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**MATSUMOTO et al.**(10) **Pub. No.: US 2018/0269432 A1**(43) **Pub. Date: Sep. 20, 2018**(54) **METHOD FOR MANUFACTURING  
ORGANIC EL PANEL****H01L 51/52** (2006.01)**H01L 51/50** (2006.01)(71) Applicant: **SUMITOMO CHEMICAL  
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**ABSTRACT**(21) Appl. No.: **15/541,547**(22) PCT Filed: **Dec. 18, 2015**(86) PCT No.: **PCT/JP2015/085557**

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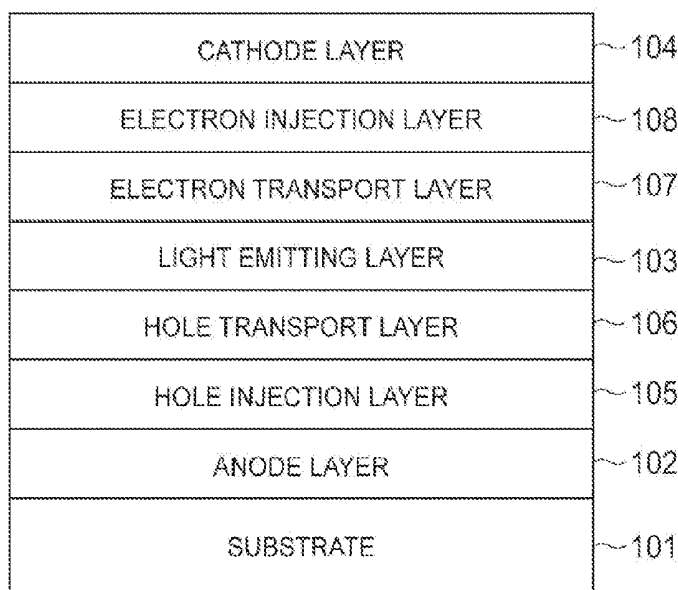
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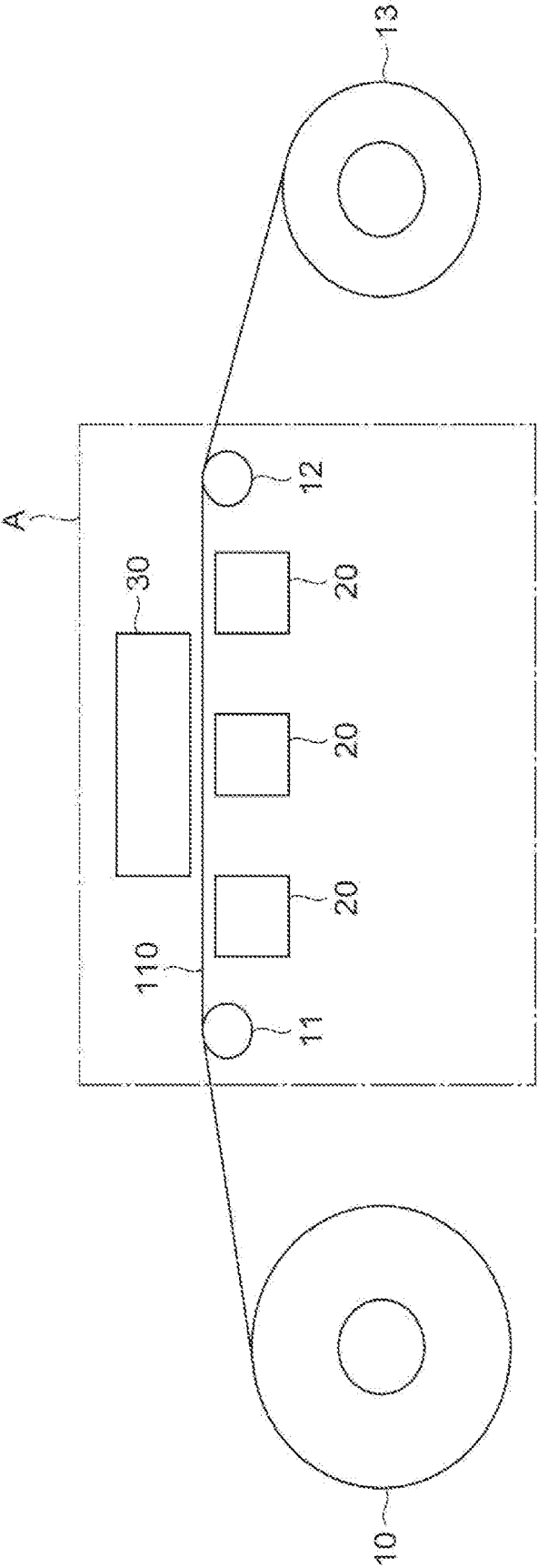
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A method for manufacturing an organic EL panel capable of reducing uneven emission luminance (uneven light emission) is disclosed. A method for manufacturing an organic EL panel according to an embodiment of the invention is a method for manufacturing an organic EL panel including a functional layer including at least a light emitting layer containing an organic material, including a coating step of forming a functional layer by horizontally conveying a base material (110) having flexibility using a roll-to-roll process and coating a coating solution containing an organic material onto the base material (110) using an inkjet applicator (30) disposed above the base material (110), wherein in the coating step, the base material (110) is floated by air using an air floating stage (20) disposed below the base material (110) and the coating solution is coated onto the base material (110).

