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(54) **Pixel, organic light emitting display and associated methods**

Pixel, organische lichtemittierende Anzeige und entsprechende Verfahren

Pixel, affichage électroluminescent organique et procédés associés

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EP 2 009 618 B1

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] Embodiments relate to a pixel, an organic light emitting display exhibiting improved image quality, and a method of driving the same.

2. Description of the Related Art

[0002] Active matrix-type flat panel displays that display images using thin film transistors have been widely used. An organic light emitting display may exhibit excellent luminous efficiency, brightness, and viewing angle, and may have a rapid response speed. The organic light emitting display displays images by using a plurality of organic light emitting diodes (OLEDs). The organic light emitting diode may include an anode electrode, a cathode electrode, and an organic light emitting layer between the anode electrode and the cathode electrode.

[0003] FIG 1 is a circuit view showing a structure of a pixel of a general organic light emitting display (US 2007/0057877 A1). Referring to FIG. 1, a pixel includes a first transistor, a second transistor, a third transistor, a capacitor, and an organic light emitting diode (OLED).

[0004] The source of the first transistor M1 is connected to a first power supply line, the drain thereof is connected to the source of the third transistor, and the gate thereof is connected to a first node N1. The first transistor M1 allows current to flow from the source to the drain corresponding to the voltage of the first node N1.

[0005] The source of the second transistor M2 is connected to a data line Dm, the drain thereof is connected to a first node N1, and the gate thereof is connected to a scan line Sn. The second transistor M2 performs a switching operation by means of the scan signal transferred through the scan line Sn to allow the data signal flowed through the data line Dm to be selectively transferred to the first node N1.

[0006] The source of the third transistor M3 is connected to the drain of the first transistor, the drain thereof is connected to the organic light emitting diode, and the gate thereof is connected to a light emitting line En. The third transistor M3 performs turn-on and turn-off operations by means of the light emitting control signal transferred through the light emitting line to allow the current flowing from the source of the first transistor to the drain thereof to be transferred to the organic light emitting diode (OLED).

[0007] The first electrode of the capacitor Cst is connected to a first power supply line ELVDD and the second electrode thereof is connected to a first node N1. When the data signal is transferred to the first node N1, the capacitor Cst allows the voltage of the transferred data signal to be maintained until the next data signal is transferred to the first node N1. Therefore, the gate of the first

transistor M1 has the voltage of the data signal by the capacitor Cst.

[0008] The organic light emitting diode (OLED) includes an anode electrode, a cathode electrode, and a light emitting layer positioned between the anode electrode and the cathode electrode, wherein the light emitting layer emits light when current flows. Therefore, if the current corresponding to the data signal is generated and provided by means of the first transistor M1, the current flows from the anode electrode to the cathode electrode so that the light emitting diode (OLED) emits light.

[0009] In the organic light emitting display comprising the circuit constituted as above, the semiconductor layer of each transistor may use polysilicon or similar suitable materials. However, polysilicon inevitably is subject to process deviations. Therefore, if the transistor is formed using polysilicon, difference occurs in charge carrier mobility and the threshold voltage of transistors which causes deviations of the current flowing into the pixel. On such a ground, pixel circuits capable of compensating for the threshold voltage are commonly used. However, the structure of the pixel circuit compensating for the threshold voltage is complicated and increases the area of the pixel circuit at the cost of the light emitting OLED area. Thus, display brightness decreases and it becomes difficult to reduce the pitch of the pixels in order to increase display resolution.

WO 98/48403 and WO 2006/054189 seek to compensate variations of the threshold voltage of a driving transistor of a pixel circuit through an auto-zeroing approach which requires additional components in each pixel circuit. US 5,990,629 proposes using a memory transistor having a gate insulating film doped with impurities as a driving transistor of a pixel circuit in order to eliminate storage capacitors of the pixel circuit.

SUMMARY OF THE INVENTION

[0010] Aspects of the invention are therefore directed to an organic light emitting display and a method of driving the same, which overcome one or more of the problems due to the limitations and disadvantages of the related art.

[0011] Accordingly, a first aspect of the invention provides an organic light emitting display, comprising a pixel unit having a plurality of pixels, a data driver connected to data lines of the pixel unit, and a scan driver connected to scan lines of the pixel unit. Each pixel includes first through third transistors, a capacitor and an organic light emitting diode. The first transistor (driving transistor) has a first electrode connected to a first power source, a control gate connected to a first node, and a second electrode. The second transistor has a first electrode connected to a data line, a second electrode connected to the first node, and a gate connected to a scan line. The third transistor has a first electrode connected to the second electrode of the first transistor, a gate connected to one of a light emitting control line and the scan line, and a second electrode. The capacitor is connected between

the first power source and the first node. The organic light emitting diode has an anode connected to the second electrode of the third transistor and a cathode connected to a second power source. According to the invention, the first transistor includes a floating gate and an insulating layer between the floating gate and the control gate.

[0012] The scan driver may be connected to light emitting control lines of the pixel unit and the gate of the third transistor of each pixel may be connected to a light emitting control line.

[0013] The first, second, and third transistors may be PMOS transistors.

[0014] Alternatively, the first transistor may be an NMOS transistor, and the second and third transistors may be PMOS transistors.

[0015] In a preferred embodiment of the invention, the gate of the third transistor of each pixel may be connected to the scan line and the third transistor of each pixel may be of an opposite conduction type as the second transistor of the pixel.

[0016] Then, the first and second transistors may be PMOS transistors, and the third transistor may be an NMOS transistor.

[0017] A second aspect of the invention is directed to a method of driving an organic light emitting display, including determining a current flowing into a first transistor of a pixel, determining a deviation of a threshold voltage of the first transistor using the determined current, and compensating for the deviation of the threshold voltage. The first transistor may be a floating gate transistor, and compensating for the deviation of the threshold voltage may include storing a voltage corresponding to the deviation of the threshold voltage in the first transistor.

