



US 20060125737A1

(19) **United States**(12) **Patent Application Publication**  
**Kwak et al.**(10) **Pub. No.: US 2006/0125737 A1**(43) **Pub. Date: Jun. 15, 2006**(54) **PIXEL AND LIGHT EMITTING DISPLAY**(52) **U.S. Cl. .... 345/76**(76) Inventors: **Won Kyu Kwak**, Seongnam (KR);  
**Sung Cheon Park**, Suwon (KR)(57) **ABSTRACT**Correspondence Address:  
**CHRISTIE, PARKER & HALE, LLP**  
**PO BOX 7068**  
**PASADENA, CA 91109-7068 (US)**

A pixel and a light emitting display including the pixel. The pixel includes first and second organic light emitting diodes (OLEDs), a driving circuit commonly connected to the plurality of OLEDs to drive the first and second OLEDs, a switching circuit connected between the first and second OLEDs and the driving circuit to sequentially control the driving of the first and second OLEDs using first and second emission control signals, and a reverse bias circuit for selectively applying a reverse bias voltage including at least one of the first and second emission control signals to the first and second OLEDs. Therefore, the reverse bias can be easily applied in the periods when the OLEDs do not emit light and thus can improve the characteristics of the OLEDs. Also, since, the first and second OLEDs are connected to one pixel circuit, it is possible to reduce the number of pixels of the light emitting display and thus to improve the aperture ratio of the light emitting display.

(21) Appl. No.: **11/274,042**(22) Filed: **Nov. 14, 2005**(30) **Foreign Application Priority Data**

Nov. 22, 2004 (KR) ..... 10-2004-0095983

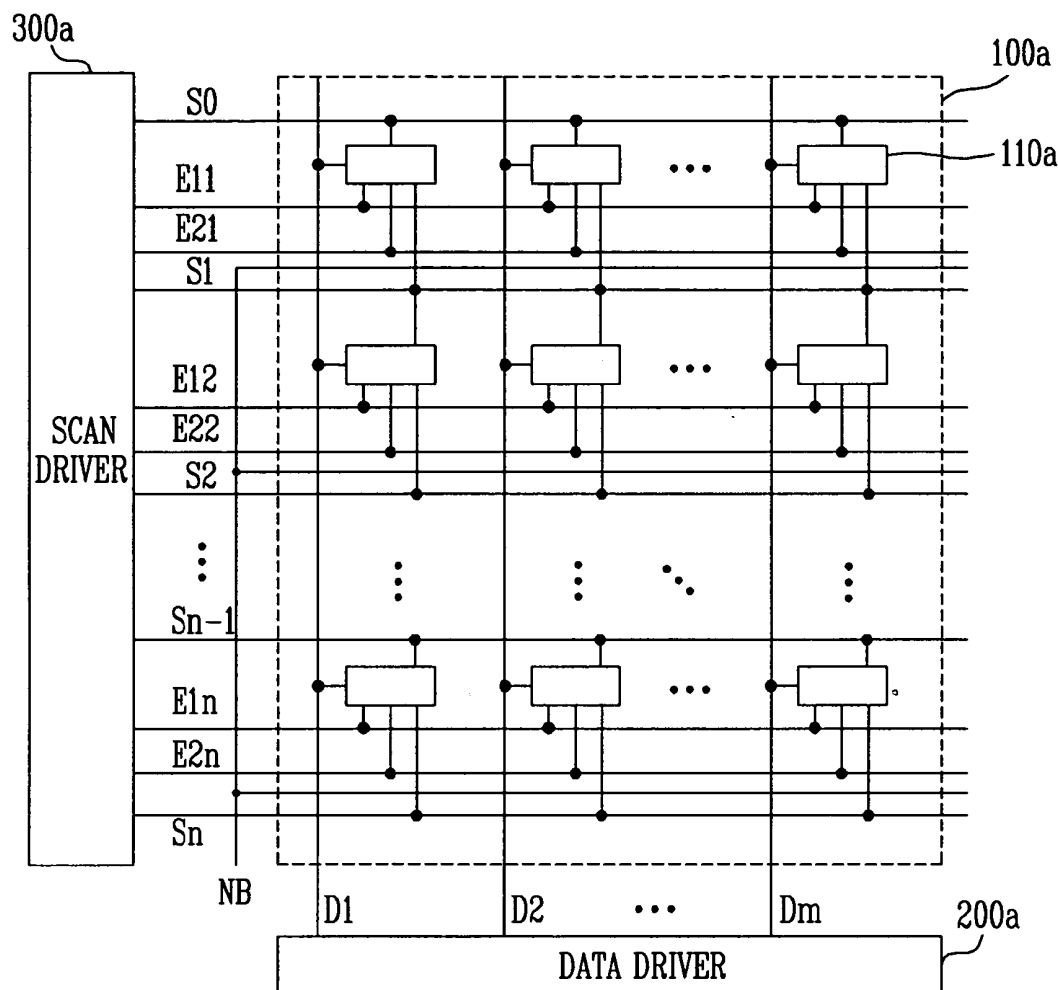
**Publication Classification**(51) **Int. Cl.**  
**G09G 3/30** (2006.01)

FIG. 1A  
(PRIOR ART)

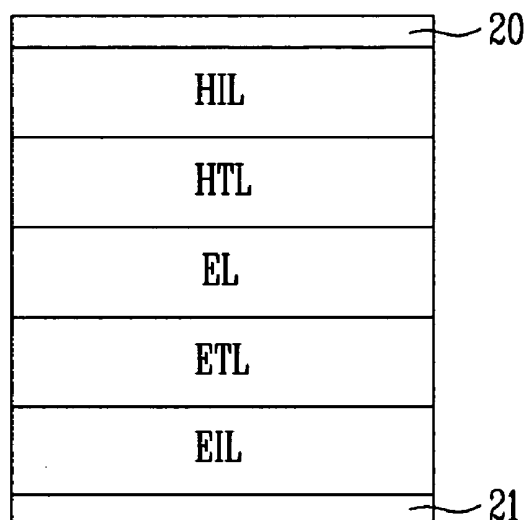


FIG. 1B  
(PRIOR ART)

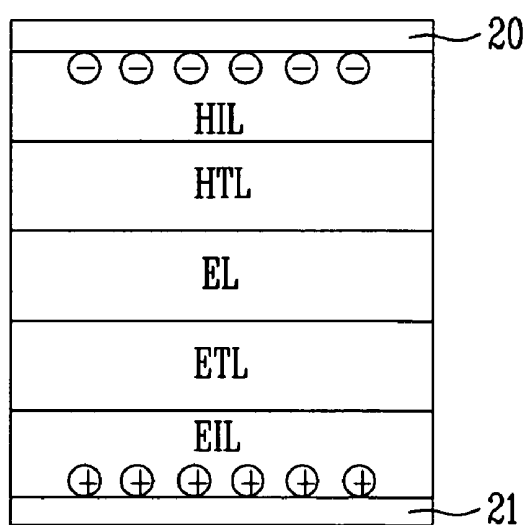


FIG. 2  
(PRIOR ART)

