US 20110025659A1

(19) United States

(12) Patent Application Publication

(10) Pub. No.: US 2011/0025659 A1

(43) Pub. Date: Feb. 3, 2011

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(54) ORGANIC LIGHT EMITTING DISPLAY DEVICE

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(21) Appl. No.: **12/774,638**

(22) Filed: **May 5, 2010**

(30) **Foreign Application Priority Data**

Jul. 29, 2009 (KR) 10-2009-0069426

Publication Classification

(51) **Int. Cl.**
G09G 3/30 (2006.01)
G09G 5/00 (2006.01)

(52) **U.S. Cl.** **345/205**; 345/80

(57) **ABSTRACT**

An organic light emitting display device may include a plurality of pixels in pixel regions defined on a substrate, each of the pixels being coupled to a current scan line, a data line, a first power source, a second power source and a third power source, wherein each of the pixels includes a pixel circuit having a plurality of transistors and one or more capacitors, and an organic light emitting diode (OLED) including a first electrode and coupled to the pixel circuit, the OLED configured to emit light with a luminance corresponding to a driving current flowing from the first power source to the second power source via the pixel circuit, wherein the third power source is configured to supply a constant voltage to the pixel circuit through a supply line, and wherein the supply line is in a same layer and of a same material as the first electrode.

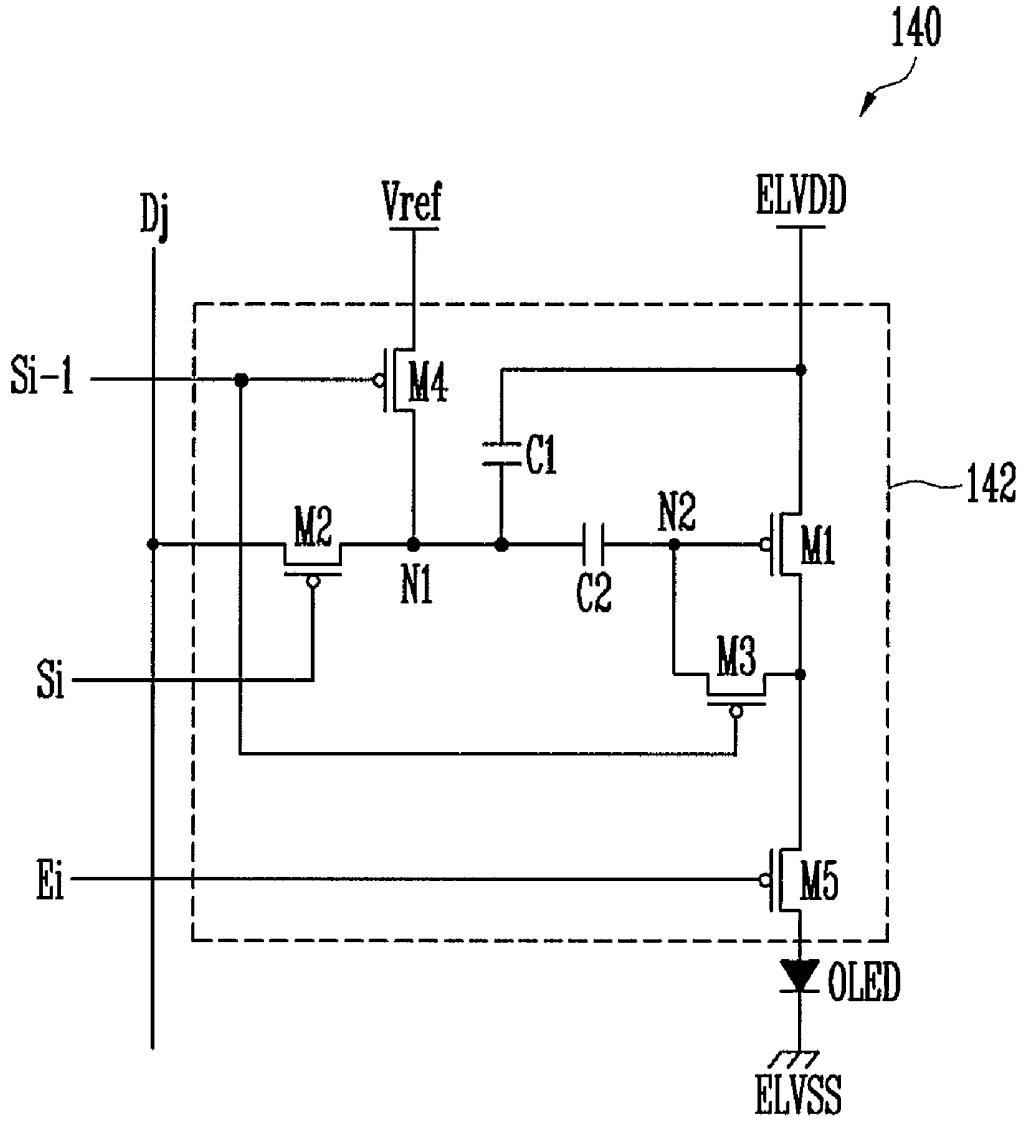


FIG. 1

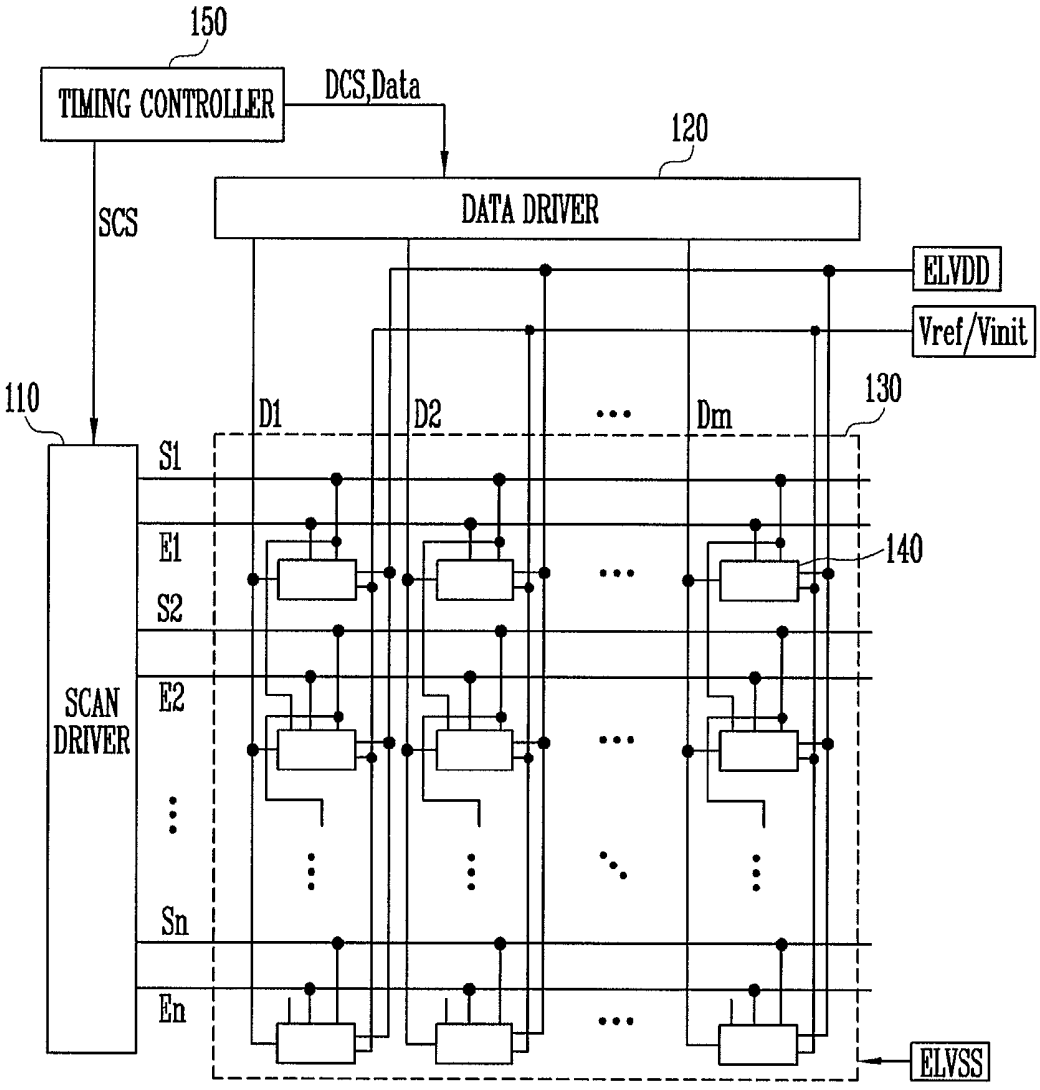

150
TIMING CONTROLLER
DCS,Data
120
DATA DRIVER
SCS
ELVDD
Vref/Vinit
110
D1
D2
Dm
130
S1
E1
140
S2
SCAN DRIVER
E2
Sn
En
ELVSS

