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(54) **ORGANIC EL PANEL**

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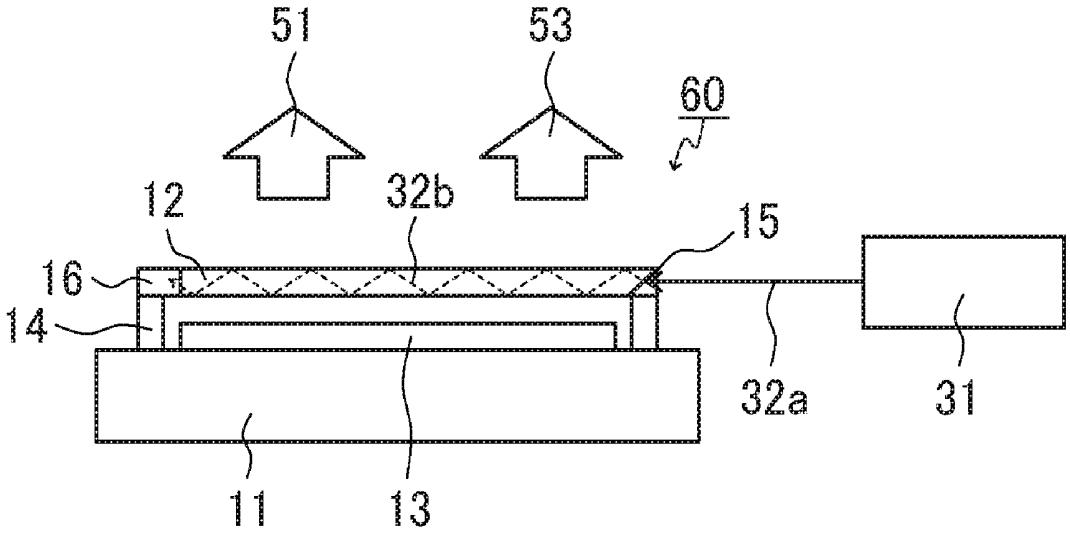
(57) **ABSTRACT**

The present invention provides a novel organic EL panel adapted to be color tunable by a user, for example. An organic EL panel **10** of the present invention includes: a first substrate **11**; a second substrate **12**; an organic EL element **13**; and a sealing layer **14**. One surface of the first substrate **11** is a mounting surface on which the organic EL element **13** is disposed. The first substrate **11** and the second substrate **12** are laminated in such a manner that the mounting surface of the first substrate **11** and one surface of the second substrate **12** face each other with the sealing layer **14** interposed therebetween. The sealing layer **14** seals a gap between the first substrate **11** and the second substrate **12** along an entire periphery of a region where the first substrate **11** and the second substrate **12** face each other. The first substrate **11** includes a light incident section **15** on which laser light is incident and a light guide section **16** that directs the incident laser light in an in-plane direction.



