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(54) LIGHT-EMITTING ELEMENT, DISPLAY DEVICE, AND METHOD FOR MANUFACTURING LIGHT-EMITTING ELEMENT

LICHTEMITTIERENDES ELEMENT, ANZEIGEVORRICHTUNG UND VERFAHREN ZUR HERSTELLUNG DES LICHTEMITTIERENDEN ELEMENTS

ELÉMENT ÉLECTROLUMINESCENT, DISPOSITIF D'AFFICHAGE ET PROCÉDÉ DE FABRICATION D'UN ÉLÉMENT ÉLECTROLUMINESCENT

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Description

[Technical Field]

[0001] The present invention relates to a light emitter, a display apparatus and a method of manufacturing the light emitter, and in particular to an organic EL element used in a display apparatus such as a flat display apparatus.

[Background Art]

[0002] Conventionally, in a manufacturing process of an organic EL element, patterning by an ink-jet method is used to form a light-emitting layer. The ink-jet method is suitable for forming a uniform thin film pattern in a micro area. The ink-jet method forms the uniform thin film pattern at a pixel region defined by a bank by ejecting drops of an ink composition (hereinafter, referred to simply as "ink") containing an organic EL material into the pixel region and drying the ink.

[0003] When the above method is employed, a surface of the bank is subjected to, for example, a liquid-repellent treatment using fluorine plasma. As a result, the surface of the bank has low wettability to the ink and the ejected ink becomes less likely to overflow the bank and flow in an adjacent pixel region. Accordingly, high-definition patterning becomes possible.

[0004] Moreover, Patent Literature 1 discloses a technology for patterning a higher-definition light-emitting layer by: having a two-layered bank composed of a upper bank layer made of a liquid-repellent material and a lower bank layer made of a liquid-philic material; making the upper bank layer have low wettability to the ink so that the ink is less likely to overflow the bank; and making the lower bank layer have high wettability to the ink so that the ink easily stays in the pixel region.

[0005] US2005073243 (A) relates to a light emitting device and a method of manufacturing the same.

[0006] JP2007220656 (A) discloses a light emitter including a bank and a charge injection transport layer principally composed of a metal compound that is more liquid-philic than a surface of the bank such that the surface of the bank is liquid-repellent with respect to the charge injection transport layer, and the charge injection transport layer further having a recessed structure.

J [Citation List]

[Patent Literature]

[0007] [Patent Literature 1]
Japanese Patent Application Publication No. 2003-249375

[Summary of Invention]

[Technical Problem]

[0008] However, in order to have the two-layered bank, manufacturing cost of the organic EL element increases since the number of processes increases compared with having a single-layered bank.

[0009] In view of the above problem, the present invention aims to provide a light emitter on which a high definition light-emitting layer is patterned and which can be manufactured at a low price.

[Solution to Problem]

[0010] A light emitter pertaining to an embodiment of the present invention is defined in claim 1. A manufacturing method of a light emitter of claim 1 is defined in claim 11. Further advantageous embodiments are defined in the dependent claims.

[Advantageous Effects of Invention]

[0011] According to the light emitter pertaining to the embodiment of the present invention, the portion of the charge injection transport layer has the recessed structure so that in the region defined by the bank, the portion of the charge injection transport layer is lower than the bottom surface of the bank. Accordingly, in a manufacturing process, a recessed portion of the charge injection transport layer can accumulate drops of ink that have been ejected in the region defined by the bank. In addition, on an inner surface of the recessed portion, the charge injection transport layer is principally composed of a metal compound that is more liquid-philic than the surface of the bank and has high wettability to the ink. Accordingly, the inner surface of the recessed portion can stably hold the drops of the ink therein. Therefore, the drops of the ink do not easily overflow the bank and flow in an adjacent pixel region, and a high definition light-emitting layer can be patterned. Additionally, the recessed portion can be easily formed by, for example, melting a part of the charge injection transport layer with pure water. Also, unlike a light emitter of Patent Literature 1, a complicated process for making a two-layer bank is unnecessary. As a result, it is possible to enable such a light emitter at a low price.

[Brief Description of Drawings]

[0012]

FIG. 1 is a schematic view showing a layered condition of layers constituting a light emitter pertaining to a third embodiment.

FIG. 2 is an enlarged view of a part enclosed with a dashed line in FIG. 1.

FIG. 3 is an enlarged view of the part enclosed with the dashed line in FIG. 1, with respect to the light emitter pertaining to a modification.

FIG. 4 is an enlarged view of the part enclosed with the dashed line in FIG. 1, with respect to the light emitter pertaining to the modification.

FIGs. 5A and 5B are schematic views for explaining a best thickness of a light-emitting layer.

FIG. 6 is an enlarged view of the part enclosed with the dashed line in FIG. 1, with respect to the light emitter pertaining to the modification.

FIGs. 7A-7D are processing drawings for explaining a method of manufacturing the light emitter pertaining to a first embodiment.

FIGs. 8E-8H are processing drawings for explaining the method of manufacturing the light emitter pertaining to the first embodiment, which follows FIG. 7D.

FIG. 9 is a schematic view showing a layered condition of layers constituting a light emitter pertaining to a second embodiment.

FIGs. 10A-10D are processing drawings for explaining a method of manufacturing the light emitter pertaining to the second embodiment.

FIG. 11 is a schematic view showing a layered condition of layers constituting a light emitter pertaining to a third reference embodiment not forming part of the present invention.

FIGs. 12A-12D are processing drawings for explaining a method of manufacturing the light emitter pertaining to the third reference embodiment.

FIG. 13 is a perspective view showing apparatuses such as a display apparatus pertaining to a fourth embodiment.

[Embodiments]

[0013] A light emitter pertaining to an embodiment of the present invention is defined in claim 1.

[0014] Here, a term "charge injection transport layer" is a collective term for layers such as a hole injection layer, a hole transport layer, a hole injection and transport layer, an electron injection layer, an electron transport layer and an electron injection and transport layer. For example, the charge injection transport layer may be composed of the hole injection layer, the hole transport layer, the electron injection layer, the electron transport layer, and an electron injection transport layer.

[0015] Note that, terms "liquid-philic" and "liquid-repellent" are each used in a relative sense. As described above, a bank has liquid-repellency at least on a surface thereof. On the other hand, when the charge injection transport layer is principally composed of a metal compound with liquid-philicity, a surface of the charge injection transport layer is more liquid-philic than the surface of the bank, and the surface of the bank is more liquid-repellent than the surface of the charge injection transport layer. Also, the surface of the charge injection transport layer with liquid-philicity relatively has high wettability to ink, and the surface of the bank with liquid-repellency relatively has low wettability to the ink. Note that, liquid-philicity or liquid-repellency can be, for example, defined by a contact angle at which the ink meets the surface of the bank or the charge injection transport layer. For example, when the contact angle is equal to or smaller than 10°, the surface is defined to have liquid-philicity, and when the contact surface is equal to or greater than 35°, the surface is defined to have liquid-repellency.

[0016] A display apparatus pertaining to the embodiment of the present invention is defined in claim 10.

[0017] A manufacturing method of a light emitter pertaining to an embodiment of the present invention is defined in claim 11.

[0018] The following explains a light emitter, a display apparatus and a method of manufacturing the light emitter with reference to the drawings. Note that contraction scale of members shown in each drawing differs from real scale.

[First Embodiment]

<Schematic Structure of Light emitter>

[0019] FIG. 1 is a schematic view showing a layered condition of layers constituting a light emitter pertaining to a first embodiment, and FIG. 2 is an enlarged view of a part enclosed with a dashed line in FIG. 1.

[0020] As FIG. 1 shows, the light emitter pertaining to the first embodiment is a top emission type organic EL element including RGB pixels that are arranged in a matrix or in line. Each pixel has a layer structure and each layer is disposed on a substrate.

[0021] On a TFT substrate 1 (hereinafter, referred to simply as "substrate 1"), a first electrode 2, which is an anode, is formed together with other first electrodes 2 in a matrix or in line. On the first electrode 2, an indium tin oxide (ITO) layer 3, and a hole injection layer 4 as the charge injection transport layer are layered in this order. Note that, while the ITO layer 3 is layered only on the first electrode 2, the hole injection layer 4 is formed not only above the first electrode 2 but also across an entire upper surface of the substrate 1.

[0022] On the hole injection layer 4, a bank 5 that defines pixels is formed, and in a region defined by the bank 5, a light-emitting layer 6 is disposed. Furthermore, on the light-emitting layer 6, an electron injection layer 7, a second electrode 8, which is a cathode, and a passivation layer 9 are formed so as to be continuous with respective layers of an adjacent pixel, passing over the region defined by the bank 5.

[0023] The region defined by the bank 5 has a multilayer structure according to which the ITO layer 3, the hole injection layer 4, the light-emitting layer 6 and the electron injection layer 7 are layered in this order. Such a layer structure constitutes a functional layer. Note that, the functional layer may include other layers such as the hole transport layer or the electron transport layer.

<Constituent Components of Light emitter>

[0024] The substrate 1 is formed with an insulating material such as soda glass, nonfluorescent glass, phosphate glass, borate glass, quartz, acrylic resin, styrenic resin, polycarbonate resin, epoxy resin, polyethylene, polyester, silicone resin, alumina, etc.

[0025] The first electrode 2 is formed with Ag (silver). Note that the first electrode 2 may be formed with APC (alloy of silver, palladium, and copper), ARA (alloy of silver, rubidium, and gold), MoCr (alloy of molybdenum and chromium), NiCr (alloy of nickel and chromium), etc. In the case of a top emission type light emitter, it is preferable that the first electrode 2 be formed with a light-reflective material.

[0026] The ITO layer 3 exists between the first electrode 2 and the hole injection layer 4 and has a function of guaranteeing excellent bondability between the first electrode 2 and the hole injection layer 4.

[0027] The hole injection layer 4 contains a metal compound soluble in a predetermined solvent. To be specific, the hole injection layer 4 is formed with WOx (tungsten oxide) or MoWOx (molybdenum tungsten oxide). Note that the hole injection layer 4 only has to be formed with a metal compound that is more liquid-philic than a surface of the bank 5. Examples of a metal compound having liquid-philicity include a metal oxide, metal nitride, or metal oxynitride.

