US 20030189400A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2003/0189400 A1**

Nishio et al. (43) **Pub. Date: Oct. 9, 2003**

(54) **METHOD OF MANUFACTURING ORGANIC ELECTROLUMINESCENT PANEL, ORGANIC ELECTROLUMINESCENE DEVICE, AND MASK**

(76) Inventors: **Yoshitaka Nishio**, Hirakata-city (JP); **Hiroshi Matsuki**, Hashima-gun (JP)

Correspondence Address:
MCDERMOTT WILL & EMERY
600 13TH STREET, N.W.
WASHINGTON, DC 20005-3096 (US)

(21) Appl. No.: **10/378,667**

(22) Filed: **Mar. 5, 2003**

(30) **Foreign Application Priority Data**

Mar. 5, 2002 (JP) JP2002-059591

Publication Classification

(51) **Int. Cl.**^{7} **H01J 1/62**; H01J 63/04

(52) **U.S. Cl.** **313/504**

(57) **ABSTRACT**

A method of manufacturing an organic EL panel is provided, which is capable of forming an organic luminescent layer without scratching an organic layer formed beneath. An organic luminescent layer is formed by evaporating an organic luminescent material over a hole injecting electrode by placing a mask used to evaporate a luminescent layer to be kept spaced apart from a substrate. By placing the mask while a bottom surface thereof is brought into contact with top surfaces of spacers, it is possible to space apart the mask from a hole transporting layer formed over the substrate. Although it is necessary to fine-tune the position of the mask during the color-layer successive deposition step of the organic luminescent layers, by performing the positioning while the mask is kept spaced apart from the substrate, it is possible to reduce a possibility that the mask scratches the hole transporting layer.