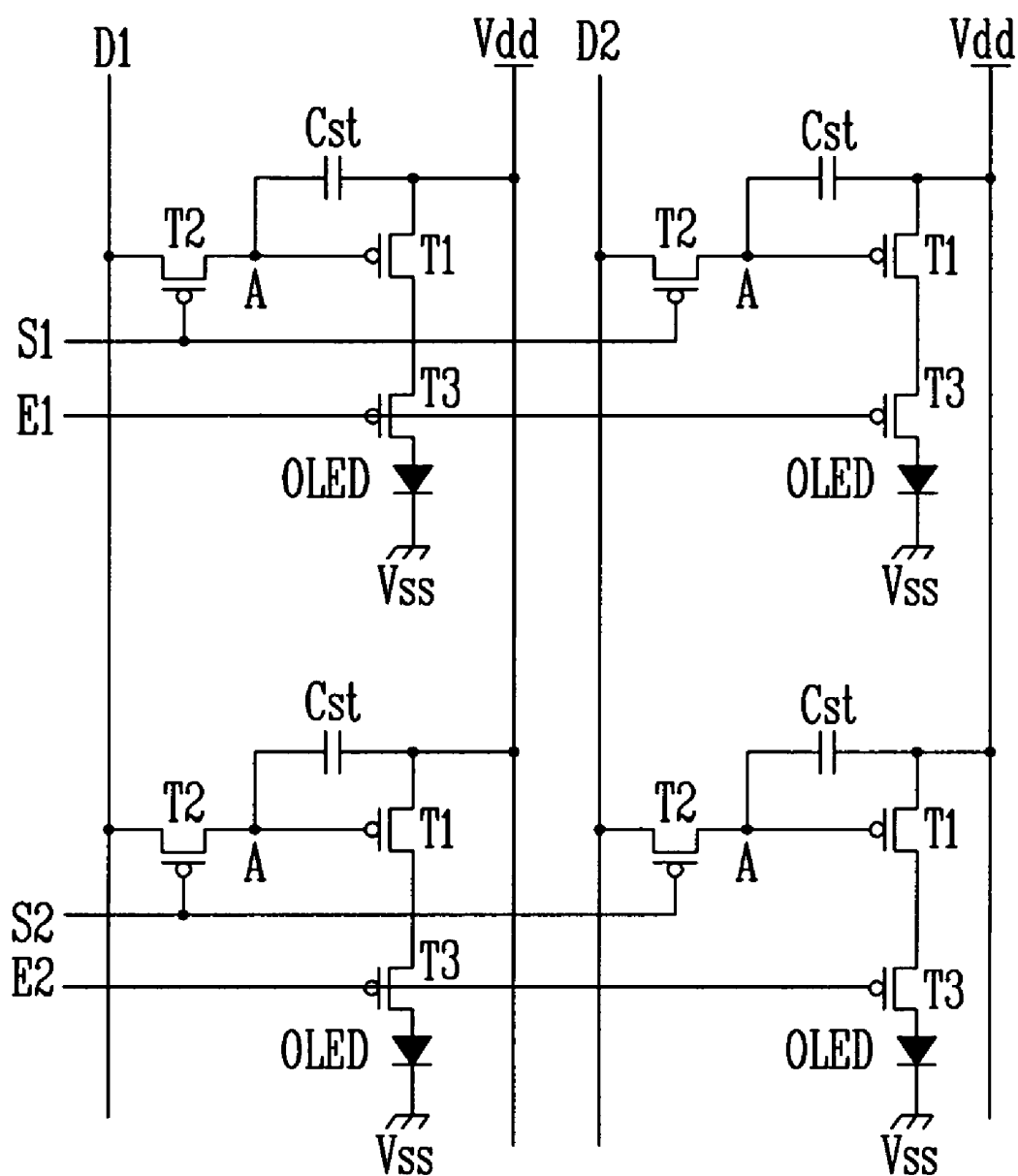


FIG. 3

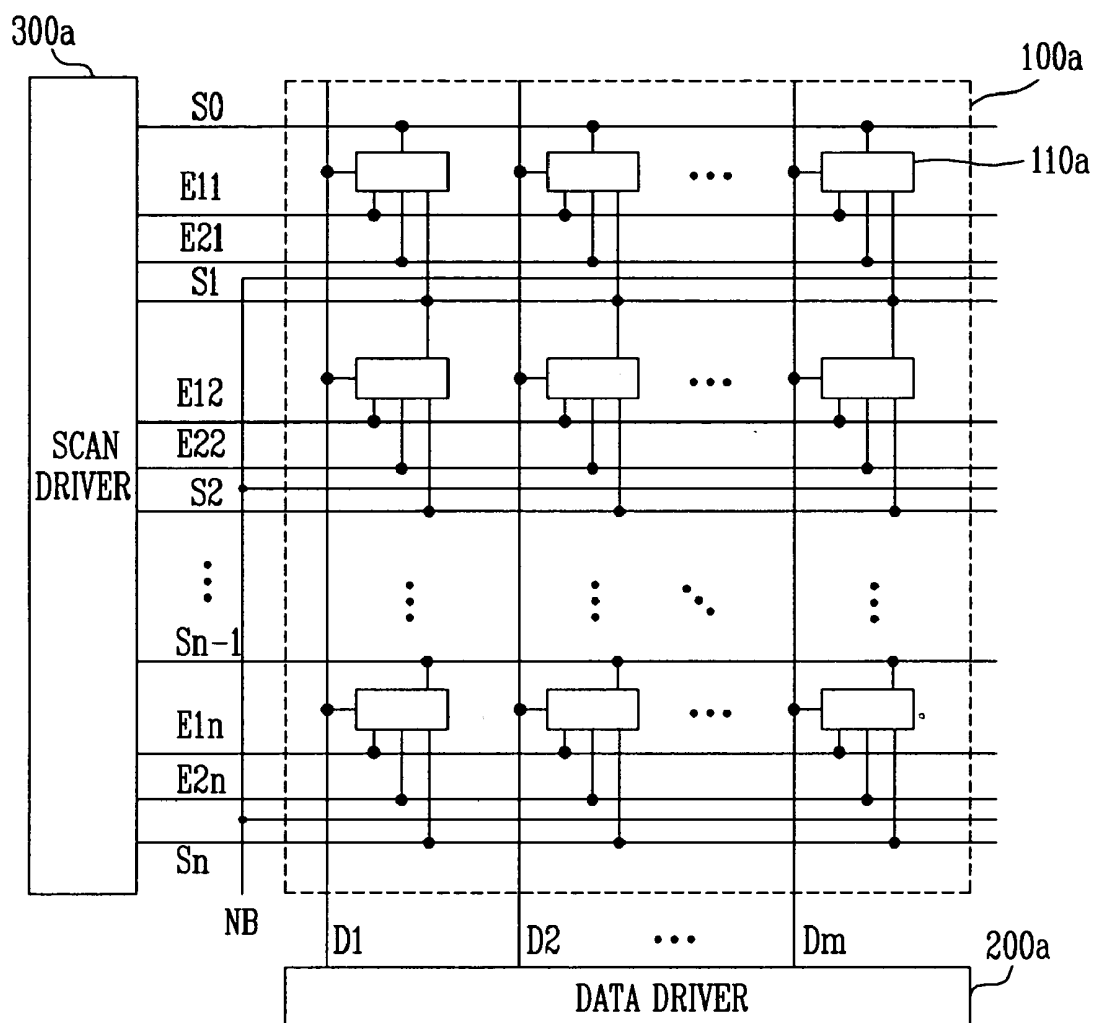


FIG. 4

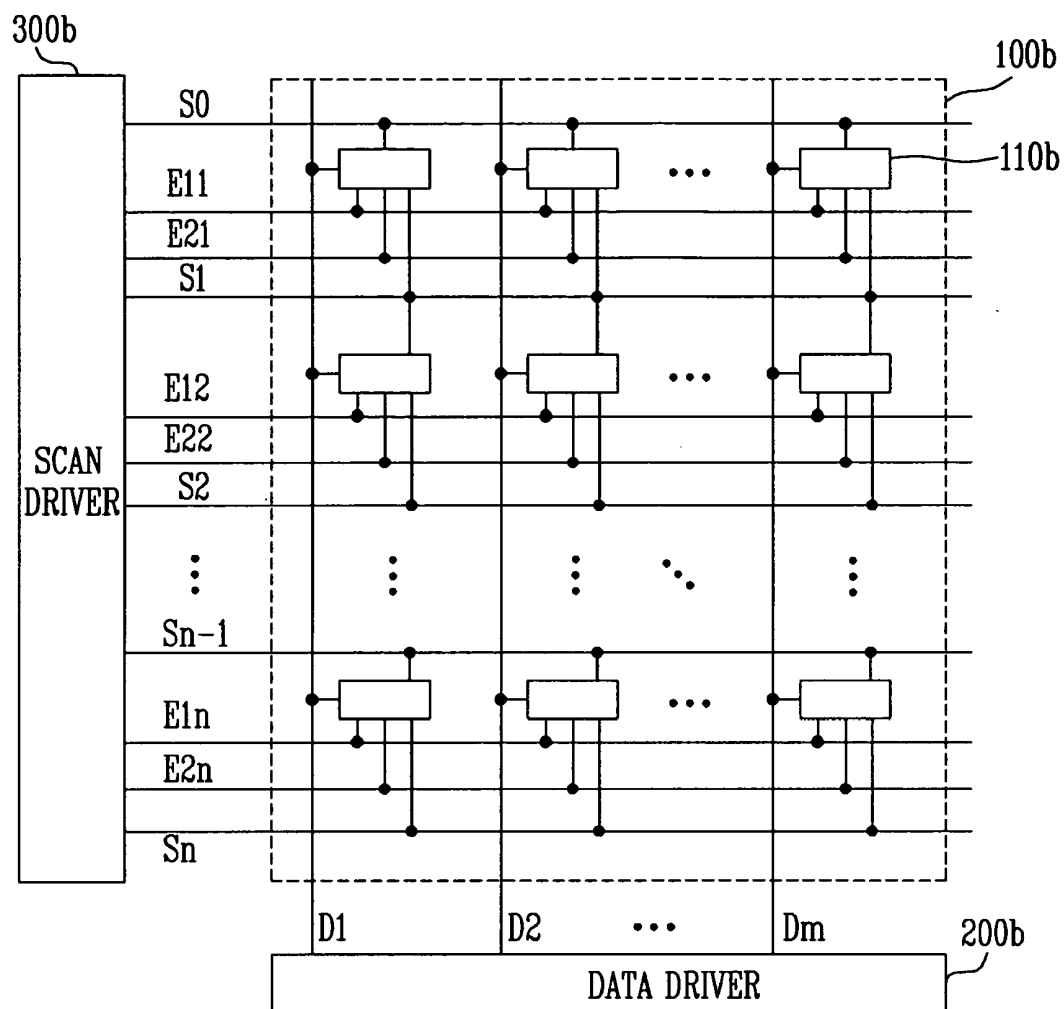


FIG. 5

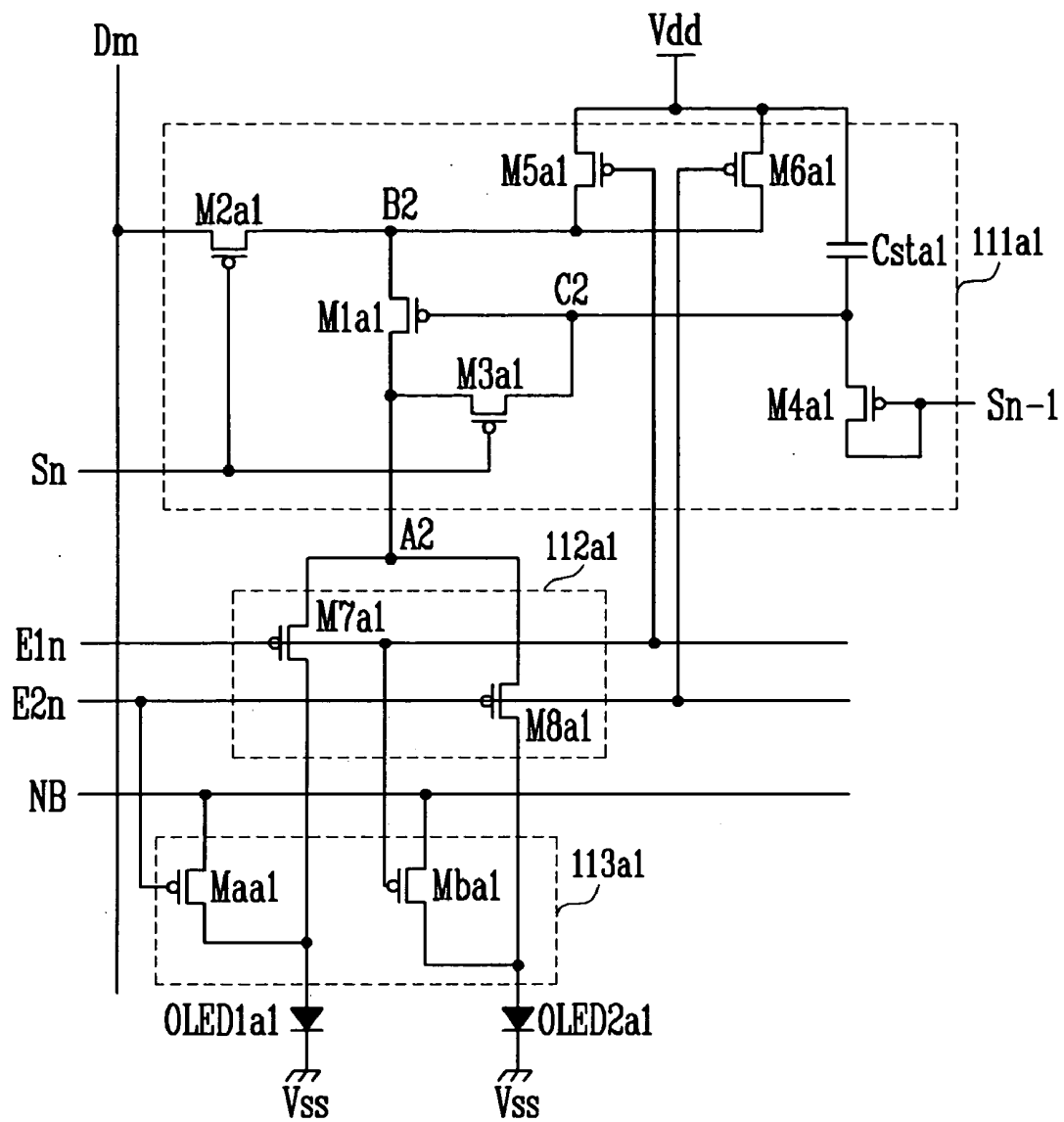


FIG. 6

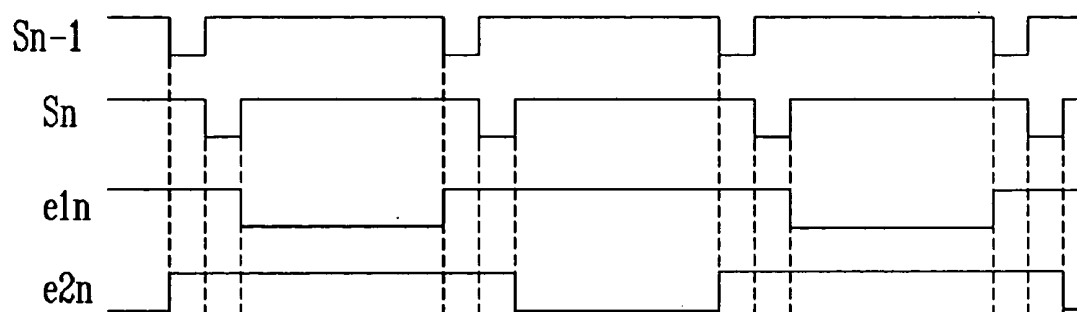


FIG. 7

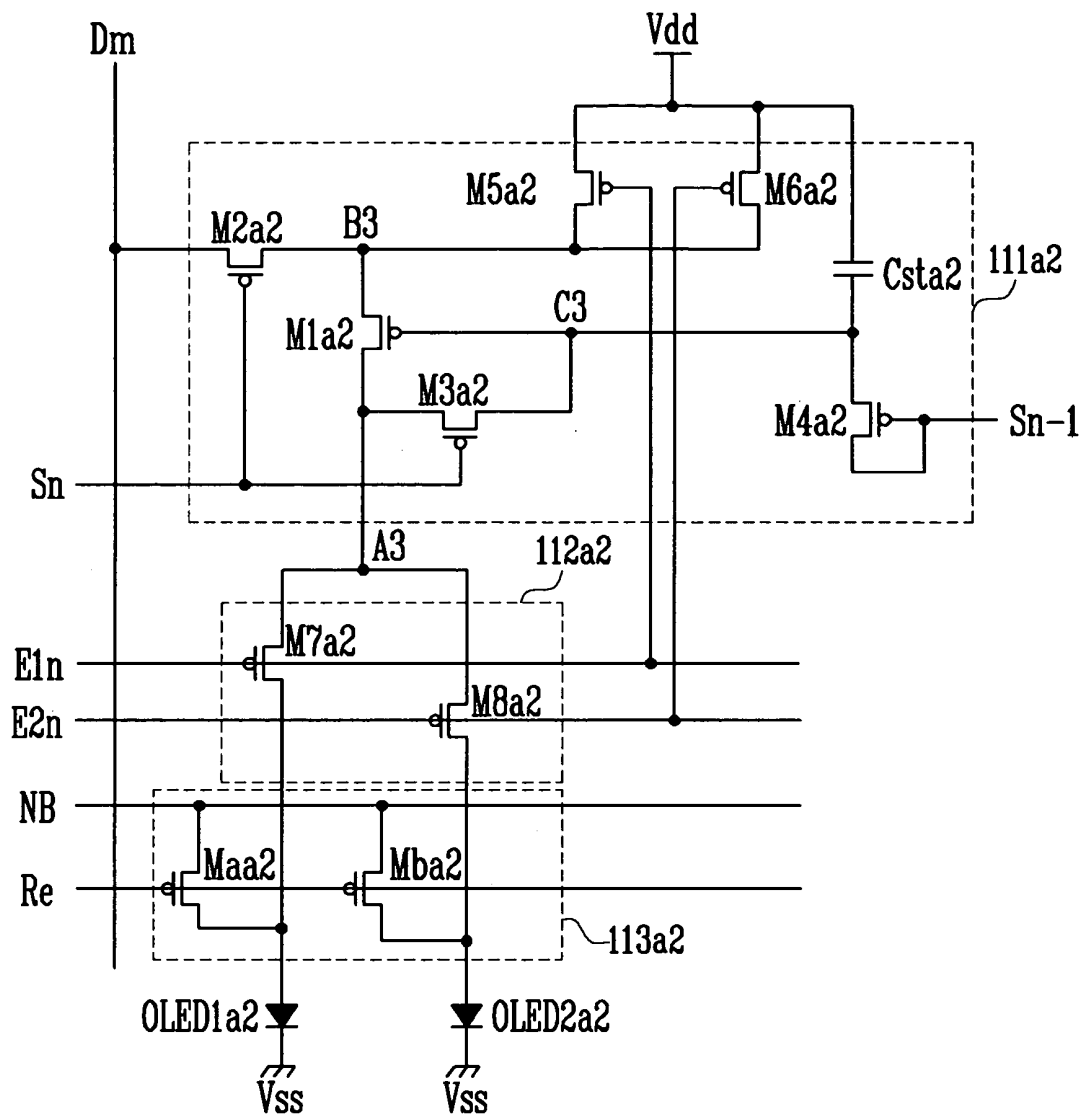




FIG. 8

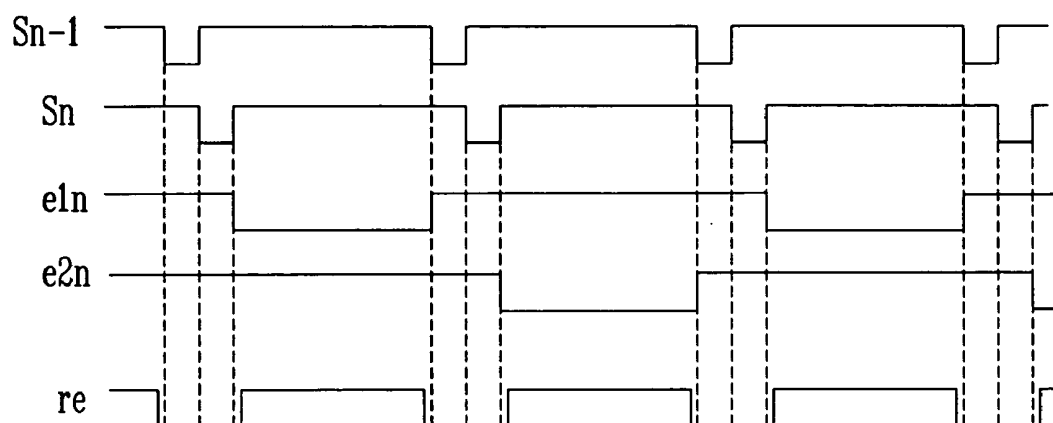


FIG. 9

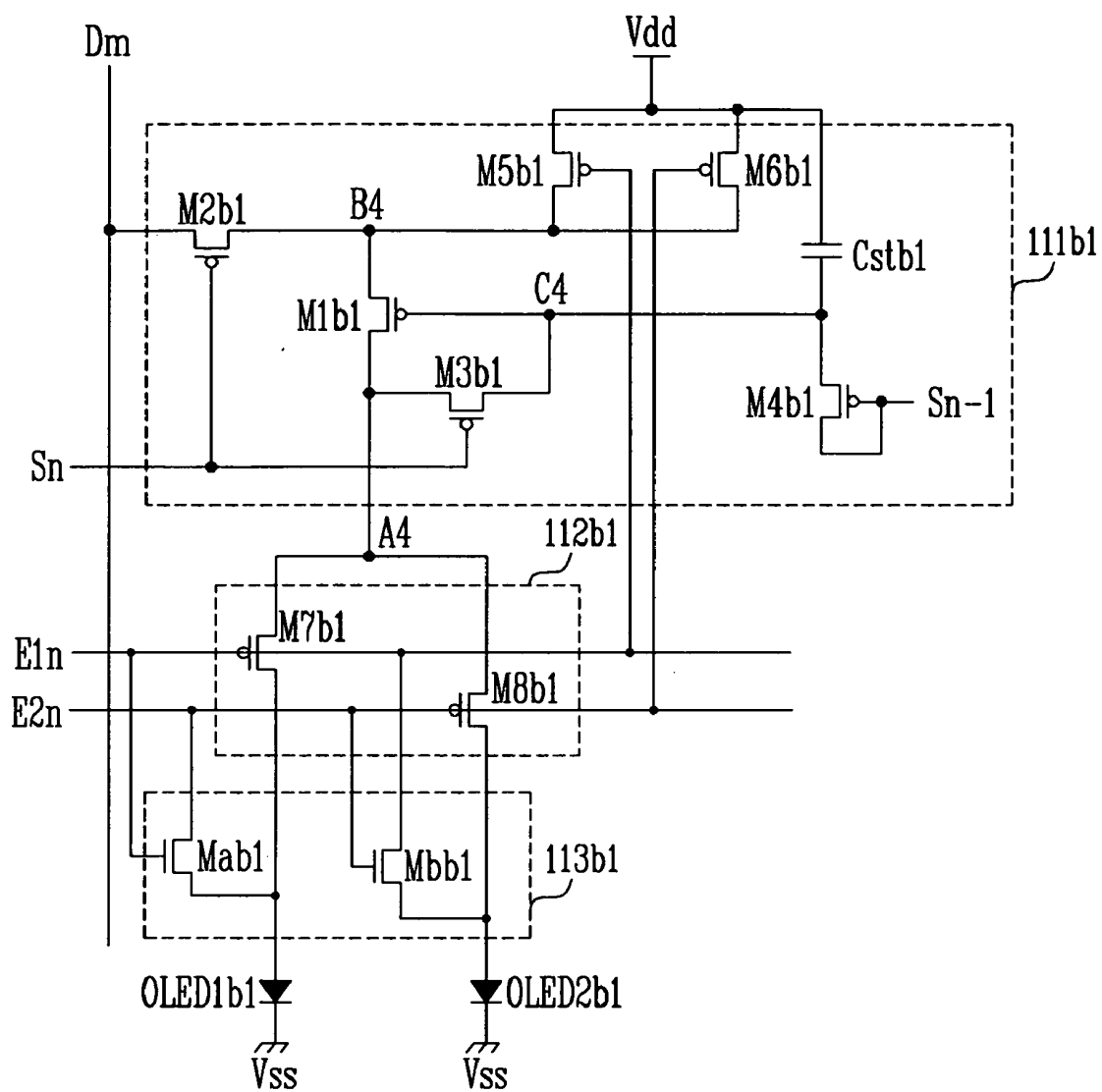


FIG. 10

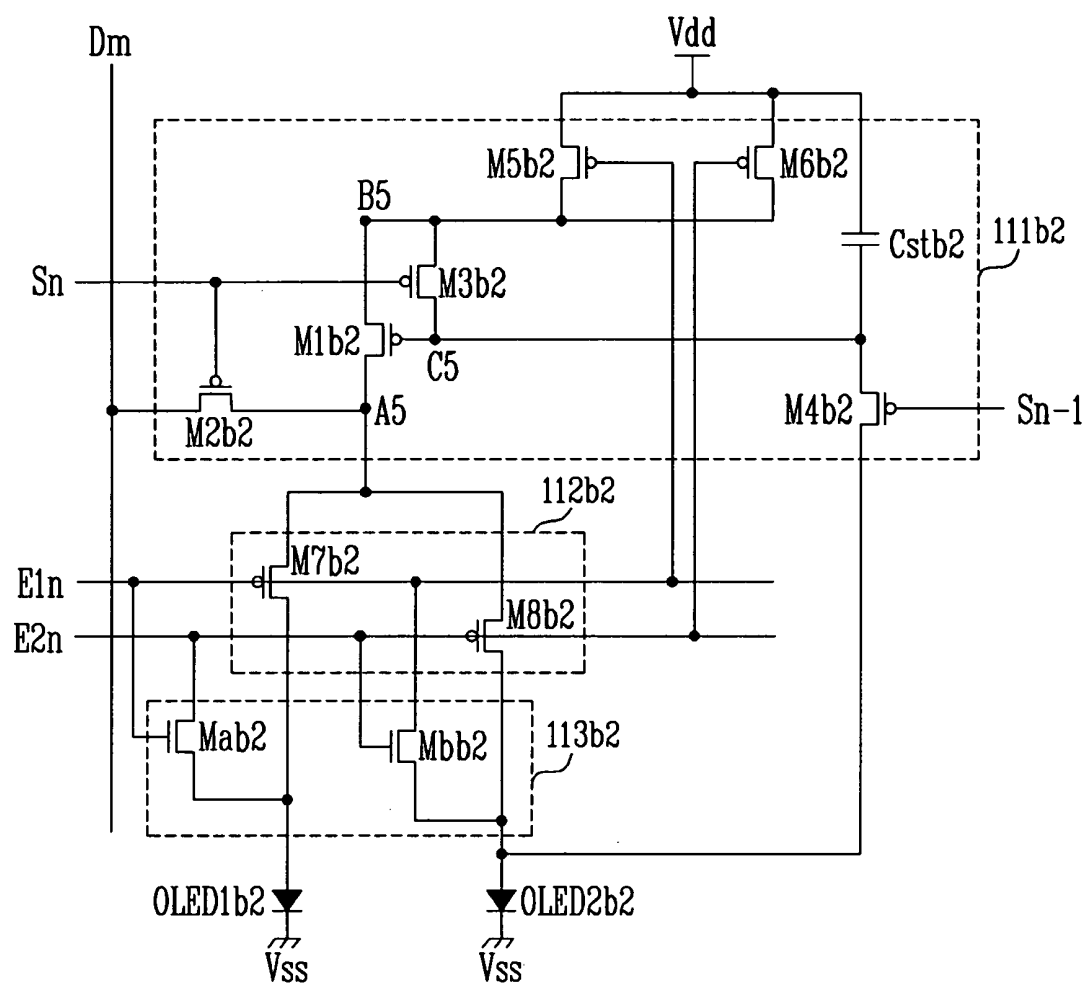


FIG. 11

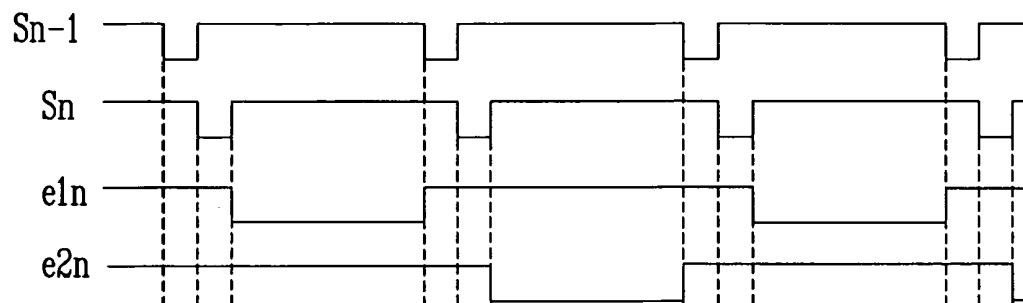
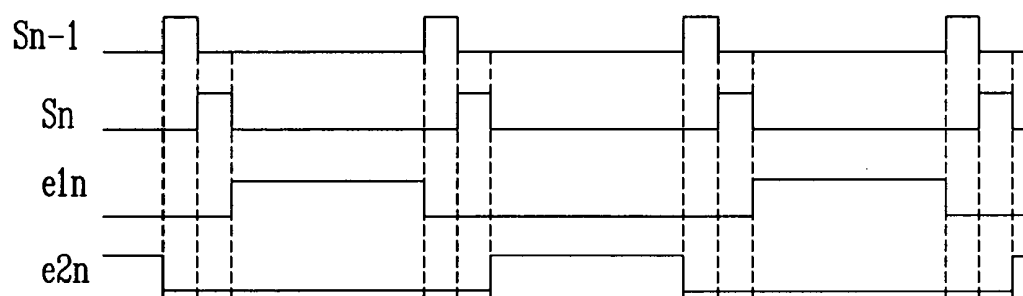


FIG. 12



## PIXEL AND LIGHT EMITTING DISPLAY

### CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to and the benefit of Korean Patent Application No. 10-2004-0095983, filed on Nov. 22, 2004, in the Korean Intellectual Property Office, the entire contents of which is incorporated herein by reference.

### BACKGROUND

#### [0002] 1. Field of the Invention

[0003] The present invention relates to a pixel and a light emitting display, and more particularly, to a pixel and a light emitting display using the pixel, the pixel including a plurality of organic light emitting diodes (OLEDs) so that an aperture ratio of the light emitting display can be improved and a reverse bias voltage can be easily applied to the OLEDs.

#### [0004] 2. Discussion of Related Art

[0005] Recently, various flat panel displays having weight and volume less than comparable cathode ray tube (CRT) displays have been developed. In particular, light emitting displays having high luminous efficiency, high brightness, wide view angle, and high response speed are in the lime-light.

[0006] An organic light emitting diode (OLED) has a structure in which an emission layer that is a thin film for emitting light is positioned between a cathode electrode and an anode electrode. Electrons and holes are injected into the emission layer so that they can be recombined to generate exciters that emit light when their energies are reduced.

