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(54) MANUFACTURING METHOD OF ORGANIC ELECTROLUMINESCENT DISPLAY DEVICE

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(52) **U.S. Cl.** **427/66**; 427/68; 427/248.1

(57) **ABSTRACT**

A vapor-depositing mask is disposed adjacent a surface of a substrate disposed in a vacuum chamber, vapor-depositing beams containing an organic EL material are generated by a vapor-depositing beam generator, the vapor-depositing beams pass through openings in the vapor-depositing mask, and the organic EL material is vapor-deposited in a predetermined region on the surface of the substrate. The vapor-depositing beams are guided through a plurality of vapor-depositing beam passing pipes provided in the vapor-depositing beam generator. Alternatively, the vapor-depositing beams generated by the vapor-depositing beam generator are guided through a vapor-depositing beam direction adjusting board having a plurality of vapor-depositing beam passing holes. This enhances directional uniformity of the vapor-depositing beams, thereby enabling making each film thickness of organic EL material layers uniform and thus enhancing precision of forming patterns of the layers.

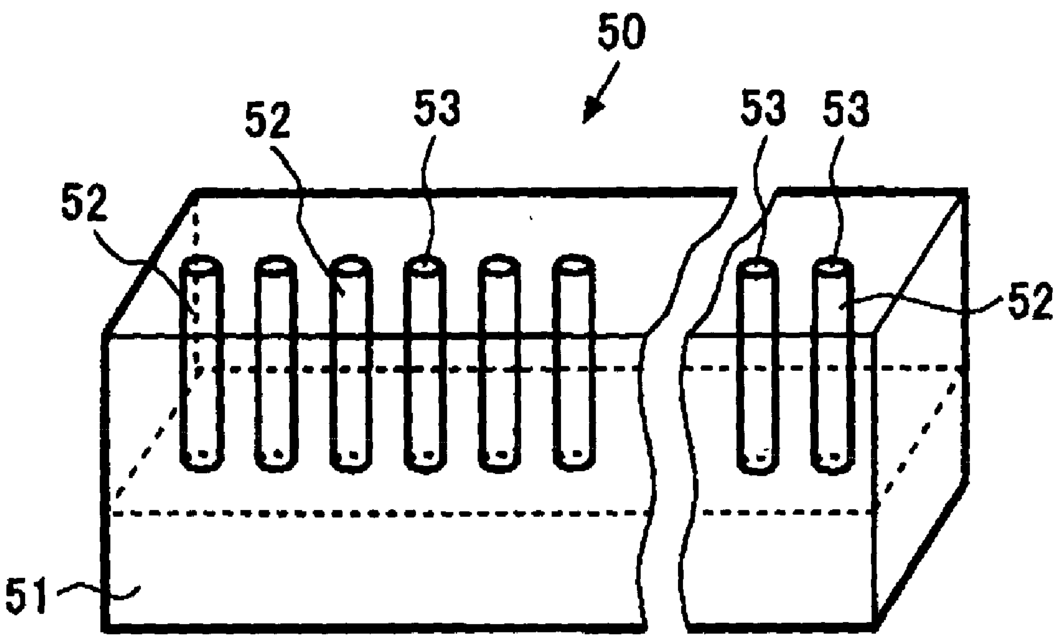


FIG.1

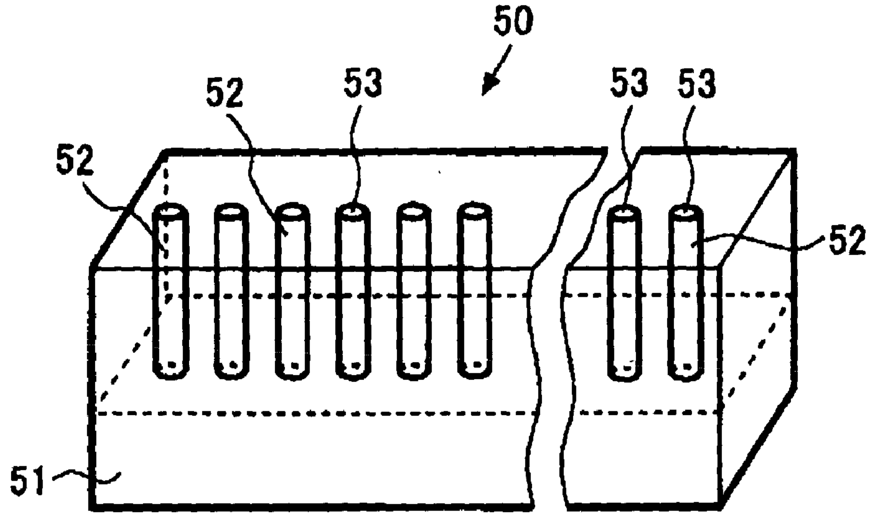


FIG.2

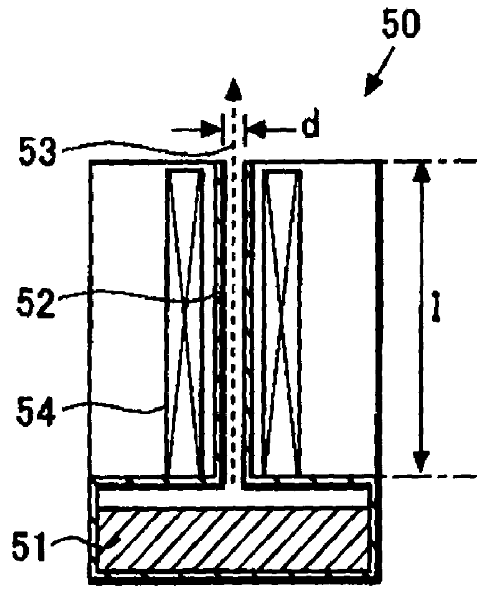


FIG.3

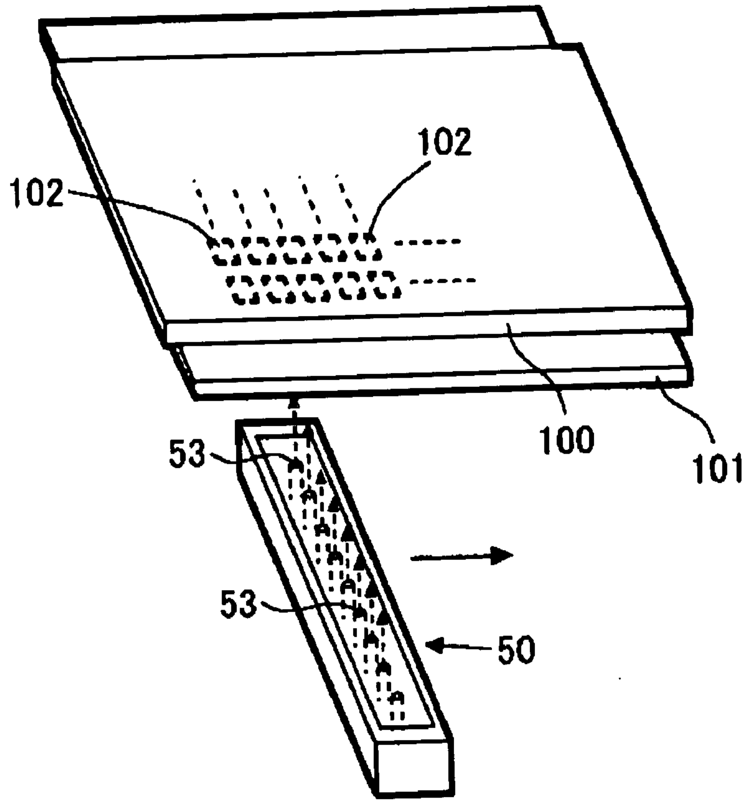


FIG.4

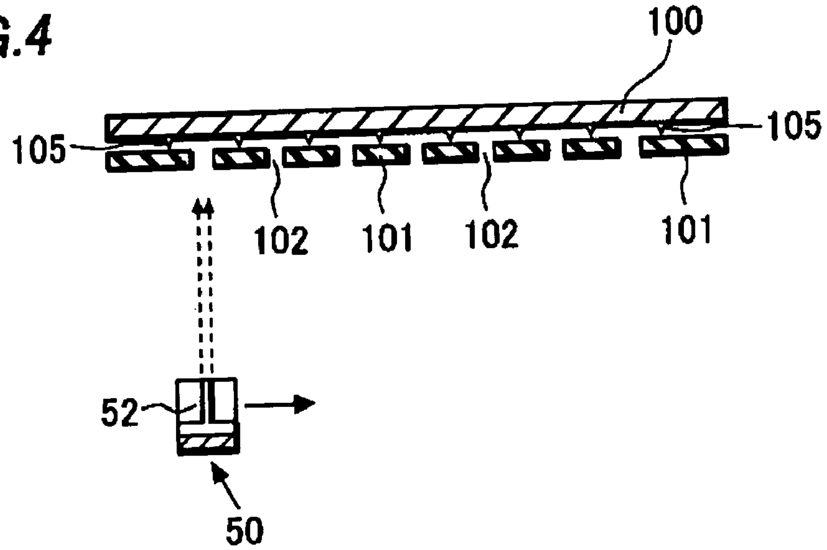


FIG.5A

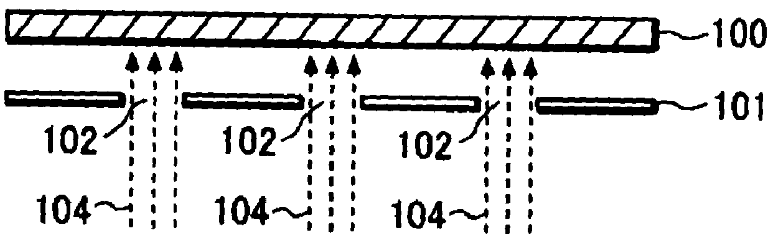


FIG.5B

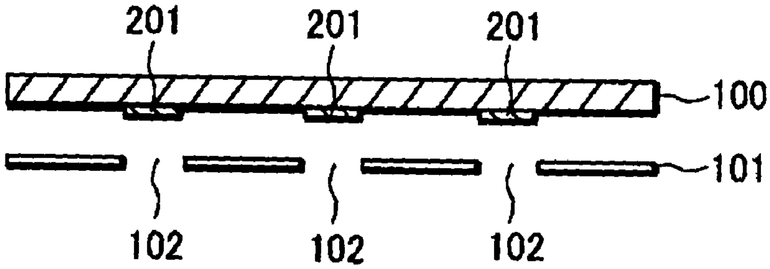


FIG.6

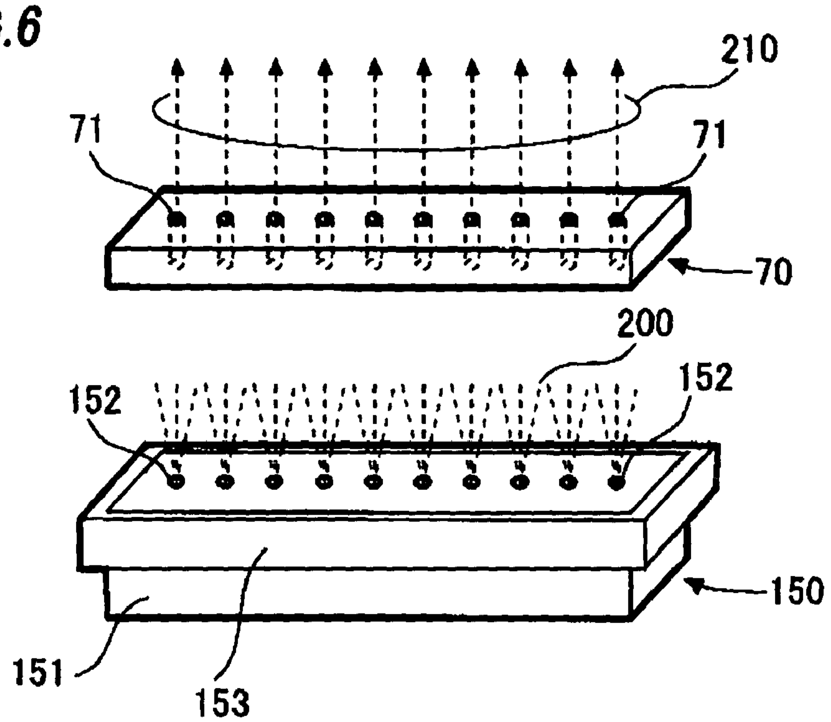

210
71
71
70
200
152
152
150
151
153

FIG.7

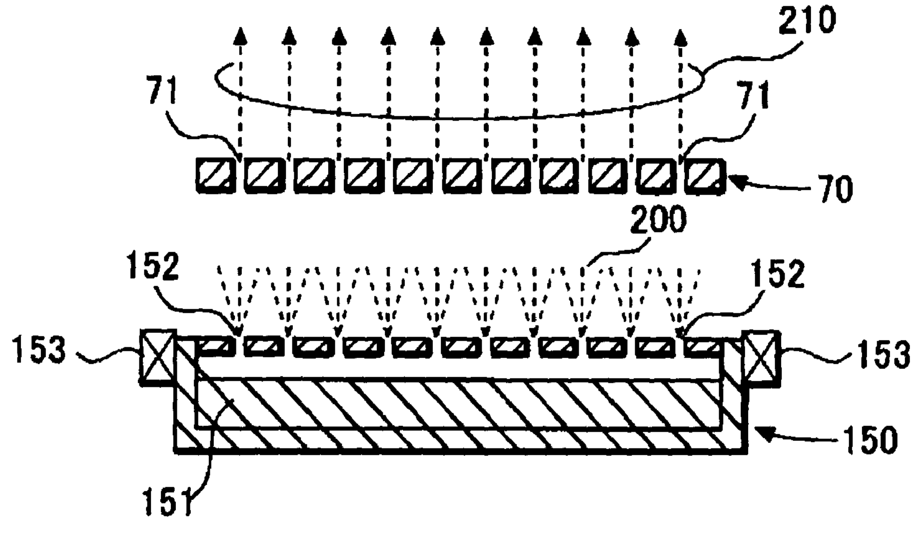

210
71
71
70
200
152
152
153
153
150
151

FIG.8

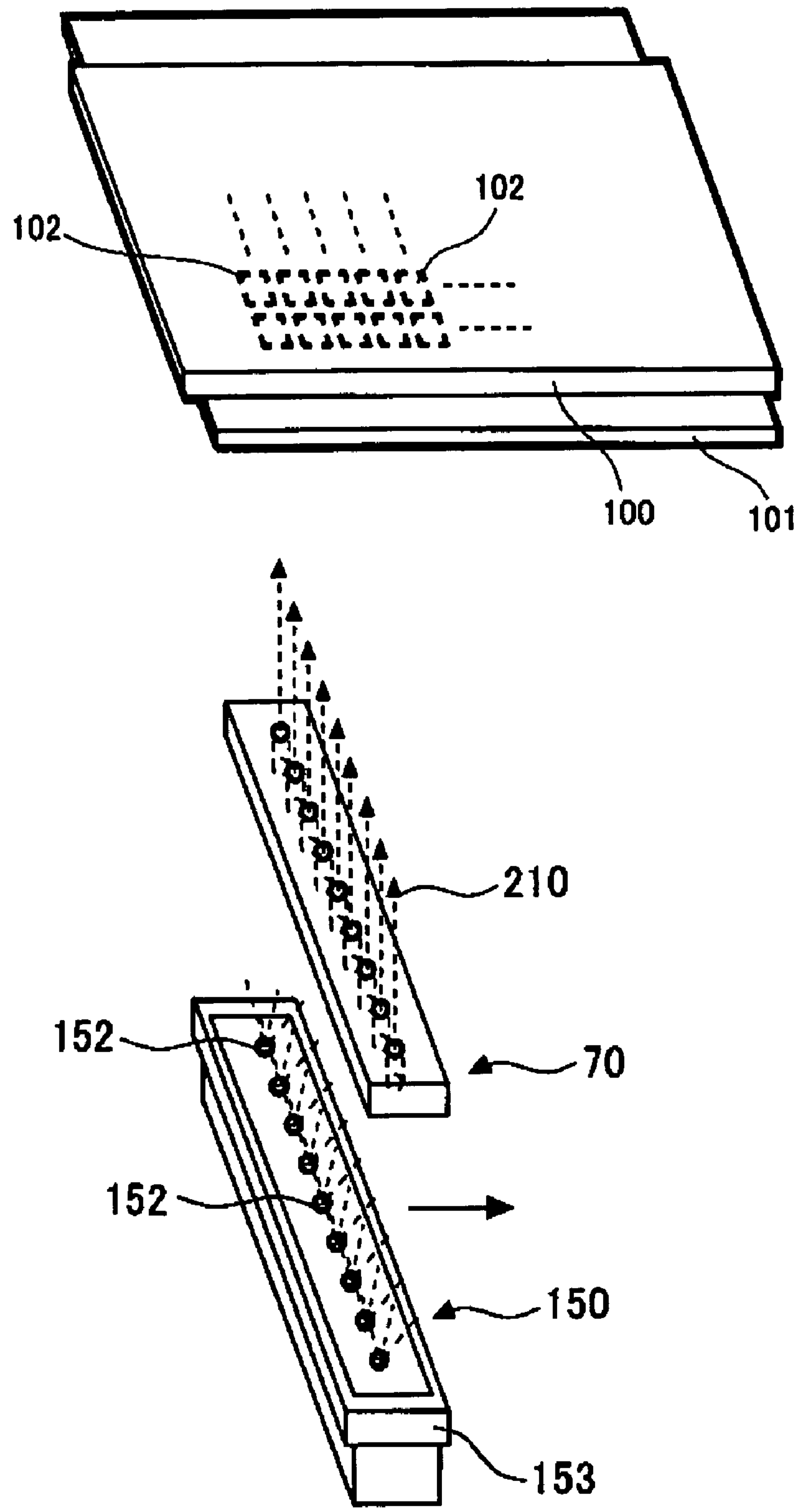


FIG.9

