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Kim

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(54) **PIXEL AND ORGANIC LIGHT EMITTING DISPLAY DEVICE USING THE SAME**

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G09G 3/32 (2006.01)

(52) **U.S. Cl.**
USPC **345/82**; 345/76; 345/89; 345/92; 315/169.1; 315/169.3

(58) **Field of Classification Search**
USPC 345/76–100, 204, 690, 9; 315/169.1–169.3
See application file for complete search history.

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(57) **ABSTRACT**

A pixel to compensate for the deterioration of an organic light emitting diode, the pixel including an organic light emitting diode; a pixel circuit including a driving transistor controlling an amount of current supplied to the organic light emitting diode; and a compensator compensating for the deterioration of the organic light emitting diode by using on-voltage applied when current flows in the organic light emitting diode and off-voltage applied when current does not flow in the organic light emitting diode; wherein the compensator includes: a compensating capacitor having a second terminal connected to a gate electrode of the driving transistor; and a first compensating transistor connected between a first terminal of the compensating capacitor and an anode electrode of the organic light emitting diode.

27 Claims, 6 Drawing Sheets

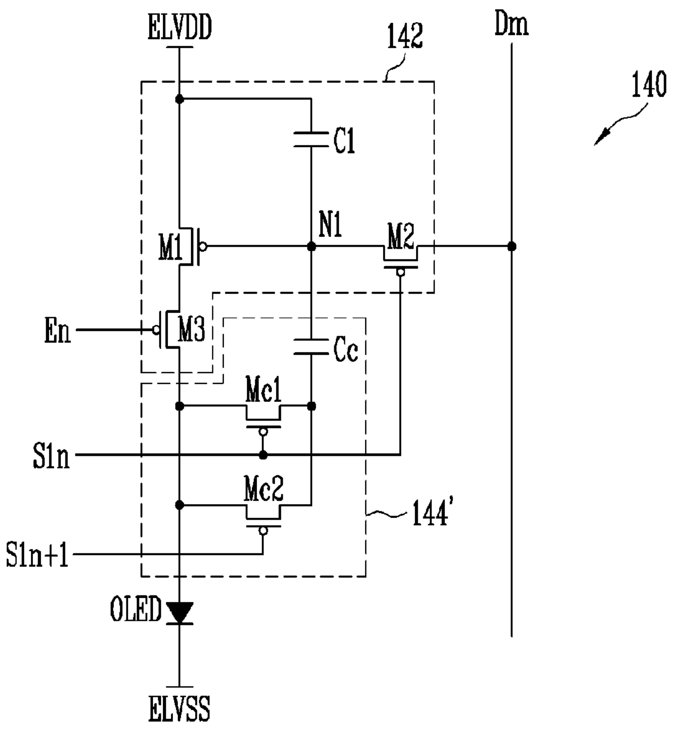


FIG. 1
(Related Art)