[0007] A light emitting diode (LED) includes an emission layer that can be formed of an organic or inorganic material. As such, the LED can be classified as either an inorganic LED or an organic LED (or OLED), depending on the type of the emission layer.

[0008] **FIGS. 1A and 1B** illustrate a conventional OLED. Referring to **FIGS. 1A and 1B**, the OLED includes an emission layer EL, a hole transfer layer HTL, and an electron transfer layer ETL formed between an anode electrode 20 and a cathode electrode 21.

[0009] The anode electrode 20 is connected to a first power source so as to supply holes to the emission layer EL. The cathode electrode 20 is connected to a second power source lower than the first power source so as to supply electrons to the emission layer EL. That is, the anode electrode 20 has positive (+) potential higher than the potential of the cathode electrode 21, and the cathode electrode 21 has negative (-) potential lower than the potential of the anode electrode 20.

[0010] The hole transfer layer HTL accelerates the holes supplied from the anode electrode 20 to supply the holes to the emission layer EL. The electron transfer layer ETL accelerates the electrons supplied from the cathode electrode 21 to supply the electrons to the emission layer EL. The holes supplied from the hole transfer layer HTL and the electrons supplied from the electron transfer layer ETL collide with the emission layer EL. At this time, the electrons

and the holes are recombined with each other. Therefore, predetermined light is generated. In more detail, the emission layer EL is formed of an organic material so that, when the electrons and the holes are recombined with each other, one of red R, green G, and blue B light components is generated.