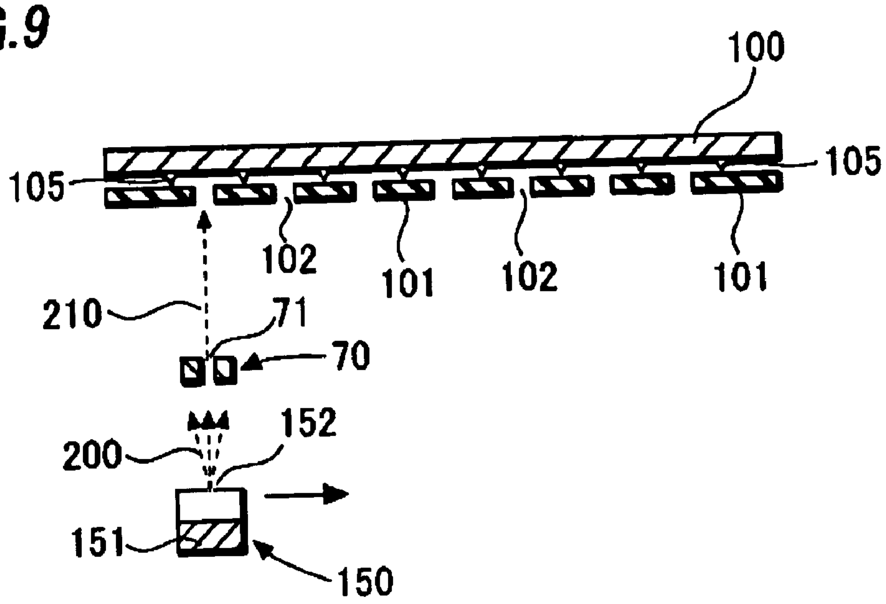


FIG.10A

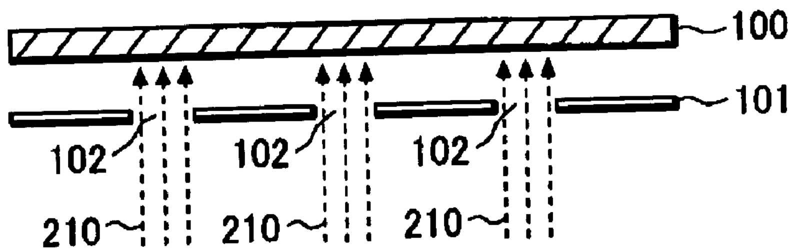


FIG.10B

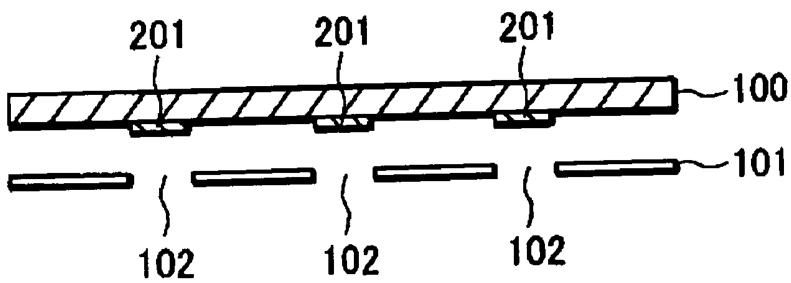


FIG. 11

PRIOR ART

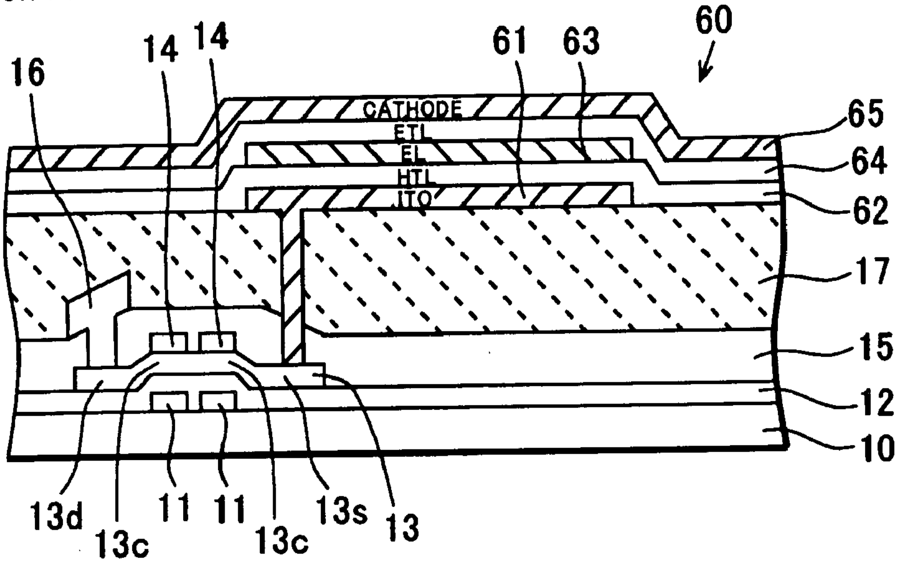


FIG. 12A

PRIOR ART

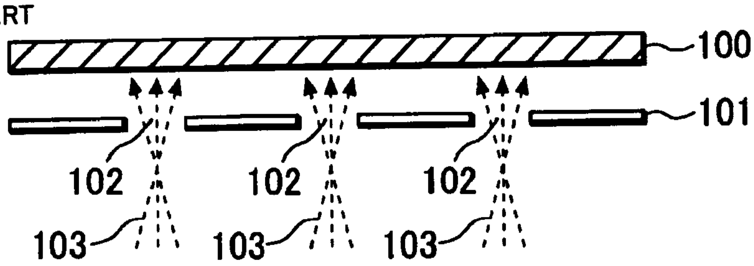
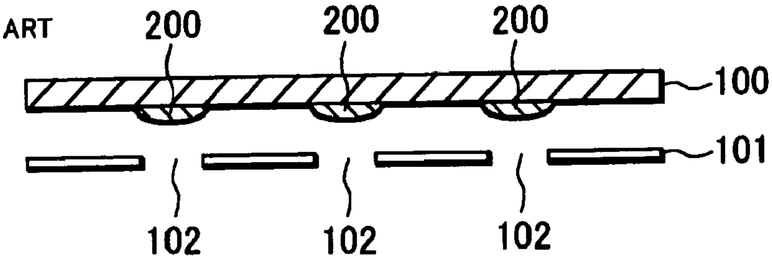


FIG. 12B

PRIOR ART



MANUFACTURING METHOD OF ORGANIC ELECTROLUMINESCENT DISPLAY DEVICE

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a manufacturing method of an electroluminescent display device, particularly to a vapor-deposition process of an organic electroluminescent material.