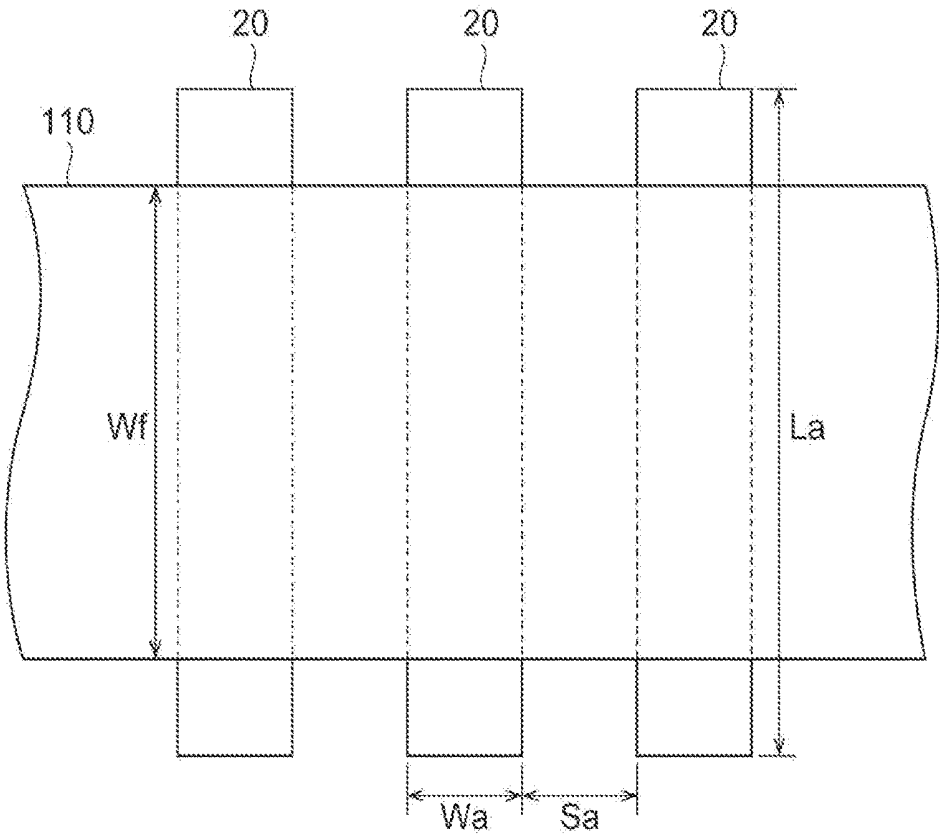
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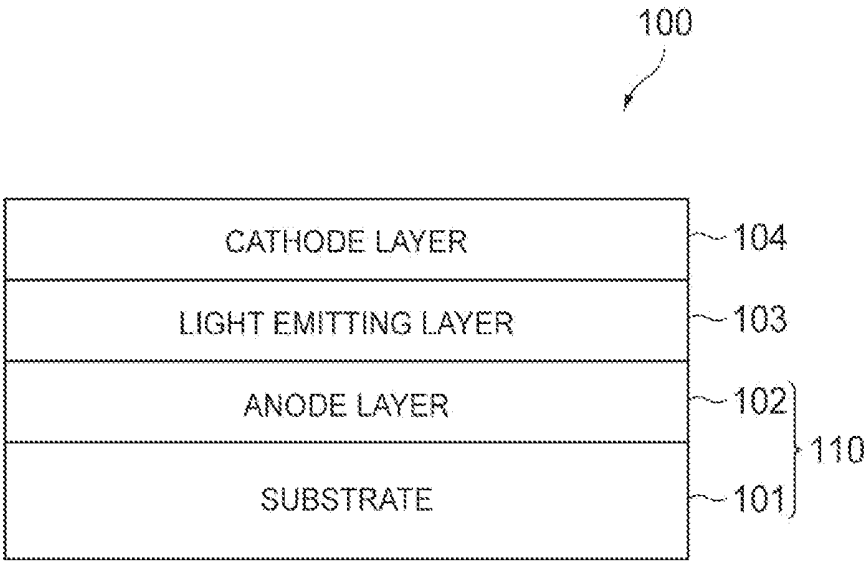
**Fig. 1**