[0011] In addition, the OLED includes a hole injection layer HIL positioned between the hole transfer layer HTL and the anode electrode 20 and an electron injection layer EIL positioned between the electron transfer layer ETL and the cathode electrode 21. The hole injection layer HIL supplies the holes to the hole transfer layer HTL. The electron injection layer EIL supplies the electrons to the electron transfer layer ETL.

[0012] **FIG. 2** is a circuit diagram of a part of a conventional light emitting display. Referring to **FIG. 2**, four pixels are adjacent to each other, and each pixel includes an OLED and a pixel circuit. The pixel circuit includes a first transistor T1, a second transistor T2, a third transistor T3, and a capacitor Cst. Each of the first, second, and third transistors T1, T2, and T3 includes a gate, a source, and a drain; and the capacitor Cst includes a first electrode and a second electrode.

[0013] Since the pixels have the same structure, only the pixel on the left top will be described in more detail. The source of the first transistor T1 is connected to a power source Vdd through a power source supply line, the drain of the first transistor T1 is connected to the source of the third transistor T3, and the gate of the first transistor T1 is connected to a node A. The node A is connected to the drain of the second transistor T2. The first transistor T1 supplies a current corresponding to a data signal to the OLED.

[0014] The source of the second transistor T2 is connected to a data line D1, the drain of the second transistor T2 is connected to the node A, and the gate of the second transistor T2 is connected to a scan line S1. The second transistor T2 applies the data signal to the node A in accordance with a scan signal applied to the gate thereof.

[0015] The source of the third transistor T3 is connected to the drain of the first transistor T1, the drain of the third transistor T3 is connected to an anode electrode of the OLED, and the gate of the third transistor T3 is connected to an emission control line E1 to respond to an emission control signal. Therefore, the third transistor T3 controls the flow of a current that flows from the first transistor T1 to the OLED in accordance with the emission control signal to control emission of the OLED.

[0016] The first electrode of the capacitor Cst is connected to the power source Vdd through the power source supply line, and the second electrode of the capacitor Cst is connected to the node A. The capacitor Cst stores charges in accordance with the data signal and applies a signal to the gate of the first transistor T1 in accordance with the stored charges for one frame so that the operation of the first transistor T1 is maintained for the one frame.

[0017] Referring back to **FIG. 1B**, since the voltage applied from the OLED to the anode electrode 20 is always set higher than the voltage applied to the cathode electrode 21, as illustrated in **FIG. 1B**, negative (-) carriers are positioned on the anode electrode 20, and positive (+) carriers are positioned on the cathode electrode 21.

[0018] Here, when the negative (−) carriers positioned on the anode electrode 20 and the positive (+) carriers positioned on the cathode electrode 21 are maintained for a long period of time, the movements of the electrons and holes that contribute to light emission are reduced so that brightness deteriorates and afterimage is generated.

[0019] In particular, the afterimage increases when the same image (for example, a still image) is displayed for a long period of time and deteriorates a display quality. When the afterimage is generated, the OLED deteriorates, and the life of the light emitting display is reduced.

[0020] Since one OLED is connected to one pixel circuit, a plurality of pixel circuits are necessary in order to emit light from a plurality of OLEDs so that a large number of the pixel circuits are needed.

[0021] Also, as illustrated in FIG. 2, since one emission control line needs to be connected to a pixel row, the aperture ratio of the light emitting display deteriorates due to the emission control line.

#### SUMMARY OF THE INVENTION

[0022] Accordingly, an embodiment of the present invention provides a pixel circuit and a light emitting display using the same, in which a reverse bias (or a reverse bias voltage) can be easily applied to an organic light emitting diode (OLED) to improve the characteristics of the OLED, and/or in which a plurality of OLEDs are connected to one pixel circuit to reduce the number of pixel circuits of a light emitting display and to improve the aperture ratio of the light emitting display.

[0023] One embodiment of the present invention provides a pixel including first and second organic light emitting diodes (OLEDs), a driving circuit commonly connected to the first and second OLEDs to drive the first and second OLEDs, a switching circuit connected between the first and second OLEDs and the driving circuit to sequentially control the driving of the first and second OLEDs using first and second emission control signals, and a reverse bias circuit for applying a reverse bias voltage including at least one of the first and second emission control signals to the first and second OLEDs. The driving circuit includes a first transistor for receiving a first power of a first power source to selectively supply a driving current corresponding to a first voltage applied to a gate of the first transistor to the first and second OLEDs, a second transistor for selectively applying a data signal to a first electrode of the first transistor in accordance with a first scan signal, a third transistor for selectively connecting the first transistor to serve as a diode in accordance with the first scan signal so that an electric current can flow through to the first transistor, a capacitor for storing the voltage applied to the gate of the first transistor while the data signal is applied to the first electrode of the first transistor and for maintaining the stored voltage at the gate of the first transistor for a period when at least one of the first and second OLEDs emits light, a fourth transistor for selectively applying an initializing voltage to the capacitor in accordance with a second scan signal, a fifth transistor for selectively applying the first power of the first power source to the first transistor in accordance with the first emission control signal, and a sixth transistor for selectively applying the first power of the first power source to the first transistor in accordance with the second emission control signal.

[0024] One embodiment of the present invention provides a pixel including first and second organic light emitting diodes (OLEDs), a driving circuit commonly connected to the first and second OLEDs to drive the first and second OLEDs, a switching circuit connected between the first and second OLEDs and the driving circuit to sequentially control the driving of the first and second OLEDs using first and second emission control signals, and a reverse bias circuit connected to a reverse bias line for transmitting a reverse bias voltage to selectively apply the reverse bias voltage to the first and second OLEDs in accordance with the first and second emission control signals so that the reverse bias voltage is applied to the first and second OLEDs. The driving circuit includes a first transistor for receiving a first power source to selectively supply a driving current corresponding to a first voltage applied to a gate of the first transistor to the first and second OLEDs, a second transistor for selectively applying the data signal to a first electrode of the first transistor in accordance with a first scan signal, a third transistor for selectively connecting the first transistor to serve as a diode in accordance with the first scan signal so that an electric current can flow through the first transistor, a capacitor for storing the voltage applied to the gate of the first transistor while the data signal is applied to the first electrode of the first transistor and for maintaining the stored voltage at the gate of the first transistor for a period when at least one of the first and second OLEDs emits light, a fourth transistor for selectively applying an initializing voltage to the capacitor in accordance with a second scan signal, a fifth transistor for selectively applying the first power of the first power source to the first transistor in accordance with the first emission control signal, and a sixth transistor for selectively applying the first power of the first power source to the first transistor in accordance with the second emission control signal.

[0025] One embodiment of the present invention provides a pixel including first and second organic light emitting diodes (OLEDs), a driving circuit commonly connected to the first and second OLEDs to drive the first and second OLEDs, a switching circuit connected between the first and second OLEDs and the driving circuit to sequentially control the driving of the first and second OLEDs using first and second emission control signals, and a reverse bias circuit connected to a reverse bias line for transmitting a reverse bias voltage and a reverse bias control line for transmitting a reverse voltage control signal to selectively apply the reverse bias voltage to the first and second OLEDs in accordance with the reverse voltage control signal so that the reverse bias voltage is applied to the first and second OLEDs. The driving circuit includes a first transistor for receiving a first power of a first power source to selectively supply a driving current corresponding to a first voltage applied to a gate of the first transistor to the first and second OLEDs, a second transistor for selectively applying the data signal to a first electrode of the first transistor in accordance with a first scan signal, a third transistor for selectively connecting the first transistor to serve as a diode in accordance with the first scan signal so that an electric current can flow through the first transistor, a capacitor for storing the voltage applied to the gate of the first transistor while the data signal is applied to the first electrode of the first transistor and for maintaining the stored voltage at the gate of the first transistor for a period when at least one of the first and second OLEDs emits light, a fourth transistor for

selectively applying an initializing voltage to the capacitor in accordance with a second scan signal, a fifth transistor for selectively applying the first power source to the first transistor in accordance with the first emission control signal, and a sixth transistor for selectively applying the first power of the first power source to the first transistor in accordance with the second emission control signal.

[0026] One embodiment of the present invention provides a light emitting display including an image display unit including a plurality of pixels to display an image, a scan driver for transmitting first and second scan signals and first and second emission control signals to the image display unit, and a data driver for transmitting a data signal to the image display unit. The pixel is one of the above-described pixels.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0027] The accompanying drawings, together with the specification, illustrate exemplary embodiments of the present invention, and, together with the description, serve to explain the principles of the present invention.

[0028] **FIGS. 1A and 1B** illustrate a conventional organic light emitting diode (OLED);

[0029] **FIG. 2** is a circuit diagram illustrating a part of a conventional light emitting display;

[0030] **FIG. 3** illustrates a structure of a light emitting display according to a first embodiment of the present invention;

[0031] **FIG. 4** illustrates a structure of a light emitting display according to a second embodiment of the present invention;

[0032] **FIG. 5** is a circuit diagram illustrating a first embodiment of a pixel used with the light emitting display of **FIG. 3**;

[0033] **FIG. 6** illustrates waveforms for operating the pixel of **FIG. 5**;

[0034] **FIG. 7** is a circuit diagram illustrating a second embodiment of a pixel used with the light emitting display of **FIG. 3**;

[0035] **FIG. 8** illustrates waveforms for operating of the pixel of **FIG. 7**;

[0036] **FIG. 9** is a circuit diagram illustrating a first embodiment of a pixel used with the light emitting display of **FIG. 4**;

[0037] **FIG. 10** is a circuit diagram illustrating a second embodiment of a pixel used with the light emitting display of **FIG. 4**;

[0038] **FIG. 11** illustrates a first embodiment of waveforms for operating the pixel of **FIG. 9** and the pixel of **FIG. 10**; and

[0039] **FIG. 12** illustrates a second embodiment of waveforms for operating the pixel of **FIG. 9** and the pixel of **FIG. 10**.

#### DETAILED DESCRIPTION

[0040] In the following detailed description, certain exemplary embodiments of the present invention are shown and

described, by way of illustration. As those skilled in the art would recognize, the described exemplary embodiments may be modified in various ways, all without departing from the spirit or scope of the present invention. Accordingly, the drawings and description are to be regarded as illustrative in nature, rather than restrictive.

[0041] In the present application, when a first part is referred to as being connected to a second part, the first may be directly connected to the second part or indirectly connected to the second part via a third part.

[0042] **FIG. 3** illustrates a structure of a light emitting display according to a first embodiment of the present invention. Referring to **FIG. 3**, the light emitting display includes an image display unit **100a**, a data driver **200a**, and a scan driver **300a**.

[0043] The image display unit **100a** includes a plurality of pixels **110a** including a plurality of organic light emitting diodes (OLEDs), a plurality of scan lines **S0, S1, S2, . . . , Sn-1, and Sn** arranged in a row direction, a plurality of first emission control lines **E11, E12, . . . , E1n-1, and E1n** and second emission control lines **E21, E22, . . . , E2n-1, and E2n** arranged in the row direction, a plurality of data lines **D1, D2, . . . , Dm-1, and Dm** arranged in a column direction, a plurality of pixel power source lines (not shown) for supplying pixel power from a pixel power source **Vdd**, and a reverse bias line **NB** that transmits a reverse bias voltage.

[0044] The pixels **110a** receive scan signals through the scan lines **S0, S1, S2, . . . , Sn-1, and Sn** and generate driving currents corresponding to data signals (e.g., data voltages) transmitted from data lines **D1, D2, . . . , Dm-1, and Dm**. The driving currents are transmitted to the OLEDs in accordance with first and second emission control signals transmitted through the first emission control lines **E11, E12, . . . , E1n-1, and E1n** and the second emission control lines **E21, E22, . . . , E2n-1, and E2n** so that an image is displayed. Also, the OLEDs receive a reverse bias voltage from the reverse bias line **NB** while the OLEDs do not emit light so that it is possible to prevent the OLEDs from deteriorating and to thus prolong the life of the light emitting display.

[0045] The data driver **200a** is connected to the data lines **D1, D2, . . . , Dm-1, and Dm** to transmit the data signals to the image display unit **100a**.

[0046] The scan driver **300a** is formed on a side of the image display unit **100a** and is connected to the scan lines **S0, S1, S2, . . . , Sn-1, and Sn**, the first emission control lines **E11, E12, . . . , E1n-1, and E1n**, and the second emission control lines **E21, E22, E2n-1, and E2n** to transmit the scan signals and the first and second emission control signals to the image display unit **100a**.

[0047] **FIG. 4** illustrates a structure of a light emitting display according to a second embodiment of the present invention. Referring to **FIG. 4**, the light emitting display includes the image display unit **100b**, the data driver **200b**, and the scan driver **300b**.

[0048] The image display unit **100b** includes a plurality of pixels **110b** including a plurality of organic light emitting diodes (OLEDs), the plurality of scan lines **S0, S1, S2, . . . , Sn-1, and Sn** arranged in a row direction, a plurality of first emission control lines **E11, E12, . . . , E1n-1, and E1n** and second emission control lines **E21, E22, . . . , E2n-1, and E2n**

arranged in the row direction, a plurality of data lines D1, D2, . . . , Dm-1, and Dm arranged in a column direction, and the plurality of pixel power source lines (not shown) for supplying pixel power from a pixel power source Vdd.