[0018] Storing the voltage corresponding to the deviation of the threshold voltage may include controlling an amount of electrons stored in a floating gate of the floating gate transistor. The method may further include extracting electrons stored in the floating gate into a channel region of the first transistor to lower the threshold voltage. Extracting electrons into the channel region may include providing a high state voltage to a source of the first transistor and providing a low state voltage to a control gate of the first transistor. The method may further include injecting electrons into the floating gate to raise the threshold voltage. Injecting electrons into the floating gate may include providing a low state voltage to a source of the first transistor and providing a high state voltage to a control gate of the first transistor.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The above and other features and advantages will become more apparent to those of ordinary skill in the art by describing in detail example embodiments with reference to the attached drawings, in which:

[0020] FIG. 1 is a circuit view showing a structure of a pixel of a general organic light emitting display;

[0021] FIG. 2 illustrates a schematic view of an organic light emitting display according to an embodiment;

[0022] FIG. 3 illustrates a cross-sectional view of a transistor having a non-volatile memory element;

5 [0023] FIG. 4 illustrates a graph of current flowing into a drain of a transistor as a function of control gate voltage and changes in the threshold voltage of the transistor;

[0024] FIG. 5 illustrates a graph of a relationship between threshold voltage and stress time;

10 [0025] FIG. 6 illustrates a circuit view of a portion of a pixel unit of the organic light emitting display of FIG. 2; and

[0026] FIGS. 7 and 8 illustrate embodiments of pixel circuits in the organic light emitting display of FIG. 2.

15 DETAILED DESCRIPTION OF THE INVENTION

[0027] Example embodiments will now be described more fully hereinafter with reference to the accompanying drawings; however, they may be embodied in different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art.

20 [0028] In the figures, the dimensions of layers and regions may be exaggerated for clarity of illustration. It will also be understood that when a layer or element is referred to as being "on" another layer or substrate, it can be directly on the other layer or substrate, or intervening layers may also be present. Further, it will be understood that when a layer is referred to as being "under" another layer, it can be directly under, and one or more intervening layers may also be present. In addition, it will also be understood that when a layer is referred to as being "between" two layers, it can be the only layer between the two layers, or one or more intervening layers may also be present. Like reference numerals refer to like elements throughout.

25 [0029] Where an element is described as being connected to a second element, the element may be directly connected to the second element, or may be indirectly connected to the second element via one or more other elements. Further, where an element is described as being connected to a second element, it will be understood that the elements may be electrically connected, e.g., in the case of transistors, capacitors, power sources, nodes, etc. Where two or more elements are described as being connected to a node, the elements may be directly connected to the node, or may be connected via
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conductive features to which the node is common. Thus, where embodiments are described or illustrated as having two or more elements that are connected to a common point, it will be appreciated that the elements may be connected to respective points on a conductive feature that extends between the respective points.

[0030] FIG. 2 illustrates a schematic view of an organic light emitting display according to an embodiment. Referring to FIG. 2, the organic light emitting display in-

cludes a pixel unit 100, a data driver 110, and a scan driver 120.

[0031] The pixel unit 100 includes a plurality of pixels 101. Each pixel 101 includes an organic light emitting diode configured to emit light corresponding to a flow of current. The pixel unit 100 includes n scan lines $S_1, S_2, \dots, S_{n-1},$ and S_n transferring scan signals, the scan lines extending in a row direction, n light emitting control lines $E_1, E_2, \dots, E_{n-1},$ and E_n transferring light emitting control signals, the light emitting control lines extending in the row direction, and m data lines $D_1, D_2, \dots, D_{m-1},$ and D_m transferring data signals, the data lines extending in a column direction.

[0032] The pixel unit 100 is connected to external first and second power sources ELVDD and ELVSS, respectively. The pixel unit 100 displays an image by light emitting the organic light emitting diodes using the scan signals, the data signals, the light emitting control signals, the first power source ELVDD and the second power source ELVSS. A low state voltage may be provided by the second power source ELVSS during an image-display operation of the organic light emitting diode, i.e., when current flows in the organic light emitting diode to display images. As described in detail below, one or both of the first and second power sources may supply various voltages, such that ELVDD may supply a higher or lower voltage than ELVSS, in order to facilitate compensation of a threshold voltage of a non-volatile memory element.

[0033] The data driver 110 generates the data signals by receiving video data with red, blue, and green components, and applies the data signals to the pixel unit 100. The data driver 110 applies the data signals to the pixel unit 100 via the data lines $D_1, D_2, \dots, D_{m-1},$ and D_m of the pixel unit 100.

[0034] The scan driver 120 includes a scan driving circuit generating the scan signals and a light emitting control signal driving circuit generating the light emitting control signals, and applies the scan signals and light emitting control signals to the pixel unit 100. The scan driving circuit is connected to the scan lines $S_1, S_2, \dots, S_{n-1},$ and S_n to transfer the scan signals to a specific row of the pixel unit 100. The light emitting control signal driving circuit is connected to the light emitting control lines $E_1, E_2, \dots, E_{n-1},$ and E_n to transfer the light emitting control signals to a specific row of the pixel unit 100.

[0035] In an implementation, the light emitting control signal driving circuit may be connected to first and second light emitting control lines to transfer the first and second light emitting control signals to a specific row of the pixel unit 100. The data signals output from the data driver 110 are supplied to the pixel 101 to which the scan signals are transferred. As a result, a driving current may be generated in the pixel 101, the generated driving current being supplied to the organic light emitting diode by the first and second light emitting control signals.

[0036] FIG. 3 illustrates a cross-sectional view of a transistor having a non-volatile memory (NVM) element, which may be implemented in each pixel of the organic

light emitting display shown in FIG. 2. Referring to FIG. 3, an insulating film 204, e.g., a tunnel oxide film, may be formed on a silicon substrate 201, e.g., an N-type silicon substrate. The silicon substrate 201 may be polysilicon. A floating gate 205 may be formed on the oxide film, an oxide-nitride-oxide (ONO) layer 206 may be formed on the floating gate 205, and a control gate 207 may be formed on the ONO layer 206. A source 202 and a drain 203 may be formed on sides of the gate electrode made up of the floating gate 205 and the control gate 207.

[0037] To raise the threshold voltage of the NVM element, hot electrons beyond the energy barrier of the tunnel oxide film may be injected into a potential well formed in the floating gate 205 using hot electron injection. The injection of electrons into the floating gate may raise the threshold voltage of the transistor.

[0038] To lower the threshold voltage of the NVM element, electrons stored in the potential well of the floating gate 205 may be extracted into the silicon substrate using tunneling. The removal of electrons from the floating gate may lower the threshold voltage.

[0039] FIG. 4 illustrates a graph of current flowing into the drain of a transistor as a function of control gate voltage and changes in the threshold voltage of the transistor. In FIG. 4, the horizontal axis represents the voltage V_{CG} of the control gate and the vertical axis represents the current I_D flowing into the drain of the transistor. A thick curve in FIG. 4 represents an ideal curve. FIG. 5 illustrates a graph of a relationship between threshold voltage and stress time.

[0040] Referring to FIG. 4, if the threshold voltage is controlled, the amount of the current I_D flowing into the drain of the transistor changes corresponding to the voltage V_{CG} of the control gate. In particular, if the threshold voltage is raised, the curve moves from left to right (hereinafter referred to a "positive" (+) shift). If the threshold voltage is lowered, the curve moves from right to left (a "negative" (-) shift).

