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(54) **DISPLAY DEVICE, DISPLAY PANEL, DISPLAY INSPECTION METHOD, AND DISPLAY PANEL MANUFACTURING METHOD**

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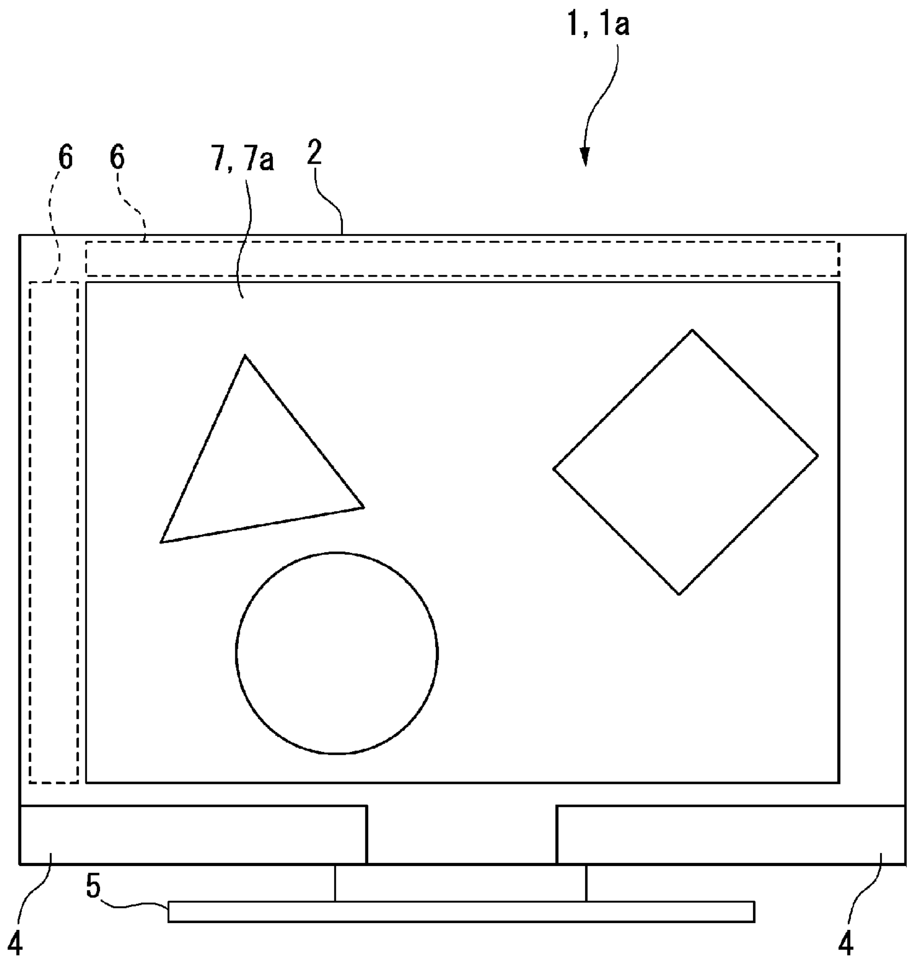
(57) **ABSTRACT**

An organic electroluminescent device is provided which includes a plurality of electrodes stacked on a substrate, at least one of the electrodes being transparent, an organic electroluminescent layer that is layered between the plurality of electrodes and emits light by an electric field generated between the plurality of electrodes and by applied voltage, and a light-masking sealing layer that covers the plurality of electrodes and the organic electroluminescent layer and has a transmissivity that is at least lower than that of the organic electroluminescent layer with a certain wavelength range.



[FIG. 1]

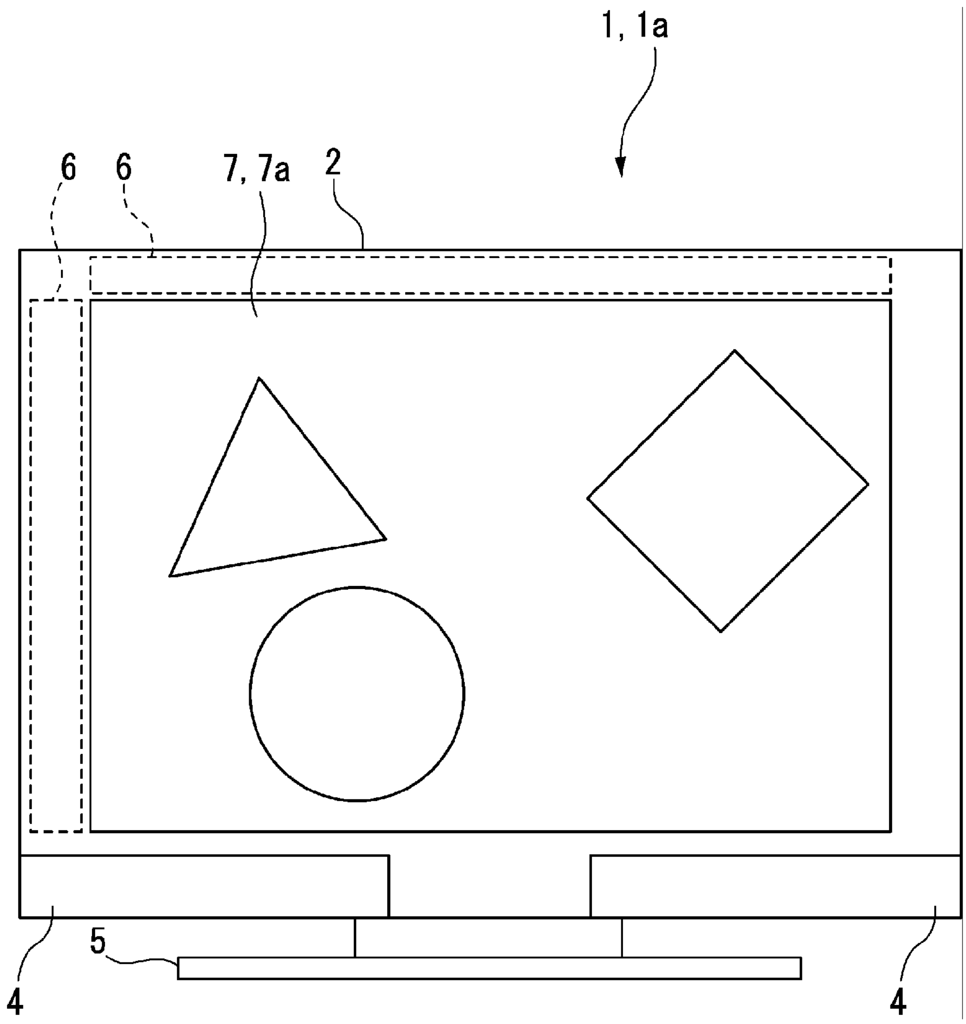


FIG. 2

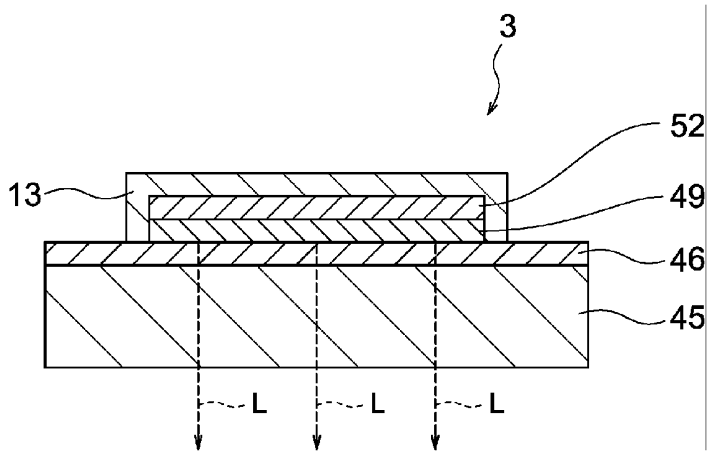


FIG. 3

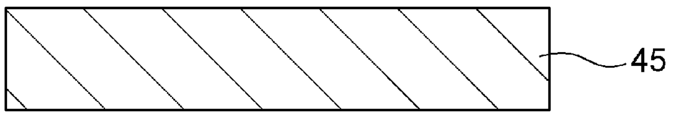
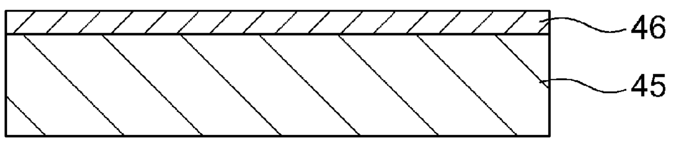
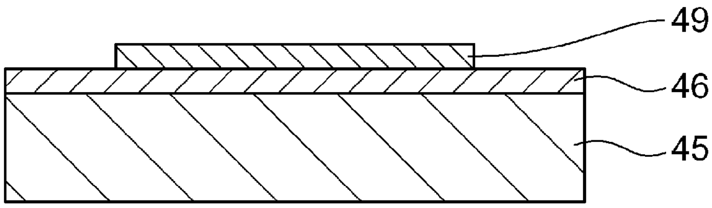