[0003] 2. Description of the Related Art

[0004] In recent years, organic electroluminescent (hereafter, referred to as organic EL) display devices with an organic EL element have been receiving an attention as a display device substituting for a CRT and an LCD. For example, research and development are being pursued for the organic EL display device provided with a thin film transistor (hereafter, referred to as TFT) as a switching element for driving the organic EL element.

[0005] **FIG. 11** is a cross-sectional view of a pixel of the organic EL display device. This pixel has a TFT for driving the organic EL element disposed in a periphery of an intersection of a gate signal line having a gate electrode **11** and a drain signal line (not shown). A drain of the TFT is connected to the drain signal line, the gate electrode **11** is connected to the gate signal line (not shown), and a source **13***s* is connected to an anode **61** of the EL element. In the EL display device, a plurality of the pixels is disposed in a matrix to form a display region. A manufacturing method of this organic EL display device will be described hereinafter.

[0006] A pixel is formed by sequentially laminating the TFTs and the organic EL element on a transparent insulating substrate **10** made of glass or synthetic resin. First, the gate electrode **11** made of a metal having a high melting point such as Cr (chromium) is formed on the insulating substrate **10**, and a gate insulating film **12** and an active layer **13** made of a p-Si film are sequentially formed thereon.

[0007] In the active layer **13**, a channel **13***c* is formed above the gate electrode **11**. The source **13***s* and the drain **13***d*, each of which is formed of a low impurity concentration region and a high impurity concentration region on the outside of the low impurity concentration region, are formed on each side of this channel **13***c* in the active layer **13**. The source **13***s* and the drain **13***d* are formed on each side of the gate electrode **11** by ion doping with a stopper insulating film **14** as a mask above the channel **13***c* and further ion doping with covering each sides of the gate electrode **11** by a resist.

[0008] An interlayer insulating film **15** formed by sequentially laminating a SiO2 film, a SiN film, and a SiO2 film covers the whole surfaces of the gate insulating film **12**, the active layer **13**, and the stopper insulating film **14**. A drain electrode **16** is formed by filling tithe a metal such as Al (aluminum) a contact hole provided correspondingly to the drain **13***d*. A planarization insulating film **17** for planarizing a surface and made of, for example, an organic resin, is formed on the whole surfaces.

[0009] A contact hole is formed in a position corresponding to the source **13***s* in the planarization insulating film **17**. An anode **61** made of ITO (indium tin oxide), which contacts the source **13***s* through the contact hole and serves as a source electrode, is formed on the planarization insulating film **17**. The anode **61** is made of a transparent electrode such as ITO.

[0010] The organic EL element **60** has a general structure of laminating sequentially the anode **61**, a hole transport layer **62** formed of a first hole transport layer made of MTDATA (4,4-bis (3-methylphenylphenylamino) biphenyl) and a second hole transport layer made of TPD (4,4,4-tris (3-methylphenylphenylamino) triphenylanine), an emissive layer **63** made of Bebq2 (bis(10-hydroxybenzo[h]quinolinato)beryllium) containing a quinacridone derivative, an electron transport layer **64** made of Bebq2 and a cathode **65** made of magnesium-indium alloy, aluminum or aluminum alloy.

[0011] The organic EL element **60** emits light by an electric current supplied through the above TFT for driving the organic EL element. That is, holes injected from the anode **61** and electrons injected from the cathode **65** are recombined in the emissive layer **63** and excitons are formed by exciting organic molecules of the emissive layer **63**. Light is emitted from the emissive layer **63** in a process of radiation of the excitons and then released outside after going through the transparent anode **61** to the transparent insulating substrate **10**, thereby to complete light-emission.

[0012] Since organic EL materials used for the above described hole transport layer **62**, emissive layer **63**, and electron transport layer **64**, which form the organic EL element **60**, have a low solvent resistance and is sensitive to moisture, the photolithography in a manufacturing process of a semiconductor can not be used. Therefore, a vapor-deposition method with a so-called shadow mask is used for pattern formation of the hole transport layer **62**, the emissive layer **63**, the electron transport layer **64**, and the cathode **65**, which form the organic EL element **60**.

[0013] The related art is disclosed in Japanese Laid-open Patent Application No. 2001-175200.

[0014] When forming the pattern of the organic EL element **60** by the above described vapor-deposition method with the shadow mask, the shadow mask **101** is disposed adjacent a surface of the insulating substrate **100**, as shown in **FIG. 12A**. This is because a contact between the shadow mask **101** and the insulating substrate **100** provides a possibility of damaging the surface of the insulating substrate **100**.

[0015] Vapor-deposition beams **103** containing an organic EL material, which are generated by a vapor-deposition beam generator (not shown), are led to the insulating substrate **100** through openings **102** provided in the shadow mask **101**. Then, as shown in **FIG. 12**B, the organic EL material is vapor-deposited in a region corresponding to the openings **102** on the surface of the insulating substrate **100**.

[0016] If the directional uniformity, or collimation, of the vapor-deposition beams is low, however, a shadow effect occurs to provide oblique components of the vapor-deposition beams from edges of the openings **102** of the shadow mask **101** so that the organic EL material is vapor-deposited in an outer region of the openings **102**. Furthermore, density of the vapor-deposition beams is lowered, especially at the edges of the openings **102** rather than a center thereof. This makes each thickness of the vapor-deposited organic EL material layers **200** non-uniform, that is, high at the center and low at the periphery, thereby providing a possibility of damaging properties of the organic EL element **60** (as shown in **FIG. 12B**).

SUMMARY OF THE INVENTION

[**0017**] The invention provides a manufacturing method of an organic electroluminescent display device. The method includes providing a vapor-deposition beam generator having a plurality of vapor-deposition beam passing pipes and containing therein an electroluminescent material. The pipes are aligned substantially parallel to each other. The method also includes placing a substrate in a vacuum chamber, placing a vapor-deposition mask having a plurality of openings adjacent a surface of the substrate, and vapor-depositing the organic electroluminescent material on a predetermined region of the surface of the substrate through the openings in the vapor deposition mask by generating vapor-deposition beams that are regulated by the vapor-deposition beam passing pipes.