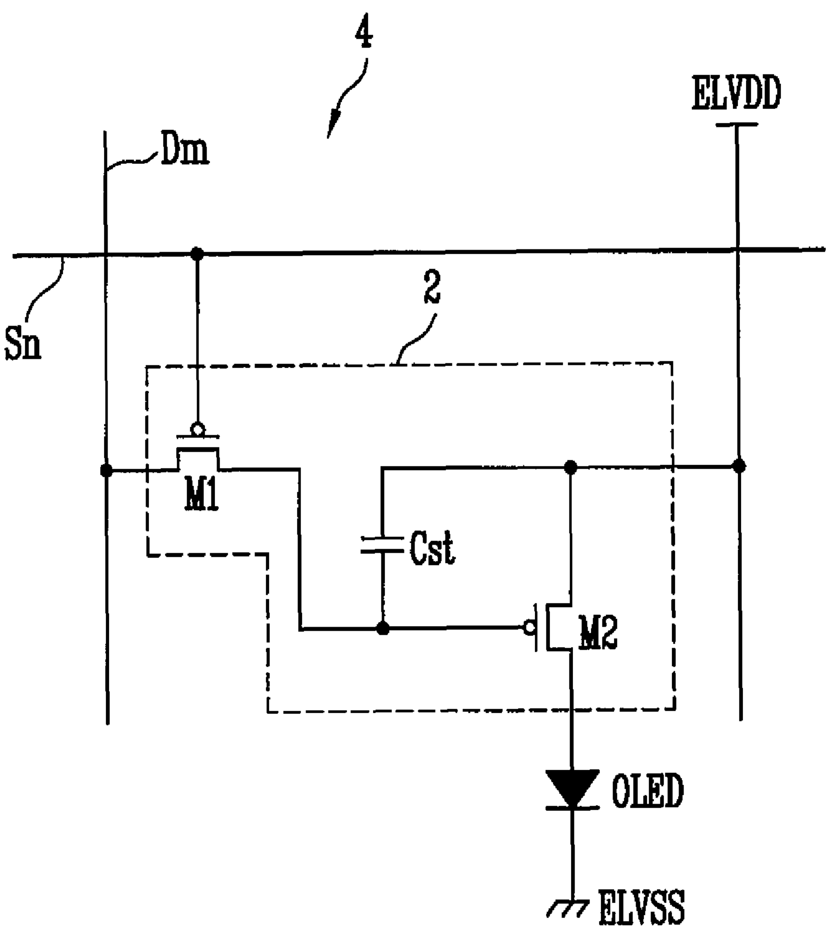


FIG. 2

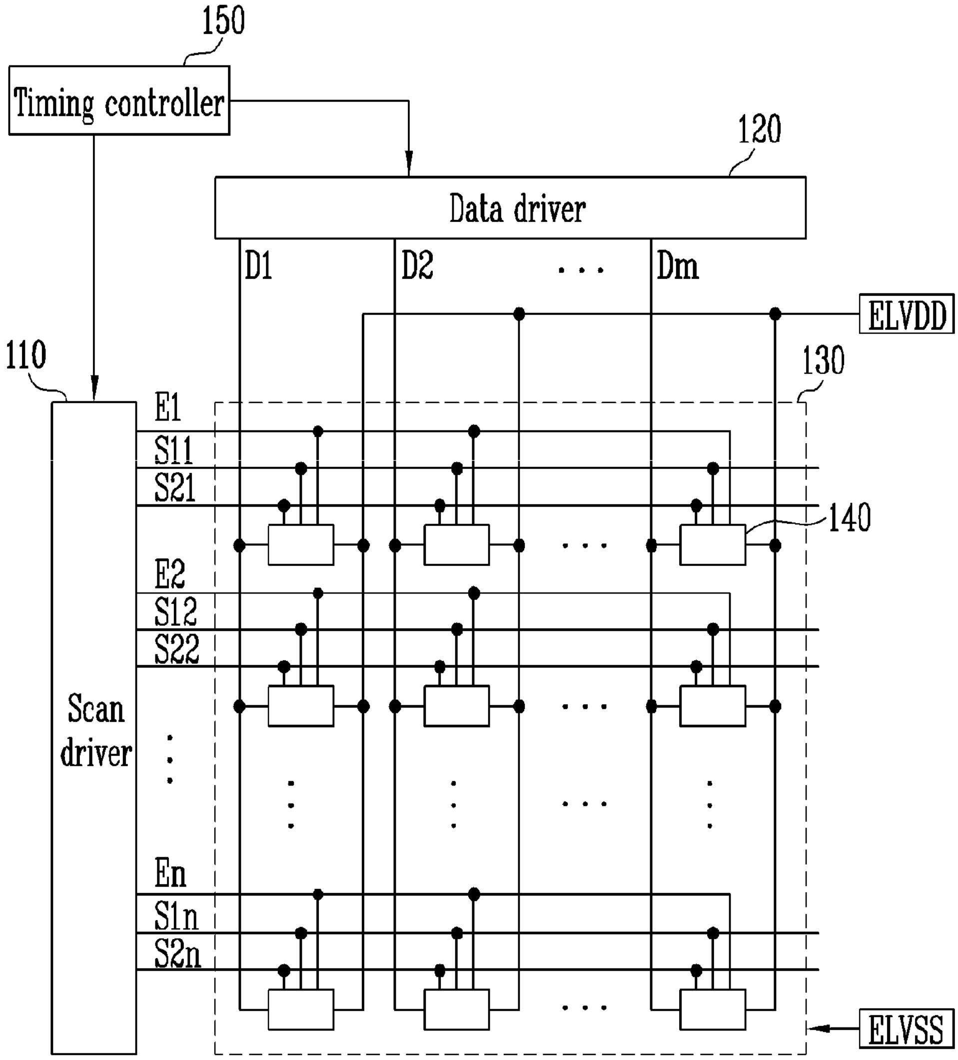

150
Timing controller
120
Data driver
D1
D2
Dm
ELVDD
110
130
E1
S11
S21
140
E2
S12
S22
Scan driver
En
S1n
S2n
ELVSS

FIG. 3

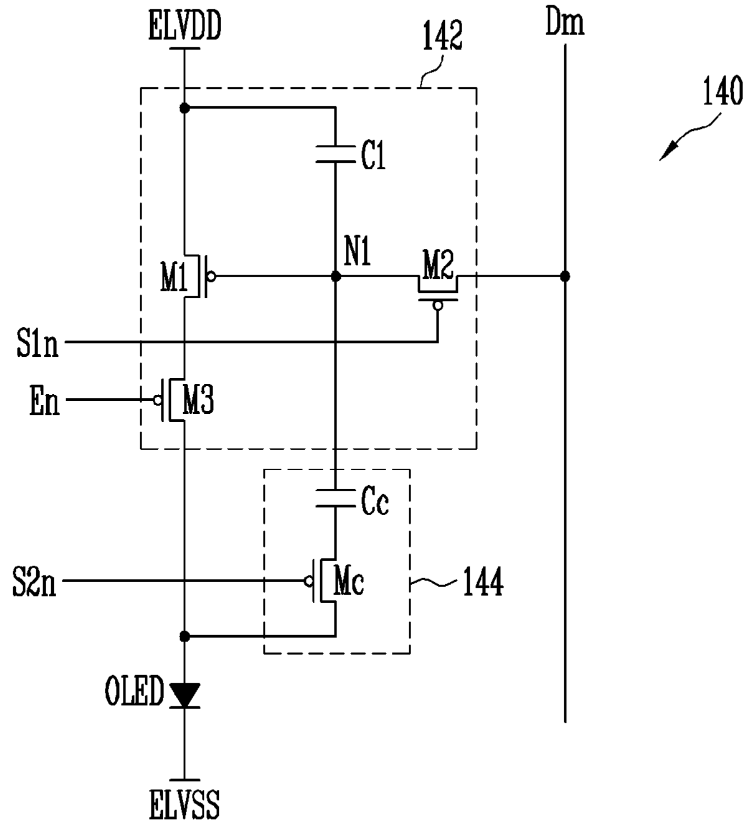

ELVDD
142
Dm
140
C1
N1
M1
M2
S1n
En
M3
Cc
S2n
Mc
144
OLED
ELVSS

FIG. 4

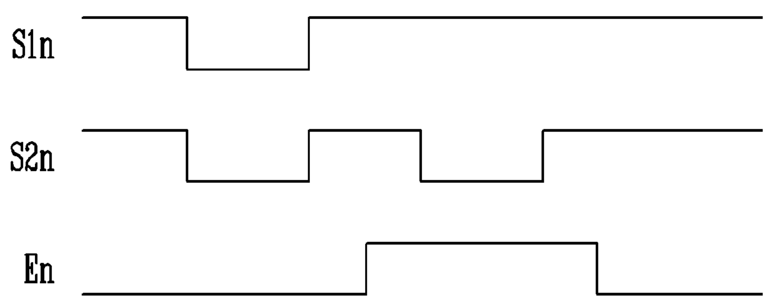

S1n
S2n
En

FIG. 5

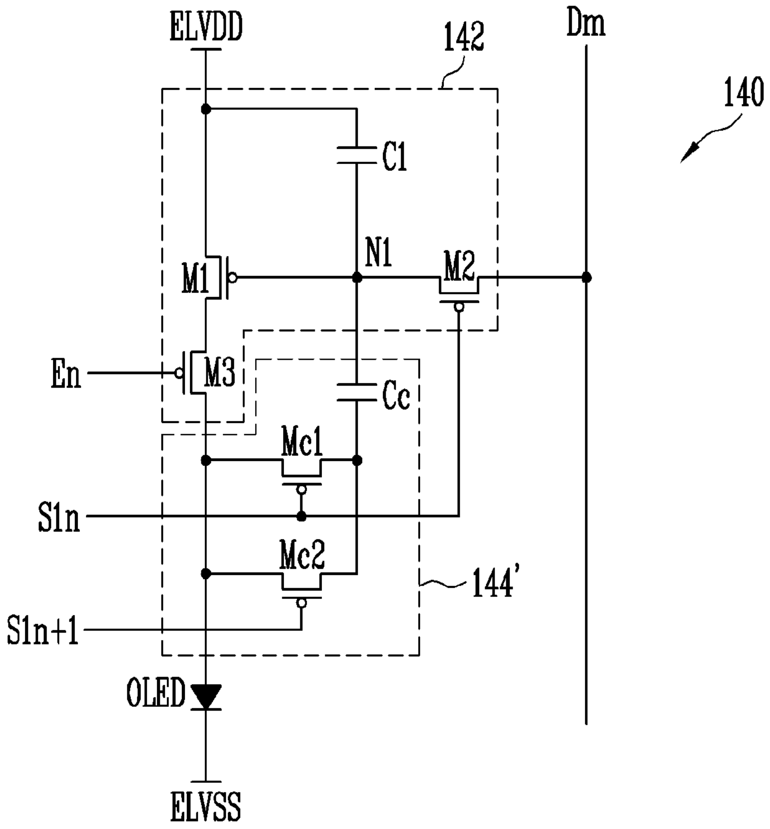

ELVDD