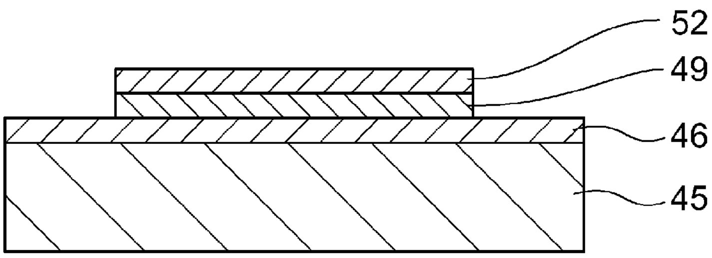
FIG. 4



【FIG. 5】



【FIG. 6】



【FIG. 7】

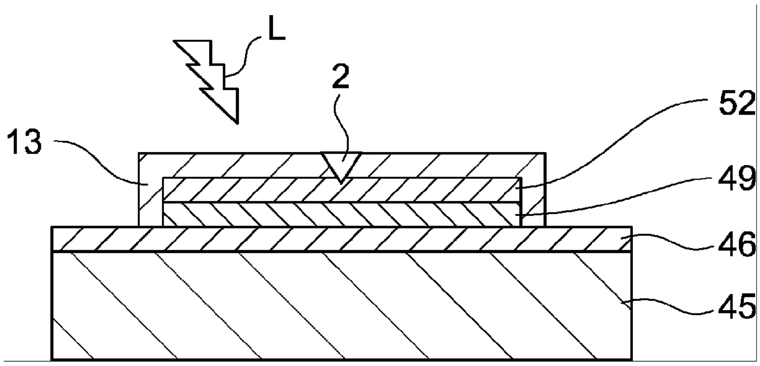


FIG. 8

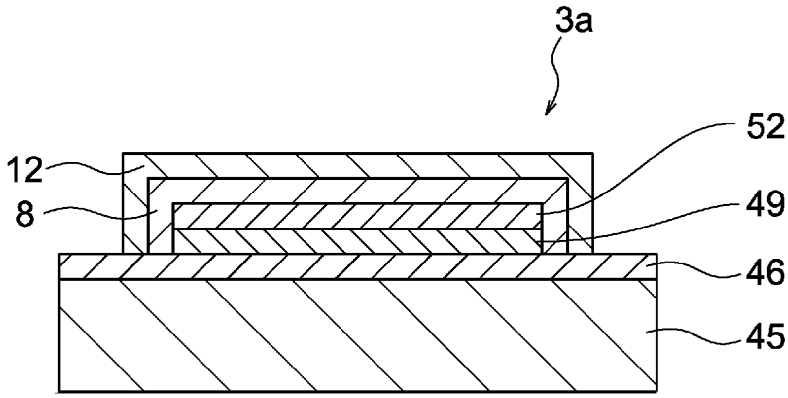


FIG. 9

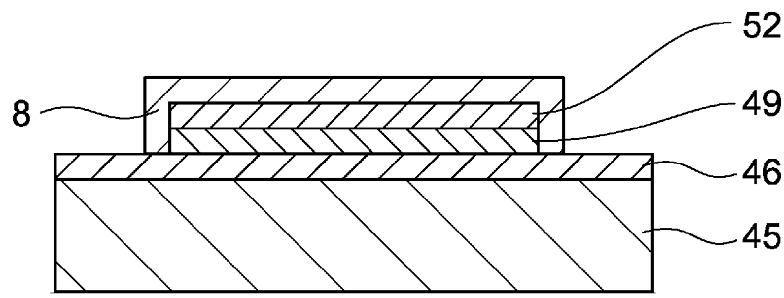
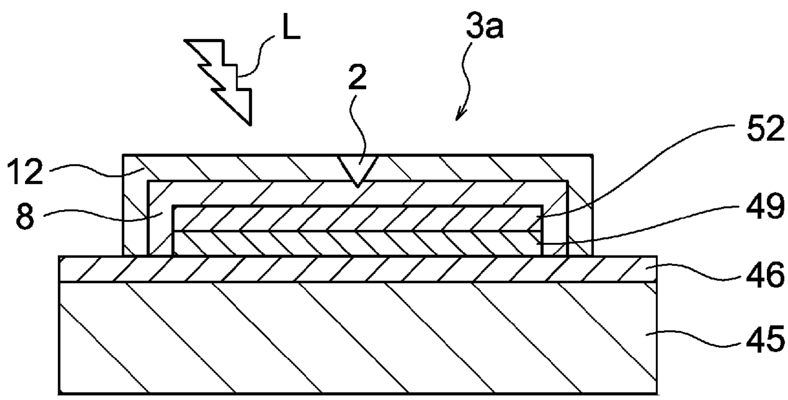


FIG. 10



DISPLAY DEVICE, DISPLAY PANEL, DISPLAY INSPECTION METHOD, AND DISPLAY PANEL MANUFACTURING METHOD

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This is an application PCT/JP2007/56645, filed Mar. 28, 2007, which was not published under PCT article 21(2) in English.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a display device, display panel, display panel inspection method, and display panel manufacturing method comprising an organic electroluminescent device wherein an organic electroluminescent layer emits light by an electric field generated in a plurality of electrodes.

[0004] 2. Description of the Related Art

[0005] In recent years, display devices that employ a so-called organic electroluminescent device have been developed as the next generation display to replace the liquid crystal display. A display that employs such an electroluminescent device (hereinafter "organic EL display") is capable of achieving high-brightness light emission even at a low voltage.

[0006] Such an organic EL display has attracted much attention as a self-luminous planar display device, and emits light with high light emission efficiency based on a simple device structure. Specifically, the organic electroluminescent device of the organic EL display is a device wherein holes and electrons respectively injected from a plurality of opposing electrodes are combined within a light-emitting layer that employs an organic substance, thereby generating an energy that excites a fluorescent substance within the light-emitting layer, causing the device to emit light.

[0007] In the organic electroluminescent devices of recent years, a sealing technique (generally referred to as "film sealing") by which a sealing layer having moisture barrier and gas barrier characteristics is formed as a film on a substrate on which the aforementioned electrodes and organic electroluminescent layer are formed has been employed. The principle behind this sealing technique is to cover the EL substrate with a sealing layer having moisture barrier and gas barrier characteristics so as to achieve sealing capability, and then further increase this sealing capability by using a multi-layered structure.

[0008] At this time, however, a non-luminous region of the organic electroluminescent device referred to as a "dark spot" may increase in size, resulting in a defect. The main cause of such a dark spot is a pinhole that occurs during film formation. Moisture permeation then occurs from this point defect, enlarging the non-luminous spot of the organic electroluminescent device into a circular shape. Whether or not this circular-shaped non-luminous defect will further enlarge due to subsequent moisture permeation is determined by whether or not a defect exists in the sealing layer and the size of the defective area. In related art for reducing such dark spots and the like, methods of providing a buffer layer (planarization layer) that covers the defective area, etc., are known (refer to JP, A, 10-312883).

[0009] With such a sealing technique, it is possible to reduce the number of defects in the sealing layer of organic electroluminescent devices of prior art. Nevertheless, in a case where a point defect that cannot be completely covered by a buffer layer exists, a great amount of time is generally required to recognize the spot as a large non-luminous defect of the display device prior to product shipment. Thus, in the inspection stage performed prior to shipment, the problem arises that defective organic electroluminescent device products cannot be completely sorted out.

[0010] The above-described problem is given as one example of the problems that are to be solved by the present invention.

