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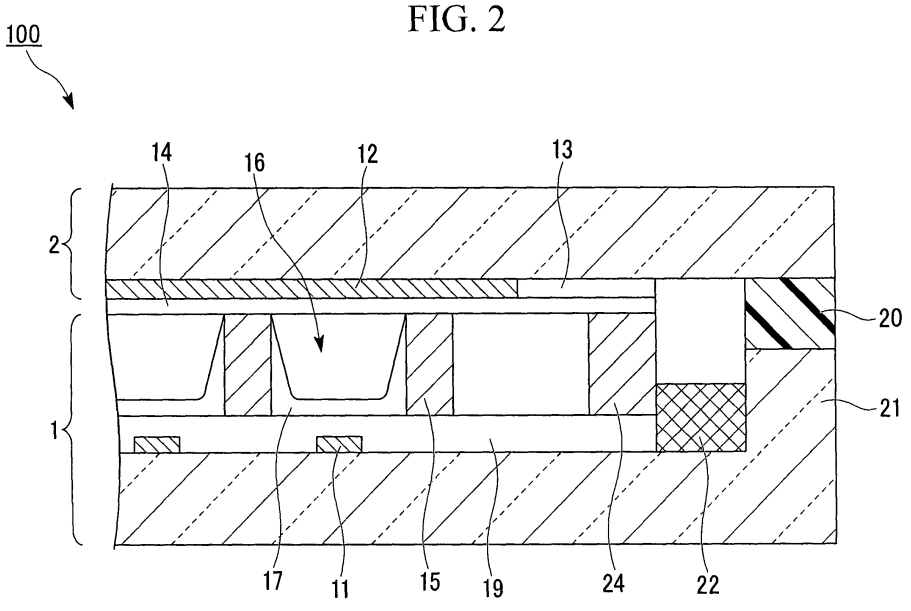
(54) METHOD FOR MANUFACTURING SEALING PANEL AND PLASMA DISPLAY PANEL

(57) A sealing panel (100) that can suppress a rise in discharge voltage is provided. The sealing panel (100) includes a resin material-containing sealing material (20) disposed on the whole periphery in a part between a pair of substrates (1, 2), wherein a getter (22), which adsorbs an impurity gas released from the sealing material (20) and an impurity gas passing through the sealing material (20), is formed continuously or intermittently along the inner periphery of the sealing material (20). Further, an ultraviolet shielding wall (24) for preventing ultraviolet light generated within the sealing panel (100) from being incident to the sealing material (20) is formed continuously along the inner periphery of the sealing material (20).

FIG. 2



EP 2 009 667 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a sealing panel and a method for producing a plasma display panel.
This application claims priority on Japanese Patent Application No. 2006-107547 filed on April 10, 2006, the contents of which are incorporated herein by reference.

BACKGROUND ART

[0002] A plasma display panel is provided with a front substrate on which a sustain electrode and a scanning electrode are formed and a rear substrate on which an address electrode and a fluorescent substance are formed. Both of these substrates are fastened by a sealing material arranged at the peripheral edge and a discharge gas is sealed between the substrates.
When voltage is applied across these electrodes, the discharge gas is plasmized to emit ultraviolet light. The ultraviolet light is made incident to a fluorescent substance, thereby exciting the fluorescent substance to emit visible light.

[0003] Conventionally, a low-melting point glass was used as a sealing material for both of the substrates. However, in recent years, there has been proposed a technology in which resin materials are employed (refer to Patent Document 1, for example). Employing resin materials allows wider heating and cooling conditions to be used in sealing panels, thus making it possible to greatly reduce the amount of time needed to produce panels.
Patent Document 1: Japanese Unexamined Patent Application, First Publication No. 2002-75197.

DISCLOSURE OF THE INVENTION

Problem to be Solved by the Invention

[0004] However, when a resin material is employed as a sealing material, there is a concern that an impurity gas (such as water or carbon dioxide gas) may be released from the resin material into the panel. Further, when a mixture of a low-melting point glass with a resin material as a binder is used as a sealing material, there is a concern that an impurity gas may be released into the panel during sealing of the panel. Still further, there is a concern that after a panel is sealed, an impurity gas may make an intrusion into the panel through the sealing material from outside. In addition, when ultraviolet light generated inside the panel is made incident into the sealing material, the resin material may be decomposed to release an impurity gas (CH-based gas) into the panel. Thus, there is a problem that the purity of a discharge gas sealed inside the panel is lowered by these impurity gases, thereby raising the discharge voltage. The electric power consumption of a plasma display panel increases in association with a rise in discharge voltage.
Further, impurity gas released from a sealing material into the panel during sealing of the panel is adsorbed onto a film formed on the surface of a substrate. Thereby, the secondary electron emission coefficient of the surface of the substrate is lowered to raise the discharge voltage. When voltage is applied across the substrates for a predetermined time (initial aging treatment), the impurity gas is desorbed from the surfaces of the substrates, which stabilizes the discharge voltage. However, since the desorbed impurity gas remains between the substrates resulting in a decrease in the desorbing speed of the impurity gas, it is necessary to carry out a prolonged initial aging treatment.

[0005] The present invention has been made to solve the above problem, and has an object of providing a sealing panel capable of suppressing a rise in discharge voltage and a method for producing a plasma display panel.

Means for Solving the Problem

[0006] In order to achieve the above-described object, the sealing panel according to the present invention is a sealing panel which includes: a sealing material which contains a resin material and is disposed on the whole periphery in a part between a pair of substrates; and a discharge gas which is sealed between the pair of substrates with the sealing material, an adsorption material which adsorbs an impurity gas released from the sealing material and an impurity gas passing through the sealing material, is formed continuously or intermittently along the inner periphery of the sealing material.
It may be arranged such that the sealing material is a mixture of a glass material with a resin material as a binder.
According to the above constitution, an impurity gas released from the sealing material and an impurity gas that passes through the sealing material can be adsorbed by an adsorption material, thus making it possible to suppress a decrease of the purity of a discharge gas sealed between the pair of substrates and also making it possible to prevent an impurity gas from being adsorbed on the surface of the substrate. Therefore, it is possible to suppress a rise in discharge voltage.
In addition, it is possible to reduce the amount of time needed to conduct an initial aging treatment or eliminate the necessity of conducting the initial aging treatment.

[0007] Further, it may be arranged such that the adsorption materials are provided on a plurality of peripheries in a concentric manner.
According to the above constitution, an impurity gas can be reliably adsorbed.
Further, it may be arranged such that some of the adsorption materials among the adsorption materials provided on a plurality of peripheries are loaded on one of a substrate of the pair the substrates; and the remaining adsorption materials among the adsorption materials installed on a plurality of peripheries are loaded on the other substrate of the pair of the substrates.

According to the above constitution, the impurity gas intrudes along a longer channel and also adsorption materials are arranged along the channel, thus making it possible to improve the adsorption efficiency of the impurity gas.

[0008] It may be arranged such that an ultraviolet shielding wall which prevents ultraviolet light generated inside the sealing panel from being incident to the sealing material is formed continuously along the inner periphery of the sealing material.

According to the above constitution, it is possible to prevent ultraviolet light generated inside the sealing panel from being incident to the sealing material. It is, thereby, possible to suppress the release of an impurity gas from the sealing material and suppress a rise in discharge voltage.

[0009] It may be arranged such that the leading end of the ultraviolet shielding wall installed upright on a substrate of the pair of substrates is in contact with the other substrate of the pair of substrates.

According to the above constitution, it is possible to block an impurity gas released from the sealing material and an impurity gas intruding through the sealing material by the ultraviolet shielding wall and thereby suppress a decrease of the purity of a discharge gas.

[0010] It is desirable that the adsorption materials are arranged between the sealing material and the ultraviolet shielding wall.

According to the above constitution, the adsorption materials can be used to securely adsorb an impurity gas blocked by the ultraviolet shielding wall.

[0011] Further, it is desirable that the sealing panel is a plasma display panel; and the ultraviolet shielding wall is constituted of the same material as that of a partition placed between pixels of the plasma display panel.

[0012] According to the above constitution, it is possible to form the ultraviolet shielding wall at the same time with the partition, thereby simplifying production steps to reduce the production cost.