FIG. 2

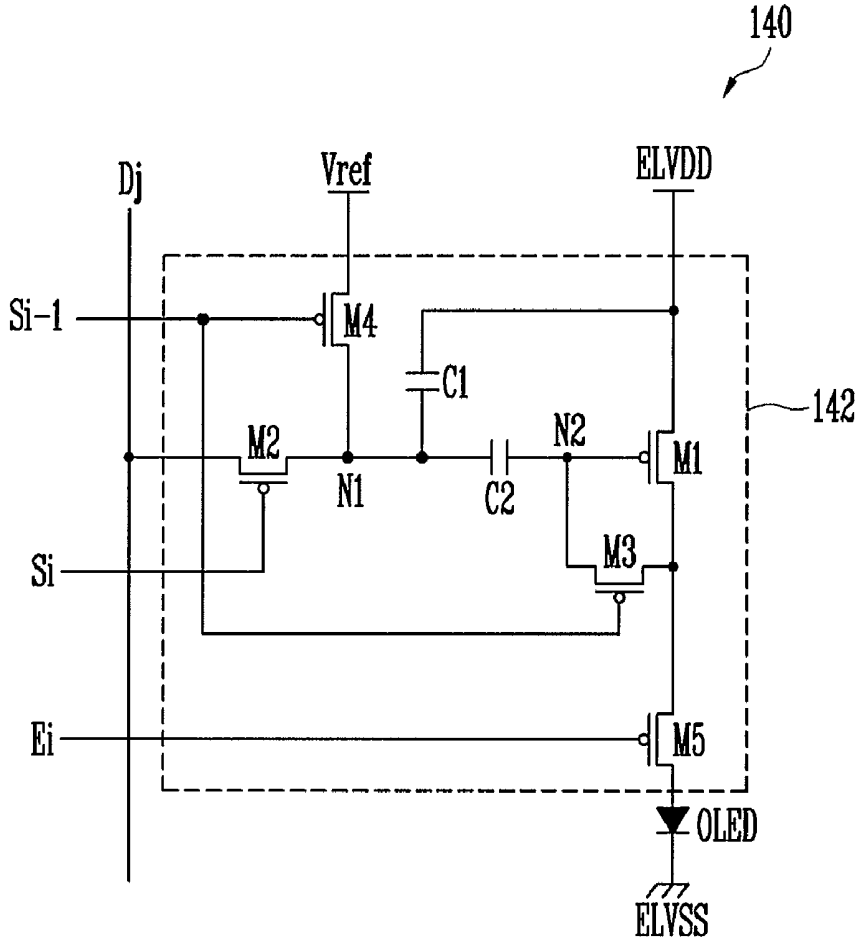

140
Dj
Vref
ELVDD
Si-1
M4
C1
142
M2
N2
M1
N1
C2
Si
M3
Ei
M5
OLED
ELVSS

FIG. 3

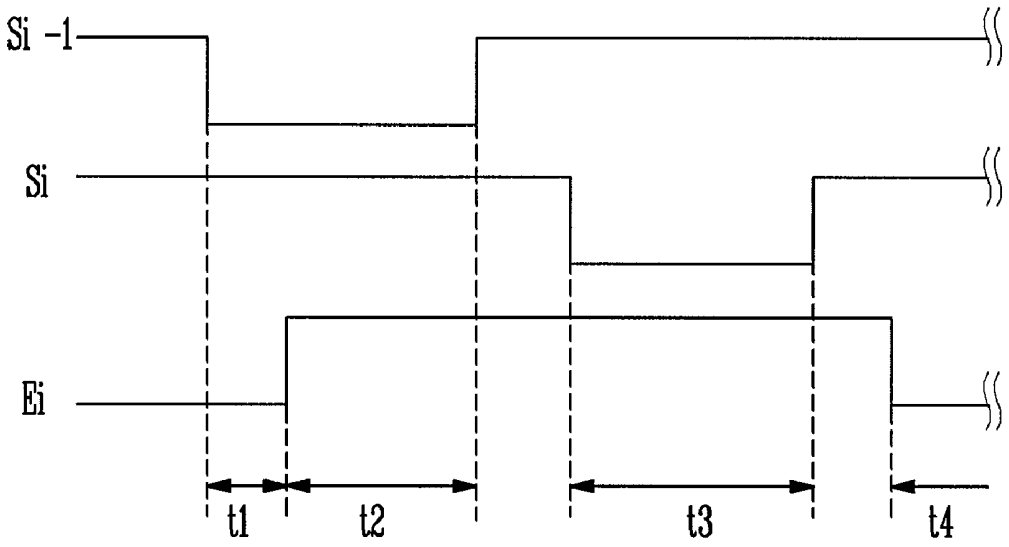

Si -1
Si
Ei
t1
t2
t3
t4

FIG. 4

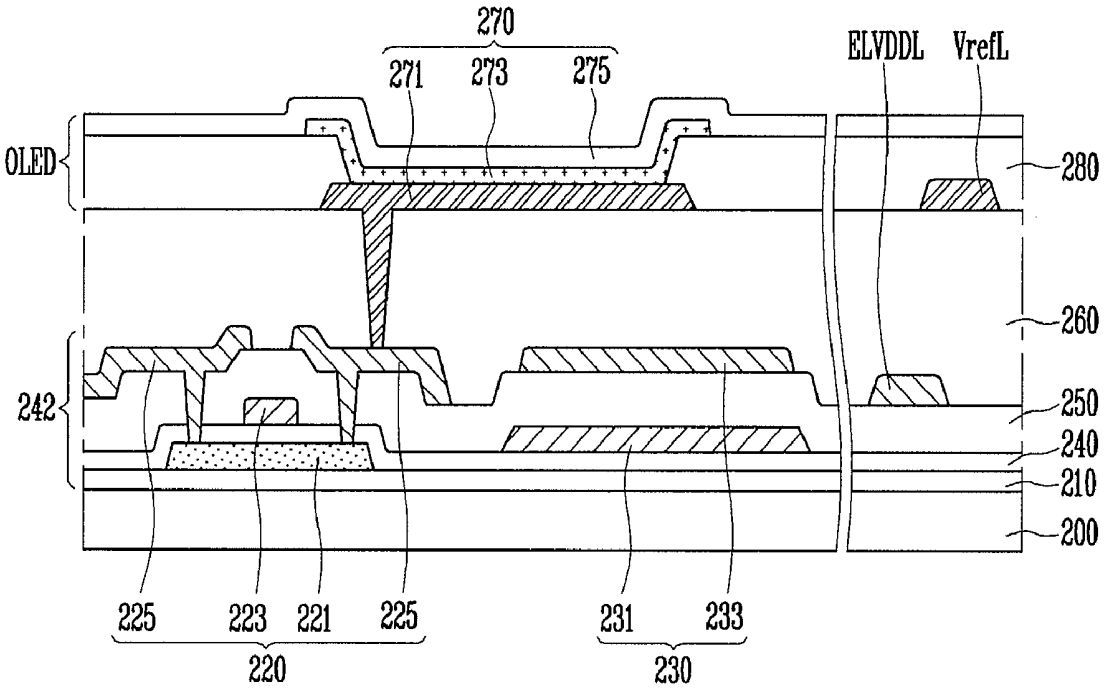

270
271
273
275
ELVDDL
VrefL
OLED
280
260
242
250
240
210
200
225
223
221
225
231
233
220
230