SUMMARY OF THE INVENTION

[0011] To solve the foregoing problem, the invention according to claim **1** is a display device comprising: a display panel having an organic electroluminescent device; and a driving circuit, the organic electroluminescent device including: a plurality of electrodes stacked on a substrate, one of the electrodes being transparent; an organic electroluminescent layer that is stacked between the plurality of electrodes and emits light by means of an electric field generated between the plurality of electrodes by an applied voltage, and a light-masking sealing layer that covers the plurality of electrodes and the organic electroluminescent layer, and has a transmissivity that is at least lower than that of the organic electroluminescent layer within a certain wavelength range; and the driving circuit providing an applied voltage between the plurality of electrodes in accordance with inputted image data so as to drive each of the organic electroluminescent devices of the display panel.

[0012] To solve the foregoing problem, the invention according to claim **4** is a display device comprising: a display panel having an organic electroluminescent device; and a driving circuit, the organic electroluminescent device including: a plurality of electrodes stacked on a substrate, one of the electrodes being transparent, an organic electroluminescent layer that is stacked between the plurality of electrodes and emits light by means of an electric field generated between the plurality of electrodes by an applied voltage, a light-emitting covering layer that covers the plurality of electrodes and the organic electroluminescent layer, and emits light by light excitation based on irradiated excitation light, and a sealing layer that seals the light-emitting covering layer and has light-masking characteristics with respect to at least a light emitted by the light-emitting covering layer; and the driving circuit providing an applied voltage between the plurality of electrodes in accordance with inputted image data so as to drive each of the organic electroluminescent devices of the display panel.

[0013] To solve the foregoing problem, the invention according to claim **7** is a display panel comprising an organic electroluminescent device, the organic electroluminescent device including: a plurality of electrodes stacked on a substrate, one of the electrodes being transparent; an organic electroluminescent layer that is stacked between the plurality of electrodes and emits light by means of an electric field generated between the plurality of electrodes by an applied voltage; and a light-masking sealing layer that covers the plurality of electrodes and the organic electroluminescent layer, and has a transmissivity that is at least lower than that of the organic electroluminescent layer within a certain wavelength range.

[0014] To solve the foregoing problem, the invention according to claim **8** is a display panel comprising an organic electroluminescent device, the organic electroluminescent device including: a plurality of electrodes stacked on a substrate, one of the electrodes being transparent; an organic electroluminescent layer that is stacked between the plurality of electrodes and emits light by means of an electric field generated between the plurality of electrodes by an applied voltage; a light-emitting covering layer that covers the plurality of electrodes and the organic electroluminescent layer, and emits light by light excitation based on irradiated excitation light; and a sealing layer that seals the light-emitting covering layer and has light-masking characteristics with respect to at least the light emitted by the light-emitting covering layer.

[0015] To solve the foregoing problem, the invention according to claim **9** is a display panel inspection method, comprising the steps of: a light irradiation step for irradiating light on a light-masking sealing layer of each organic electroluminescent device of a display panel, the display panel including the organic electroluminescent device, the organic electroluminescent having: a plurality of electrodes, stacked on a substrate, one of the electrodes being transparent; an organic electroluminescent layer that is stacked between the plurality of electrodes and emits light by means of an electric field generated between the plurality of electrodes by an applied voltage; and the light-masking sealing layer that covers the plurality of electrodes and the organic electroluminescent layer and has a transmissivity that is at least lower than that of the organic electroluminescent layer within a certain wavelength range; and a defect inspection step for determining that a defect exists in the light-masking sealing layer when a light-transmitting spot exists in the light-masking sealing layer, and for determining that a defect does not exist in the light-masking sealing layer when a light-transmitting spot does not exist in the light-masking sealing layer.

[0016] To solve the foregoing problem, the invention according to claim **10** is a display panel inspection method, comprising the steps of: a light irradiation step for irradiating light on a sealing layer of each organic electroluminescent device of a display panel, the display panel including the organic electroluminescent device, the organic electroluminescent having: a plurality of electrodes stacked on a substrate, one of the electrodes being transparent; an organic electroluminescent layer that is stacked between the plurality of electrodes and emits light by means of an electric field generated between the plurality of electrodes by an applied voltage; a light-emitting covering layer that covers the plurality of electrodes and the organic electroluminescent layer and emits light by light excitation based on irradiated excitation light, and the sealing layer that seals the light-emitting covering layer and has light-masking characteristics with respect to at least the light emitted by the light-emitting sealing layer; and a defect inspection step for determining that a defect exists in the sealing layer when a light-emitting spot exists in the sealing layer, and for determining that a defect does not exist in the sealing layer when a light-emitting spot does not exist in the sealing layer.

[0017] To solve the foregoing problem, one embodiment of the invention is a display panel manufacturing method, comprising the steps of: a first electrode formation step for stacking a transparent first electrode on a substrate; a light-emitting layer formation step for forming on the first electrode an organic electroluminescent layer that emits light by an electric field; a second electrode formation step for forming a second electrode on the organic electroluminescent layer; a sealing layer formation step for forming a light-masking sealing layer that covers the first electrode, the organic electroluminescent layer, and the second electrode and has a transmissivity that is at least lower than that of the organic electroluminescent layer within a certain wavelength; and a light irradiation step for irradiating light on the light masking sealing layer of each organic electroluminescent device of a display panel, the organic electroluminescent device comprising the substrate, the first electrode, the organic electroluminescent layer, the second electrode, and the light-masking sealing layer.

[0018] To solve the foregoing problem, one embodiment the invention is a display panel manufacturing method, comprising the steps of: a first electrode formation step for stacking a transparent first electrode on a substrate; a light-emitting layer formation step for forming on the first electrode an organic electroluminescent layer that emits light by an electric field; a second electrode formation step for forming a second electrode on the organic electroluminescent layer; a light-emitting covering layer formation step for forming a light-emitting covering layer that covers the first electrode, the organic electroluminescent layer, and the second electrode, and emits light by light excitation based on irradiated excitation light; a sealing layer formation step for forming a sealing layer that seals the light-emitting covering layer and has light-masking characteristics with respect to at least a light emitted by the light-emitting covering layer; and a light irradiation step for irradiating light on the sealing layer of each organic electroluminescent device of a display panel, the organic electroluminescent device comprising the substrate, the first electrode, the organic electroluminescent layer, the.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] FIG. **1** is a front view illustrating an example of the outer appearance of the display device of embodiment 1.

[0020] FIG. **2** is a cross-sectional view illustrating a configuration example of the organic electroluminescent device arranged in the display panel of embodiment 1.

[0021] FIG. **3** is a cross-sectional view illustrating an example of the mode in which the organic electroluminescent device is manufactured.

[0022] FIG. **4** is a cross-sectional view illustrating an example of the mode in which the organic electroluminescent device is manufactured.

[0023] FIG. **5** is a cross-sectional view illustrating an example of the mode in which the organic electroluminescent device is manufactured.

[0024] FIG. **6** is a cross-sectional view illustrating an example of the mode in which the organic electroluminescent device is manufactured.

[0025] FIG. **7** is a cross-sectional view illustrating an example of a mode of inspecting the organic electroluminescent device of the display panel.

[0026] FIG. **8** is a cross-sectional view illustrating a configuration example of the organic electroluminescent device arranged in the display panel of embodiment 2.

[0027] FIG. **9** is a cross-sectional view illustrating an example of the mode in which the organic electroluminescent device is manufactured.

[0028] FIG. 10 is a cross-sectional view illustrating an example of a mode of inspecting the organic electroluminescent device of the display panel.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0029] The following describes an embodiment of the present invention with reference to accompanying drawings.

Embodiment 1

[0030] FIG. 1 is a front view illustrating an example of the outer appearance of a display device **1** comprising an organic electroluminescent device **3** of embodiment 1.

[0031] The display device **1** has a housing **2** and legs **5**. The housing **2** is supported on an installation surface by the legs **5**. This housing **2**, based on its outer appearance, comprises a display panel **7** and two speakers **4**. The display panel **7** is provided at the center of the housing **2** and, at this center of the housing **2**, has a function of displaying images based on image data inputted from an external source. The speakers **4** are respectively provided on the right side and left side underneath the housing **2**.

[0032] The speakers **4** have a function of outputting sound in synchronization with the image displayed on the display panel **7**. The housing **2** comprises a drive circuit **6** within its interior. This drive circuit **6** performs drive control for displaying images based on the aforementioned image data on the display panel **7**.