[0028] When the hole injection layer 4 is formed with a metal oxide, holes can be easily injected, contributing to effective light emission by electrons in the light-emitting layer 6, which allows for excellent light-emitting characteristics to be obtained. Examples of a metal oxide include an oxide of chromium (Cr), molybdenum (Mo), tungsten (W), vanadium (V), niobium (Nb), tantalum (Ta), titanium (Ti), zircon (Zr), hafnium (Hf), scandium (Sc), yttrium (Y), thorium (Th), manganese (Mn), iron (Fe), ruthenium (Ru), osmium (Os), cobalt (Co), nickel (Ni), copper (Cu), zinc (Zn), cadmium (Cd), aluminum (Al), gallium (Ga), indium (In), silicon (Si), germanium (Ge), stannum (Sn), lead (Pb), antimony (Sb), bismuth (Bi), and so-called rare earth from lanthanum (La) to lutetium (Lu). Especially, aluminum oxide (Al_2O_3), copper oxide (CuO) and silicon monoxide (SiO) can contribute to a prolonged service life.

[0029] It is preferable that the metal compound be composed of a transition metal. The transition metal occupies a plurality of potential levels since there are a plurality of oxidation numbers. This makes hole injection easy and allows for reduction of driving voltage.

[0030] As FIG. 2 shows, the hole injection layer 4 extends along the bottom surface of the bank 5 to an adjacent pixel. Also, a portion of the charge injection transport layer 4 in a region defined by the bank 5 has a recessed structure according to which the portion of the charge injection transport layer 4 is lower than the bottom surface of the bank 5, and includes a recessed portion 4a (indicated with mesh hatching in FIG. 2) formed by being dissolved by a predetermined solvent. In addition, with regard to the hole injection layer 4, only a film thickness in the region defined by the bank 5 is smaller than a film thickness in other regions, and the film thickness in the other regions is entirely and substantially uniform. Since the hole injection layer 4 is formed by a metal compound having liquid-philicity, an inner surface 4b of the recessed portion 4a has excellent wettability to ink. Accordingly, this allows for drops of the ink ejected into the region defined by the bank 5 to easily adhere to the inner surface 4b of the recessed portion 4a, and the drops of the ink easily stay within the region defined by the bank 5.

[0031] Note that, the hole injection layer 4 only has to have a recessed structure according to which the recessed portion 4a is lower than a bottom periphery 5d of the bottom surface of the bank 5, and does not have to be lower than the entire bottom surface of the bank 5. In the recessed structure of the present embodiment, the recessed portion 4a is lower than a peripheral portion 5a of the bottom surface of the bank but not lower than a central part 5b of the bottom surface of the bank. Alternatively, for example, by setting the central part 5b as high as the peripheral portion 5a and planarizing the bottom surface of the bank 5, as an alternate long and two short dashes line 5c shows in FIG. 2, it may be possible to have the recessed structure according to which the recessed portion 4a is lower than the entire bottom surface of the bank 5.

[0032] The hole injection layer 4 has a recessed structure according to which a portion of the hole injection layer 4 is lower than and aligned with the bottom periphery 5d of the bank. To be specific, an upper surface of the hole injection layer 4, which is defined by the bank 5, is sunken from a level of the bottom periphery 5d i n a direction substantially vertical to the upper surface of the substrate 1. Like this, in the case of the recessed structure according to which the portion of the hole injection layer 4 is lower than and aligned with the bottom periphery 5d of the bank 5, a film thickness of the light-emitting layer 6 can be uniformed over a wide range, and as a result, irregular luminance is not likely to occur in the light-emitting layer 6.

[0033] Alternatively, the hole-injection layer 4 is not limited to having the recessed structure according to which the portion of the hole-injection layer 4 is lower than and aligned with the bottom periphery 5d of the bank 5. For example, as shown in FIG. 3, the hole-injection layer 4 may have a structure according to which a portion of the hole-injection layer 4 retreats to a position that is closer to an adjacent pixel than the bottom periphery 5d of the bank 5 is. Furthermore, the hole-injection layer 4 may have a recessed structure according to which a portion of the hole-injection layer 4 that is closer to a center of the pixel than the bottom periphery 5d of the bank 5 is is recessed. In such a case, a profile of the recessed portion 4a is a shape indicated by a line with alternate long and two short dashes 10 in FIG. 3.

[0034] The recessed structure of the hole-injection layer 4 has a cup-like shape. To be more specific, an inner surface 4b of the recessed portion 4a is composed of an inner bottom surface 4c and an inner side surface 4d. The inner bottom surface 4c is substantially parallel with the upper surface of the substrate 1 and uniformed, and is in contact with a bottom surface 6a of the light-emitting layer 6. The inner side surface 4d extends from a periphery of the inner bottom surface 4c in a direction perpendicular to the upper surface of the substrate 1 and is in contact with a side surface 6b of the light-emitting layer 6. When the recessed structure has a cup-like shape, the inner side surface 4d prevents the drops of the ink within the recessed portion 4a from moving in a direction parallel to the upper surface of the substrate 1. Accordingly, it is possible to more stably hold the drops of the ink within the region defined by the bank 5. Moreover, when the recessed structure has the cup-like shape, the inner surface 4b of the recessed portion 4a becomes larger in area, and a contact surface of the drops of the ink and the hole-injection layer 4 becomes larger in area. Accordingly, it is possible to more stably hold the drops of the ink within the region defined by the bank 5. Therefore, high-definition patterning of the light-emitting layer 6 is possible.

[0035] Note that a recessed structure of the hole-injection layer 4 is not limited to the cup-like shape. As shown in FIG. 4, a cross-sectional shape of the recessed portion 4a (indicated with mesh hatching in FIG. 4) may have a plate-like shape such as substantially a fan-shape or substantially a V shape.

[0036] Returning to FIG. 2, though the invention of the present application does not specifically specify the average depth t of the recessed portion 4a, the average depth t may be 5-100 nm, for example. If the average depth t of the recessed portion 4a is equal to or greater than 5 nm, it is possible to hold sufficient amount of the ink within the recessed portion 4a. Accordingly, it is possible to stably maintain the ink within the region defined by the bank 5. Furthermore, since the light-emitting layer 6 is formed until a periphery of the bank 5 without being rejected, the short circuit between the electrodes 2 and 8 can be prevented.

[0037] Note that, the average depth t of the recessed portion 4a can be obtained by measuring a surface profile of the hole injection layer 4 with use of a stylus profiler meter or an AFM (Atomic Force Microscope), and calculating a difference between an average height of a portion that is a crest and an average height of a portion that is a trough based on the surface profile.

[0038] On the other hand, the film thickness of the light-emitting layer 6 is not specifically determined. However, if an average film thickness h of the light-emitting layer 6 after dried is equal to or greater than 100 nm and an average depth t of the recessed portion 4a is equal to or smaller than 100 nm, for example, it is possible to uniform a film thickness of the light-emitting layer 6 at the region defined by the bank 5.

[0039] Furthermore, it is preferable that a difference between the average film thickness h of the light-emitting layer 6 and the average depth t of the recessed portion 4a be equal to or smaller than 20 nm. When the average film thickness h of the light-emitting layer 6 is much smaller than the average depth t of the recessed portion 4a (for example, $t - h > 20$ nm), there is a portion that is out of contact with the light-emitting layer 6 (portion not covered with the light-emitting layer 6) at the inner side surface 4d of the recessed portion 4a, as FIG. 5A shows. Then a short circuit might occur between the electrodes 2 and 8 at that portion. On the other hand, when the average film thickness h of the light-emitting layer 6 is much greater than the average depth t of the recessed portion 4a (for example, $h - t > 20$ nm), liquid-repellency of the bank 5 causes a film thickness of a bank vicinity portion 6c of the light-emitting layer 6 to become smaller than other portions, as FIG. 5B shows. As a result, a cross-sectional shape of the light-emitting layer 6 has a substantially convex shape, and this might result in irregular light emission caused by a difference of film thickness.

[0040] Note that, the inner side surface 4d of the recessed portion 4a only has to be in contact with at least a part of the side surface 6b of the light-emitting layer 6. For example, as FIG. 2 and FIG. 5B show, when the average film thickness h of the light-emitting layer 6 is equal to or greater than the average depth t of the recessed portion 4a, only a part of a lower part of the side surface 6b of the light-emitting layer 6 is in contact with the inner side surface 4d of the recessed portion 4a. On the other hand, as FIG. 5A shows, when the average film thickness h of the light-emitting layer 6 is smaller than the average depth t of the recessed portion 4a, the side surface 6b of the light-emitting layer 6 is entirely in contact with the inner side surface 4d of the recessed portion 4a.

[0041] As FIG. 6 shows, in the recessed portion 4a of the hole injection layer 4, a liquid-philic layer 12 such as an IL layer (intermediate layer) may be formed under the light-emitting layer 6. In this case, the drops of the ink are ejected not on the inner bottom surface 4c of the recessed portion 4a but on an upper surface 12a of the liquid-philic layer 12. However, since the upper surface 12a is liquid-philic, it is possible to stably hold the drops of the ink within the region defined by the bank 5. However, if the recessed portion 4a is totally filled with the liquid-philic layer 12, the inner side surface 4d of the recessed portion 4a becomes out of contact with the ink. Accordingly, an average film thickness g of the liquid-philic layer 12 is preferably smaller than the average depth t of the recessed portion 4a.

[0042] The bank 5 is formed with an organic material such as resin or an inorganic material such as glass and has insulating properties. Examples of the organic material include acrylic resin, polyimide resin, novolac-type phenolic resin, etc. Examples of the inorganic material include silicon oxide (SiO_2), silicon nitride (Si_3N_4), etc. It is preferable that the bank 5 have organic solvent resistance, and have certain light transparency to visible light.

Furthermore, since the bank 5 is etched, baked, etc. when formed, it is preferable that the bank 5 be formed from a material highly resistant to the etching and baking processes.

[0043] At least the surface of the bank 5 is provided with liquid-repellency. Accordingly, when the bank 5 is formed with a liquid-philic material, it is necessary that the surface of the bank 5 be subjected to, for example, a liquid-repellent treatment in order to make the surface of the bank 5 liquid-repellent.

[0044] Note that the bank 5 may be a pixel bank or a line bank. In the case of a pixel bank, the bank 5 is formed to surround a whole circumference of the light-emitting layer 6 including a pixel. In the case of a line bank, the bank 5 is formed to define a plurality of pixels by column or by row. In other words, the bank 5 exists only as columns or as rows on either side of a light-emitting layer 6, and a light-emitting layer 6 is continuous with other light-emitting layers 6 in the same column or row.