[0041] With respect to the curve representing the ideal change, the threshold voltage of the transistor is compensated to allow the amount of current flowing into the drain of the transistor corresponding to the voltage V_{CG} of the control gate to follow the ideal curve.

[0042] In FIG. 5, the vertical axis represents a variation value of ΔV_{th} of the threshold voltage and the horizontal axis represents time. The variation value ΔV_{th} of the threshold voltage can be changed by controlling the stress time and the voltage of the control gate.

[0043] As shown in FIG. 5, if the voltage V_{CG} of the control gate is large, the variation value ΔV_{th} of the threshold voltage may become large. If the voltage V_{CG} of the control gate is small, the variation value ΔV_{th} of the threshold voltage may become small.

[0044] FIG. 6 illustrates a circuit view of a portion of a pixel unit 100 of the organic light emitting display of FIG. 2. Referring to FIG. 6, a 2x2 portion of the pixel unit 100 is illustrated, including first to fourth pixels 101a, 101 b, 101 c, and 101d. As shown in FIG. 6, each pixel 101 may

include a first transistor M1, a second transistor M2, a third transistor M3, a capacitor Cst, and an organic light emitting diode OLED. Each first transistor M1 may include an NVM element, e.g., the NVM element illustrated in FIG. 3.

[0045] The amount of current flowing into any one of the first to fourth pixels 101a, 101b, 101c, and 101d may be measured as described below.

[0046] In order to measure the current flowing into the first pixel 101a, a first voltage, e.g., 0V, is supplied to a first power line from the first power source ELVDD, and a second voltage, e.g., a negative voltage, is supplied to a second power line from the second power source ELVSS. Data signals, e.g., having voltage of -15 V to +15 V, are supplied to a first data line D 1, and third voltage, e.g., a high voltage, is applied to a second data line D2. Scan signals having a fourth voltage, e.g., a voltage much lower than the voltage of the data signals provided to the first data line D1, are supplied to a first scan line S1. Scan signals having a fifth voltage, e.g., a high state voltage, are supplied to a second scan line S2. Light emitting control signals having a sixth voltage, e.g., a low state voltage, are supplied to a first light emitting control line E1. Light emitting control signals having a seventh voltage, e.g., a high state voltage, are supplied to a second light emitting control line E2. The third voltage, the fifth voltage and the seventh voltage may be the same.

[0047] With the power sources and signals provided as described above, in the first pixel 101a, the data signals flow through the first data line D1, and the second transistor M2 is turned-on by the voltage applied through the first scan line S1. Thus, the voltage of the data signals is supplied to a first node N1. Additionally, the voltage of the data signals is supplied from the first node N1 to the gate of the first transistor M1. The voltage of 0 V is supplied from the first power source ELVDD to the source of the first transistor M1. The third transistor M3 is turned-on by the light emitting control signal transferred through the first light emitting control line E1, so that current flows from the source to the drain of the first transistor M1, through the third transistor M3, and to the organic light emitting diode OLED.

[0048] However, with respect to the second pixel 101b, although the second transistor M2 is turned-on by the scan signals transferred through the first scan line S1 and the third transistor M3 is turned-on by the light emitting control signals transferred through the first light emitting control line E1, the first transistor M1 is turned-off by the high state data signals transferred through the second data line D2, thereby blocking the generation of current.

[0049] In the case of the third pixel 101 c, the second transistor M2 is turned-off by the scan signals transferred through the second scan line S2, preventing the data signals transferred through the first data line D1 from being supplied to the control gate of the first transistor M1. Also, the third transistor M3 is turned-off by the light emitting control signals transferred through the second

light emitting control line E2, blocking the generation of current.

[0050] In the case of the fourth pixel 101 d, the high state data signals are transferred through the second data line D2. Further, the scan signals transferred through the second scan line S2 have the high state voltage, so that the second transistor M2 is turned-off. The third transistor M3 is turned-off by the light emitting control signals transferred through the second light emitting control line E2, blocking the generation of current. Thus, with the power sources and signals provided as described above, current flows only in the first pixel 101a.

[0051] The above-described operations may be extended such that the current flowing into the second pixel 101 b, the third pixel 101 c, and the fourth pixel 101d can be measured in sequence. In particular, it will be appreciated that the operation of the above-described first through fourth pixels 101a through 101d may be controlled by the data signals transferred through the data lines D1 and D2, the scan signals transferred through the scan lines S1 and S2, and the voltage of the light emitting control signals transferred through the light emitting control lines E1 and E2, such that the current flowing into the second pixel 101b, the third pixel 101c, and the fourth pixel 101d can be measured in sequence.

[0052] Compensation of the threshold voltage of the first transistor M1 will now be described. The compensation value for compensating the threshold voltage of the first transistor M1 in the first pixel 101a may be determined using the current measured above.

[0053] The compensation value can be determined using the values of the voltage of the control gate and the current flowing into the first pixel 101a. The case of compensating the threshold voltage by raising the threshold voltage, as well as the case of compensating the threshold voltage by lowering the threshold voltage, may be based on the determined value, as will now be described in detail.

[0054] The case where the threshold voltage of the first pixel 101a is compensated by raising the threshold voltage will now be described.

[0055] For the first pixel 101a, the first power source ELVDD applies a voltage much lower than the low state, and the second power source ELVSS applies the voltage of 0V. Data signals having the high state voltage are transferred through the first data line D1, the scan signal having the low state voltage is transferred through the first scan line S 1, and the light emitting signal transferred through the first light emitting control line E1 becomes a high state. Accordingly, electrons are injected into the floating gate of the first transistor M1 in the first pixel 101a, so that the threshold voltage is raised. Electrons may be caused to flow into the floating gate of the first transistor M1 at a rate that depends on the voltage of the data signals.

[0056] As described above, electrons may be caused to flow into the floating gate of the first transistor M1 of the first pixel 101a, thereby increasing the threshold volt-

age of the first transistor, when a high state voltage, i.e., a data signal having a high voltage, is transferred to the gate of the first transistor M1, a voltage lower than a low state voltage is provided by the first power source ELVDD to the source of the first transistor M1, and a voltage of 0V is supplied from the second power source ELVSS. The low state voltage may be provided by the second power source ELVSS during an image-display operation of the organic light emitting diode, i.e., when current flows in the organic light emitting diode to display images.

[0057] Additionally, data signals having the low state voltage are transferred through the second data line D2, scan signals having the high state voltage are transferred through the second scan line S2, and the light emitting signal transferred through the second light emitting control line E2 becomes a high state.