[0033] The display panel **7** is a panel that employs a so-called organic electroluminescent device (organic EL device). The display panel **7** comprises a configuration wherein a large number of organic electroluminescent devices are arranged in a matrix shape. These organic electroluminescent devices arranged in a matrix shape are driven and controlled per pixel based on the control performed by the drive circuit **6**.

[0034] FIG. 2 is a cross-sectional view illustrating a configuration example of the organic electroluminescent device **3** arranged in the display panel **7** of FIG. 1.

[0035] The organic electroluminescent device **3** is a bottom-emission type organic electroluminescent device, for example, with one device formed correspondingly for each color red, green, and blue, for example. In the organic electroluminescent device **3**, an anode **46** (transparent electrode), a light-emitting layer **49** (organic electroluminescent layer), and a cathode **52** (electrode) are stacked in the described order on a glass substrate **45**. The organic electroluminescent device **3** is structured so that the anode **46**, etc., are covered by a light-masking sealing layer **13**. This light-masking sealing layer **13** employs a material having a lower transmissivity than that of the light-emitting layer **49** within a certain wavelength range.

[0036] The anode **46** and the cathode **52** (electrodes) comprise a configuration in which the two are stacked on the glass substrate **45**, with one being transparent. Further, the anode **46** and the cathode **52** are respectively made of a material such as ITO (Indium Tin Oxide) and Al. Furthermore, the organic electroluminescent device **3** may employ a structure wherein an electric charge and exciter diffusion layer for capturing an electric charge and exciter within the light-emitting layer **49** is layered. The organic electroluminescent device **3** shown in the figure corresponds to one pixel section.

[0037] The glass substrate **45** is formed by a transparent material. Note that the anode **46** may be made of the material IZO rather than the above-mentioned ITO. The anode **46** comprises a transparent electrode through which a light L emitted by the light-emitting layer **49** is transmitted, as described later. The anode **46** (one of the plurality of electrodes) is formed on the glass substrate **45** at large, along the glass substrate **45**. This anode **46** has a function of supplying holes to the light-emitting layer **49** described later.

[0038] The light-emitting layer **49** is a light-emitting device that employs a so-called electroluminescence (EL) phenomenon. The light-emitting layer **49** is layered between the plurality of electrodes **46** and **52**, and has the function of emitting light by an electric field generated between the plurality of electrodes **46** and **52** by an applied voltage. This light-emitting layer **49** outputs its own light L by utilizing a phenomenon in which light is emitted based on energy received from an external force using an electric field.

[0039] In a case where the organic electroluminescent device **3** is a bottom-emission type, as in the present embodiment, for example, the light-emitting layer **49** largely emits the light L (external light) downward. The light L thus emitted by the light-emitting layer **49** is not only removed to an external source of the organic electroluminescent device **3** as external light, but is also sometimes lost within the organic electroluminescent device **3**.

[0040] The light-masking sealing layer **13** covers the plurality of electrodes (the anode **46** and the cathode **52**) and the light-emitting layer **49**. This light-masking sealing layer **13** has a function of not permitting light transmission during light irradiation in the inspection method (inspection process) described later. The light-masking sealing layer **13** also has the function of masking light so that the light emitted by the light-emitting layer **49** is not leaked to the outside. The light-masking sealing layer **13** has gas barrier characteristics. The material employed in the light-masking sealing layer **13** may be either a metal material, such as Al, Cu, or Cr, a metal oxide or metal nitride having low transmissivity, such as CrN. The thickness of the light-masking sealing layer **13** is at least, for example, greater than or equal to 10 nm and less than or equal to 100 μm, preferably greater than or equal to 100 nm and less than or equal to 10 μm, for example.

Operation Example of the Organic Electroluminescent Device 3

[0041] The organic electroluminescent device **3** and the display device **1** into which the organic electroluminescent device **3** is built thus comprise the above-described configuration, and an example of the operation of the organic electroluminescent device **3** and the display device **1** into which the organic electroluminescent device **3** is built will now be described.

[0042] In the display device **1** illustrated in FIG. 1, a large number of organic electroluminescent devices **3** are arranged in a matrix shape in the display panel **7** thereof, and the large number of organic electroluminescent devices **3** operate as described below based on the control performed by the drive circuit **6**.

[0043] First, the drive circuit **6** drives each of the organic electroluminescent devices **3** based on inputted imaged data so as to display an image based on the image data on the display panel **7**. Then, in each of the organic electroluminescent devices **3**, this drive circuit **6** applies DC voltage from a predetermined power supply (not shown) between the anode **46** and the cathode **52** illustrated in FIG. **2**.

[0044] When DC voltage is thus applied to the anode **46** and the cathode **52**, the anode **46** discharges holes. The holes discharged from the anode **46** arrive at the light-emitting layer **49**. In this manner, the light-emitting layer **49** is capable of receiving holes from the anode **46**. On the other hand, the cathode **52** injects electrons into the light-emitting layer **49**. In this manner, the light-emitting layer **49** is capable of receiving electrons discharged from the cathode **52**.

[0045] The light-emitting layer **49** operates as described below based on the holes and electrons thus injected. The injected holes and electrons are recombined inside the light-emitting layer **49**, and there are in an excited state, which is in an unstable, high-energy state. The light-emitting layer **49** then promptly returns to its original ground state, which is a stable, low-energy state. At this time, the light-emitting layer **49** emits the light L based on the difference in energy between the excited state and the ground state.

[0046] With this arrangement, the display device **1** illustrated in FIG. **1** emits the light L from the pixels corresponding to each of the organic electroluminescent devices **3** based on the control performed by the drive circuit **6**, making it possible to display a predetermined image on the display panel **7**. At this time, the display device **1** is capable of outputting sound from the speakers **4** in synchronization with the display of this image.

Display Panel Manufacturing Method **1** of Embodiment 1

[0047] With the operation example of the organic electroluminescent device **3** and the display device **1** as described above, an example of the manufacturing method of the organic electroluminescent device **3** arranged in the display panel **7** will now be described with reference to FIG. **1** and FIG. **2**. Note that the manufacturing method of the display panel **7** includes the inspection method of the organic electroluminescent device **3**.

[0048] FIG. **3** to FIG. **7** are each cross-sectional views illustrating an example in which the organic electroluminescent device **3** of the display panel **7** is manufactured according to the manufacturing method of the display panel **7** of embodiment 1.

[0049] First, the glass substrate **45** is prepared as illustrated in the figures, and the transparent anode **46** is formed as a film on top of this glass substrate **45** as illustrated (first electrode formation step). The light-emitting layer **49** is then formed on top of the anode **46** thus formed, at a position where the organic electroluminescent device **3** is to be formed, as illustrated in the figures (light-emitting layer formation step).

[0050] Furthermore, as illustrated in FIG. **6**, the cathode **52** is formed as a film on top of this light-emitting layer **49** (second electrode formation step). The light-masking sealing layer **13** is then formed on top of the cathode **52** so as to cover not only the cathode **52** but the light-emitting layer **49** as well as the cathode **52** as illustrated in FIG. **2** (part of the light-masking sealing layer formation step). This light-masking sealing layer **13** employs a sealing base material having a transmissivity that is at least lower than that of the light-emitting layer **49** within a certain wavelength range, as described above. This sealing base material may be formed by a vapor deposition method based on CVD (Chemical Vapor Deposition) or sputtering, for example, or may be formed using an evaporation method using vacuum evaporation, for example. In such a case, the sealing base material forms a 300 nm CrN layer from reactive sputtering using Cr as the sputtering target and N_2 as the reactive gas.

[0051] While the light-masking sealing layer **13** is thus formed, the defect **2** such as illustrated in the FIG. **7** sometimes occurs in the light-masking sealing layer **13** when the device is thus sealed by the light-masking sealing layer **13**. This defect **2** is very small, for example, and difficult to visually recognize as is. In this embodiment, the sealed stated achieved by the light-masking sealing layer **13** is then further inspected as described below.

Display Panel Inspection Process of Embodiment 1

[0052] First, light is irradiated from the glass substrate side on the organic electroluminescent device **3** as illustrated in the figure. Then, since the CrN, for example, forms an even film serving as the light-masking sealing layer **13** on the organic electroluminescent device **3**, the transmitted light is not detected if the defect **2** does not exist in the light-masking sealing layer **13**. Nevertheless, in a particular organic electroluminescent device **3**, it is possible to confirm a light-transmitting spot **2** of a diameter of about 2 μm, for example, in the light-masking sealing layer **13**. That is, this light-transmitting spot is the area of the defect **2** in the light-masking sealing layer **12** (CrN layer) responsible for gas barrier characteristics.

