for partly exposing the first electrode **60**. Then, a film of a hydrophobic material is formed, and a part thereof is selectively removed, thereby forming a hydrophobic film having an opening for partly exposing the opening of the hydrophilic film. The plural organic EL devices **40** surrounded by the separators **130** emit light of the same color, for example, in units of a column. In the step of forming the hydrophobic film, a frame-shaped support section **300** having approximately the same height as the separators **130** is formed at the same time on the outer periphery of the display area **102**.

[0063] Following the above steps, a light-emission material is applied by, e.g. an ink jet method, onto the first electrode **60** exposed from the opening of the separator **130**. Thus, the organic light-emitting layer **64** is formed. Subsequently, the second electrode **66** is formed on the organic light-emitting layer **64**. Thereby, the organic EL device **40** is formed.

[0064] On the other hand, the desiccating agent **204** is disposed in the recess portion **202** of the sealing substrate **200**. Then, seal materials **400** are applied onto the mother substrate **500**. For example, the seal material **400** is applied onto the support section **300** in a frame shape. In an atmosphere subjected to dew-point management, a plurality of sealing substrates **200** are disposed and sealed to be opposed to each display area **102** on the mother substrate **500**. Thereby, the organic EL devices **40** are sealed in the sealed spaces between the mother substrate **500** and the sealing substrates **200**. In this case, the support sections **300** on the mother substrate **500** support the sealing substrates **200**. Thus, the seal materials **400** applied to the support sections **300** are present on both sides of the support sections **300** and bond the mother substrate **500** and sealing substrates **200**.

[0065] Thereafter, the mother substrate **500** is cut into unit sizes corresponding to the respective organic EL display apparatuses. Specifically, predetermined cutting-lines are scribed on the surface of the mother substrate **500** by a scriber formed of a sharp, hard member of, e.g. diamond. Cracks are made along the cutting-lines. After cracks, i.e. scribe lines SL, are formed along the cutting-lines, an impact is uniformly applied along the scribe lines SL, using a rubber rod-like member called a break bar. Thereby, the cracks are progressed within the substrate along the scribe lines SL, and the mother substrate **500** is cut.

[0066] When a plurality of organic EL display apparatuses are cut out of the single mother substrate, as described above, it is desirable to situate the support sections **300** near the scribe lines SL. Thereby, in the step of cutting the mother substrate **500**, the support sections **300** function as fulcrum and occurrence of defects in scribing can be prevented. Moreover, high-precision cutting is enabled with respect to display apparatuses for small-sized mobile terminals, which have little margin in the frame size. Additionally, it is desirable that the support sections **300** be disposed substantially in parallel with the scribe lines SL. With such disposition, higher-precision cutting of the mother substrate is enabled. It is preferable that, as shown in FIG. 5, the support

sections **300** be-situated on both sides of the scribe lines **SL** in the vicinity of the central portion of the mother substrate **500** where a plurality of organic EL display apparatuses are located adjacent to one another. With such arrangement, higher-precision cutting of the mother substrate can be achieved.

[0067] The support section **300** with a predetermined width is disposed in a frame shape along the outer periphery of the sealing substrate **200**. The array substrate **100** and sealing substrate **200** are sealed via the support section **300**. Therefore, the strength of the display apparatus as a whole can be increased.

[0068] Another method of manufacturing the organic EL device having the above-described structure will now be described. In the method of this example, two mother substrates are used to form a plurality of organic EL display apparatus cells. Thereafter, array substrates and sealing substrates corresponding to a plurality of organic EL display apparatuses are cut out of the mother substrates.

[0069] As is shown in **FIGS. 6 and 7**, a plurality of display areas **102** and drive circuits **107, 108** are formed on a mother substrate for array substrates (first mother substrate) **500**. Then, a support section **300** is formed on an outer periphery portion of each display area **102**. A desiccating agent **204** is disposed in each recess portion **202** of a mother substrate for sealing substrates (second mother substrate) **600**. Subsequently, seal material **400** is applied to each sealing substrate **200** in a frame shape. In an atmosphere subjected to dew-point management, the mother substrate **600** is sealed on the mother substrate **500**. Thereafter, the mother substrate **500** and mother substrate **600** are cut into unit sizes corresponding to the respective display areas **102**. Thereby, organic EL display apparatuses each having the array substrate **100** and sealing substrate **200** which are sealed by the seal material **400** are cut out.