On the other hand, a method for producing the plasma display panel according to the present invention is a method for producing a plasma display panel which is provided with: a sealing material containing a resin material arranged on the whole periphery in a pair of substrates; and a discharge gas filled between the pair of substrates sealed with the sealing material, the method including: forming an ultraviolet shielding wall for preventing ultraviolet light generated inside the plasma display panel from being incident to the sealing material simultaneously with a partition placed between pixels of the plasma display panel.

A partition of the plasma display panel is to prevent an erroneous discharge between adjacent pixels and formed to have a height equal to a clearance of a pair of substrates. The partition is formed at the same time as the ultraviolet shielding wall, thus making it possible to form the ultraviolet shielding wall with a height which is equal to a clearance of the pair of substrates.

Thereby, it is possible to securely prevent ultraviolet light generated inside the plasma display panel from being incident to a sealing material. It is, therefore, possible to suppress the release of an impurity gas from the sealing material and also suppress a rise in discharge voltage.

Advantageous Effects of the Invention

[0013] According to the sealing panel and the method for producing the plasma display panel of the present invention, it is possible to suppress a decrease of the purity of a discharge gas sealed between the pair of substrates. Further, an impurity gas can be prevented from being adsorbed on the surface of the substrate. Therefore, it is possible to suppress a rise in discharge voltage. In addition, it is possible to reduce the aging treatment time or eliminate the initial aging treatment.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

Fig. 1 is an exploded perspective view of a three-electrode AC-type plasma display panel.
Fig. 2 is a sectional view showing the peripheral edge portion of a plasma display panel.
Fig. 3A is a plan view of a plasma display panel equipped with a getter.
Fig. 3B is a plan view of a plasma display panel equipped with a getter.
Fig. 3C is a plan view of a plasma display panel equipped with a getter.
Fig. 4A is an explanatory view of a plasma display panel equipped with a plurality of getters.
Fig. 4B is an explanatory view of a plasma display panel equipped with a plurality of getters.
Fig. 4C is an explanatory view of a plasma display panel equipped with a plurality of getters.
Fig. 5 is a flow chart covering a method producing a plasma display panel.
Fig. 6A is a graph showing the results of a moisture absorption test of a plasma display panel.
Fig. 6B is a graph showing the results of a moisture absorption test of a plasma display panel.
Fig. 7A is a graph showing the results of an aging test of a plasma display panel.
Fig. 7B is a graph showing the results of an aging test of a plasma display panel.

Description of the Reference Symbols

[0015]

1: rear substrate
2: front substrate
15: partition
16: discharge chamber
20: sealing material

22: getter (adsorption material)
24: ultraviolet shielding wall
100: plasma display panel (sealing panel)

BEST MODE FOR CARRYING OUT THE INVENTION

[0016] Hereinafter, embodiments according to the present invention will be explained with reference to the drawings. It is noted that in the individual drawings referred to in the following explanation, the scale of each member is adequately changed so that it can be drawn in a recognizable dimension.
In the present specification, the "inner face" of a substrate shall be the surface facing a surface of the other substrate which is paired with the substrate.

(Plasma display panel)

[0017] Fig. 1 is an exploded perspective view of the three-electrode AC-type plasma display panel. The plasma display panel (hereinafter, abbreviated as "PDP") 100 is provided with a rear substrate 1 and a front substrate 2 which are arranged so as to be opposed to each other and a plurality of discharge chambers 16 which are formed between the substrates 1 and 2.
[0018] Address electrodes 11 are formed on the inner face of the rear substrate 1 at predetermined intervals in a striped manner. A dielectric layer 19 is formed so as to cover the address electrodes 11. Further, a partition (rib) 15 is formed in parallel with the address electrodes 11 on the upper face of the dielectric layer 19 between adjacent address electrodes 11. Still further, a fluorescent substance 17 is placed on the upper face of the dielectric layer 19 between adjacent partitions 15 and on the side face of the partition 15. The fluorescent substance 17 emits any one of red, green and blue fluorescence.
[0019] On the other hand, a display electrode 12 (scanning electrode 12a and sustain electrode 12b) is formed on the inner face of the front substrate 2 at predetermined intervals in a striped manner. The display electrode 12 is constituted of a transparent conductive material such as ITO and arranged in a direction orthogonal to the address electrode 11.
The intersecting point of the address electrode 11 and the display electrode 12 is given as a pixel of PDP 100. Further, a dielectric layer 13 is formed so as to cover the display electrode 12, and a protective film 14 is formed so as to cover the dielectric layer 13. This protective film 14 protects the dielectric layer 13 from positive ions generated by plasmizing a discharge gas. This film is constituted of oxides of alkali earth metals such as MgO and SrO.
[0020] The above-described rear substrate 1 and the front substrate 2 are laminated together to form discharge chambers 16 between the adjacent partitions 15. A discharge gas such as a mixed gas ofNe and Xe is sealed inside the discharge chambers 16.
Then, direct-current voltage is applied across the address electrode 11 and the scanning electrode 12a to cause a counter discharge. Further, alternative-current voltage is applied across the scanning electrode 12a and the sustain electrode 12b to cause a surface discharge. Then, the discharge gas sealed inside the discharge chambers 16 is plasmized, thereby irradiating vacuum ultraviolet light. The fluorescent substance 17 is excited by this ultraviolet light to emit visible light from the front substrate 2.

(Sealing material)

[0021] Fig. 2 is a sectional view showing the peripheral edge portion of a plasma display panel. Projections 21 are formed at the peripheral edge of the rear substrate 1 in an architrave shape. A sealing material 20 containing a resin material is arranged between the leading end face of the projection 21 and the front substrate 2, thereby both substrates 1 and 2 are sealed. As the sealing material 20, for example, thermo-setting resins such as epoxy resin and acrylic resin or ultraviolet light curing resins are employed. As described above, when the sealing material 20 containing a resin material is employed, heating and cooling conditions are alleviated greatly during sealing of the panel, as compared with the case where a conventional sealing material composed of a low-melting point glass is employed. Thus, it is possible to greatly reduce the amount of time needed to produce the panel. It is noted that a sealing material may be employed which is obtained by mixing a low-melting point glass with a resin as a binder.

(Adsorption material)

[0022] Incidentally, during sealing the substrates 1 and 2, impurity gases are released from the sealing material 20 containing a resin material. In addition to H_2O and CO_2, for example, gases such as CO, H_2 and CH based gases are released from the sealing material 20 which is made up of epoxy resin or of acrylic resin. Further, in the case of a sealing material obtained by mixing a low-melting point glass with acrylic resin, CO_2, O_2 gas and others are released from the low-melting point glass, while H_2O, CO_2, CO gas and others are released from the acrylic resin. Further, there is a concern that impurity gases such as H_2O may intrude into a PDP from outside through the sealing material 20 after sealing.
[0023] Thus, a getter (adsorption material) 22 which adsorbs an impurity gas is provided along the inner periphery of the sealing material 20. The getter 22 adsorbs water (H_2O), oxygen (O_2) gas, carbon-based gases such as CO and CO_2 and others such as CH-based. hydrocarbon gas. Specifically, SrO formed in a sheet to give the thickness of about 150 μm may be employed as the getter 22. Further, active metals such as Ba, Ca or Sr formed to give the thickness of 5 to 10 μm may be employed as the getter 22. A Zr-V-Fe-Ti -based material may also be employed as the getter 22.

[0024] Fig. 3A to Fig. 3C are plan views showing a plasma display panel equipped with a getter.
As shown in Fig. 3A, it is desirable that the getter 22 is formed continuously along the inner whole periphery of the sealing material 20. As shown in Fig. 3B and Fig. 3C, it may be formed intermittently along the whole inner periphery of the sealing material 20.
It is noted that, as shown in Fig. 2, the getter 22 may be arranged on the surface of the rear substrate 1 on the inner side of the sealing material 20 or may be arranged on the surface of the front substrate 2. Further, as shown in Fig. 2, the thickness of the getter 22 may be thinner than that of the clearance between both the substrates 1 and 2 or may be equal to that of the clearance of the substrates 1 and 2.

[0025] Fig. 4A and Fig. 4B are plan views showing a plasma display panel equipped with a plurality of getters. As shown in Fig. 4A, a plurality of getters 22a and 22b may be arranged along the inner periphery of the sealing material 20 in a concentric manner. A plurality of the getters 22a and 22b may be formed continuously as shown in Fig. 4A, or they may be formed intermittently as shown in Fig. 4B. Further, among these plurality of getters, some of them are formed continuously, while the remaining getters may be formed intermittently. As described so far, by arranging a plurality of the getters 22a and 22b in a concentric manner, an impurity gas can be reliably adsorbed.