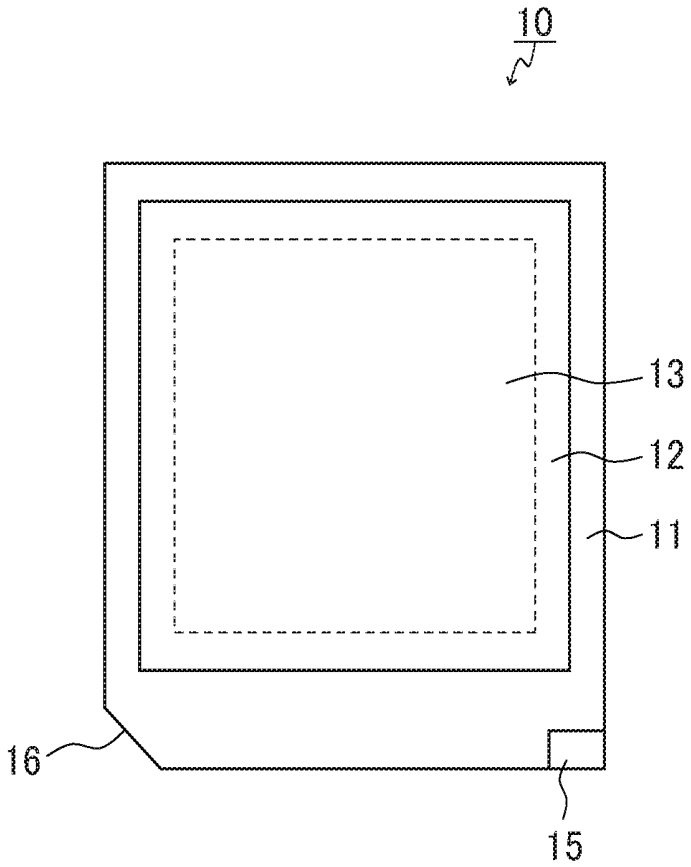


FIG. 1A

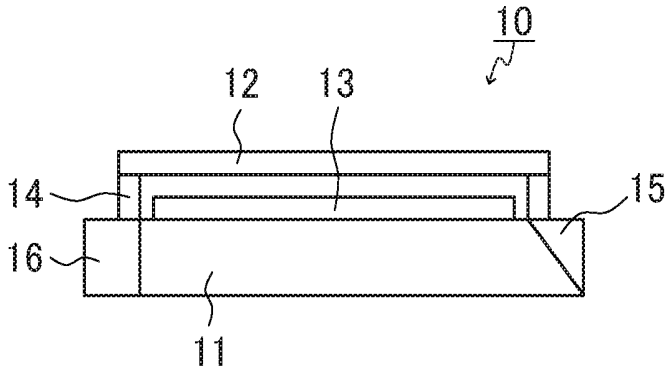


FIG. 1B

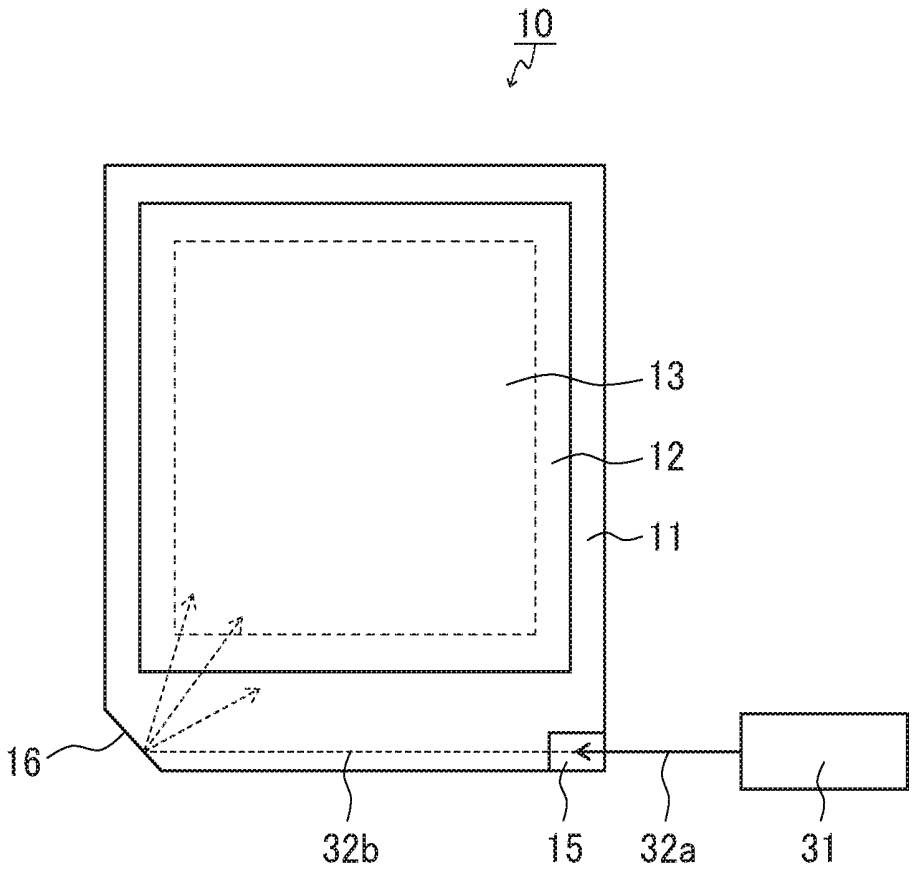


FIG. 2A

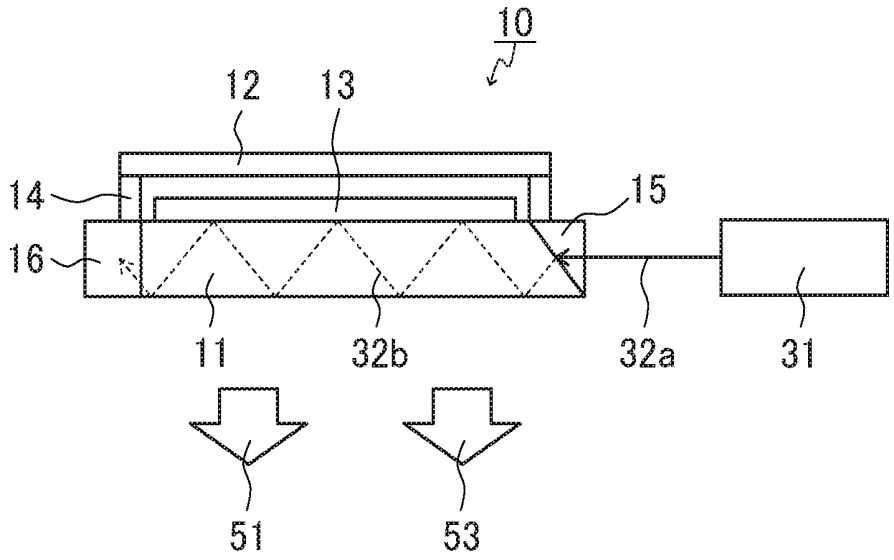


FIG. 2B

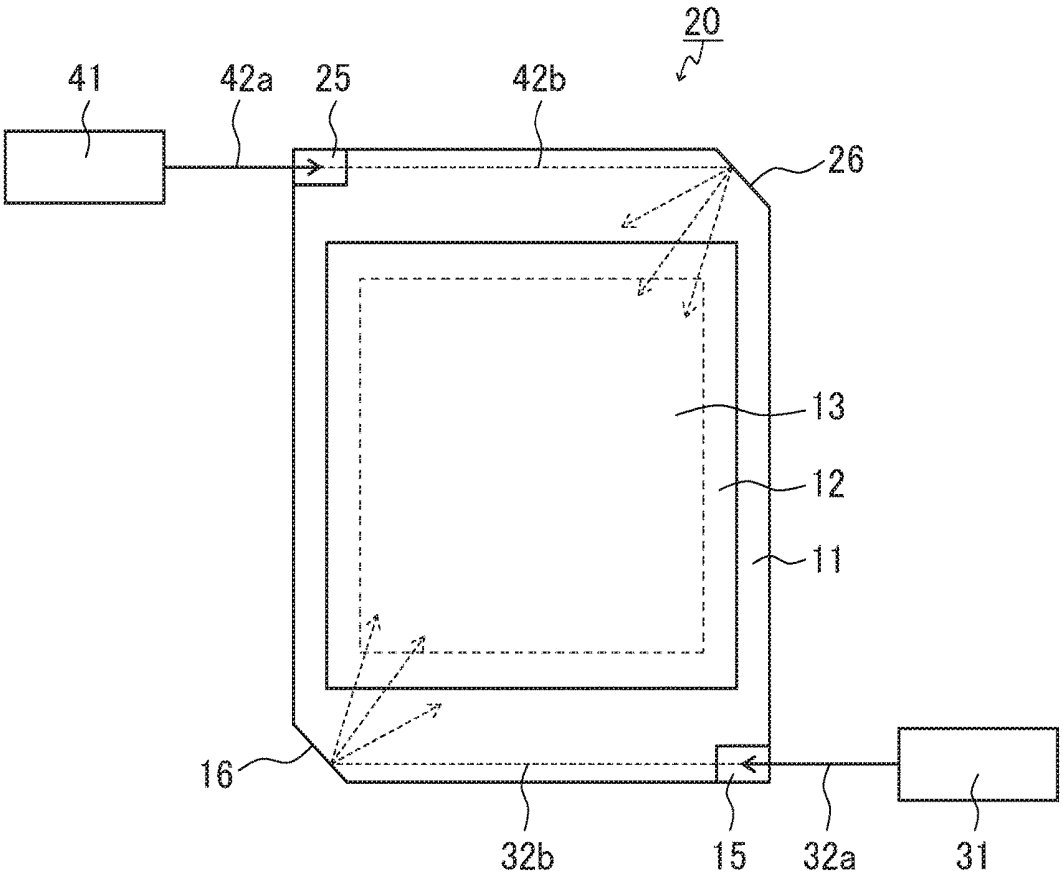