[0045] Specifically, it is preferable that the organic light-emitting layer 6 be formed from a fluorescent material such as an oxinoid compound, perylene compound, coumarin compound, azacoumarin compound, oxazole compound, oxadiazole compound, perinone compound, pyrrolo-pyrrole compound, naphthalene compound, anthracene compound, fluorene compound, fluoranthene compound, tetracene compound, pyrene compound, coronene compound, quinolone compound and azaquinolone compound, pyrazoline derivative and pyrazolone derivative, rhodamine compound, chrysene compound, phenanthrene compound, cyclopentadiene compound, stilbene compound, diphenylquinone compound, styryl compound, butadiene compound, dicyanomethylene pyran compound, dicyanomethylene thiopyran compound, fluorescein compound, pyrylium compound, thiapyrylium compound, selenapyrylium compound, telluropyrylium compound, aromatic aldadiene compound, oligophenylene compound, thioxanthene compound, anthracene compound, cyanine compound, acridine compound, metal complex of a 8-hydroxyquinoline compound, metal complex of a 2-bipyridine compound, complex of a Schiff base and a group three metal, metal complex of oxine, rare earth metal complex, etc., as recited in Japanese Unexamined Patent Application Publication No. H5-163488. When the light-emitting layer 6 includes a layer formed with a high-polymer material, the light-emitting layer 6 can be formed by a printing technology such as an ink-jet method, and a nozzle coating method. Accordingly, compared with a deposition method using a low-molecular material, is it possible to easily contribute to cost reduction.

[0046] The electron injection layer 7 has the function of transporting electrons injected through the second electrode 8 to the light-emitting layer 6 and is preferably formed, for example, from barium, phthalocyanine, lithium fluoride, or a combination thereof.

[0047] The second electrode 8 is formed from ITO, indium zinc oxide (IZO), etc. In the case of a top emission type light emitter, it is preferable that the first electrode 8 be formed with a light transparent material.

[0048] The passivation layer 9 has the function of controlling the light-emitting layer 6 or other layers from being exposed to water or air and is formed, for example, from silicon nitride (SiN), silicon oxynitride (SiON), etc. In the case of a top emission type light emitter, it is preferable that the passivation layer 9 be formed from a light transparent material.

<Method of Manufacturing Light emitter>

[0049] FIGs. 7A-7D are processing drawings for explaining a method of manufacturing a light emitter pertaining to the first embodiment. FIGs. 8E-8H are processing drawings for explaining the method of manufacturing the light emitter pertaining to the first embodiment, which follows FIG. 7D.

[0050] In the manufacturing process of a light emitter pertaining to the first embodiment, first, as FIG. 7A shows, the first electrode 2 is formed on the substrate 1 that is made of glass together with other first electrodes 2 in a matrix or in line, by forming a thin Ag film, for example, by a sputtering method and then patterning the thin Ag film, for example, by photolithography. Note that the thin Ag film may be formed by vacuum deposition or the like.

[0051] Next, as FIG. 7B shows, a thin ITO film is formed by, for example, sputtering, and then the ITO layer 3 is formed by patterning the thin ITO film by photolithography, for example.

[0052] Following this, the thin film 11 containing a metal compound soluble in a predetermined solvent is formed. For example, using a compound containing WOx or MoWOx, the thin film 11 formed from WOx or MoWOx are formed by a vacuum deposition method or a sputtering method, to be uniform all over an upper surface of the substrate 1.

[0053] Next, as FIG. 7C shows, the bank 5 is formed, for example, by photolithography, so as to surround each pixel region (region at which the first electrode 2 is positioned). In such a case, for example, a resist film (for example, resin film) including a resist material is formed on the thin film 11, for example, by coating, and a resist pattern is formed on the resist film. After that, a desired portion of the resist film is etched by applying a developing solution and removed to form patterning of the bank 5. Note that, when the bank 5 is formed from an inorganic material, the bank is formed by a CVD method, for example. Residuals of the resist film that are attached on a surface of the thin film 11 after etching are removed by hydrofluoric acid, for example. Furthermore, a liquid-repellent treatment is applied to the surface of the bank 5, if necessary.

[0054] Next, as FIG. 7D shows, the hole injection layer 4 is formed by forming the recessed portion 4a by melting a part of the thin film 11. Thereby, in the hole injection layer 4, the region defined by the bank 5 has a film thickness smaller than a film thickness of other areas. The recessed portion 4a is formed, for example, when an impure substance such as hydrofluoric acid remaining on the surface of the bank 5 is being cleaned with pure water after residuals of the resist film are removed, by melting the region defined by the bank 5 on an upper surface of the thin film 11 with the pure water. In such a case, pure water is the predetermined solvent, and it is possible to change a depth and a shape of the recessed portion 4a by changing condition of cleaning with the pure water.

[0055] As a specific method, for example, the substrate 1 is cleaned by ejecting pure water (for example, of a room temperature) thereon, while a spin coater keeps rotating the substrate 1. After that, while the substrate 1 is kept rotating, pure water is stopped being ejected and then drained. In this case, it is possible to change the depth and the shape of the recessed portion 4a by changing a time period for ejecting the pure water. Since a melting speed of the thin film 11 also changes according to a temperature of pure water, it is also possible to adjust the depth and the shape of the recessed portion 4a by the temperature of pure water.

[0056] A method for forming the recessed portion 4a is not limited to the above. For example, after the formation of the bank 5, while the residuals of the resist film that are attached on the surface of the thin film 11 are being cleaned with a cleaning liquid such as pure water, the recessed portion 4a may be formed by melting a part of the thin film 11 by the cleaning liquid at the same time. In such a case, the predetermined solvent is the cleaning liquid. Alternatively, while the resist film is being etched by the developing solution to form the bank 5 and the residuals of the resist film that are attached on the thin film 11 are being cleaned by the developing solution, the recessed portion 4a may be formed by melting the part of the thin film 11 at the same time. In such a case, the predetermined solvent is the developing solution.

[0057] When the hole injection layer 4 is formed by dissolving the thin film 11 with use of a solvent such as a cleaning liquid and a developing solution that are used in forming the bank, productive efficiency is high since a different predetermined solvent to form the recessed portion 4a is not required and an additional process to form the recessed portion 4a is also not required.

[0058] Note that the recessed portion 4a is not limited to be formed by using the predetermined solvent. Another method like the following may be used. For example, first, a thin film made of WOx or MoWOx is formed with use of spattering and photolithography at all the area except an area at which the first electrode 2 is located. After that, on the thin film, another thin film made of WOx or MoWOx is formed to cover all the area and the hole injection layer 4 having a recessed shape is formed at the area at which the first electrode 2 is located.

[0059] Next, as FIG. 8E shows, the light-emitting layer 6 is formed by ejecting drops of the ink by, for example, the ink-jet method in the region defined by the bank 5, coating the ink along the inner bottom surface 4c and the inner side surface 4d of the hole injection layer 4, and drying the ink. Note that the ink may be ejected by other methods such as a dispenser method, a nozzle coating method, a spin coat method, an intaglio printing, and a letterpress printing.

[0060] Next, as FIG. 8F shows, a thin barium film that will be the electron injection layer 7 is formed by, for example, vacuum deposition. Then as FIG. 8G shows, an ITO thin film that will be the second electrode 8 is formed by, for example, spattering. After that, as FIG. 8H shows, the passivation layer 9 is formed.

[Second Embodiment]

[0061] A light emitter pertaining to a second embodiment is greatly different from the light emitter pertaining to the first embodiment in that the ITO layer is not formed under the hole injection layer and that a protection film is formed on the hole injection layer. The following explanation focuses on the difference from the first embodiment, and explanation of the same structure as the first embodiment will be simplified or omitted.

<Structure of Light emitter>

[0062] FIG. 9 is a schematic view showing a layered condition of layers constituting a light emitter pertaining to a second embodiment. As FIG. 9 shows, a light emitter pertaining to the second embodiment includes a first electrode 102, which is an anode, formed on a substrate 101, and a hole injection layer 104 and a protective layer 110 are layered thereon in this order as a charge injection transport layer. Note that the hole injection layer 104 is formed across an entire upper surface of the substrate 101, but the protective layer 110 is not formed above the first electrode 102. In addition, an ITO layer does not exist between the first electrode 102 and the hole injection layer 104.

[0063] On the hole injection layer 104, a bank 105 for defining pixels is formed. A light-emitting layer 106 is layered in a region defined by the bank 105, and on the light-emitting layer 106, an electron injection layer 107, a second electrode 108, which is a cathode, and a passivation layer 109 are formed so as to be continuous with respective layers of an adjacent pixel, passing over the region defined by the bank 105.

<Method of Manufacturing Light emitter>

[0064] FIGs. 10A-10D are processing drawings for explaining a method of manufacturing a light emitter pertaining to the second embodiment. In the manufacturing process of the light emitter pertaining to the second embodiment, as FIG. 10A shows, first, on the substrate 101 that is made of glass, the first electrode 102 is formed with an aluminum-based (Al) material. Next, a thin film 111 made of WOx or MoWOx, which will be the hole injection layer 104 later, is formed on the first electrode

102. Then a thin film 112 made of WOx or MoWOx, which will be the protective layer 110, is formed on the thin film 111. The thin film 112 protects the hole injection layer 104 during etching for forming the bank 105.

[0065] Next, as FIG. 10B shows, the bank 105 is formed on the thin film 112. To be specific, a resist film including a resist material is formed on the thin film 112, and a resist pattern is formed on the film. After that a desired portion of the resist film is etched by applying a developing solution and removed to form patterning of the bank 105. Note that an impure substance such as hydrofluoric acid remaining on a surface of the bank 105 after the formation of the bank is cleaned by a cleaning liquid such as pure water and removed, and a region defined by the bank 105 on an upper surface of the thin film 112 is melted by the cleaning liquid and becomes recessed.

[0066] Furthermore, as FIG. 10C shows, as the treatment with the cleaning liquid continues, the entire region defined by the bank 105 on the thin film 112 melts and accordingly the protective layer 110 is formed. When the thin film 112 melts, the thin film 111 is exposed and the region defined by the bank 105 on the upper surface of the thin film 111 melts and becomes recessed and then a recessed portion 104a is formed. Thus, the hole injection layer 104 is formed.

[0067] Next, as FIG. 10D shows, the light-emitting layer 106 is formed within the region defined by the bank 105. Subsequent processes are the same as in Embodiment 1, and therefore a description thereof is omitted.