*Fig.2*



*Fig.3*



**Fig.4**

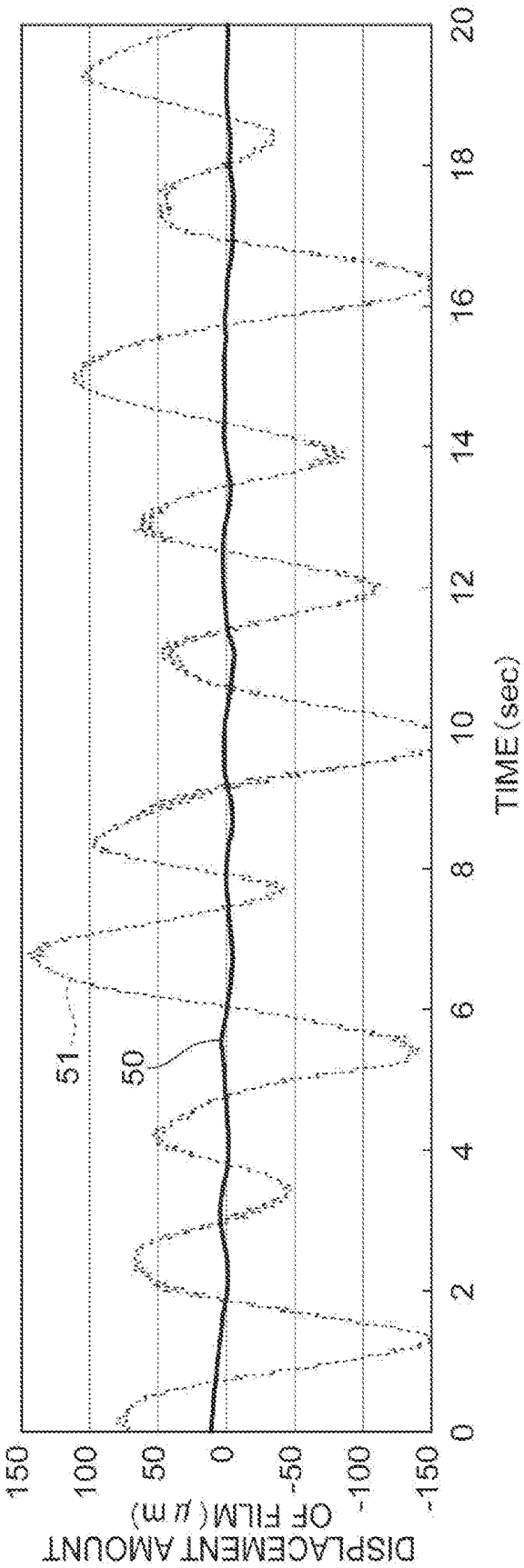
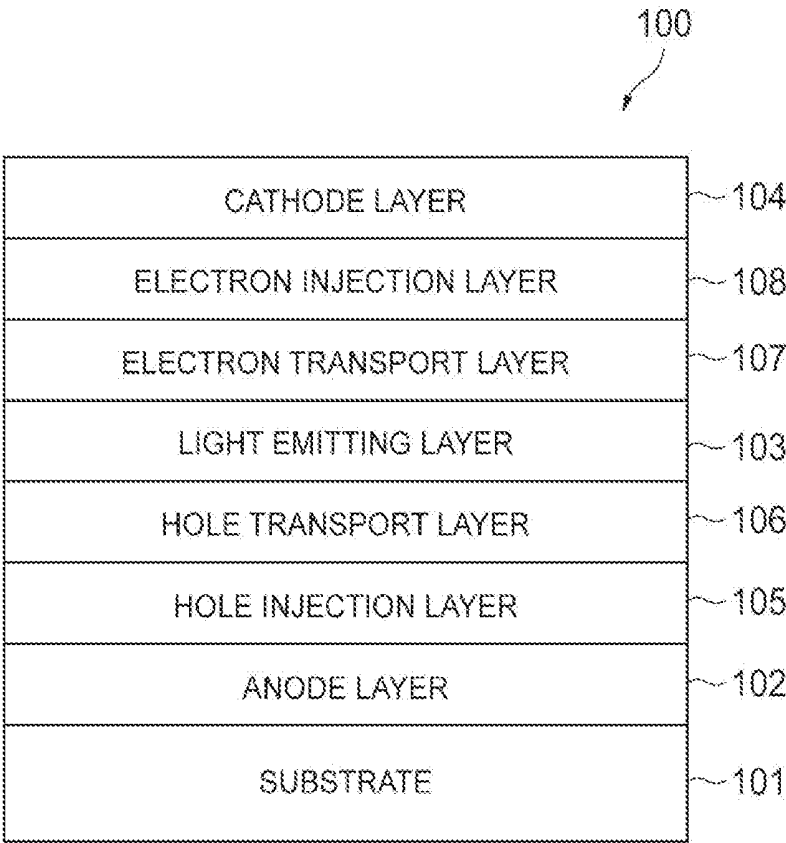
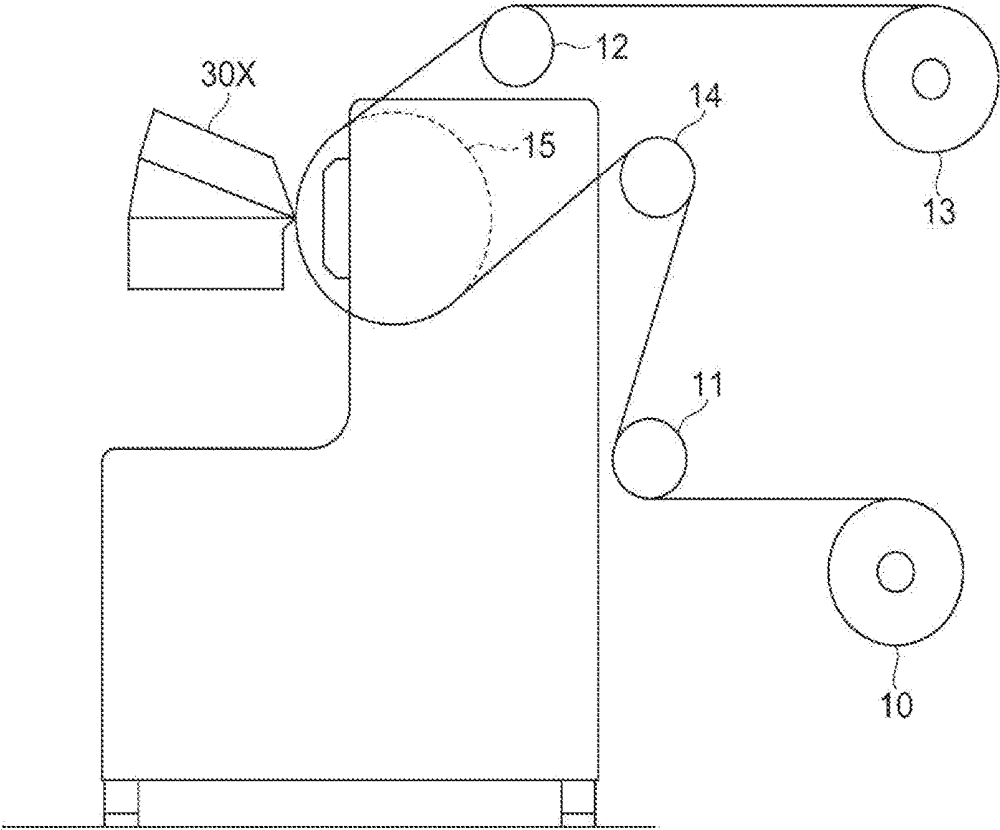


Fig.5



**Fig.6**



## METHOD FOR MANUFACTURING ORGANIC EL PANEL

### TECHNICAL FIELD

**[0001]** The present invention relates to a method for manufacturing an organic EL panel.

### BACKGROUND

**[0002]** An organic EL panel including a light emitting layer (a functional layer) containing an organic EL (Electro Luminescence) material between a pair of electrode layers is known. Such an organic EL panel also includes various functional layers such as a hole injection layer, a hole transport layer, an electron transport layer, and an electron injection layer containing an organic material between the pair of electrode layers. There is a case in which such an organic EL panel is formed on a film-shaped substrate (a substrate having flexibility or a flexible substrate) and is formed in a film shape.