[0058] It will be appreciated that the compensation of the threshold voltage can be controlled by changing the voltage of the first power source ELVDD. In particular, to increase the compensation of the threshold voltage, the voltage of the first power source ELVDD may be lowered. To reduce the compensation of the threshold voltage, the voltage of the first power source ELVDD may be raised.

[0059] With respect to the second pixel 101b, although the scan signals transferred through the first scan line S1 are in a low state, the data signals transferred through the second data line D2 have the low state voltage. Accordingly, the second transistor M2 is turned-off and the control gate of the first transistor M1 is turned-off, so that the threshold voltage of the first transistor M1 in the second pixel 101b is not compensated.

[0060] In the case of the third pixel 101c, although the data signals transferred through the first data line D1 are in a high state, the scan signals transferred through the second scan line S2 are in a high state. Accordingly, the second transistor M2 is turned-off and the control gate of the first transistor M1 is thus placed in a floating state. Therefore, the threshold voltage of the first transistor M1 in the third pixel 101c is not compensated.

[0061] In the case of the fourth pixel 101d, the scan signals transferred through the second scan line S2 are in a high state, so that the second transistor M2 is turned off and the control gate of the first transistor M1 is placed in a floating state. Therefore, the threshold voltage of the first transistor M1 in the fourth pixel 101d is not compensated.

[0062] The above-described operations may be extended to the remaining pixels. In particular, if the voltages of the data signals and the scan signals are sequentially controlled, the threshold voltages of the second pixel to the fourth pixel 101b, 101c, and 101d may also be compensated.

[0063] The case where the threshold voltage of the first pixel 101a is compensated by lowering the threshold voltage will now be described.

[0064] For the first pixel 101a, the first power source ELVDD applies the high state voltage and the second

power source ELVSS applies the voltage of 0V. Data signals having a voltage much lower than the low state are transferred through the first data line D1. The scan signal transferred through the first scan line S1 has a voltage much lower than the voltage of the data signals flowing into the first data line D1. The light emitting signal transferred through the first light emitting control line E1 becomes a high state. Accordingly, electrons stored in the floating gate are extracted into the channel region of the first transistor M1 so that the threshold voltage of the first transistor M1 of the first pixel 101a is lowered.

[0065] Additionally, the data signals having the high state voltage are transferred through the second data line D2, the scan signals transferred through the second scan line S2 have the high state voltage, and the light emitting signal transferred through the second light emitting control line E2 becomes a high state.

[0066] The compensation of the threshold voltage can be controlled by changing the voltage of the first data line D1. In particular, to increase the compensation of the threshold voltage, the voltage of the first data line D1 may be lowered. To reduce the compensation of the threshold voltage, the voltage of the first data line D1 may be raised.

[0067] With respect to the second pixel 101b, the scan signals transferred through the first scan line S1 are in a low state and the data signals transferred through the second data line D2 have the high state voltage. As a result, the first transistor M1 of the second pixel 101b is turned-off. Accordingly, the threshold voltage of the first transistor M1 of the second pixel 101b is not compensated.

[0068] In the case of the third pixel 101c, the data signals transferred through the first data line D1 are in a high state and the scan signals transferred through the second scan line S2 are in a high state. Accordingly, the second transistor M2 is turned-off and the control gate of the first transistor M1 is placed in a floating state. Therefore, the threshold voltage of the first transistor M1 of the third pixel 101c is not compensated.

[0069] In the case of the fourth pixel 101d, the scan signals transferred through the second scan line S2 are in a high state. Accordingly, the second transistor M2 is turned off so that the control gate of the first transistor M1 is placed in a floating state. Therefore, the threshold voltage of the first transistor M1 of the fourth pixel 101d is not compensated.

[0070] The above-described operations may be extended to the remaining pixels. In particular, if the voltages of the data signals and the scan signals are sequentially controlled, the threshold voltages of the second pixel to the fourth pixel 101b, 101c, and 101d may also be compensated.

[0071] If the threshold voltages of the first transistors M1 are compensated using the operations described above, the organic light emitting display may display a uniform screen. Additionally, the pixel circuits may be simplified by eliminating the need for a separate threshold voltage compensation circuit.

[0072] FIGS. 7 and 8 illustrate embodiments of pixel circuits in the organic light emitting display of FIG. 2. Referring to FIG. 7, the first transistor M1 may be implemented as an NVM element of an NMOS type. As illustrated in FIG. 5, if the voltage of the control gate is lowered, the threshold voltage is lowered and, if the voltage of the control gate is raised, the threshold voltage is raised.

[0073] Referring to FIG. 8, the third transistor M3 may be implemented as an NMOS transistor. Further, the second transistor M2 and the third transistor M3 may be connected to a same scan line Sn. Accordingly, the second transistor M2 and the third transistor M3 may be alternately turned-on. Therefore, when the data signals are supplied to the pixel, the third transistor M3 is turned-off, and then the third transistor M3 is turned-on after a predetermined time so that current flows in the pixel.

[0074] As described above, a threshold voltage of a transistor may be compensated by storing a compensation value for the threshold voltage in the transistor using a non-volatile memory element. Accordingly, a separate threshold compensation circuit may be omitted, thereby simplifying the circuit structure.

Claims

1. An organic light emitting display, comprising:

a pixel unit (100) having a plurality of pixels (101);
 a data driver (110) connected to data lines (D1...Dm) of the pixel unit (100); and
 a scan driver (120) connected to scan lines (S1...Sn) of the pixel unit (100), wherein each pixel (101) includes:

a driving transistor (M1) having a first electrode connected to a first power source (ELVDD), a control gate connected to a first node (N1), and a second electrode;

a second transistor (M2) having a first electrode connected to a data line (D1...Dm), a second electrode connected to the first node (N1), and a gate connected to a scan line (S1...Sn);

a third transistor (M3) having a first electrode connected to the second electrode of the driving transistor (M1), a gate connected to one of a light emitting control line (E1...En) and the scan line (S1...Sn), and a second electrode;

a capacitor (Cst) connected between the first power source (ELVDD) and the first node (N1); and

an organic light emitting diode (OLED) having an anode connected to the second electrode of the third transistor (M3) and a cath-

ode connected to a second power source (ELVSS), **characterised in that** the driving transistor (M1) includes a floating gate and an insulating layer between the floating gate and the control gate.

2. The organic light emitting display as claimed in claim 1, wherein:

the scan driver (120) is connected to light emitting control lines (E1...En) of the pixel unit (100), and
 the gate of the third transistor (M3) of each pixel is connected to a light emitting control line (E1...En).

