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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. 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.

[Citation List]

[Patent Literature]

[0006] [Patent Literature 1]
Japanese Patent Application Publication No. 2003-249375

[Summary of Invention]

[Technical Problem]

[0007] 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.

[0008] 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]

[0009] A light emitter pertaining to an embodiment of the present invention is a light emitter as defined in claim 1. A manufacturing method of a light emitter of claim 1 is defined in claim 5. Further advantageous embodiments are defined in the dependent claims.

[Advantageous Effects of Invention]

[0010] The light emitter pertaining to the embodiment of the present invention includes a charge injection transport layer including a recessed portion having an inner bottom surface that is in contact with a bottom surface of the light-emitting layer and an inner side surface that is continuous with the inner bottom surface. Accordingly, in a manufacturing process, the recessed portion can accumulate drops of ink that have been ejected in a region defined by a 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]

[0011]

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

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

FIGs. 3A-3D are schematic views for explaining a form of a recessed portion.

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

FIGs. 5A-5D are schematic views for explaining the form of the recessed portion.

FIGs. 6A and 6B are schematic views for explaining a best thickness of a light-emitting layer.

FIG. 7 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 not forming part of the present invention.

FIGs. 8A-8D are processing drawings for explaining a method of manufacturing the light emitter pertaining to the first embodiment.

FIGs. 9E-9H are processing drawings for explaining the method of manufacturing the light emitter pertaining to the first embodiment, which follows FIG. 8D.

FIG. 10 is a schematic view showing a layered condition of layers constituting a light emitter pertaining to a second embodiment.

FIGs. 11A-11D are processing drawings for explaining a method of manufacturing the light emitter pertaining to the second embodiment.

FIG. 12 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. 13A-13D are processing drawings for explaining a method of manufacturing the light emitter pertaining to the third reference embodiment.

FIG. 14 is a perspective view showing apparatuses such as a display apparatus pertaining to a fourth embodiment.

[Description of Embodiments]

[Embodiments]

[0012] A light emitter pertaining to an embodiment of the present invention is defined in claim 1.

[0013] 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 hole injection and transport layer, the electron injection layer, the electron transport layer, and an electron injection transport layer.

[0014] 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.

[0015] Also, according to a specific aspect of the light emitter, the charge injection transport layer is a hole injection layer including a metal oxide.

[0016] Also, according to a specific aspect of the light emitter, the metal oxide is an oxide of one of tungsten and molybdenum.

[0017] A display apparatus pertaining to the embodiment of the present invention is defined in claim 4.

[0018] A manufacturing method of the light emitter pertaining to the embodiment of the present invention is defined in claim 5.

[0019] 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>

[0020] 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.

[0021] 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.

[0022] 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.

[0023] 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.

[0024] 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>

[0025] 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.

[0026] 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.

[0027] 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.

[0028] 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.

[0029] 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.

[0030] 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.

[0031] 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 in 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.

[0032] 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 peripheral portion 5a 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 the 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 bottom 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.

[0033] 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 in 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.

[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] As described above, in the present embodiment, the bank 5 and the hole injection layer 4 are connected to each other in a substantially vertical direction, and then the ink easily gets wet at a bottom of the light-emitting layer 6. Accordingly, the light-emitting layer 6 with excellent efficiency can be formed. Here, when the bank 5 and the hole injection layer 4 are connected to each other in a horizontal direction, the ink do not easily get wet in the vicinity of a connection section of the bank 5 with the hole injection layer 4. Accordingly, the light-emitting layer 6 might not be fully formed at the bottom surface thereof, and as a result, electrical leakage might occur. That is, a technical meaning resides in that the bank 5 and the hole injection layer 4 are connected to each other not in the horizontal direction but in the substantially vertical direction in order to excellently form the light-emitting layer 6.

[0036] Note that, in the case that the bank 5 and the hole injection layer 4 are connected to each other in the substantially vertical direction, the direction is not limited to the vertical direction but may be a diagonal direction. In other word, the direction only has to be a direction substantially perpendicular to the horizontal direction.

[0037] The following explains the recessed structure of the hole injection layer 4 in more detail. As FIG. 3A shows, the inner side surface 4d of the recessed portion 4a is composed of an lower side edge that is continuous with the inner bottom surface 4c and an upper side edge 4e (hereinafter, referred to as "upper edge 4e") that is continuous with the lower side edge. The upper edge 4e of the inner side surface 4d of the recessed portion 4a is aligned with a part of the bottom periphery 5d of the bank 5, the part of being in contact with the light-emitting layer 6, and the inner side surface 4d and the inner bottom surface 4c are continuous with each other in an R shape. Note that, when the upper edge 4e of the inner side surface 4d is aligned with the bottom periphery 5d of the bank 5, the recessed portion 4a is not limited to the shape shown in FIG. 3A, in which the inner side surface 4d is substantially vertical to the inner bottom surface 4c. As FIG. 3B shows, the inner side surface 4d and a side surface 5e of the bank 5 may have substantially the same inclination and extend on the same plane. As FIG. 3C shows, the inner side surface 4d and the inner bottom surface 4c may be continuous with each other not in the R shape. As FIG. 3D shows, the inner side surface 4d may be inclined opposite to the side surface 5e of the bank 5 so as to go under the bank 5.

[0038] Alternatively, the hole injection layer 4 is not limited to have the recessed structure according to which the hole injection layer 4 is lower than and aligned with the bottom periphery 5d of the bank 5. For example, as FIG. 4 shows, the upper edge 4e of the inner side surface 4d may not be aligned with the bottom periphery 5d of the bank 5, and the upper edge 4e may be closer to an adjacent pixel than the bottom periphery 5d is. In such a case, As FIG. 5A shows, the inner side surface 4d of the recessed portion 4a has the upper edge 4e that is in contact with a bottom surface 5a of the bank 5. Note that, when the upper edge 4e of the inner side surface 4d is in contact with the bottom surface 5a of the bank 5, the recessed portion 4a is not limited to the shape shown in FIG. 5A, in which the inner side surface 4d is substantially vertical to the inner bottom surface 4c. As FIG. 5B shows, the inner side surface 4d and a side surface 5e of the bank 5 may have a substantially same inclination. As FIG. 5C shows, the inner side surface 4d and the inner bottom surface 4c may be continuous with each other not in the R shape. As FIG. 5D shows, the inner side surface 4d may be inclined opposite to the side surface 5e of the bank 5 so as to go under the bank 5.