**[0003]** As a method for manufacturing the film-shaped organic EL panel, a method for forming various functional layers by a coating method such as an inkjet coating method and a die coater coating method using a roll-to-roll process is known. Non-Patent Literature 1 discloses a die coater coating method (a slit coat coating method).

**[0004]** A case of forming the light emitting layer of the organic EL panel using the slit coat coating method will be described with reference to FIG. 6. In the slit coat coating method shown in FIG. 6, a film-shaped base material including a substrate and an electrode is conveyed by a roll-to-roll structure including an unwinding roller 10 and a winding roller 13 and conveying rollers 11, 12, 14, and 15 and a coating solution including an organic EL material is coated onto the base material by a slit coat applicator 30X, thereby forming a light emitting layer thin film. At that time, the base material is fixed and stabilized by using a backup roller 15 in order to stabilize an underlying base material.

**[0005]** Fixing and stabilizing an underlying base material by using an adsorption stage instead of the backup roller 15 are also known.

### CITATION LIST

#### Non-Patent Literature

**[0006]** [Non-Patent Literature 1] Techno Smart Co., Ltd., Multi-layer Die Coater, [online], [Accessed on Nov. 17, 2014], the Internet <URL:<http://www.ctiweb.co.jp/soran/products/410>>

### SUMMARY OF INVENTION

#### Technical Problem

**[0007]** The slit coat coating method disclosed in Non-Patent Literature 1 is suitable for a case in which a coating solution having high viscosity is used. Incidentally, a case in which a coating solution having low viscosity is used to form a thinner film may be conceived. However, when the coating solution having low viscosity is used in the slit coat coating method disclosed in Non-Patent Literature 1, dripping occurs.

**[0008]** When the backup roller is used as in the slit coat coating method disclosed in Non-Patent Literature 1, the film thickness becomes uneven due to a mechanical vibra-

tion of the backup roller and thus the emission luminance becomes uneven (uneven light emission). Meanwhile, since the base material is temporarily adsorbed when the adsorption stage is used, the base material is conveyed intermittently and thus productivity is degraded.

**[0009]** Regarding the dripping, a case in which the base material is horizontally conveyed and a coating solution is coated onto a top surface of the base material by a coater disposed above the base material may be conceived. Regarding the prevention of the mechanical vibration and the intermittent conveying, a case in which the backup roller and the adsorption stage are not used may be conceived. For example, the substrate may be horizontally conveyed by two conveying rollers separated from each other by a predetermined distance, and a coating solution may be coated onto the base material from above between two conveying rollers without using the backup roller and the adsorption stage.

**[0010]** However, in a configuration in which the backup roller and the adsorption stage are not used for the horizontal conveying in the case of the film-shaped base material, the base material droops due to its own weight between two rolls and thus the base material is vibrated up and down. Due to this vibration, the film thickness of the coating film becomes uneven. As a result, the emission luminance becomes uneven (uneven light emission).

**[0011]** Here, an object of the invention is to provide a method for manufacturing an organic EL panel capable of reducing uneven emission luminance (uneven light emission).

#### Solution to Problem

**[0012]** A method for manufacturing an organic EL panel of the invention is a method for manufacturing an organic EL panel including a functional layer including at least a light emitting layer containing an organic material, including a coating step of forming the functional layer by horizontally conveying a base material having flexibility using a roll-to-roll process and coating a coating solution containing the organic material onto the base material using an inkjet applicator disposed above the base material, wherein in the coating step, the base material is floated by air using an air floating stage disposed below the base material and the coating solution is coated onto the base material. The coating step can be applied to form a light emitting layer (functional layer) containing an organic EL material and can be also applied to form a functional layer such as a hole injection layer, a hole transport layer, an electron transport layer, and an electron injection layer containing an organic material.

**[0013]** According to the method for manufacturing the organic EL panel, since the base material is floated by air, it is possible to suppress drooping of the base material due to its own weight and to suppress vertical vibration of the base material. Thus, it is possible to reduce unevenness in film thickness of the coating film caused by the vertical vibration of the base material. As a result, it is possible to reduce uneven emission luminance (uneven light emission).

**[0014]** According to the method for manufacturing the organic EL panel, since the base material is horizontally conveyed and the coating solution (having low viscosity) is coated onto the base material from above, dripping can be prevented.

**[0015]** According to the method for manufacturing the organic EL panel, since the coating film (functional layer)

can be continuously and stably formed in the roll-to-roll process, it is possible to continuously manufacture a high-quality organic EL panel having no uneven emission luminance (uneven light emission) with high throughput.

**[0016]** The air floating stage may be formed of a porous material. The air floating stage is not used to convey the base material, but is used to float a part of the base material which droops due to its own weight. A relatively large amount of air produced by relatively large holes formed by processing is thus too strong. However, according to this embodiment, it is possible to float a part of the base material which droops due to its own weight by the use of a relatively small amount of air produced by the relatively small holes of the porous material.