[0053] Thus, since such the defect **2** is visually recognizable as a light-transmitting spot, according to this inspection method, it is possible to quickly and easily recognize the presence of a (expanding) spot-shaped defect **2** that enlarges with the passage of time at ambient temperature, prior to shipment of the organic electroluminescent device **3**, for example. This makes it possible to prevent outflow to the market of the defective display device **1** that employs the display panel **7** comprising a built-in organic electroluminescent device **3** having the defect **2**, for example.

[0054] In this embodiment, since the light-masking sealing layer **13** is employed as the sealing member as described above, the defect **2** is detectable as a light-transmitting spot or abnormal light-transmitting spot from the irradiation of white light, etc., in the inspection process.

[0055] The display device **1** of the above embodiment comprises the display panel **7** having the organic electroluminescent device **3**; and the driving circuit, the organic electroluminescent device **3** comprising the plurality of electrodes **46** and **52** (anode and cathode) stacked on the substrate **45**, one of the electrodes **46**, **52** being transparent, the organic electroluminescent layer **49** (light-emitting layer) that is layered between the plurality of electrodes **46** and **52** and emits light by means of an electric field generated between the plurality of electrodes **46** and **52** by an applied voltage, and the light-masking sealing layer that covers the plurality of electrodes **46** and **52** and the organic electroluminescent layer **49** and has a transmissivity that is at least lower than the organic electroluminescent layer **49** (light-emitting layer) within a certain wavelength range; and the drive circuit providing an applied voltage between the plurality of electrodes **46** and **52** in accordance with inputted image data so as to drive each of the organic electroluminescent devices **3** of the display panel **7**.

[0056] In the display panel **7** of the above embodiment is arranged the organic electroluminescent device **3** comprising the plurality of electrodes **46** and **52** stacked on the substrate, one of the electrodes being transparent; the organic electroluminescent layer **49** that is layered between the plurality of electrodes **46** and **52** and emits light by means of an electric field generated between the plurality of electrodes **46** and **52** by an applied voltage, and the light-masking sealing layer **13** that covers the plurality of electrodes **46** and **52** and the organic electroluminescent layer **49**, and has a transmissivity that is at least lower than that of the organic electroluminescent layer **49** within a certain wavelength range.

[0057] With such a configuration, when the light of the above-described certain wavelength range is irradiated from the outside toward the substrate **45**, the light passes through the organic electroluminescent layer **49** (light-emitting layer) and reaches the light-masking sealing layer **13**. At this time, when the defect **2** has occurred in the light-masking sealing layer **13**, light leaks out from the area of the defect **2** only, even though all light should be masked by the light-masking sealing layer **13**. This makes it possible to easily visually recognize only the area of the defect **2** as a light-emitting spot. With this arrangement, it is possible to easily visually detect whether or not the defect **2** is present in the light-masking sealing layer **13** using the simple method of irradiating light from the outside, through the substrate **45**, and toward the light-masking sealing layer **13**.

[0058] To identify prior to shipment whether the defect **2** (dark spot) is a point defect having expandability, any known general analytical method may be used, such as surface shape analysis by a white light interference microscope or AFM. While these methods make it possible to measure the convexoconcave shape of the light-masking sealing layer **13** and detect the size of the defect **2** on the overall surface of the display panel **7**, difficulties arise when an attempt is made to detect the defect **2** having an extremely small size on the overall surface of the display panel **7**. The information thus measured is referred to as height information. Nevertheless, according to this embodiment, it is possible to easily detect the defect **2**, even if the defect **2** is of an extremely small size. Further, when the display panel **7** (organic EL panel) has a large surface area and three-dimensional analysis is employed, surface shape analysis related to the presence of such the defect **2** requires much time, and any attempt to ascertain the presence of the defect **2** in the light-masking sealing layer **13** by height information only is confronted with difficulties. On the other hand, the defect **2** is readily detectable within a short period of time according to this embodiment, making it possible to identify whether or not the defect **2** exists in the light-masking sealing layer **13**.

[0059] The display device **1** and the display panel **7** of this embodiment each further comprise the light-masking sealing layer **13** formed by a vapor deposition method in addition to the above configuration. With this arrangement, the light-masking sealing layer **13** can be simply formed using a general film formation method.

[0060] The display device **1** and the display panel **7** of this embodiment each further comprise the light-masking sealing layer **13** formed by an evaporation method in addition to the above configuration. With this arrangement, the light-masking sealing layer **13** can be simply formed using a general film formation method.

[0061] The inspection method of the display panel **7** of the above embodiment comprises the step of: a light irradiating step for irradiating light on the light-masking sealing layer **13** of each of the organic electroluminescent devices **3** of the display panel **7**, the display panel **7** including the organic electroluminescent devices **3**, the organic electroluminescent devices **3** having: the plurality of electrodes **46** and **52** stacked on the substrate **45**, one of the electrodes **46**, **52** being transparent; the organic electroluminescent layer **49** that is layered between the plurality of electrodes **46** and **52** and emits light by means of an electric field generated between the plurality of electrodes **46** and **52** by an applied voltage; and the light-masking sealing layer **13** that covers the plurality of electrodes **46** and **52** and the organic electroluminescent layer **49** and has a transmissivity that is at least lower than that of the organic electroluminescent layer **49** within a certain wavelength range; and a defect inspection step for determining that a defect exists in the light-masking sealing layer **13** in a case where a light-transmitting spot exists in the light-masking sealing layer **13** and for determining that a defect does not exist in the light-masking sealing layer **13** in a case where a light-transmitting spot does not exist in the light-masking sealing layer **13**.

[0062] With a display panel **7***a* manufactured using such a manufacturing method, when light of the above-described certain wavelength range is irradiated from the outside toward the substrate **45**, the light passes through the organic electroluminescent layer **49** (light-emitting layer) and reaches the light-masking sealing layer **13**. At this time, when the defect **2** has occurred in the light-masking sealing layer **13**, light leaks out from the area of the defect **2** only, even though all light should be masked by the light-masking sealing layer **13**. This makes it possible to easily visually recognize only the area of the defect **2** as a light-emitting spot. With this arrangement, it is possible to easily visually detect whether or not the defect **2** is present in the light-masking sealing layer **13** using the simple method of irradiating light from the outside, through the substrate **45**, and toward the light-masking sealing layer **13**.

[0063] While the above-described surface shape analysis method makes it possible to measure the convexoconcave shape of the light-masking sealing layer **13** and detect the size of the defect **2** on the overall surface of the display panel **7**, difficulties arise when an attempt is made to detect the defect **2** having an extremely small size on the overall surface of the display panel **7**. Nevertheless, according to this embodiment, it is possible to easily detect the defect **2**, even if the defect **2** is of an extremely small size. Further, when the display panel **7** (organic EL panel) has a large surface area and three-dimensional analysis is employed, surface shape analysis related to the presence of such the defect **2** requires much time, and any attempt to ascertain the presence of the defect **2** in the light-masking sealing layer **13** by height information only is confronted with difficulties. On the other hand, the defect **2** is readily detectable within a short period of time according to this embodiment, making it possible to identify whether or not the defect **2** exists in the light-masking sealing layer **13**.

Embodiment 2

[0064] FIG. **8** is a cross-sectional view illustrating a configuration example of an organic electroluminescent device **3***a* arranged in the display panel **7***a* of a display device **1***a* of embodiment 2.

[0065] The organic electroluminescent device **3***a* of embodiment 2 has substantially the same configuration and operates substantially in the same manner as the organic electroluminescent device **3** of embodiment 1. The same reference numerals as those employed in FIG. **1** to FIG. **7** of embodiment 1 will therefore be used for the same components and operation, and descriptions thereof will be omitted.

The following will describe the organic electroluminescent device **3***a* while focusing on unique points.

[0066] The organic electroluminescent device **3***a* of embodiment 2 differs from the organic electroluminescent device **3** of embodiment 1 in that a light-emitting covering layer **8** and a sealing layer **12** are formed in place of the light-masking sealing layer **13**. Specifically, the organic electroluminescent device **3***a* comprises the following configuration.