[**0018**] The invention also provides a manufacturing method of an organic electroluminescent display device. The method includes placing a substrate in a vacuum chamber, placing a vapor-deposition mask having a plurality of openings adjacent a surface of the substrate, placing a vapor-deposition beam generator for generating vapor-deposition beams containing an organic electroluminescent material so as to face the vapor-deposition mask, and placing a vapor-deposition beam direction adjusting board having a plurality of vapor-deposition beam passing holes between the vapor-deposition beam generator and the vapor-deposition mask. The holes are aligned substantially parallel to each other. The method also includes vapor-depositing the organic electroluminescent material on a predetermined region of the surface of the substrate by generating the vapor-deposition beams containing the organic electroluminescent material and by leading the beams through the vapor-deposition beam passing holes of the vapor-deposition beam direction adjusting board and through the openings of the vapor-deposition mask.

[**0019**] The invention further provides a deposition method that includes placing a deposition source containing a deposition material in a vacuum chamber, placing a substrate in the vacuum chamber, placing a vapor-deposition mask having a plurality of openings between the deposition source and the substrate, and evaporating the deposition material from the deposition source so as to form a flux of the deposition material. The method also includes forming a substantially collimated beam of the evaporation material by forcing at least part of the flux to pass through a conduit, and directing the collimated beam through the openings of the vapor-deposition mask to the substrate.

BRIEF DESCRIPTION OF THE DRAWINGS

[**0020**] **FIG. 1** is a perspective view of a vapor-deposition beam generator to be used for a manufacturing method of an organic EL element according to a first embodiment of the invention.

[**0021**] **FIG. 2** is a cross-sectional view of the vapor-deposition beam generator to be used for the manufacturing method of the organic EL element according to the first embodiment of the invention.

[**0022**] **FIG. 3** is an explanatory view of a manufacturing method of an organic EL display device according to the first embodiment of the invention.

[**0023**] **FIG. 4** is an explanatory view of the manufacturing method of the organic EL display device according to the first embodiment of the invention.

[**0024**] **FIGS. 5A and 5B** are explanatory views of the manufacturing method of the organic EL display device according to the first embodiment of the invention.

[**0025**] **FIG. 6** is a perspective view of a vapor-deposition beam generator to be used for a manufacturing method of an organic EL element according to a second embodiment of the invention.

[**0026**] **FIG. 7** is a cross-sectional view of the vapor-deposition beam generator to be used for the manufacturing method of the organic EL element according to the second embodiment of the invention.

[**0027**] **FIG. 8** is an explanatory view of a manufacturing method of an organic EL display device according to the second embodiment of the invention.

[**0028**] **FIG. 9** is an explanatory view of the manufacturing method of the organic EL display device according to the second embodiment of the invention.

[**0029**] **FIGS. 10A and 10B** are explanatory views of the manufacturing method of the organic EL display device according to the second embodiment of the invention.

[**0030**] **FIG. 11** is a cross-sectional view of a pixel of an organic EL display device according to the conventional art.

[**0031**] **FIGS. 12A and 12B** are explanatory views of a manufacturing method of the organic EL display device according to the conventional art.

DETAILED DESCRIPTION OF THE INVENTION

[**0032**] A first embodiment of the invention will be described with reference to the drawings in detail. **FIG. 1** is a perspective view of a vapor-deposition beam generator **50**, **FIG. 2** is a cross-sectional view of **FIG. 1**, **FIG. 3** is a perspective view showing a vapor-deposition process of an organic EL material, and **FIG. 4** is a cross-sectional view of **FIG. 3**.

[**0033**] In a manufacturing method of an organic EL display device of the first embodiment, the insulating substrate **10** is prepared, and the TFT for driving an organic EL element and the organic EL element **60** are sequentially formed on the insulating substrate **10**. This is the same as the process described in the related art except the process of forming the organic EL element **60**.

[**0034**] The hole transport layer **62**, the emissive layer **63**, the electron transport layer **64**, and the cathode **65** of the organic EL element **60** are patterned by a vapor-deposition method with the shadow mask **101**. Vapor-deposition beams are enhanced in its directional uniformity through vapor-deposition beam passing pipes **52** which are long and narrow and attached to the vapor-deposition beam generator **50**.

[**0035**] The vapor-deposition beam generator **50** is provided with storage **51** for storing the organic EL material on a bottom of a box having a predetermined shape, as shown in **FIGS. 1 and 2**. Although not shown, a heater is provided in the storage **51** so that the organic EL material stored in the storage **51** is heated to be in a molten state.

[**0036**] Above the storage **51**, the plurality of the vapor-deposition beam passing pipes **52**, which is long and narrow and communicates with the storage **51**, is provided in a row along a longitudinal direction of the box. A heater **54** for heating the vapor-deposition beams which pass through the vapor-deposition beam passing pipes **52** is attached adjacent each of the vapor-deposition beam passing pipes **52**. Nozzles **53** of the vapor-deposition beam passing pipes **52** are exposed, being in plane with an upper surface of the box.

[**0037**] A ratio of a pipe diameter d to a pipe length l of each of the vapor-deposition beam passing pipes **52** needs to be at least 1:5. This is for enhancing directional uniformity of the vapor-deposition beams and securing uniformity in a layer thickness and precision of pattern formation of the vapor-deposited organic EL material layers, i.e., the hole transport layer **62**, the emissive layer **63**, the electron transport layer **64**, and the cathode **65**. Furthermore, in consideration of dispersion and repeatability of the vapor-deposition beams, the ratio of the pipe diameter d to the pipe length l is preferably at least 1:10.

[**0038**] Although the vapor-deposition beam passing pipes **52** are preferably in a cylindrical shape for smoothly guiding the vapor-deposition beams of high directional uniformity, it is not restricted to this shape but can be in a prism shape or other shapes. When the ratio of the pipe diameter d to the pipe length l of the vapor-deposition beam passing pipe **52** is 1:5, for example, the vapor-deposition beam passing pipe **52** is preferably 0.5 mm in diameter d and 2.5 mm in length l in practice.

[**0039**] Then, as shown in **FIGS. 3 and 4**, the insulating substrate **100** having the TFT for driving the organic EL element or the like is disposed in a vacuum chamber, and the shadow mask **101** is disposed adjacent and opposite to the insulating substrate **100**.