142
Dm
140
C1
N1
M1
M2
En
M3
Cc
Mc1
S1n
Mc2
144'
S1n+1
OLED
ELVSS

FIG. 6

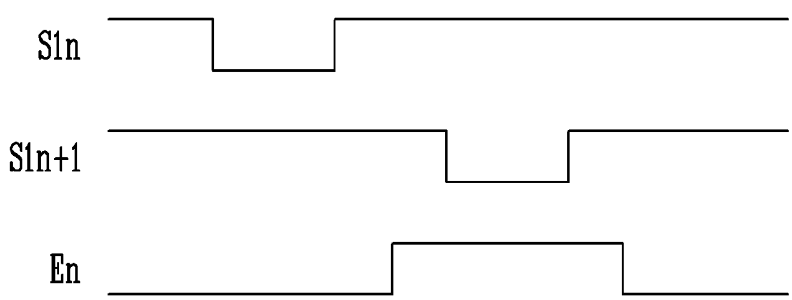

S1n
S1n+1
En

FIG. 7

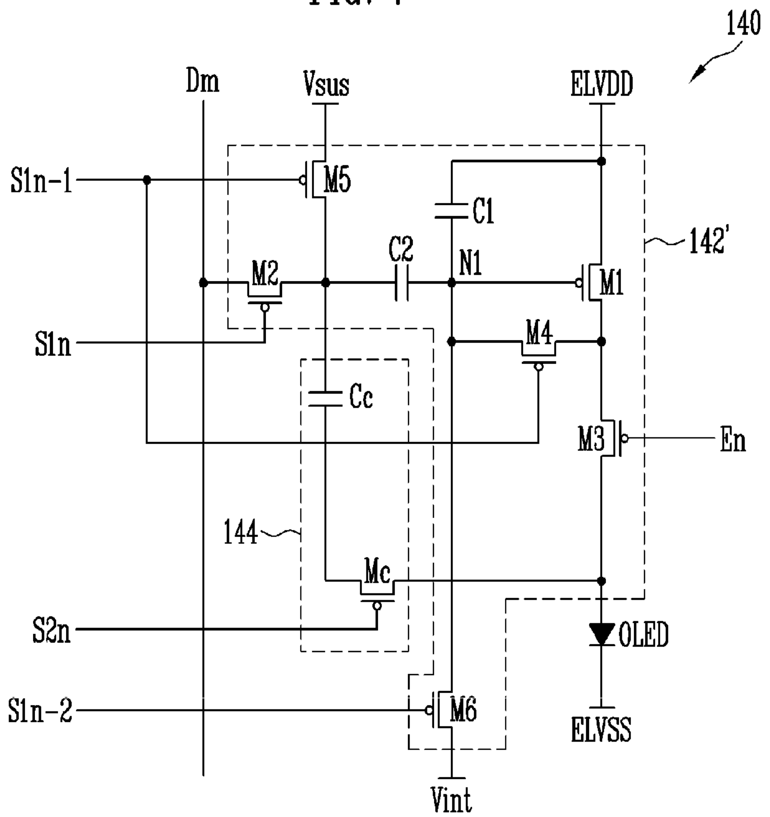

140
Dm
Vsus
ELVDD
S1n-1
M5
C1
142'
C2
N1
M2
M1
S1n
M4
Cc
M3
En
144
Mc
S2n
OLED
S1n-2
M6
ELVSS
Vint

FIG. 8

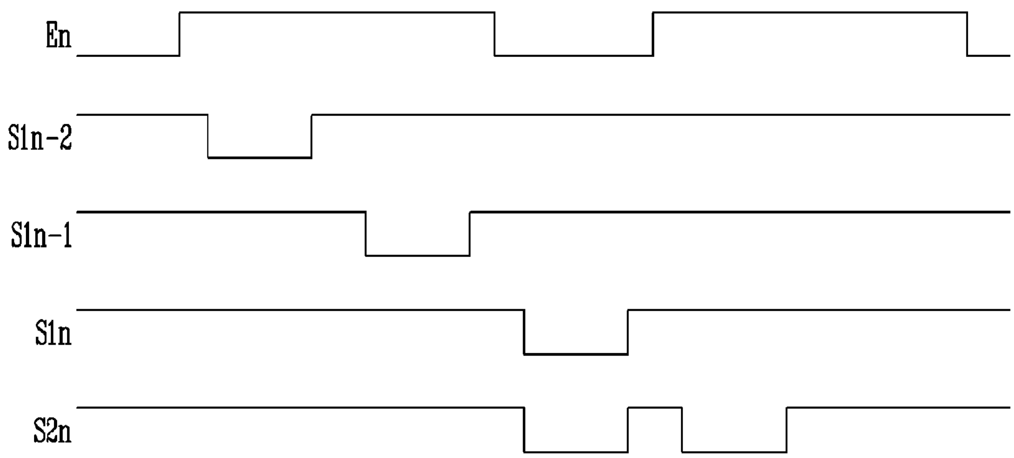

En
S1n-2
S1n-1
S1n
S2n

FIG. 9

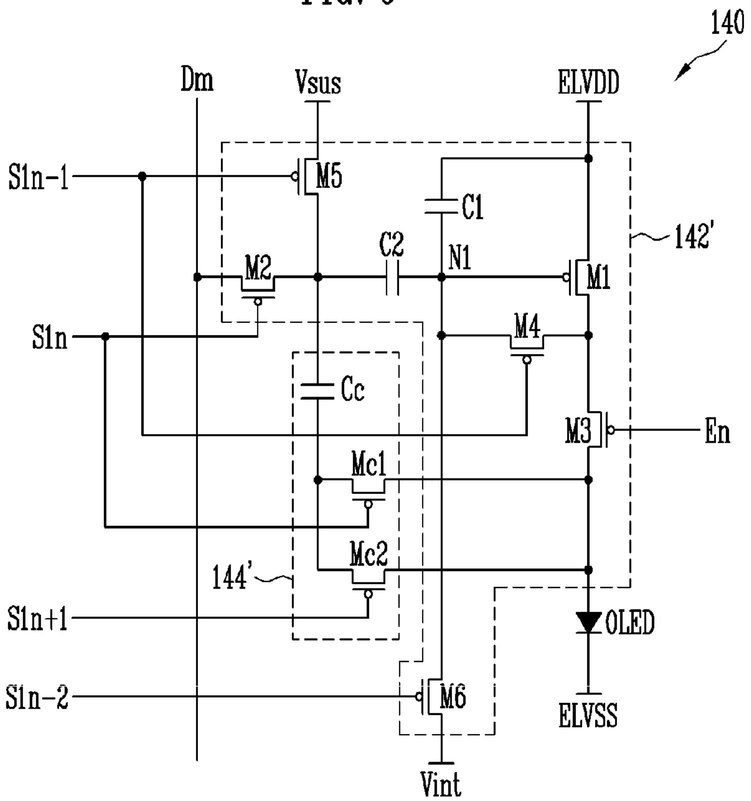
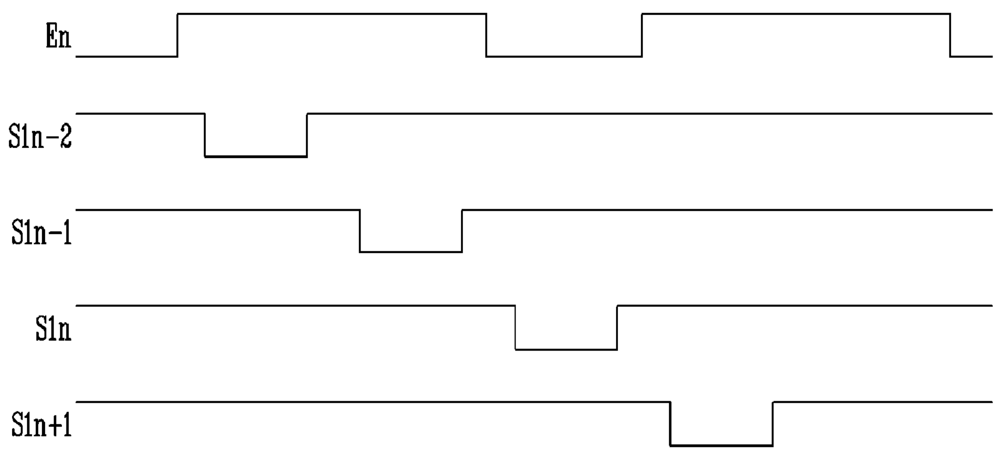