20
41
42a
25
42b
26
13
12
11
16
32b
15
32a
31

FIG. 3

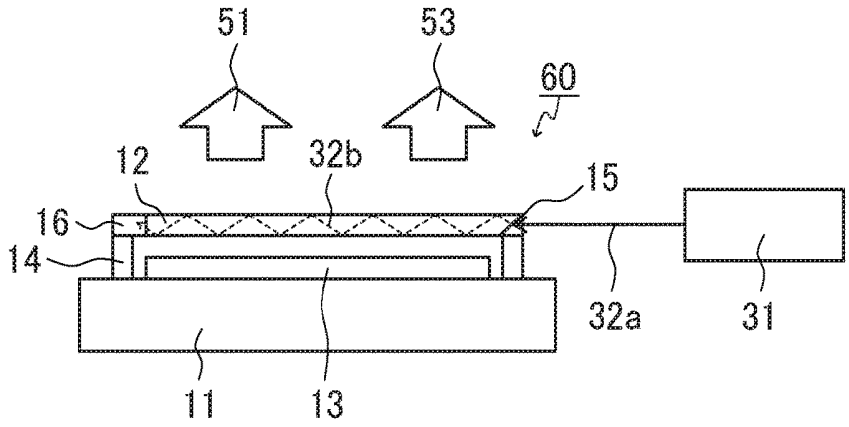

51
53
60
12
32b
15
16
14
32a
31
11
13

FIG. 4

ORGANIC EL PANEL

TECHNICAL FIELD

[0001] The present invention relates to an organic EL panel.