[**0040**] The openings **102** are formed correspondingly to each pattern of organic EL material layers. The vapor-deposition beam generator **50** is disposed opposite to the shadow mask **101**. The molten organic EL material stored in the storage **51** of the vapor-deposition beam generator **50** is vaporized, passes through the vapor-deposition beam passing pipes **52** to be the vapor-deposition beams of high directional uniformity, and is guided to the shadow mask **101**. The vapor-deposition beam generator **50** is moved in parallel with the shadow mask **101** so that the vapor-deposition beams are led to the whole surface of the shadow mask **101**. Accordingly, the patterns of the organic EL material layers are each formed.

[**0041**] **FIGS. 5A and 5B** show the state in which the vapor-deposition beams **104** are led to the insulating substrate **100** through the shadow mask **101**. As shown in **FIG. 5**A, the vapor-deposition beams **104** all travel in the same direction perpendicular to the shadow mask **101** and the insulating substrate **100**. Therefore, a shadow effect does not occur and vapor-deposition in an outer region of the opening **102** is prevented. The thickness of the vapor-deposited organic EL material **201** is uniform at any position.

[**0042**] When the shadow mask **101** is disposed adjacent and opposite to the insulating substrate **100**, it is preferable to dispose a plurality of spacers **105** between the insulating substrate **100** and the shadow mask **101** (shown in **FIG. 4**) in order to provide a predetermined space (for example, several ten micrometers) therebetween. This prevents the insulating substrate **100** from contacting the shadow mask **101** and being damaged at its film or elements on the surface.

[**0043**] Additionally, the organic EL material layer includes a plurality of layers such as the hole transport layer **62**, the emissive layer **63**, the electron transport layer **64**, and the cathode **65**. After vapor-depositing the hole transport layer **62** in one vacuum chamber, for example, the insulating substrate **100** vapor-deposited with the hole transport layer **62** is transferred to other vacuum chamber, and the emissive layer **63** is formed on the hole transport layer **62** by repeating the similar process. Accordingly, the hole transport layer **62**, the emissive layer **63**, the electron transport layer **64**, and the cathode **65** are sequentially laminated to form the organic EL element **60**.

[**0044**] Incidentally, although the plurality of the vapor-deposition beam passing pipes **52** is formed standing in a row along a longitudinal direction of the box as a linear source in the described first embodiment, the invention is not restricted to this but the vapor-deposition beam passing pipes **52** can be disposed in a matrix form.

[**0045**] Next, a second embodiment of the invention will be described with reference to the drawings in detail. **FIG. 6** is a perspective view of a vapor-deposition beam direction adjusting board **70** provided opposite to a vapor-deposition beam generator **150**, and **FIG. 7** is a cross-sectional view of **FIG. 6**. **FIG. 8** is a perspective view showing a vapor-deposition process of the organic EL material, and **FIG. 9** is a cross-sectional view of **FIG. 8**.

[**0046**] In a manufacturing method of an organic EL display device of the second embodiment, the insulating substrate **10** is prepared, and the TFT for driving the organic EL element and the organic EL element **60** are sequentially formed on the insulating substrate **10**. This process is the same as the process described in the related art except the process of forming the organic EL element **60**.

[**0047**] The hole transport layer **62**, the emissive layer **63**, the electron transport layer **64**, and the cathode **65** of the organic EL element **60** are patterned by the vapor-deposition method with the shadow mask **101**.

[**0048**] In the vapor-deposition beam generator **150**, storage **151** for storing the organic EL material is provided at a bottom of a box having a predetermined shape, as shown in **FIGS. 6 and 7**.

[**0049**] The storage **151** is provided with a heater **153** so that the organic EL material stored in the storage **151** can be in a molten state by heating. Above the storage **151**, a plurality of vapor-deposition beam irradiating holes **152** is formed in a row along a longitudinal direction of the box. The vapor-deposition beams are irradiated from the plurality of the vapor-deposition beam irradiating holes **152** formed in the vapor-deposition beam generator **150**. Vapor-deposition beams **200** coming out of the vapor-deposition beam irradiating holes **152** pass through a plurality of vapor-deposition beam passing holes **71** in the vapor-deposition beam direction adjusting board **70** provided opposite to the vapor-deposition beam irradiating holes **152** in the vapor-deposition beam generator **150**, thereby forming vapor-deposition beams **210** having high directional uniformity.

[**0050**] The number of the vapor-deposition beam irradiating holes **152** is not necessarily the same as that of the vapor-deposition beam passing holes **71**. Although the vapor-deposition beam passing holes **71** are preferably in a cylindrical shape formed by hollowing out the vapor-deposition beam direction adjusting board **70**, those are not restricted to this but can be in a prism shape formed by hollowing out the vapor-deposition beam direction adjusting board **70**.

[**0051**] A diameter of the vapor-deposition beam passing hole **71** is approximately 0.1 to 1 mm to enhance the directional uniformity well.

[**0052**] The vapor-deposition beam direction adjusting board **70** is preferably provided with a heating element such as a heater (not shown) and heated. The vapor-deposition beam direction adjusting board **70** may include the heating element. Accordingly, the vapor-deposition beams **210** passing through the plurality of the vapor-deposition beam passing holes **71** in the vapor-deposition beam direction adjusting board **70** are heated, thereby preventing the vapor-deposition material from adhering to the vapor-deposition beam passing holes **71**.

[**0053**] As shown in **FIGS. 8 and 9**, the insulating substrate **100** formed with the TFT for driving the organic EL element or the like is disposed in a vacuum chamber, and the shadow mask **101** is disposed adjacent and opposite to this insulating substrate **100**.

[**0054**] The shadow mask **101** is formed with the plurality of the openings **102** correspondingly to the patterns of the organic EL material layers. The above described vapor-deposition beam generator **150** is disposed opposite to the shadow mask **101**. Furthermore, the vapor-deposition beam direction adjusting board **70** provided with the plurality of the vapor-deposition beam passing holes **71** is disposed opposite to the vapor-deposition beam generator **150**.

[**0055**] The organic EL material in a molten state which is stored in the storage **151** of the vapor-deposition beam generator **150** is vaporized so that the vapor-deposition beams **200** come out of the vapor-deposition beam irradiating holes **152**. The vapor-deposition beams **200** pass through the vapor-deposition beam passing holes **71** in the vapor-deposition beam direction adjusting board **70** provided opposite to the vapor-deposition beam irradiating holes **152** to become the vapor-deposition beams **210** having high directional uniformity, thereby irradiating the shadow mask **101**. The vapor-deposition beam generator **150** and the vapor-deposition beam direction adjusting board **70** are simultaneously moved in parallel with the shadow mask **101** so that the vapor-deposition beams **210** having high directional uniformity are incident on the whole surface of the shadow mask **101**, thereby forming the patterns of the organic EL material layers.