[0067] First, the organic electroluminescent device **3***a* is a bottom-emission type organic electroluminescent device, for example, with one device formed correspondingly for each color red, green, and blue, for example. This organic electroluminescent device **3***a* comprises a structure wherein the anode **46** (transparent electrode), the light-emitting layer **49** (organic electroluminescent layer), and the cathode **52** (electrode) are stacked in the described order on the glass substrate **45** and then covered by the light-emitting covering layer **8**. Further, on this light-emitting covering layer **8** is formed the sealing layer **12** which seals the light-emitting covering layer **8** and has light-masking characteristics with respect to the light emitted by the light-emitting covering layer **8**. That is, the sealing layer **12** transmits excitation light (ultraviolet light from an Hg lamp, for example) to generate light excitation on the light-emitting covering layer **8**, and has the function of masking the light (orange light of an approximate 580 nm wavelength, for example) emitted by light excitation by the light-emitting covering layer **8**.

[0068] The anode **46** and the cathode **52** (electrodes) comprise a configuration in which the two are stacked on the glass substrate **45**, with one being transparent. Further, the anode **46** and the cathode **52** are respectively made of a material such as ITO (Indium Tin Oxide) and Al. Furthermore, the organic electroluminescent device **3***a* may employ a structure wherein an electric charge and exciter diffusion layer for capturing an electric charge and exciter within the light-emitting layer **49** is layered. The organic electroluminescent device **3***a* shown in the figure corresponds to one pixel section.

[0069] The glass substrate **45** is formed by a transparent material. Note that the anode **46** may be made of the material IZO rather than the above-mentioned ITO. The anode **46** comprises a transparent electrode through which a light L emitted by the light-emitting layer **49** is transmitted, as described later. The anode **46** (one of the plurality of electrodes) is formed on the glass substrate **45** at large, along the glass substrate **45**. This anode **46** has a function of supplying holes to the light-emitting layer **49** described later.

[0070] The light-emitting layer **49** is a light-emitting device that employs a so-called electroluminescence (EL) phenomenon. The light-emitting layer **49** is layered between the plurality of electrodes **46** and **52**, and has the function of emitting light by an electric field generated between the plurality of electrodes **46** and **52** by an applied voltage. This light-emitting layer **49** outputs its own light L by utilizing a phenomenon in which light is emitted based on energy received from an external source using an electric field.

[0071] In a case where the organic electroluminescent device **3** is a bottom-emission type, as in the present embodiment, for example, the light-emitting layer **49** largely emits the light L (external light) downward. The light L thus emitted by the light-emitting layer **49** is not only removed to an external source of the organic electroluminescent device **3***a* as external light, but is also sometimes lost within the organic electroluminescent device **3***a*.

[0072] The sealing layer **12** also has the function of masking light so that the light emitted by the light-emitting covering layer **8**, which absorbed light, is not leaked to the outside. The material employed in the sealing layer **12** has gas barrier characteristics, and may be either a metal material, such as Al, Cu, or Cr, or a metal oxide or metal nitride having low transmissivity, such as CrN. The thickness of the sealing layer **12** is at least, for example, greater than or equal to 10 nm and less than or equal to 100 μm, preferably greater than or equal to 100 nm and less than or equal to 10 μm, for example.

[0073] The light-emitting covering layer **8** may be an inorganic or organic material, and does not necessarily have to have gas barrier characteristics. The inorganic material employed may be a direct transition-type semiconductor material, such as GaN, and the emission center material employed may be SiOx, SiNx, AlOx, AlNx, or the like topped with a rare earth element such as Tb (green emission), a transition metal element such as Mn (orange emission), or the like. The organic material employed may be a light-emitting low molecular organic material such as α-NPD, or a high-molecular organic material. Similarly, the thickness of the light-emitting covering layer **8** is at least greater than or equal to 10 nm and less than or equal to 100 μm, preferably greater than or equal to 100 nm and less than or equal to 10 μm.

Display Panel Manufacturing Method of Embodiment 2

[0074] With the operation example of the organic electroluminescent device **3***a* and the display device **1***a* as described above, an example of the manufacturing method of the organic electroluminescent device **3***a* arranged in the display panel **7***a* will now be described with reference to FIG. **1** and FIG. **8**. Note that the manufacturing method of the display panel **7***a* includes the inspection method of the organic electroluminescent device **3***a*.

[0075] FIG. **3** to FIG. **6** and FIG. **9** to FIG. **10** are each cross-sectional views illustrating an example of the mode in which the organic electroluminescent device **3** of the display panel **7***a* is manufactured according to the manufacturing method of the display panel **7***a* of embodiment 2.

[0076] First, the glass substrate **45** is prepared as illustrated in FIG. **3**, and the transparent anode **46** is formed as a film on top of this glass substrate **45** as illustrated in FIG. **4** (first electrode formation step). The light-emitting layer **49** is then formed on top of the anode **46** thus formed, at a position where the organic electroluminescent device **3** is to be formed, as illustrated in FIG. **5** (light-emitting layer formation step).

[0077] Furthermore, as illustrated in FIG. **6**, the cathode **52** is formed as a film on top of this light-emitting layer **49** (second electrode formation step). A covering base material is then further formed on top of the cathode **52** so as to cover not only the cathode **52** but the light-emitting layer **49** as well as the cathode **52** (part of the light-emitting covering layer formation step). This covering base material may be formed by a vapor deposition method based on CVD (Chemical Vapor Deposition) or sputtering, for example, or may be formed using an evaporation method based on vacuum evaporation, for example. In this case, the covering base material is formed with α-NPD by vacuum evaporation, for example, in an amount of approximately 300 nm. In this manner, the organic electroluminescent device **3***a* is thus manufactured.

[0078] On the organic electroluminescent device **3***a* thus configured is formed the light-emitting covering layer **8** as illustrated in FIG. **8** (part of the light-emitting covering layer formation step). Further, on this light-emitting covering layer **8** is formed the sealing layer **12** by sputtering, for example (sealing layer formation step). A 300 nm CrN layer is formed from reactive sputtering using, for example, Cr as the sputtering film formation target and N_2 as the reactive gas.

[0079] While the light-emitting covering layer **8** is thus formed, the defect **2** such as illustrated in the figure sometimes occurs in the light-emitting covering layer **8** when the device is thus sealed by the light-emitting covering layer **8**. This defect **2** is very small, for example, and difficult to visually recognize as is. In this embodiment, the sealed stated achieved by the light-emitting covering layer **8** is then inspected as described below.

Display Panel Inspection Process of Embodiment 2

[0080] First, the organic electroluminescent device **3***a* irradiates excitation light from the side closer to the sealing layer **12** as illustrated in FIG. **10**. The light-emitting covering layer **8** is excited by the excitation light (ultraviolet light L from an Hg lamp, for example) thus irradiated, causing excitation of only the part of the light-emitting covering layer **8** under the defect **2**, and light emits therefrom. Then, light emission is not detected from any area of the light-emitting covering layer **8** other than the area of the defect **2** since an even layer of CrN, for example, is formed thereon. Nevertheless, in a certain organic electroluminescent device **3***a*, it is possible to confirm the emission of blue light from the light-emitting covering layer **8** which comprises the material α-NPD, for example, as a light-emitting spot having an approximate 2 μm diameter. That is, this light-emitting spot is from the area of the defect **2** in the sealing layer **12** (CrN layer, for example) responsible for gas barrier characteristics.

[0081] Thus, since such the defect **2** is visually recognizable as a light-emitting spot according to this inspection method, it is possible to quickly and easily recognize the presence of an (expanding) spot-shaped defect **2** that enlarges with the passage of time at ambient temperature, prior to shipment of the organic electroluminescent device **3***a*, for example. This makes it possible to prevent outflow to the market of the defective display device **1***a*, for example, that employs the display panel **7***a* comprising a built-in organic electroluminescent device **3***a* having the defect **2**.

[0082] In this embodiment, the light-emitting covering layer **8** that contains a material that emits light by light excitation is thus employed as the sealing member, enabling detection of the defect **2** as a light-emitting spot by irradiation of excitation light such as ultraviolet light or the like from the light-emitting covering layer **8**.