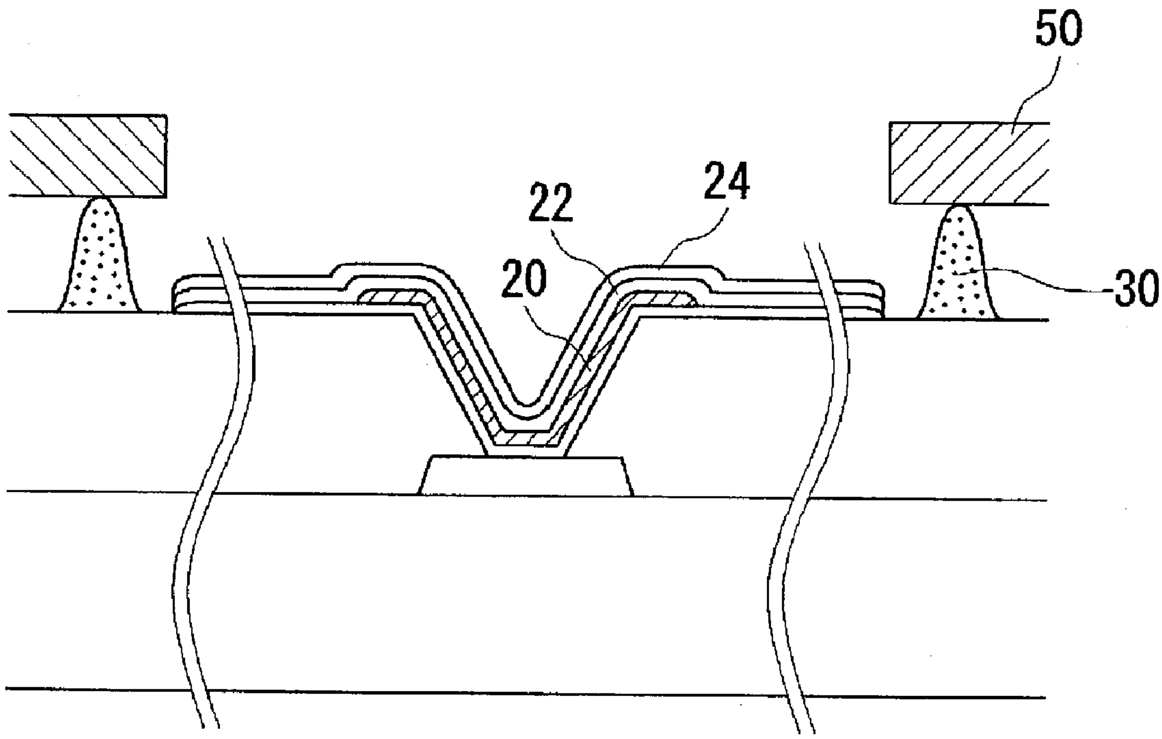


FIG. 1

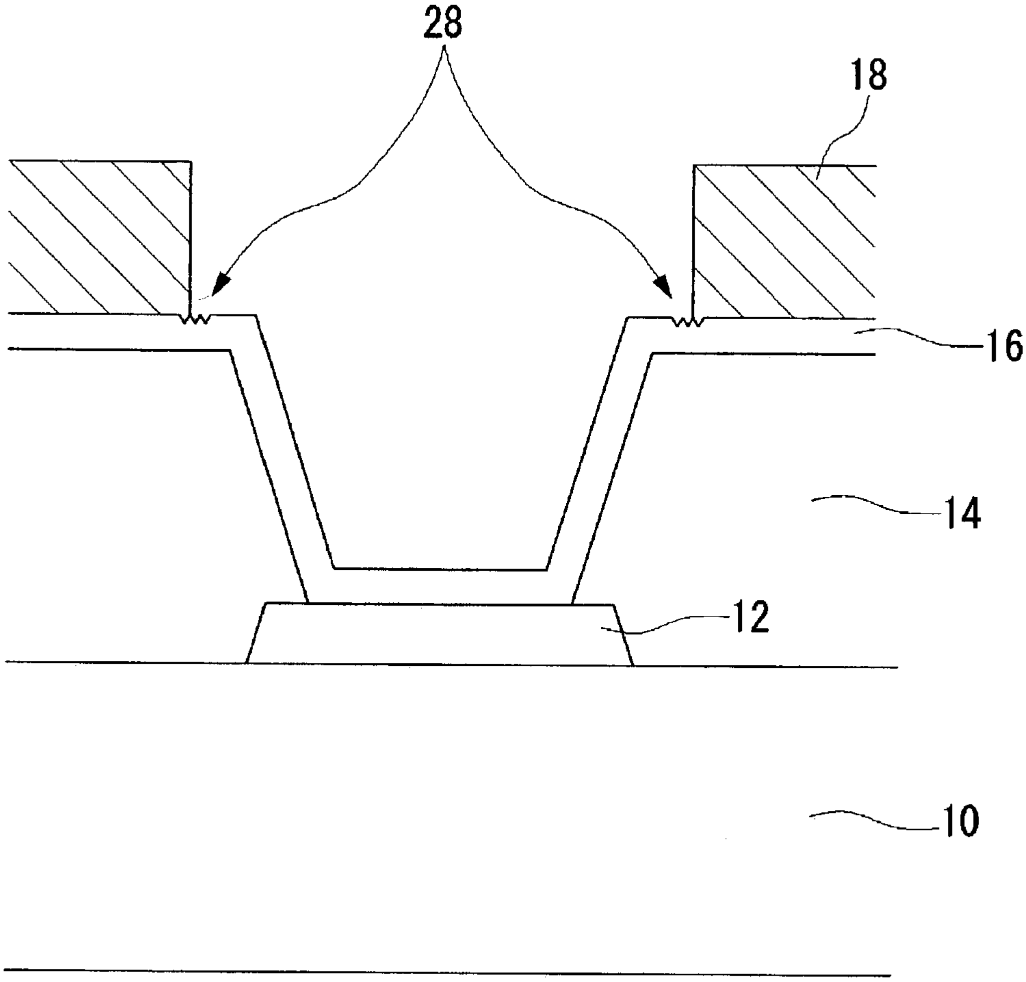


FIG.2A

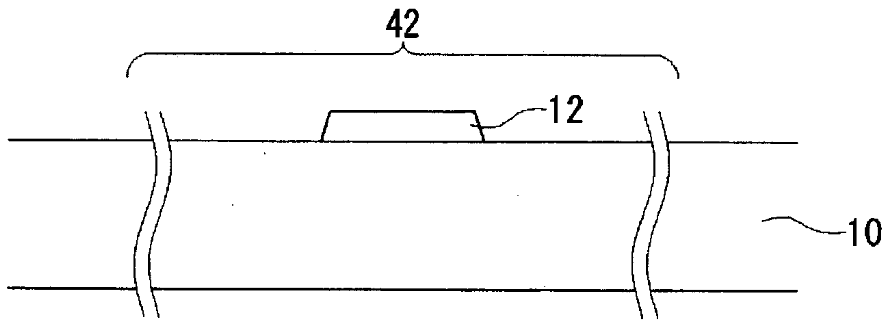


FIG.2B

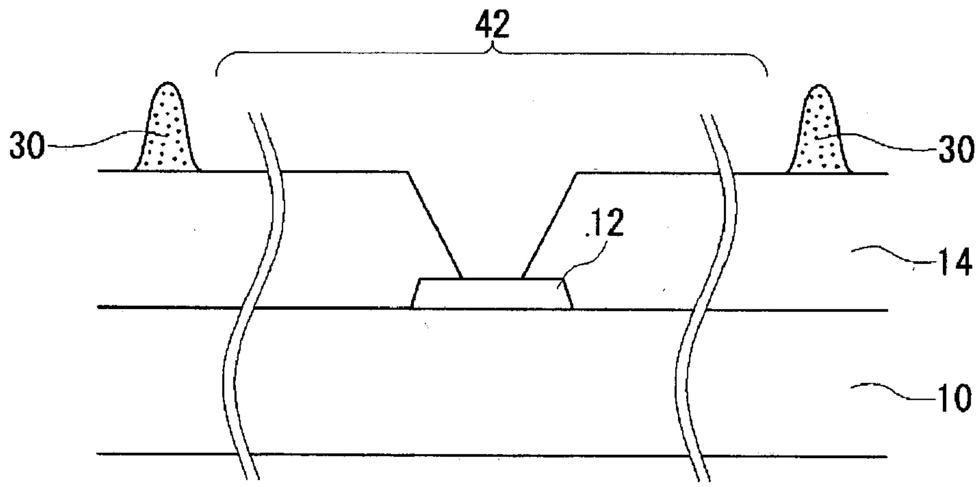


FIG.2C

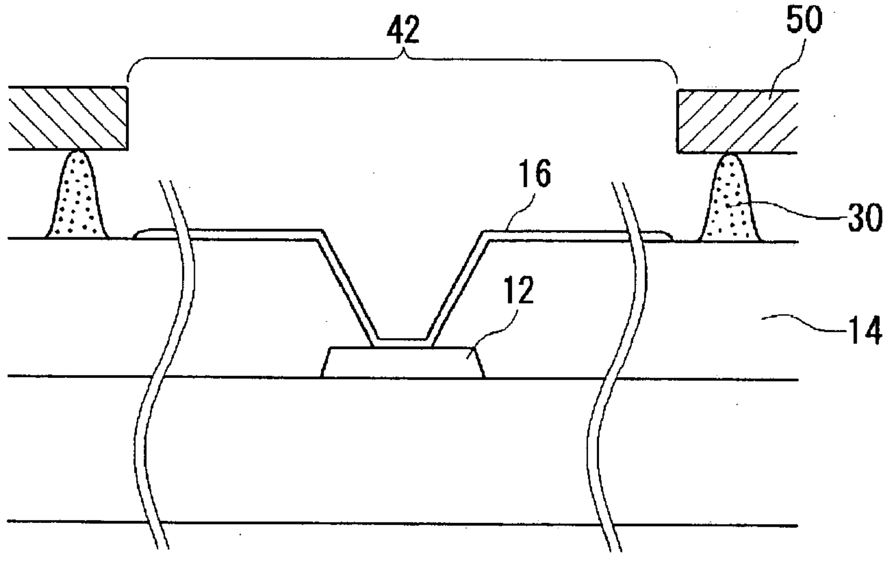


FIG.3A

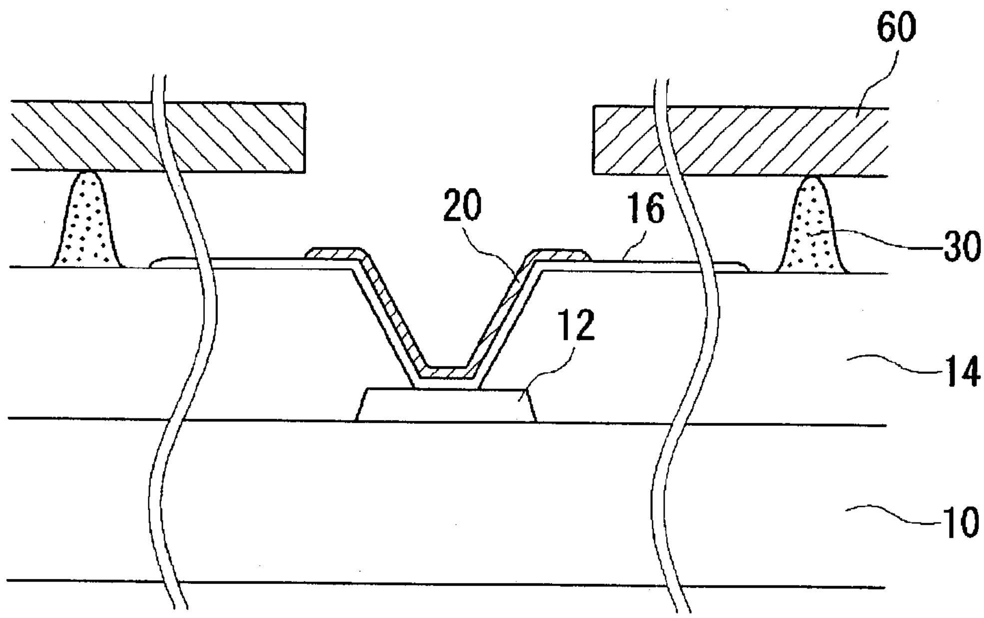


FIG.3B

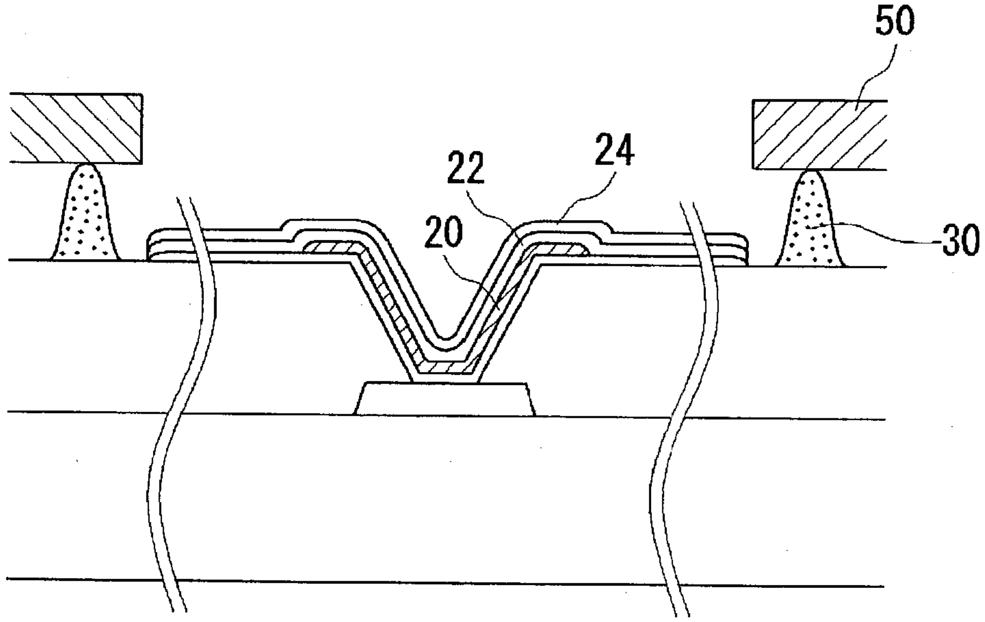


FIG.4A

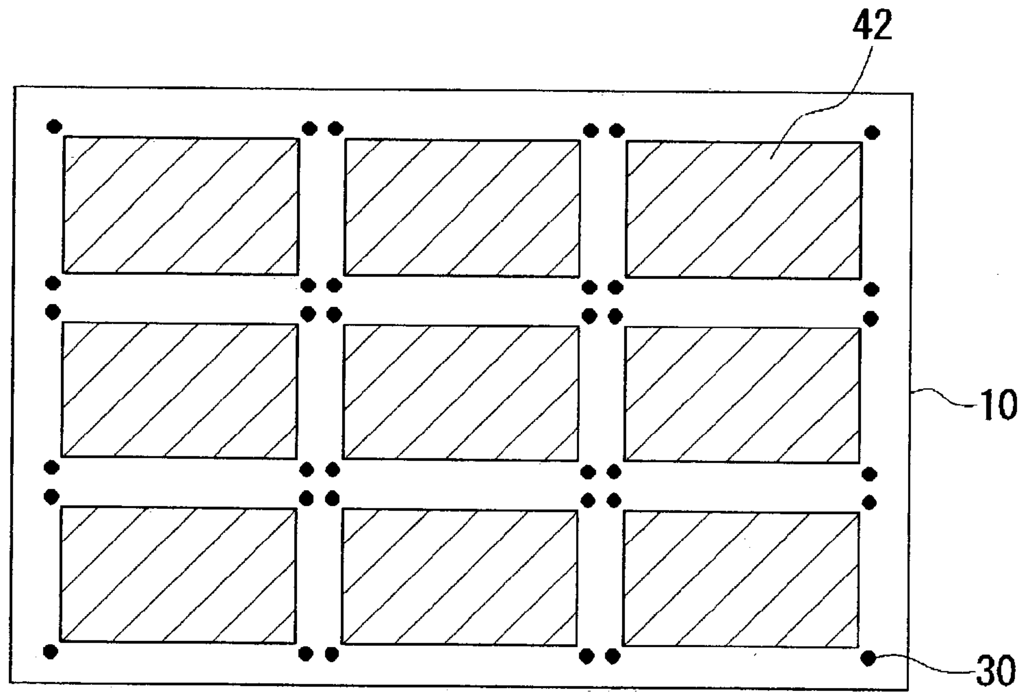


FIG.4B

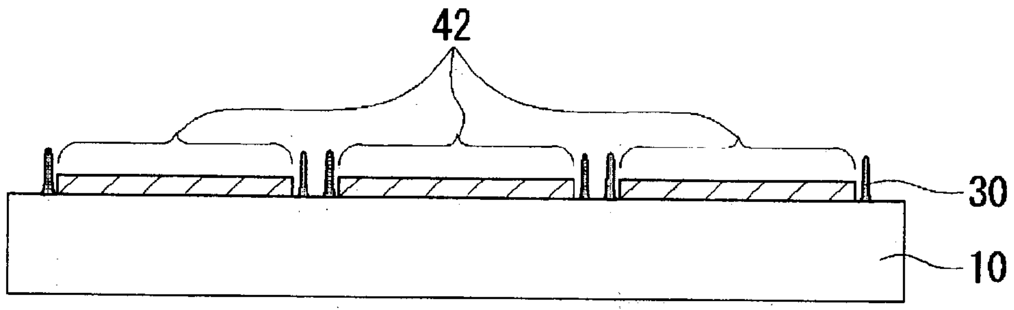


FIG.4C

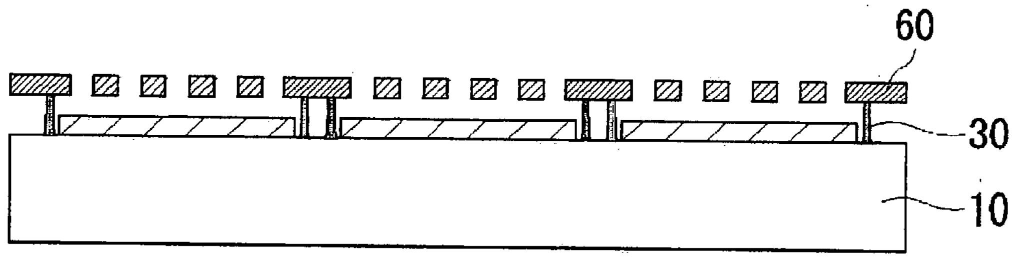


FIG. 5

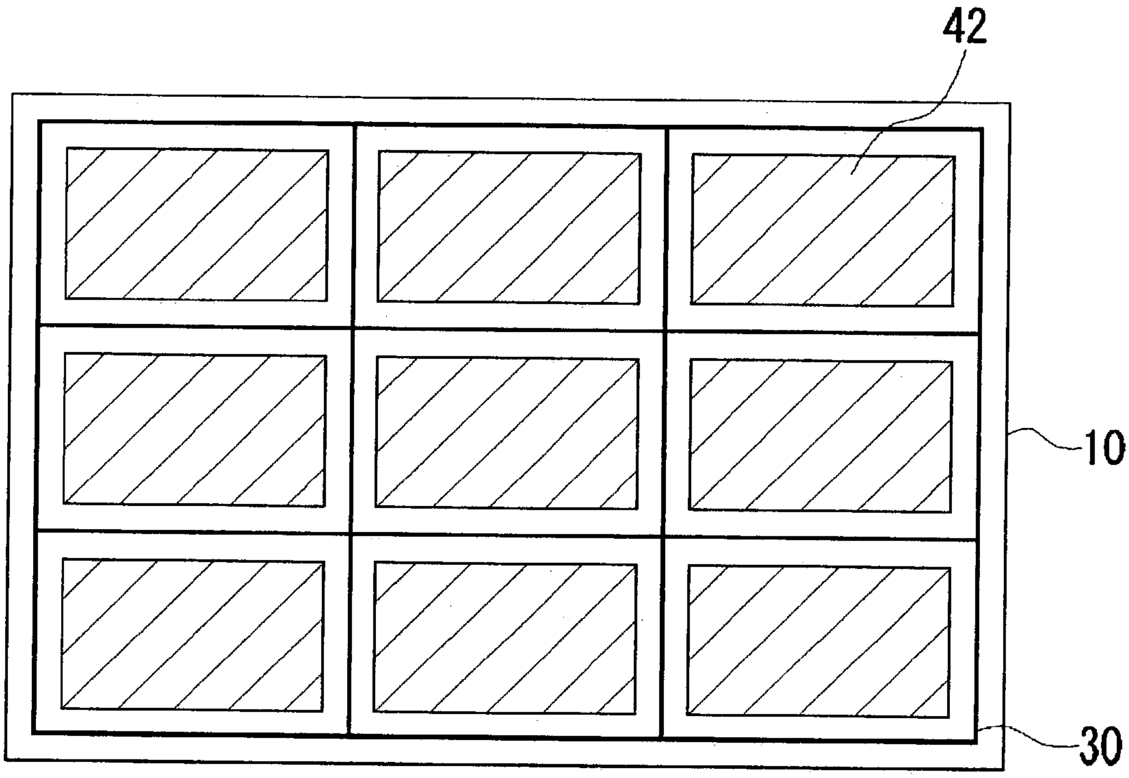


FIG. 6

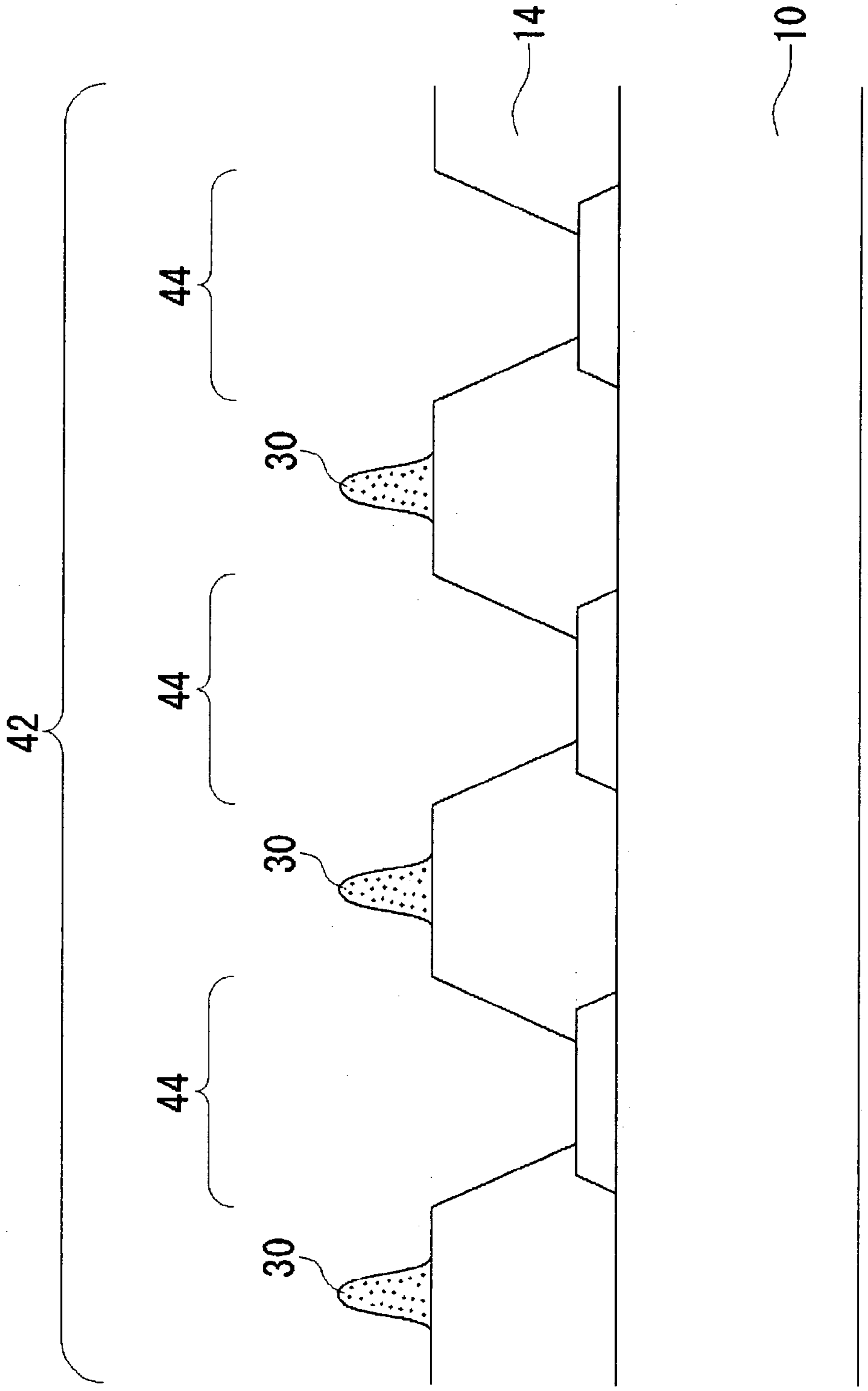


FIG. 7

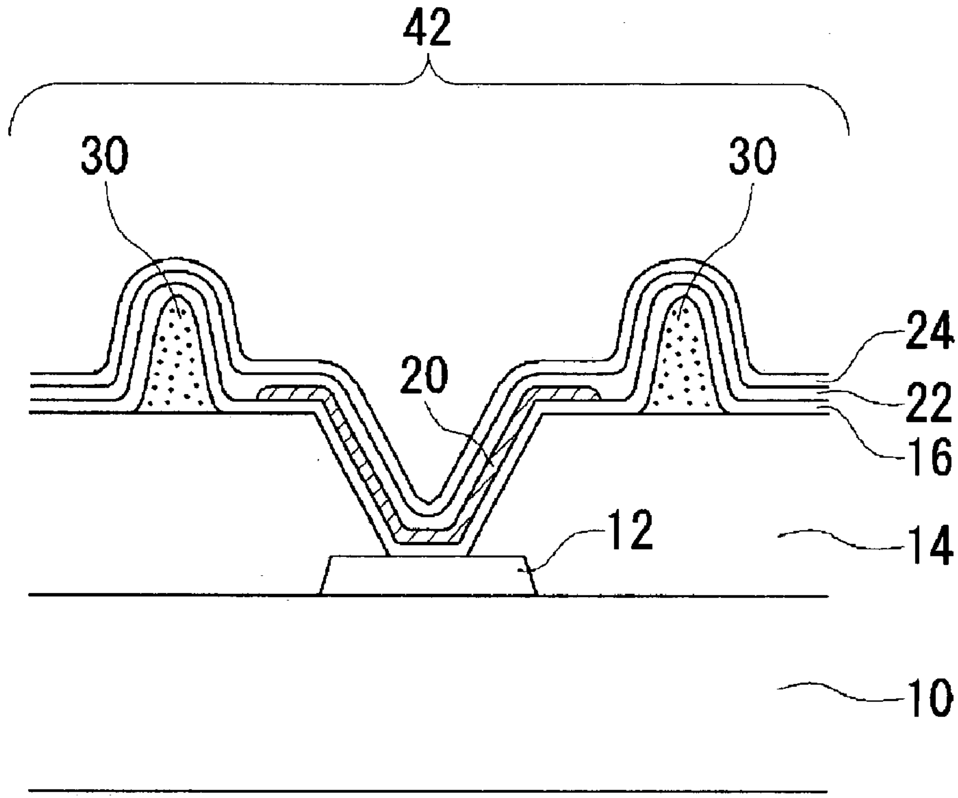