[Third Reference Embodiment not forming part of the present invention]

[0068] A light emitter pertaining to a third reference embodiment is greatly different from the light emitter pertaining to the second embodiment in an area at which a hole injection layer is formed. The following explanation focuses on the difference from the second embodiment, and explanation of the same structure as the second embodiment will be simplified or omitted.

<Structure of Light emitter>

[0069] FIG. 11 is a schematic view showing a layered condition of layers constituting a light emitter pertaining to the third reference embodiment. As FIG. 11 shows, a light emitter pertaining to the third reference embodiment includes a first electrode 202, which is an anode, formed on a substrate 201, and a hole injection layer 204 and a protective layer 210 are layered thereon in this order as a charge injection transport layer. Note that the hole injection layer 204 is not formed across the entire upper surface of the substrate 1, but formed only on the first electrode 202 and at a surrounding area of the first electrode 202. On the other hand, the protective layer 210 is not formed above the first electrode 202.

[0070] On the hole injection layer 204, a bank 205 for defining pixels is formed. A light-emitting layer 206 is layered in a region defined by the bank 205, and on the light-emitting layer 206, an electron injection layer 207, a second electrode 208, which is a cathode, and a passivation layer 209 are formed so as to be continuous with respective layers of an adjacent pixel, passing over the region defined by the bank 205.

<Method of Manufacturing Light emitter>

[0071] FIGs. 12A-12D are processing drawings for explaining a method of manufacturing a light emitter pertaining to the third reference embodiment. In the manufacturing process of the light emitter pertaining to the third reference embodiment, as FIG. 13A shows, first, on the substrate 101 that is made of glass, the first electrode 102 is formed with an A1 material. Next, an oxide film 211 that will be a hole injection layer 204 is formed by oxidizing an exposed surface (upper surface and side surface) of the first electrode 102. Then a thin film 212 made of WOx or MoWOx, which will be the protective layer 210 later, is formed on the oxide film 211.

[0072] Next, as FIG. 12B shows, the bank 205 is formed on the thin film 212. An impure substance such as hydrofluoric acid remaining on a surface of the bank 205 is cleaned with a cleaning liquid such as pure water and removed, and a region defined by the bank 205 on an upper surface of the thin film 212 is melted by the cleaning liquid and becomes recessed.

[0073] Furthermore, as FIG. 12C shows, as the treatment with the cleaning liquid continues, all the region of the thin film 212, which is defined by the bank 205, melts and accordingly a final form, that is, the protective layer 210 is formed. In addition, when the thin film 212 melts, the region defined by the bank 205 on the thin film 211 is exposed. Accordingly, the upper surface of the region also melts and becomes recessed, and then the recessed portion 204a is formed. Thus, the hole injection layer 204 is formed.

[0074] Next, as FIG. 12D shows, the light-emitting layer 206 is formed within the region defined by the bank 205. Subsequent processes are the same as in First Embodiment, and therefore a description thereof is omitted.

[Fourth Embodiment]

[0075] FIG. 13 is a perspective view showing apparatuses such as a display apparatus pertaining to a fourth embodiment. As FIG. 14 shows, a display apparatus 300 pertaining to an embodiment of the present invention is an organic EL display formed by a plurality of pixels arranged in a matrix. Each pixel emits a color corresponding to one of R (red), G (green), or B (blue) and composed of a light emitter pertaining to the embodiment of the present invention.

[Modification]

[0076] As described above, the light emitter, the display apparatus and the manufacturing method of the light emitter pertaining to the present embodiments have been explained. However, the light emitter, the display apparatus and the manufacturing method of the light emitter pertaining to an embodiment of the present invention are not limited to the above embodiments.

[0077] For example, the charge injection transport layer is not limited to the hole injection layer, and may be the hole transport layer or hole injection and transport layer. Also, the first electrode may be a cathode, and the second electrode may be an anode. In such a case, the charge injection transport layer may be the electron injection layer, the electron transport layer or the electron injection and transport layer.

[0078] Also, the light emitter is not limited to the top-emission type, and may be a bottom-emission type.

[Industrial Applicability]

[0079] The present invention can be utilized for an organic EL display apparatus used in an apparatus such as a plane light source and a plat display apparatus.

[Reference Signs List]

[0080]

2, 102, 102 first electrodes
4, 104, 204 charge injection transport layer
4a recessed portion
4c inner bottom surface of recessed portion
4d inner side surface of recessed portion
5, 105, 205 banks
5a bottom surface of bank
5d bottom periphery of bank
6, 106, 206 light-emitting layers
6a bottom surface of light-emitting layer
6b side surface of light-emitting layer
8,108,208 second electrodes

Claims

1. A light emitter including:

   a first electrode (2, 102, 202), a charge injection transport layer (4, 104, 204), a light-emitting layer (6, 106, 206), and a second electrode (8, 108, 208) that are layered in this order on a substrate (1, 101, 201),
   at least the light-emitting layer (6, 106, 206) being defined by a bank (5, 105, 205), wherein the bank (5, 105, 205) is disposed on the charge injection transport layer (4, 104, 204),
   the charge injection transport layer (4, 104, 204) is a single layer and is principally composed of a metal compound that is more liquid-philic than a surface of the bank such that the surface of the bank is liquid-repellent with respect to the charge injection transport layer (4, 104, 204),
   the charge injection transport layer (4, 104, 204) has a recessed structure so that in a region defined by the bank (5, 105, 205), the charge injection transport layer (4, 104, 204) is lower than a bottom surface (5a) of the bank (5, 105, 205),
   the recessed structure of the charge injection transport layer (4, 104, 204) has (i) an inner bottom surface (4c) and (ii) an inner side surface (4d) that is continuous with the inner bottom surface (4c),
   the inner bottom surface (4c) and the inner side surface (4d) are parts of the same charge injection transport layer (4, 104, 204), **characterized in that** the charge injection transport layer (4, 104, 204) extends along the bottom surface (5a) of the bank (5, 105, 205) to an adjacent pixel, and the inner bottom surface (4c) is parallel with an upper surface of the substrate (1, 101, 201).

2. The light emitter of Claim 1, wherein the recessed structure has a cup-like shape.

3. The light emitter of Claim 1, wherein in the region defined by the bank (5, 105, 205), the charge injection transport layer (4, 104, 204) having the recessed structure is lower than and aligned with a bottom periphery (5d) of the bank (5, 105, 205).

4. The light emitter of Claim 1, wherein the metal compound is one of a metal oxide, a metal nitride and a metal oxynitride.

5. The light emitter of Claim 1, wherein the light-emitting layer (6, 106, 206) includes a layer containing a high-polymer material.

6. The light emitter of Claim 1, wherein the charge injection transport layer (4, 104, 204) extends along the bottom surface (5a) of the bank (5, 105, 205) to an adjacent pixel.

7. The light emitter of Claim 1, wherein the charge injection transport layer (4, 104, 204) is more liquid-philic than the bank (5, 105, 205).

8. The light emitter of Claim 1, wherein the charge injection transport layer (4, 104, 204) is a hole-injection layer including a metal oxide.

9. The light emitter of Claim 4 wherein the metal oxide is an oxide of one of tungsten and molybdenum.

10. A display apparatus comprising a plurality of the light

emitters of any of Claims 1 to 9.

11. A manufacturing method of a light emitter defined in claim 1, comprising:

    a first step of forming the first electrode (2, 102, 202) on a substrate (1, 101, 201);
    a second step of forming, above the first electrode (2, 102, 202), a thin film including a metal compound that is soluble in a predetermined solvent;
    a third step of forming the bank (5, 105, 205) on the thin film by (i) forming a resist film including a resist material on the thin film and (ii) etching the resist film with a developing solution;
    a fourth step of, after the formation of the bank (5, 105, 205), forming the charge injection transport layer (4, 104, 204) by cleaning residuals of the resist film that adhere to the thin film with a cleaning liquid and dissolving a part of the thin film with the cleaning liquid or the developing solution, the charge injection transport layer (4, 104, 204) including a recessed portion (4a) having (i) an inner bottom surface (4c) and (ii) an inner side surface (4d) that is continuous with the inner bottom surface (4c);
    a fifth step of (i) forming an intermediate layer (12) on the inner bottom surface (4c) and the inner side surface (4d) of the recessed portion of the charge injection transport layer (4, 104, 204), and (ii) forming the light-emitting layer above the intermediate layer (12) by ejecting drops of ink into the region defined by the bank and drying the ink; and
    a sixth step of forming the second electrode (8, 108, 208) above the light-emitting layer (6, 106, 206).

12. The method of Claim 11, wherein
the predetermined solvent is one or both of (i) the developing solution for removing a part of a resist film used to form the bank (5, 105, 205) and (ii) the cleaning liquid for cleaning residuals of the resist film that are remaining after the formation of the bank (5, 105, 205).

Patentansprüche

1. Lichtemitter umfassend:

    eine erste Elektrode (2, 102, 202), eine Ladungsinjektions-Transportschicht (4, 104, 204), eine lichtemittierende Schicht (6, 106, 206) und eine zweite Elektrode (8, 108, 208), die in dieser Reihenfolge auf ein Substrat (1, 101, 201) geschichtet sind, wobei wenigstens die lichtemittierende Schicht (6, 106, 206) durch eine Bank (5, 105, 205) definiert ist, wobei
    die Bank (5, 105, 205) auf der Ladungsinjektions-Transportschicht (4, 104, 204) angeordnet ist, die Ladungsinjektions-Transportschicht (4, 104, 204) eine einzelne Schicht ist und hauptsächlich aus einer Metallverbindung besteht, die flüssigkeitsanziehender ist als eine Oberfläche der Bank, so dass die Oberfläche der Bank in Bezug auf die Ladungsinjektions-Transportschicht (4, 104, 204) flüssigkeitsabstoßend ist,
    die Ladungsinjektions-Transportschicht (4, 104, 204) eine ausgenommene Struktur aufweist, so dass in einem durch die Bank (5, 105, 205) definierten Bereich die Ladungsinjektions-Transportschicht (4, 104, 204) niedriger als eine Unterseite (5a) der Bank (5, 105, 205) ist,
    die ausgenommene Struktur der Ladungsinjektions-Transportschicht (4, 104, 204) (i) eine innere Unterseite (4c) und (ii) eine innere Seitenfläche (4d) aufweist, die mit der inneren Unterseite (4c) fortlaufend ist, und
    die innere Unterseite (4c) und die innere Seitenfläche (4d) Teile derselben Ladungsinjektions-Transportschicht (4, 104, 204) sind,
    dadurch gekennzeichnet, dass
    sich die Ladungsinjektions-Transportschicht (4, 104, 204) entlang der Unterseite (5a) der Bank (5, 105, 205) zu einem benachbarten Pixel erstreckt und die innere Unterseite (4c) parallel zu einer Oberseite des Substrats (1, 101, 201) ist.