[0049] The pixels 110a receive scan signals through the scan lines S0, S1, S2, . . . , Sn-1, and Sn and generate driving currents corresponding to the data signals (e.g., data voltages) transmitted from data lines D1, D2, . . . , Dm-1, and Dm. The driving currents are transmitted to the OLEDs in accordance with the first and second emission control signals transmitted through the first emission control lines E11, E12, . . . , E1n-1, and E1n and the second emission control lines E21, E22, . . . , E2n-1, and E2n so that an image is displayed. Also, in the embodiment of FIG. 4, one of the first and second emission control signals is used as the reverse bias voltage (e.g., a low voltage level) in the pixels 110a and is transmitted to at least one of the OLEDs when another one of the first and second emission control signals is in a high level (e.g., a high voltage level) so that the OLEDs are applied with the reverse voltage. Therefore, in the embodiment of FIG. 4, it is not necessary to include additional reverse bias lines so that the aperture ratio of the light emitting display does not have to be reduced by additional wiring lines.

[0050] The data driver 200b is connected to the data lines D1, D2, . . . , Dm-1, and Dm to transmit the data signals to the image display unit 100b.

[0051] The scan driver 300b is formed on a side of the image display unit 100b and is connected to the scan lines S0, S1, S2, . . . , Sn-1, and Sn, the first emission control lines E11, E12, . . . , E1n-1, and E1n, and the second emission control lines E21, E22, . . . , E2n-1, and E2n to transmit the scan signals and the first and second emission control signals to the image display unit 100b.

[0052] FIG. 5 is a circuit diagram illustrating a first embodiment of a pixel used with the light emitting display of FIG. 3. Referring to FIG. 5, the pixel includes a pixel circuit that is composed of a driving circuit 111a1 including first to sixth transistors M1a1 to M6a1 and a capacitor Csta1, a switching circuit 112a1 including seventh and eighth transistors M7a1 and M8a1, and a reverse bias circuit 113a1 including first and second switching devices Maa1 and Mba1. The first to eighth transistors M1a1 to M8a1 and the first and second switching devices Maa1 and Mba1 are formed of PMOS transistors, and each transistor includes a source, a drain, and a gate. The capacitor Csta1 includes a first electrode and a second electrode. Since the drains and the sources of the first to eighth transistors M1a1 to M8a1 and the first and second switching devices Maa1 and Mba1 have no physical difference, each source and each drain may respectively be referred to as a first electrode and a second electrode.

[0053] The drain of the first transistor M1a1 is connected to the first node A2, the source of the first transistor M1a1 is connected to a second node B2, and the gate of the first transistor M1a1 is connected to a third node C2 so that a current flows from the second node B2 to the first node A2 in accordance with a voltage of the third node C2.

[0054] The source of the second transistor M2a1 is connected to a data line Dm, the drain of the second transistor M2a1 is connected to the second node B2, and the gate of

the second transistor M2a1 is connected to a first scan line Sn so that the second transistor M2a1 performs a switching operation in accordance with first scan signal sn transmitted through the first scan line Sn to selectively apply a data signal transmitted through the data line Dm to the second node B2.

[0055] The source of the third transistor M3a1 is connected to the first node A2, the drain of the third transistor M3a1 is connected to the third node C2, and the gate of the third transistor M3a1 is connected to the first scan line Sn so that the potential of the first node A2 is made equal to the potential of the third node C2 by the first scan signal sn transmitted through the first scan line Sn. Therefore, the first transistor M1a1 can serve as a diode for an electric current to flow through the first transistor M1a1 (in one direction).

[0056] The source and gate of the fourth transistor M4a1 are connected to a second scan line Sn-1, and the drain of the fourth transistor M4a1 is connected to the third node C2 so that the fourth transistor M4a1 transmits an initializing signal to the third node C2. The initial signal is a second scan signal sn-1 input to select the row that precedes by one row the row to which the first scan signal sn is input to select. The second scan signal sn-1 is transmitted through the second scan line Sn-1. The second scan line Sn-1 is the scan line connected to the row that precedes the row to which the first scan line Sn is connected by one row.

[0057] The source of the fifth transistor M5a1 is connected to a pixel power source line of a pixel power source Vdd, the drain of the fifth transistor M5a1 is connected to the second node B2, and the gate of the fifth transistor M5a1 is connected to a first emission control line E1n so that the fifth transistor M5a1 selectively applies a pixel power of the pixel power source Vdd to the second node B2 in accordance with a first emission control signal e1n transmitted through the first emission control line E1n.

[0058] The source of the sixth transistor M6a1 is connected to the pixel power source line of the pixel power source Vdd, the drain of the sixth transistor M6a1 is connected to the second node B2, and the gate of the sixth transistor M6a1 is connected to a second emission control line E2n so that the sixth transistor M6a1 selectively applies the pixel power of the pixel power source Vdd to the second node B2 in accordance with a second emission control signal e2n transmitted through the second emission control line E2n.

[0059] The source of the seventh transistor M7a1 is connected to the first node A2, the drain of the seventh transistor M7a1 is connected to a first OLED OLED1a1, and the gate of the seventh transistor M7a1 is connected to the first emission control line E1n so that the seventh transistor M7a1 selectively applies the current that flows through the first node A2 to the first OLED OLED1a1 in accordance with the first emission control signal e1n transmitted through the first emission control line E1n to emit light from the first OLED OLED1a1.

[0060] The source of the eighth transistor M8a1 is connected to the first node A2, the drain of the eighth transistor M8a1 is connected to a second OLED OLED2a1, and the gate of the eighth transistor M8a1 is connected to the second emission control line E2n so that the eighth transistor M8a1 applies the current that flows through the first node A2 to the



second OLED OLED2a1 in accordance with the second emission control signal e2n transmitted through the second emission control line E2n to emit light from the second OLED OLED2a1.

[0061] The source of the first switching device Maa1 is connected to a reverse bias line NB, the drain of the first switching device Maa1 is connected to the first OLED OLED1a1, and the gate of the first switching device Maa1 is connected to the second emission control line E2n so that the first switching device Maa1 applies a reverse bias signal transmitted through the reverse bias line NB to the first OLED OLED1a1 in accordance with the second emission control signal e2n transmitted through the second emission control line E2n to apply the reverse voltage to the first OLED OLED1a1.

[0062] The source of the second switching device Mba1 is connected to the reverse bias line NB, the drain of the second switching device Mba1 is connected to the second OLED OLED2a1, and the gate of the second switching device Mba1 is connected to the first emission control line E1n so that the second switching device Mba1 applies the reverse bias signal transmitted through the reverse bias line NB to the second OLED OLED2a1 in accordance with the first emission control signal e1n transmitted through the first emission control line E1n to apply the reverse voltage to the second OLED OLED2a1.

[0063] The first electrode of the capacitor Csta1 is connected to the pixel power source line of the pixel power source Vdd and the second electrode of the capacitor Csta1 is connected to the third node C2 so that the capacitor Csta1 is initialized by the initializing signal transmitted to the third node C2 through the fourth transistor M4a1, and the voltage corresponding to the data signal is stored in the capacitor Csta1 and is transmitted to the third node C2. Therefore, the gate voltage of the first transistor M1a1 is maintained for a predetermined time by the capacitor Csta1.

[0064] FIG. 6 illustrates waveforms for operating the pixel of FIG. 5. Referring to FIG. 6, the pixel is operated by the first and second scan signals sn and sn-1, the data signal, the first and second emission control signals e1n and e2n, and the reverse bias signal (not shown). The first and second scan signals sn and sn-1 and the first and second emission control signals e1n and e2n are periodic signals and the second scan signal sn-1 is a scan signal transmitted to a scan line that precedes the scan line to which the first scan signal sn is transmitted.

[0065] In operation, the fourth transistor M4a1 is first turned on by the second scan signal sn-1 and the second scan signal sn-1 is transmitted to the capacitor Csta1 through the fourth transistor M4a1 so that the capacitor Csta1 is initialized.

[0066] The second and third transistors M2a1 and M3a1 are then turned on by the first scan signal sn so that the potential of the second node B2 is made equal to the potential of the third node C2. Therefore, the first transistor M1a1 is connected like a diode so that an electric current can flow through the first transistor M1a1. In addition, the data signal is transmitted to the second node B2 through the second transistor M2a1. Therefore, the data signal is applied to the second electrode of the capacitor Csta1 through the second transistor M2a1, the first transistor M1a1, and the

third transistor M3a1 so that the voltage corresponding to difference between the data signal and the threshold voltage is applied to the second electrode of the capacitor Csta1.

[0067] After the first scan signal sn is transited to the high level, when the first emission control signal e1n is transited to the low level and is maintained in the low level for a predetermined (and/or uniform) period, the fifth and seventh transistors M5a1 and M7a1 are turned on by the first emission control signal e1n so that the voltage corresponding to EQUATION 1 is applied between the gate and source of the first transistor M1a1.

$$V_{gs} = V_{dd} - (V_{data} - |V_{th}|) \quad [\text{EQUATION 1}]$$

[0068] wherein, Vgs, Vdd, Vdata, and Vth represent the voltage between the source and the gate of the first transistor M1a1, a pixel power source voltage, the voltage of the data signal, and the threshold voltage of the first transistor M1a1, respectively.

[0069] Therefore, the current obtained by EQUATION 2 flows to the first node A2.

$$I = \frac{\beta}{2} (V_{gs} - |V_{th}|)^2 = \quad [\text{EQUATION 2}]$$

$$\frac{\beta}{2} (V_{data} - V_{dd} + V_{th} - V_{th})^2 = \frac{\beta}{2} (V_{data} - V_{dd})^2$$

[0070] wherein, I, Vgs, Vdd, Vth, and Vdata represent the current that flows through the OLED OLED1a1, the voltage between the source and the gate of the first transistor M1a1, the voltage of the pixel power source, the threshold voltage of the first transistor M1a1, and the voltage of the data signal, respectively.

[0071] Therefore, the current flows to the first node A2 regardless of the threshold voltage of the first transistor M1a1.

[0072] At this time, since the second emission control signal e2n is in the high level, the first switching device Maa1 is maintained at a turned off state by the second emission control signal e2n so that the reverse bias signal (e.g., a reverse bias voltage) transmitted through the reverse bias line NB connected to the source of the first switching device Maa1 is not transmitted to the first OLED OLED1a1. On the other hand, the second switching device Mba1 is turned on by the first emission control signal e1n so that the reverse bias signal or voltage transmitted through the reverse bias line NB connected to the source of the second switching device Mba1 is transmitted to the second OLED OLED2a1. Therefore, the second OLED OLED2a1 is reverse biased.

[0073] Next, the voltage value corresponding to difference between the pixel power source and the data signal is stored in the capacitor Csta1 by the first and second scan signals sn and sn-1 and the data signal, the voltage corresponding to the EQUATION 1 is transmitted between the source and gate of the first transistor M1a1, the sixth and eighth transistors M6a1 and M8a1 are turned on by the second emission control signal e2n, and the current corresponding to the EQUATION 2 flows to the second OLED OLED2a1.

[0074] At this time, since the second emission control signal e2n is in the low level, the first switching device Maa1

is maintained at a turned-on state by the second emission control signal  $e2n$  so that the reverse bias signal or voltage transmitted through the reverse bias line NB connected to the source of the first switching device Maa1 is transmitted to the first OLED OLED1a1. Therefore, the first OLED OLED1a1 is reverse biased. On the other hand, the second switching device Mba1 is turned off by the first emission control signal  $e1n$  so that the reverse bias signal or voltage is not transmitted through the reverse bias line NB connected to the source of the second switching device Mba1.

[0075] FIG. 7 is a circuit diagram illustrating a second embodiment of a pixel used with the light emitting display of FIG. 3. Referring to FIG. 7, the pixel is composed of a pixel circuit and first and second organic light emitting diodes OLED1a2 and OLED2a2. The pixel circuit is composed of a driving circuit 111a2 including first to sixth transistors M1a2 to M6a2 and a capacitor Csta2, a switching circuit 112a2 including seventh and eighth transistors M7a2 and M8a2, and a reverse bias circuit 113a2 including first and second switching devices Maa2 and Mba2. The first to eighth transistors M1a2 to M8a2 and the first and second switching devices Maa2 and Mba2 are formed of PMOS transistors and each transistor includes a source, a drain, and a gate. The capacitor Csta2 includes a first electrode and a second electrode. Since the drains and the sources of the first to eighth transistors M1a2 to M8a2 and the first and second switching devices Maa2 and Mba2 have no physical difference, each source and each drain may respectively be referred to as a first electrode and a second electrode.

[0076] The drain of the first transistor M1a2 is connected to a first node A3, the source of the first transistor M1a2 is connected to a second node B3, and the gate of the first transistor M1a2 is connected to a third node C3 so that a current flows from the second node B3 to the first node A3 in accordance with a voltage of the third node C3.

[0077] The source of the second transistor M2a2 is connected to a data line Dm, the drain of the second transistor M2a2 is connected to the second node B3, and the gate of the second transistor M2a2 is connected to a first scan line Sn so that the second transistor M2a2 performs a switching operation in accordance with a first scan signal sn transmitted through the first scan line Sn to selectively apply a data signal transmitted through the data line Dm to the second node B3.

[0078] The source of the third transistor M3a2 is connected to the first node A3, the drain of the third transistor M3a2 is connected to the third node C3, and the gate of the third transistor M3a2 is connected to the first scan line Sn so that the potential of the first node A3 is made equal to the potential of the third node C3 by the first scan signal sn transmitted through the first scan line Sn. Therefore, the first transistor M1a2 can be connected as a diode for an electric current to flow through the first transistor M1a2.