[0039] Since the inner side surface 4d has the upper edge 4e that is aligned with the bottom periphery 5d of the bank 5 or the upper edge 4e is in contact with the bottom surface 5a of the bank 5, a short circuit is not likely to occur between the electrodes 2 and 8. Supposedly, as a line with alternate long and two short dashes 10 shows in FIG. 4, when the upper edge 4e of the inner side surface 4d is not aligned with the bottom periphery 5d of the bank 5 and the upper edge 4e is closer to an adjacent pixel than the bottom periphery 5d is, a short circuit might occur between the electrodes 2 and 8 via an exposed area 4f that is a part of an upper surface of the hole injection layer 4 and exposed from the bank 5. Especially, as described later, when an average film thickness h of the light-emitting layer 6 is smaller or equal to an average depth t of the recessed portion 4a, an uncovered area 4f of hole injection layer 4 that is a part of an upper surface of the hole injection layer 4 and uncovered with the bank 5 might be in contact with the electron injection layer 7 or the second electrode 8. Accordingly, a short circuit might occur between the electrodes 2 and 8.

[0040] 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.

[0041] 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.

[0042] 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.

[0043] 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. 6A 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. 6B 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.

[0044] 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. 6B 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. 6A 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.

[0045] As FIG. 7 shows a modification of the first embodiment (the said modification) not forming part of the present invention, 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.

[0046] 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.

[0047] 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.

[0048] 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.

[0049] 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.

[0050] 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.

[0051] 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.

[0052] 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>

[0053] FIGs. 8A-8D are processing drawings for explaining a method of manufacturing a light emitter pertaining to the first embodiment. FIGs. 9E-9H are processing drawings for explaining the method of manufacturing the light emitter pertaining to the first embodiment, which follows FIG. 8D.

[0054] In the manufacturing process of a light emitter pertaining to the first embodiment, first, as FIG. 8A 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.

[0055] Next, as FIG. 8B 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.

[0056] 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.

[0057] Next, as FIG. 8C 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.

[0058] Next, as FIG. 8D 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.

[0059] 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.

[0060] 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.

[0061] 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.

[0062] 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.

[0063] Next, as FIG. 9E 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.

[0064] Next, as FIG. 9F shows, a thin barium film that will be the electron injection layer 7 is formed by, for example, vacuum deposition. Then as FIG. 9G shows, an ITO thin film that will be the second electrode 8 is formed by, for example, spattering. After that, as FIG. 9H shows, the passivation layer 9 is formed.

[Second Embodiment]

[0065] 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>

[0066] FIG. 10 is a schematic view showing a layered condition of layers constituting a light emitter pertaining to a second embodiment. As FIG. 10 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.

[0067] 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>

[0068] FIGs. 11A-11D 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. 11A 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.

[0069] Next, as FIG. 11B 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.

[0070] Furthermore, as FIG. 11C 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.

[0071] Next, as FIG. 11D 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]

[0072] 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>

[0073] FIG. 12 is a schematic view showing a layered condition of layers constituting a light emitter pertaining to the third reference embodiment. As FIG. 12 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.

[0074] 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>

[0075] FIGs. 13A-13D 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 Al 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.

[0076] Next, as FIG. 13B 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.

[0077] Furthermore, as FIG. 13C 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.

[0078] Next, as FIG. 13D 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]

[0079] FIG. 14 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]

[0080] 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.

[0081] 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.

[0082] Also, the light emitter is not limited to the top-emission type, and may be a bottom-emission type.

[Industrial Applicability]

[0083] 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]

[0084]

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
4e	upper edge
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
300	display apparatus

Claims

1. A light emitter including:

a first electrode (2, 102, 202), a charge injection transport layer (4, 104, 204) including a metal compound that is soluble in a predetermined solvent, 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 includes a recessed portion (4a) having (i) an inner bottom surface (4c) that is in contact with a bottom surface (6a) of the light emitting layer (6, 106, 206) and (ii) an inner side surface (4d) that is continuous with the inner bottom surface (4c) and in contact at least with a part of a side surface (6b) of the light emitting layer (6, 106, 206), and
the inner side surface (4d) of the recessed portion (4a) has a lower edge and an upper edge (4e), the lower edge being continuous with the inner bottom surface (4c), the upper edge (4e) being one of (i) aligned with a part of a bottom periphery (5e) of the bank (5, 105, 205), the part being in contact with the light emitting layer (6, 106, 206), and (ii) in contact with a bottom surface (5a) of the bank (5, 105, 205),
the inner bottom surface (4c) and the inner side surface (4d) are parts of the same charge injection transport layer (4, 104, 204), thereby including the same metal compound,
the same metal compound being included continuously from the lower edge to the upper edge of the inner side surface,
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 substantially parallel with an upper surface of the substrate (1, 101, 201).

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

3. The light emitter of Claim 2, wherein the metal oxide is an oxide of one of tungsten and molybdenum.

4. A display apparatus comprising the light emitter of any of Claims 1 to 3.

5. 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 and forming the recessed portion by dissolving a part of the thin film with the cleaning liquid or the developing liquid;
a fifth step of forming the light emitting layer (6, 106, 206) by (i) coating the inner bottom surface (4c) and the inner side surface (4d) the charge injection transport layer (4, 104, 204)with ink by ejecting drops of the ink into the region defined by the bank (5, 105, 205) and (ii) drying the ink; and
a sixth step of forming a second electrode (8, 108, 208) above the light-emitting layer (6, 106, 206).

6. The method of Claim 5, wherein
the charge injection transport layer includes the metal compound that is soluble in the predetermined solvent, and
the recessed portion (4a) is a portion of the charge injection transport layer (4, 104, 204) where the metal compound has been dissolved by the predetermined solvent.

7. The method of Claim 6, 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), die eine Metallverbindung enthält, die in einem vorbestimmten Lösungsmittel löslich ist,
   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,
   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 einen ausgenommenen Abschnitt (4a) umfasst, der (i) eine innere Unterseite (4c), die in Kontakt mit einer Unterseite (6a) der Lichtemissionsschicht (6, 106, 206) ist, und (ii) eine innere Seitenfläche (4d) umfasst, die mit der inneren Unterseite (4c) kontinuierlich und in Kontakt mit wenigstens einem Teil einer Seitenfläche (6b) der lichtemittierenden Schicht (6, 106, 206) ist, und
   die innere Seitenfläche (4d) des ausgenommenen Abschnitts (4a) einen unteren Rand und einen oberen Rand (4e) hat, wobei der untere Rand mit der inneren Unterseite (4c) kontinuierlich ist, der obere Rand (4e) (i) mit einem Teil eines unteren Umfangs (5e) der Bank (5, 105, 205) ausgerichtet ist, wobei der Teil in Kontakt mit der lichtemittierenden Schicht (6, 106, 206) ist, oder (ii) in Kontakt mit einer Unterseite (5a) der Bank (5, 105, 205) ist,
   die innere Unterseite (4c) und die innere Seitenfläche (4d) Teile derselben Ladungsinjektions-Transportschicht (4, 104, 204) sind, wodurch sie dieselbe Metallverbindung enthalten und
   dieselbe Metallverbindung kontinuierlich von dem unteren Rand zu dem oberen Rand der inneren Seitenfläche enthalten ist,
   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) im Wesentlichen parallel zu einer Oberseite des Substrats (1, 101, 201) ist.