140
Dm
Vsus
ELVDD
S1n-1
M5
C1
142'
C2
N1
M2
M1
S1n
M4
Cc
M3
En
Mc1
Mc2
144'
S1n+1
OLED
S1n-2
M6
ELVSS
Vint

FIG. 10


En
S1n-2
S1n-1
S1n
S1n+1

PIXEL AND ORGANIC LIGHT EMITTING DISPLAY DEVICE USING THE SAME

CROSS-REFERENCE TO RELATED APPLICATION

This application claims the benefit of Korean Application No. 10-2010-0074650, filed Aug. 2, 2010, in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

An aspect of the present invention relates to a pixel and an organic light emitting display device using the pixel, and more particularly to a pixel that compensates deterioration of an organic light emitting diode and an organic light emitting display device using the pixel.

2. Description of the Related Art

Recently, a variety of flat panel displays having reduced weight and volume as compared to cathode ray tubes, have been developed. Typical flat panel displays include a liquid crystal display, a field emission display, a plasma display panel, and an organic light emitting display device, etc.

The organic light emitting display device displays an image, using an organic light emitting diode that produces light by recombining an electrode and a hole. The organic light emitting display device has the advantage that it has high response speed and is driven by low power.

FIG. **1** is a circuit diagram illustrating a pixel of an organic light emitting display device in the related art. Referring to FIG. **1**, a pixel **4** of an organic light emitting display device of the related art includes: an organic light emitting diode OLED; and a pixel circuit **2** connected with a data line Dm and a scan line Sn and controlling the organic light emitting diode OLED.

The anode electrode of the organic light emitting diode OLED is connected to the pixel circuit **2** and the cathode electrode is connected to the second power supply ELVSS. The organic light emitting diode produces light with predetermined luminance in response to the current supplied from the pixel circuit **2**.

The pixel circuit **2** controls the amount of current supplied to the organic light emitting diode OLED, in response to a data signal supplied to the data line Dm, when a scan signal is supplied to the scan line Sn. For this configuration, the pixel circuit **2** includes: a second transistor connected between a first power supply ELVDD and the organic light emitting diode OLED; a first transistor M1 connected between the second transistor M**2**, the data line Dm, and the scan line Sn; and a storage capacitor Cst connected between a gate electrode and a first electrode of the second transistor M**2**.

A gate electrode of the first transistor M**1** is connected to the scan line Sn and a first electrode is connected to the data line Dm. Further, a second electrode of the first transistor M**1** is connected to one terminal of the storage capacitor Cst. In this configuration, the first electrode is any one of a source electrode and a drain electrode and the second electrode is the other electrode different from the first electrode. For example, when the first electrode is the source electrode, the second electrode is the drain electrode. The first transistor M**1** connected to the scan line Sn and the data line Dm is turned on and supplies a data signal, which is supplied through the data line Dm, to the storage capacitor Cst. In this operation, the storage capacitor Cst is charged to a voltage corresponding to the data signal.

The gate electrode of the second transistor M**2** is connected to one terminal of the storage capacitor Cst and the first electrode of the second transistor M**2** is connected to the first power supply ELVDD and the other terminal of the storage capacitor Cst. Further, the second electrode of the second transistor M**2** is connected to the anode of the organic light emitting diode OLED. The second transistor M**2** controls the amount of current flowing from the first power supply ELVDD to the second power supply ELVSS through the organic light emitting diode OLED, in response to the voltage value stored in the storage capacitor Cst. In this configuration, the organic light emitting diode OLED emits light corresponding to the amount of current supplied from the second transistor M**2**.

However, the organic light emitting display device having the above configuration according to the related art has a problem that it cannot display an image with desired luminance, by efficiency change due to the deterioration of the organic light emitting diode. In other words, as time passes, the organic light emitting diode is deteriorated and accordingly it is not possible to display an image with a desired luminance.

SUMMARY OF THE INVENTION

An aspect of the present invention provides a pixel compensating deterioration of an organic light emitting diode, and an organic light emitting display device using the pixel.

Another aspect of the present invention provides a pixel that can compensate deterioration of an organic light emitting diode, regardless of voltage drop of a second power supply ELVSS, and an organic light emitting display device using the pixel.

According to an aspect of the present invention, there is provided a pixel including: an organic light emitting diode; a pixel circuit including a driving transistor controlling an amount of current supplied to the organic light emitting diode; and a compensator compensating deterioration of the organic light emitting diode by using on-voltage applied when current flows in the organic light emitting diode and off-voltage applied when current does not flow in the organic light emitting diode; the compensator including: a compensating capacitor having a second terminal connected to a gate electrode of the driving transistor; and a first compensating transistor connected between a first terminal of the compensating capacitor and an anode electrode of the organic light emitting diode.

According to another aspect of the present invention, the driving transistor controls current flowing to the organic light emitting diode in response to a data signal transmitted when a first scan signal is supplied to an i-th (i is a natural number) first scan line. The first compensating transistor is turned on for a first period and a second period after the first period of one frame period, in response to a second scan signal supplied to the i-th second scan line. The first period is a period when the first scan signal is supplied to the i-th first scan signal and the second period is a period when the first scan signal is supplied to an i+1-th first scan line. The on-voltage is supplied to the first terminal of the compensating capacitor for the first period and the off-voltage is supplied to the first terminal of the compensating capacitor for the second period. The compensator further includes a second compensating transistor that is connected between the first terminal of the compensating capacitor and the anode electrode of the organic light emitting diode and islurned on at a different time from the first compensating transistor. The first compensating transistor is turned on when the first scan signal is supplied to the 1-th first scan line and the second compensating transistor is turned on when the first scan signal is supplied to the i+1-th first scan line.

According to another aspect of the present invention, the on-voltage is supplied to the first terminal of the compensating capacitor when the first compensating transistor is turned on, and the off-voltage is supplied to the first terminal of the compensating capacitor when the second compensating transistor is turned on. The pixel circuit includes: a first capacitor connected between a gate electrode of the driving transistor and a first power supply; a second transistor connected between the gate electrode of the driving transistor and a data line and turned on when the first scan signal is supplied to the i-th first scan line; and a third transistor connected between a second electrode of the driving transistor and the organic light emitting diode and turned off when an emission control signal is supplied to an i-th emission control line. The emission control signal supplied to the i-th emission control line overlaps the first scan signal supplied to an i+1-th first scan line.