[0079] The source and gate of the fourth transistor M4a2 are connected to a second scan line Sn-1 and the drain of the fourth transistor M4a2 is connected to the third node C3 so that the fourth transistor M4a2 transmits an initializing signal to the third node C3. The initial signal is a second scan signal sn-1 input to select the row that precedes by one row the row to which the first scans signal sn is input to select. The second scan signal sn-1 is transmitted through the second scan line Sn-1. The second scan line Sn-1 is the scan

line connected to the row that precedes the row to which the first scan line Sn is connected by one row.

[0080] The source of the fifth transistor M5a2 is connected to a pixel power source line of a pixel power source Vdd, the drain of the fifth transistor M5a2 is connected to the second node B3, and the gate of the fifth transistor M5a2 is connected to a first emission control line E1n so that the fifth transistor M5a2 selectively applies a pixel power of the pixel power source Vdd to the second node B3 in accordance with a first emission control signal  $e1n$  transmitted through the first emission control line E1n.

[0081] The source of the sixth transistor M6a2 is connected to the pixel power source line of the pixel power source Vdd, the drain of the sixth transistor M6a2 is connected to the second node B3, and the gate of the sixth transistor M6a2 is connected to a second emission control line E2n so that the sixth transistor M6a2 selectively applies the pixel power of the pixel power source Vdd to the second node B3 in accordance with a second emission control signal  $e2n$  transmitted through the second emission control line E2n.

[0082] The source of the seventh transistor M7a2 is connected to the first node A3, the drain of the seventh transistor M7a2 is connected to a first OLED OLED1a2, and the gate of the seventh transistor M7a2 is connected to the first emission control line E1n so that the seventh transistor M7a2 selectively applies the current that flows through the first node A3 to the first OLED OLED1a2 in accordance with the first emission control signal  $e1n$  transmitted through the first emission control signal E1n to emit light from the first OLED OLED1a2.

[0083] The source of the eighth transistor M8a2 is connected to the first node A3, the drain of the eighth transistor M8a2 is connected to a second OLED OLED2a2, and the gate of the eighth transistor M8a2 is connected to the second emission control line E2n so that the eighth transistor M8a2 applies the current that flows through the first node A3 to the second OLED OLED2a2 in accordance with the second emission control signal  $e2n$  transmitted through the second emission control line E2n to emit light from the second OLED OLED2a2.

[0084] The source of the first switching device Maa2 is connected to a reverse bias line NB, the drain of the first switching device Maa2 is connected to the first OLED OLED1a2, and the gate of the first switching device Maa2 is connected to a reverse bias control line Re so that the first switching device Maa2 applies a reverse bias signal transmitted through the reverse bias line NB to the first OLED OLED1a2 in accordance with a reverse bias control signal re transmitted through the reverse bias control line Re to apply the reverse voltage to the first OLED OLED1a2.

[0085] The source of the second switching device Mba2 is connected to the reverse bias line NB, the drain of the second switching device Mba2 is connected to the second OLED OLED2a2, and the gate of the second switching device Mba2 is connected to the reverse bias control line Re so that the second switching device Mba2 applies the reverse bias signal transmitted through the reverse bias line NB to the second OLED OLED2a2 in accordance with the reverse bias control signal re transmitted through the reverse bias control line Re to apply the reverse voltage to the second OLED OLED2a2.

[0086] The first electrode of the capacitor Csta2 is connected to the pixel power source line of the pixel power source Vdd, the second electrode of the capacitor Csta2 is connected to the third node C3 so that the capacitor Csta2 is initialized by the initializing signal transmitted to the third node C3 through the fourth transistor M4a2, and the voltage corresponding to the data signal is stored in the capacitor Csta2 and is transmitted to the third node C3. Therefore, the gate voltage of the first transistor M1a2 is maintained for a predetermined time by the capacitor Csta2.

[0087] FIG. 8 illustrates waveforms for operating the pixel of FIG. 7. Referring to FIG. 8, the pixel is operated by the first and second scan signals sn and sn-1, the data signal, the first and second emission control signals e1n and e2n, the reverse bias signal (not shown), and the reverse bias control signal re. The first and second scan signals sn and sn-1, the first and second emission control signals e1n and e2n, and the reverse bias control signal re are periodic signals. The second scan signal sn-1 is a scan signal transmitted to a scan line that precedes the scan line to which the first scan signal sn is transmitted.

[0088] As shown in FIG. 8, when the reverse bias control signal re is in the high level, the first and second switching devices Maa2 and Mba2 are turned off so that the reverse bias signal is not transmitted to the first and second OLEDs OLED1a2 and OLED2a2. Therefore, when a current flows to the first OLED OLED1a2 or the second OLED OLED2a2, the reverse bias signal is not applied.

[0089] When the current does not flow to the first OLED OLED1a2 and the second OLED OLED2a2, since the reverse bias control signal re is in the low level, the first and second switching devices Maa2 and Mba2 are turned on so that the reverse bias signal or voltage is transmitted to the first and second OLEDs OLED1a2 and OLED2a2. Therefore the reverse bias voltage is applied to the first and second OLEDs OLED1a2 and OLED2a2.

[0090] FIG. 9 illustrates a first embodiment of a pixel used with the light emitting display of FIG. 4. Referring to FIG. 9, the pixel includes a pixel circuit that is composed of a driving circuit 111b1 including first to sixth transistors M1b1 to M6b1 and a capacitor Cstb1, a switching circuit 112b1 including seventh and eighth transistors M7b1 and M8b1, and a reverse bias circuit 113b1 including first and second switching devices Mab1 and Mbb1. The first to eighth transistors M1b1 to M8b1 are formed of PMOS transistors and the first and second switching devices Mab1 and Mbb1 are formed of NMOS transistors. Each transistor includes a source, a drain, and a gate.

[0091] The capacitor Cstb1 includes a first electrode and a second electrode. Since the drains and the sources of the first to eighth transistors M1b1 to M8b1 and the first and second switching devices Mab1 and Mbb1 have no physical difference, each source and each drain may respectively be referred to as a first electrode and a second electrode.

[0092] The drain of the first transistor M1b1 is connected to a first node A4, the source of the first transistor M1b1 is connected to a second node B4, and the gate of the first transistor M1b1 is connected to a third node C4 so that a current flows from the second node B4 to the first node A4 in accordance with a voltage of the third node C4.

[0093] The source of the second transistor M2b1 is connected to a data line Dm, the drain of the second transistor

M2b1 is connected to the second node B4, and the gate of the second transistor M2b1 is connected to a first scan line Sn so that the second transistor M2b1 performs a switching operation in accordance with a first scan signal sn transmitted through the first scan line Sn to selectively apply a data signal transmitted through the data line Dm to the second node B4.

[0094] The source of the third transistor M3b1 is connected to the first node A4, the drain of the third transistor M3b1 is connected to the third node C4, and the gate of the third transistor M3b1 is connected to the first scan line Sn so that the potential of the first node A4 is made equal to the potential of the third node C4 by the first scan signal sn transmitted through the first scan line Sn. Therefore, the first transistor M1b1 can be connected like a diode for an electric current to flow through the first transistor M1b1.

[0095] The source and gate of the fourth transistor M4b1 are connected to a second scan line Sn-1 and the drain of the fourth transistor M4b1 is connected to the third node C4 so that the fourth transistor M4b1 transmits an initializing signal to the third node C4. The initial signal is a second scan signal sn-1 input to select the row that precedes by one row the row to which the first scan signal sn is input to select. The second scan sn-1 is transmitted through the second scan line Sn-1. The second scan line Sn-1 is the scan line connected to the row that precedes the row to which the first scan line Sn is connected by one row.

[0096] The source of the fifth transistor M5b1 is connected to a pixel power source line of the pixel power source Vdd, the drain of the fifth transistor M5b1 is connected to the second node B4, and the gate of the fifth transistor M5b1 is connected to a first emission control line E1n so that the fifth transistor M5b1 selectively applies a pixel power of the pixel power source Vdd to the second node B4 in accordance with a first emission control signal e1n transmitted through the first emission control line E1n.

[0097] The source of the sixth transistor M6b1 is connected to the pixel power source line of the pixel power source Vdd, the drain of the sixth transistor M6b1 is connected to the second node B4, and the gate of the sixth transistor M6b1 is connected to a second emission control line E2n so that the sixth transistor M6b1 selectively applies the pixel power of the pixel power source Vdd to the second node B4 in accordance with a second emission control signal e2n transmitted through the second emission control line E2n.

[0098] The source of the seventh transistor M7b1 is connected to the first node A4, the drain of the seventh transistor M7b1 is connected to a first OLED OLED1b1, and the gate of the seventh transistor M7b1 is connected to the first emission control line E1n so that the seventh transistor M7b1 selectively applies the current that flows through the first node A4 to the first OLED OLED1b1 in accordance with the first emission control signal e1n transmitted through the first emission control signal E1n to emit light from the first OLED OLED1b1.

[0099] The source of the eighth transistor M8b1 is connected to the first node A4, the drain of the eighth transistor M8b1 is connected to a second OLED OLED2b1, and the gate of the eighth transistor M8b1 is connected to the second emission control line E2n so that the eighth transistor M8b1

applies current that flows through the first node A4 to the second OLED OLED2b1 in accordance with the second emission control signal e2n transmitted through the second emission control line E2n to emit light from the second OLED OLED2b1.

[0100] The source of the first switching device Mab1 is connected to the second emission control line E2n, the drain of the first switching device Mab1 is connected to the first OLED OLED1b1, and the gate of the first switching device Mab1 is connected to the first emission control line E1n so that the first switching device Mab1 applies the second emission control signal e2n transmitted through the second emission control line E2n to the first OLED OLED1b1 in accordance with the first emission control signal e1n transmitted through the first emission control line E1n. At this time, when the first emission control signal e1n transmitted through the first emission control line E1n is in the high level, the first switching device Mab1 is turned on, and the second emission control signal e2n is in the low level so that the potential of the anode electrode of the first OLED OLED1b1 is lower than the potential of the cathode electrode. Therefore, the first OLED OLED1b1 is reverse biased.

[0101] The source of the second switching device Mbb1 is connected to the first emission control line E1n, the drain of the second switching device Mbb1 is connected to the second OLED OLED2b1, and the gate of the second switching device Mbb1 is connected to the second emission control line E2n so that the switching device Mbb1 applies the first emission control signal e1n transmitted through the first emission control line E1n to the second OLED OLED2b1 in accordance with the second emission control signal e2n transmitted through the second emission control line E2n. At this time, when the second emission control signal e2n transmitted through the second emission control line E2n is in the high level, the second switching device Mbb1 is turned on and the first emission control signal e1n is in the low level so that the potential of the anode electrode of the second OLED OLED2b1 is lower than the potential of the cathode electrode. Therefore, the second OLED OLED2b1 is reverse biased.

[0102] The seventh and eighth transistors M7b1 and M8b1 are formed of the PMOS transistors, and the first and second switching devices Mab1 and Mbb1 are formed of the NMOS transistors so that the seventh transistor M7b1 and the first switching device Mab1 are turned on or off at different times by the first emission control signal e1n and so that the eighth transistor M8b1 and the second switching device Mbb1 are turned on or off at different times by the second emission control signal e2n.

[0103] The first electrode of the capacitor Cstb1 is connected to the pixel power source line of the pixel power source Vdd and the second electrode of the capacitor Cstb1 is connected to the third node C4 so that the capacitor Cstb1 is initialized by the initializing signal transmitted to the third node C4 through the fourth transistor M4b1 and so that the voltage corresponding to the data signal is stored in the capacitor Cstb1 and is transmitted to the third node C4. Therefore, the gate voltage of the first transistor M1b1 is maintained for a predetermined time by the capacitor Cstb1.

[0104] FIG. 10 is a circuit diagram illustrating a second embodiment of a pixel used with the light emitting display

of FIG. 4. Referring to FIG. 10, the pixel includes a pixel circuit that is composed of a driving circuit 111b2 including first to sixth transistors M1b2 to M6b2 and a capacitor Cstb2, a switching circuit 112b2 including seventh and eighth transistors M7b2 and M8b2, and a reverse bias circuit 113b2 including first and second switching devices Mab2 and Mbb2. The first to eighth transistors M1b2 to M8b2 are formed of the PMOS transistors, and the first and second switching devices Mab2 and Mbb2 are formed of the NMOS transistor. Each transistor includes a source, a drain, and a gate.

[0105] The capacitor Cstb2 includes a first electrode and a second electrode. Since the drains and the sources of the first to eighth transistors M1b2 to M8b2 and the first and second switching devices Mab2 and Mbb2 have no physical difference, each source and each drain may respectively be referred to as a first electrode and a second electrode.

[0106] The drain of the first transistor M1b2 is connected to a first node A5, the source of the first transistor M1b2 is connected to a second node B5, and the gate of the first transistor M1b2 is connected to a third node C5 so that a current flows from the second node B5 to the first node A5 in accordance with a voltage of the third node C5.

[0107] The source of the second transistor M2b2 is connected to a data line Dm, the drain of the second transistor M2b2 is connected to the first node A5, and the gate of the second transistor M2b2 is connected to the first scan line Sn so that the second transistor M2b2 performs a switching operation in accordance with a first scan signal sn transmitted through the first scan line Sn to selectively apply a data signal transmitted through the data line Dm to the first node A5.