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

3. Lichtemitter nach Anspruch 2, bei dem das Metalloxid ein Oxid von Wolfram oder Molybdän ist.

4. Anzeigevorrichtung, umfassend den Lichtemitter nach einem der Ansprüche 1 bis 3.

5. 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 dünnen Film haften, und Ausbilden des ausgenommenen Abschnitts durch Auflösen eines Teils des Dünnfilms mit der Reinigungsflüssigkeit oder der Entwicklungsflüssigkeit;
   einen fünften Schritt des Ausbildens der lichtemittierenden Schicht (6, 106, 206) durch (i) Beschichten der inneren Unterseite (4c) und der inneren Seitenfläche (4d) der Ladungsinjektions-Transportschicht (4, 104, 204) mit Tinte durch Ausstoßen von Tintentropfen in den von der Bank (5, 105, 205) definierten Bereich und (ii) Trocknen der Tinte; und
   einen sechsten Schritt des Ausbildens einer zweiten Elektrode (8, 108, 208) über der lichtemittierenden Schicht (6, 106, 206).

6. Verfahren nach Anspruch 5, bei dem
   die Ladungsinjektions-Transportschicht die Metallverbindung umfasst, die in dem vorbestimmten Lösungsmittel löslich ist, und
   der ausgenommene Abschnitt (4a) ein Abschnitt der Ladungsinjektions-Transportschicht (4, 104, 204) ist, in dem die Metallverbindung durch das vorbestimmte Lösungsmittel gelöst worden ist.

7. Verfahren nach Anspruch 6, bei dem das vorbestimmte Lösungsmittel (i) die Entwicklungslösung zum Entfernen eines Teils eines Resistfilms ist, der zum Ausbilden 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. Émetteur de lumière incluant :

   une première électrode (2, 102, 202), une couche de transport et d'injection de charge (4, 104, 204) incluant un composé métallique qui est soluble dans un solvant prédéterminé,
   une couche d'émission de lumière (6, 106, 206) et une seconde électrode (8, 108, 208) qui sont mises en couche dans cet ordre sur un substrat (1, 101, 201),
   au moins la couche d'émission de lumière (6, 106, 206) étant définie par une batterie (5, 105, 205),
   dans lequel la batterie (5, 105, 205) est disposée 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 inclut une partie en creux (4a) possédant (i) une surface de fond interne (4c) qui est en contact avec la surface de fond (6a) de la couche d'émission de lumière (6, 106, 206) et (ii) une surface latérale interne (4d) qui est continue avec la surface de fond interne (4c) et en contact au moins avec une partie d'une surface latérale (6b) de la couche d'émission de lumière (6, 106, 206), et
   la surface latérale interne (4d) de la partie en creux (4a) possède une bordure inférieure et une bordure supérieure (4e), la bordure inférieure étant continue avec la surface de fond interne (4c), la bordure supérieure (4e) étant (i) soit alignée avec une partie de la périphérie inférieure (5e) de la batterie (5, 105, 205), ladite partie étant en contact avec la couche d'émission de lumière (6, 106, 206), et (ii) soit en contact avec la surface de fond (5a) de la batterie (5, 105, 205),
   la surface de fond interne (4c) et la surface latérale interne (4d) sont des parties de la même couche de transport et d'injection de charge (4, 104, 204), incluant ainsi le même composé métallique,
   le même composé métallique étant inclus de manière continue depuis la bordure inférieure jusqu'à la bordure supérieure de la surface latérale interne,
   caractérisé en ce que
   la couche de transport et d'injection de charge (4, 104, 204) s'étend le long de la surface de fond (5a) de la batterie (5, 105, 205) jusqu'à un pixel adjacent, et
   la surface de fond interne (4c) est pratiquement parallèle à la surface supérieure du substrat (1, 101, 201).

2. Émetteur de lumière 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.

3. Émetteur de lumière selon la revendication 2, dans lequel l'oxyde métallique est un oxyde soit de tungstène, soit de molybdène.

4. Appareil d'affichage comprenant l'émetteur de lumière conforme à l'une quelconque des revendications 1 à 3.

5. Procédé de fabrication d'un émetteur de lumière 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 de la batterie (5, 105, 205) sur le film mince (i) en formant un film de résine photosensible incluant un matériau de résine sur le film mince et (ii) en gravant le film de résine avec une solution de développement,
   une quatrième étape de formation de la couche de transport et d'injection de charge (4, 104, 204), après la formation de la batterie (5, 105, 205), en nettoyant les résidus du film de résine photosensible qui adhèrent au film mince et en formant la partie en creux par dissolution d'une partie du film mince avec le liquide de nettoyage ou le liquide de développement,
   une cinquième étape de formation de la couche d'émission de lumière (6, 106, 206) (i) en recouvrant la surface de fond interne (4c) et la surface latérale interne (4d) de la couche de transport et d'injection de charge (4, 104, 204) avec de l'encre en éjectant des gouttelettes de l'encre dans la zone définie par la batterie (5, 105, 205) et (ii) en séchant l'encre, et
   une sixième étape de formation d'une seconde électrode (8, 108, 208) par-dessus la couche d'émission de lumière (6, 106, 206).

6. Procédé selon la revendication 5, dans lequel
   la couche de transport et d'injection de charge inclut le composé métallique qui est soluble dans le solvant prédéterminé, et
   la partie en creux (4a) est une partie de la couche de transport et d'injection de charge (4, 104, 204) où le composé métallique a été dissous dans le solvant prédéterminé.

7. Procédé selon la revendication 6, dans lequel le sol-

vant prédéterminé est l'un ou les deux parmi (i) la solution de développement destinée à supprimer une partie d'un film de résine photosensible utilisé pour former la batterie (5, 105, 205) et (ii) le liquide de nettoyage destiné à nettoyer les résidus du film de résine photosensible qui restent après la formation de la batterie (5, 105, 205).