BACKGROUND ART

[0002] An organic electro-luminescence (EL) panel is a self-emitting panel provided with an organic EL element (organic EL layer), and can be used as a lighting device, a light source, or a display device, for example. The emission color of the organic EL panel is determined by the material of the organic EL layer (light emission layer). Thus, when the organic EL panel is in practical use, the emission color is fixed already. On this account, it is generally impossible for a user to adjust the emission color (to perform color tuning) of the organic EL panel.

[0003] Under these circumstances, there has been proposed an organic EL panel configured so that organic EL layers for red, green, and blue (RGB) are formed separately, and color adjustment is achieved by adjusting the balance among the emission intensities of RGB (Patent Document 1).

CITATION LIST

Patent Document(s)

[0004] Patent Document 1: JP H2(1990)-44392 A

BRIEF SUMMARY OF THE INVENTION

Problem to be Solved by the Invention

[0005] However, in the organic EL panel with the above-described RGB separation structure, it is necessary to provide the RGB light emission layers separately. The aperture ratio is thus restricted, so that it is difficult to increase the amount of luminous flux emitted from the light emission surface of the organic EL panel. One possible method for increasing the amount of luminous flux is to increase the driving current. This, however, shortens the life of the organic EL panel.

[0006] With the foregoing in mind, it is an object of the present invention to provide a novel organic EL panel adapted to be color tunable by a user, for example.

Means for Solving Problem

[0007] In order to achieve the above object, the present invention provides an organic EL panel including: a first substrate; a second substrate; at least one organic EL element; and a sealing layer, wherein one surface of the first substrate is a mounting surface on which the at least one organic EL element is disposed, the first substrate and the second substrate are laminated in such a manner that the mounting surface of the first substrate and one surface of the second substrate face each other with the sealing layer interposed therebetween, the sealing layer seals a gap between the first substrate and the second substrate along an entire periphery of a region where the first substrate and the second substrate face each other, and at least one of the first substrate and the second substrate includes at least one light incident section on which laser light is incident and at least one light guide section that directs the incident laser light in an in-plane direction.

Effects of the Invention

[0008] The present invention can provide a novel organic EL panel adapted to be color tunable by a user, for example.

BRIEF DESCRIPTION OF DRAWINGS

[0009] FIG. **1**A is a plan view showing an example of the configuration of an organic EL panel according to a first embodiment. FIG. **1**B is a side view of the organic EL panel shown in FIG. **1**A, as viewed from the side of a side surface connecting the light incident section and the light guide section.

[0010] FIGS. **2**A and **2**B illustrate the movement of light in the organic EL panel shown in FIGS. **1**A and **1**B.

[0011] FIG. **3** is a plan view showing an example of the configuration of an organic EL panel according to a second embodiment.

[0012] FIG. **4** is a side view showing an example of the configuration of an organic EL panel according to a third embodiment.

MODE FOR CARRYING OUT THE INVENTION

[0013] The organic EL panel of the present invention will be described specifically below with reference to the accompanying drawings. It is to be noted, however, that the present invention is by no means limited by the following description. In FIGS. **1** to **4** to be described below, the same components are given the same reference numerals, and duplicate explanations thereof may be omitted. Also, in the drawings, the structure of each component may be shown in an simplified form as appropriate for the sake of convenience in illustration, and also, each component may be shown schematically with a dimension ratio and the like that are different from the actual dimension ratio and the like.

First Embodiment

[0014] The present embodiment is directed to an example of an organic EL panel configured so that a first substrate has one light incident section and one light guide section. FIGS. **1**A and **1**B show an organic EL panel of the present embodiment. FIG. **1**A is a plan view showing an example of the configuration of an organic EL panel of the present embodiment. FIG. **1**B is a side view of the organic EL panel shown in FIG. **1**A, as viewed from the side of a side surface connecting a light incident section and a light guide section. As shown in FIGS. **1**A and **1**B, the organic EL panel **10** of the present embodiment includes a first substrate **11**, a second substrate **12**, an organic EL element **13**, and a sealing layer **14**. One surface of the first substrate **11** (the upper surface in FIG. **1**B) is a mounting surface on which the organic EL element **13** is disposed. The first substrate **11** and the second substrate **12** are laminated in such a manner that the mounting surface of the first substrate **11** and one surface of the second substrate **12** (the lower surface in FIG. **1**B) face each other with the sealing layer **14** interposed therebetween. The sealing layer **14** seals a gap between the first substrate **11** and the second substrate **12** along an entire periphery of a region where the first substrate **11** and the second substrate **12** face each other. The first substrate **11** has a light incident section **15** on which laser light is incident