FIG. 5

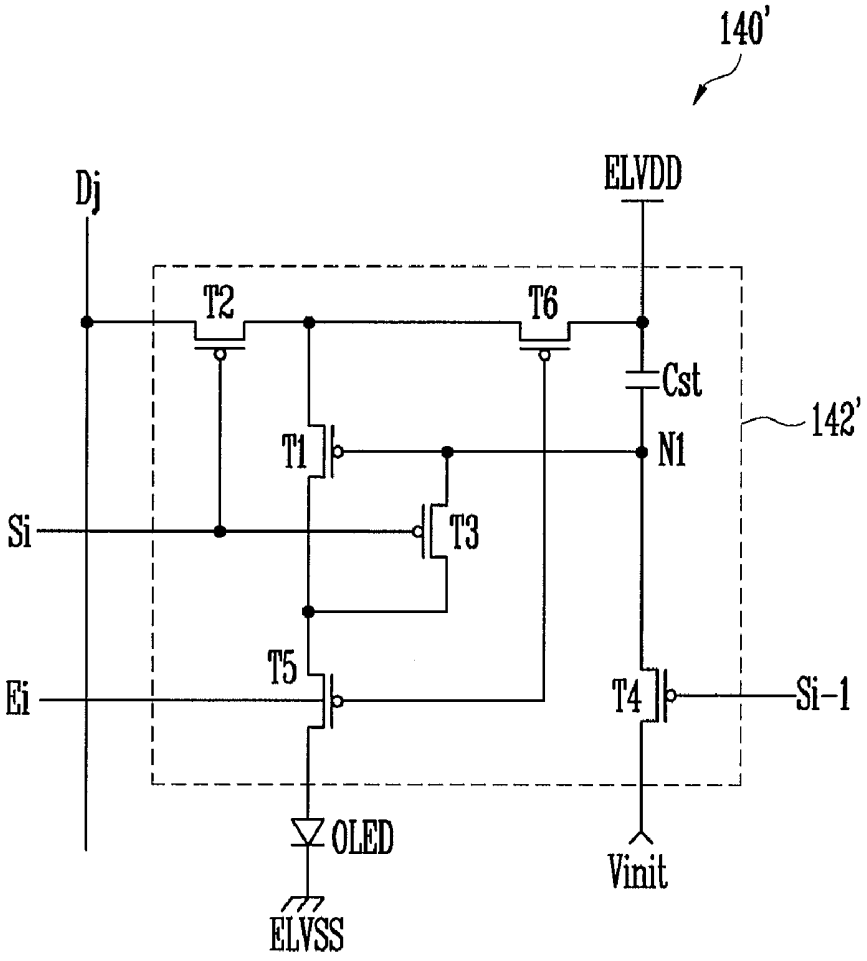

140'
Dj
ELVDD
T2
T6
Cst
142'
T1
N1
Si
T3
T5
Ei
T4
Si-1
OLED
Vinit
ELVSS

FIG. 6

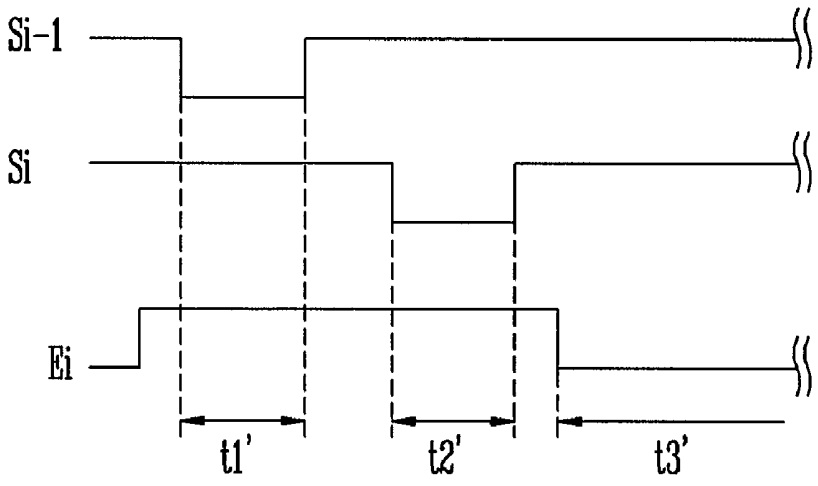
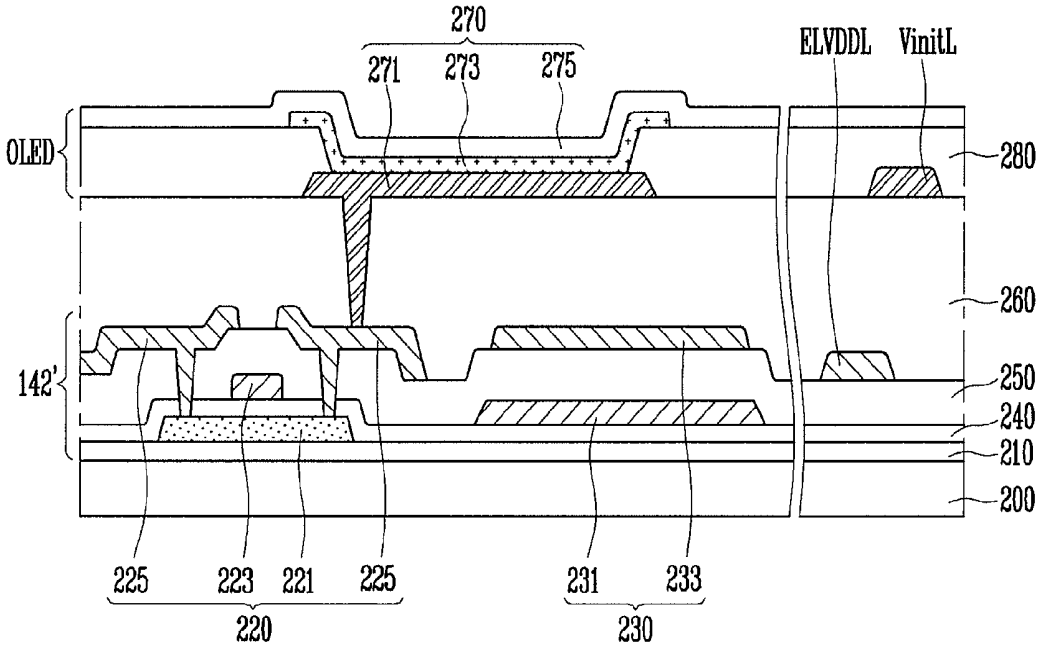

Si-1
Si
Ei
t1'
t2'
t3'

FIG. 7


270
271
273
275
ELVDDL
VinitL
OLED
280
260
142'
250
240
210
200
225
223
221
225
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233
220
230

ORGANIC LIGHT EMITTING DISPLAY DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to and the benefit of Korean Patent Application No. 10-2009-0069426, filed on Jul. 29, 2009, in the Korean Intellectual Property Office, the entire content of which is incorporated herein by reference.

BACKGROUND

[0002] 1. Field

[0003] An aspect of the present invention generally relates to an organic light emitting display device.

[0004] 2. Description of the Related Art

[0005] An organic light emitting display device is a type of flat panel display device that uses an organic compound as a light emitting material. As such, the organic light emitting display device has been expected to be used for various types of display devices including a portable display device because of high luminance and color purity, thin, lightweight and low power consumption characteristics.

[0006] An organic light emitting display device typically includes a plurality of pixels each having an organic light emitting diode as a self-luminescent element. In the case of an active matrix organic light emitting display device, a pixel circuit is further provided with each pixel. The pixel circuit includes a plurality of transistors for driving the organic light emitting diode and one or more capacitors.

[0007] Typically, an active matrix organic light emitting display device is manufactured by forming pixel circuits on a substrate and then forming an organic light emitting diode on each of the pixel circuits so that the organic light emitting diode is connected to the pixel circuit through a via hole.

[0008] As compensation elements are added to the pixel circuits, for compensating for characteristic variations of the transistors due to the process variations, the configuration of the pixel circuits has become complicated.

[0009] As such, it can be difficult to secure sufficient space for forming capacitors due to limitations of the design space in a limited pixel region. As a result, image quality can be unequal or non-uniform. Further, because it is difficult to secure sufficient spacing between wires, yield is lowered.

SUMMARY

[0010] Accordingly, in several embodiments, there is provided an organic light emitting display device capable of displaying uniform images and improving a yield by simplifying the design of a pixel circuit through effective arrangement of wires and other circuit components.

[0011] According to an aspect of the present invention, there is provided an organic light emitting display device including a plurality of pixels in pixel regions defined on a substrate, each of the pixels being coupled to at least a current scan line, a data line, a first power source, a second power source and a third power source, wherein each of the pixels includes a pixel circuit having a plurality of transistors and one or more capacitors, and an organic light emitting diode including a first electrode and coupled to the pixel circuit, the organic light emitting diode configured to emit light with a luminance corresponding to a driving current flowing from the first power source to the second power source via the pixel circuit, wherein the third power source is configured to supply a constant voltage to the pixel circuit through a supply line of the third power source, and wherein the supply line is formed in a same layer and of a same material as the first electrode.

[0012] Here, the third power source may be a power source that does not form a current path to the organic light emitting diode. The third power source may be configured to supply a constant voltage to the pixel circuit during the period before a current scan signal is supplied from the current scan line.

[0013] The supply line of the third power source may be formed of the same material as that of an anode electrode of the organic light emitting diode in the same layer.

[0014] A supply line of the first power source may be formed in a different layer from that in which the supply line of the third power source is formed. Here, the supply line of the first power source may be formed of the same material and in the same layer as that of one electrode of the transistor.

[0015] The first power source may be configured as a high-potential pixel power source, and the second power source may be configured as a low-potential pixel power source. The third power source may be set to a different voltage than the first power source and the second power source.

[0016] The pixel circuit may include a plurality of transistors formed on the substrate, and one or more capacitors formed using a same material as an electrode material of the transistors during the same process of forming the transistors. The organic light emitting diode may be formed on the pixel circuit with an insulating layer interposed therebetween, and the first electrode of the organic light emitting diode may be coupled to a source or drain electrode of the transistors through a via hole in the insulating layer.

[0017] Here, the organic light emitting diode may include an anode electrode formed on the insulating layer, an organic emission layer formed on the anode electrode and a cathode electrode formed on the organic emission layer. The organic light emitting diode may emit light in the direction of the cathode electrode.