According to another aspect of the present invention, the pixel circuit further includes: a fourth transistor connected between the gate electrode and the second electrode of the driving transistor and is turned on when the first scan signal is supplied to the i−1-th scan line; a second transistor connected between the gate electrode of the driving transistor and the second electrode of the second transistor; a fifth transistor connected between the second electrode of the second transistor and a reference power supply and turned on when the first scan signal is supplied to the i−1-th first scan line; and a sixth transistor connected between the gate electrode of the driving transistor and an initial power supply and turned on when the first scan signal is supplied to the i−2-th first scan line. The reference power supply is set at voltage higher than the data signal. The initial power supply is set at a voltage lower than the data signal. The emission control signal supplied to the i-th emission control line overlaps the first scan signal supplied to an i−2-th first scan line, an i−1-th first scan line, and an i+1-th first scan line, except for the first scan line supplied to the i-th first scan line. The second terminal of the compensating capacitor is connected to the second electrode of the second transistor.

According to another aspect of the present invention, the more the organic light emitting diode is deteriorated, the larger the increase ratio of the on-voltage, as compared with the off-voltage.

According to another embodiment of the present invention, there is provided an organic light emitting display device, including: a scan driver sequentially supplying first scan signals to first scan lines; a data driver supplying data signals to data lines to be synchronized with the first scan signals; and pixels positioned at intersections of the first scan lines and the data lines, in which the pixels positioned in an i-th (i is a natural number) horizontal line each include: a pixel circuit including a driving transistor controlling the amount of current supplied to the organic light emitting diode; and a compensator compensating deterioration of the organic light emitting diode by using on-voltage applied when current flows in the organic light emitting diode and off-voltage applied when current does not flow in the organic light emitting diode, and the compensator includes: a compensating capacitor having a second terminal connected to a gate electrode of the driving transistor; and a first compensating transistor connected between a first terminal of the compensating capacitor and an anode electrode of the organic light emitting diode.

According to another aspect of the present invention, second scan lines are formed in parallel with the first scan lines, and the first compensating transistor is turned on when a second scan signal is supplied to an i-th second scan line. The scan driver supplies a first second scan signal to the i-th second scan line to overlap the first scan signal supplied to an i-th first scan line, and supplies a second second scan signal to the i-th second scan line to overlap the second scan signal supplied to an i+1-th scan line. The compensator further includes a second compensating transistor that is connected between the first terminal of the compensating capacitor and the anode electrode of the organic light emitting diode and is turned on at a different time from the first compensating transistor. The first compensating transistor is turned on when the first scan signal is supplied to the 1-th first scan line and the second compensating transistor is turned on when the first scan signal is supplied to the i+1-th first scan line.

According to another aspect of the present invention, it is possible to control voltage of a gate electrode of a driving transistor such that deterioration of an organic light emitting diode can be compensated, making it possible to display an image with desired luminance. Further, it is possible to compensate deterioration of the organic light emitting diode (OLED), regardless of voltage drop of a second power supply ELVSS, because on-voltage and off-voltage of the organic light emitting diode according to an aspect of the present invention are used.

Additional aspects and/or advantages of the invention will be set forth in part in the description which follows and, in part, will be obvious from the description, or may be learned by practice of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

These and/or other aspects and advantages of the invention will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawings of which:

FIG. **1** is a circuit diagram illustrating a pixel of the related art;

FIG. **2** is a diagram illustrating an organic light emitting display device according to an embodiment of the present invention;

FIG. **3** is a diagram illustrating an embodiment of a pixel shown in FIG. **2**;

FIG. **4** is a waveform diagram illustrating a method of driving the pixel shown in FIG. **3**;

FIG. **5** is a diagram illustrating another embodiment of a pixel shown in FIG. **2**;

FIG. **6** is a waveform diagram illustrating a method of driving the pixel shown in FIG. **5**;

FIG. **7** is a diagram illustrating another embodiment of a pixel shown in FIG. **2**;

FIG. **8** is a waveform diagram illustrating a method of driving the pixel shown in FIG. **7**;

FIG. **9** is a diagram illustrating another embodiment of a pixel shown in FIG. **2**; and

FIG. **10** is a waveform diagram illustrating a method of driving the pixel shown in FIG. **9**.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Reference will now be made in detail to the present embodiments of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to the like elements throughout. The embodiments are described below in order to explain the aspects of the present invention by referring to the figures.

FIG. **2** is a diagram illustrating an organic light emitting display device according to an embodiment of the present invention. Referring to FIG. **2**, an organic light emitting display device includes a pixel unit **130** including pixels **140** positioned at the intersections of first scan lines S**11** to S**1***n*, second scan lines S**21** to S**2***n*, emission control lines E**1** to En, and data lines D**1** to Dm, a scan driver **110** driving the first scan lines S**11** to S**1***n*, the second scan lines S**21** to S**2***n*, and the emission control lines E**1** to En, a data driver **120** driving the data lines D**1** to Dm, and a timing controller **150** controlling the scan driver **110** and the data driver **120**.

The scan driver **110** supplies first scan signals to the first scan signal lines S**11** to S**1***n* and second scan signals to the second scan lines S**21** to S**2***n*, by control of the timing controller **150**. Further, the scan driver **110** supplies emission control signals to the emission control lines E**1** to En, by the control of the timing controller **150**.

The scan driver **110** sequentially supplies one first scan signal to each of the first scan lines S**11** to S**1***n*. Further, the scan driver **110** sequentially supplies two second scan signals to the second scan lines S**21** to S**2***n*. The first second scan signal supplied to the i-th (i is a natural number) second scan line S**2***i* overlaps the first scan signal supplied to the i-th first scan line S**1***i*, and the second second scan signal overlaps the first scan signal supplied to the i+1-th first scan line S**1***i*+1. Further, the scan driver **110** supplies an emission control signal to the i-th emission control line Ei to overlap the second second scan signal supplied to the i-th second scan lien S**2***i*.

Meanwhile, the emission control signal is set to a voltage (e.g. high polarity) in which the transistors in the pixels **140** can be turned off, and the first scan signal and the second scan signal are set to a voltage (e.g. low polarity) in which the transistors can be turned on.

The data driver **120** generates data signals by control of the timing controller **150** and supplies the generated data signals to the data lines D**1** to Dm to be synchronized with the first scan signals.

The timing controller **150** controls the scan driver **110** and the data driver **120**. Further, the timing controller **150** transmits data supplied from the outside to the data driver **120**.

The pixel unit **130** supplies power, which is supplied from the first power supply ELVDD and the second power supply ELVSS at the outside, to the pixels **140**. The pixels **140** supplied with the power from the first power supply ELVDD and the second power supply ELVSS produce light corresponding to a data signal.

The pixels generate light with desired luminance by compensating for the deterioration of the organic light emitting diodes therein. In detail, the emission efficiency decreases with the deterioration of the organic light emitting diode, such that the luminance of the generated light is reduced. Therefore, the pixels **140** compensate for the deterioration of the organic light emitting diode by increasing the amount of current supplied to the organic light emitting diode, in accordance with the deterioration of the organic light emitting diode.

FIG. **3** is a diagram illustrating the pixel shown in FIG. **2**. The pixels connected with the **1***n*-th scan line S**1***n* and the m-th data line Dm is shown in FIG. **3**, for the convenience of description.

Referring to FIG. **3**, a pixel **140** includes a organic light emitting diode OLED, a pixel circuit **142** controlling an amount of current supplied to the organic light emitting diode OLED, and a compensator **144** controlling control of a gate electrode of a driving transistor M**1** included in the pixel circuit **142** in accordance with deterioration of the organic light emitting diode OLED.