[0108] The source of the third transistor M3b2 is connected to the second node B5, the drain of the third transistor M3b2 is connected to the third node C5, and the gate of the third transistor M3b2 is connected to the first scan line Sn so that the potential of the second node B5 is made equal to the potential of the third node C5 by the first scan signal sn transmitted through the first scan line Sn. Therefore, the first transistor M1b2 can serve as a diode for an electric current to flow through the first transistor M1b2.

[0109] The source of the fourth transistor M4b2 is connected to an anode electrode of an OLED2b2, the drain of the fourth transistor M4b2 is connected to the third node C5, and the gate of the fourth transistor M4b2 is connected to a second scan line Sn-1 so that the fourth transistor M4b2 applies a voltage to the third node C5 when no current flows to the first and second OLEDs OLED1b2 and OLED2b2 to the third node C5 in accordance with a second scan signal sn-1. At this time, the voltage applied by the fourth transistor M4b2 to the third node C5 in accordance with the second scan signal sn-1 is used as an initializing signal for initializing the capacitor Cstb2.

[0110] The source of the fifth transistor M5b2 is connected to a pixel power source line of the pixel power source Vdd, the drain of the fifth transistor M5b2 is connected to the second node B5, and the gate of the fifth transistor M5b2 is connected to a first emission control line E1n so that the fifth transistor M5b2 selectively applies a pixel power of the pixel power source Vdd to the second node B5 in accordance with a first emission control signal e1n transmitted through the first emission control line E1n.

[0111] The source of the sixth transistor **M6b2** is connected to the pixel power source line of the pixel power source **Vdd**, the drain of the sixth transistor **M6b2** is connected to the second node **B5**, and the gate of the sixth transistor **M6b2** is connected to a second emission control line **E2n** so that the sixth transistor **M6b2** selectively applies the pixel power of the pixel power source **Vdd** to the second node **B5** in accordance with a second emission control signal **e2n** transmitted through the second emission control line **E2n**.

[0112] The source of the seventh transistor **M7b2** is connected to the first node **A5**, the drain of the seventh transistor **M7b2** is connected to a first OLED **OLED1b2**, and the gate of the seventh transistor **M7b2** is connected to the first emission control line **E1n** so that the seventh transistor **M7b2** selectively applies the current that flows through the first node **A5** to the first OLED **OLED1b2** in accordance with the first emission control signal **e1n** transmitted through the first emission control signal **E1n** to emit light from the first OLED **OLED1b2**.

[0113] The source of the eighth transistor **M8b2** is connected to the first node **A5**, the drain of the eighth transistor **M8b2** is connected to a second OLED **OLED2b2**, and the gate of the eighth transistor **M8b2** is connected to the second emission control line **E2n** so that the eighth transistor **M8b2** applies the current that flows through the first node **A5** to the second OLED **OLED2b2** in accordance with the second emission control signal **e2n** transmitted through the second emission control line **E2n** to emit light from the second OLED **OLED2b2**.

[0114] The source of the first switching device **Mab2** is connected to the second emission control line **E2n**, the drain of the first switching device **Mab2** is connected to the first OLED **OLED1b2**, and the gate of the first switching device **Mab2** is connected to the first emission control line **E1n** so that the first switching device **Mab2** is turned on when the first emission control signal **e1n** transmitted through the first emission control line **E1n** is in the high level. At this time, the second emission control signal **e2n** is in the low level so that the potential of the anode electrode of the first OLED **OLED1b2** is lower than the potential of the cathode electrode. Therefore, the first OLED **OLED1b2** is reverse biased.

[0115] The source of the second switching device **Mbb2** is connected to the first emission control line **E1n**, the drain of the second switching device **Mbb2** is connected to the second OLED **OLED2b2**, and the gate of the second switching device **Mbb2** is connected to the second emission control line **E2n** so that the switching device **Mbb2** is turned on when the second emission control signal **e2n** transmitted through the second emission control line **E2n** is in the high level. At this time, the first emission control signal **e1n** is in the low level so that the potential of the anode electrode of the first OLED **OLED1b2** is lower than the potential of the cathode electrode. Therefore, the first OLED **OLED1b2** is reverse biased.

[0116] In more detail, the source of the first switching device **Mab2** is connected to the second emission control line **E2n**, the drain of the first switching device **Mab2** is connected to the first OLED **OLED1b2**, and the gate of the first switching device **Mab2** is connected to the first emission control signal **e1n** so that the first switching device

**Mab2** applies the second emission control signal **e2n** transmitted through the second emission control line **E2n** to the first OLED **OLED1b2** in accordance with the first emission control signal **e1n** transmitted through the first emission control line **E1n**. At this time, when the first emission control signal **e1n** transmitted through the first emission control line **E1n** is in the high level, the first switching device **Mab2** is turned on and the second emission control signal **e2n** is in the low level so that the potential of the anode electrode of the first OLED **OLED1b2** is lower than the potential of the cathode electrode. Therefore, the first OLED **OLED1b2** is reverse biased.

[0117] The source of the second switching device **Mbb2** is connected to the first emission control line **E1n**, the drain of the second switching device **Mbb2** is connected to the second OLED **OLED2b2**, and the gate of the second switching device **Mbb2** is connected to the second emission control line **E2n** so that the second switching device **Mbb2** applies the first emission control signal **e1n** transmitted through the first emission control signal **E1n** to the second OLED **OLED2b2** in accordance with the second emission control signal **e2n** transmitted through the second emission control line **E2n**. At this time, when the second emission control signal **e2n** transmitted through the second emission control line **E2n** is in the high level, the second switching device **Mbb2** is turned on, and the first emission control signal **e1n** is in the low level so that the potential of the anode electrode of the second OLED **OLED2b2** is lower than the potential of the cathode electrode. Therefore, the second OLED **OLED2b2** is reverse biased.

[0118] The seventh and eighth transistors **M7b2** and **M8b2** are formed of the PMOS transistors, and the first and second switching devices **Mab2** and **Mbb2** are formed of the NMOS transistors so that the seventh transistor **M7b2** and the first switching device **Mab2** are turned on or off at different times by the first emission control signal **e1n** and so that the eighth transistor **M8b2** and the second switching device **Mbb2** are turned on or off at different times by the second emission control signal **e2n**.

[0119] The first electrode of the capacitor **Cstb2** is connected to the pixel power source line of the pixel power source **Vdd**, and the second electrode of the capacitor **Cstb2** is connected to the third node **C5** so that the capacitor **Cstb2** is initialized by the initializing signal transmitted to the third node **C5** through the fourth transistor **M4b2** and so that the voltage corresponding to the data signal is stored in the capacitor **Cstb2** and is transmitted to the third node **C5**. Therefore, the gate voltage of the first transistor **M1b2** is maintained for a predetermined time by the capacitor **Cstb2**.

[0120] FIG. 11 illustrates a first embodiment of waveforms for operating the pixel of FIG. 9 and the pixel of FIG. 10. Referring to FIG. 11, a pixel (e.g., a pixel 110b) is operated by the first and second scan signals **sn** and **sn-1** and the first and second emission control signals **e1n** and **e2n**.

[0121] For exemplary purposes, an operation of the pixel of FIG. 10 will be described in more detail with the waveforms of FIG. 11. In operation, the fourth transistor **M4b2** is first turned on by the second scan signal **sn-1**, and the initializing signal is transmitted to the capacitor **Cstb2** through the fourth transistor **M4b2** so that the capacitor **Cstb2** is initialized.

[0122] Then, the second and third transistors **M2b2** and **M3b2** are turned on by the first scan signal **sn** so that the

potential of the second node B5 is made equal to the potential of the third node C5. Therefore, the first transistor M1b2 is connected like a diode so that an electric current can flow through the first transistor M1b2. In addition, the data signal is transmitted to the second node B5 through the second transistor M2b2. Therefore, the data signal is applied to the second electrode of the capacitor Cstb2 through the second transistor M2b2, the first transistor M1b2, and the third transistor M3b so that the voltage corresponding to difference between the data signal and the threshold voltage is applied to the second electrode of the capacitor Cstb2.

[0123] After the first scan signal sn is transited to the high level, when the first emission control signal e1n is transited to the low level and is maintained in the low level for a predetermined time, the fifth and seventh transistors M5b2 and M7b2 are turned on by the first emission control signal e1n so that the voltage corresponding to the EQUATION 1 is applied between the gate and source of the first transistor M1b2.

[0124] Therefore, the current corresponding to the EQUATION 2 flows to the first node A5 regardless of the threshold voltage of the first transistor M1b2.

[0125] At this time, since the second emission control signal e2n is in the high level and the first emission control signal e1n is in the low level state, the first switching device Mab2 is maintained to be turned off by the first emission control signal e1n so that the first switching device Mab2 is turned off. Therefore, the current that flows to the first OLED OLED1b2 is not affected by the second emission control signal e2n.

[0126] On the other hand, the second switching device Mbb2 is turned on by the second emission control signal e2n. At this time, since the signal e1n transmitted through the first emission control line E1n connected to the source of the second switching device Mbb2 is in the low level, the low signal is transmitted to the anode electrode of the second OLED OLED2b2 so that the second OLED OLED2b2 is reverse biased.

[0127] Then, the voltage value corresponding to difference between the pixel power source and the data signal is stored in the capacitor Cstb2 in accordance the first and second scan signals sn and sn-1, the voltage corresponding to the EQUATION 1 is applied between the source and gate of the first transistor M1b2, the sixth and eighth transistors M6b2 and M8b2 are turned on by the second emission control signal e2n, and the current corresponding to the EQUATION 2 flows to the second OLED OLED2b2.

[0128] At this time, since the first emission control signal e1n is in the high level and the second emission control signal e2n is in the low level, the seventh transistor M7b2 is turned off and the eighth transistor M8b2 is turned on so that the current flows to the second OLED OLED2b2 through the eighth transistor M8b2. The first switching device Mab2 is maintained to be turned on by the first emission control signal e1n so that the second emission control signal e2n connected to the source of the first switching device Mab2 is transmitted to the first OLED OLED1b2. Therefore, the first OLED OLED1b2 is reverse biased. On the other hand, the second switching device Mbb2 is turned off so that the current that flows to the second OLED OLED2b2 is not affected by the first emission control signal e1n.

[0129] Here, in the pixels of FIGS. 9 and 10, the first to eighth transistors M1b to M8b (e.g., M1b1 to M8b1 or M1b2 to M8b2) are formed of the PMOS transistors, and the first and second switching devices Mab and Mbb (e.g., Mab1 and Mbb1 or Mab2 and Mbb2) are formed of the NMOS transistors. However, when the first to eighth transistors M1b to M8b are formed of the NMOS transistors and the first and second switching devices Ma and Mb are formed of the PMOS transistors, the pixel(s) operates in accordance with the waveforms illustrated in FIG. 12.

[0130] As described above, according to a pixel circuit and a light emitting display of the present invention, a reverse bias (or a reverse bias voltage) can be easily applied in the periods when OLEDs do not emit light and thus can improve the characteristics of the OLEDs. Also, since a plurality of OLEDs are connected to one pixel circuit, it is possible to reduce the number of pixel circuits of a light emitting display and thus to improve the aperture ratio of the light emitting display.

[0131] While the invention has been described in connection with certain exemplary embodiments, it is to be understood by those skilled in the art that the invention is not limited to the disclosed embodiments, but, on the contrary, is intended to cover various modifications included within the spirit and scope of the appended claims and equivalents thereof.

What is claimed is:

1. A pixel comprising:

- first and second organic light emitting diodes (OLEDs);
- a driving circuit commonly connected to the first and second OLEDs to drive the first and second OLEDs;
- a switching circuit connected between the first and second OLEDs and the driving circuit to sequentially control the driving of the first and second OLEDs using first and second emission control signals; and
- a reverse bias circuit for selectively applying a reverse bias voltage comprising at least one of the first and second emission control signals to the first and second OLEDs,

wherein the driving circuit comprises:

- a first transistor for receiving a first power of a first power source to selectively supply a driving current corresponding to a first voltage applied to a gate at the first transistor to the first and second OLEDs;
- a second transistor for selectively applying a data signal to a first electrode of the first transistor in accordance with a first scan signal;
- a third transistor for selectively connecting the first transistor to serve as a diode in accordance with the first scan signal so that an electric current can flow through the first transistor;
- a capacitor for storing the voltage applied to the gate of the first transistor while the data signal is applied to the first electrode of the first transistor and for maintaining the stored voltage at the gate of the first transistor for a period when at least one of the first and second OLEDs emits light;

a fourth transistor for selectively applying an initializing voltage to the capacitor in accordance with a second scan signal;

a fifth transistor for selectively applying the first power of the first power source to the first transistor in accordance with the first emission control signal; and

a sixth transistor for selectively applying the first power of the first power source to the first transistor in accordance with the second emission control signal.

2. The pixel as claimed in claim 1, wherein the reverse bias applying circuit comprises:

a first switching device for selectively applying the second emission control signal to the first OLED in accordance with the first emission control signal; and

a second switching device for selectively applying the first emission control signal to the second OLED in accordance with the second emission control signal.

3. The pixel as claimed in claim 1, wherein the second scan signal is transmitted to a first scan line preceding a second scan line for transmitting the first scan signal.

4. The pixel as claimed in claim 1, wherein the initializing voltage comprises the second scan signal.

5. The pixel as claimed in claim 1, wherein the initializing voltage comprises a voltage applied to at least one of the first and second OLEDs when the first and second OLEDs are turned off.