[0018] The anode electrode of the organic light emitting diode and the supply line of the third power source may be formed of a material selected from the group consisting of ITO/Ag/ITO, ITO/Al/ITO, ITO/AlNiLa/ITO and ITO/AlNiLa.

[0019] According to one embodiment of the present invention, a supply line for supplying a third power source is not configured to form a current path to an organic light emitting diode unlike the high-potential and low-potential pixel power sources which may form such a current path. The supply line may be formed of the same material as that of one electrode of the organic light emitting diode, (i.e., an anode electrode of an organic light emitting diode in the same layer). In such case, wires of the pixels may be effectively arranged.

[0020] Accordingly, in several embodiments, the design of a pixel circuit positioned below the organic light emitting diode is simplified, so that an organic light emitting display device may display uniform images and may improve yield by sufficiently ensuring space for forming capacitors, spacing between wires, and other appropriate spacing for circuit components.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] The accompanying drawings, together with the specification, illustrate exemplary embodiments of the present invention, and, together with the description, serve to explain aspects of the present invention.

[0022] FIG. **1** is a block diagram of an organic light emitting display device including a number of pixels according to one embodiment of the present invention.

[0023] FIG. **2** is a schematic circuit diagram illustrating an embodiment of one of the pixels illustrated in FIG. **1**.

[0024] FIG. **3** is a waveform diagram illustrating a method for driving the pixel illustrated in FIG. **2** according to one embodiment of the present invention.

[0025] FIG. **4** is a cross sectional view illustrating a portion of the pixel illustrated in FIG. **2** according to one embodiment of the present invention.

[0026] FIG. **5** is a schematic circuit diagram illustrating another embodiment of the pixel illustrated in FIG. **1**.

[0027] FIG. **6** is a waveform diagram illustrating a method for driving the pixel illustrated in FIG. **5** according to one embodiment of the present invention.

[0028] FIG. **7** is a cross sectional view illustrating a portion of the pixel illustrated in FIG. **5** according to one embodiment of the present invention.

DETAILED DESCRIPTION

[0029] In the following detailed description, only certain exemplary embodiments of the present invention have been shown and described, simply by way of illustration. As those skilled in the art would realize, the described embodiments may be modified in various different 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 and not restrictive. In addition, when an element is referred to as being "on" another element, it can be directly on the another element or be indirectly on the another element with one or more intervening elements interposed therebetween. Also, when an element is referred to as being "connected to" another element, it can be directly connected to the another element or be indirectly connected to the another element with one or more intervening elements interposed therebetween. Hereinafter, like reference numerals refer to like elements.

[0030] FIG. **1** is a block diagram of an organic light emitting display device including a number of pixels according to one embodiment of the present invention.

[0031] Referring to FIG. **1**, the organic light emitting display device includes a display region **130** having a plurality of pixels **140** coupled to scan lines S**1** to Sn, emission control lines E**1** to En and data lines D**1** to Dm; a scan driver **110** for driving the scan lines S**1** to Sn and the emission control lines E**1** to En; a data driver **120** for driving the data lines D**1** to Dm; and a timing controller **150** for controlling the scan driver **110** and the data driver **120**.

[0032] The display region **130** includes a plurality of pixels **140** formed in regions defined by the scan lines S**1** to Sn, the emission control lines E**1** to En and the data lines D**1** to Dm. The display region **130** receives a first power source ELVDD, a second power source ELVSS and a third power source Vref/Vinit. Each of the three power sources may be sources external to the display region **130**.

[0033] More specifically, the plurality of pixels **140** are formed in pixel regions defined on a substrate, respectively. A pixel **140** positioned on an i-th row (the "i" is a natural number) and a j-th column (the "j" is a natural number) is coupled to at least a current scan line Si, a data line Dj, the first power source ELVDD, the second power source ELVSS and the third power source Vref/Vinit. When a current scan signal is supplied from the current scan line Si, the pixel **140** stores a data signal supplied from the data line Dj and emits light with luminance corresponding to the data signal.

[0034] To this end, each of the pixels **140** includes a pixel circuit including a plurality of transistors and one or more capacitors; and an organic light emitting diode coupled to the pixel circuit to emit light with luminance corresponding to a driving current flowing from the first power source ELVDD to the second power source ELVSS via the pixel circuit and the organic light emitting diode. Here, the first power source ELVDD is set as a high-potential (i.e., high voltage) pixel power source, and the second power source ELVSS is set as a low-potential (i.e., low voltage) pixel power source.

[0035] However, in one embodiment of the present invention, the pixels **140** may further include compensation elements for compensating for threshold voltage variations of the driving transistors and other variations. In this case, the third power source Vref/Vinit is used. The third power source Vref/Vinit is configured as a voltage source for supplying a constant voltage to the pixels **140**. The third power source Vref/Vinit may be configured as a reference power source Vref having a higher voltage than that of the data signal, an initialization power source Vinit having a lower voltage than that of the data signal, or as another suitable power source. The third power source may be variously changed depending on the configuration of pixels.

[0036] The third power source Vref/Vinit may be configured to supply the respective pixels **140** before the current scan signal is supplied from the current scan line Si. For example, the pixels **140** are further coupled to the previous scan line Si-**1** so that an initializing process using the third power source Vref/Vinit and/or a threshold-voltage compensating process may be performed when the previous scan signal is supplied from the previous scan line Si-**1** and so that a voltage corresponding to the data signal may be stored when the current scan signal is supplied from the current scan line Si. Although not illustrated in FIG. **1**, a zeroth scan line S**0** (not shown) may be additionally formed to be coupled to the pixels **140** positioned on the first row.

[0037] The timing controller **150** generates a data driving control signal DCS and a scan driving control signal SCS, corresponding to synchronization signals supplied from external control circuitry. The data driving control signal DCS generated from the timing controller **150** is supplied to the data driver **120**, and the scan driving control signal SCS generated from the timing controller **150** is supplied to the scan driver **110**. The timing controller **150** also supplies a data signal Data supplied from the external control circuitry to the data driver **120**.

[0038] The scan driver **110** receives the scan driving control signal SCS supplied from the timing controller **150**. The scan driver **110** sequentially supplies scan signals to the scan lines S**1** to Sn, and sequentially supplies emission control signals to the emission control lines E**1** to En. Here, the emission control signal may be supplied to overlap with at least two scan signals, i.e., previous and current scan signals, during at least some periods. To this end, the width of emission control signals (i.e., a duration of the emission control signals) may be set wider than that of scan signals.

[0039] The data driver **120** receives a data driving control signal DCS supplied from the timing controller **150**. The data driver **120** then generates data signals and supplies the generated data signals to the data lines D**1** to Dm.

[0040] FIG. **2** is a schematic circuit diagram illustrating an embodiment of a pixel **140** illustrated in FIG. **1**. For conve-

nience of illustration, a pixel positioned on an i-th row (the "i" is a natural number) and a j-th column (the "j" is a natural number) is illustrated in FIG. **2**.

[0041] Referring to FIG. **2**, the pixel **140** includes a pixel circuit **142** having a plurality of transistors M**1** to M**5** and capacitors C**1** and C**2**; and an organic light emitting diode OLED for receiving a driving current supplied from the pixel circuit **142**. In other embodiments, pixel circuit **142** may include additional capacitors.

[0042] When a previous scan signal is provided from a previous scan line Si-**1**, the pixel circuit **142** may compensate for the voltage drop of the first power source ELVDD and the threshold voltage of the first transistor M**1** (driving transistor). When a current scan signal is supplied from a current scan line Si, the pixel circuit **142** stores a voltage corresponding to a data signal and then supplies a driving current corresponding to the data signal to the organic light emitting diode OLED.

[0043] To this end, the pixel circuit **142** is connected to the current scan line Si, the previous scan line Si-**1**, an emission control line Ei, a data line Dj, the first power source ELVDD, a third power source Vref and the organic light emitting diode OLED. The pixel circuit **142** includes first to fifth transistors M**1** to M**5**, and first and second capacitors C**1** and C**2**.

[0044] The first transistor M**1** is coupled between the first power source ELVDD and the organic light emitting diode OLED to control a driving current corresponding to a voltage applied to a gate electrode of the first transistor M**1**.

[0045] More specifically, a first electrode (i.e., a source electrode) of the first transistor M**1** is coupled to the first power source ELVDD, and a second electrode (i.e., a drain electrode) of the first transistor M**1** is coupled to the organic light emitting diode OLED via the fifth transistor M**5**. The gate electrode of the first transistor M**1** is coupled to a second node N**2**. The first transistor M**1** controls the driving current supplied to the organic light emitting diode OLED. The driving current may correspond to the voltage at the second node N**2**, which corresponds to the voltage stored in the first and second capacitors C**1** and C**2**.

[0046] The second transistor M**2** is coupled between the data line Dj and a first node N**1**. When the current scan signal is supplied from the current scan line Si, the second transistor M**2** allows a data signal to be supplied to the pixel **140**.