The anode electrode of the organic light emitting diode OLED is connected to the pixel circuit **142** and the cathode electrode of the organic light emitting diode OLED is connected to the second power supply ELVSS. The organic light emitting diode OLED produces light with predetermined luminance in response to the current supplied from the pixel circuit **142**. For this configuration, the first power supply ELVDD is set at a voltage higher than the second power supply ELVSS.

The pixel circuit **142** controls the amount of current supplied to the organic light emitting diode OLED in response to the data signal. For convenience, it is exemplified that three transistors M**1** to M**3** and one capacitor C**1** are included in the pixel circuit **142** as shown in FIG. **3**. However, aspects of the present invention are not limited thereto and more or less transistors and capacitors may be present. Practically, the pixel circuit **142** can be implemented by various circuits known in the art.

A gate electrode of the first transistor M**1** is connected to a first node N**1** and a first electrode of the first transistor M**1** is connected to the first power supply ELVDD. Further, a second electrode of the first transistor M**1** is connected to a first electrode of the third transistor M**3**. The first transistor M**1** controls the amount of current flowing from the first power supply ELVDD to the second power supply ELVSS through the organic light emitting diode OLED, in response to the voltage applied to the first node N**1**.

A first electrode of the second transistor M**2** is connected to the data line Dm and a second electrode of the second transistor M**2** is connected to the first node N**1**. Further, a gate electrode of the second transistor M**2** is connected to the first scan line S**1***n*. The second transistor M**2** is turned on and electrically connects the data line Dm with the first node N**1**, when the first scan signal is supplied to the first scan line S**1***n*.

A first electrode of the third transistor M**3** is connected to a second electrode of the first transistor M**1** and a second electrode of the third transistor M**3** is connected to the anode of the organic light emitting diode OLED. Further, the gate electrode of the third transistor M**3** is connected to the emission control line En. The third transistor having this configuration is turned off when an emission signal is supplied to the emission control line En.

The first capacitor C**1** is connected between the first node N**1** and the first power supply ELVDD. The first capacitor C**1** is charged to a voltage corresponding to the data signal.

The compensator **144** controls voltage of the first node N**1** in accordance with deterioration of the organic light emitting diode OLED. For this operation, the compensator **144** includes a compensating transistor Mc and a compensating capacitor Cc.

The compensating transistor Mc has a first electrode connected to the anode electrode of the organic light emitting diode OLED and a second electrode connected to a first terminal of the compensating capacitor Cc. Further, a gate electrode of the compensating transistor Mc is connected to the second scan line S**2***n*. The compensating transistor Mc is turned on and electrically connects the anode electrode of the organic light emitting diode OLED with the first terminal of the compensating capacitor Cc, when a second scan signal is supplied to the second scan line S**2***n*.

The first terminal of the compensating capacitor Cc is connected to the second electrode of the compensating transistor Mc and the second electrode of the compensating capacitor Cc is connected to the first node N**1**. The compensating capacitor Cc controls voltage of the first node N**1** in accordance with voltage changes of the organic light emitting diode OLED.

FIG. **4** is a waveform diagram illustrating a method of driving the pixel shown in FIG. **3**. Referring to FIG. **4**, a scan signal is supplied to the first scan line S**1***n*, and a first second scan signal is supplied to the second scan line S**2***n*.

As the first scan signal is supplied to the first scan signal S**1***n*, the second transistor M**2** is turned on. As the second transistor M**2** is turned on, a data signal is supplied from the data line Dm to the first node N**1**, and accordingly, the first capacitor C**1** is charged at a voltage corresponding to the data signal. In this operation, the first transistor M**1** supplies current corresponding to the voltage applied to the first node N**1** to the organic light emitting diode OLED through the third transistor M**3**, and accordingly, a predetermined voltage is applied to the organic light emitting diode OLED. Hereafter, for the convenience of description, the voltage applied to the organic light emitting diode OLED, corresponding to the current supplied from the first transistor M**1**, is referred to as on-voltage of the organic light emitting diode OLED.

As the first second scan signal is supplied to the second scan line S**2***n*, the compensating transistor Mc is turned on. As the compensating transistor Mc is turned on, the on-voltage of the organic light emitting diode OLED is supplied to the first terminal of the compensating capacitor Cc. That is, while the data signal is supplied to the first node N**1**, the first terminal of the compensating capacitor Cc is set to the on-voltage of the organic light emitting diode OLED.

Thereafter, the second second scan signal is supplied to the second scan line S**2***n* and the emission control signal is supplied to the emission control line En to overlap the second scan signal. As the emission control signal is supplied to the emission control line En, the third transistor M**3** is turned off As the third transistor M**3** is turned off, the first transistor M**1** and the anode electrode of the organic light emitting diode OLED are electrically disconnected. Hereafter, for the convenience of description, the voltage applied to the organic light emitting diode OLED when the organic light emitting diode OLED and the first transistor M**1** are electrically disconnected is referred to as an off-voltage of the organic light emitting diode OLED.

As the second second scan signal is supplied to the second scan line S**2***n*, the compensating transistor Mc is turned on. As the compensating transistor Mc is turned on, the off-voltage of the organic light emitting diode OLED is supplied to the first terminal of the compensating capacitor Cc. The compensating capacitor Cc controls voltage of the first node N**1** in accordance with voltage changes of the organic light emitting diode OLED.

$$Vg(V_{N1})=V_{data}+Cc/(Cc+C1)\times(-(\mathrm{On}_{Voltage}-\mathrm{Off}_{Voltage})) \quad \text{[Formula 1]}$$

Vdata is voltage of the data signal in Formula 1. Further, —(on voltage—off voltage) is a voltage drop ratio of the first node N1 to a voltage difference between the on-voltage and the off-voltage.

In detail, the more the organic light emitting diode OLED is deteriorated, the more the resistance increases, and accordingly, the on-voltage of the organic light emitting diode OLED increases (practically, the off-voltage also increases, but the increase is vary small as compared with the on-voltage, such that it will be assumed that the off-voltage is fixed regardless of deterioration of the organic light emitting diode OLED).

For example, when the organic light emitting diode OLED is deteriorated, the on-voltage is set at 6V, and when it is not deteriorated, the on-voltage is set at 5V. Assume that the off-voltage of the organic light emitting diode OLED is 3V.

When the organic light emitting diode OLED is not deteriorated, the voltage of the first terminal of the compensating capacitor Cc drops from 5V to 3V, and the voltage of the first node N1 correspondingly drops. Further, when the organic light emitting diode OLED deteriorates, the voltage of the first terminal of the compensating capacitor Cc drops from 6V to 3 V, and the voltage of the first node N**1** correspondingly drops. That is, the compensator **144** decreases the voltage of the first node N1 so as to compensate for the deterioration of the organic light emitting diode OLED.

Furthermore, according to an aspect of the present invention, it is possible to control the voltage of the first node regardless of the voltage drop of the second power supply ELVSS. In other words, the on-voltage and the off-voltage of the organic light emitting diode OLED are continuously supplied to the first terminal of the compensating capacitor Cc. The second power ELVSS included in the on-voltage and the second power ELVSS included in the off-voltage are offset, such that the voltage of the first node N**1** is controlled regardless of the voltage drop of the second power ELVSS.