[0083] The display device **1** of the above embodiment comprises the display panel **7** having the organic electroluminescent device **3**; and the driving circuit **6**, the organic electroluminescent device **3** including the plurality of electrodes **46** and **52** stacked on the substrate **45** (glass substrate), one of the electrodes **46**, **52** being transparent, the organic electroluminescent layer **49** (light-emitting layer) that is layered between the plurality of electrodes **46** and **52** and emits light by means of an electric field generated between the plurality of electrodes **46** and **52** by an applied voltage, the light-emitting covering layer **8** that covers the plurality of electrodes **46** and **52** and the organic electroluminescent layer **49** and emits light by light excitation based on irradiated excitation light, and the sealing layer **12** that seals the light-emitting covering layer **8** and has light-masking characteristics with respect to at least the light emitted by the light-emitting covering layer **8**; and the drive circuit **6** providing an applied voltage between the plurality of electrodes **46** and **52** in accordance with inputted image data so as to drive each of the organic electroluminescent devices **3** of the display panel **7**.

[0084] In the display panel **7** of the embodiment is arranged the organic electroluminescent device **3** comprising the plurality of electrodes **46** and **52** stacked on the substrate **45** (glass substrate), one of the electrodes being transparent; the organic electroluminescent layer **49** (light-emitting layer) that is layered between the plurality of electrodes **46** and **52** and emits light by means of an electric field generated between the plurality of electrodes **46** and **52** by an applied voltage; the light-emitting covering layer **8** that covers the plurality of electrodes **46** and **52** and the organic electroluminescent layer **49**, and emits light by light excitation based on irradiated excitation light; and the sealing layer **12** that seals the light-emitting covering layer **8** and has light-masking characteristics with respect to at least the light emitted by the light-emitting covering layer **8**.

[0085] With such a configuration, when the excitation light is irradiated on the sealing layer **12** from the outside, the light arrives at the light-emitting covering layer **8** via the defect **2** of the sealing layer **12**. The light-emitting covering layer **8** then emits light by light excitation based on the absorbed excitation light. At this time, when the defect **2** has occurred in the sealing layer **12**, light is leaked from the dark section masked by the sealing layer **12** only in the area of the defect **2**. This makes it possible to easily visually recognize only the area of the defect **2** as a light-emitting spot. With this arrangement, the sealing layer **12** can be easily visually inspected for the defect **2** using the simple method of irradiating excitation light on the sealing layer **12**.

[0086] While the above-described surface shape analysis method makes it possible to measure the convexoconcave shape of the sealing layer **12** and detect the size of the defect **2** on the overall surface of the display panel **7***a* as described above, difficulties arise when an attempt is made to detect the defect **2** having an extremely small size on the overall surface of the display panel **7***a*. Nevertheless, according to this embodiment, it is possible to easily detect the defect **2**, even if the defect **2** is of an extremely small size. Further, when the display panel **7***a* (organic EL panel) has a large surface area and three-dimensional analysis is employed, surface shape analysis related to the presence of such the defect **2** requires much time, and any attempt to ascertain the presence of the defect **2** in the sealing layer **12** by the aforementioned height information only is confronted with difficulties. On the other hand, the defect **2** is readily detectable within a short period of time according to this embodiment, making it possible to identify whether or not the defect **2** exists in the sealing layer **12**.

[0087] The display device **1***a* and the display panel **7***a* are each provided with the sealing layer **12** formed by a vapor deposition method. With this arrangement, the sealing layer **12** can be simply formed using a general film formation method.

[0088] The display device **1***a* and the display panel **7***a* are each provided with the sealing layer **12** formed by an evaporation method. With this arrangement, the sealing layer **12** can be simply formed using a general film formation method.

[0089] The inspection method of the display panel **7** of the above embodiment comprises the steps of: a light irradiating step for irradiating light on the sealing layer **12** of each of the organic electroluminescent devices **3** of the display panel **7**, the display panel **7** including the organic electroluminescent device **3**, the organic electroluminescent device **3** having; the plurality of electrodes **46** and **52** stacked on the substrate **45**, one of the electrodes **46**, **52** being transparent; the organic electroluminescent layer **49** that is layered between the plurality of electrodes **46** and **52** and emits light by means of an electric field generated between the plurality of electrodes **46** and **52** by an applied voltage; the light-emitting covering layer **8** that covers the plurality of electrodes **46** and **52** and the organic electroluminescent layer **49** and emits light by light excitation based on irradiated excitation light, and the sealing layer **12** that seals the light-emitting covering layer **8** and has light-masking characteristics with respect to at least the light emitted by the light-emitting covering layer **8**; and a defect inspection step for determining that the defect **2** exists in the sealing layer **12** in a case where a light-emitting spot exists in the sealing layer **12**, and for determining that a defect does not exist in the sealing layer **12** in a case where a light-emitting spot does not exist in the sealing layer **12**.

[0090] With such a configuration, when excitation light is irradiated on the sealing layer **12** from the outside, the light arrives at the light-emitting covering layer **8** via the defect **2** of the sealing layer **12**. The light-emitting covering layer **8** then emits light by light excitation based on the absorbed excitation light. At this time, when the defect **2** has occurred in the sealing layer **12**, light is leaked from the dark section masked by the sealing layer **12** only in the area of the defect **2**. This makes it possible to easily visually recognize only the area of the defect **2** as a light-emitting spot. With this arrangement, the sealing layer **12** can be easily visually inspected for the defect **2** using the simple method of irradiating excitation light on the sealing layer **12**.

[0091] According to this embodiment, compared to a case where surface shape analysis by a white light interference microscope or AFM such as described above is employed, it is possible to easily detect the defect **2** having an extremely small size as described above. Further, surface shape analysis related to the presence of such the defect **2** is confronted with difficulties when an attempt is made to ascertain the presence of the defect **2** in the sealing layer **12** based on height information only. However, the defect **2** is readily detectable within a short period of time according to this embodiment, making it possible to identify whether or not the defect **2** exists in the sealing layer **12**.

[0092] The manufacturing method of the display panel **7** of the above embodiment comprises a first electrode formation step for stacking a transparent first electrode **46** on the substrate **45** (glass substrate); a light-emitting layer formation step for forming on the first electrode **46** the organic electroluminescent layer **49** (light-emitting layer) that emits light by an electric field, a second electrode formation step for forming the second electrode **52** on the organic electroluminescent layer **49**, a light-emitting covering layer formation step for forming the light-emitting covering layer **8** that covers the first electrode **46**, the organic electroluminescent layer **49**, and the second electrode **52**, and emits light by light excitation based on irradiated excitation light; a sealing layer formation step for forming the sealing layer **12** that seals the light-emitting covering layer **8** and has light-masking characteristics with respect to the light emitted by the light-emitting covering layer **8**; and the light irradiation step for irradiating light on the sealing layer **12** of each of the organic electroluminescent devices **3** of the display panel **7**, the organic electroluminescent device **3** comprising the substrate **45**, the first electrode **46**, the organic electroluminescent layer **49**, the second electrode **52**, the light-emitting covering layer **8**, and the sealing layer **12**.

[0093] When excitation light is irradiated on the sealing layer **12** from outside the display panel **7** manufactured by such a manufacturing method, the excitation light transmitted through the sealing layer **12** arrives at the light-emitting covering layer **8** or at the light-emitting covering layer **8** via the defect **2** of the sealing layer **12**. The light-emitting covering layer **8** then emits light by light excitation based on the absorbed excitation light. At this time, when the defect **2** has occurred in the sealing layer **12**, light is leaked from the dark section masked by the sealing layer **12** only in the area of the defect **2**. This makes it possible to easily visually recognize only the area of the defect **2** as a light-emitting spot. With this arrangement, the sealing layer **12** can be easily visually inspected for the defect **2** using the simple method of irradiating excitation light on the sealing layer **12**.

[0094] According to this embodiment, compared to a case where surface shape analysis by a white light interference microscope or AFM such as described above is employed, it is possible to easily detect the defect **2** having an extremely small size as described above. Further, surface shape analysis related to the presence of such the defect **2** is confronted with difficulties when an attempt is made to ascertain the presence of the defect **2** in the sealing layer **12** based on height information only. Nevertheless, the defect **2** is readily detectable within a short period of time according to this embodiment, making it possible to identify whether or not the defect **2** exists in the sealing layer **12**.

[0095] Note that this embodiment is not limited to the above, and various modifications are possible. In the following, details of such modifications will be described one by one.

[0096] While the above embodiments have described illustrative scenarios in which the organic electroluminescent devices **3** and **3**_a_ each comprise the light-emitting layer **49** between the anode **46** and the cathode **52**, the present invention is not limited thereto, allowing the following as well.