and a light guide section **16** that directs the incident laser light in an in-plane direction. The organic EL panel **10** of the present embodiment is configured so as to include one light incident section **15** and one light guide section **16**. The details of the light incident section **15** and the light guide section **16** are described below. While the organic EL panel **10** shown in FIGS. **1**A and **1**B is substantially rectangular, the shape of the organic EL panel of the present invention is not limited thereto. For example, the shape of the organic EL panel of the present invention may be a substantially polygonal shape other than the substantially rectangular shape, such as a substantially parallelogram shape (including a substantially square shape and a substantially rhombic shape) other than the substantially rectangular shape, a substantially trapezoidal shape, a substantially pentagonal shape, or a substantially hexagonal shape.

[0015] The material of the first substrate **11** is not limited as long as it has a light-transmitting property sufficient to allow light emitted from the organic EL element **13** and laser light to be radiated to the outside of the organic EL panel **10**. Examples of the material of the first substrate **11** include: glass such as alkali-free glass, soda-lime glass, borosilicate glass, aluminosilicate glass, and quartz glass; and polyester resins such as polyethylene naphthalate and polyethylene terephthalate. Preferably, the first substrate **11** is formed of glass. The size (the length and the width) of the first substrate **11** is not particularly limited, and can be set as appropriate depending on a desired size of the organic EL panel **10**, for example. The thickness of the first substrate **11** also is not particularly limited, and can be set as appropriate depending on the material of the first substrate **11**, environment in which the first substrate **11** is used, and the like. Generally, the thickness of the first substrate **11** is 1 mm or less.

[0016] The position at which the light incident section **15** is disposed is not particularly limited. Preferably, as shown in FIG. **1**A, the light incident section **15** is disposed at a corner of the side surface of the first substrate **11** (the lower right corner in FIG. **1**A). The light incident section **15** may have any mechanism as long as it allows laser light to be incident on the first substrate **11** from the outside of the panel **10**. Preferably, as shown in FIG. **1**B, the light incident section **15** is a Brewster window (a plane inclined at a Brewster's angle). The Brewster's angle is an angle of incidence at which the reflectance of p-polarized light incident on an interface between two substances with different refractive indices is 0 (zero), and is represented by Equation (1). In Equation (1), n_1 indicates the refractive index of a substance on the light incident side, and n_2 indicates the refractive index of a substance on the light transmission side. For example, when light in the air with a refractive index of 1 is incident on glass with a refractive index of 1.5, the Brewster's angle θ_B is about 56°. When the light incident section **15** is the Brewster window, the loss due to the surface reflection is reduced, whereby the incident efficiency of the laser light on the first substrate **11** is improved. The size of the Brewster window is not particularly limited. Since laser light emitted outside the panel **10** can be converged by an optical system before it is incident on the Brewster window, the size of the Brewster window may be at least a few tenths of millimeters in lengthwise and crosswise, for example.

$$\text{Brewster's angle } \theta_B = \arctan(n_2/n_1) \quad (1)$$

[0017] The light guide section **16** may be disposed at any position in the first substrate **11**, as long as it can direct the laser light incident on the first substrate **11** in an in-plane direction. In the organic EL panel **10** of the present embodiment, it is preferable that, as shown in FIG. **1**A, the light incident section **15** causes the incident laser light to enter from the corner at which the light incident section **15** is disposed (the lower right corner in FIG. **1**A) toward an adjacent corner of the side surface of the first substrate **11** (the lower left corner in FIG. **1**A) and the first substrate **11** has the light guide section **16** at the adjacent corner of the side surface of the first substrate **11** (the lower left corner in FIG. **1**A).

[0018] The light guide section **16** may have any mechanism as long as it can direct the laser light incident on the first substrate **11** in an in-plane direction. For example, the light guide section **16** may have a light reflecting mechanism or a light scattering mechanism. In the organic EL panel **10** shown in FIGS. **1**A and **1**B, the light guide section **16** is an inclined plane having a light reflecting mechanism. The light reflecting mechanism is not limited to the inclined plane, and may be any mechanism such as a reflecting mirror, for example. The light scattering mechanism may be any mechanism, such as a roughened surface of the first substrate **11**, for example. The light guide section **16** may have the light reflecting mechanism only, the light scattering mechanism only, or may have both the light reflecting mechanism and the light scattering mechanism.