**[0017]** A vertical vibration amount (displacement amount) of the base material may be equal to or smaller than 70  $\mu\text{m}$  ( $\pm 35 \mu\text{m}$ ). According to this embodiment, since the vertical vibration amount of the base material is as small as equal to or smaller than 70  $\mu\text{m}$  (displacement amount of  $\pm 35 \mu\text{m}$ ), it is possible to reduce unevenness in film thickness of the coating film caused by the vertical vibration of the base material. As a result, it is possible to reduce uneven emission luminance (uneven light emission).

**[0018]** A gap between the air floating stage and the base material may be equal to or larger than 30  $\mu\text{m}$  and equal to or smaller than 1 mm. According to this embodiment, it is possible to appropriately suppress the vertical vibration of the film caused by the blowing air between the air floating stage and the base material. When the gap is smaller than 30  $\mu\text{m}$ , there is a concern that the back surface of the base material may be damaged due to contact between the air floating stage and the base material. In contrast, when the gap is larger than 1 mm, an air layer between the air floating stage and the base material becomes uneven and thus an effect of suppressing the vertical vibration becomes small.

**[0019]** The viscosity of the coating solution may be equal to or larger than 1 cp and equal to or smaller than 20 cp. According to this embodiment, even with a low-viscosity coating solution of equal to or larger than 1 cp and equal to or smaller than 20 cp, it is possible to reduce unevenness in film thickness of the coating film caused by the vertical vibration of the base material. As a result, it is possible to reduce uneven emission luminance (uneven light emission). Further, dripping can be prevented as described above.

**[0020]** A tensile force (tension) of the base material may be equal to or larger than 20 N and equal to or smaller than 150 N. According to the embodiment, since wrinkles and slack in the conveying direction do not occur in the film itself conveyed to enter the air floating stage, it is possible to form a stable and uniform coating film while suppressing a vertical vibration.

**[0021]** An air flow speed of the air floating stage may be equal to or greater than 0.001 m/sec and equal to or less than 0.3 m/sec. As described above, the air floating stage is not used to convey the base material, but is used to float a part of the base material which droops due to its own weight. Thus, a relatively large amount of air produced by relatively large holes formed by processing is too strong. However, according to the embodiment, since the air flow speed is as low as equal to or greater than 0.001 m/sec and equal to or less than 0.3 m/sec, it is possible to float a part of the base material which droops due to its own weight.

#### Advantageous Effects of Invention

**[0022]** According to the invention, it is possible to reduce uneven emission luminance (uneven light emission) of an organic EL panel.

#### BRIEF DESCRIPTION OF DRAWINGS

**[0023]** FIG. 1 is a diagram showing a method for manufacturing an organic EL panel according to an embodiment of the invention.

**[0024]** FIG. 2 is a diagram showing a processing area A shown in FIG. 1 when viewed from above.

**[0025]** FIG. 3 is a cross-sectional view of the organic EL panel according to the embodiment.

**[0026]** FIG. 4 is a diagram showing verification results.

**[0027]** FIG. 5 is a cross-sectional view of an organic EL panel according to a modified example.

**[0028]** FIG. 6 is a diagram showing a method for manufacturing an organic EL panel of the related art.

#### DESCRIPTION OF EMBODIMENTS

**[0029]** Hereinafter, a preferred embodiment of the invention will be described in detail with reference to the drawings. In the drawings, the same reference numerals will be given to the same or equivalent parts.

**[0030]** FIG. 1 is a diagram showing a method for manufacturing an organic EL panel according to an embodiment of the invention and FIG. 2 is a diagram showing a processing area A shown in FIG. 1 when viewed from above. FIG. 3 is a cross-sectional view of the organic EL panel according to the embodiment.

**[0031]** As shown in FIG. 3, an organic EL panel 100 of the embodiment has a configuration in which an anode layer 102, a light emitting layer (functional layer) 103, and a cathode layer 104 are sequentially laminated on a film-shaped substrate (substrate having flexibility or a flexible substrate) 101. As a material of the film-shaped substrate 101, for example, a transparent plastic, more specifically, PEN (Polyethylene Naphthalate) may be exemplified. For the film-shaped substrate 101, a substrate having a thickness of about 100  $\mu\text{m}$  is typically exemplified. As the anode layer 102, for example, an electrode having light transmittance, more specifically, a conductive metal oxide thin film termed of a relatively transparent material such as ITO (Tin-doped Indium Oxide) and IZO (Indium Zinc Oxide) is exemplified. The light emitting layer 103 includes various known organic EL materials such as a low-molecular-weight type material and a high-molecular-weight type material. As the cathode layer 104, for example, an electrode having light reflectivity, more specifically, a conductive metal thin film formed of a metal material is exemplified.

**[0032]** In a method for manufacturing the organic EL panel shown below, a step (coating step) of forming the light emitting layer 103 on a film-shaped base material 110 including the substrate 101 and the anode layer 102 will be described and a known step of forming the anode layer 102 and the cathode layer 104 will be omitted. The anode layer 102 and the cathode layer 104 can be formed by, for example, a known method such as a vapor deposition method and a coating method for forming an electrode layer.

**[0033]** First, as shown in FIGS. 1 and 2, the film base material 110 is horizontally conveyed by using the roll-to-roll process. Specifically, the film base material 110 is unwound from the unwinding roller 10, and the film base

material **110** is horizontally conveyed in the processing area A by the conveying rollers **11** and **12**, and is wound by the winding roller **13**.

[0034] For example, on the assumption of the PEN film base material **110** having a thickness of 125  $\mu\text{m}$  and a width Wf of 320 mm, a conveying speed of the film base material **110** is set to, for example, be equal to or greater than 2 m/min and equal to or less than 6 m/min and a tension applied in the conveying direction of the film base material **110** is set to, for example, be equal to or larger than 20 N and equal to or smaller than 150 N and desirably equal to or larger than 30 N and equal to or smaller than 100 N. The tension (tensile force) applied in the conveying direction of the film base material **110** may be adjusted by a tension adjusting mechanism (not shown).