[0097] That is, in the organic electroluminescent devices **3** and **3**_a_, a mode where a hole injection layer **47** and a hole transport layer **48** are each provided between the anode **46** and the light-emitting layer **49**, as well as a mode where an electron transport layer **50** and an electron injection layer **51** are provided between the light-emitting layer **49** and the cathode **52** are allowed. The material used for the hole injection layer **47**, the hole transport layer **48**, the electron transport layer **50**, and the electron injection layer **51** may be CuPc, NPB, Alg_3, and LiF, respectively.

[0098] The hole injection layer **47** is stacked so that the holes are readily removable from the anode **46**. The hole transport layer **48** has a function of transporting the holes removed from the anode **46** by the hole injection layer **47** to the light-emitting layer **49**. The hole injection layer **47** is mainly stacked on the anode **46**. The hole transport layer **48** is stacked on the hole injection layer **47**.

[0099] The electron transport layer is stacked on the light-emitting layer **49**. Furthermore, the electron injection layer **51** is stacked on the electron transport layer **50**. The cathode **52** is formed on the electron injection layer **51**. Of these, the electron injection layer **51** has the function of readily removing the electrons from the cathode **52**. Additionally, the electron transport layer **50** has the function of efficiently transporting the electrons removed from the cathode **52** by the electron injection layer **51** to the light-emitting layer **49**.

[0100] The sealing technique applied in the above embodiments may be an organic memory, sensor, or solar cell sealing technique for both the organic electroluminescent devices **3** and **3***a*. Further, in the above embodiments, various modes may be used for the configuration of sections other than the sections touched upon in the descriptions above. While the above embodiments have described illustrative scenarios in which the glass substrate **45** is used as the substrate, the present invention is not limited thereto, allowing use of a variety of materials. Further, in the above embodiments, the driving method of the display device **1** is not particularly limited.

[0101] Further, in the inspection process of the above embodiment 1, the wavelength of the light used in the inspection is not limited as long as it is not harmful to the organic electroluminescent device, and may be general white light, for example. Additionally, the excitation light irradiated to detect the defect **2** in the inspection process of the above embodiment 2 is not limited to ultraviolet light, allowing use of various wavelengths. Specifically, as the excitation light in the above embodiment 2, an excitation wavelength having the highest light emission efficiency is preferred. Furthermore, as the excitation light in the above embodiment 2, use of an excitation light having a long wavelength that minimizes damage to the organic electroluminescent device **3**, etc., is preferred.

1-11. (canceled)

12. A display device comprising:

a display panel having an organic electroluminescent device; and

a driving circuit,

said organic electroluminescent device including:

a plurality of electrodes stacked on a substrate, one of said electrodes being transparent;

an organic electroluminescent layer that is stacked between said plurality of electrodes and emits light by means of an electric field generated between said plurality of electrodes by an applied voltage, and a light-masking sealing layer that covers said plurality of electrodes and said organic electroluminescent layer, and has a transmissivity that is at least lower than that of said organic electroluminescent layer within a certain wavelength range; and said driving circuit providing an applied voltage between said plurality of electrodes in accordance with inputted image data so as to drive each of said organic electroluminescent devices of said display panel.

13. The display device according to claim **12**, wherein:

said light-masking sealing layer is formed by a vapor deposition method.

14. The display device according to claim **12**, wherein:

said light-masking sealing layer is formed by an evaporation method.

15. A display device comprising:

a display panel having an organic electroluminescent device; and

a driving circuit, said organic electroluminescent device including:

a plurality of electrodes stacked on a substrate, one of said electrodes being transparent, an organic electroluminescent layer that is stacked between said plurality of electrodes and emits light by means of an electric field generated between said plurality of electrodes by an applied voltage, a light-emitting covering layer that covers said plurality of electrodes and said organic electroluminescent layer, and emits light by light excitation based on irradiated excitation light, and a sealing layer that seals said light-emitting covering layer and has light-masking characteristics with respect to at least a light emitted by said light-emitting covering layer; and said driving circuit providing an applied voltage between said plurality of electrodes in accordance with inputted image data so as to drive each of said organic electroluminescent devices of said display panel.

16. The display device according to claim **15**, wherein:

said sealing layer is formed by a vapor deposition method.

17. The display device according to claim **15**, wherein;

said sealing layer is formed by an evaporation method.

18. A display panel comprising an organic electroluminescent device,

said organic electroluminescent device including:

a plurality of electrodes stacked on a substrate, one of said electrodes being transparent;

an organic electroluminescent layer that is stacked between said plurality of electrodes and emits light by means of an electric field generated between said plurality of electrodes by an applied voltage; and a light-masking sealing layer that covers said plurality of electrodes and said organic electroluminescent layer, and has a transmissivity that is at least lower than that of said organic electroluminescent layer within a certain wavelength range.

19. A display panel comprising an organic electroluminescent device,

said organic electroluminescent device including:

a plurality of electrodes stacked on a substrate, one of said electrodes being transparent;

an organic electroluminescent layer that is stacked between said plurality of electrodes and emits light by means of an electric field generated between said plurality of electrodes by an applied voltage;

a light-emitting covering layer that covers said plurality of electrodes and said organic electroluminescent layer, and emits light by light excitation based on irradiated excitation light; and a sealing layer that seals said light-emitting covering layer and has light-masking characteristics with respect to at least the light emitted by said light-emitting covering layer.

20. A display panel inspection method, comprising the steps of:

a light irradiation step for irradiating light on a light-masking sealing layer of each organic electroluminescent device of a display panel, said display panel including said organic electroluminescent device, said organic electroluminescent having: a plurality of electrodes stacked on a substrate, one of said electrodes being transparent; an organic electroluminescent layer that is stacked between said plurality of electrodes and emits light by means of an electric field generated between said plurality of electrodes by an applied voltage; and said light-masking sealing layer that covers said plurality of electrodes and said organic electroluminescent layer and has a transmissivity that is at least lower than that of said organic electroluminescent layer within a certain wavelength range; and a defect inspection step for determining that a defect exists in said light-masking sealing layer when a light-transmitting spot exists in said light-masking sealing layer, and for determining that a defect does not exist in said light-masking sealing layer when a light-transmitting spot does not exist in said light-masking sealing layer.

21. A display panel inspection method, comprising the steps of:

a light irradiation step for irradiating light on a sealing layer of each organic electroluminescent device of a display panel, said display panel including said organic electroluminescent device, said organic electroluminescent having: a plurality of electrodes stacked on a substrate, one of said electrodes being transparent; an organic electroluminescent layer that is stacked between said plurality of electrodes and emits light by means of an electric field generated between said plurality of electrodes by an applied voltage; a light-emitting covering layer that covers said plurality of electrodes and said organic electroluminescent layer and emits light by light excitation based on irradiated excitation light, and said sealing layer that seals said light-emitting covering layer and has light-masking characteristics with respect to at least the light emitted by said light-emitting covering layer; and a defect inspection step for determining that a defect exists in said sealing layer when a light-emitting spot exists in said sealing layer, and for determining that a defect does not exist in said sealing layer when a light-emitting spot does not exist in said sealing layer.

22. A display panel manufacturing method, comprising the steps of:

a first electrode formation step for stacking a transparent first electrode on a substrate;

a light-emitting layer formation step for forming on said first electrode an organic electroluminescent layer that emits light by an electric field;

a second electrode formation step for forming a second electrode on said organic electroluminescent layer; a sealing layer formation step for forming a light-masking sealing layer that covers said first electrode, said organic electroluminescent layer, and said second electrode and has a transmissivity that is at least lower than that of said organic electroluminescent layer within a certain wavelength; and a light irradiation step for irradiating light on said light-masking sealing layer of each organic electroluminescent device of a display panel, said organic electroluminescent device comprising said substrate, said first electrode, said organic electroluminescent layer, said second electrode, and said light-masking sealing layer.

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专利名称(译)	显示装置，显示面板，显示器检查方法和显示面板制造方法
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摘要(译)

提供一种有机电致发光器件，其包括堆叠在基板上的多个电极，至少一个电极是透明的，有机电致发光层，其层叠在多个电极之间，并且通过在多个电极之间产生的电场发光。电极和施加的电压，以及覆盖多个电极和有机电致发光层的遮光密封层，其透射率至少低于具有特定波长范围的有机电致发光层的透射率。