2. Lichtemitter nach Anspruch 1, bei dem die ausgesparte Struktur eine becherartige Form aufweist.

3. Lichtemitter nach Anspruch 1, bei dem in dem Bereich, der durch die Bank (5, 105, 205) definiert ist, die Ladungsinjektions-Transportschicht (4, 104, 204) mit der ausgenommenen Struktur niedriger als ein unterer Rand (5d) der Bank (5, 105, 205) ist und mit diesem ausgerichtet ist.

4. Lichtemitter nach Anspruch 1, bei dem die Metallverbindung ein Metalloxid oder ein Metallnitrid oder ein Metalloxinitrid ist.

5. Lichtemitter nach Anspruch 1, bei dem die lichtemittierende Schicht (6, 106, 206) eine Schicht umfasst, die ein hochpolymeres Material enthält.

6. Lichtemitter nach Anspruch 1, bei dem sich die Ladungsinjektions-Transportschicht (4, 104, 204) entlang der Unterseite (5a) der Bank (5, 105, 205) zu einem benachbarten Pixel erstreckt.

7. Lichtemitter nach Anspruch 1, bei dem die Ladungsinjektions-Transportschicht (4, 104, 204) flüssigkeitsanziehender als die Bank (5, 105, 205) ist.

8. Lichtemitter nach Anspruch 1, bei dem die Ladungsinjektions-Transportschicht (4, 104, 204) eine Lochinjektionsschicht ist, die ein Metalloxid enthält.

9. Lichtemitter nach Anspruch 4, bei dem das Metalloxid ein Oxid aus Wolfram oder Molybdän ist.

10. Anzeigevorrichtung umfassend eine Mehrzahl von Lichtemittern nach einem der Ansprüche 1 bis 9.

11. Herstellungsverfahren für einen Lichtemitter nach Anspruch 1, umfassend:

einen ersten Schritt des Ausbildens der ersten Elektrode (2, 102, 202) auf einem Substrat (1, 101, 201);
einen zweiten Schritt des Ausbildens eines Dünnfilms über der ersten Elektrode (2, 102, 202), der eine Metallverbindung enthält, die in einem vorbestimmten Lösungsmittel löslich ist;
einen dritten Schritt des Ausbildens der Bank (5, 105, 205) auf dem Dünnfilm durch (i) Ausbilden eines Resistfilms, der ein Resistmaterial enthält, auf dem Dünnfilm und (ii) Ätzen des Resistfilms mit einer Entwicklungslösung;
einen vierten Schritt, nach dem Ausbilden der Bank (5, 105, 205), des Ausbildens der Ladungsinjektions-Transportschicht (4, 104, 204) durch Reinigen von Rückständen des Resistfilms, die an dem Dünnfilm anhaften, mit einer Reinigungsflüssigkeit und Auflösen eines Teils des Dünnfilms mit der Reinigungsflüssigkeit oder der Entwicklungslösung, wobei die Ladungsinjektions-Transportschicht (4, 104, 204) einen ausgenommenen Abschnitt (4a) umfasst, der (i) eine innere Unterseite (4c) und (ii) eine innere Seitenfläche (4d) umfasst, die mit der inneren Unterseite (4c) kontinuierlich ist;
einen fünften Schritt (i) des Ausbildens einer Zwischenschicht (12) auf der inneren Unterseite (4c) und der inneren Seitenfläche (4d) des ausgesparten Bereichs der Ladungsinjektions-Transportschicht (4, 104, 204), und (ii) des Ausbildens der lichtemittierenden Schicht über der Zwischenschicht (12) durch Ausstoßen von Tintentropfen in den durch die Bank definierten Bereich und Trocknen der Tinte; und
einen sechsten Schritt des Ausbildens der zweiten Elektrode (8, 108, 208) über der lichtemittierenden Schicht (6, 106, 206).

12. Verfahren nach Anspruch 11, bei dem
das vorbestimmte Lösungsmittel (i) die Entwicklungslösung zum Entfernen eines Teils eines Resistfilms, der zur Ausbildung der Bank (5, 105, 205) verwendet wird, und/oder (ii) die Reinigungsflüssigkeit zum Reinigen von Rückständen des Resistfilms ist, die nach der Ausbildung der Bank (5, 105, 205) zurückbleiben.

Revendications

1. Élément électroluminescent incluant :

une première électrode (2, 102, 202), une couche de transport et d’injection de charge (4, 104, 204), une couche électroluminescente (6, 106, 206) et une seconde électrode (8, 108, 208) qui sont disposées en couches dans cet ordre sur un substrat (1, 101, 201),
au moins la couche électroluminescente (6, 106, 206) étant définie par un remblai (5, 105, 205), dans lequel
le remblai (5, 105, 205) est disposé sur la couche de transport et d’injection de charge (4, 104, 204),
la couche de transport et d’injection de charge (4, 104, 204) est une couche simple et est essentiellement constituée d’un composé métallique qui a plus d’affinité avec les liquides qu’une surface du remblai, de sorte que la surface du remblai repousse les liquides par rapport à la couche de transport et d’injection de charge (4, 104, 204),
la couche de transport et d’injection de charge (4, 104, 204) a une structure en creux, de sorte que, dans une région définie par le remblai (5, 105, 205), la couche de transport et d’injection de charge (4, 104, 204) est plus basse qu’une surface inférieure (5a) du remblai (5, 105, 205),
la structure en creux de la couche de transport et d’injection de charge (4, 104, 204) présente (i) une surface inférieure intérieure (4c) et (ii) une surface latérale intérieure (4d) qui est continue avec la surface inférieure intérieure (4c),
la surface inférieure intérieure (4c) et la surface latérale intérieure (4d) font partie de la même couche de transport et d’injection de charge (4, 104, 204),
caractérisé en ce que
la couche de transport et d’injection de charge (4, 104, 204) s’étend le long de la surface inférieure (5a) du remblai (5, 105, 205) vers un pixel adjacent, et
la surface inférieure intérieure (4c) est parallèle à une surface supérieure du substrat (1, 101, 201).

2. Élément électroluminescent selon la revendication 1, dans lequel la structure en creux a une forme en coupe.

3. Élément électroluminescent selon la revendication 1, dans lequel, dans la région définie par le remblai (5, 105, 205), la couche de transport et d’injection de charge (4, 104, 204) présentant la structure en creux est plus basse qu'un contour inférieur (5d) du remblai (5, 105, 205) et est alignée avec ledit contour.

4. Élément électroluminescent selon la revendication 1, dans lequel le composé métallique est un oxyde métallique, un nitrure métallique ou un oxynitrure métallique.

5. Élément électroluminescent selon la revendication 1, dans lequel la couche électroluminescente (6, 106, 206) inclut une couche contenant un matériau haut polymère.

6. Élément électroluminescent selon la revendication 1, dans lequel la couche de transport et d'injection de charge (4, 104, 204) s'étend le long de la surface inférieure (5a) du remblai (5, 105, 205) vers un pixel adjacent.

7. Élément électroluminescent selon la revendication 1, dans lequel la couche de transport et d'injection de charge (4, 104, 104) a plus d'affinité avec les liquides que le remblai (5, 105, 205).

8. Élément électroluminescent selon la revendication 1, dans lequel la couche de transport et d'injection de charge (4, 104, 204) est une couche d'injection de trous incluant un oxyde métallique.

9. Élément électroluminescent selon la revendication 4, dans lequel l'oxyde métallique est un oxyde de tungstène ou de molybdène.

10. Appareil d'affichage comprenant une pluralité d'éléments électroluminescents selon l'une quelconque des revendications 1 à 9.

11. Procédé de fabrication d'un élément électroluminescent défini dans la revendication 1, comprenant :

une première étape de formation de la première électrode (2, 102, 202) sur un substrat (1, 101, 201) ;
une deuxième étape de formation, par-dessus la première électrode (2, 102, 202), d'un film mince incluant un composé métallique qui est soluble dans un solvant prédéterminé ;
une troisième étape de formation du remblai (5, 105, 205) sur le film mince, consistant à (i) former un film de réserve incluant un matériau de réserve sur le film mince et (ii) attaquer le film de réserve à l'aide d'une solution de développement ;
une quatrième étape, succédant à la formation du remblai (5, 105, 205), de formation de la couche de transport et d'injection de charge (4, 104, 204) consistant à éliminer les résidus du film de réserve qui adhèrent au film mince à l'aide d'un liquide nettoyant et à dissoudre une partie du film mince avec le liquide nettoyant ou la solution de développement, la couche de transport et d'injection de charge (4, 104, 204) comportant une partie en creux (4a) qui présente (i) une surface inférieure intérieure (4c) et (ii) une surface latérale intérieure (4d) qui est continue avec la surface inférieure intérieure (4c) ;
une cinquième étape de (i) formation d'une couche intermédiaire (12) sur la surface inférieure intérieure (4c) et la surface latérale intérieure (4d) de la partie en creux de la couche de transport et d'injection de charge (4, 104, 204) et de (ii) formation de la couche électroluminescente par-dessus la couche intermédiaire (2) en éjectant des gouttes d'encre dans la région définie par le remblai et en séchant l'encre ; et
une sixième étape de formation de la seconde électrode (8, 108, 208) par-dessus la couche électroluminescente (6, 106, 206).

12. Procédé selon la revendication 11, dans lequel le solvant prédéterminé est (i) la solution de développement destinée à éliminer une partie d'un film de réserve utilisé pour former le remblai (5, 105, 205) et/ou (ii) le liquide nettoyant destiné à nettoyer les résidus du film de réserve qui subsistent après la formation du remblai (5, 105, 205).