[0035] In the processing area A in which the film base material **110** is horizontally conveyed, the film base material **110** is floated by air using three air floating stages **20** disposed below the film base material **110**. Each of the air floating stages **20** is formed of porous carbon and blows air from a plurality of minute holes. For example, a width Wa of a top surface facing the film base material **110** in the air floating stage **20** is about 100 mm and a length La thereof is about 500 mm. The air floating stages **20** are arranged in the conveying direction at an interval Sa of 100 mm.

[0036] For example, the PEN film base material **110** having a thickness of 125  $\mu\text{m}$  and a width Wf of 320 mm is assumed and an air blowing flow rate is set to be equal to or greater than  $1 \times 10^{-4}$  L/(cm<sup>2</sup>·sec) and equal to or less than  $3 \times 10^{-2}$  L/(cm<sup>2</sup>·sec) (air flow speed conversion which is equal to or greater than 0.001 m/sec and equal to or less than 0.3 m/sec) and desirably equal to or greater than  $1 \times 10^{-4}$  L/(cm<sup>2</sup>·sec) and equal to or less than  $1 \times 10^{-2}$  L/(cm<sup>2</sup>·sec).

[0037] Accordingly, a gap between the air floating stage **20** and the film base material **110** is set to be equal to or larger than 30  $\mu\text{m}$  and equal to or smaller than 1 mm and desirably equal to or larger than 50  $\mu\text{m}$  and equal to or smaller than 500  $\mu\text{m}$ . As a result, a vibration amount (highest position minus lowest position) of the film base material **110** is equal to or smaller than 70  $\mu\text{m}$  and desirably equal to or smaller than 40  $\mu\text{m}$ . In other words, a displacement amount of the film base material **110** is equal to or smaller than  $\pm 35$   $\mu\text{m}$  and desirably equal to or smaller than  $\pm 20$   $\mu\text{m}$ .

[0038] The air floating stage **20** is not used to convey the film base material **110**, but is used to float a part of the film base material **110** which droops due to its own weight. Thus, a relatively large amount of air produced by relatively large holes formed by processing is too strong. According to the air floating stage **20** of the embodiment, it is possible to float a part of the film base material **110** which droops due to its own weight by the use of a relatively small amount of air produced by relatively minute holes of the porous material.

[0039] In the case of a relatively large amount of air produced by relatively large holes formed by processing, there is a case in which ink of a nozzle of an inkjet applicator **30** may dry. However, in the case of a relatively small amount of air produced by relatively small holes of the porous material of the embodiment, such a problem does not arise.

[0040] In the processing area A in which the film base material **110** is horizontally conveyed, ink (coating solution) including an organic EL material is coated onto the film base material **110** by the inkjet applicator **30** disposed above the film base material **110** and the air floating stage **20** to form

the light emitting layer **103**. For the light emitting layer **103**, a layer having a thickness after drying of 20 nm to 100 nm (for example, a coating thickness of 0.4  $\mu\text{m}$  to 2  $\mu\text{m}$ ) is typically exemplified.

[0041] The inkjet applicator **30** includes a plurality of nozzles arranged in a direction of the width Wf of the film base material **110**. For example, the inkjet applicator **30** may have a resolution of 600 dpi.

[0042] As the ink, relatively low-viscosity ink having a viscosity which is equal to or larger than 1 cP and equal to or smaller than 20 cP and desirably equal to or larger than 2 cP and equal to or smaller than 10 cP is used. For example, a solution including an organic EL material and an organic solvent may be used as the ink. As the organic EL material, a low-molecular-weight type material, a high-molecular-weight type material, or a mixture thereof may be used. The organic solvent may be any solvent as long as the solvent dissolves an organic EL material and is appropriately selected in consideration of the evaporation speed of the solvent, the surface tension and the viscosity of the solution, and the like. As the organic solvent, a single solvent or a mixed solvent may be used.

[0043] According to the method for manufacturing the organic EL panel of the embodiment, since the film base material **110** is floated by air, it is possible to suppress the film base material **110** from drooping due to its own weight and to suppress the vertical vibration of the film base material **110**. Thus, it is possible to reduce unevenness in film thickness of the light emitting layer (coating film) **103** caused by the vertical vibration of the film base material **110**. As a result, it is possible to reduce uneven light emission luminance (uneven light emission).

[0044] According to the method for manufacturing the organic EL panel of the embodiment, since the film base material **110** is horizontally conveyed and the ink (coating solution) is coated onto the film base material **110** from above, it is possible to prevent dripping.

[0045] According to the method for manufacturing the organic EL panel of the embodiment, since the coating film (light emitting layer) **103** can be continuously and stably formed in the roll-to-roll process, it is possible to continuously manufacture a high-quality organic EL panel having no uneven emission luminance (uneven light emission) with high throughput.

[0046] Hereinafter, the above-described effect will be verified.

#### [Verification 1]

[0047] A light emitting layer was formed in such a manner that ink (coating solution) containing an organic EL material was coated onto a glass substrate instead of the film base material **110** using the inkjet applicator **30**. A polymer white light emitting material SCW 140 (having a solid content concentration of 7% and a viscosity of 5 cp) manufactured by Sumitomo Chemical Co., Ltd. was used as an ink and the thickness of the light emitting layer after drying was set to 70 nm. A vertical vibration was applied to the glass substrate when coating the ink thereon. In the present verification, uneven emission luminance (uneven light emission) was visually checked for by irradiating UV rays from an UV lamp to the light emitting layer.