[**0056**] Incidentally, although the vapor-deposition beam generator **150** and the vapor-deposition beam direction adjusting board **70** are not connected when simultaneously moved in parallel with the shadow mask **101** in **FIGS. 8 and 9**, those may be physically connected as an integral unit. Since the vapor-deposition beam generator **150** and the vapor-deposition beam direction adjusting board **70** can be moved relatively to the shadow mask **101**, the vapor-deposition beam generator **150** and the vapor-deposition beam direction adjusting board **70** may be stationary and the insulating substrate **100** and the shadow mask **101** may move instead.

[**0057**] **FIGS. 10A and 10B** show the state in which the vapor-deposition beams **210** are guided to the insulating substrate **100** through the shadow mask **101**. As shown in **FIG. 10**A, all the directions of the vapor-deposition beams **210** are almost vertical to the shadow mask **101** and the insulating substrate **100**, thereby eliminating the shadow effect and preventing vapor-deposition in an outer region of the openings **102**. Furthermore, a thickness of the vapor-deposited organic EL material **201** is uniform at any position.

[**0058**] When the shadow mask **101** is disposed adjacent and opposite to the insulating substrate **100**, it is preferable to provide the spacers **105** between the insulating substrate **100** and the shadow mask **101** in order to secure a predetermined space (for example, several ten micrometers). This prevents the insulating substrate **100** from contacting the shadow mask **101** and from being damaged at its film or elements on the surface.

[**0059**] Additionally, the organic EL material layer includes a plurality of layers such as the hole transport layer **62**, the emissive layer **63**, the electron transport layer **64**, and the cathode **65**. After vapor-depositing the hole transport layer **62** in one vacuum chamber, for example, the insulating substrate **100** vapor-deposited with the hole transport layer **62** is transferred to other vacuum chamber, and the emissive layer **63** is formed on the hole transport layer **62** by repeating the similar process. Accordingly, the hole transport layer **62**, the emissive layer **63**, the electron transport layer **64**, and the cathode **65** are sequentially laminated to form the organic EL element **60**.

[**0060**] Incidentally, although the plurality of the vapor-deposition beam irradiating holes **152** and the vapor-deposition beam passing holes **71** are formed standing in a row along a longitudinal direction of the box as a linear source in the described second embodiment, the invention is not restricted to this but the vapor-deposition beam irradiating holes **152** and the vapor-deposition beam passing holes **71** can be disposed in a matrix.

What is claimed is:

1. A manufacturing method of an organic electroluminescent display device, comprising:

providing a vapor-deposition beam generator comprising a plurality of vapor-deposition beam passing pipes and containing therein an electroluminescent material, the pipes being aligned substantially parallel to each other;

placing a substrate in a vacuum chamber;

placing a vapor-deposition mask having a plurality of openings adjacent a surface of the substrate; and

vapor-depositing the organic electroluminescent material on a predetermined region of the surface of the substrate through the openings in the vapor deposition mask by generating vapor-deposition beams that are regulated by the vapor-deposition beam passing pipes.

2. The manufacturing method of claim 1, wherein a ratio of a diameter of the pipes to a length of the pipes is 1:5 or greater.

3. The manufacturing method of claim 1, wherein the vapor-depositing comprises heating the vapor-deposition beams while the beams pass through the vapor-deposition beam passing pipes.

4. A manufacturing method of an organic electroluminescent display device, comprising:

placing a substrate in a vacuum chamber;

placing a vapor-deposition mask having a plurality of openings adjacent a surface of the substrate;

placing a vapor-deposition beam generator for generating vapor-deposition beams containing an organic electroluminescent material so as to face the vapor-deposition mask;

placing a vapor-deposition beam direction adjusting board having a plurality of vapor-deposition beam passing holes between the vapor-deposition beam generator and the vapor-deposition mask, the holes being aligned substantially parallel to each other; and

vapor-depositing the organic electroluminescent material on a predetermined region of the surface of the substrate by generating the vapor-deposition beams containing the organic electroluminescent material and by leading the beams through the vapor-deposition beam passing holes of the vapor-deposition beam direction adjusting board and through the openings of the vapor-deposition mask.

5. The manufacturing method of claim 4, wherein the vapor-deposition beam passing holes are provided in a row along a longitudinal direction of the vapor-deposition beam direction adjusting board.

6. The manufacturing method of claim 4, further comprising heating the vapor-deposition beam direction adjusting board.

7. The manufacturing method of claim 4, wherein the vapor-deposition beam direction adjusting board comprises a heating element.

8. A deposition method comprising:

placing a deposition source containing a deposition material in a vacuum chamber;

placing a substrate in the vacuum chamber;

placing a vapor-deposition mask having a plurality of openings between the deposition source and the substrate;

evaporating the deposition material from the deposition source so as to form a flux of the evaporation material;

forming a substantially collimated beam of the deposition material by forcing at least part of the flux to pass through a conduit; and

directing the collimated beam through the openings of the vapor-deposition mask to the substrate.

9. The deposition method of claim 8, wherein the substrate comprises a plurality device elements formed thereon, the forming the collimated beam comprises forming a plurality of the collimated beams, and the directing collimated beam comprises directing the plurality of the collimated beams to corresponding device elements of the substrate.

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摘要(译)

气相沉积掩模邻近设置在真空室中的基板表面设置，含有有机EL材料的气相沉积光束由气相沉积光束发生器产生，气相沉积光束穿过蒸汽中的开口 - 沉积掩模，并且有机EL材料气相沉积在基板表面上的预定区域中。气相沉积光束被引导通过设置在气相沉积束发生器中的多个气相沉积光束通过管道。或者，由气相沉积束发生器产生的气相沉积束被引导通过具有多个气相沉积束通孔的气相沉积束方向调节板。这增强了气相沉积光束的定向均匀性，从而使得有机EL材料层的每个膜厚度均匀，从而提高了形成层的图案的精度。