FIG.8A

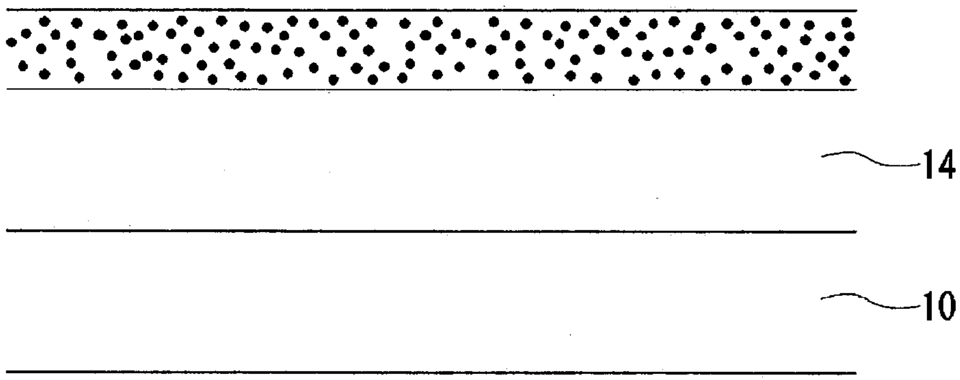


FIG.8B

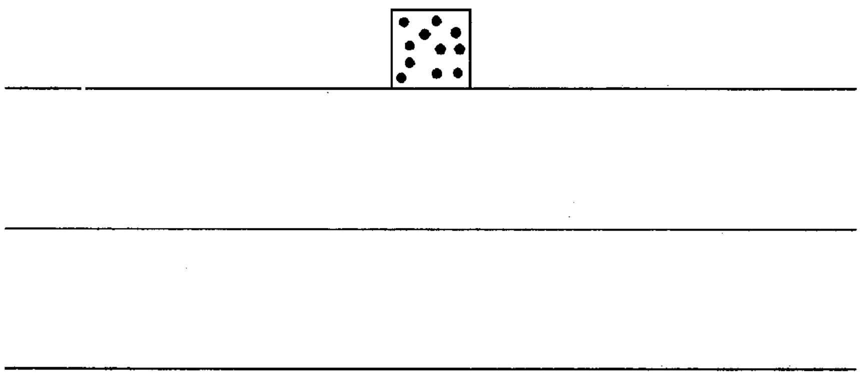


FIG.8C

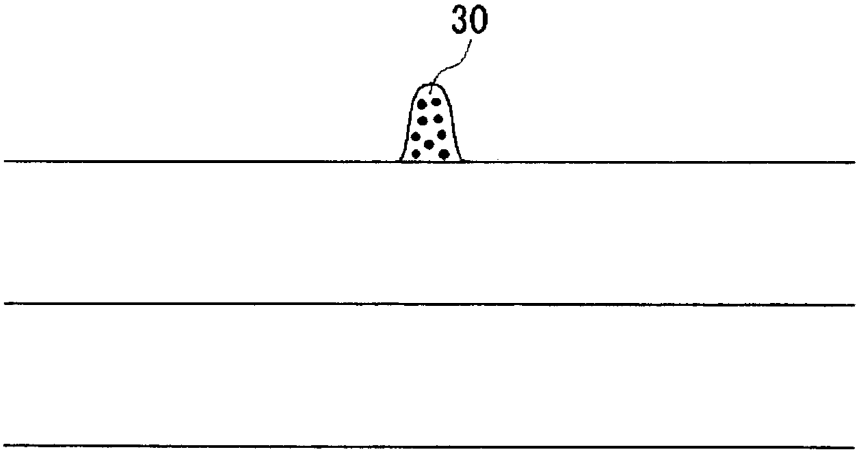


FIG.9A

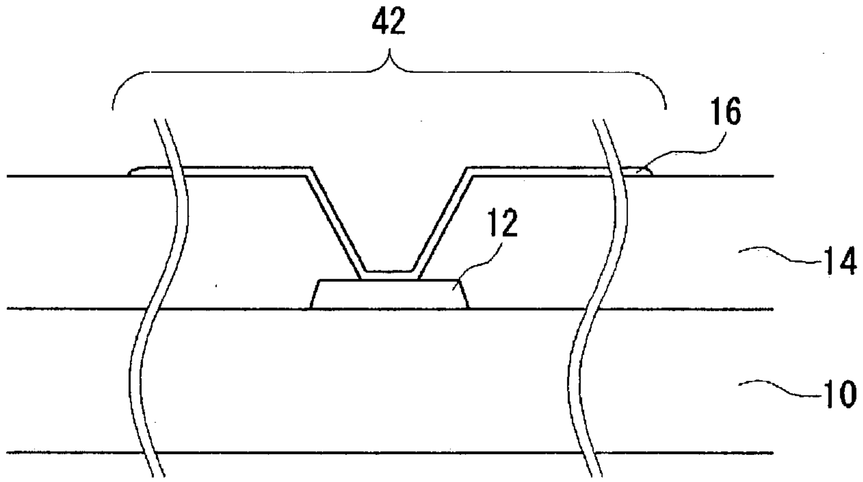


FIG.9B

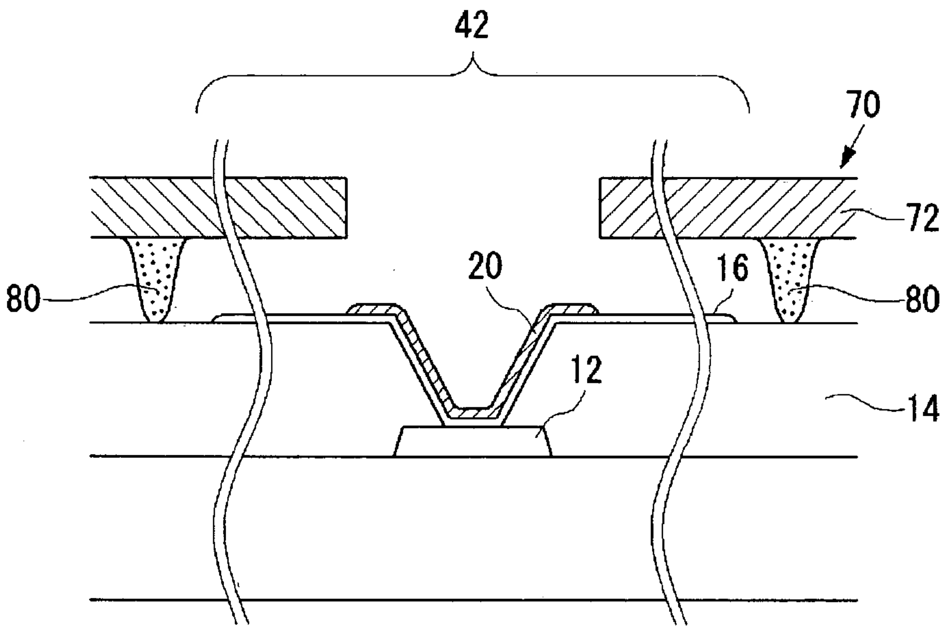


FIG.9C

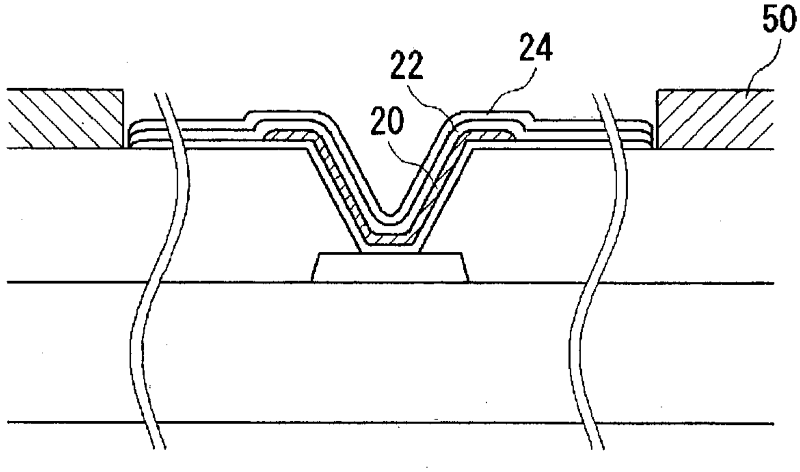


FIG.10A

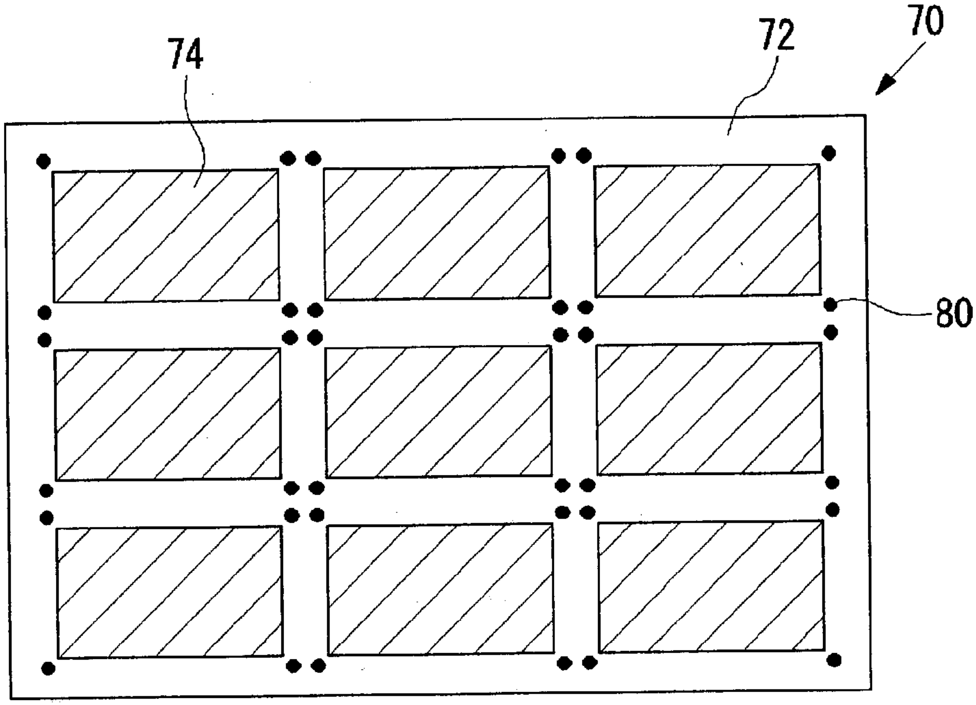


FIG.10B

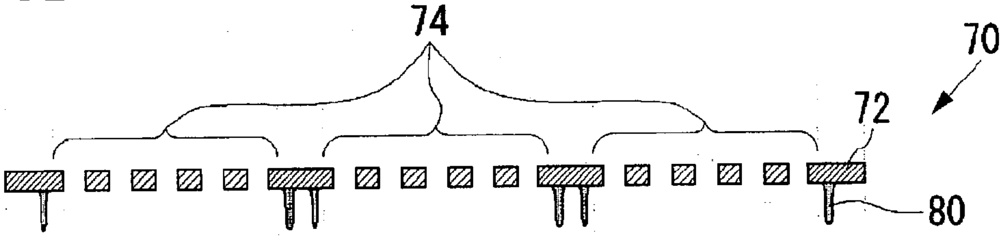


FIG.10C

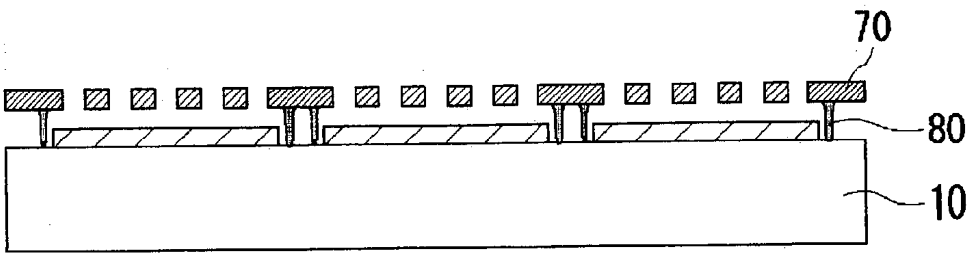
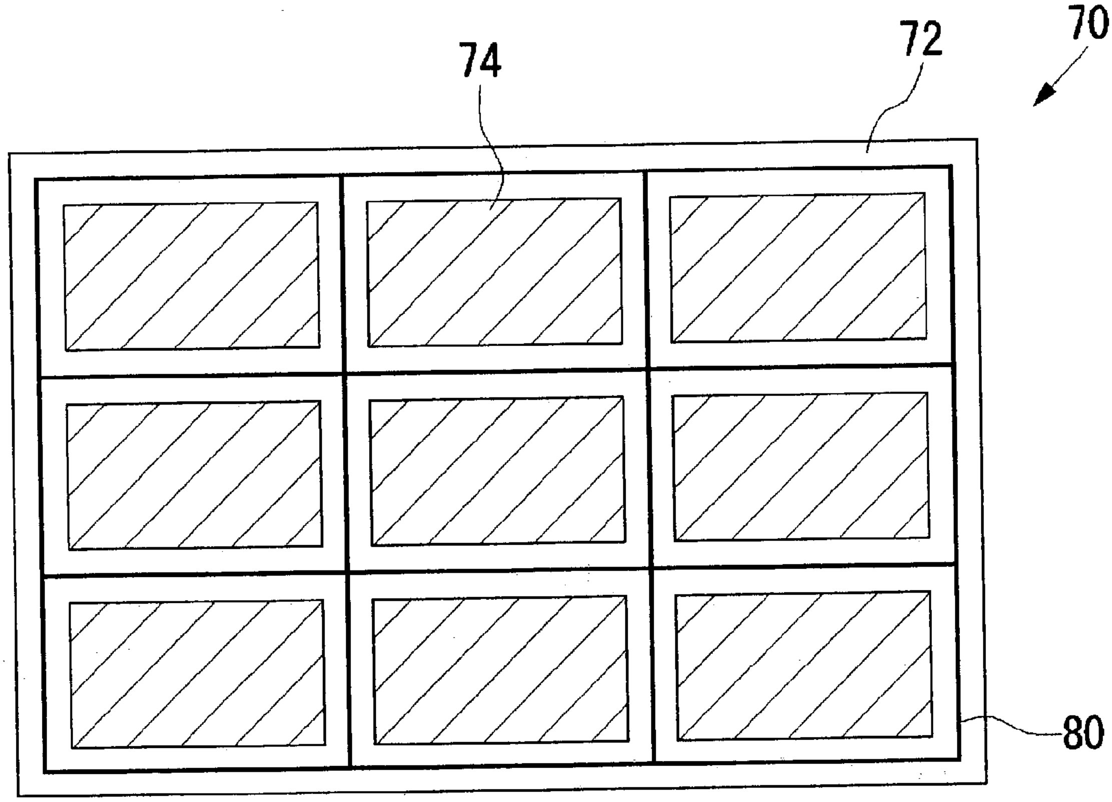


FIG. 11



METHOD OF MANUFACTURING ORGANIC ELECTROLUMINESCENT PANEL, ORGANIC ELECTROLUMINESCENE DEVICE, AND MASK

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to an organic electroluminescent device, a method of manufacturing an organic electroluminescent panel, and a mask used in a manufacturing sequence of the organic electroluminescent panel.

[0003] 2. Description of the Related Art

[0004] An organic electroluminescent panel (hereinafter, also referred to as "organic EL panel") is self-luminous and therefore has better visibility than a liquid crystal panel. Since it does not need a backlight, it can be a thin and light display panel. Hence, the organic EL panel attracts attention as a panel that will take over the liquid crystal panel in the near future. In general, an organic electroluminescent device (hereinafter, also referred to "organic EL device") provided to the organic EL panel emits light through recombination of electrons injected from an electron injecting electrode to an electron transporting layer with holes injected from a hole injecting electrode to a hole transporting layer at the interface between the organic luminescent layer and the hole transporting layer or inside of the organic luminescent layer in the vicinity of the interface. A color organic EL panel is manufactured by forming organic luminescent layers of respective colors by evaporating organic materials emitting red, green, and blue light, respectively.