[0048] According to this verification, the emission luminance was uneven at a vertical vibration amount (highest position minus lowest position) of 130  $\mu\text{m}$  (displacement

amount of  $\pm 65 \mu\text{m}$ ) and the emission luminance was even at a vertical vibration amount of  $70 \mu\text{m}$  (displacement amount  $\pm 35 \mu\text{m}$ ) and a vertical vibration amount of  $40 \mu\text{m}$  ( $\pm 20 \mu\text{m}$ ). From this, it could be understood that the uneven emission luminance is reduced at a vertical vibration amount of  $70 \mu\text{m}$  or less, desirably  $40 \mu\text{m}$  or less, in other words, a vertical displacement amount of  $\pm 35 \mu\text{m}$  or less, desirably  $\pm 20 \mu\text{m}$  or less.

[Verification 2]

[0049] According to the manufacturing method shown in FIGS. 1 and 2, the PEN film base material 110 having a thickness of  $125 \mu\text{m}$  and a width  $W_f$  of  $320 \text{ mm}$  was horizontally conveyed. At that time, comparison verification was performed between a case of performing the air floating using the air floating stage 20 and a case of not performing the air floating. The verification conditions in the case of performing the air floating were as below.

[0050] Air blowing flow rate:  $3 \times 10^{-4} \text{ L}/(\text{cm}^2 \cdot \text{sec})$  (Air flow speed conversion:  $0.003 \text{ m/sec}$ )

[0051] Gap between Air Floating Stage 20 and Film Base Material 110:  $50 \mu\text{m}$

[0052] Further, the other common verification conditions were as below.

[0053] Conveying Speed of Film Base Material 110:  $6 \text{ m/min}$

[0054] Tension Applied in Conveying Direction of Film Base Material 110:  $30 \text{ N}$

[0055] In the present verification, the vertical displacement amount of the film base material 110 was measured by measuring the vertical position of the film base material 110 at intervals of  $1 \text{ msec}$  for  $20 \text{ seconds}$  using a laser displacement sensor instead of the inkjet applicator 30. Verification results are shown in FIG. 4.

[0056] According to FIG. 4, in the case of not performing the air floating using the air floating stage 20, the vertical vibration amount (highest position minus lowest position) was  $315 \mu\text{m}$  as shown in a curve 51. In contrast, in the case of performing the air floating using the air floating stage 20, the vertical vibration amount was reduced to  $17 \mu\text{m}$  as shown in a curve 50.

[0057] From both the verification 1 and the verification 2, it was verified that the uneven emission luminance could be reduced by the air floating using the air floating stage 20.

[0058] The invention is not limited to the above-described embodiment and can be modified into various forms. For example, in the embodiment, a step of coating the light emitting layer of the organic EL panel including the light emitting layer (functional layer) between a pair of electrodes has been exemplified. However, features of the invention can also be applied to steps of coating functional layers containing various organic materials, such as a hole injection layer, a hole transport layer, an electron transport layer, and an electron injection layer of various organic EL panels below.

[0059] a) Anode/Light Emitting Layer/Cathode

[0060] b) Anode/Hole Injection Layer/Light Emitting Layer/Cathode

[0061] c) Anode/Hole Injection Layer/Light Emitting Layer/Electron Injection Layer/Cathode

[0062] d) Anode/Hole Injection Layer/Light Emitting Layer/Electron Transport Layer/Electron Injection Layer/Cathode

[0063] e) Anode/Hole Injection Layer/Hole Transport Layer/Light Emitting Layer/Cathode

[0064] f) Anode/Hole Injection Layer/Hole Transport Layer/Light Emitting Layer/Electron Injection Layer/Cathode

[0065] g) Anode/Hole Injection Layer/Hole Transport Layer/Light Emitting Layer/Electron Transport Layer/Electron Injection Layer/Cathode

[0066] h) Anode/Light Emitting Layer/Electron Injection Layer/Cathode

[0067] i) Anode/Light Emitting Layer/Electron Transport Layer/Electron Injection Layer/Cathode

[0068] Here, the sign “/” indicates a state where layers which are adjacent to each other with the sign “/” interposed therebetween are laminated on each other.

[0069] For example, in a case of a step of coating the hole injection layer 105 shown in FIG. 5, the ink (coating solution) containing the organic EL material for the light emitting layer in the step of coating the light emitting layer may be replaced by the ink (coating solution) containing the organic material for the hole injection layer. In a step of coating the hole transport layer 106 shown in FIG. 5, the ink (coating solution) containing the organic EL material for the light emitting layer in the step of coating the light emitting layer may be replaced by the ink (coating solution) containing the organic material for the hole transport layer and further the film base material 110 may be replaced by the film base material including the substrate 101, the anode layer 102, and the hole injection layer 105. In a step of coating the light emitting layer 103 shown in FIG. 5, the film base material 110 may be replaced by the film base material including the substrate 101, the anode layer 102, the hole injection layer 105, and the hole transport layer 106. In a step of coating the electron transport layer 107 shown in FIG. 5, the ink (coating solution) containing the organic EL material for the light emitting layer in the step of coating the light emitting layer may be replaced by the ink (coating solution) containing the organic material for the electron transport layer and further the film base material 110 may be replaced by the film base material including the substrate 101, the anode layer 102, the hole injection layer 105, the hole transport layer 106, and the light emitting layer 103. In a step of coating the electron injection layer 108 shown in FIG. 5, the ink (coating solution) containing the organic EL material for the light emitting layer in the step of coating the light emitting layer may be replaced by the ink (coating solution) containing the organic material for the electron injection layer and further the film base material 110 may be replaced by the film base material including the substrate 101, the anode layer 102, the hole injection layer 105, the hole transport layer 106, the light emitting layer 103, and the electron transport layer 107.