FIG. 1

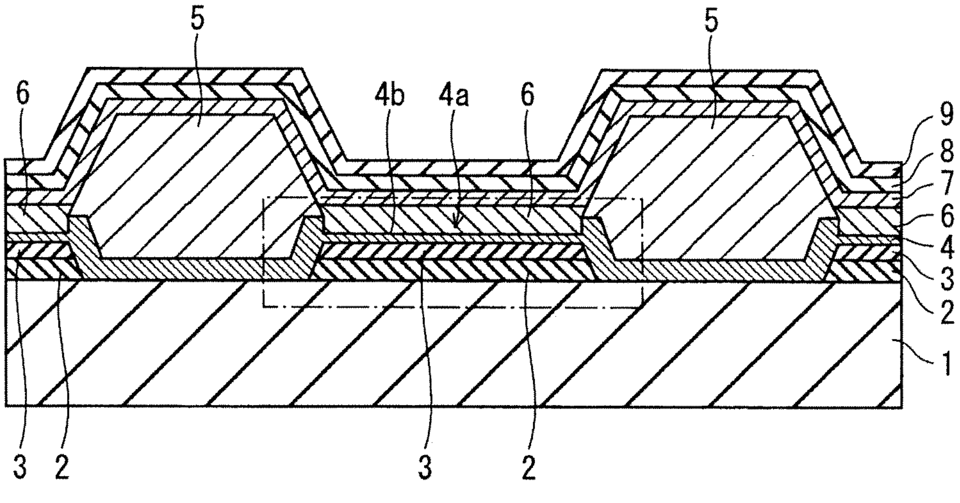

FIG. 2

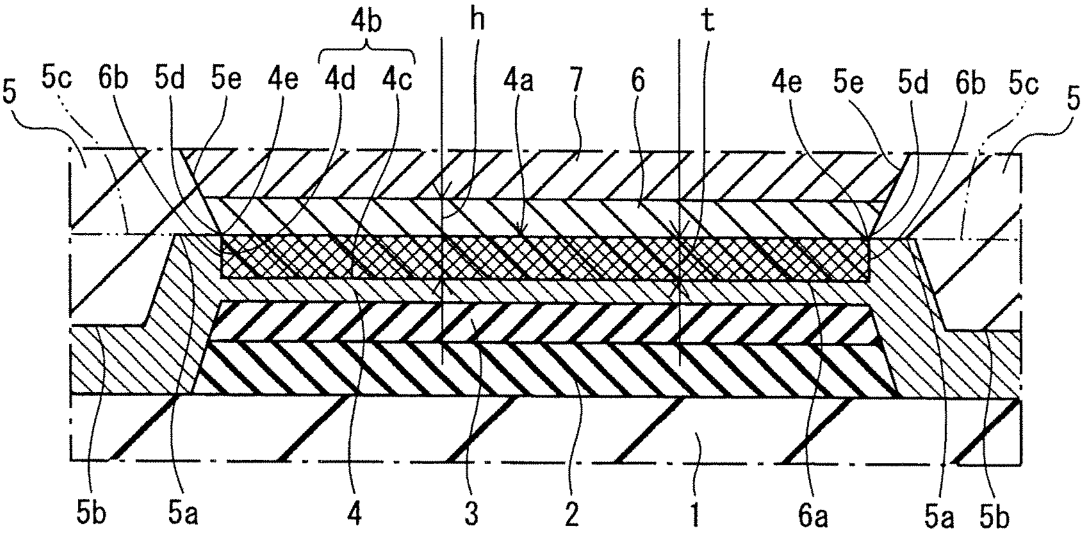

FIG. 3A

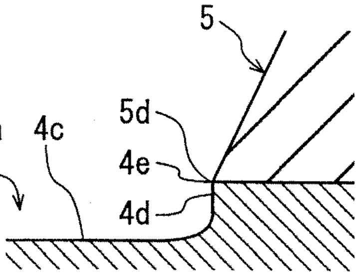

FIG. 3B

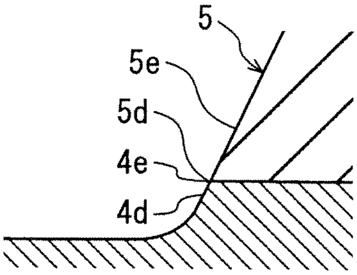

FIG. 3C

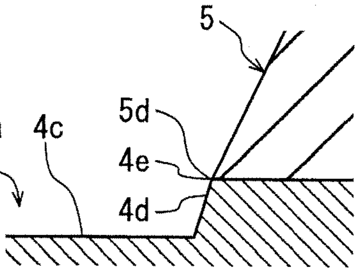

FIG. 3D

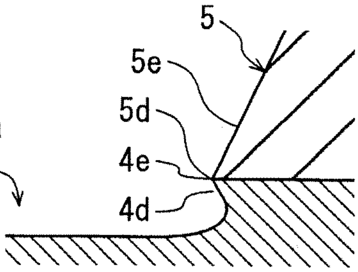

FIG. 4

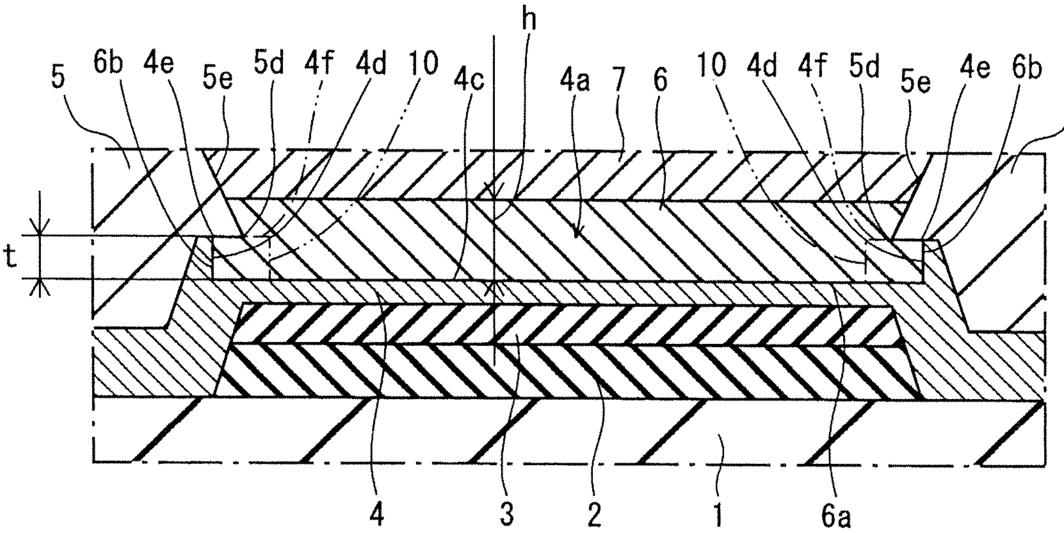

FIG. 5A

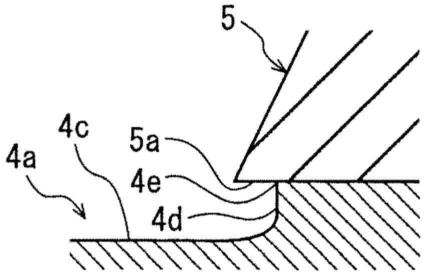