6. A pixel comprising:

first and second organic light emitting diodes (OLEDs);

a driving circuit commonly connected to the first and second OLEDs to drive the first and second OLEDs;

a switching circuit connected between the first and second OLEDs and the driving circuit to sequentially control the driving of the first and second OLEDs using first and second emission control signals; and

a reverse bias circuit connected to a reverse bias line for transmitting a reverse bias voltage to selectively apply the reverse bias voltage to the first and second OLEDs in accordance with the first and second emission control signals so that the reverse bias voltage is applied to the first and second OLEDs,

wherein the driving circuit comprises:

a first transistor for receiving a first power of a first power source to selectively supply a driving current corresponding to a first voltage applied to a gate of the first transistor to the first and second OLEDs;

a second transistor for selectively applying a data signal to a first electrode of the first transistor in accordance with a first scan signal;

a third transistor for selectively connecting the first transistor to serve as a diode in accordance with the first scan signal so that an electric current can flow through the first transistor;

a capacitor for storing the voltage applied to the gate of the first transistor while the data signal is applied to the first electrode of the first transistor and for maintaining the stored voltage at the gate of the first transistor for a period when at least one of the first and second OLEDs emits light;

a fourth transistor for selectively applying an initializing voltage to the capacitor in accordance with a second scan signal;

a fifth transistor for selectively applying the first power of the first power source to the first transistor in accordance with the first emission control signal; and

a sixth transistor for selectively applying the first power of the first power source to the first transistor in accordance with the second emission control signal.

7. The pixel as claimed in claim 6, wherein the reverse bias applying circuit comprises:

a first switching device for selectively applying the reverse bias voltage to the first OLED in accordance with the first emission control signal; and

a second switching device for selectively applying the reverse bias voltage to the second OLED in accordance with the second emission control signal.

8. The pixel as claimed in claim 6, wherein the second scan signal is transmitted to a first scan line preceding a second scan line for transmitting the first scan signal.

9. The pixel as claimed in claim 6, wherein the initializing voltage comprises the second scan signal.

10. The pixel as claimed in claim 6, wherein the initializing voltage comprises a voltage applied to at least one of the first and second OLEDs when the first and second OLEDs are turned off.

11. A pixel comprising:

first and second organic light emitting diodes (OLEDs);

a driving circuit commonly connected to the first and second OLEDs to drive the first and second OLEDs;

a switching circuit connected between the first and second OLEDs and the driving circuit to sequentially control the driving of the first and second OLEDs using first and second emission control signals; and

a reverse bias circuit connected to a reverse bias line for transmitting a reverse bias voltage and a reverse bias control line for transmitting a reverse voltage control signal to selectively apply the reverse bias voltage to the first and second OLEDs in accordance with the reverse voltage control signal so that the reverse bias voltage is applied to the first and second OLEDs,

wherein the driving circuit comprises:

a first transistor for receiving a first power of a first power source to selectively supply a driving current corresponding to a first voltage applied to a gate of the first transistor to the first and second OLEDs;

a second transistor for selectively applying a data signal to a first electrode of the first transistor in accordance with a first scan signal;

a third transistor for selectively connecting the first transistor to serve as a diode in accordance with the first scan signal so that an electric current can flow through the first transistor;

a capacitor for storing the voltage applied to the gate of the first transistor while the data signal is applied to the first electrode of the first transistor and for maintaining

the stored voltage at the gate of the first transistor for a period when at least one of the first and second OLEDs emits light;

a fourth transistor for selectively applying an initializing voltage to the capacitor in accordance with a second scan signal;

a fifth transistor for selectively applying the first power of the first power source to the first transistor in accordance with the first emission control signal; and

a sixth transistor for selectively applying the first power of the first power source to the first transistor in accordance with the second emission control signal.

**12.** The pixel as claimed in claim 11, wherein the reverse bias applying circuit comprises:

a first switching device for selectively applying the reverse bias voltage to the first OLED in accordance with the reverse voltage control signal; and

a second switching device for selectively applying the reverse bias voltage to the second OLED in accordance with the reverse voltage control signal.

**13.** The pixel as claimed in claim 11, wherein the reverse voltage control signal is at a switch turned-on level when at least one of the first and second scan signals is at a transistor turned-on level.

**14.** The pixel as claimed in claim 11, wherein the second scan signal is transmitted to a first scan line preceding a second scan line for transmitting the first scan signal.

**15.** The pixel as claimed in claim 11, wherein the initializing voltage comprises the second scan signal.

**16.** The pixel as claimed in claim 11, wherein the initializing voltage comprises a voltage applied to at least one of the first and second OLEDs when the first and second OLEDs are turned off.

**17.** A light emitting display comprising:

an image display unit including a plurality of pixels to display an image;

a scan driver for transmitting first and second scan signals and first and second emission control signals to the image display unit; and

a data driver for transmitting a data signal to the image display unit,

wherein at least one of the pixels comprises:

first and second organic light emitting diodes (OLEDs);

a driving circuit commonly connected to the first and second OLEDs to drive the first and second OLEDs;

a switching circuit connected between the first and second OLEDs and the driving circuit to sequentially control the driving of the first and second OLEDs using the first and second emission control signals; and

a reverse bias circuit for selectively applying a reverse bias voltage comprising at least one of the first and second emission control signals to the first and second OLEDs,

wherein the driving circuit comprises:

a first transistor for receiving a first power of a first power source to selectively supply a driving current corre-

sponding to a first voltage applied to a gate of the first transistor to the first and second OLEDs;

a second transistor for selectively applying a data signal to a first electrode of the first transistor in accordance with the first scan signal;

a third transistor for selectively connecting the first transistor to serve as a diode in accordance with the first scan signal so that an electric current can flow through the first transistor;

a capacitor for storing the voltage applied to the gate of the first transistor while the data signal is applied to the first electrode of the first transistor and for maintaining the stored voltage at the gate of the first transistor for a period when at least one of the first and second OLEDs emits light;

a fourth transistor for selectively applying an initializing voltage to the capacitor in accordance with the second scan signal;

a fifth transistor for selectively applying the first power of the first power source to the first transistor in accordance with the first emission control signal; and

a sixth transistor for selectively applying the first power of the first power source to the first transistor in accordance with the second emission control signal.

**18.** A light emitting display comprising:

an image display unit including a plurality of pixels to display an image;

a scan driver for transmitting first and second scan signals and first and second emission control signals to the image display unit; and

a data driver for transmitting a data signal to the image display unit,

wherein at least one of the pixels comprises:

first and second organic light emitting diodes (OLEDs);

a driving circuit commonly connected to the first and second OLEDs to drive the first and second OLEDs;

a switching circuit connected between the first and second OLEDs and the driving circuit to sequentially control the driving of the first and second OLEDs using the first and second emission control signals; and

a reverse bias circuit connected to a reverse bias line for transmitting a reverse bias voltage to selectively apply the reverse bias voltage to the first and second OLEDs in accordance with the first and second emission control signals so that the reverse bias voltage is applied to the first and second OLEDs,

wherein the driving circuit comprises:

a first transistor for receiving a first power of a first power source to selectively supply a driving current corresponding to a first voltage applied to a gate of the first transistor to the first and second OLEDs;

a second transistor for selectively applying a data signal to a first electrode of the first transistor in accordance with the first scan signal;



a third transistor for selectively connecting the first transistor to serve as a diode in accordance with the first scan signal so that an electric current can flow through the first transistor;

a capacitor for storing the voltage applied to the gate of the first transistor while the data signal is applied to the first electrode of the first transistor and for maintaining the stored voltage at the gate of the first transistor for a period when at least one of the first and second OLEDs emits light;

a fourth transistor for selectively applying an initializing voltage to the capacitor in accordance with the second scan signal;

a fifth transistor for selectively applying the first power of the first power source to the first transistor in accordance with the first emission control signal; and

a sixth transistor for selectively applying the first power of the first power source to the first transistor in accordance with the second emission control signal

**19.** A light emitting display comprising:

an image display unit including a plurality of pixels to display an image;

a scan driver for transmitting first and second scan signals and first and second emission control signals to the image display unit; and

a data driver for transmitting a data signal to the image display unit,

wherein at least one of the pixels comprises:

first and second organic light emitting diodes (OLEDs);

a driving circuit commonly connected to the first and second OLEDs to drive the first and second OLEDs;

a switching circuit connected between the first and second OLEDs and the driving circuit to sequentially control the driving of the first and second OLEDs using the first and second emission control signals; and

a reverse bias circuit connected to a reverse bias line for transmitting a reverse bias voltage and a reverse bias control line for transmitting a reverse bias voltage control signal to selectively apply the reverse bias voltage to the first and second OLEDs in accordance with the reverse bias voltage control signal so that the reverse bias voltage is applied to the first and second OLEDs,

wherein the driving circuit comprises:

a first transistor for receiving a first power of a first power source to selectively supply a driving current corresponding to a first voltage applied to a gate of the first transistor to the first and second OLEDs;

a second transistor for selectively applying the data signal to a first electrode of the first transistor in accordance with the first scan signal;

a third transistor for selectively connecting the first transistor to serve as a diode in accordance with the first scan signal so that an electric current can flow through the first transistor;

a capacitor for storing the voltage applied to the gate of the first transistor while the data signal is applied to the first electrode of the first transistor and for maintaining the stored voltage at the gate of the first transistor for a period when at least one of the first and second OLEDs emits light;

a fourth transistor for selectively applying an initializing voltage to the capacitor in accordance with the second scan signal;

a fifth transistor for selectively applying the first power of the first power source to the first transistor in accordance with the first emission control signal; and

a sixth transistor for selectively applying the first power of the first power source to the first transistor in accordance with the second emission control signal.

**20.** A pixel for a light emitting display comprising:

first and second organic light emitting diodes (OLEDs);

a driving circuit commonly connected to the first and second OLEDs to drive the first and second OLEDs;

a switching circuit connected between the first and second OLEDs and the driving circuit to sequentially control the driving of the first and second OLEDs using the first and second emission control signals; and

a reverse bias circuit for selectively applying a reverse bias voltage to the first and second OLEDs.

**21.** The pixel as claimed in claim 20, wherein the reverse bias voltage comprises at least one of the first and second emission control signals.

**22.** The pixel as claimed in claim 21, wherein the reverse bias circuit selectively applies the reverse bias voltage to the first and second OLEDs in accordance with one of the first and second emission control signals when another one of the first and second emission control signals is used as the reverse bias voltage.

**23.** The pixel as claimed in claim 20, wherein the reverse bias circuit is connected to a reverse bias line for transmitting the reverse bias voltage and selectively applies the reverse bias voltage to the first and second OLEDs in accordance with the first and second emission control signals.

**24.** The pixel as claimed in claim 20, wherein the reverse bias circuit is connected to a reverse bias line for transmitting a reverse bias voltage and a reverse bias control line for transmitting a reverse bias voltage control signal, and wherein the reverse bias circuit selectively applies the reverse bias voltage to the first and second OLEDs in accordance with the reverse bias voltage control signal.

**25.** The pixel as claimed in claim 20, wherein the driving circuit comprises:

a first transistor for receiving a first power of a first power source to selectively supply a driving current corresponding to a first voltage applied to a gate of the first transistor to the first and second OLEDs;

a second transistor for selectively applying the data signal to a first electrode of the first transistor in accordance with the first scan signal;

a third transistor for selectively connecting the first transistor to serve as a diode in accordance with the first scan signal so that an electric current can flow through the first transistor;

a capacitor for storing the voltage applied to the gate of the first transistor while the data signal is applied to the first electrode of the first transistor and for maintaining the stored voltage at the gate of the first transistor for a period when at least one of the first and second OLEDs emits light;

a fourth transistor for selectively applying an initializing voltage to the capacitor in accordance with the second scan signal;

a fifth transistor for selectively applying the first power of the first power source to the first transistor in accordance with the first emission control signal; and

a sixth transistor for selectively applying the first power of the first power source to the first transistor in accordance with the second emission control signal.

\* \* \* \* \*

专利名称(译)	像素和发光显示器		
公开(公告)号	<a href="#">US20060125737A1</a>	公开(公告)日	2006-06-15
申请号	US11/274042	申请日	2005-11-14
[标]申请(专利权)人(译)	KWAK WON KYU 朴成喆		
申请(专利权)人(译)	KWAK WON KYU 朴成喆		
当前申请(专利权)人(译)	三星DISPLAY CO. , LTD.		
[标]发明人	KWAK WON KYU PARK SUNG CHEON		
发明人	KWAK, WON KYU PARK, SUNG CHEON		
IPC分类号	G09G3/30		
CPC分类号	G09G3/3233 G09G2300/0804 G09G2300/0819 G09G2300/0842 G09G2300/0861 G09G2310/0251 G09G2310/0256 G09G2320/043		
优先权	1020040095983 2004-11-22 KR		
其他公开文献	US7557784		
外部链接	<a href="#">Espacenet</a> <a href="#">USPTO</a>		

#### 摘要(译)

像素和包括像素的发光显示器。该像素包括第一和第二有机发光二极管（OLED），共同连接到多个OLED以驱动第一和第二OLED的驱动电路，连接在第一和第二OLED之间的开关电路和驱动电路，以顺序地控制使用第一和第二发射控制信号驱动第一和第二OLED，以及反向偏置电路，用于选择性地将包括第一和第二发射控制信号中的至少一个的反向偏置电压施加到第一和第二OLED。因此，可以在OLED不发光的时段中容易地应用反向偏压，从而可以改善OLED的特性。而且，由于第一OLED和第二OLED连接到一个像素电路，因此可以减少发光显示器的像素数量，从而提高发光显示器的开口率。