[0070] In the embodiment, as a method for manufacturing the organic EL panel, a manufacturing method in which the anode layer is disposed on the substrate side relative to the light emitting layer and the cathode layer is disposed on the opposite side to the substrate relative to the light emitting layer has been exemplified. However, features of the invention can be also applied to a manufacturing method in which the cathode layer is disposed on the substrate side relative to the light emitting layer and the anode layer is disposed on the opposite side to the substrate relative to the light emitting layer.

[0071] Features of the invention can be also applied to a manufacturing method in which a barrier layer is formed on any one of or both surfaces of the film base material.

[0072] In the embodiment, porous carbon has been exemplified as the material of the air floating stage, but various porous materials capable of blowing air can be employed.

[0073] In the embodiment, various conditions such as the air blowing flow rate, the number, the size, and the intervals of the air floating stages, the gap between the air floating stage and the film base material, and the tension applied in the conveying direction of the film base material have been exemplified. However, these conditions are set by assuming a PEN film base material having a thickness of 125  $\mu\text{m}$  and a width of 320 mm. When at least one of the size and the material of the film base material is greatly changed, these conditions may be appropriately changed so that the vertical vibration amount of the film base material becomes equal to or smaller than 70  $\mu\text{m}$ , in other words, the vertical displacement amount becomes equal to or smaller than  $\pm 35$

#### REFERENCE SIGNS LIST

[0074] 10 Unwinding roller  
 [0075] 11, 12, 14 Conveying roller  
 [0076] 13 Winding roller  
 [0077] 15 Backup roller (conveying roller)  
 [0078] 20 Air floating stage  
 [0079] 30 Inkjet applicator  
 [0080] 30X Slit coat applicator  
 [0081] 100 Organic EL panel  
 [0082] 101 Substrate  
 [0083] 102 Anode layer  
 [0084] 103 Light emitting layer  
 [0085] 104 Cathode layer  
 [0086] 105 Hole injection layer  
 [0087] 106 Hole transport layer  
 [0088] 107 Electron transport layer  
 [0089] 108 Electron injection layer  
 [0090] 110 Film base material (base material).

1. A method for manufacturing an organic EL panel including a functional layer including at least a light emitting layer containing an organic material, comprising:

a coating step of forming the functional layer by horizontally conveying a base material having flexibility using a roll-to-roll process and coating a coating solution containing the organic material onto the base material using an inkjet applicator disposed above the base material,

wherein in the coating step, the base material is floated by air using an air floating stage disposed below the base material and the coating solution is coated onto the base material.

2. The method for manufacturing the organic EL panel according to claim 1, wherein the air floating stage is formed of a porous material.

3. The method for manufacturing the organic EL panel according to claim 1, wherein a vertical vibration amount of the base material is equal to or smaller than 70  $\mu\text{m}$ .

4. The method for manufacturing the organic EL panel according to claim 3, wherein a gap between the air floating stage and the base material is equal to or larger than 30  $\mu\text{m}$  and equal to or smaller than 1 mm.

5. The method for manufacturing the organic EL panel according to claim 3, wherein a viscosity of the coating solution is equal to or larger than 1 cp and equal to or smaller than 20 cp.

6. The method for manufacturing the organic EL panel according to claim 3, wherein a tensile force of the base material is equal to or larger than 20 N and equal to or smaller than 150 N.

7. The method for manufacturing the organic EL panel according to claim 3, wherein an air flow speed generated by the air floating stage is equal to or greater than 0.001 msec and equal to or less than 0.3 msec.

8. The method for manufacturing the organic EL panel according to claim 2, wherein a vertical vibration amount of the base material is equal to or smaller than 70  $\mu\text{m}$ .

9. The method for manufacturing the organic EL panel according to claim 8, wherein a gap between the air floating stage and the base material is equal to or larger than 30  $\mu\text{m}$  and equal to or smaller than 1 mm.

10. The method for manufacturing the organic EL panel according to claim 8, wherein a viscosity of the coating solution is equal to or larger than 1 cp and equal to or smaller than 20 cp.

11. The method for manufacturing the organic EL panel according to claim 8, wherein a tensile force of the base material is equal to or larger than 20 N and equal to or smaller than 150 N.

12. The method for manufacturing the organic EL panel according to claim 8, wherein an air flow speed generated by the air floating stage is equal to or greater than 0.001 msec and equal to or less than 0.3 msec.

\* \* \* \* \*

|                |                                                                                                                                                         |         |            |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|---------|------------|
| 专利名称(译)        | 制造有机EL板的方法                                                                                                                                              |         |            |
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| [标]申请(专利权)人(译) | 住友化学有限公司                                                                                                                                                |         |            |
| 申请(专利权)人(译)    | 住友化学公司                                                                                                                                                  |         |            |
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| 优先权            | 2015001579 2015-01-07 JP                                                                                                                                |         |            |
| 其他公开文献         | US10686162                                                                                                                                              |         |            |
| 外部链接           | <a href="#">Espacenet</a> <a href="#">USPTO</a>                                                                                                         |         |            |

摘要(译)

公开了一种用于制造能够降低不均匀发光亮度（不均匀发光）的有机EL面板的方法。根据本发明实施方案的制造有机EL面板的方法是制造包括功能层的有机EL面板的方法，所述功能层至少包括含有有机材料的发光层，包括通过以下方式形成功能层的涂布步骤使用卷对卷工艺水平输送具有挠性的基材（110），并使用含有有机材料的涂料溶液涂覆到基材上（110）。喷墨涂布器（30）设置在基材上方（110），其中在涂布步骤中，基材（110）通过以下方式漂浮：使用设置在基材（110）下方的气浮台（20）的空气，将涂料溶液涂在基材上（110）。