[0019] As the organic EL element **13**, a conventionally known and commonly used organic EL element may be used. The organic EL element **13**, which includes an organic EL layer and a pair of electrodes, is a laminate in which an electrode layer as one of the pair of electrodes, the organic EL layer, and another electrode layer as the other one of the pair of electrodes are laminated in this order, for example. The pair of electrodes is the combination of an anode layer and a cathode layer, for example. The anode layer is a transparent electrode formed of indium tin oxide (ITO) or the like, for example. The cathode layer is a counter electrode formed of a metal or the like, for example. The organic EL layer has a multilayer structure including, in sequence, a hole injection layer, a hole transport layer, a light emission layer containing an organic EL material, an electron transport layer, and an electron injection layer, for example. The organic EL panel shown in FIGS. **1**A and **1**B is of bottom emission type, for example. In the organic EL panel of bottom emission type, it is preferable that, for example, the organic EL element **13** is a laminate in which the transparent electrode (anode), the organic EL layer, and the counter electrode (cathode) are laminated in this order from the first substrate **11** side. Although FIGS. **1**A and **1**B show an example where one organic EL element **13** is disposed in a central portion on the mounting surface of the first substrate **11**, the organic EL panel **10** of the present embodiment is not limited to this example, and a plurality of (two or more) organic EL elements may be disposed on the mounting surface of the first substrate **11**. The emission color of the organic EL element **13** is not particularly limited. For example, when the organic EL panel **10** is used as a general interior lighting device, the emission color of the organic EL element **13** may be white or the like. When the organic EL panel **10** is used as a design-oriented lighting device or an automobile lighting device, the emission color of the organic EL element **13** may be white, red (R), or the like.

[0020] The second substrate **12** is a sealing substrate for shielding the organic EL element **13** from the surrounding atmosphere. The second substrate **12** is not limited as long as it can shield the organic EL element **13** from the surrounding atmosphere. For example, sealing glass can be used as the second substrate **12**. The size (length and width) of the second substrate **12** is not particularly limited, and may be adjusted as appropriate so as to be substantially the same as or slightly smaller than the size of the first substrate **11**, for example. The thickness of the second substrate **12** also is not particularly limited. For example, the thickness of the second substrate **12** is in the range from 0.5 to 1 mm.

[0021] The sealing layer **14** is formed by, for example, applying an adhesive along the outer edge of one surface of the second substrate **12** (the lower surface in FIG. **1**B). The adhesive is not particularly limited. For example, an ultraviolet (UV) curable resin or the like can be used suitably as the adhesive. The sealing layer **14** is formed so as to be slightly thicker than the organic EL element **13**. For example, the thickness thereof is in the range from 0.1 to 100 μm.

[0022] Next, with reference to FIGS. **2**A and **2**B, the movement of light in the organic EL panel shown in FIGS. **1**A and **1**B will be described. As shown in FIGS. **2**A and **2**B, the organic EL panel **10** of the present embodiment is used with a laser **31** disposed near the light incident section **15**. The laser **31** emits light having a color different from the color of light emitted from the organic EL element **13**. The emission color of the laser **31** is not particularly limited as long as it is different from the emission color of the organic EL element **13**, and may be any color such as red (R), green (G), or blue (B), for example.

[0023] As indicated with a solid-line arrow **32***a* in FIGS. **2**A and **2**B, light emitted from the laser **31** travels in the air toward the light incident section **15**. Then, as indicated with a dashed-line arrow **32***b* in FIG. **2**B, the laser light that has reached the light incident section **15** travels toward the light guide section **16** while being reflected repeatedly from the lower surface and the upper surface of the first substrate **11**. Then, as shown in FIG. **2**A, the laser light is directed in an in-plane direction by being reflected from the light guide section **16**. Subsequently, as indicated with a thick arrow **51** in FIG. **2**B, the laser light directed in the in-plane direction is radiated in the air outside the organic EL panel **10** from the other surface of the first substrate **11** (the lower surface in FIG. **2**B). At this time, emitted light **53** from the organic EL element **13** is mixed with the laser light **51**, whereby color tuning is achieved. The laser light **32***b* traveling inside the first substrate **11** is intended to be radiated in the air outside the organic EL panel **10** from the first substrate **11** in the end. Thus, the first substrate **11** preferably is configured so that a side surface, a corner, or the like facing the light guide section **16** has a light scattering mechanism, such as a roughened surface of the first substrate **11**.

[0024] According to the organic EL panel **10** of the present embodiment, it becomes possible for a user to adjust the emission color (to perform color tuning) of the organic EL panel **10** by selecting the laser **31** with emission color necessary for the color tuning, for example. Furthermore, according to the organic EL panel **10** of the present embodiment, the aperture ratio is not restricted, so that a larger amount of luminous flux is emitted from the light emission surface (the lower surface of the first substrate **11** in FIG. **2**B), as compared with the organic EL panel with the above-described RGB separation structure.