FIG. 5B

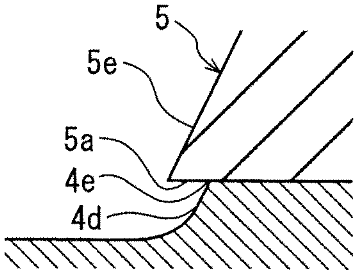

FIG. 5C

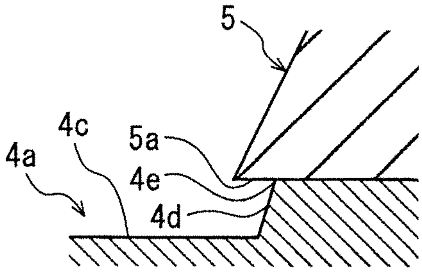

FIG. 5D

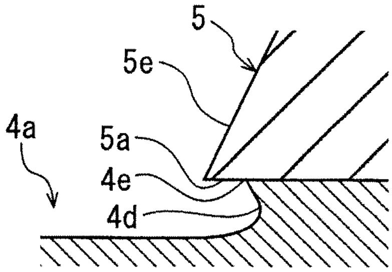

FIG. 6A

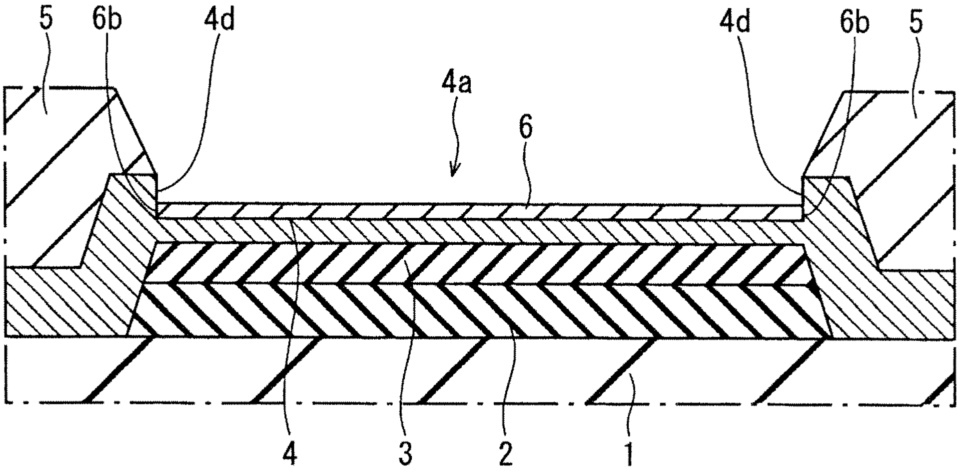

FIG. 6B

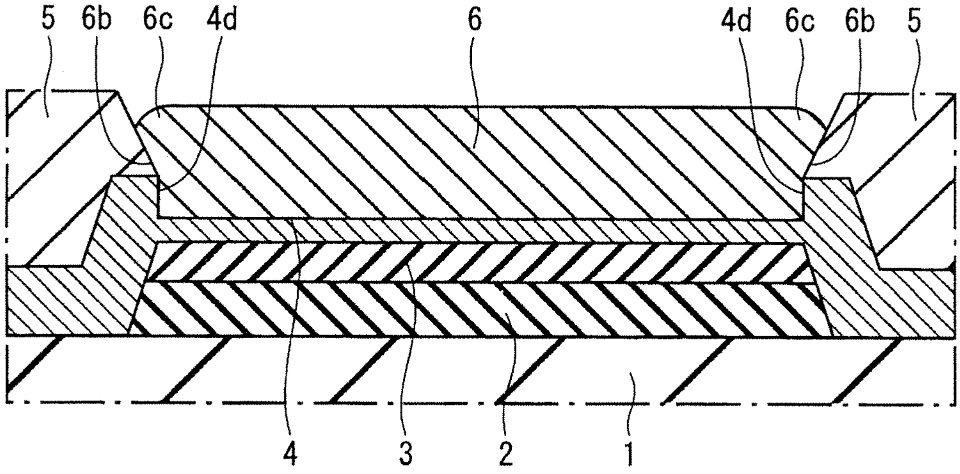

FIG. 7

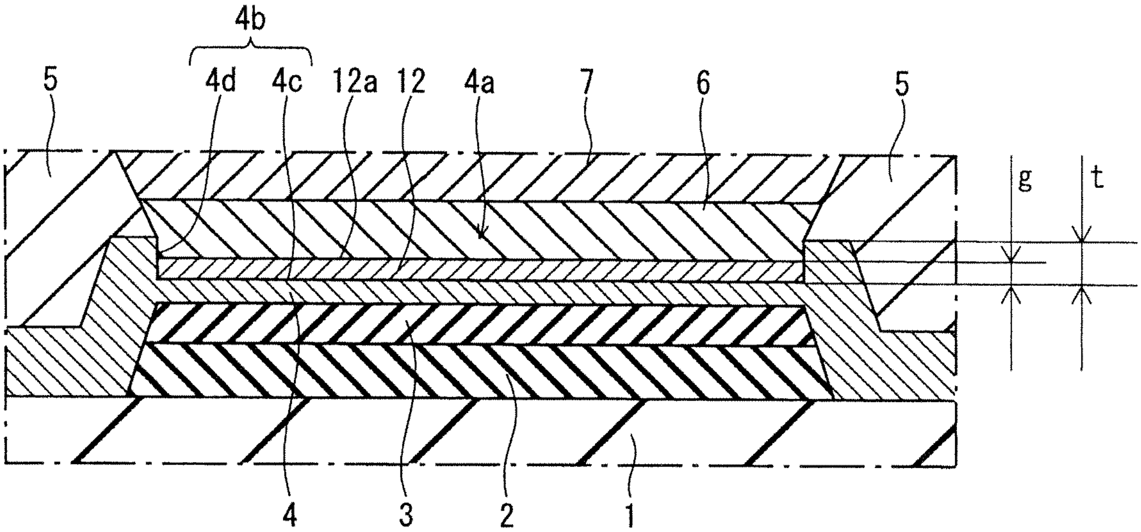

FIG. 8A

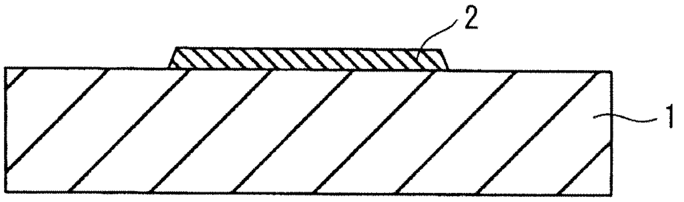

FIG. 8B