[0005] **FIG. 1** is a view showing a conventional manufacturing sequence at a step of evaporating an organic luminescent layer. The drawing shows a state where a hole injecting electrode **12**, an insulation layer **14**, and a hole transporting layer **16** are formed in order on a substrate **10**. According to the conventional evaporation step of the organic luminescent layer, a mono-color luminescent material is evaporated while the bottom surface of a mask **18** used to form an organic luminescent layer is brought into contact with the hole transporting layer **16**, and then a luminescent material of another color is evaporated using the mask **18** in a different chamber. This step is generally referred to as the color-layer successive deposition step of luminescent materials. In the conventional color-layer successive deposition step, because the positioning is performed while the bottom surface of the mask **18** is brought into contact with the hole transporting layer **16**, the mask **18** possibly scrapes the surface of the hole transporting layer **16** and leaves flaws **28**. These flaws **28** cause a pin-hole in the electron injecting electrode formed in a latter film formation step, and gives rise to a dark spot defect.

SUMMARY OF THE INVENTION

[0006] It is therefore an object of the invention to provide a method of manufacturing an organic EL panel, capable of solving the above problems and an organic EL device as well as a mask used in the manufacturing sequence of the organic EL panel.

[0007] The following description will describe means to achieve the above and other objects. Terms specifying the positional relations, such as "above,""over,""on," and "beneath," are used in the specification, and these terms are used, in connection with the positional relation of the substrate and a mask, on the assumption that the substrate is present at the lower side and the mask is present at the upper side relatively with respect to each other. Hence, for example, in a vacuum evaporation apparatus for resistance heating evaporation, the substrate may be held above the mask in term of spatial relations. Nevertheless, the specification describes the positional relation on the assumption that the substrate is at the lower side and the mask is at the upper side relatively with respect to each other for ease of explanation, and it is obvious to those skilled in the art that these terms are to be understood in light of the foregoing also in the appended claims.

[0008] In order to achieve the above and other objects, a method of manufacturing an organic electroluminescent panel according to one of aspects of the invention includes: forming a first electrode on a substrate; forming an organic luminescent layer over the first electrode by placing a mask to be kept spaced apart from a layer formed on the substrate; and forming a second electrode over the organic luminescent layer. The first electrode can be either a hole injecting electrode or an electron injecting electrode, and the second electrode can be either the electron injecting electrode or the hole injecting electrode. By spacing apart the mask from the layer formed on the substrate, it is possible to reduce a possibility that the mask scratches the layer formed on the substrate.

[0009] A method of manufacturing an organic electroluminescent panel according to another aspect of the invention includes: forming a first electrode on a substrate; forming spacers protruding in a direction perpendicular to a surface of the substrate; forming an organic luminescent layer over the first electrode by placing a mask while a surface thereof is brought into contact with the spacers; and forming a second electrode over the organic luminescent layer. By bringing the surface of the mask into contact with the spacers, it is possible to space apart the mask from the layer formed on the substrate, which can reduce a possibility that the mask scratches the layer formed on the substrate.

[0010] The forming spacers may include forming spacers each having a slope inclined gently downward. For example, the forming spacers may include: applying a resist material over the substrate; etching the resist material applied so that a part of the resist material is left at an outside of a luminescent region on the substrate; and allowing the resist material left to undergo reflow through heat treatment.

[0011] A method of manufacturing an organic electroluminescent panel according to still another aspect of the invention includes: forming a first electrode on a substrate; forming an organic luminescent layer over the first electrode by placing a mask, which has spacers protruding in a direction perpendicular to a surface of thereof, above the substrate; and forming a second electrode over the organic luminescent layer. The spacers provided to the mask allow a mask main body on which is formed a specific pattern to be spaced apart from the layer formed on the substrate, which can reduce a possibility that the mask main body scratches the layer formed on the substrate. The spacers and the mask main body may be made of a same material. By making the spacers and the mask main body from the same material, a used mask can be readily recycled. For example, in a case where the mask main body is made of a nickel material containing cobalt, a used mask can be readily recycled by forming the spacers also from the nickel material containing cobalt through an etching technique or a plating technique.

[0012] A mask according to still another aspect of the invention is a mask used to form an organic luminescent layer during a manufacturing sequence of an organic electroluminescent panel. The mask includes a mask main body on which a specific pattern is formed, and spacers protruding in a direction perpendicular to a surface of the mask main body, and the spacers and the mask main body are made of a same material. By forming the mask main body and the spacers from the same material, the mask main body and the spacers can be melted together without the need of separation when a used mask is melted to be recycled.

[0013] An organic electroluminescent device according to still another aspect of the invention includes: a first electrode formed on a substrate; spacers protruding in a direction perpendicular to a surface of the substrate at an outside of a luminescent region on the substrate; an organic luminescent layer formed over the first electrode within the luminescent region on the substrate; and a second electrode formed over the organic luminescent layer. In the evaporation step of the organic luminescent layer, the spacers are formed to protrude upward above the substrate for the mask to be placed on the top surfaces thereof. After the luminescent layer is evaporated, the spacers may protrude from a lamination structure on the substrate, or may be present within the lamination structure while protruding upward. The luminescent region means a region where the organic luminescent layer is formed, and the region at the outside of the luminescent region includes a region at the outside of the panel region where no organic EL device is formed. Also, the region at the outside of the luminescent region may include a region where no organic luminescent layer is formed within the panel region.

[0014] A method of manufacturing an organic electroluminescent panel according to still another aspect of the invention includes: forming a first electrode within each of a plurality of panel regions on a substrate; forming spacers protruding in a direction perpendicular to a surface of the substrate; forming an organic luminescent layer over the first electrode by placing a mask while a surface thereof is brought into contact with the spacers; forming a second electrode over the organic luminescent layer; and dividing the substrate into the respective panel regions. According to this manufacturing method, it is possible to manufacture a plurality of organic EL panels from a single substrate.

[0015] An organic electroluminescent device according to still another aspect of the invention includes: a first electrode formed within each of a plurality of panel regions on a substrate; spacers protruding in a direction perpendicular to a surface of the substrate at an outside of luminescent regions on the substrate; an organic luminescent layer formed over the first electrode within each of the luminescent regions on the substrate; and a second electrode formed over the organic luminescent layer. In the evaporation step of the organic luminescent layer, the spacers are formed to protrude upward above the substrate for the mask to be placed on the top surfaces thereof. After the luminescent layer is evaporated, the spacers may protrude from a lamination structure on the substrate, or may be present within the lamination structure while protruding upward. The luminescent region means a region where the organic luminescent layer is formed, and the region at the outside of the luminescent region includes a region at the outside of the panel region where no organic EL device is formed. Also, the region at the outside of the luminescent region may include a region where no organic luminescent layer is formed within the panel region.

[0016] It is to be noted that any arbitrary combination of the above-described structural components, and expressions changed between a method, an apparatus, a system and so forth are all effective as and encompassed by the present embodiments.

[0017] Moreover, this summary of the invention does not necessarily describe all necessary features so that the invention may also be sub-combination of these described features.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] **FIG. 1** is a view showing a conventional manufacturing sequence at a step of evaporating an organic luminescent layer;

[0019] **FIG. 2A** is a view showing a state where a hole injecting electrode is formed within a panel region on a substrate;

[0020] **FIG. 2B** is a view showing a state where spacers protruding in a direction perpendicular to the surface of the substrate are formed;

[0021] **FIG. 2C** is a view showing a state where a hole transporting layer is formed;

[0022] **FIG. 3A** is a view showing a state where an organic luminescent layer is formed;

[0023] **FIG. 3B** is a view showing a state where an electron transporting layer and an electron injecting electrode are formed;

[0024] **FIG. 4A** is a view showing one example of the shape and the layout of the spacers;

[0025] **FIG. 4B** is a side view of the substrate;

[0026] **FIG. 4C** is a view showing a state where a mask is placed while the bottom surface thereof is brought into contact with the spacers;

[0027] **FIG. 5** is a view showing another example of the shape and the layout of the spacers;

[0028] **FIG. 6** is a view showing a state where spacers are formed within the panel region on the substrate;

[0029] **FIG. 7** is a view showing a state where an organic layer is evaporated using the spacers shown in **FIG. 6**;

[0030] **FIG. 8A** is a view showing a state where a resist material is applied on an insulation layer on the substrate through spin-coating;

[0031] **FIG. 8B** is a view showing a state where a part of the applied resist material is subjected to exposure and development;

[0032] **FIG. 8C** is a view showing a state where the remaining resist material is allowed to undergo reflow through heat treatment;

[0033] **FIG. 9A** is a view showing a state where a hole injecting electrode, an insulation layer, and a hole transporting layer are formed within a panel region on a substrate;

[0034] **FIG. 9B** is a view showing a state where an organic luminescent layer is formed over the hole injecting electrode;

[0035] **FIG. 9C** is a view showing a state where an electron transporting layer and an electron injecting electrode are formed over the organic luminescent layer;

[0036] **FIG. 10A** is a view showing one example of the shape and the layout of spacers;

[0037] **FIG. 10B** is a side view of a mask:

[0038] **FIG. 10C** is a view showing a state where a mask is placed while the spacers are brought into contact with the top surface of a lamination structure on the substrate; and

[0039] **FIG. 11** is a view showing another example of the shape and the layout of the spacers.