[0026] Fig. 4C is a sectional view taken along the A-A line in Fig. 4A. As shown in Fig. 4C, among a plurality of the getters 22a and 22b, some of the getters 22a may be loaded on the rear substrate 1, while the remaining getters 22b may be loaded on the front substrate 2. Thereby, an impurity gas intrudes along a longer channel and also the getters 22a and 22b are arranged along the channel, thus making it possible to improve the adsorption efficiency of the impurity gas. It is noted that all the plurality of the getters 22a and 22b may be loaded on the rear substrate 1 or all of them may be loaded on the front substrate 2.

(Ultraviolet shielding wall)

[0027] Reverting to Fig. 2, an ultraviolet shielding wall 24 is continuously installed along the inner periphery of the above-described getter 22. The ultraviolet shielding wall 24 prevents ultraviolet light generated in the discharge chamber 16 from being incident to the sealing material 20 and formed to give about 1 mm in width by an ultraviolet absorbing material such as $PbO \cdot B_2O_3 \cdot SiO_2$. As shown in Fig. 2, the ultraviolet shielding wall 24 may be installed upright on the rear substrate 1 or may be installed upright on the front substrate 2.

[0028] The height of the ultraviolet shielding wall 24 is formed equal to the clearance between the pair of substrates 1 and 2. Thus, the leading end of the ultraviolet shielding wall 24 installed upright on the rear substrate 1 is firmly attached to the front substrate 2. According to the above constitution, it is possible to block an impurity gas released from the sealing material 20 and an impurity gas intruding through the sealing material 20 by the ultraviolet shielding wall. It is desirable that the above getter 22 is placed between the sealing material 20 and the ultraviolet shielding wall 24.
According to the above constitution, an impurity gas released from the sealing material 20 can be blocked by the ultraviolet shielding wall 24 and securely adsorbed by the getter 22.

[0029] It is desirable that the ultraviolet shielding wall 24 is constituted of the same ultraviolet absorbing material as that of the partition 15 and installed upright on the rear substrate 1 on which the partition 15 is installed. Thereby, as will be described later, the ultraviolet shielding wall 24 is formed simultaneously as the partition 15, thus making it possible to simplify the production steps and reduce the production cost.
Incidentally, the partition 15 of the PDP prevents an erroneous discharge between adjacent discharge chambers 16 and formed to have a height equal to the clearance between the rear substrate 1 and the front substrate 2. By forming the partition 15 simultaneously with the ultraviolet shielding wall 24, the ultraviolet shielding wall 24 can be formed to have a height equal to a clearance between both the substrates 1 and 2. Thereby, ultraviolet light generated at the discharge chamber 16 can be securely prevented from being incident to the sealing material 20.

(Method for producing plasma display panel)

[0030] Next, a method for producing the plasma display panel according to the present embodiment will be explained with reference to Fig. 2 and Fig. 5. Fig. 5 is a flow chart showing a method for producing the plasma display panel according to the present embodiment.
First, a display electrode 12 and a dielectric layer 13 are formed on the inner face of the front substrate 2 shown in Fig. 2 (step 32). Further, an address electrode 11 and a dielectric layer 19 are formed on the inner face of the rear substrate 1 (step 42).

[0031] Next, a partition 15 and an ultraviolet shielding wall 24 are formed simultaneously on the surface of a dielectric layer 19 of the rear substrate 1 (step 44). Specifically, a film of ultraviolet absorbing material is first formed on the inner face of the rear substrate 1. More specifically, an ultraviolet absorbing material in paste form is applied to give the thickness of about 200 μm by a printing method or the like and dried to form the film. Next, a dry film resist (DFR) is laminated on the surface of the film. Next, the DFR is exposed and developed to provide a pattern along the configurations of the partition 15 and the ultraviolet shielding wall 24. Next, sandblasting is performed using the DFR pattern as a mask, thereby giving a pattern to the film according to the configuration of the partition 15 and the ultraviolet shielding wall 24. Next, the DFR is peeled and removed. The rear sub-

strate 1 is put into a kiln to bake the partition 15 and the ultraviolet shielding wall 24. Therefore, the partition 15 and the ultraviolet shielding wall 24 are formed on the inner face of the rear substrate 1.

[0032] As another method for forming them simultaneously, there is a method in which before the address electrode 11 and the dielectric layer 19 are formed, a DFR is laminated on the inner face of the rear substrate 1. Next, the DFR is exposed and developed to give a pattern according to the configurations of the partition 15 and the ultraviolet shielding wall 24. Next, sandblasting is performed using the DFR pattern as a mask, thereby digging down into the rear substrate 1 composed of an ultraviolet absorbing material such as glass to a depth of about 150 μm. Next, the DFR is peeled and removed. Therefore, the partition 15 and the ultraviolet shielding wall 24 are formed directly on the inner face of the rear substrate 1. Thereafter, the address electrode 11 and others are formed. Note that it is possible to form the partition 15 and the ultraviolet shielding wall 24 simultaneously with a method other than the above-described method.

Next, the inner side of adjacent partitions is coated with a fluorescent substance 17.

[0033] Next, the sealing material 20 and the getter 22 are arranged on the whole periphery of the rear substrate 1 (step 46). The sealing material 20 is arranged by applying a sealing material in paste form. The sealing material is applied by a droplet discharge method such as a dispenser method and an inkjet method or by a printing method. Further, the getter 22 is arranged by laminating a SrO material sheet having the width of about 3 mm to 10 mm and the thickness of about 150 μm. The SrO material sheet can be formed by procedures in which SrO powder is placed into a mold, formed under a pressure of 200 to 400kgf/cm2 and further baked at about 1,200°C for about 30 minutes in a N_2 atmosphere.

[0034] Next, the front substrate 2 and the rear substrate 1 are put into a vacuum integrated process machine 50 to conduct the following steps up to a sealing step without exposure of the substrates 1 and 2 to an atmosphere.

First, the rear substrate 1 is heated in a vacuum, thereby performing degassing treatment of the sealing material 20 containing a resin material and exhaust treatment (step 48). The sealing material 20 can be degassed and the getter 22 can be activated by this heating. Further, the front substrate 2 is heated in a vacuum, thereby performing degassing treatment of a dielectric layer 13 and the like (step 34). Next, a protective film 14 is formed on the inner face of the front substrate 2 by an electron beam (EB) vapor deposition or the like (step 36).

[0035] In recent years, in order to reduce the electric power consumption of a PDP, an SrO-based material such as (SrCa)O has been studied as a constituent of the protective film 14 in place of a conventional material of MgO. The SrO-based material is much higher in hygroscopicity than MgO and has a feature that the color is changed upon absorption of moisture. In this respect, the vacuum integrated process machine 50 performs steps from a degassing step of the substrates 1 and 2 to a sealing step of the substrates 1 and 2 via a forming step of the protective film 14, thus making it possible to prevent the change in color and rise in discharge voltage resulting from the moisture absorption of the protective film 14.

[0036] Next, both the substrates 1 and 2 are sealed (step 52). More specifically, these substrates 1 and 2 are first put into a chamber, and a discharge gas is introduced into the chamber. Next, the substrates 1 and 2 are in alignment (positioned) and temporarily fastened. Next, electric voltage is applied across the substrates 1 and 2 to perform aging discharge. Further, a driving voltage is applied across the electrodes of these substrates 1 and 2 to conduct a light emission test. As a result, the rear substrate 1 or the front substrate 2 which is found to be abnormal is removed, and the substrates 1 and 2 which are confirmed to normally emit light are fastened with each other. Specifically, in the case where the sealing material 20 is constituted of an ultraviolet light curing resin, the sealing material is cured by irradiating ultraviolet light to the sealing material 20. Further, in the case where the sealing material 20 is constituted of a thermo-setting resin, the sealing material 20 is cured by heating the sealing material 20.

Thus, these substrates 1 and 2 are sealed in a state that a discharge gas is sealed inside the substrates 1 and 2.