[0025] The organic EL panel **10** of the present embodiment can be used in a wide range of applications, such as a lighting device of bottom emission type, a light source, and a display device, for example.

Second Embodiment

[0026] The present embodiment is directed to an example of an organic EL panel configured so that a first substrate includes two light incident sections and two light guide sections. FIG. **3** is a plan view showing an example of the configuration of an organic EL panel of the present embodiment. As shown in FIG. **3**, an organic EL panel **20** of the present embodiment has the same configuration as the organic EL panel **10** of the first embodiment, except that the first substrate **11** further includes a second light incident section **25** and a second light guide section **26** and that the organic EL panel **20** is used with, in addition to the laser **31**, a second laser **41** disposed near the second light incident section **25**. The second light incident section **25** has the same shape and mechanism as the light incident section **15**, and the second light guide section **26** has the same shape and mechanism as the light guide section **16**. The second light incident section **25** is disposed at a corner facing the light incident section **15**, and the second light guide section **26** is disposed at a corner facing the light guide section **16**. It is to be noted, however, that the organic EL panel **20** of the present embodiment is not limited to this example, and the positions of the second light incident section **25** and the second light guide section **26** are interchangeable. The second laser **41** has the same configuration as the laser **31**, except that it emits light having a color different from the colors of lights emitted from the organic EL element **13** and the laser **31**.

[0027] As indicated with a solid-line arrow **42***a* in FIG. **3**, light emitted from the second laser **41** travels in the air toward the second light incident section **25**. Then, as indicated with a dashed-line arrow **42***b* in FIG. **3**, the laser light that has reached the second light incident section **25** travels toward the second light guide section **26** and is directed in an in-plane direction by being reflected from the second light guide section **26**. The laser light directed in the in-plane direction is radiated in the air outside the organic EL panel **20** from the other surface of the first substrate **11**. Thus, according to the organic EL panel **20** of the present embodiment, it is possible to mix three emission colors, namely, the emission color of the organic EL element **13**, the emission color of the laser **31**, and the emission color of the second laser **41**.

[0028] When the organic EL panel of the present invention is formed in a substantially hexagonal shape, a substantially octagonal shape, or the like, for example, it becomes possible to mix three or more colors with the emission color of the organic EL element by providing three or more light incident sections and light guide sections on the first substrate and using the organic EL panel with three or more lasers.

Third Embodiment

[0029] The present embodiment is directed to an example of an organic EL panel configured so that a second substrate includes one light incident section and one light guide

section. FIG. **4** shows an example of the configuration of an organic EL panel of the present embodiment. FIG. **4** is a side view of an organic EL panel **60** of the present embodiment, as viewed from the side of a side surface connecting a light incident section and a light guide section. As shown in FIG. **4**, the organic EL panel **60** of the present embodiment has the same configuration as the organic EL panel **10** of the first embodiment, except that, instead of the first substrate **11**, the second substrate **12** includes the light incident section **15** and the light guide section **16**. The organic EL panel shown in FIG. **4** is of top emission type, for example. In the organic EL panel of top emission type, it is preferable that, for example, the organic EL element **13** is a laminate in which the counter electrode (cathode), the organic EL layer, and the transparent electrode (anode) are laminated in this order from the first substrate **11** side. According to the organic EL panel **60** of the present embodiment, laser light **51** and emitted light **53** from the organic EL element **13** can be radiated from the upper side of the panel **60**. The organic EL panel **60** of the present embodiment can be used in a wide range of applications, such as a lighting device of top emission type, a light source, and a display device, for example.

[0030] Also in the organic EL panel of the present embodiment, it is possible to mix two or more colors with the emission color of the organic EL element by providing two or more light incident sections and light guide sections on the second substrate in the same manner as they are provided on the first substrate in the second embodiment and using the organic EL panel with two or more lasers.

[0031] The first to third embodiments are directed to illustrative examples where the organic EL panel is configured so that either of the first substrate and the second substrate has the light incident section(s) and the light guide section(s). It should be noted, however, that the organic EL panel of the present invention may be configured so that both the first substrate and the second substrate has the light incident section(s) and the light guide section(s).

[0032] While the present invention has been described above with reference to exemplary embodiments, the present invention is by no means limited thereto. Various changes and modifications that may become apparent to those skilled in the art may be made in the configuration and specifics of the present invention without departing from the scope of the present invention.

[0033] This application claims priority from Japanese Patent Application No. 2015-105785 filed on May 25, 2015. The entire disclosure of this Japanese patent application is incorporated herein by reference.

INDUSTRIAL APPLICABILITY

[0034] The present invention can provide a novel organic EL panel adapted to be color tunable by a user, for example. The organic EL panel of the present invention can be used in a wide range of applications, such as a lighting device of bottom emission type, top emission type, or the like, a light source, and a display device, for example.