DETAILED DESCRIPTION OF THE INVENTION

[0040] The invention will now be described based on preferred embodiments which do not intend to limit the scope of the present invention but exemplify the invention. All of the features and the combinations thereof described in the embodiments are not necessarily essential to the invention.

[0041] **FIG.** 2A through **FIG.** 2C and **FIG.** 3A through **FIG. 3B** are views showing the manufacturing sequence of an organic EL panel according to a first embodiment of the invention. **FIG. 2A** is a view showing a state where a hole injecting electrode **12** is formed within a panel region **42** on a substrate **10**. The panel region **42** referred to herein means a region where an organic EL device will be formed on the substrate **10**. The substrate **10** may be a glass substrate on which a thin film transistor (TFT) is formed as a switching element. In a case where a plurality of organic EL panels are manufactured from a single substrate **10**, a plurality of panel regions **42** are present on the substrate **10**. The hole injecting electrode **12** is made of indium tin oxide (ITO). **FIG. 2A** shows only one hole injecting electrode **12** for one pixel configuration. It should be appreciated, however, that as many hole injecting electrodes **12** as the pixels of the organic EL panel are actually formed in each panel region **42** at their respective predetermined positions.

[0042] **FIG. 2B** is a view showing a state where spacers **30** protruding in a direction perpendicular to the surface of the substrate **10** are formed. In this step, an insulation layer **14** is formed by applying a resist material on the substrate **10** first, and then by transferring a specific pattern such that exposes the hole injecting electrode **12** through exposure followed by development. Then, the spacers **30** protruding upward above the substrate **10** are formed at the outside of the panel region **42**. A plurality of spacers **30** are provided at the outside of the panel region **42** to place a mask, and it is preferable that each has substantially an equal height. In this example, the spacers **30** are formed on the insulation layer **14**. It should be appreciated, however, that the spacers **30** may be formed directly on the substrate **10** in another example. It is preferable to perform the step of forming the spacers **30** before an organic layer is evaporated.

[0043] **FIG. 2C** is a view showing a state where a hole transporting layer **16** is formed. In this step, the hole transporting layer **16** is formed by evaporating N,N'di(naphthalene-1-yl)-N,N'-diphenyl-benzidine by placing a mask **50** for overall film formation to be brought into contact with the top surfaces of the spacers **30**.

[0044] **FIG. 3A** is a view showing a state where an organic luminescent layer **20** is formed. In this step, the organic luminescent layer **20** is formed by evaporating an organic luminescent material over the hole injecting electrode **12** while a mask **60** used to form a luminescent layer is kept spaced apart from the layer formed on the substrate **10**. By placing the mask **60** while the bottom surface thereof is brought into contact with the top surfaces of the spacers **30**, it is possible to space apart the mask **60** from the hole transporting layer **16** over the substrate **10**. In order to enable color display of the organic EL panel, the mask **60** is prepared for each of the colors including red, green, and blue, and the organic luminescent layers **20** of the respective colors are formed in different chambers. It is necessary to fine-tune the position of the mask **60** during this color-layer successive deposition step. However, by performing the positioning while the mask **60** is spaced apart from the substrate **10**, it is possible to reduce a possibility that the mask **60** scratches the hole transporting layer **16**.

[0045] **FIG. 3B** is a view showing a state where an electron transporting layer **22** and an electron injecting electrode **24** are formed. In this step, the electron transporting layer **22** may be formed commonly on the red, green, and blue organic luminescent layers **20** through the use of the mask **50** for overall film formation, or alternatively, it may be formed separately on the organic luminescent layers **20** of the respective colors. In the case of forming the electron transporting layer **20** for each color, as shown in **FIG. 3A, a** mono-color organic luminescent layer **20** is formed using the mask **60**, and the electron transporting layer **22** is evaporated on the organic luminescent layer **20** thus formed, after which an organic luminescent layer **20** of another color and the electron transporting layer **22** therefor are formed in a different chamber. After the electron transporting layer **22** is formed, the electron injecting electrode **24** is formed over the organic luminescent layers **20** using the mask **50** for overall film formation. In a case where a plurality of panel regions are present on a single substrate **10**, the respective panel regions are separated, and a lamination structure, that is, an organic EL device, is covered with a sealing body. An organic EL panel is thus manufactured.

[0046] **FIG. 4A** is a view showing one example of the shape and the layout of the spacers **30**. Herein, 3×3 panel regions **42** are provided on the substrate **10,** and a plurality of spacers **30** are placed at the outside of the panel regions **42** on the periphery of the respective panel regions **42**. In a case where the mask **50** is placed above the substrate **10** in terms of spatial relations within the evaporation apparatus, it is preferable to place the plurality of spacers **30** at adequately close intervals, so that the mask **50** will not cause deflection when placed thereon. In this example, the spacers

30 are located at positions corresponding to the four corners of the panel region **42** at the outside of the respective panel regions **42**.

[0047] **FIG. 4B** is a view showing a side surface of the substrate **10**. The drawing shows a state where the spacers **30** protruding in a direction perpendicular to the surface of the substrate **10** are provided at the outside of the panel regions **42**. It is preferable that the spacers **30** are formed to be higher than the organic luminescent layer to be formed. In general, it is sufficient to form the spacers **30** in a height of approximately 3 to 5 μm.

[0048] **FIG. 4C** is a view showing a state where the mask **60** is placed while the bottom surface thereof is brought into contact with the spacers **30**. Since the organic layer formed on the panel regions **42** will not come in contact with the mask **60**, it is possible to reduce a possibility that the mask **60** scratches the organic layer at the positioning.

[0049] **FIG. 5** is a view showing another example of the shape and the layout of the spacers **30**. In this example, the spacers **30** are formed linearly at the outside of the panel regions **42** to enclose the respective panel regions **42**. It should be noted, however, that the shapes and the layouts of the spacers **30** shown in **FIG. 4**A through **FIG. 4**C and **FIG. 5** are for illustrative purpose only, and it is to be understood by those skilled in the art that various modifications are available.

[0050] **FIG. 6** is a view showing a state where the spacers **30** are formed within the panel region **42** on the substrate **10**. Within the panel region **42** are luminescent regions **44** on which the organic luminescent layers are to be evaporated, and therefore, it is preferable to form the spacers **30** on the insulation layer **14** at the outside of the luminescent regions **44** so as not interfere with emission of light. The spacers **30** may be formed for the respective pixels within the panel region **42**, or provided at adequate intervals. The spacers **30** may be formed directly on the substrate **10**.

[0051] **FIG. 7** is a view showing a state where an organic layer is evaporated using the spacers **30** shown in **FIG. 6**. In the case of overall film formation, a mask is placed on the spacers **30** at the outside of the panel region **42**, and an organic material is then evaporated. In the color-layer successive deposition step of the organic luminescent layers, the organic luminescent layers **20** of respective colors are formed by positioning the mask placed on the spacers **30** at both the inside and outside of the panel region **42** and evaporating a mono-color organic luminescent material, and successively by positioning the mask and evaporating an organic luminescent material of another color in a different chamber.

[0052] As shown in the drawing, organic layers are laminated on the spacers **30** within the panel region **42** during the overall film formation step. In this example, the hole transporting layer **16**, the electron transporting layer **22**, and the electron injecting electrode **24** are formed on the spacers **30**. For this reason, in a case where the spacers **30** have a sharp edge, the coverage is deteriorated, and a pin-hole may possibly occur in the uppermost electron injecting electrode **24**. In order to avoid such an inconvenience, it is preferable that the spacers **30** have slopes gently inclined downward so that the organic layers are formed in a satisfactory manner.

[0053] **FIG. 8**A through **FIG. 8C** are views showing the steps of forming the spacer **30** protruding in a direction perpendicular to the surface of the substrate **10**. As shown in **FIG. 8A, a** resist material is applied on the insulation layer **14** on the substrate **10** by spin-coating. The resist material can be a photosensitive material, such as acrylic resin, or the same material as that of the insulation layer **14**. Subsequently, as shown in **FIG. 8**B, the applied resist material is subjected to exposure and development so that a part of the resist material will be left at a predetermined position at the outside of the luminescent region. Then, as shown in **FIG. 8**C, the resist material thus left is allowed to undergo reflow through heat treatment. By allowing the resist material to undergo reflow, it is possible to form the spacer **30** having a slope gently inclined downward. In particular, in the case of forming the spacers **30** within the panel region, it is preferable to shape the spacer **30** to widen toward the end in order to form the organic layers, such as the hole transporting layer **16**, on the spacers **30** in a satisfactory manner. In the case of forming the spacers **30** at the outside of the panel regions, it is also possible to reduce a possibility that the spacer **30** is scraped by the mask by forming the spacer **30** into a stable shape such that widens toward the end. In this example, the spacer **30** is formed by applying the resist material on the insulation layer **14**; however, it is also possible to form the spacer **30** by subjecting the insulation layer **14** itself to exposure and development.

[0054] **FIG. 9**A through **FIG. 9C** are views showing the manufacturing sequence of an organic EL panel according to a second embodiment of the invention. **FIG. 9A** is a view showing a state where a hole injecting electrode **12**, an insulation layer **14**, and a hole transporting layer **16** are formed within a panel region **42** on the substrate **10**.