(Moisture absorption test and Aging test)

[0037] The inventor of the present application performed a moisture absorption test to the PDP according to the above embodiment and a conventional PDP, by which any change in discharge voltage was measured. The PDP according to the present embodiment was, as shown in Fig. 2, provided with the getter 22 and the ultraviolet shielding wall 24. Specifically, a sheet-like substance obtained by baking SrO in N_2 gas as the getter 22 was employed. Further, $PbO{\cdot}B_2O_3{\cdot}SiO_2$, which was the same material as that of the partition 15, was employed as a constituent of the ultraviolet shielding wall 24, and the ultraviolet shielding wall 24 was formed simultaneously with the partition 15. It is noted that an ultraviolet light curing resin was employed as the sealing material 20. Further, a film composed of SrO·20 mol% CaO with the thickness of 8000 Angstroms was formed as the protective film 14 by EB vapor deposition. Ne-4% Xe gas was sealed as a discharge gas at 400 Torr.

On the other hand, the conventional PDP was such that the getter 22 and the ultraviolet shielding wall 24 were removed from the PDP according to the present embodiment.

[0038] The moisture absorption test was conducted by placing these PDPs to stand in a thermostatic chamber at a constant temperature of 85°C and the humidity of 95%. Next, the relationship between the standing time and the discharge sustain voltage was studied.

Fig. 6A and Fig. 6B are graphs showing the results of the moisture absorption test of the PDPs. Specifically, Fig. 6A shows the results of the PDP according to the present embodiment, while Fig. 6B shows the results of the conventional PDP. It is noted that in the following graphs, a final cell turn on voltage means a driving voltage needed to start discharging all cells in a PDP which is composed of 300 cells arranged in two-dimensional matrix. Further, a first cell turn off voltage is a voltage at which the first cell is turned off when the driving voltage is gradually lowered from a state that all the cells are turned on.

[0039] In the case of the conventional PDP shown in Fig. 6B, there was found a great increase in the first cell turn off voltage and the final cell turn on voltage after a short time standing in the chamber. This is considered to be due to the fact that water inside the thermostatic chamber passed through the sealing material and intruded into the PDP, resulting in a decrease in the purity of a discharge gas.

On the other hand, in the case of the PDP according to the present embodiment shown in Fig. 6A, variations in voltage was within 5V even after a long time standing in the chamber, and the results of the test were practically acceptable. This is considered to be due to the fact that water passed through the sealing material and intruded into the PDP, but the water was adsorbed by a getter, thereby suppressing the decrease of the purity of the discharge gas.

[0040] Further, the inventor of the present application performed an aging test to the PDP according to the present embodiment and the conventional PDP, by which any change in discharge voltage was measured. In order to confirm the effect of the ultraviolet shielding wall, a PDP in which a getter was removed was employed as the PDP according to the present embodiment. Further, a PDP in which the ultraviolet shielding wall and the getter were removed was employed as the conventional PDP. The aging test was conducted by applying voltage to these PDPs for a long time at room temperature with a humidity of 50%, and the relationship between the aging time and the discharge sustain voltage was studied.

[0041] Fig. 7A and 7B are graphs showing the results of the aging test of these PDPs. Specifically, Fig. 7A shows the results of the PDP according to the present embodiment, while Fig. 7B shows the results according to the conventional PDP.

In the case of the conventional PDP shown in Fig. 7B, the discharge sustain voltage was increased with an increase in aging time and the final cell turn on voltage was increased by about 30V after 2000-hour of aging. This is considered to be due to the fact that ultraviolet light generated by discharge in the PDP kept entering a sealing material for a long time, by which a resin material contained in the sealing material decomposed and a CH-based impurity gas was released into the PDP, resulting in a decrease in purity of the discharge gas.

[0042] On the other hand, in the case of the PDP according to the present embodiment shown in Fig. 7A, the voltage was increased by less than 10V even after 2000-hour of aging. This is considered to be due to the fact that ultraviolet light generated by discharge in the PDP was absorbed by the ultraviolet shielding wall, thereby preventing an impurity gas from being released from the sealing material, resulting in a suppressed decrease of the purity of the discharge gas.

[0043] As described above in detail, the PDP according to the present embodiment is constituted so that getters are formed continuously or intermittently along the inner periphery of a sealing material. According to the above constitution, an impurity gas released from the sealing material or an impurity gas intruding through the sealing material are adsorbed by the getters, thus making it possible to suppress a decrease of the purity of a discharge gas sealed between a pair of substrates. Therefore, it is possible to suppress a rise of discharge voltage. Further, since an impurity gas can be adsorbed by the getters, it is possible to prevent the impurity gas from being adsorbed by a hygroscopic protective film. Thereby, it is possible to suppress the decrease of the secondary electron emission coefficient on the surface of a substrate and also suppress the rise of discharge voltage. Further, it is possible to adsorb with the getters an impurity gas desorbed from the protective film upon application of voltage across the substrates for a predetermined amount of time (initial aging treatment) without remaining between the substrates. Thereby, the impurity gas can be desorbed completely and quickly. As a result, the initial aging time can be reduced.

[0044] Further, the PDP according to the present embodiment is constituted so as to have an ultraviolet light shielding wall formed continuously along the inner periphery of the sealing material. According to the above constitution, since ultraviolet light generated inside the sealing panel is absorbed by the ultraviolet shielding wall, the light is prevented from being incident to the sealing material. Thereby, it is possible to suppress the release of an impurity gas from the sealing material and suppress a rise of discharge voltage.

[0045] The present invention shall not be limited in technical scope to the above described individual embodiments but may include any modifications of the above embodiments within a scope not departing from the gist of the present invention.

In other words, specific materials and constitutions described in the above embodiments are only examples and may be modified, whenever necessary.

[0046] For example, in the above embodiment, the present invention is applied to a plasma display panel, but may be applied to a field emission display panel. The field emission display panel is such that electrons are emitted from an electron emitting source (emitter) arranged for every pixel into vacuum, and collided against a fluorescent substance, thereby attaining light emission. Specifically, the field emission display panel includes a FED (Field Emission Display) equipped with a projection-like electron emitting element and a SED (Surface-Con-

duction Electron Emitter Display) equipped with a surface conductance-type electron emitting element. In a case where the present invention is applied to the field emission display panel, it is also possible to suppress a rise of discharge voltage.

INDUSTRIAL APPLICABILITY

[0047] The present invention is applicable to a sealing panel and a method for producing a plasma display panel.

Claims

1. A sealing panel comprising:

a sealing material which contains a resin material and is disposed on the whole periphery in a part between a pair of substrate; and
a discharge gas which is sealed between the pair of substrates with the sealing material, wherein
an adsorption material which adsorbs an impurity gas released from the sealing material and an impurity gas passing through the sealing material, is formed continuously or intermittently along the inner periphery of the sealing material.

2. The sealing panel according to claim 1, wherein the sealing material is a mixture of a glass material with a resin material as a binder.

3. The sealing panel according to claim 1, wherein the adsorption materials are provided on a plurality of peripheries in a concentric manner.

4. The sealing panel according to claim 3, wherein,
some of the adsorption materials among the adsorption materials provided on a plurality of peripheries are loaded on one of a substrate of the pair the substrates; and
the remaining adsorption materials among the adsorption materials installed on a plurality of peripheries are loaded on the other substrate of the pair of the substrates.

5. The sealing panel according to any one of claim 1 to claim 4, wherein an ultraviolet shielding wall which prevents ultraviolet light generated inside the sealing panel from being incident to the sealing material is formed continuously along the inner periphery of the sealing material.

6. The sealing panel according to claim 5, wherein the leading end of the ultraviolet shielding wall installed upright on a substrate of the pair of substrates is in contact with the other substrate of the pair of substrates.

7. The sealing panel according to claim 5 or claim 6, wherein the adsorption materials are arranged between the sealing material and the ultraviolet shielding wall.

8. The sealing panel according to any one of claim 5 to claim 7, wherein
the sealing panel is a plasma display panel; and
the ultraviolet shielding wall is constituted of the same material as that of a partition placed between pixels of the plasma display panel.

9. A method for producing a plasma display panel which is provided with: a sealing material containing a resin material arranged on the whole periphery in a pair of substrates; and a discharge gas filled between the pair of substrates sealed with the sealing material, the method comprising: forming an ultraviolet shielding wall for preventing ultraviolet light generated inside the plasma display panel from being incident to the sealing material simultaneously with a partition placed between pixels of the plasma display panel.