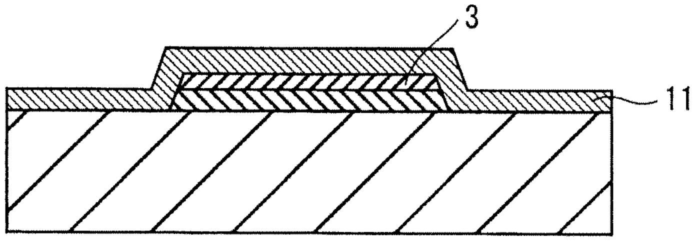

FIG. 8C

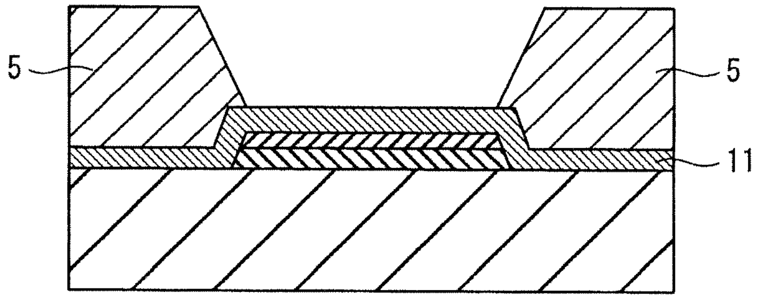

FIG. 8D

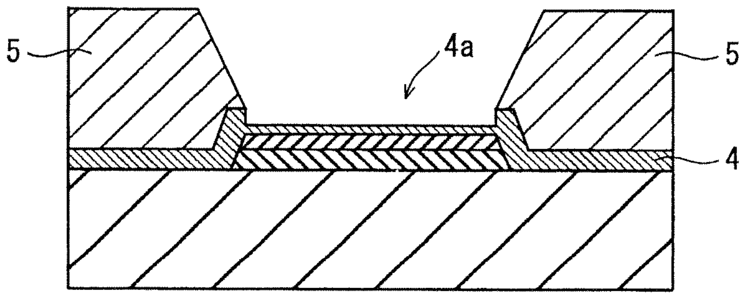

FIG. 9E

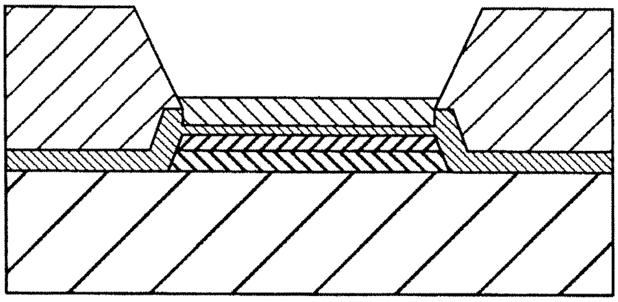

FIG. 9F

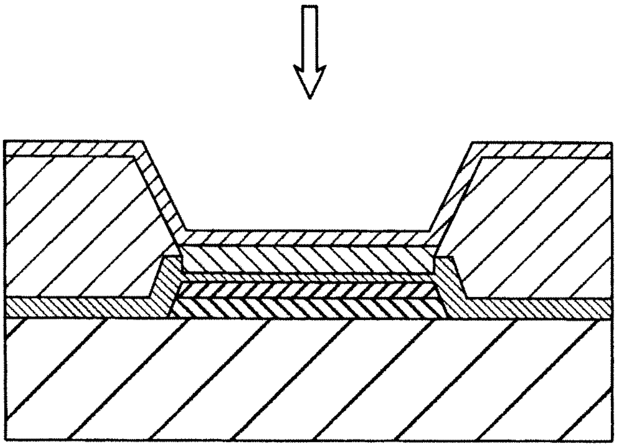

FIG. 9G

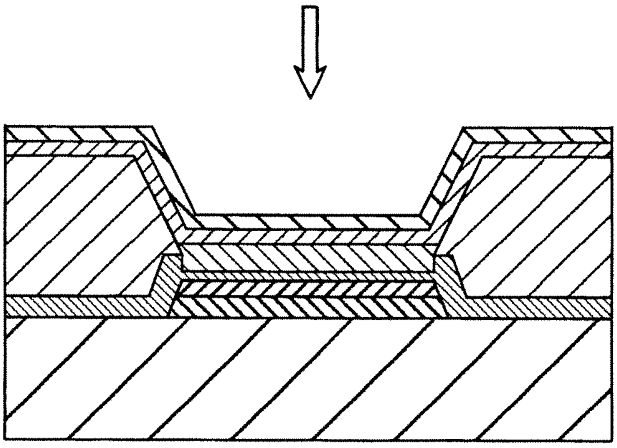

FIG. 9H

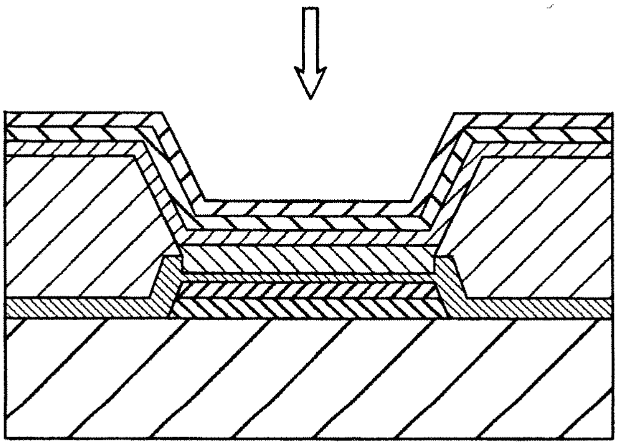

FIG. 10

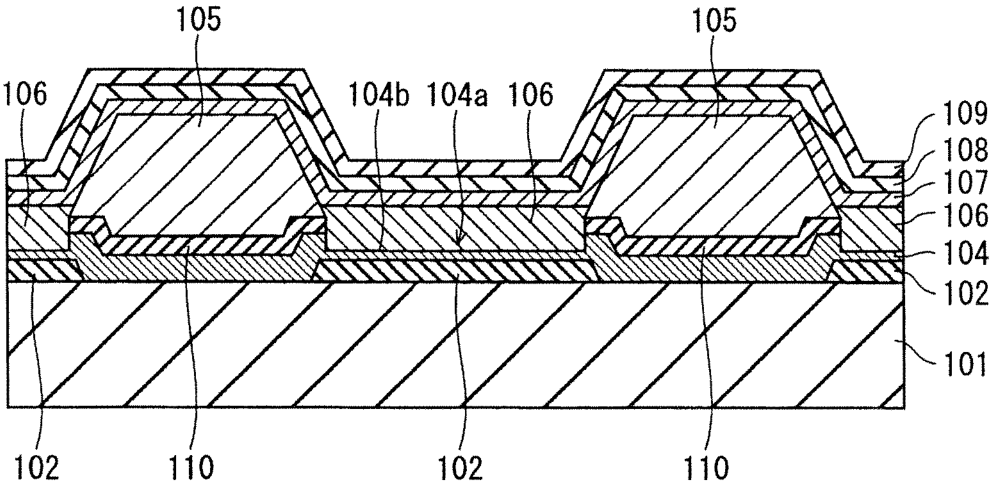