FIG. 1

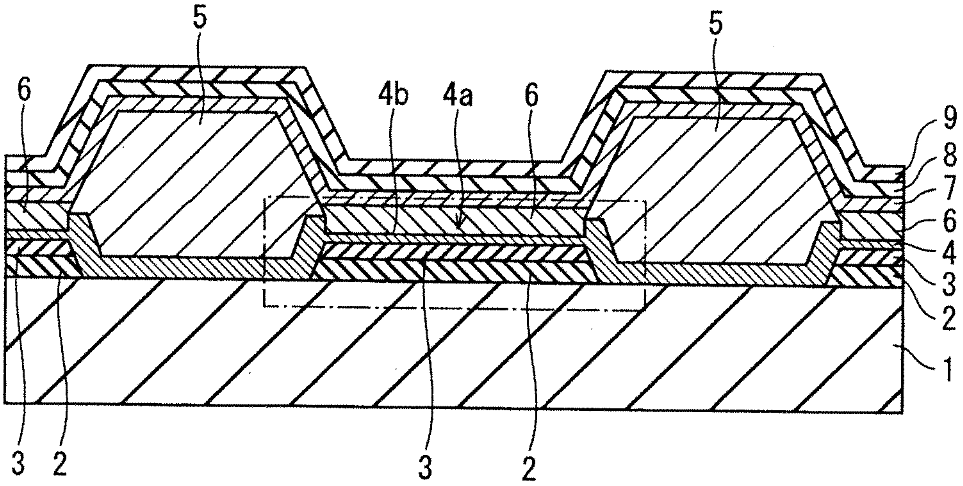

FIG. 2

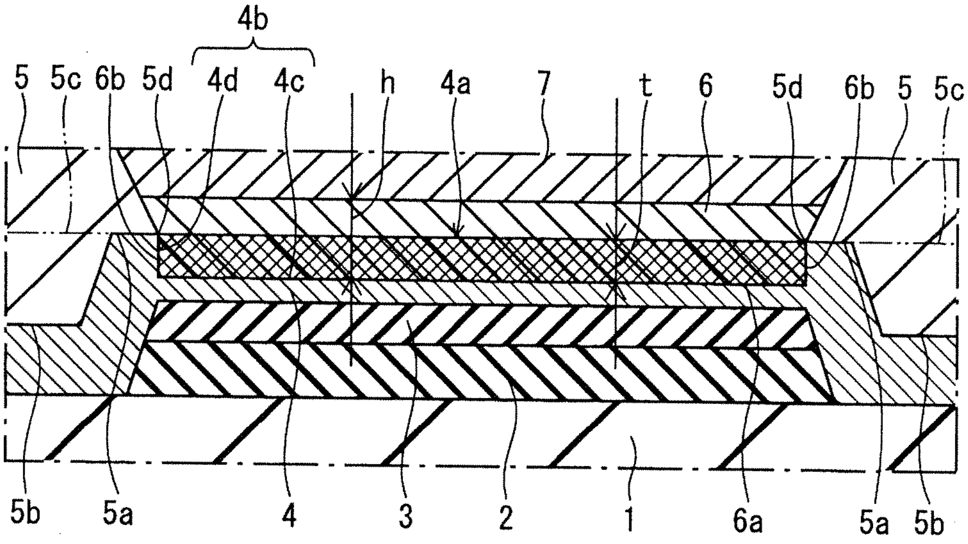
4b
5
5c
6b
5d
4d
4c
h
4a
7
t
6
5d
6b
5
5c
5b
5a
4
3
2
1
6a
5a
5b

FIG. 3

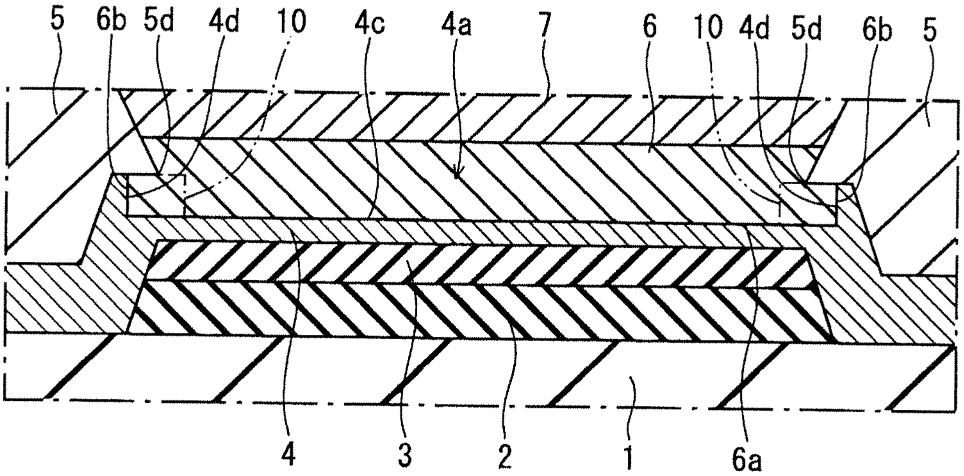
5
6b
5d
4d
10
4c
4a
7
6
10
4d
5d
6b
5
4
3
2
1
6a