FIG. 1

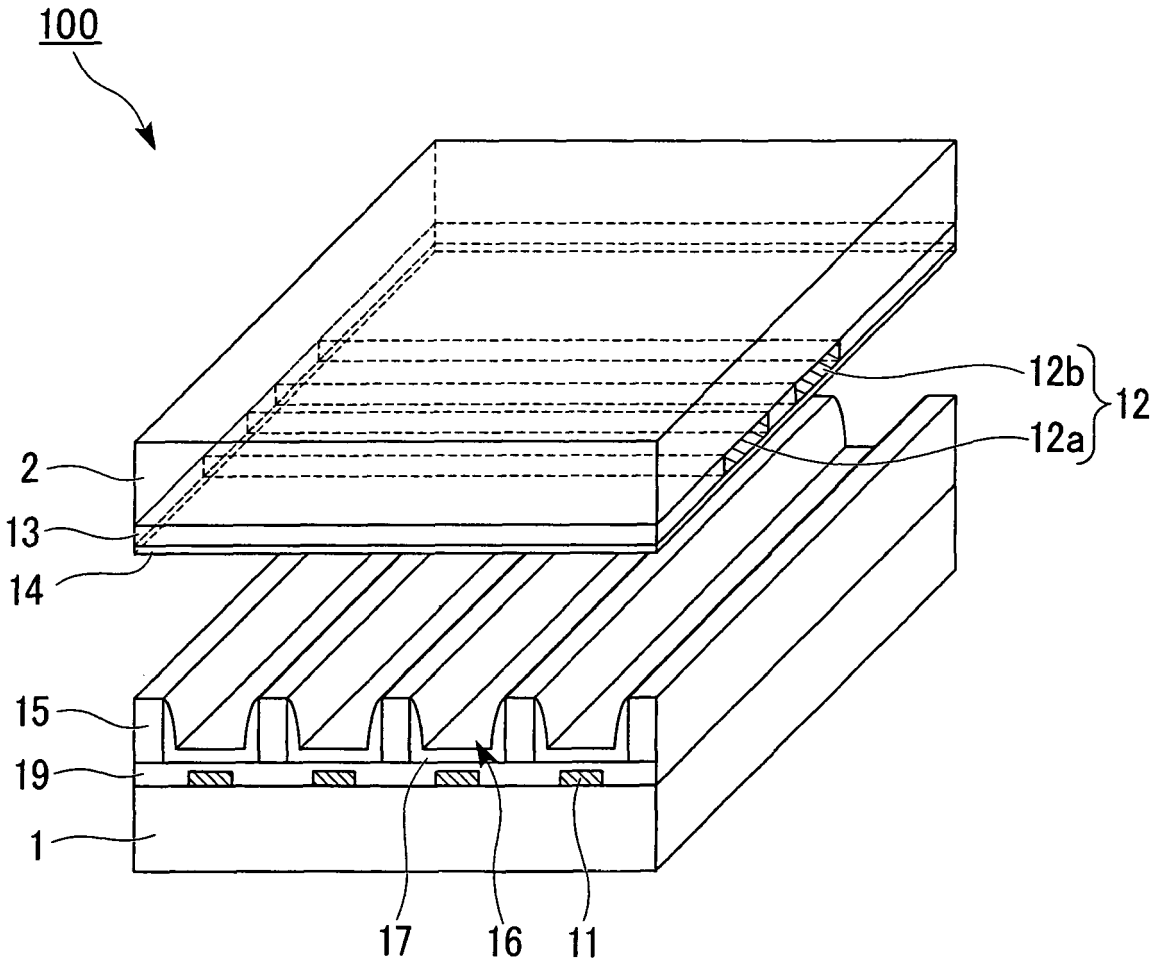


FIG. 2

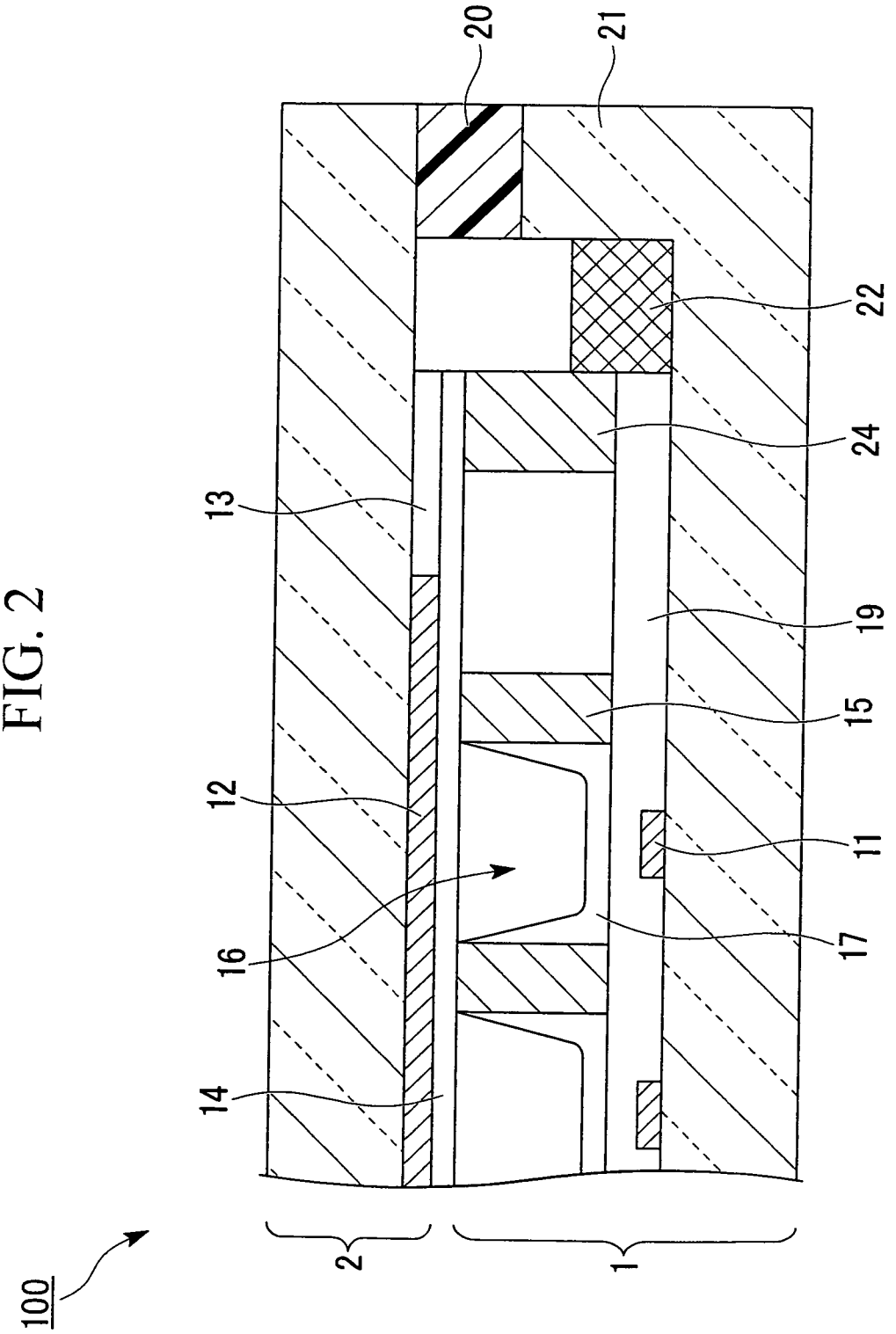


FIG. 3A

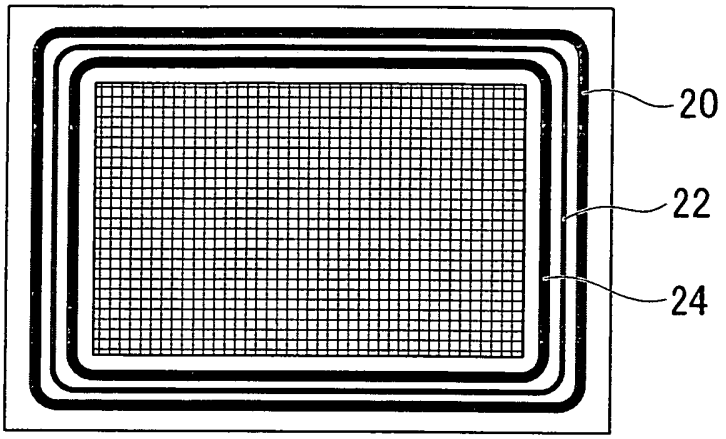


FIG. 3B

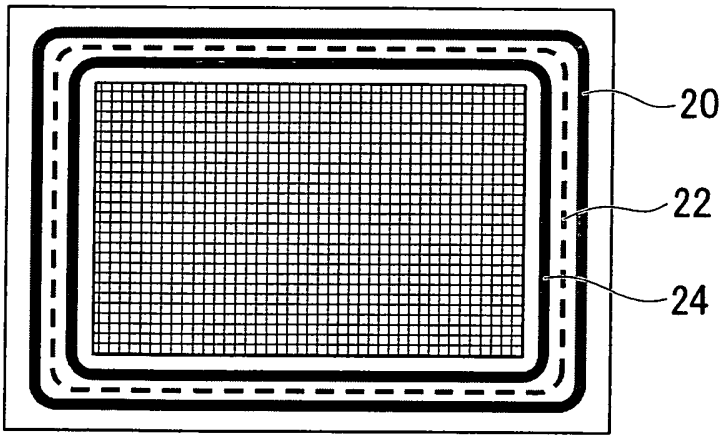


FIG. 3C

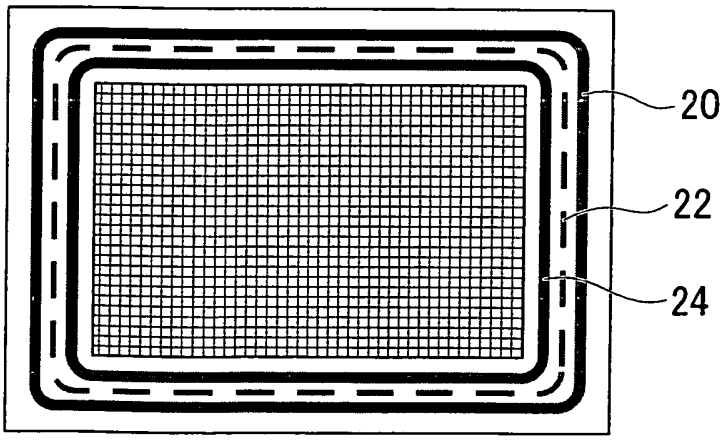


FIG. 4A

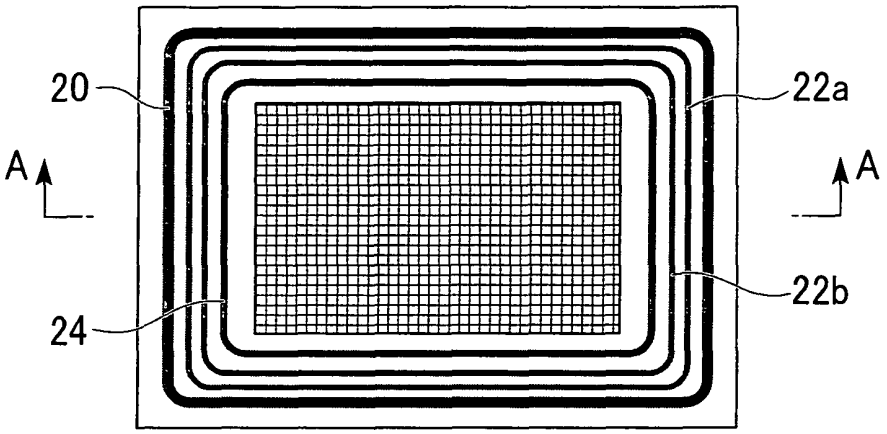


FIG. 4B

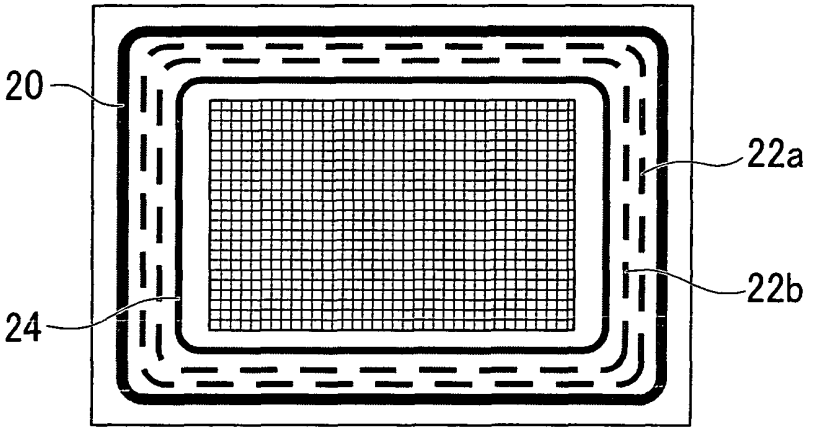


FIG. 4C

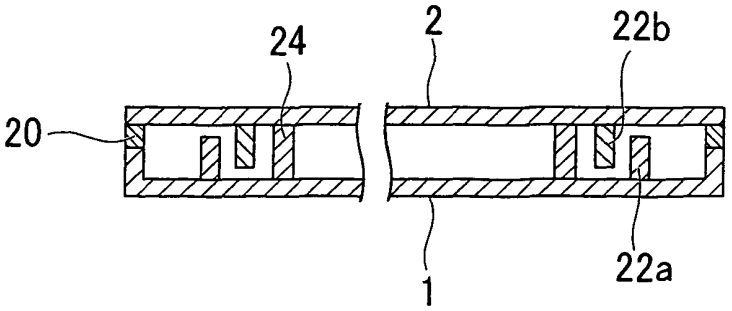