FIG. **5** is a diagram illustrating the pixel shown in FIG. **2** according to another embodiment of the present invention. For convenience of explanation, the same components as in FIG. **3** are designated by the same reference numerals and the detailed description is not provided.

Referring to FIG. **5**, a compensator **144'** includes a first compensating transistor Mc**1**, a second compensating transistor Mc**2**, and a compensating capacitor Cc.

The first compensating transistor Mc**1** has a first electrode connected to the anode electrode of the organic light emitting diode OLED and a second electrode connected to a first terminal of the compensating capacitor Cc. Further, a gate electrode of the first compensating transistor Mc**1** is connected to the n-th first scan line S**1***n*. The first compensating transistor Mc**1** is turned on and electrically connects the anode electrode of the organic light emitting diode OLED with the first terminal of the compensating capacitor Cc, when a first scan signal is supplied to the n-th first scan line S**1***n*.

The second compensating transistor Mc**2** has a first electrode connected to the anode electrode of the organic light emitting diode OLED and a second electrode connected to a first terminal of the compensating capacitor Cc. Further, a gate electrode of the second compensating transistor Mc**2** is connected to the n+1-th first scan line S**1***n*+1. The second compensating transistor Mc**2** is turned on and electrically connects the anode electrode of the organic light emitting diode OLED with the first terminal of the compensating capacitor Cc, when a first scan signal is supplied to the n+1-th first scan line S**1***n*+1.

The first terminal of the compensating capacitor Cc is connected to the second electrodes of the first and second compensating transistor Mc**1** and Mc**2** and the second electrode of the compensating capacitor Cc is connected to the first node N**1**. The compensating capacitor Cc controls voltage of the first node N**1** in accordance with voltage changes of the organic light emitting diode OLED.

In the pixel **140** described above, the on-voltage of the organic light emitting diode OLED is supplied to the compensating capacitor Cc by using the first compensating transistor Mc**1** connected to the n-th first scan line S**1***n*, and the off-voltage of the organic light emitting diode OLED is supplied to the compensating capacitor Cc by using the second compensating transistor Mc**2** connected to the n+1-th first scan line S**1***n*+1. In this case, it is possible to remove the second scan line S**2***n* shown in FIG. **3**.

FIG. **6** is a waveform diagram illustrating a method of driving the pixel shown in FIG. **5**. Referring to FIG. **6**, the first scan signal is first supplied to the n-th first scan line S**1***n*. As the first scan signal is supplied to the n-th first scan line S1*n*, the second transistor M2 and the first compensating transistor Mc1 are turned on.

As the second transistor M2 is turned on, a data signal is supplied from the data line Dm to the first node N1, and accordingly, the first capacitor C1 is charged at a voltage corresponding to the data signal.

As the first compensating transistor Mc1 is turned on, the on-voltage of the organic light emitting diode OLED is supplied to the first terminal of the compensating capacitor Cc. That is, while the data signal is supplied to the first node N1, the first terminal of the compensating capacitor Cc is set to the on-voltage of the organic light emitting diode OLED.

Thereafter, the first scan signal is supplied to the n+1-th first scan line S1*n*+1, and the emission control signal is supplied to the emission control line En. As the emission control signal is supplied to the emission control line En, the third transistor M3 is turned off.

As the first scan signal is supplied to the n+1-th first scan line S1*n*+1, the second compensating transistor Mc2 is turned on. As the second compensating transistor Mc2 is turned on, the off-voltage of the organic light emitting diode OLED is supplied to the first terminal. The compensating capacitor Cc controls voltage of the first node N1 in accordance with voltage changes of the organic light emitting diode OLED, as expressed in Formula 1. That is, the compensating capacitor Cc controls the voltage of the first node N1 in accordance with the deterioration of the organic light emitting diode OLED, and accordingly, it is possible to compensate for the deterioration of the organic light emitting diode OLED.

FIG. **7** is a diagram illustrating another embodiment of the pixel shown in FIG. **2**. In explaining FIG. **7**, the same components as in FIG. **3** are designated by the same reference numerals and therefore a detailed description is not provided.

Referring to FIG. **7**, in the pixel **140**, the configuration is the same as that shown in FIG. **3**, except for the pixel circuit **142'**. FIG. **7** includes an embodiment modified from the pixel circuit **142'**, and the method of compensating for the deterioration of the organic light emitting diode OLED is the same as that illustrated in FIG. **3**.

The pixel circuit **142'** controls the amount of current supplied to the organic light emitting diode OLED in response to the data signal. For this operation, the pixel circuit **142'** includes first to sixth transistors M1 to M6, a first capacitor C1, and a second capacitor C2.

A gate electrode of the first transistor M1 is connected to a first node N1 and a first electrode of the first transistor M1 is connected to the first power supply ELVDD. Further, a second electrode of the first transistor M1 is connected to a first electrode of the third transistor M3. The first transistor M1 supplies current corresponding to the voltage applied to the first node N1 to the organic light emitting diode OLED.

A first electrode of the second transistor M2 is connected to the data line Dm and a second electrode of the second transistor M2 is connected to the first terminal of the second capacitor C2. Further, a gate electrode of the second transistor M2 is connected to the n-th first scan line S1*n*. The second transistor M2 is turned on and electrically connects the data line Dm with the first terminal of the second capacitor C2, when a first scan signal is supplied to the n-th first scan line S1*n*.

A first electrode of the third transistor M3 is connected to a second electrode of the first transistor M1 and a second electrode of the third transistor M3 is connected to the anode of the organic light emitting diode OLED. Further, the gate electrode of the third transistor M3 is connected to the emission control line En. The third transistor having this configuration is turned off when an emission signal is supplied to the emission control line En.

A first electrode of the fourth transistor M4 is connected to a second electrode of the first transistor M1 and a first electrode of the fourth transistor M4 is connected to the first node N1. Further, a gate electrode of the fourth transistor M4 is connected to the n−1-th first scan line S1*n*−1. The fourth transistor M4 is turned on and connects the first transistor M1 in a diode type, when a first scan signal is supplied to the n−1-th scan line S1*n*−1.

A first electrode of the fifth transistor M5 is connected to a reference power supply Vsus and a second electrode of the fifth transistor M5 is connected to the first terminal of the second capacitor C2. Further, a gate electrode of the fifth transistor M5 is connected to the n−1-th first scan line S1*n*−1. The fifth transistor M5 is turned on and supplies the voltage of the reference power supply Vsus to the first terminal of the second capacitor C2, when a first scan signal is supplied to the n−1-th first scan line S1*n*−1. In this configuration, the voltage of the reference power supply Vsus is different from that of the data signal. For example, the reference power Vsus may be set at a voltage higher than the data signal.

A first electrode of the sixth transistor M6 is connected to the first node N1 and the second electrode of the sixth transistor M6 is connected to an initial power supply Vint. Further, a gate electrode of the sixth transistor m6 is connected to the n−2-th first scan line S1*n*−2. The sixth transistor M6 is turned on and supplies the voltage of the initial power supply Vint to the first node n1, when the first scan signal is supplied to the n−2-th first scan line S1*n*−2. In this configuration, the voltage of the initial power supply Vint is set lower than that of the data signals.

The first capacitor C1 is connected between the first node N1 and the first power supply ELVDD. The first capacitor C1 is charged at a voltage corresponding to a data signal and threshold voltage of the first transistor M1.