EXPLANATION OF REFERENCE NUMERALS

[0035] **10**, **20**, **60**: organic EL panel
[0036] **11**: first substrate
[0037] **12**: second substrate
[0038] **13**: organic EL element
[0039] **14**: sealing layer
[0040] **15**, **25**: light incident section
[0041] **16**, **26**: light guide section
[0042] **31**, **41**: laser
[0043] **32***a*, **32***b*, **42***a*, **42***b*, **51**: laser light
[0044] **53**: emitted light from organic EL

1. An organic EL panel comprising:
a first substrate;
a second substrate;
at least one organic EL element; and
a sealing layer,
wherein one surface of the first substrate is a mounting surface on which the at least one organic EL element is disposed,
the first substrate and the second substrate are laminated in such a manner that the mounting surface of the first substrate and one surface of the second substrate face each other with the sealing layer interposed therebetween,
the sealing layer seals a gap between the first substrate and the second substrate along an entire periphery of a region where the first substrate and the second substrate face each other, and
at least one of the first substrate and the second substrate comprises at least one light incident section on which laser light is incident and at least one light guide section that directs the incident laser light in an in-plane direction.

2. The organic EL panel according to claim **1**, wherein
the light incident section has a Brewster's angle.

3. The organic EL panel according to claim **1**, wherein
the light guide section has at least one of a light reflecting mechanism and a light scattering mechanism.

4. The organic EL panel according to claim **1**, wherein
at least one of the first substrate and the second substrate has the light incident section at a corner of a side surface thereof.

5. The organic EL panel according to claim **4**, wherein
the light incident section causes the incident laser light to travel from the corner at which the light incident section is disposed toward at least one adjacent corner on the side surface of the at least one of the first substrate and the second substrate.

6. The organic EL panel according to claim **5**, wherein
at least one of the first substrate and the second substrate has the light guide section at least one adjacent corner on the side surface of the at least one of the first substrate and the second substrate.

7. The organic EL panel according to claim **1**, wherein
the organic EL panel comprises two or more light incident sections as the at least one light incident section and two or more light guide sections as the at least one light guide section,
the light incident sections are provided at different corners of at least one of the first substrate and the second substrate, respectively, and
the light guide sections are provided at different corners of the at least one of the first substrate and the second substrate, respectively.

8. The organic EL panel according to claim **1**, wherein
at least one of the first substrate and the second substrate is a glass substrate.

9. The organic EL panel according to claim **1**, wherein the organic EL element comprises an organic EL layer and a pair of electrodes.

10. The organic EL panel according to claim **9**, wherein the organic EL element is a laminate in which an electrode layer as one of the pair of electrodes, the organic EL layer, and another electrode layer as the other one of the pair of electrodes are laminated in this order and the electrode layer on the first substrate side is a transparent electrode, and

the first substrate has the light incident section and the light guide section.

11. The organic EL panel according to claim **9**, wherein the organic EL element is a laminate in which an electrode layer as one of the pair of electrodes, the organic EL layer, and another electrode layer as the other one of the pair of electrodes are laminated in this order and the electrode layer on the second substrate side is a transparent electrode, and

the second substrate has the light incident section and the light guide section.

* * * * *

专利名称(译)	有机el面板		
公开(公告)号	US20180151844A1	公开(公告)日	2018-05-31
申请号	US15/575990	申请日	2016-05-09
[标]申请(专利权)人(译)	NEC照明株式会社		
申请(专利权)人(译)	NEC照明有限公司.		
当前申请(专利权)人(译)	NEC照明有限公司.		
[标]发明人	AOKI YASUSHI		
发明人	AOKI, YASUSHI		
IPC分类号	H01L51/52		
CPC分类号	H01L51/5281 H01L51/5246 G02B6/0068 G02B6/0075 G02B6/0088 F21Y2101/00 F21Y2113/10 F21Y2113/20 F21Y2115/15 G02B6/0076 H01L51/0096 H01L51/5262 Y02E10/549		
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外部链接	Espacenet USPTO		

摘要(译)

例如，本发明提供了一种新颖的有机EL面板，其适于由用户调色。本发明的有机EL板 10>包括：第一基板11; 第二基板 12; 有机EL元件 13 和密封层。第一基板11的一个表面是安装表面，有机EL元件 13 处置。以使得第一基板11的安装表面和第一基板11的一个表面的方式层叠第一基板 11 和第二基板 12 。第二基板 12 彼此面对，密封层 14 介于它们之间。密封层 14 b> 11 且第二基板 12 彼此面对。第一基板 11包括入射激光的光入射部分 15 16，其引导入射的激光进入入射激光的入射部分 15 面内方向。