FIG. 5

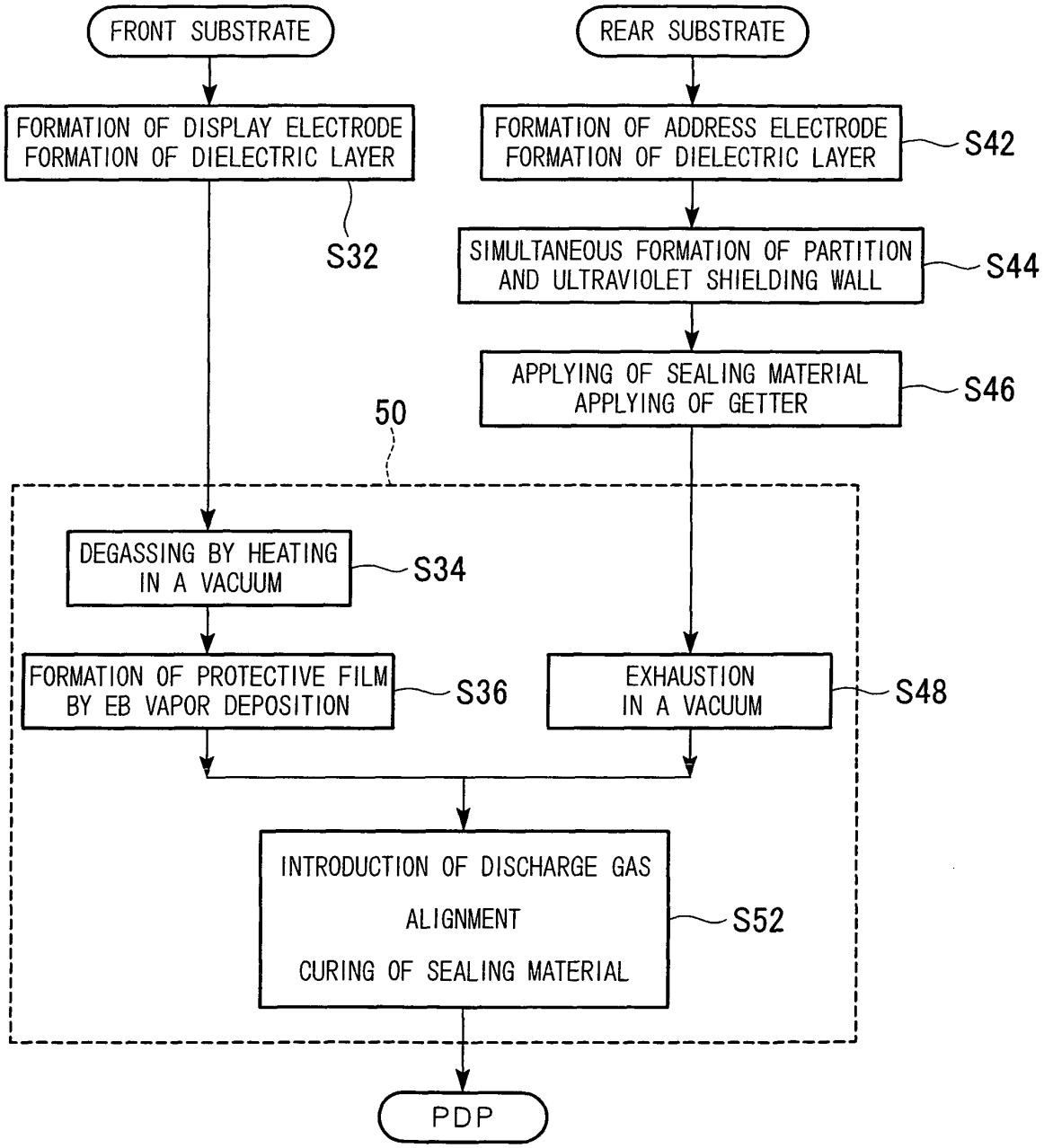
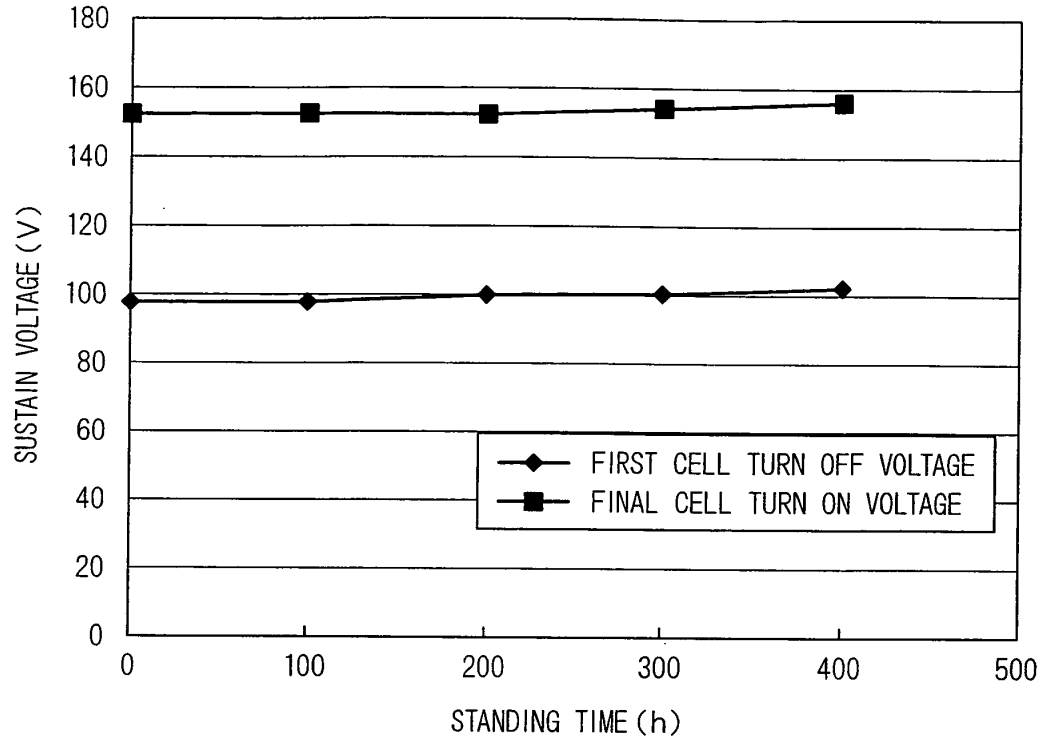

FRONT SUBSTRATE
REAR SUBSTRATE
FORMATION OF DISPLAY ELECTRODE
FORMATION OF DIELECTRIC LAYER
S32
FORMATION OF ADDRESS ELECTRODE
FORMATION OF DIELECTRIC LAYER
S42
SIMULTANEOUS FORMATION OF PARTITION AND ULTRAVIOLET SHIELDING WALL
S44
APPLYING OF SEALING MATERIAL
APPLYING OF GETTER
S46
50
DEGASSING BY HEATING IN A VACUUM