FIG. 4

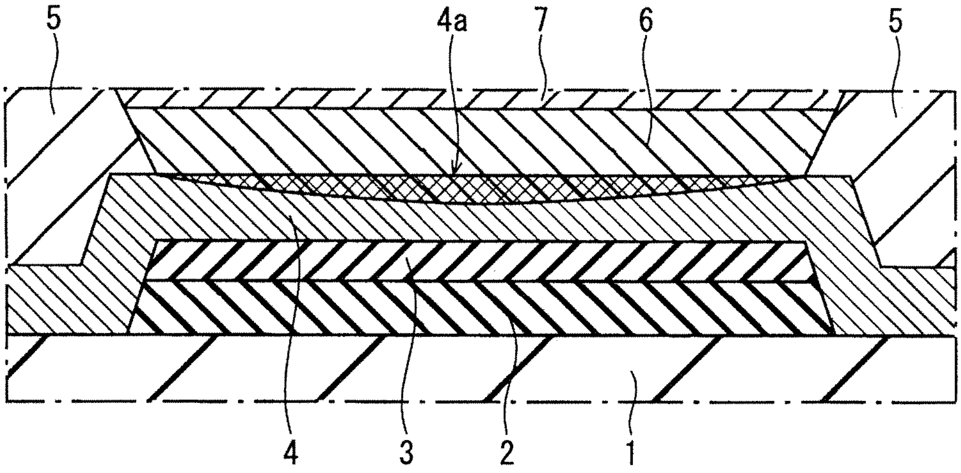

FIG. 5A

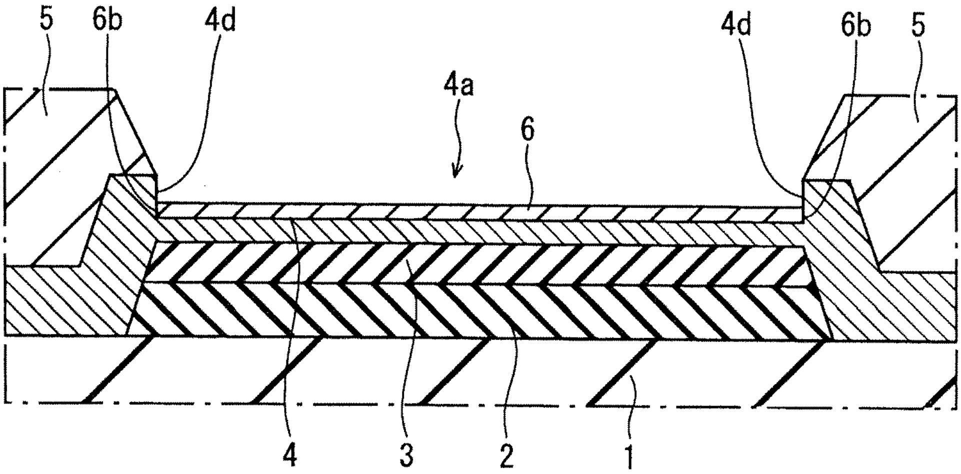

FIG. 5B

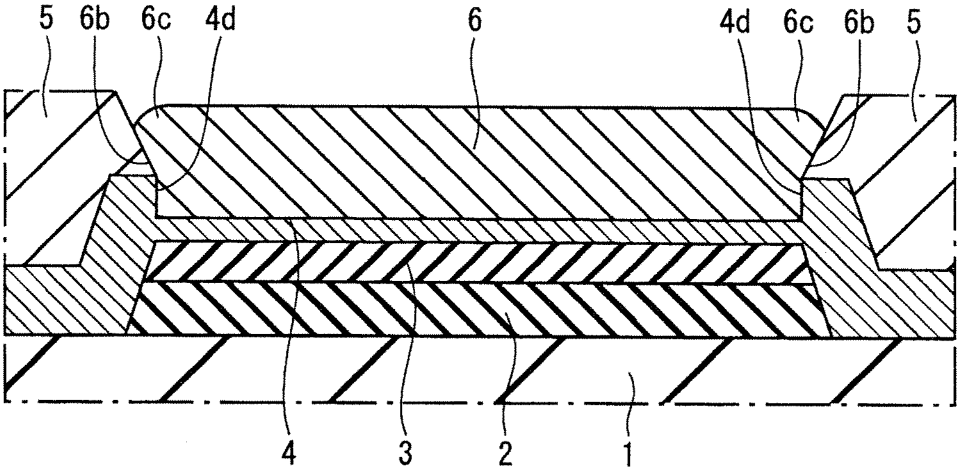

FIG. 6

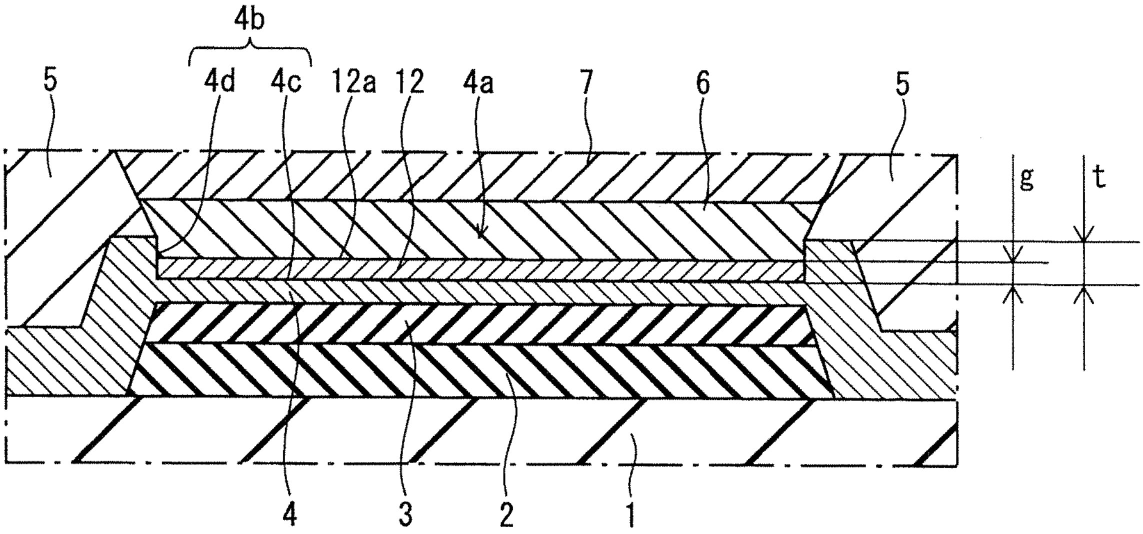

FIG. 7A

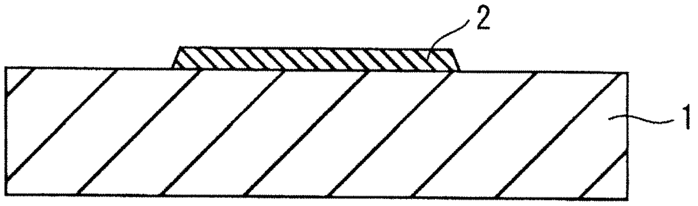

FIG. 7B

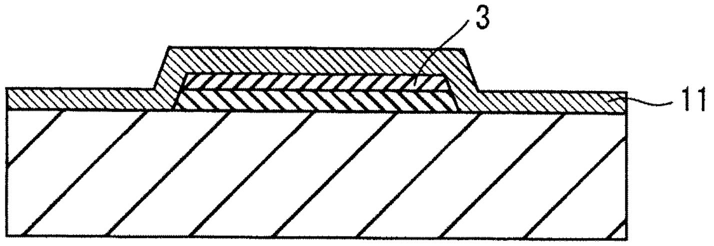

FIG. 7C

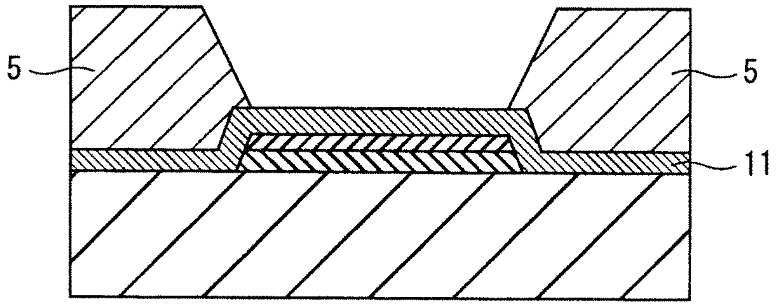

FIG. 7D

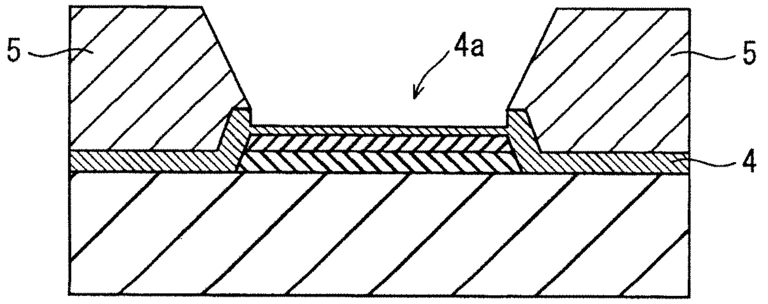

FIG. 8E

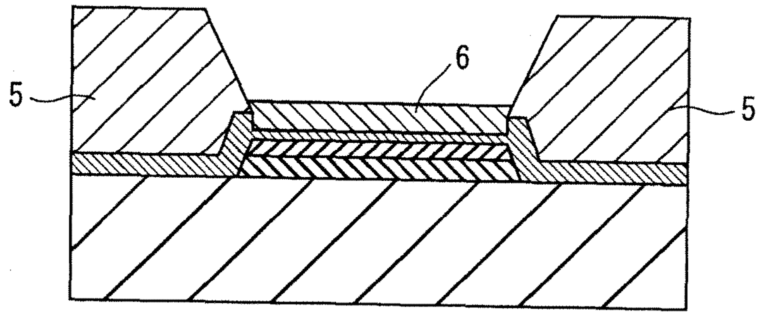

FIG. 8F

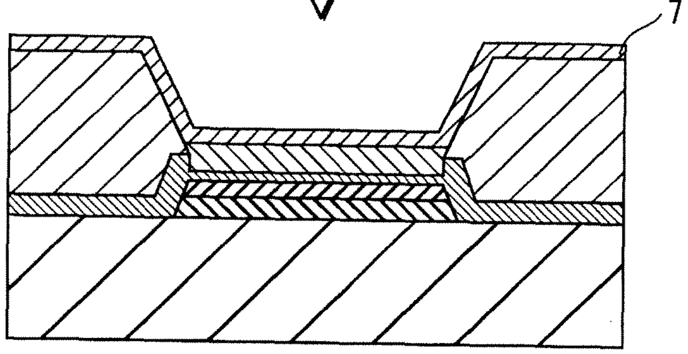

FIG. 8G

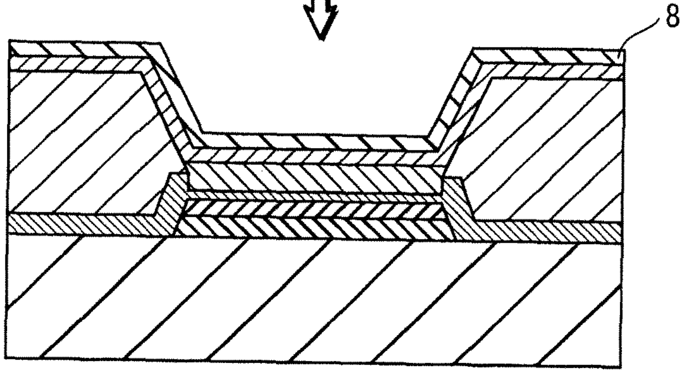

FIG. 8H

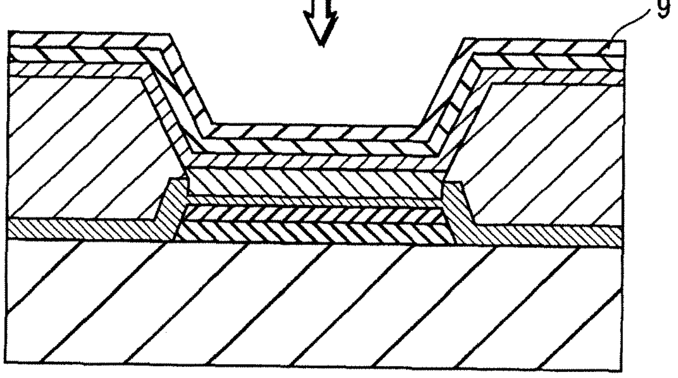

FIG. 9

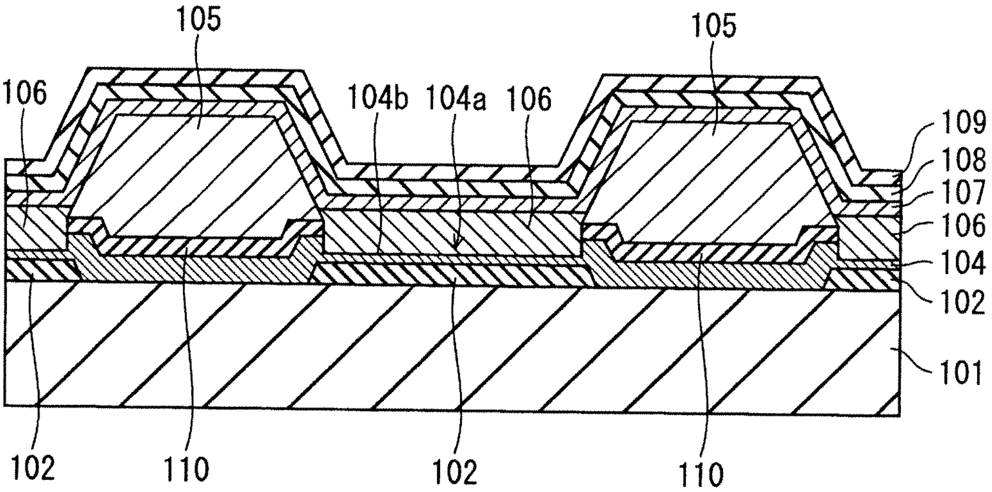
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FIG. 10A