[0047] More specifically, a first electrode of the second transistor M**2** is coupled to the data line Dj, and a second electrode of the second transistor M**2** is coupled to the first node N**1**. Here, the first node N**1** is a connection node of the second and fourth transistors M**2** and M**4** and the first and second capacitors C**1** and C**2**. A gate electrode of the second transistor M**2** is coupled to the current scan line Si. When the current scan signal is supplied from the current scan line Si, the second transistor M**2** is turned on to allow a data signal from the data line Dj to be supplied to the first node N**1**.

[0048] The third transistor M**3** is coupled between the gate electrode and second electrode (drain electrode) of the first transistor M**1**. The third transistor M**3** allows the first transistor M**1** to be diode-coupled when a voltage is applied to a gate electrode of the third transistor M**3**.

[0049] More specifically, a first electrode of the third transistor M**3** is coupled to the second electrode of the first transistor M**1**, and a second electrode of the third transistor M**3** is coupled to the second node N**2**. The gate electrode of the third transistor M**3** is coupled to the previous scan line Si-**1**. When the previous scan signal is supplied from the previous scan line Si-**1**, the third transistor M**3** is turned on to allow the first transistor M**1** to be diode-coupled.

[0050] The fourth transistor M**4** is coupled between the first node N**1** and the third power source Vref. The fourth transistor M**4** is turned on by the previous scan signal to allow the voltage of the third power source Vref to be supplied to the first node N**1**. Here, the third power source Vref does not form a current path to the organic light emitting diode unlike the first power source ELVDD and the second power source ELVSS. The third power source Vref instead supplies a constant voltage to the pixel circuit **142** during the period before the current scan signal is supplied from the current scan line Si (i.e., the period in which the previous scan signal is provided from the previous scan line Si-**1**). The third power source Vref is configured as a reference power source having a voltage higher than that of the data signal and lower than that of the first power source ELVDD.

[0051] More specifically, a first electrode of the fourth transistor M**4** is coupled to the third power source Vref, and a second electrode of the fourth transistor M**4** is coupled to the first node N**1**. A gate electrode of the fourth transistor M**4** is coupled to the previous scan line Si-**1**. When the previous scan signal is supplied from the previous scan line Si-**1**, the fourth transistor M**4** is turned on to allow the third power source Vref to be coupled to the first node N**1**. Then, the voltage of the third power source Vref is supplied, via the first node N**1**, to the first and second capacitors C**1** and C**2**.

[0052] The fifth transistor M**5** is coupled between the first transistor M**1** and the organic light emitting diode OLED. The switching (i.e., turning on/off) of the fifth transistor M**5** is controlled by an emission control signal supplied from the emission control line Ei.

[0053] More specifically, a first electrode of the fifth transistor M**5** is coupled to the second electrode of the first transistor M**1**, and a second electrode of the fifth transistor M**5** is coupled to an anode electrode of the organic light emitting diode OLED. A gate electrode of the fifth transistor M**5** is coupled to the emission control line Ei. When the voltage level of the emission control signal supplied from the emission control line Ei is at a high level, the fifth transistor M**5** is turned off to allow the pixel circuit **142** to be isolated from the organic light emitting diode OLED. When the voltage of the emission control signal is changed from the high level to a low level, the fifth transistor M**5** is turned on to allow the driving current supplied from the first transistor M**1** to be supplied to the organic light emitting diode OLED.

[0054] The first capacitor C**1** is coupled between the first node N**1** and the first power source ELVDD. Here, a second electrode of the first capacitor C**1** is coupled to the gate electrode of the first transistor M**1** via the second capacitor C**2**. The first capacitor C**1** allows a voltage corresponding to the data signal to be stored therein and maintains the stored voltage during the period in which the pixel **140** emits light.

[0055] The second capacitor C**2** is coupled between the first and second nodes N**1** and N**2**. The second capacitor C**2** allows a compensation voltage to be stored therein and maintains the stored voltage during the period in which the pixel **140** emits light. Here, the compensation voltage includes compensation for both the threshold voltage of the first transistor M**1** and the voltage drop of the first power source ELVDD.

[0056] In FIG. **2**, the first power source ELVDD is coupled to each of the pixels **140** to supply a current (i.e., predetermined current) to the pixel **140**. That is, the first power source ELVDD is a power source for forming a current path to the

organic light emitting diode. In accordance with the positions of the pixels **140**, a voltage drop/loss may occur in the voltage of the first power source ELVDD supplied to each of the pixels **140**. However, in the embodiment illustrated in FIG. **2**, the third power source Vref is a power source that does not supply driving current to the respective pixels **140**, i.e., a power source that does not form a current path to the organic light emitting diode. As such, the third power source Vref may maintain the same voltage regardless of the positions of the pixels **140**. Here, the voltage of the third power source Vref may be set to a voltage level higher than that of the data signal. The voltage of the third power source Vref may also be set to a voltage level lower than or identical to that of the first power source ELVDD.

[0057] The organic light emitting diode OLED is coupled between the pixel circuit **142** and the second power source ELVSS to emit light with a luminance corresponding to the driving current flowing from the first power source ELVDD to the second power source ELVSS via the pixel circuit **142** and the organic light emitting diode OLED. The organic light emitting diode OLED includes an organic emission layer for emitting light of red, green or blue so as to generate light of the color corresponding to the driving current.

[0058] FIG. **3** is a waveform diagram illustrating a method for driving the pixel illustrated in FIG. **2** according to one embodiment of the present invention.

[0059] Referring to FIG. **3**, the pixel **140** receives low-level previous and current scan signals, sequentially supplied from the previous and current scan lines (Si-**1** and Si). The pixel **140** also receives a high-level emission control signal, supplied from the emission control line Ei. Here, the high-level emission control signal overlaps with low level portions of the previous scan signal and the current scan signal.

[0060] After the supply of the previous scan signal is started (i.e., driven to a low-level), the emission control signal is changed to a high-level voltage at which the fifth transistor M**5** is turned off. After the supply of the current scan signal is finished (i.e., driven to a high level), the emission control signal is changed to a low-level voltage at which the fifth transistor M**5** is turned on.

[0061] Meanwhile, the pixel **140** receives the first power source ELVDD, the second power source ELVSS and the third power source Vref, supplied from sources external to the pixel. The pixel **140** receives a data signal supplied from the data line Dj.

[0062] The pixel **140** compensates for the variation between the voltage drop of the first power source ELVDD and the threshold voltage of the first transistor M**1**, using the difference between the first power source ELVDD and the third power source Vref.

[0063] More specifically, the emission control signal maintains a low level during a first period t**1** that is a portion of the period in which the previous scan signal is supplied from the previous scan line Si-**1**. Accordingly, the fifth transistor M**5** maintains a turned-on state during t**1**. The third and fourth transistors M**3** and M**4** are turned on by a low-level previous scan signal during the first period t**1**.

[0064] If the third transistor M**3** is turned on during the first period t**1**, the gate electrode of the first transistor M**1** is electrically coupled to the organic light emitting diode OLED via the third transistor M**3**. Therefore, the voltage at the gate electrode of the first transistor M**1**, i.e., the voltage at the second node N**2**, is initialized to about the voltage of the second power source ELVSS. That is, during the first period t**1**, that is a portion of the period in which the previous scan signal is supplied from the previous scan line Si-**1**, the voltage at the second node N**2** is initialized.

[0065] Thereafter, if the voltage level of the emission control signal supplied from the emission control line Ei is changed to a high level, during a second period t**2**, the fifth transistor M**5** is turned off except during the first period t**1**. Then, a voltage obtained by subtracting the threshold voltage of the first transistor M**1** from the first power source ELVDD is applied to the gate electrode of the first transistor M**1** diode-coupled by the third transistor M**3**.

[0066] The first node N**1** is charged with the voltage of the third power source Vref by the fourth transistor M**4** maintaining a turned-on state during the second period t**2**. Here, the voltage of the third power source Vref may be set higher than that of the data signal and/or set identical to or lower than that of the first power source ELVDD. For convenience of illustration, it is assumed that the voltage of the third power source Vref is identical to that of the first power source ELVDD. Then, a voltage corresponding to the threshold voltage of the first transistor M**1** is stored in the second capacitor C**2**. If a voltage drop is generated from the first power source ELVDD, the threshold voltage of the first transistor M**1** and the voltage drop of the first power source ELVDD are stored in the second capacitor C**2**. Accordingly, it is possible to concurrently compensate for the voltage drop of the first power source ELVDD and the threshold voltage of the first transistor M**1**.

[0067] Thereafter, if the current scan signal is supplied from the current scan line Si, the second transistor M**2** is turned on during a third period t**3**. If the second transistor M**2** is turned on, the data signal supplied from the data line Dj is supplied to the first node N**1**. Therefore, the voltage at the first node N**1** is dropped from the third power source Vref to the voltage of the data signal. Then, the voltage at the second node N**2**, which is set as a floating state during the third period t**3**, is also dropped corresponding to the voltage drop at the first node N**1**. That is, the voltage stored in the second capacitor C**2** is stably maintained during the third period t**3**. Meanwhile, the first capacitor C**1** is charged with a voltage corresponding to the data signal supplied to the first node N**1** during the third period t**3**.