S34
FORMATION OF PROTECTIVE FILM BY EB VAPOR DEPOSITION
S36
EXHAUSTION IN A VACUUM
S48
INTRODUCTION OF DISCHARGE GAS
ALIGNMENT
CURING OF SEALING MATERIAL
S52
PDP

FIG. 6A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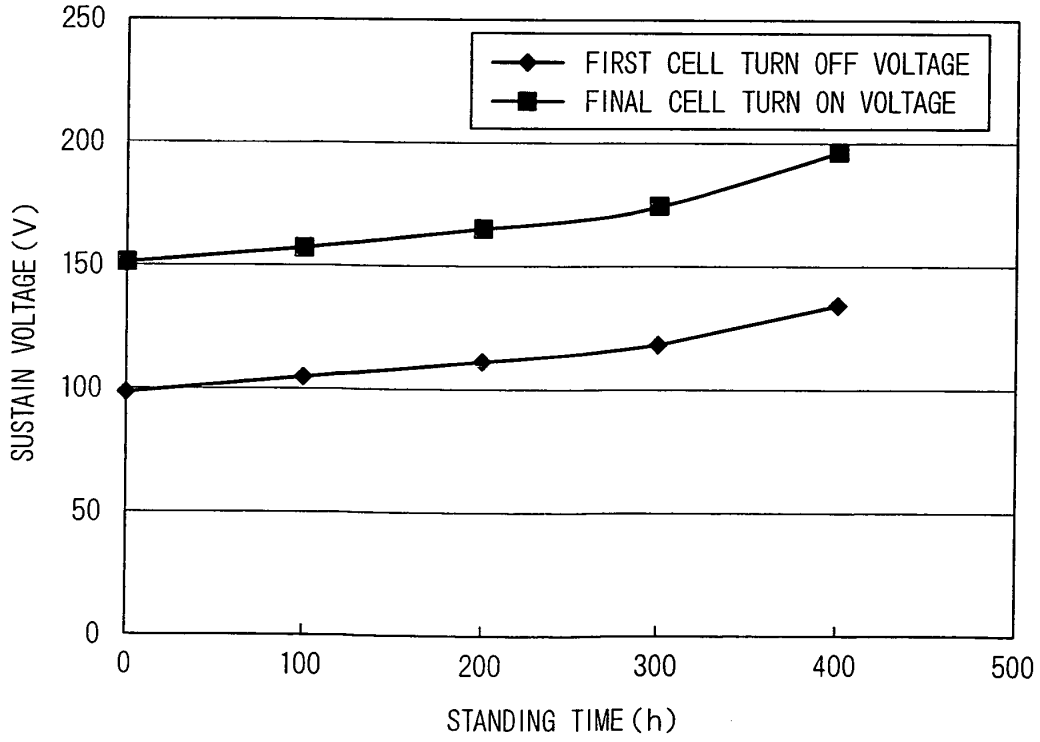
160
140
120
100
80
60
40
20
0
SUSTAIN VOLTAGE (V)
0
100
200
300
400
500
STANDING TIME (h)
FIRST CELL TURN OFF VOLTAGE
FINAL CELL TURN ON VOLTAGE