3. The organic light emitting display as claimed in one of the claims 1 or 2, wherein the first (M1), second (M2), and third transistors (M3) are PMOS transistors.

4. The organic light emitting display as claimed in one of the claims 1 or 2, wherein the driving transistor (M1) is an NMOS transistor, and the second (M2) and third transistors (M3) are PMOS transistors.

5. The organic light emitting display as claimed in claim 1, wherein:

the gate of the third transistor (M3) of each pixel (101) is connected to the scan line (S1...Sn), and the third transistor (M3) of each pixel (101) is of an opposite conduction type as the second transistor (M2) of the pixel (101).

6. The organic light emitting display as claimed in claim 5, wherein the first (M1) and second transistors (M2) are PMOS transistors, and the third transistor (M3) is an NMOS transistor.

7. A compensation method for an organic light emitting display, comprising:

determining a current flowing into a driving transistor (M1) of a pixel (101);
 determining a deviation of a threshold voltage of the driving transistor (M1) using the determined current; and
 compensating for the deviation of the threshold voltage, wherein:

the driving transistor (M1) is a floating gate transistor, and
 compensating for the deviation of the threshold voltage includes storing a voltage corresponding to the deviation of the threshold voltage in the driving transistor (M1).

8. The method as claimed in claim 7, wherein storing the voltage corresponding to the deviation of the threshold voltage includes controlling an amount of electrons stored in a floating gate (205) of the floating gate transistor. 5
9. The method as claimed in claim 8, further comprising extracting electrons stored in the floating gate (205) into a channel region of the driving transistor (M1) to lower the threshold voltage. 10
10. The method as claimed in claim 9, wherein extracting electrons into the channel region includes providing a high state voltage to a source of the driving transistor (M1) and providing a low state voltage to a control gate (207) of the driving transistor (M1). 15
11. The method as claimed in claim 8, further comprising injecting electrons into the floating gate (205) to raise the threshold voltage. 20
12. The method as claimed in claim 11, wherein injecting electrons into the floating gate (205) includes providing a low state voltage to a source of the driving transistor (M1) and providing a high state voltage to a control gate of the driving transistor (M1). 25

Patentansprüche

1. Organische lichtemittierende Anzeige, aufweisend:

eine Pixeleinheit (100), die eine Vielzahl von Pixeln (101) aufweist:

einen Datentreiber (110), der mit Datenleitungen (D1...Dm) der Pixeleinheit (100) verbunden ist; und

einen Ansteuertreiber (120), der mit Ansteuerleitungen (S1...Sn) der Pixeleinheit (100) verbunden ist, wobei jeder Pixel (101) aufweist:

einen Ansteuertransistor (M1), der eine erste Elektrode, die mit einer ersten Energiequelle (ELVDD) verbunden ist, ein Steuer-Gate, das mit einem ersten Knoten (N1) verbunden ist, und eine zweite Elektrode aufweist;

einen zweiten Transistor (M2), der eine erste Elektrode, die mit einer Datenleitung (D1 ... Dm) verbunden ist, eine zweite Elektrode, die mit dem ersten Knoten (N1) verbunden ist, und ein Gate, das mit einer Ansteuerleitung (S1...Sn) verbunden ist, aufweist;

einen dritten Transistor (M3), der eine erste Elektrode, die mit der zweiten

Elektrode des Ansteuertransistors (M1) verbunden ist, ein Gate, das entweder mit einer Lichtemissionskontrollleitung (E1 ... En) oder mit der Ansteuerleitung (S1... Sn) verbunden ist, und eine zweite Elektrode aufweist; einen Kondensator (Cst), der zwischen die ersten Energiequelle (ELVDD) und den ersten Knoten (N1) geschaltet ist; und eine organische lichtemittierende Diode (OLED), die eine Anode, die mit der zweiten Elektrode des dritten Transistors (M3) verbunden ist, und eine Kathode, die mit einer zweiten Energiequelle (ELVSS) verbunden ist, aufweist, **dadurch gekennzeichnet, dass** der Ansteuertransistor (M1) ein Floating-Gate (schwebendes Gate) und eine Isolierschicht zwischen dem Floating-Gate und dem Steuer-Gate aufweist.

2. Organische lichtemittierende Anzeige nach Anspruch 1, wobei:

der Ansteuertreiber (120) mit Lichtemissionskontrollleitungen (E1...En) der Pixeleinheit (100) verbunden ist, und das Gate des dritten Transistors (M3) jedes Pixels mit einer Lichtemissionskontrollleitung (E1...En) verbunden ist.

3. Organische lichtemittierende Anzeige nach einem der Ansprüche 1 oder 2, wobei der erste (M1), zweite (M2) und dritte (M3) Transistor PMOS-Transistoren sind.

4. Organische lichtemittierende Anzeige nach einem der Ansprüche 1 oder 2, wobei der Ansteuertransistor (M1) ein NMOS-Transistor ist und der zweite (M2) und dritte (M3) Transistor PMOS-Transistoren sind.

5. Organische lichtemittierende Anzeige nach Anspruch 1, wobei:

das Gate des dritten Transistors (M3) jedes Pixels (101) mit der Ansteuerleitung (S1... Sn) verbunden ist, und der dritte Transistor (M3) jedes Pixels (101) einem dem zweiten Transistor (M2) des Pixels (101) entgegengesetzten Leitungstyp entspricht.

6. Organische lichtemittierende Anzeige nach Anspruch 5, wobei der erste (M1) und zweite (M2) Transistor PMOS-Transistoren sind und der dritte Tran-

sistor (M3) ein NMOS-Transistor ist.

7. Kompensationsverfahren für eine organische lichtemittierende Anzeige, aufweisend:

Bestimmung eines Stroms, der in einen Ansteuertransistor (M1) eines Pixels (101) fließt;
Bestimmung einer Abweichung einer Schwellenspannung des Ansteuertransistors (M1) mittels des bestimmten Stroms; und
Kompensation der Abweichung der Schwellenspannung, wobei:

der Ansteuertransistor (M1) ein Floating-Gate-Transistor ist, und
die Kompensation der Abweichung der Schwellenspannung ein Speichern einer Spannung entsprechend der Abweichung der Schwellenspannung im Ansteuertransistor (M1) umfasst.

8. Verfahren nach Anspruch 7, wobei das Speichern der Spannung entsprechend der Abweichung der Schwellenspannung die Steuerung einer Menge von Elektronen, die in einem Floating-Gate (205) des Floating-Gate-Transistors gespeichert sind, umfasst.