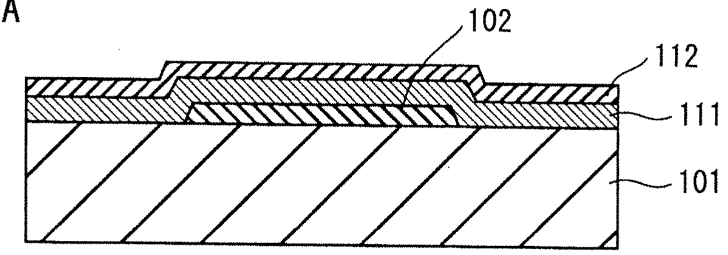

FIG. 10B

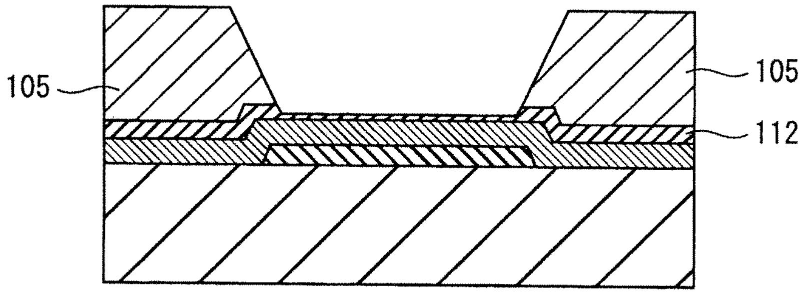

FIG. 10C

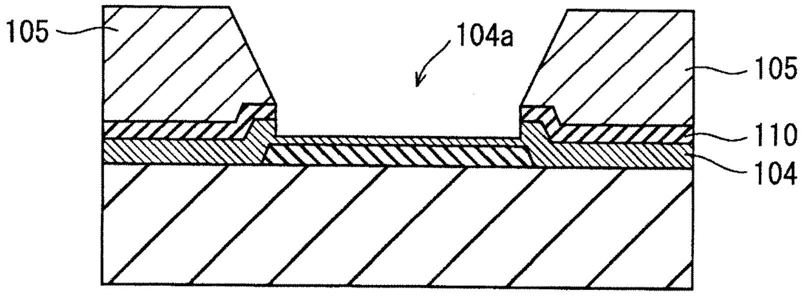

FIG. 10D

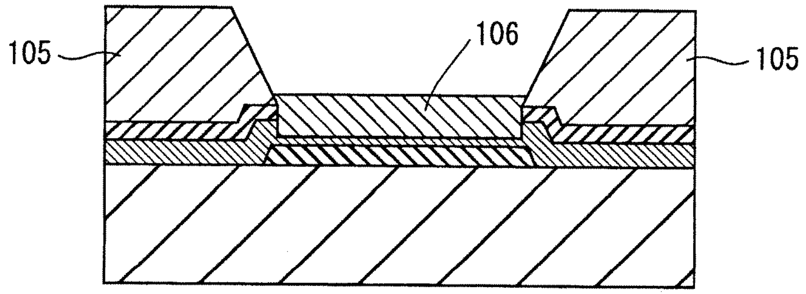

FIG. 11

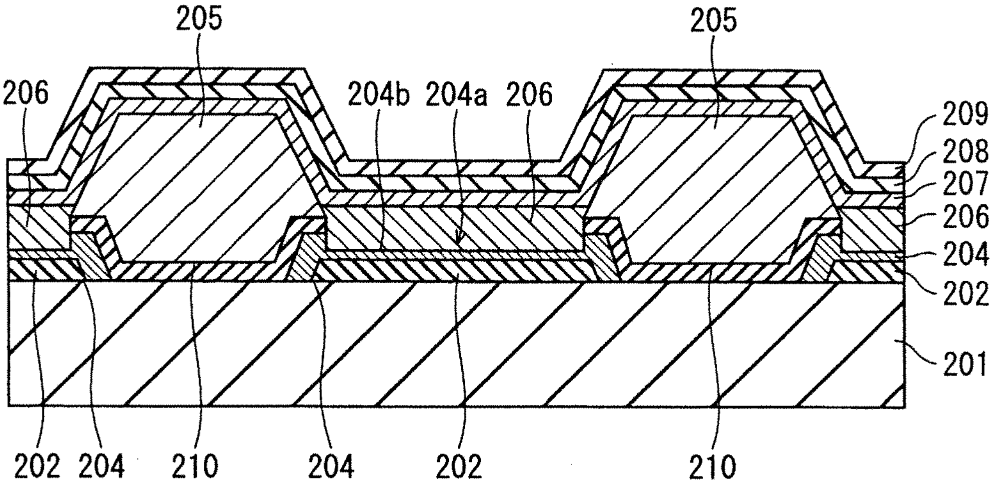
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FIG. 12A

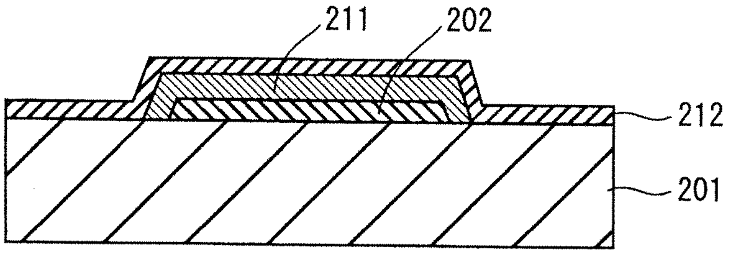


FIG. 12B

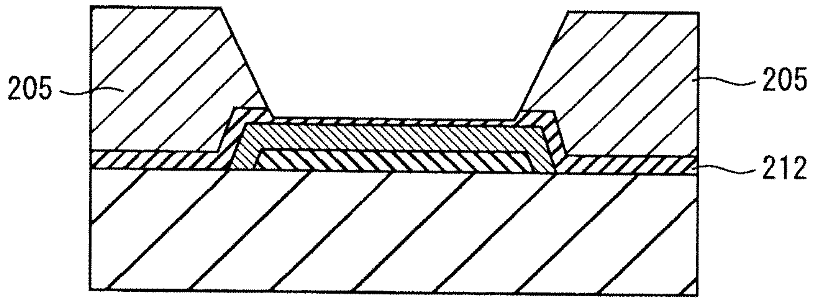


FIG. 12C

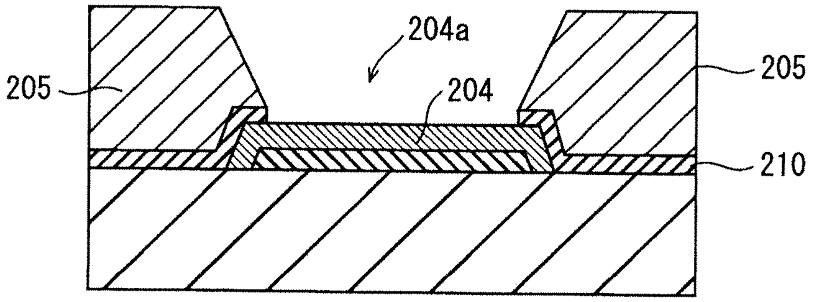


FIG. 12D

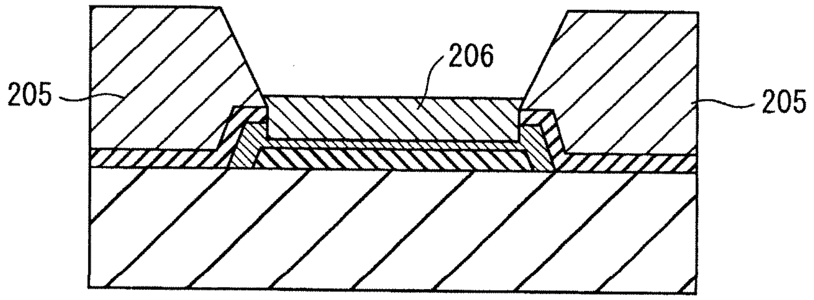
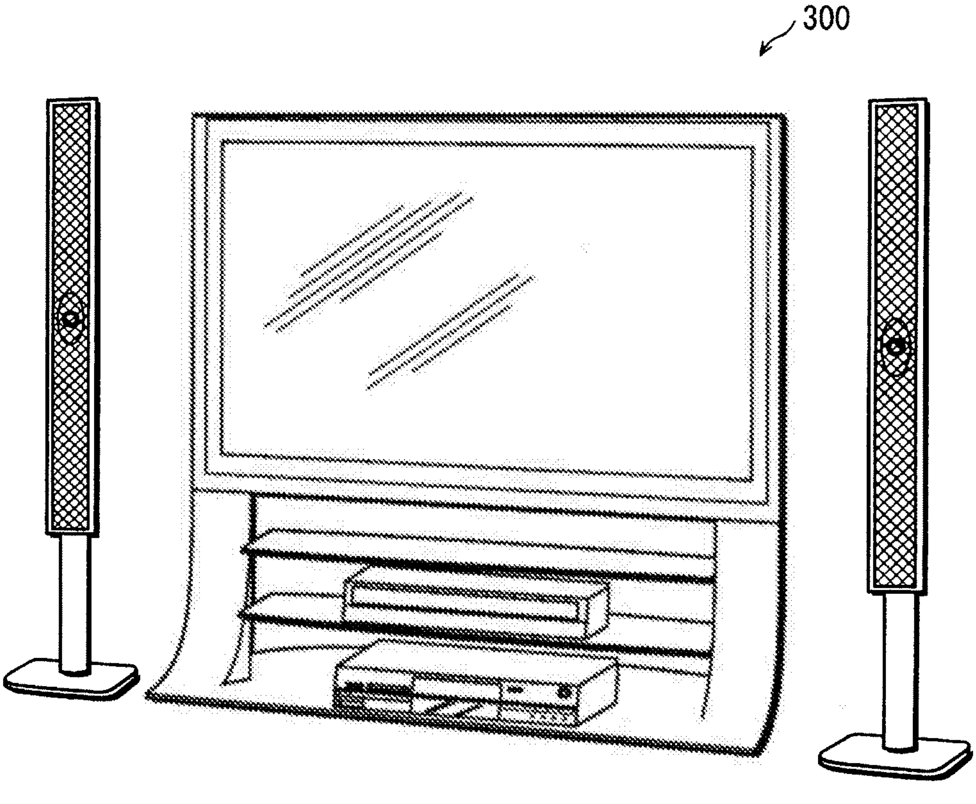


FIG. 13



REFERENCES CITED IN THE DESCRIPTION

Patent documents cited in the description

- US 2005073243 A **[0005]**
- JP 2007220656 A **[0006]**
- JP 2003249375 A **[0007]**
- JP H5163488 B **[0045]**

专利名称(译)	发光元件，显示装置和发光元件的制造方法		
公开(公告)号	EP2398085B1	公开(公告)日	2018-06-27
申请号	EP2010741077	申请日	2010-02-09
[标]申请(专利权)人(译)	松下电器产业株式会社		
申请(专利权)人(译)	松下电器产业株式会社		
当前申请(专利权)人(译)	JOLED INC.		
[标]发明人	HARADA KENJI TAKEUCHI TAKAYUKI NISHIYAMA SEIJI KOMATSU TAKAHIRO		
发明人	HARADA, KENJI TAKEUCHI, TAKAYUKI NISHIYAMA, SEIJI KOMATSU, TAKAHIRO		
IPC分类号	H01L51/50 H05B33/10 H05B33/12 H05B33/22 H01L27/32		
CPC分类号	H01L27/3246 H01L51/0005 H01L51/0018 H01L51/5048 H01L51/56 H01L51/5296		
优先权	2009028971 2009-02-10 JP		
其他公开文献	EP2398085A1 EP2398085A4		
外部链接	Espacenet		

摘要(译)

本发明提供一种将高精细的发光层图案化并且可以以低成本制造的发光体。为了实现该目的，发光器件包括依次层叠的第一电极2，电荷注入传输层4，发光层6和第二电极8，并且至少发光层6是由堤5限定。堤5至少在其表面上是疏液的，并且电荷注入传输层4主要由比堤的表面亲液性更高的金属化合物组成。此外，电荷注入传输层4具有凹陷结构，使得在由堤5限定的区域中，电荷注入传输层4低于堤5的底表面5a。

FIG. 1