FIG. 6B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SUSTAIN VOLTAGE (V)
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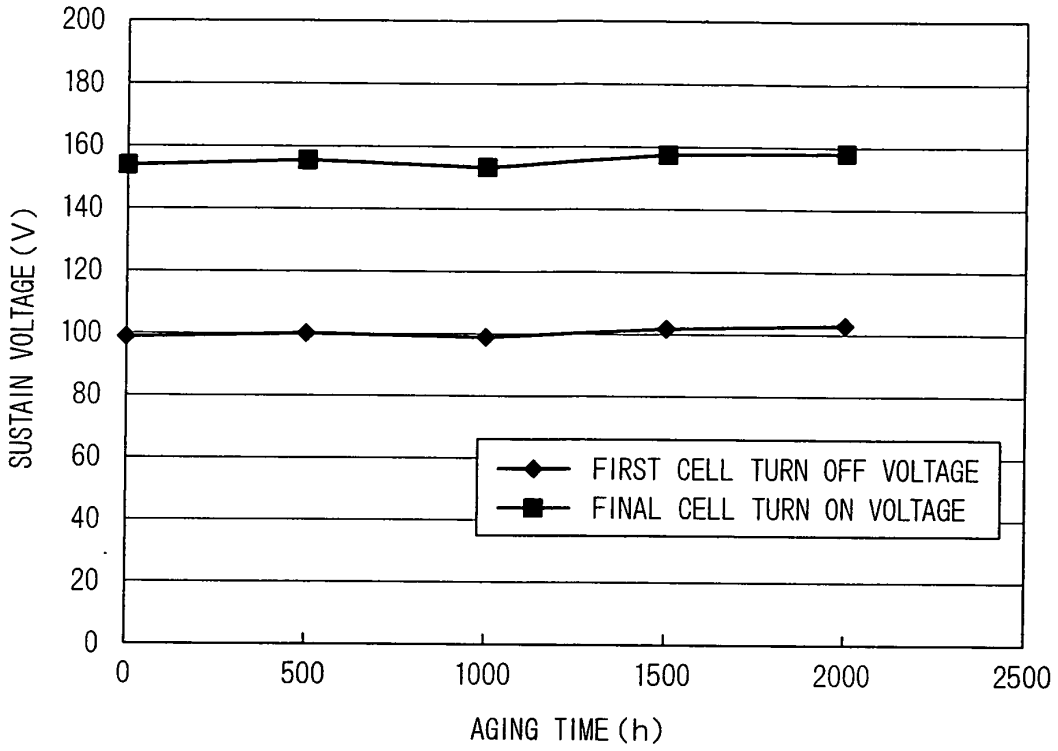
STANDING TIME (h)
FIRST CELL TURN OFF VOLTAGE
FINAL CELL TURN ON VOLTAGE

FIG. 7A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SUSTAIN VOLTAGE (V)
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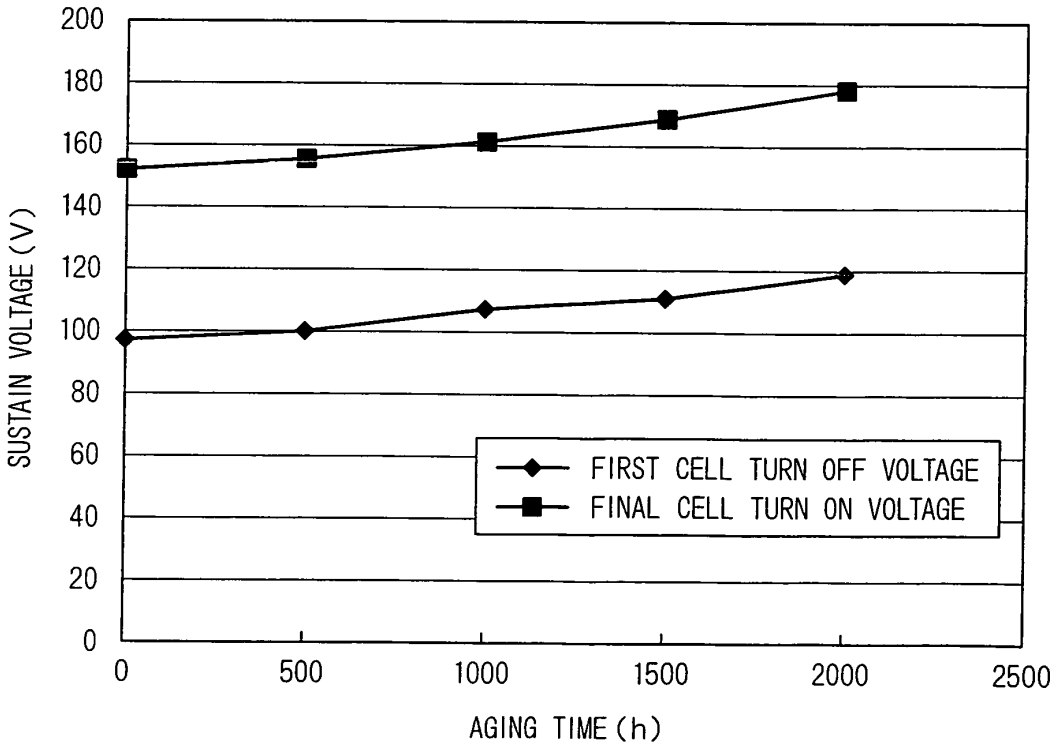
2000
2500
AGING TIME (h)
FIRST CELL TURN OFF VOLTAGE
FINAL CELL TURN ON VOLTAGE

FIG. 7B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1500
2000
2500
AGING TIME (h)
FIRST CELL TURN OFF VOLTAGE
FINAL CELL TURN ON VOLTAGE

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2007/057561

A. CLASSIFICATION OF SUBJECT MATTER
H01J5/20(2006.01)i, *H01J7/18*(2006.01)i, *H01J9/02*(2006.01)i, *H01J11/02*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H01J5/20-5/30, H01J7/18, H01J9/02, H01J11/00-11/04, H01J17/00-17/49

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2007
Kokai Jitsuyo Shinan Koho 1971-2007 Toroku Jitsuyo Shinan Koho 1994-2007

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 2005-228754 A (Pioneer Electronic Corp.), 25 August, 2005 (25.08.05), Par. Nos. [0015] to [0016]; Figs. 1 to 3 (Family: none)	9 5-8
Y	JP 2005-5259 A (Matsushita Electric Industrial Co., Ltd.), 06 January, 2005 (06.01.05), Par. Nos. [0027] to [0028], [0030] to [0032]; Fig. 5 & KR 2005/043963 A & US 2006/152156 A1 & WO 2004/102607 A1	1-8

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
02 July, 2007 (02.07.07)	10 July, 2007 (10.07.07)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2007/057561

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2005-314136 A (Matsushita Electric Industrial Co., Ltd.), 10 November, 2005 (10.11.05), Claim 6; Par. Nos. [0009], [0025] to [0026] (Family: none)	1-8
A	JP 2005-302586 A (Matsushita Electric Industrial Co., Ltd.), 27 October, 2005 (27.10.05), Full text; all drawings (Family: none)	1-4
A	JP 2000-30619 A (LG Electronics Inc.), 28 January, 2000 (28.01.00), Full text; all drawings & KR 2000/000549 A & US 6191529 B1	1-4
A	JP 11-191378 A (Saes Getters S.p.A.), 13 July, 1999 (13.07.99), Full text; all drawings & EP 911856 A2 & US 2002/008469 A1	1-4
A	JP 2002-358892 A (Matsushita Electric Industrial Co., Ltd.), 13 December, 2002 (13.12.02), Par. No. [0046]; Fig. 1(b) (Family: none)	1-4
A	WO 2006/019032 A1 (Matsushita Electric Industrial Co., Ltd.), 23 February, 2006 (23.02.06), Par. Nos. [0098] to [0110]; Figs. 15 to 17 (Family: none)	5-9
A	JP 2000-277020 A (Pioneer Electronic Corp.), 06 October, 2000 (06.10.00), Full text; all drawings & US 6400080 B1	5-9
A	JP 2003-68201 A (Matsushita Electric Industrial Co., Ltd.), 07 March, 2003 (07.03.03), Par. Nos. [0059] to [0061]; Fig. 6 & EP 1114433 A1 & KR 2006/097769 A & US 6848964 B1 & US 2005/151475 A1 & WO 00/16364 A1	5-9

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2007/057561

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

For the following reason, this international application includes two inventions which do not satisfy the requirement of unity of invention.
Main invention: Claims 1 to 8, second invention: claim 9

The special technical feature of the main invention is a sealing panel comprising a pair of substrates sealed with the aid of a resin material-containing sealing material, wherein an adsorbent material is formed continuously or intermittently along the inner periphery of the sealing material.

The special technical feature of the second invention is a method for

(continued to extra sheet)

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

the

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, payment of a protest fee..

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☒ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (2)) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2007/057561

Continuation of Box No.III of continuation of first sheet(2)

manufacturing a plasma display panel comprising a pair of substrates sealed with a resin material-containing sealing material, wherein an ultraviolet shielding wall is formed simultaneously with the formation of a partition wall.

The technique for sealing the pair of substrates with the resin material-containing sealing material is known as disclosed in patent document 1: JP 2002-75197 proposed by the applicant in paragraph [0003] in the description.

Thus, there is no technical relationship between the main invention and the second invention involving one or more of the same or corresponding special technical features, so that these inventions are not considered as being so linked as to form a single general inventive concept.

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REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2006107547 A **[0001]**
- JP 2002075197 A **[0003]**