9. Verfahren nach Anspruch 8, weiterhin aufweisend die Extraktion von Elektronen, die im Floating-Gate (205) gespeichert sind, in ein Kanalgebiet des Ansteuertransistors (M1) zur Senkung der Schwellenspannung.

10. Verfahren nach Anspruch 9, wobei die Extraktion von Elektronen in das Kanalgebiet die Bereitstellung einer Hochzustandsspannung an einer Source des Ansteuertransistors (M1) und die Bereitstellung einer Niedrigzustandsspannung an einem Steuer-Gate (207) des Ansteuertransistors (M1) umfasst.

11. Verfahren nach Anspruch 8, weiterhin aufweisend die Injektion von Elektronen in das Floating-Gate (205) zur Erhöhung der Schwellenspannung.

12. Verfahren nach Anspruch 11, wobei die Injektion von Elektronen in das Floating-Gate (205) die Bereitstellung einer Niedrigzustandsspannung an einer Source des Ansteuertransistors (M1) und die Bereitstellung einer Hochzustandsspannung an einem Steuer-Gate des Ansteuertransistors (M1) umfasst.

Revendications

1. Dispositif d'affichage électroluminescent organique, comprenant :

une unité de pixels (100) qui a une pluralité de pixels (101) ;

un circuit d'attaque de données (110) connecté à des lignes de données (D1...Dm) de l'unité de pixels (100) ; et

un circuit d'attaque de balayage (120) connecté à des lignes de balayage (S1... Sn) de l'unité de pixels (100), dans lequel chaque pixel (101) comporte :

un transistor d'attaque (M1) ayant une première électrode connectée à une première source de puissance (ELVDD), une grille de commande connectée à un premier noeud (N1), et une deuxième électrode ;

un deuxième transistor (M2) ayant une première électrode connectée à une ligne de données (D1...Dm), une deuxième électrode connectée au premier noeud (N1), et une grille connectée à une ligne de balayage (S1...Sn);

un troisième transistor (M3) ayant une première électrode connectée à la deuxième électrode du transistor d'attaque (M1), une grille connectée à l'une parmi une ligne de commande électroluminescente (E1...En) et la ligne de balayage (S1...Sn), et une deuxième électrode ;

un condensateur (Cst) connecté entre la première source de puissance (ELVDD) et le premier noeud (N1); et

une diode électroluminescente organique (OLED) ayant une anode connectée à la deuxième électrode du troisième transistor (M3) et une cathode connectée à une deuxième source de puissance (ELVSS), **caractérisé en ce que** le transistor d'attaque (M1) comporte une grille flottante et une couche d'isolation entre la grille flottante et la grille de commande.

2. Dispositif d'affichage électroluminescent organique tel que revendiqué dans la revendication 1, dans lequel :

le circuit d'attaque de balayage (120) est connecté à des lignes de commande électroluminescentes (E1... En) de l'unité de pixels (100), et la grille du troisième transistor (M3) de chaque pixel est connectée à une ligne de commande électroluminescente (E1...En).

3. Dispositif d'affichage électroluminescent organique tel que revendiqué dans l'une des revendications 1 ou 2, dans lequel les premier (M1), deuxième (M2), et troisième transistors (M3) sont des transistors PMOS.

4. Dispositif d'affichage électroluminescent organique tel que revendiqué dans l'une des revendications 1 ou 2, dans lequel le transistor d'attaque (M1) est un transistor NMOS, et les deuxième (M2) et troisième transistors (M3) sont des transistors PMOS.
5. Dispositif d'affichage électroluminescent organique tel que revendiqué dans la revendication 1, dans lequel :
- la grille du troisième transistor (M3) de chaque pixel (101) est connectée à la ligne de balayage (S1...Sn), et
- le troisième transistor (M3) de chaque pixel (101) est d'un type de conductivité opposé à celui du deuxième transistor (M2) du pixel (101).
6. Dispositif d'affichage électroluminescent organique tel que revendiqué dans la revendication 5, dans lequel le premier (M1) et le deuxième (M2) transistor sont des transistors PMOS, et le troisième transistor (M3) est un transistor NMOS.
7. Procédé de compensation pour un dispositif d'affichage électroluminescent organique, comprenant le fait :
- de déterminer un courant circulant dans un transistor d'attaque (M1) d'un pixel (101) ;
- de déterminer une déviation d'une tension seuil du transistor d'attaque (M1) en utilisant le courant déterminé ; et
- de compenser la déviation de la tension seuil, dans lequel :
- le transistor d'attaque (M1) est un transistor à grille flottante, et
- la compensation de la déviation de la tension seuil comprend le fait de stocker une tension correspondant à la déviation de la tension seuil dans le transistor d'attaque (M1).
8. Procédé tel que revendiqué dans la revendication 7, dans lequel le stockage de la tension correspondant à la déviation de la tension seuil comprend le fait de commander une quantité d'électrons stockés dans une grille flottante (205) du transistor à grille flottante.
9. Procédé tel que revendiqué dans la revendication 8, comprenant en outre le fait d'extraire des électrons stockés dans la grille flottante (205) vers une région de canal du transistor d'attaque (M1) afin d'abaisser la tension seuil.
10. Procédé tel que revendiqué dans la revendication 9, dans lequel l'extraction d'électrons vers la région de canal comporte le fait de fournir une tension d'état haut à une source du transistor d'attaque (M1) et de fournir une tension d'état bas à une grille de commande (207) du transistor d'attaque (M1).
11. Procédé tel que revendiqué dans la revendication 8, comprenant en outre le fait d'injecter des électrons dans la grille flottante (205) afin d'élever la tension seuil.
12. Procédé tel que revendiqué dans la revendication 11, dans lequel l'injection d'électrons dans la grille flottante (205) comporte le fait de fournir une tension d'état bas à une source du transistor d'attaque (M1) et de fournir une tension d'état haut à une grille de commande du transistor d'attaque (M1).