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FIG. 11A

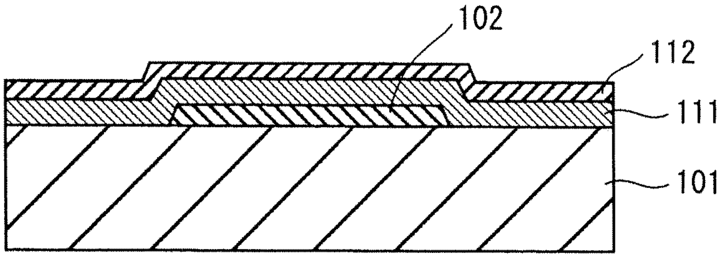

FIG. 11B

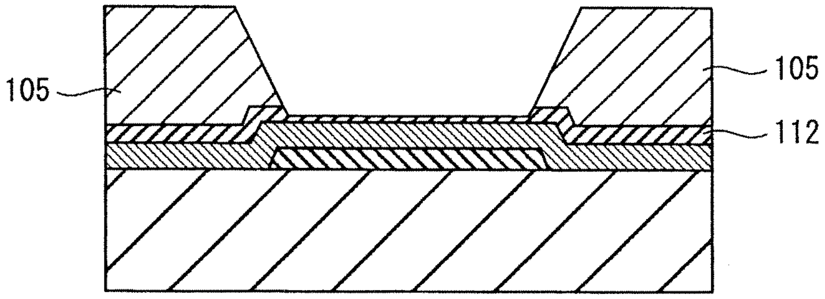

FIG. 11C

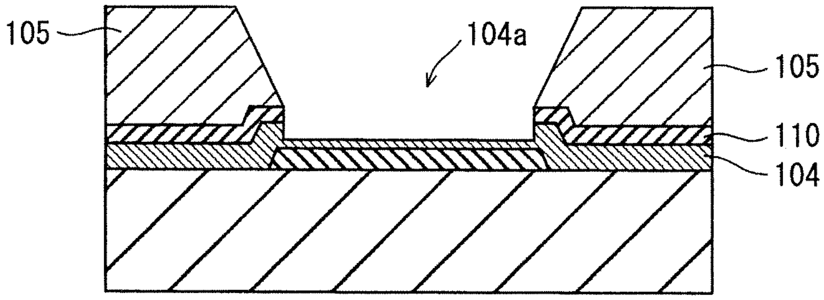

FIG. 11D

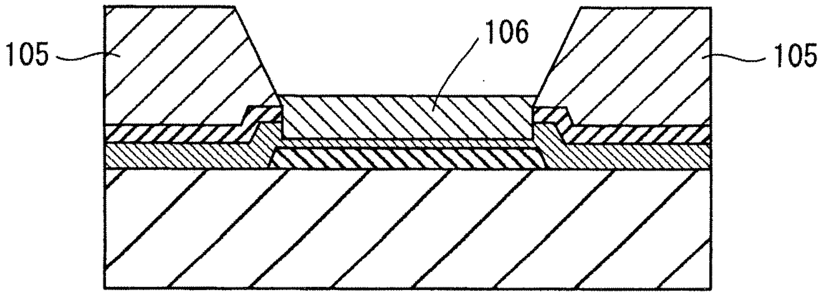

FIG. 12

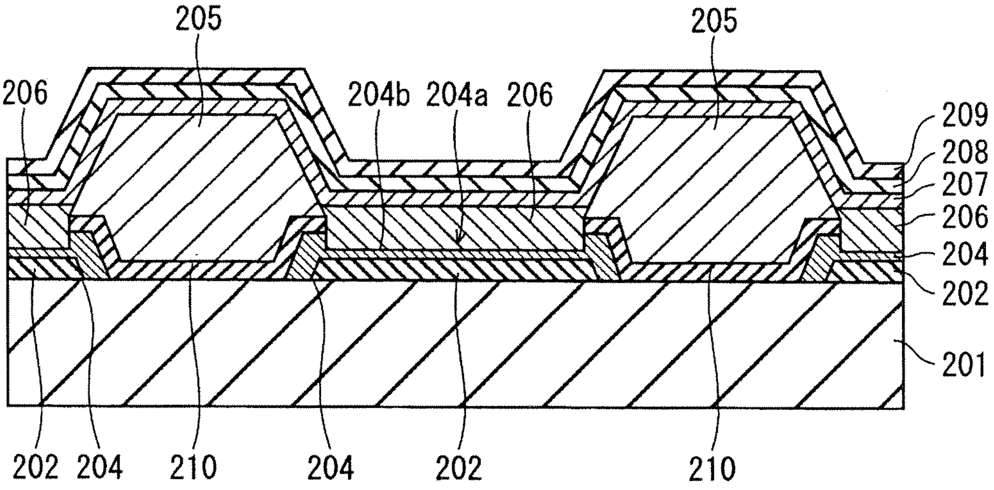
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FIG. 13A