[0068] Thereafter, if the voltage level of the emission control signal is changed to a low level at which the fifth transistor M**5** is turned on after the supply of the current scan signal is stopped, the fifth transistor M**5** is turned on during a fourth period t**4**. If the fifth transistor M**5** is turned on, the first transistor M**1** supplies a driving current corresponding to the voltage stored in the first and second capacitors C**1** and C**2** to the organic light emitting diode OLED. Therefore, the organic light emitting diode OLED emits light with luminance corresponding to the driving current.

[0069] Accordingly, the pixel **140** emits light with a desired luminance corresponding to the data signal, regardless of the threshold voltage of the driving transistor (first transistor M**1**) and the voltage drop of the first power source ELVDD.

[0070] FIG. **4** is a cross sectional view illustrating a portion of the pixel illustrated in FIG. **2** according to one embodiment of the present invention. For convenience of illustration, only one transistor (i.e., the fifth transistor) and one capacitor (i.e., the first capacitor) are illustrated in FIG. **4**. The transistor and the capacitor are referred to using general terms, i.e., a thin film transistor and a capacitor, respectively.

[0071] That is, although not illustrated in FIG. **4**, a pixel circuit formed in each of the pixel regions may include a

plurality of transistors formed on a substrate, and one or more capacitors formed in the same process of forming the plurality of transistors.

[0072] Referring to FIG. **4**, a pixel circuit **242**, including a thin film transistor **220** and a capacitor **230**, is formed on a substrate **200**. In several embodiments, pixel circuit **242** is representative of one or more components of pixel circuit **142** of FIG. **2**. An organic light emitting diode **270** connected to the thin film transistor **220** is formed on the pixel circuit **242**.

[0073] More specifically, the thin film transistor **220** includes a semiconductor layer **221** formed at an upper portion of a buffer layer **210** on the substrate **200**; a gate electrode **223** formed on the semiconductor layer **221** with a gate insulating layer **240** interposed therebetween; and source and drain electrodes **225** formed at upper portions of an interlayer insulating layer **250** on the gate electrode **223**. The source and drain electrodes **225** are connected to source and drain regions of the semiconductor layer **221** through contact holes, respectively.

[0074] The capacitor **230** includes a first electrode **231** formed on the gate insulating layer **240**, and a second electrode **233** formed opposite to the first electrode **231** on the interlayer insulating layer **250** interposed therebetween.

[0075] Here, the first electrode **231** of the capacitor **230** may be formed of the same material as that of the gate electrode **223** in the same layer during the process of forming the gate electrode **223** of the thin film transistor **220**. The second electrode **233** of the capacitor **230** may be formed of the same material as that of the source and drain electrodes **225** in the same layer during the process of forming the source and drain electrodes **225** of the thin film transistor **220**.

[0076] Although one embodiment of the capacitor **230** is illustrated in FIG. **4**, the configuration of the capacitor **230** is not limited thereto. For example, the capacitor **230** may further include another semiconductor layer formed of the same material as that of the semiconductor layer **221** in the same layer during the process of forming the semiconductor layer **221** of the thin film transistor **220**.

[0077] A planarization film **260** having an insulating property is formed on the thin film transistor **220** and the capacitor **230**, and an organic light emitting diode **270** is formed on the planarization film **260**.

[0078] The organic light emitting diode **270** includes an anode electrode **271** formed on the planarization layer **260** and connected to the source or drain electrode **225** of the thin film transistor **220** through a via hole passing through the planarization layer **260**. The organic light emitting diode **270** further includes an organic emission layer **273** formed on the anode electrode **271**, and a cathode electrode **275** formed on the organic emission layer **273**. Reference numeral **280** designates a pixel defining layer.

[0079] In one embodiment of the present invention, a first power source supply line ELVDDL for supplying the first power source ELVDD may be formed using an electrode material of the thin film transistor **220** during the process of forming the pixel circuit **242**. That is, the first power source supply line ELVDDL may be formed of the same material as that of one electrode of the thin film transistor **220** on the same layer.

[0080] Particularly, when the first power source supply line ELVDDL is coupled to the source electrode of the first transistor M**1** and one electrode of the first capacitor C**1** as illustrated in FIG. **2**, the first power source supply line ELVDDL may be patterned to be coupled to the source electrode of the first transistor M**1** and the one electrode of the first capacitor C**1** during the process of forming the source and drain electrodes **225** of the thin film transistor **220**. That is, the first power source supply line ELVDDL may be connected to the source electrode of the first transistor M**1** and the one electrode of the first capacitor C**1** in a region (not shown).

[0081] Meanwhile, the first to fifth transistors M**1** to M**5** in FIG. **2** may be simultaneously formed. In the embodiment illustrated in FIG. **4**, sections of the first to fifth transistors M**1** to M**5** are exemplified by a section of the thin film transistor **220** for convenience of illustration.

[0082] A third power source supply line VrefL for supplying a third power source Vref may be formed using an electrode material of the organic light emitting diode **270** during the process of forming the organic light emitting diode **270**. That is, the third power source supply line VrefL may be formed of the same material and in the same layer as that of one electrode of the organic light emitting diode **270**. Particularly, the third power source supply line VrefL may be formed of the same material and in the same layer as that of the anode electrode **271**.

[0083] In one embodiment, the third power source supply line VrefL is connected to the fourth transistor M**4** illustrated in FIG. **2** through another via hole (not shown) passing through the planarization layer **260**.

[0084] During the process of forming a via hole for connecting the third power source supply line VrefL to the fourth transistor M**4**, even if the pixels become non-uniform due to the high contact resistance through the via hole, current does not flow into the third power source supply line VrefL. Consequently, the luminance of the pixels is not affected.

[0085] That is, in one embodiment of the present invention, the third power source supply line VrefL having no current path formed to the organic light emitting diode is disposed in on upper layer of the pixel, i.e., the layer having the anode electrode **271** of the organic light emitting diode **270** formed therein, so as to be connected to the pixel circuit **242** through a via hole or the like.

[0086] As described above, the formation position of the third power source supply line VrefL may be changed from the layer in which the pixel circuit **242** is formed to the upper layer in which the organic light emitting diode **270** is formed, thereby simplifying the design of the pixel circuit **142**. Accordingly, the organic light emitting display device may display uniform images and improve yield by ensuring a space for forming the capacitor **230** and/or spacing between wires.

[0087] Further, the first power source supply line ELVDDL and the like are disposed in the pixel circuit **242**, so that vias are not needed and contact resistance distribution may be minimized. For example, the second power source ELVSS (not shown) may be connected to the cathode electrode **275** by a second power source supply line (not shown) connected to the cathode electrode **275** formed at a region outside of the display region in the display region structure in which the cathode electrode **275** is entirely formed in a plate shaped region of the display region.

[0088] Meanwhile, when the organic light emitting diode **270** is a front-emission-type organic light emitting diode for emitting light in a direction of the cathode electrode **275**, the anode electrode **271** may be formed of any material selected from the group consisting of ITO/Ag/ITO, ITO/Al/ITO, ITO/AlNiLa/ITO and ITO/AlNiLa. Therefore, the third power source supply line VrefL may also be formed of any material

selected from the group consisting of ITO/Ag/ITO, ITO/Al/ITO, ITO/AlNiLa/ITO and ITO/AlNiLa. That is, the material for forming the anode electrode **271** may also be used for an internal wire of the third power source supply line Vref.

[0089] In some embodiments, it has been described that the third power source supply line VrefL is formed of the same material and in the same layer as that of the anode electrode **271**. However, the present invention is not limited thereto. For example, the third power source supply line VrefL may be connected to the pixel circuit **242** through a via hole or the like by positioning another wire having a current path formed thereon, i.e., a scan, data or emission control line, in an upper layer of the pixel circuit **242**, i.e., the layer in which the anode electrode **271** of the organic light emitting diode **270** and the like are formed.

[0090] For convenience of illustration, it has been shown in FIG. **4** that the organic light emitting diode **270** is disposed to overlap with the capacitor **230** formed below the organic light emitting diode **270**. However, in the case of a back emission type, the organic light emitting diode **270** may be disposed not to overlap with the pixel circuit **242**. In the case of a front emission type, the organic light emitting diode **270** may also be disposed not to overlap with the pixel circuit **242**, depending on their design.

[0091] FIG. **5** is a circuit diagram illustrating another embodiment of the pixel illustrated in FIG. **1**. For convenience of illustration, a pixel positioned on an i-th row (the "i" is a natural number) and a j-th column (the "j" is a natural number) is illustrated in FIG. **5**.