FIG. 1
(PRIOR ART)

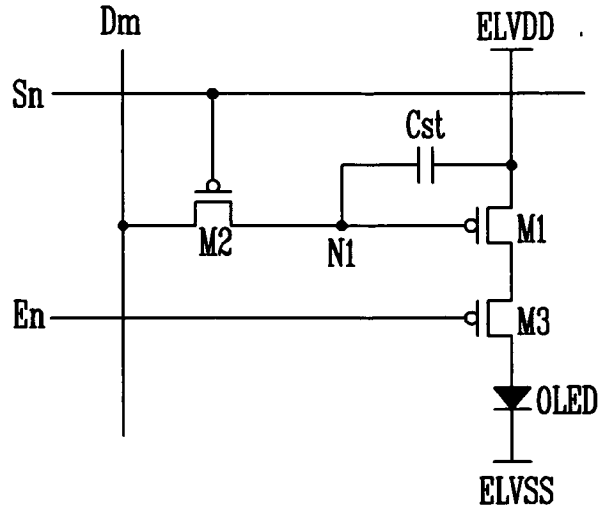


FIG. 2

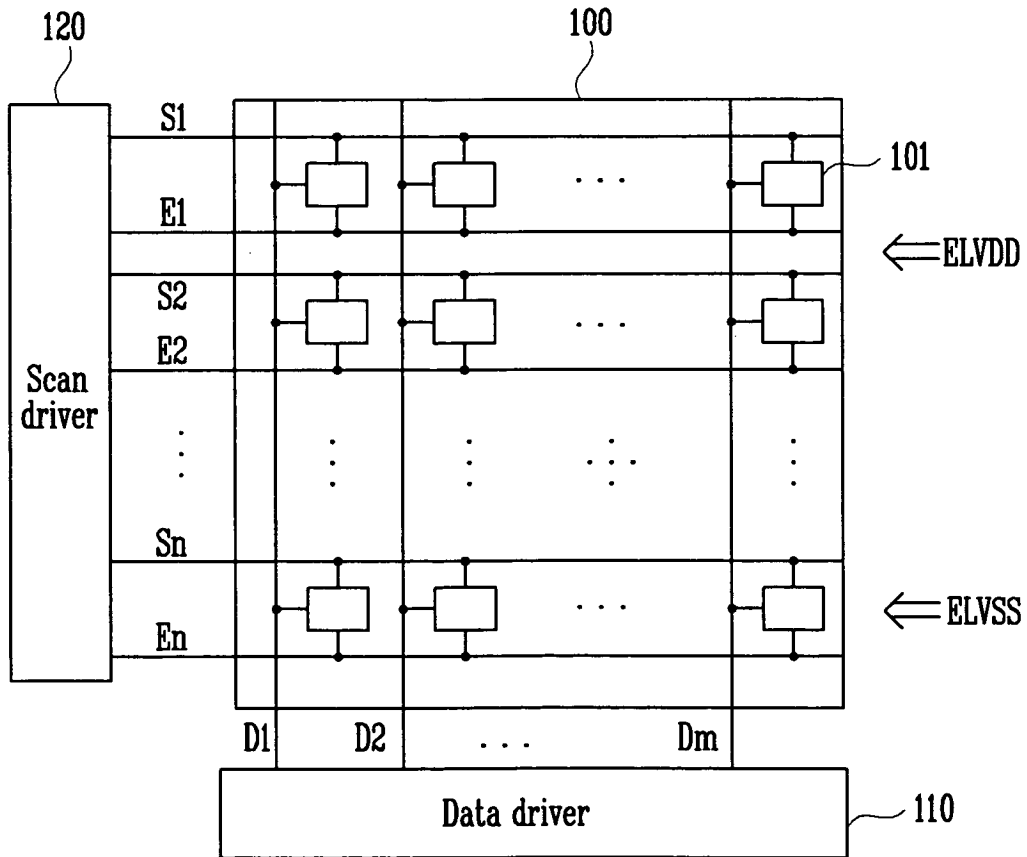


FIG. 3

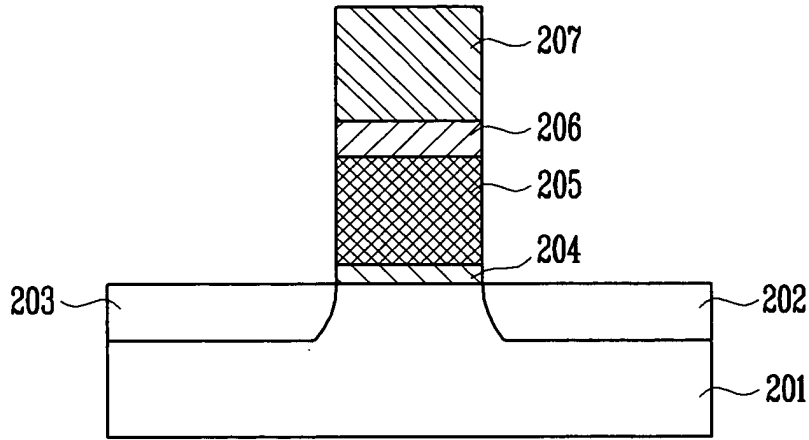


FIG. 4

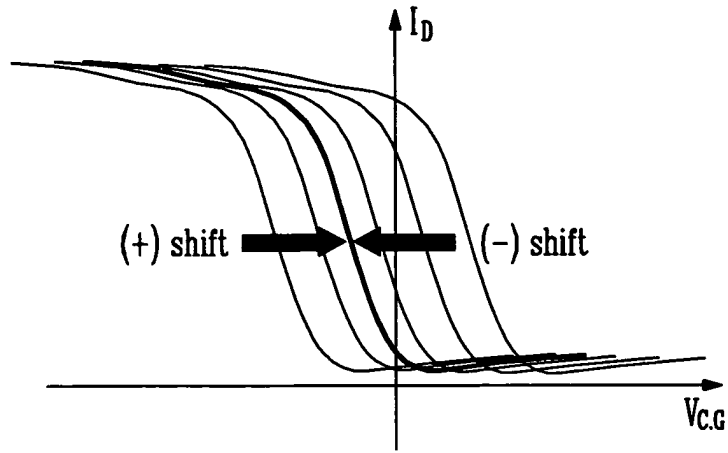


FIG. 5

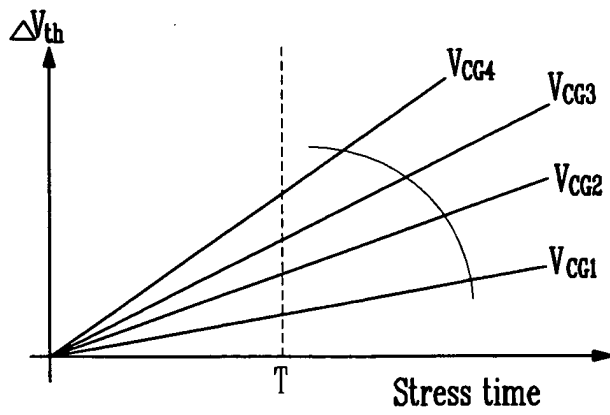


FIG. 6

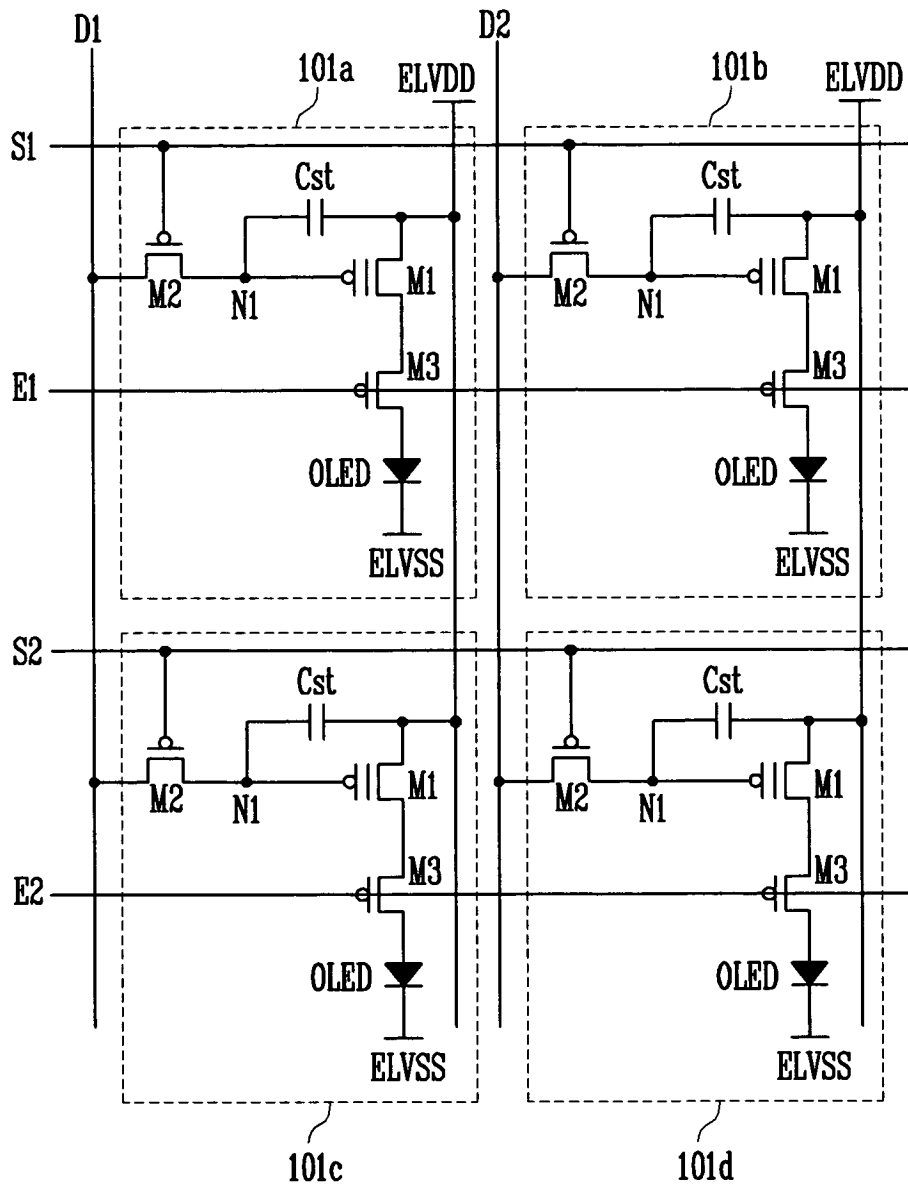


FIG. 7

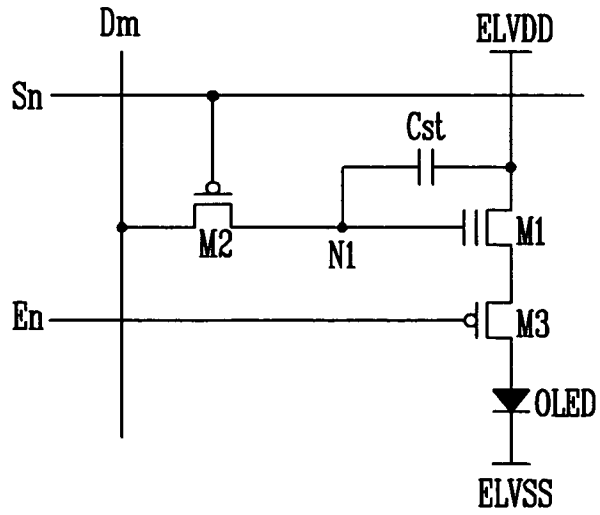
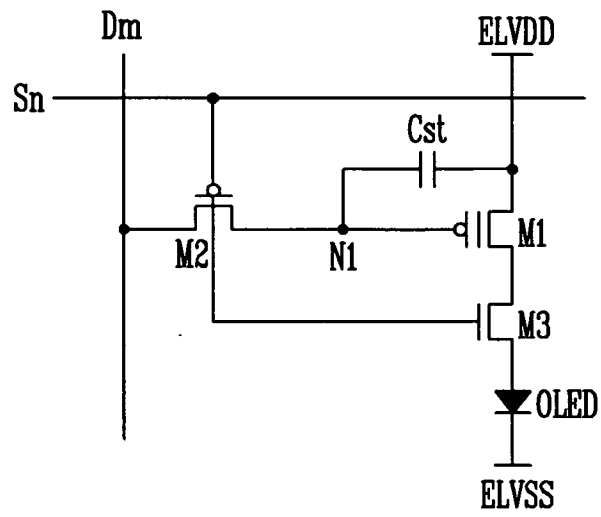


FIG. 8



REFERENCES CITED IN THE DESCRIPTION

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专利名称(译)	像素，有机发光显示器和相关方法		
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[标]申请(专利权)人(译)	三星斯笛爱股份有限公司		
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代理机构(译)	hengelhaupt, Jürgen		
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其他公开文献	EP2009618A3 EP2009618A2		
外部链接	Espacenet		

摘要(译)

像素包括有机发光二极管，具有连接到第一电源的源极的第一晶体管，连接到第一节点的控制栅极，以及连接到第二节点的漏极，其中第一晶体管包括浮置栅极和浮栅和控制栅之间的绝缘层，第二晶体管，其源极连接到数据线，漏极连接到第一节点，栅极连接到扫描线，第三晶体管，源极连接到第二晶体管节点，连接到有机发光二极管的漏极，连接到发光控制线和扫描线之一的栅极，以及连接在第一电源和第二节点之间的电容器。

FIG. 1
(PRIOR ART)

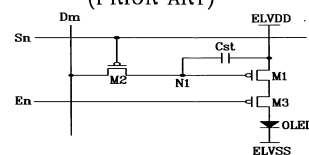


FIG. 2