[0070] With this manufacturing method, too, the same advantages as with the previously described manufacturing method can be obtained.

[0071] The present invention is not limited to the above-described embodiments, and various modifications can be made without departing from the spirit of the invention.

[0072] For example, in display apparatuses for small-sized mobile terminals, which have little margin in the frame size, the support section **300** for providing the gap may be disposed over each drive circuit arranged on the outer peripheral portion of the display area **102**. Specifically, in **FIG. 8**, a support section **300** is disposed over a drive circuit **700** such as a scan line drive circuit or a signal line drive circuit. In this case, a pressure is applied to the drive circuit **700** via the support section **300** when the array substrate **100** and sealing substrate **200** are sealed by the seal material **400** or when scribing is performed on the mother substrate **500** (**600**).

[0073] In the prior art wherein the mechanical strength for providing the gap is secured by mixing fibers in the seal material **400** without disposing the support section **300**, if the aforementioned pressure is applied, the fibers may pierce the drive circuit **700**, causing damage to the drive circuit **700**.

[0074] By contrast, in the structure shown in **FIG. 8** wherein the support section **300** is disposed on the outer

peripheral portion of the display area **102**, the applied pressure can be dispersed over the entire support section **300** and damage to the drive circuit **700** can be prevented. Therefore, even in the case of display apparatuses with little margin in the frame size, high reliability is attained.

[0075] In the above-described embodiment, the support section **300** has a continuous loop shape surrounding the display area **102**. Alternatively, insular support sections may be provided. That is, as shown in **FIG. 9**, insular support sections **300** may be disposed along the outer periphery of the display area **102** and the seal material **400** may be provided along the support section **300**.

[0076] The support section **300** may be formed of a resin material including a desiccating agent. This effectively prevents external moisture from entering the sealed space between the array substrate **100** and sealing substrate **200**. In this case, the seal material **400** may not necessarily include the desiccating agent. In addition, there is no need to dispose the desiccating agent **400** in the recess portion **202** of the sealing substrate **200**.

[0077] The above-described embodiment adopts a so-called bottom-surface emission system in which EL light is emitted from the first electrode side situated on the lower side of the array substrate. The present invention, however, is also applicable to a so-called top-surface emission system in which EL light is emitted from the second electrode side situated on the upper side.

[0078] As has been described above, the display apparatus of this invention and the method of manufacturing the same can enhance the reliability and process precision. In addition, the mechanical strength of the entire display apparatus can be increased. Furthermore, entrance of external moisture, etc. via the seal material can surely be prevented, and degradation in the display apparatus can effectively be suppressed. Besides, the gap between the array substrate and the sealing substrate can uniformly be maintained.

[0079] As has been described above, the present invention can provide a display apparatus and a method of manufacturing the same, which can enhance the reliability and processing precision.

What is claimed is:

1. A display apparatus comprising:

a first substrate including a display area having a plurality of pixels arranged in a matrix; and

a second substrate disposed to be opposed to the first substrate,

wherein the first substrate includes,

a separator that separates the pixels in the display area and is disposed to be spaced apart from the second substrate, and

a support section disposed in a frame shape on an outer peripheral portion of the display area such that a predetermined gap is provided between the first substrate and the second substrate, the support section having a height substantially equal to a height of the separator.

2. The display apparatus according to claim 1, wherein the support section and the separator are formed of the same material.

3. The display apparatus according to claim 1, wherein the support section is formed in a loop shape such that the support section seals between the display area of the first substrate and the second substrate.

4. The display apparatus according to claim 1, wherein the support section is formed in an insular shape on an outer peripheral portion of the display area.

5. The display apparatus according to claim 1, wherein the support section is disposed over a drive circuit for driving the pixels.

6. The display apparatus according to claim 1, wherein the second substrate provides a desiccating agent.

7. The display apparatus according to claim 1, wherein the support section is formed of a resin including a desiccating agent.