[0092] Referring to FIG. **5**, the pixel **140'** of this embodiment includes a pixel circuit **142'** having a plurality of transistors T**1** to T**6** and a storage capacitor Cst, and an organic light emitting diode OLED for receiving driving current supplied from the pixel circuit **142'**.

[0093] When a previous scan signal is supplied from a previous scan line Si-**1**, the pixel circuit **142'** initializes a voltage stored in the storage capacitor Cst. When a current scan signal is supplied from a current scan line Si, the pixel circuit **142'** stores a data signal voltage and a voltage corresponding to the threshold voltage of the first transistor T**1** in the storage capacitor Cst. Then, the pixel circuit **142'** supplies a driving current, corresponding to the data signal, to the organic light emitting diode OLED. In such case, the driving current is unaffected by the threshold voltage of the first transistor T**1**.

[0094] In FIG. **5**, the pixel circuit **142'** is connected to the current scan line Si, the previous scan line Si-**1**, an emission control line Ei, a data line Dj, a first power source ELVDD, a third power source Vinit and the organic light emitting diode OLED. The pixel circuit **142'** further includes first to sixth transistors T**1** to T**6** and a storage capacitor Cst.

[0095] The first transistor T**1** is coupled between the first power source ELVDD and the organic light emitting diode OLED to control a driving current corresponding to a voltage applied to a gate electrode of the first transistor T**1**.

[0096] More specifically, a first electrode (i.e., a source electrode) of the first transistor T**1** is coupled to the first power source ELVDD via the sixth transistor T**6**, and a second electrode (i.e., a drain electrode) of the first transistor T**1** is coupled to the organic light emitting diode OLED via the fifth transistor T**5**. A gate electrode of the first transistor T**1** is coupled to a first node N**1**. The first transistor T**1** controls the driving current supplied to the organic light emitting diode OLED. The driving current may correspond to a voltage at the first node N**1**, i.e., the voltage stored in the storage capacitor Cst.

[0097] The second transistor T**2** is coupled between the data line Dj and the storage capacitor Cst. When the current scan signal is supplied from the current scan line Si, the second transistor is turned on to allow a data signal to be supplied to the pixel circuit **142'**.

[0098] More specifically, a first electrode of the second transistor T**2** is coupled to the data line Dj, and a second electrode of the second transistor T**2** is coupled to the storage capacitor Cst via the first and third transistors T**1** and T**3**. A gate electrode of the second transistor T**2** is coupled to the current scan line Si. When the current scan signal is supplied from the current scan line Si, the second transistor T**2** is turned on to allow the data signal supplied from the data line Dj to be supplied to the storage capacitor Cst via the first and third transistors T**1** and T**3**.

[0099] The third transistor T**3** is coupled between the gate electrode and second electrode (drain electrode) of the first transistor T**1**. The third transistor T**3** allows the first transistor T**1** to be diode-coupled corresponding to a voltage applied to a gate electrode of the third transistor T**3**.

[0100] More specifically, a first electrode of the third transistor T**3** is coupled to the second electrode of the first transistor T**1**, and a second electrode of the third transistor T**3** is coupled to the gate electrode of the first transistor T**1**. The gate electrode of the third transistor T**3** is coupled to the current scan line Si. When the current scan signal is supplied from the current scan line Si, the third transistor T**3** is turned on to allow the first transistor T**1** to be diode-connected.

[0101] The fourth transistor T**4** is coupled between the storage capacitor Cst and the third power source Vinit. The fourth transistor T**4** is turned on by the previous scan signal to allow the voltage of the third power source Vinit to be supplied to the storage capacitor Cst.

[0102] Here, the third power source Vinit does not form a current path to the organic light emitting diode as do the first power source ELVDD and the second power source ELVSS. The third power source Vinit is a power source for supplying a constant voltage to the pixel circuit **142'** during the period before the current scan signal is supplied from the current scan line Si (i.e., the period in which the previous scan signal is provided from the previous scan line Si-**1**). The third power source Vinit is set as an initialization power source having a lower voltage of that of the data signal, i.e., a lower voltage than the minimum voltage of the data signal.

[0103] That is, when the fourth transistor T**4** is turned on, the voltage at the first node N**1** is initialized as a lower voltage than the voltage of the data signal, so that the data signal is actively supplied to the first node while the first transistor T**1** is diode-coupled in the forward direction during a subsequent period in which the data signal is written.

[0104] More specifically, a first electrode of the fourth transistor T**4** is coupled to the first node N**1**, which is coupled to the storage capacitor Cst and the gate electrode of the first transistor T**1**, and a second electrode of the fourth transistor T**4** is coupled to the third power source Vinit. A gate electrode of the fourth transistor T**4** is coupled to the previous scan line Si-**1**. When the previous scan signal is supplied from the previous scan line Si-**1**, the fourth transistor T**4** is turned on to connect the third power source Vinit to the first node N**1**.

Then, the voltage of the third power source Vinit is applied to the first node N1, and the voltage at the first node N1 is initialized.

[0105] The fifth transistor T5 is coupled between the first transistor T1 and the organic light emitting diode OLED. The switching of the fifth transistor T5 is controlled by an emission control signal supplied from the emission control line Ei.

[0106] More specifically, a first electrode of the fifth transistor T5 is coupled to the second electrode of the first transistor T1, and a second electrode of the fifth transistor T5 is coupled to an anode electrode of the organic light emitting diode OLED. A gate electrode of the fifth transistor T5 is coupled to the emission control line Ei. When the voltage level of the emission control signal supplied from the emission control line Ei is a high level, the fifth transistor T5 is turned off to allow the pixel circuit **142'** to be isolated from the organic light emitting diode OLED. When the voltage level of the emission control signal is changed from the high level to a low level, the fifth transistor T5 is turned on to allow the driving current supplied from the first transistor T1 to be supplied to the organic light emitting diode OLED.

[0107] The sixth transistor T6 is coupled between the first power source ELVDD and the first transistor T1. The switching of the sixth transistor T6 is also controlled by the emission control signal supplied from the emission control line Ei.

[0108] More specifically, a first electrode of the sixth transistor T6 is coupled to the first power source ELVDD, and a second electrode of the sixth transistor T6 is coupled to the source electrode of the first transistor T1. A gate electrode of the sixth transistor T6 is coupled to the emission control line Ei. When the voltage level of the emission control signal supplied from the emission control line Ei is a high level, the sixth transistor T6 is turned off to allow the first transistor T1 to be isolated from the first power source ELVDD. When the voltage level of the emission control signal is changed from the high level to a low level, the sixth transistor T6 is turned on to connect the first transistor T1 to the first power source ELVDD.

[0109] The storage capacitor Cst is coupled between the gate electrode of the first transistor T1 and the first power source ELVDD. The storage capacitor Cst is initialized by the third power source Vinit during the period in which the previous scan signal is supplied. The storage capacitor Cst is charged with a data signal and a voltage corresponding to the threshold voltage of the first transistor T1 during the period in which the current scan signal is supplied, and then maintains the stored voltage during the period in which the pixel **140'** emits light.

[0110] The organic light emitting diode OLED is coupled between the pixel circuit **142'** and the second power source ELVSS to emit light with luminance corresponding to the driving current flowing from the first power source ELVDD to the second power source ELVSS via the pixel circuit **142'** and the organic light emitting diode OLED. The organic light emitting diode OLED includes an organic emission layer for emitting light of red, green or blue so as to generate light of the color corresponding to the driving current.

[0111] FIG. **6** is a waveform diagram illustrating a method for driving the pixel illustrated in FIG. **5** according to one embodiment of the present invention.

[0112] Referring to FIG. **6**, the pixel **140'** receives low-level previous and current scan signals, sequentially supplied from the previous and current scan lines (Si-1 and Si), and receives a high-level emission control signal, supplied from the emission control line Ei. Here, the high-level emission control signal overlaps with the previous scan signal and the current scan signal.

[0113] In this case, the emission control signal maintains a high-level voltage at which the fifth and sixth transistors T5 and T6 are turned off during the periods when the previous and current scan signals are supplied. After the supply of the current scan signal is finished, the emission control signal is changed to a low-level voltage at which the fifth and sixth transistors T5 and T6 are turned on.

[0114] Meanwhile, the pixel **140'** receives the first power source ELVDD, the second power source ELVSS and the third power source Vinit. The pixel **140'** also receives a data signal from the data line Dj.

[0115] The operation of the pixel **140'** will be described in detail. First, the fourth transistor T4 is turned on during a first period t1' where a low-level previous scan signal is supplied from the previous scan line Si-1. Then, the voltage of the third power source Vinit is supplied to the first node N1, and the voltage at the first node N1 is initialized. Accordingly, the voltage stored in the storage capacitor Cst is also initialized. That is, the first period t1' is set as a period in which the voltage at the first node N1 is initialized.