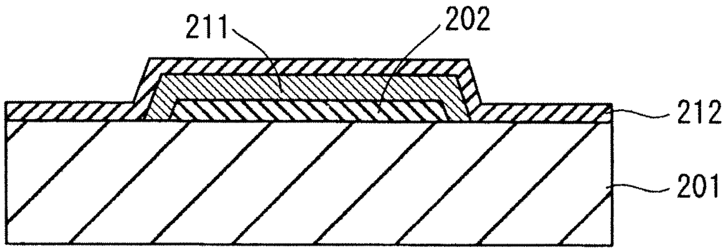


FIG. 13B

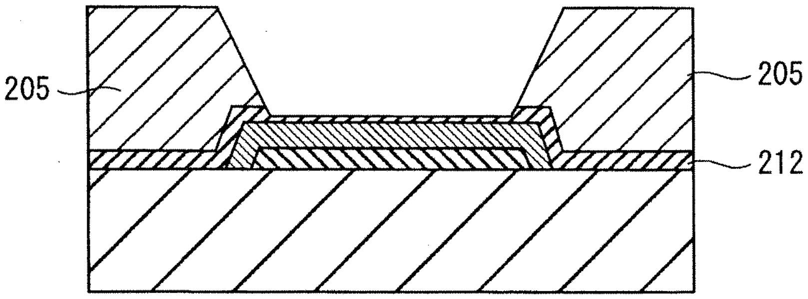


FIG. 13C

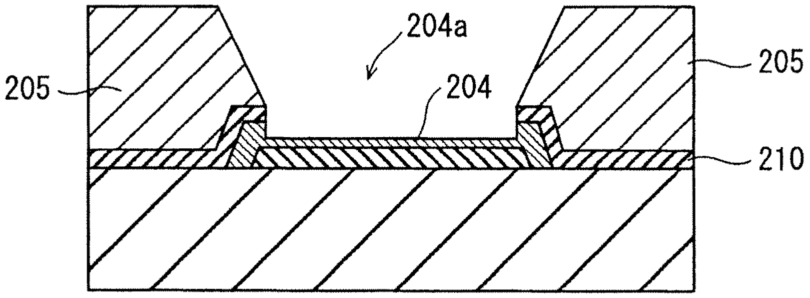


FIG. 13D

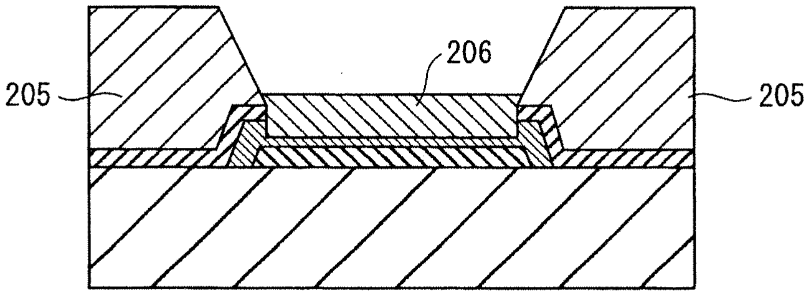
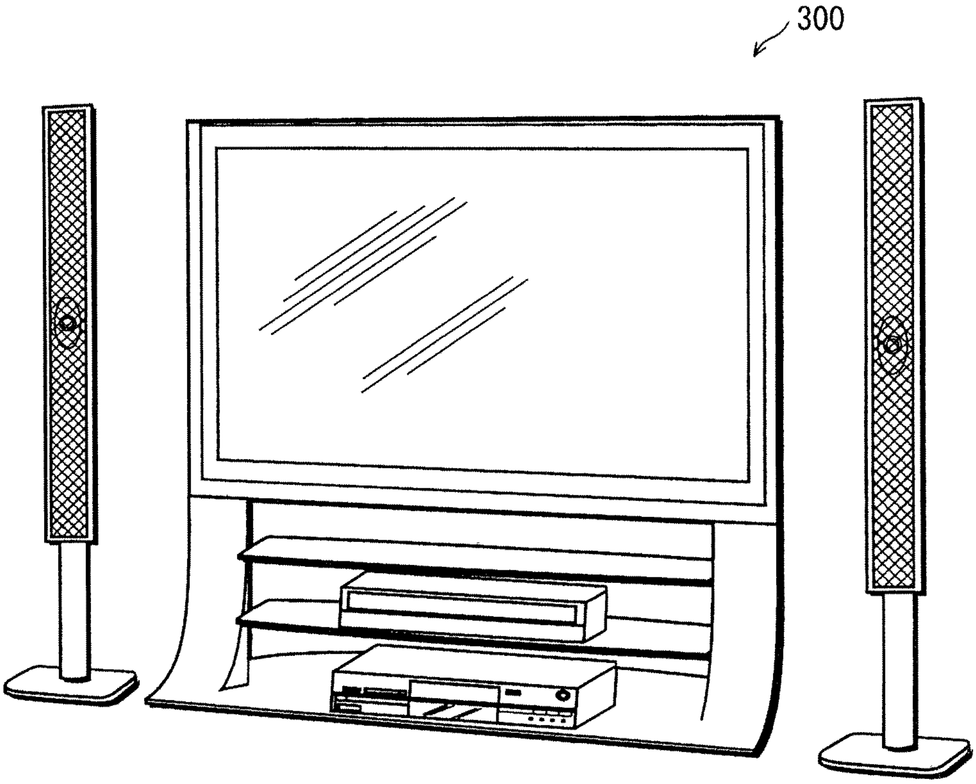


FIG. 14



REFERENCES CITED IN THE DESCRIPTION

Patent documents cited in the description

- US 2005073243 A **[0005]**
- JP 2007220656 A **[0005]**
- JP 2003249375 A **[0006]**
- JP H5163488 B **[0049]**

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	EP2398083B1	公开(公告)日	2018-06-13
申请号	EP2010741075	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 C O PANASONIC CORPORATION IPROC TAKEUCHI TAKAYUKI C O PANASONIC CORPORATION NISHIYAMA SEIJI C O PANASONIC CORPORATION IPROC KOMATSU TAKAHIRO C O PANASONIC CORPORATION IPROC		
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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	EP2398083A4 EP2398083A1		
外部链接	Espacenet		

摘要(译)

本发明提供一种发光体，其中图案化高清晰度发光层，并且可以以低成本制造。为了实现该目的，发光体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至少在其表面上是液体排斥的，并且电荷注入传输层4主要由比堤的表面更亲液的金属化合物构成。而且，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