8. The display apparatus according to claim 1, wherein the pixel includes a self-emission type display device.

9. The display apparatus according to claim 8, wherein the self-emission type display device comprises a first electrode formed in an independent insular shape for each pixel, a second electrode disposed to be opposed to the first electrode and commonly formed for all the pixels, and a light-emitting layer sandwiched between the first electrode and the second electrode.

10. The display apparatus according to claim 1, wherein the second substrate has a recess portion opposed to the display area.

11. The display apparatus according to claim 1, wherein a seal material for sealing between the first substrate and the second substrate is disposed on both sides of the support section.

12. The display apparatus according to claim 11, wherein the seal material is formed of a resin including a desiccating agent.

13. A method of manufacturing a display apparatus including a first substrate having a plurality of display pixels arranged in a display area in a matrix and a separator separating the display pixels, a second substrate disposed to be opposed to the first substrate, and a seal material that seals the first substrate and the second substrate, the method comprising:

a step of forming a support section, which has a height substantially equal to a height of the separator, on a mother substrate having display areas corresponding to a plurality of the display apparatuses, the support section being provided on an outer peripheral portion of each of the display areas;

a step of sealing using the seal material, in a state in which the second substrate is disposed to be opposed to each display area of the mother substrate, spaced apart from the separator, and put in contact with the support section; and

a step of cutting the mother substrate in accordance with the respective display areas, and cutting out the first substrate.

14. The method of manufacturing a display apparatus according to claim 13, wherein the separator and the support section are formed in the same step.

15. The method of manufacturing a display apparatus according to claim 13, wherein the seal material is disposed on both sides of the support section.

16. The method of manufacturing a display apparatus according to claim 13, wherein the support section is disposed near a scribe line for cutting the mother substrate.

17. The method of manufacturing a display apparatus according to claim 13, wherein the support section is disposed substantially in parallel with a scribe line for cutting the mother substrate.

18. A method of manufacturing a display apparatus including a first substrate having a plurality of display pixels arranged in a display area in a matrix and a separator separating the display pixels, a second substrate disposed to be opposed to the first substrate, and a seal material that seals the first substrate and the second substrate, the method comprising:

a step of forming a support section, which has a height substantially equal to a height of the separator, on a first mother substrate having display areas corresponding to a plurality of the display apparatuses, the support section being provided on an outer peripheral portion of each of the display areas;

a step of sealing using the seal material, in a state in which a second mother substrate is disposed to be opposed to each display area of the first mother substrate, spaced apart from the separator, and put in contact with the support section; and

a step of cutting the first mother substrate and the second mother substrate in accordance with the respective display areas, and cutting out the first substrate and the second substrate sealed by the seal material.

\* \* \* \* \*

专利名称(译)	显示装置及其制造方法		
公开(公告)号	<a href="#">US20040150319A1</a>	公开(公告)日	2004-08-05
申请号	US10/683360	申请日	2003-10-14
[标]申请(专利权)人(译)	TOMIMATSU敏文 小林道哉		
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IPC分类号	H05B33/04 G09F9/00 G09F9/30 G09G3/32 H01L27/32 H01L51/50 H01L51/52 H01L51/56 H05B33/22 H01J1/62		
CPC分类号	G09G3/3208 G09G3/3225 G09G2300/0842 H01L2251/566 H01L51/5237 H01L51/56 H01L27/3246 H01L51/5246 H01L51/525 H01L51/5259		
优先权	2002027123 2002-02-04 JP		
其他公开文献	US7193366		
外部链接	<a href="#">Espacenet</a> <a href="#">USPTO</a>		

#### 摘要(译)

一种显示装置，包括：阵列基板，包括：显示区域，由布置成矩阵的多个像素组成；密封基板，设置为与所述阵列基板相对。显示区域包括选择像素的像素开关，连接到像素开关的驱动控制装置，以及由驱动控制装置驱动的有机EL装置。支撑部分以框架形状设置在显示区域的外周部分上，使得在阵列基板和密封基板之间提供预定间隙。