[0116] Thereafter, the second and third transistors T2 and T3 are turned on during a second period t2' when a low-level current scan signal is supplied from the current scan line Si. If the second and third transistors T2 and T3 are turned on, the data signal supplied from the data line Dj is supplied to the first node N1 via the second transistor T2, the first transistor T1 and the third transistor T3. Since the first transistor T1 is diode-coupled by the third transistor T3, a voltage corresponding to the data signal and the threshold voltage of the first transistor T1 is supplied to the first node N1. At this time, the voltage corresponding to the data signal and the threshold voltage of the first transistor T1 is stored in the storage capacitor Cst.

[0117] Thereafter, the fifth and sixth transistors T5 and T6 are turned on during a third period t3' where the voltage level of the emission control signal supplied from the emission control line Ei is changed to a low level.

[0118] Then, a driving current corresponding to the voltage stored in the storage capacitor Cst is supplied to the organic light emitting diode OLED by the first transistor T1.

[0119] As the threshold voltage of the first transistor T1 is offset, driving current corresponding to the data signal is supplied to the organic light emitting diode OLED, and is unaffected by the threshold voltage of the first transistor T1. Accordingly, the organic light emitting diode OLED emits light with uniform luminance corresponding to the data signal, regardless of the threshold voltage of the first transistor T1.

[0120] FIG. **7** is a cross sectional view illustrating a portion of the pixel illustrated in FIG. **5** according to one embodiment of the present invention.

[0121] Referring to FIG. **7**, a third power source supply line VinitL is formed in a different layer from that of a first power source supply line ELVDDL. Particularly, the third power source supply line VinitL is formed of the same material and in the same layer as that of the anode electrode **271** of the organic light emitting diode OLED.

[0122] Here, the third power source supply line VinitL is a wire on which a current path to the organic light emitting diode is not formed. The third power source supply line VinitL is a wire for supplying the voltage of the initialization

power source Vinit to the pixel circuit **242'** during the period in which the previous scan signal is supplied. In several embodiments, pixel circuit **242'** is representative of one or more components of the pixel circuit **142'** of FIG. **5**.

[0123] In FIG. **7**, a thin film transistor **220** is illustrated representing the fifth transistor T**5** of FIG. **5**, and a capacitor **230** is illustrated representing the storage capacitor Cst of FIG. **5**. Since FIG. **7** is substantially identical to FIG. **4**, except that the third power source supply line VinitL supplies an initialization power source Vinit instead of a reference power source Vref, its detailed description is omitted.

[0124] While the present invention has been described in connection with certain exemplary embodiments, it is to be understood that the invention is not limited to the disclosed embodiments, but, on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims, and equivalents thereof.

What is claimed is:

1. An organic light emitting display device comprising:

a plurality of pixels in pixel regions defined on a substrate, each of the pixels being coupled to a current scan line, a data line, a first power source, a second power source and a third power source,

wherein each of the pixels comprises:

a pixel circuit having a plurality of transistors and one or more capacitors; and

an organic light emitting diode comprising a first electrode and coupled to the pixel circuit, the organic light emitting diode configured to emit light with a luminance corresponding to a driving current flowing from the first power source to the second power source via the pixel circuit,

wherein the third power source is configured to supply a constant voltage to the pixel circuit through a supply line, and

wherein the supply line is in a same layer and of a same material as the first electrode.

2. The organic light emitting display device according to claim **1**:

wherein the third power source and the pixel circuit are configured not to provide a current path to the organic light emitting diode, and

wherein the constant voltage is supplied to the pixel circuit before a current scan signal is supplied from the current scan line.

3. The organic light emitting display device according to claim **1**, wherein the first electrode of the organic light emitting diode is an anode electrode.

4. The organic light emitting display device according to claim **1**, wherein a supply line of the first power source is in a different layer from the layer in which the supply line of the third power source is located.

5. The organic light emitting display device according to claim **1**, wherein a supply line of the first power source is of a same material and in a same layer as an electrode of one transistor of the plurality of transistors.

6. The organic light emitting display device according to claim **5**, wherein the supply line of the first power source is of the same material and in a same layer as a source electrode and a drain electrode of the one transistor of the plurality of transistors.

7. The organic light emitting display device according to claim **1**, wherein the first power source is configured to provide a voltage that is higher than a voltage provided by the second power source.

8. The organic light emitting display device according to claim **7**, wherein the third power source is configured to provide a different voltage than the first power source and the second power source.

9. The organic light emitting display device according to claim **1**, wherein:

the pixel circuit comprises a plurality of transistors on the substrate, and one or more capacitors formed using a same material as an electrode of one of the transistors during a same process of forming the transistors; and

the organic light emitting diode is on the pixel circuit with an insulating layer interposed therebetween, and the first electrode of the organic light emitting diode is coupled to a source electrode or a drain electrode of one of the transistors through a via hole in the insulating layer.

10. The organic light emitting display device according to claim **9**, wherein the organic light emitting diode comprises:

an anode electrode on the insulating layer,

an organic emission layer on the anode electrode, and

a cathode electrode on the organic emission layer, wherein the organic light emitting diode is configured to emit light in a direction of the cathode electrode.

11. The organic light emitting display device according to claim **10**, wherein the anode electrode of the organic light emitting diode and the supply line of the third power source are formed of a material selected from the group consisting of ITO/Ag/ITO, ITO/Al/ITO, ITO/AlNiLa/ITO and ITO/AlNiLa.

12. The organic light emitting display device according to claim **1**, wherein the pixel circuit comprises:

a first transistor coupled between the first power source and the organic light emitting diode, the first transistor configured to control the driving current corresponding to a voltage applied to a gate electrode of the first transistor;

a first capacitor coupled between the gate electrode of the first transistor and the first power source;

a second transistor coupled between the data line and the first capacitor, wherein the second transistor is configured to turn on to provide a data signal from the data line to the pixel circuit when a current scan signal is supplied from the current scan line;

a third transistor coupled between the gate electrode and a drain electrode of the first transistor, the third transistor configured to turn on so that the first transistor is diode-coupled when a voltage is applied to a gate electrode of the third transistor;

a fourth transistor coupled between the first capacitor and the third power source, the fourth transistor configured to turn on so that the voltage of the third power source is supplied to the first capacitor when a previous scan signal is supplied from a previous scan line before the current scan signal is supplied; and

a fifth transistor coupled between the first transistor and the organic light emitting diode, the fifth transistor configured to turn on when an emission control signal is supplied from an emission control line.

13. The organic light emitting display device according to claim **12**, wherein the voltage of the third power source is set to a higher voltage than that of the data signal.

14. The organic light emitting display device according to claim **13**, wherein the pixel circuit further comprises a second capacitor coupled between the gate electrode of the first transistor and an electrode of the first capacitor.

15. The organic light emitting display device according to claim **14**, wherein the emission control signal is changed to a voltage level at which the fifth transistor is turned off after the previous scan signal is started, and is changed to a voltage level at which the fifth transistor is turned on after the current scan signal is finished.

16. The organic light emitting display device according to claim **12**, wherein the voltage of the third power source is lower than that of the data signal.

17. The organic light emitting display device according to claim **16**, wherein the pixel circuit further comprises a sixth transistor coupled between the first power source and the first transistor, wherein the sixth transistor is controlled by the emission control signal.

18. The organic light emitting display device according to claim **17**, wherein the emission control signal is changed to a first voltage at which the fifth and sixth transistors are turned off during a period in which the previous and current scan signals are supplied, and is changed to a second voltage at which the fifth and sixth transistors are turned on after the current scan signal is supplied.

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专利名称(译)	有机发光显示装置		
公开(公告)号	US20110025659A1	公开(公告)日	2011-02-03
申请号	US12/774638	申请日	2010-05-05
[标]申请(专利权)人(译)	KWAK WON KYU PARK李东旭 崔相MOO		
申请(专利权)人(译)	KWAK WON-KYU 朴东旭 崔相MOO		
当前申请(专利权)人(译)	KWAK WON-KYU 朴东旭 崔相MOO		
[标]发明人	KWAK WON KYU PARK DONG WOOK CHOI SANG MOO		
发明人	KWAK, WON-KYU PARK, DONG-WOOK CHOI, SANG-MOO		
IPC分类号	G09G3/30 G09G5/00		
CPC分类号	G09G3/3233 G09G2300/0426 G09G2300/0819 G09G2300/0842 H01L27/3276 G09G2300/0861 G09G2320/0223 G09G2320/043 G09G2300/0852		
优先权	1020090069426 2009-07-29 KR		
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摘要(译)

有机发光显示装置可包括在基板上限定的像素区域中的多个像素，每个像素耦合到当前扫描线，数据线，第一电源，第二电源和第三电源其中每个像素包括具有多个晶体管和一个或多个电容器的像素电路，以及包括第一电极并且耦合到像素电路的有机发光二极管（OLED），OLED被配置为发出具有亮度的光对应于经由像素电路从第一电源流到第二电源的驱动电流，其中第三电源被配置为通过供电线向像素电路提供恒定电压，并且其中供电线位于与第一电极相同的层和相同的材料。