[0055] **FIG. 9B** is a view showing a state where an organic luminescent layer **20** is formed over the hole injecting electrode **12**. In this step, a mask **70** is used, which includes a mask main body **72** on which a specific pattern is formed, and spacers **80** protruding in a direction perpendicular to the surface of the mask main body **72**. The organic luminescent layer **20** is formed on the hole injecting electrode **12** and the hole transporting layer **16** by placing the mask main body **72** above the substrate **10** while the bottom surfaces of the spacers **80** are brought into contact with the insulation layer **14**. In the color-layer successive deposition step of the organic luminescent layers **20**, since the mask main body **72** is placed to be spaced apart from the substrate **10**, the mask main body **72** will not scratch the hole transporting layer **16** formed over the substrate **10** at the positioning of the mask **70**.

[0056] **FIG. 9C** is a view showing a state where an electron transporting layer **22** and an electron injecting electrode **24** are formed on the organic luminescent layer **20**. The electron transporting layer **22** may be formed for each color of the organic luminescent layers **20** through the use of the mask **70** of **FIG. 9B**. The electron injecting electrode **24** is formed through the use of a mask **50** for overall film formation. The mask **50** can be a mask having no spacers **80** as shown in the drawing. However, it may have the spacers **80** as the mask **70** shown in **FIG. 9B**.

[0057] **FIG. 10A** is a view showing one example of the shape and the layout of the spacers **80**. Herein, 3×3 mask regions **74** are provided on the mask main body **72**, and a specific pattern is formed in each mask region **74**. On the mask main body **72**, a plurality of spacers **80** are placed at the outside of the respective mask regions **74** on the periphery. In a case where the mask **70** is placed above the substrate **10** in terms of spatial relations within the evaporation apparatus, it is preferable to place the plurality of spacers **80** at adequately close intervals, so that the mask main body **72** will not cause deflection when placed thereon. In this example, the spacers **80** are located at the positions corresponding to the four corners of the mask region **74** at the outside of the respective mask regions **74**. It is preferable to form the spacers **80** and the mask main body **72** from the same material. By so doing, when the used mask **70** is melted to be recycled, the mask main body **72** and the spacers **80** can be melted together without the need of separation.

[0058] **FIG. 10B** is a view showing a side surface of the mask **70**. The drawing shows a state where the spacers **80** protruding in a direction perpendicular to the surface of the mask main body **72** are provided at the outside of the mask regions **74**. It is preferable that the spacers **80** are formed in a height such that the surface of the mask main body **72** will not come in contact with the already formed organic luminescent layer in the case of evaporating the organic luminescent layers of plural colors.

[0059] **FIG. 10C** is a view showing a state where the mask **70** is placed while the spacers **80** are brought into contact with the top surface of the lamination structure on the substrate **10**. In the example shown in **FIG. 9**B, the spacers **80** come in contact with the top surface of the insulation layer **14**. Since the organic layers formed in the panel regions on the substrate **10** will not come in contact with the mask main body **72**, it is possible to reduce a possibility that the mask main body **72** scratches the organic layer at the positioning of the mask **70**.

[0060] **FIG. 11** is a view showing another example of the shape and the layout of the spacers **80**. In this example, the spacers **80** are formed linearly at the outside of the mask regions **74** to enclose the respective mask regions **74**. It should be noted, however, that the shapes and the layouts of the spacers **80** shown in **FIG. 10**A through **FIG. 10**C and **FIG. 11** are for illustrative purpose only, and it is to be understood by those skilled in the art that various modifications are available.

[0061] While preferred embodiments of the invention have been described, it is to be understood that the technical scope of the invention is not limited to the description in the above. The embodiments above are given solely by way of illustration. It will be understood by those skilled in the art that various modifications may be made to combinations of the foregoing components and processes, and all such modified examples are also intended to fall within the scope of the invention.

[0062] For example, the embodiments above described the color-layer successive deposition step for forming organic luminescent layers of respective colors in different chambers using a plurality of masks. However, the methods of manufacturing the organic EL panel according the embodiments above are not limited to the above description, and a step of forming organic luminescent layers using a single mask may be included instead. In addition, although the embodiments above described specific materials of the organic layers to be evaporated by way of example, it is to be understood by those skilled in the art that the specified materials are given solely by way of illustration. Furthermore, a mask may be made of magnetic materials. In this case, the mask may be attracted by an electro magnet provided at a back side of a substrate so that the mask may be fixed to the substrate.

What is claimed is:

1. A method of manufacturing an organic electroluminescent panel, the method including:

forming a first electrode on a substrate;

forming an organic luminescent layer over the first electrode by placing a mask to be kept spaced apart from a layer formed on the substrate; and

forming a second electrode over the organic luminescent layer.

2. A method of manufacturing an organic electroluminescent panel, the method including:

forming a first electrode on a substrate;

forming spacers protruding in a direction perpendicular to a surface of the substrate;

forming an organic luminescent layer over the first electrode by placing a mask while a surface thereof is brought into contact with the spacers; and

forming a second electrode over the organic luminescent layer.

3. A method of manufacturing an organic electroluminescent panel according to claim 2, wherein the forming spacers includes forming spacers each having a slope inclined gently downward.

4. A method of manufacturing an organic electroluminescent panel according to claim 3, wherein the forming spacers includes:

applying a resist material over the substrate;

etching the resist material applied so that a part of the resist material is left at an outside of a luminescent region on the substrate; and

allowing the resist material left to undergo reflow through heat treatment.

5. A method of manufacturing an organic electroluminescent panel according to claim 4, wherein each spacer has substantially an equal height.

6. A method of manufacturing an organic electroluminescent panel, the method including:

forming a first electrode on a substrate;

forming an organic luminescent layer over the first electrode by placing a mask, which has spacers protruding in a direction perpendicular to a surface of thereof, above the substrate; and

forming a second electrode over the organic luminescent layer.

7. A method of manufacturing an organic electroluminescent panel according to claim 6, wherein the spacers and a mask main body are made of a same material.

8. A method of manufacturing an organic electroluminescent panel according to claim 7, wherein each spacer has substantially an equal height.

9. A mask used to form an organic luminescent layer during a manufacturing sequence of an organic electroluminescent panel, the mask comprising:

a mask main body on which a specific pattern is formed; and

spacers protruding in a direction perpendicular to a surface of the mask main body, the spacers and the mask main body being made of a same material.

10. A mask used to form an organic luminescent layer during a manufacturing sequence of an organic electroluminescent panel according to claim 9, wherein each spacer has substantially an equal height.

11. An organic electroluminescent device, comprising:

a first electrode formed on a substrate;

spacers protruding in a direction perpendicular to a surface of the substrate at an outside of a luminescent region on the substrate;

an organic luminescent layer formed over the first electrode within the luminescent region on the substrate; and

a second electrode formed over the organic luminescent layer.

12. An organic electroluminescent device according to claim 11, wherein each spacer has substantially an equal height.

13. A method of manufacturing an organic electroluminescent panel, the method including:

forming a first electrode within each of a plurality of panel regions on a substrate;

forming spacers protruding in a direction perpendicular to a surface of the substrate;

forming an organic luminescent layer over the first electrode by placing a mask while a surface thereof is brought into contact with the spacers;

forming a second electrode over the organic luminescent layer; and

dividing the substrate into the respective panel regions.

14. An organic electroluminescent device, comprising:

a first electrode formed within each of a plurality of panel regions on a substrate;

spacers protruding in a direction perpendicular to a surface of the substrate at an outside of luminescent regions on the substrate;

an organic luminescent layer formed over the first electrode within each of the luminescent regions on the substrate; and

a second electrode formed over the organic luminescent layer.

* * * * *

专利名称(译)	制造有机电致发光面板的方法，有机电致发光器件和掩模		
公开(公告)号	US20030189400A1	公开(公告)日	2003-10-09
申请号	US10/378667	申请日	2003-03-05
[标]申请(专利权)人(译)	西尾YOSHITAKA 松木HIROSHI		
申请(专利权)人(译)	西尾YOSHITAKA 松木HIROSHI		
当前申请(专利权)人(译)	SANYO ELECTRIC CO.，LTD.		
[标]发明人	NISHIO YOSHITAKA MATSUKI HIROSHI		
发明人	NISHIO, YOSHITAKA MATSUKI, HIROSHI		
IPC分类号	H05B33/10 H01L27/32 H01L51/00 H01L51/40 H01L51/50 H01L51/56 H05B33/12 H01J1/62 H01J63/04		
CPC分类号	H01L27/3211 H01L27/3295 H01L51/56 H01L51/0013 H01L51/001		
优先权	2002059591 2002-03-05 JP		
外部链接	Espacenet USPTO		

摘要(译)

提供一种制造有机EL面板的方法，其能够形成有机发光层而不会刮擦形成在下面的有机层。通过在用于蒸发发光层的掩模上放置与基板保持间隔开的掩模，在空穴注入电极上蒸发有机发光材料，形成有机发光层。通过在掩模的底表面与隔离物的顶表面接触的同时放置掩模，可以将掩模与形成在衬底上的空穴传输层隔开。尽管在有机发光层的彩色层连续沉积步骤期间需要微调掩模的位置，但是通过在掩模与基板保持间隔的同时执行定位，可以降低可能性掩模划伤空穴传输层。