The second capacitor C2 is connected between the second electrode of the second transistor M2 and the first node N1. The second capacitor C2 is charged at a voltage corresponding to the data signal.

The compensator **144** includes a compensating transistor Mc and a compensating capacitor Cc. The compensating transistor Mc has a first electrode connected to the anode electrode of the organic light emitting diode OLED and a second electrode connected to a first electrode of the compensating capacitor Cc. Further, a gate electrode of the compensating transistor Mc is connected to the second scan line S2*n*. The compensating transistor Mc is turned on and electrically connects the anode electrode of the organic light emitting diode OLED with the first terminal of the compensating capacitor Cc, when a second scan signal is supplied to the second scan line S2*n*.

The first terminal of the compensating capacitor Cc is connected to the second electrode of the compensating transistor Mc and the second electrode of the compensating capacitor Cc is connected to the first terminal of the second capacitor C2. The compensating capacitor Cc controls voltage of the first terminal of the second capacitor C2 in accordance with voltage changes of the organic light emitting diode OLED.

FIG. **8** is a waveform diagram illustrating a method of driving the pixel shown in FIG. **7**. Referring to FIG. **8**, the scan driver **110** supplies an emission control signal to the emission control line Ei to overlap the first scan signal supplied to the i−1-th first scan line S1*n*−2, the i−1-th first scan line S1*n*, and the i+1-th first scan line Si+1. The emission control signal supplied to the emission control line Ei does not overlap the first scan signal supplied to the first scan line **S1***n*.

Explaining the operational process in detail, first, the first scan signal is supplied to the n−2-th first scan line **S1***n*−2 and the emission control signal is supplied to the emission control line En. The sixth transistor M**6** is turned on and the initial power Vint is supplied to the first node N**1**, when the first scan signal is supplied to the n−2-th first scan line **S1***n*−2. The first node N**1** is initialized to the voltage of the initial power Vint.

As the emission control signal is supplied to the emission control line En, the third transistor M**3** is turned off. As the third transistor M**3** is turned off, the second electrode of the first transistor M**1** and the organic light emitting diode OLED are electrically disconnected.

Thereafter, the first scan signal is supplied to the n−i-th first scan line **S1***n*−1. Thereafter, as the first scan signal is supplied to the n−1-th first scan line Sn−1, the fourth transistor M**4** and the fifth transistor M**5** are turned on.

The second electrode of the first transistor M**1** and the first node n**1** are electrically connected, when the fourth transistor M**4** is turned on. That is, the first transistor M**1** is connected in a diode type. In this process, since the voltage of the first node N**1** is set to the voltage of the initial power supply Vint, the first transistor M**1** is turned on. As the first transistor M**1** is turned on, the voltage of the first node N**1** is set to the voltage obtained by subtracting the threshold voltage of the first transistor M**1** from the first power supply ELVDD. The first capacitor C**1** is charged to a voltage corresponding to the threshold voltage of the first transistor M**1**.

As the fifth transistor M**5** is turned on, the voltage of the reference power supply Vsus is applied to the first terminal of the second capacitor C**2**. That is, the first terminal of the second capacitor C**2** is set to the voltage of the reference power supply Vsus while the first capacitor C**1** is charged to the voltage corresponding to the threshold voltage of the first transistor M**1**.

Thereafter, supply of the emission control signal to the emission control line En is stopped and the third transistor M**3** is turned off. Further, the first scan signal is supplied to the n-th first scan line **S1***n* and the first second scan signal is supplied to the n-th second scan line **S2***n*.

As the first scan signal is supplied to the n-th first scan line **S1***n*, the second transistor M**2** is turned on. A data signal from the data line Dm is supplied to the first terminal of the second capacitor C**2**, when the second transistor M**2** is turned on. In this operation, the voltage of the first terminal of the second capacitor C**2** drops to the voltage of the data signal from the voltage of the reference power supply Vsus. As the voltage of the first terminal of the second capacitor C**2** drops, the voltage of the first node N**1** also drops in accordance with the voltage drop of the first terminal of the second capacitor C**2**. Since the reference power supply Vsus is set to a constant voltage, the amount of voltage drop of the first node N**1** depends on the voltage of the data signal.

As the first second scan signal is supplied to the n-th second scan line **S2***n*, the compensating transistor Mc is turned on. As the compensating transistor Mc is turned on, the on-voltage of the organic light emitting diode OLED is supplied to the first terminal of the compensating capacitor Cc. That is, the first terminal of the compensating capacitor Cc is set to the on-voltage of the organic light emitting diode OLED while the voltage of the data signal is supplied to the first terminal of the second capacitor C**2**.

Thereafter, the second second scan signal is supplied to the n-th second scan line **S2***n* and the emission control signal is supplied to the emission control line En to overlap the second scan signal. As the emission control signal is supplied to the emission control line En, the third transistor M**3** is turned off.

As the second second scan signal is supplied to the n-th second scan line **S2***n*, the compensating transistor Mc is turned on. As the compensating transistor Mc is turned on, the off-voltage of the organic light emitting diode OLED is supplied to the first terminal of the compensating capacitor Cc. The compensating capacitor Cc controls voltage of the first terminal of the second capacitor C**2**, that is, the voltage of the first node, in accordance with voltage changes of the organic light emitting diode OLED. In other words, the compensating capacitor Cc controls the voltage of the first node N**1** in accordance with the deterioration of the organic light emitting diode OLED, and accordingly, it is possible to compensate for the deterioration of the organic light emitting diode OLED.

FIG. **9** is a diagram illustrating a pixel according to another embodiment of the present invention. The pixel shown in FIG. **9** is implemented by combining configurations of the pixel circuit **142'** shown in FIG. **7** and the compensator **144'** shown in FIG. **5**. The configurations of the pixel circuit **142'** and the compensator **144'** are included in the above description and their detailed description will not provided below.

FIG. **10** is a waveform diagram illustrating a method of driving the pixel shown in FIG. **9**. In explaining FIG. **10**, the configuration that is the same as those in the above embodiment is briefly described. Referring to FIG. **10**, first, the first scan signal is supplied to the n−2-th first scan line **S1***n*−2 and the emission control signal is supplied to the emission control line En. The initial power Vint is supplied to the first node N**1**, when the first scan signal is supplied to the n−2-th first scan line **S1***n*−2. As the emission control signal is supplied to the emission control line En, the third transistor M**3** is turned off.

Thereafter, as the first scan signal is supplied to the n−1-th first scan line **S1***n*−1, the fourth transistor M**4** and the fifth transistor M**5** are turned on.

As the fourth transistor M**4** is turned on, the first transistor M**1** is connected in a diode type, such that the voltage of the first node N**1** is set to the voltage obtained by subtracting the threshold voltage of the first transistor M**1** from the first power supply ELVDD. The first capacitor C**1** is charged to a voltage corresponding to the threshold voltage of the first transistor M**1**. As the fifth transistor M**5** is turned on, the voltage of the reference power supply Vsus is applied to the first terminal of the second capacitor C**2**.

Thereafter, supply of emission control signal to the emission control line En is stopped and the third transistor M**3** is turned off. Thereafter, the first scan signal is supplied to the n-th first scan line **S1***n*.

As the first scan signal is supplied to the n-th first scan line **S1***n*, the second transistor M**2** and the first compensating transistor Mc**1** are turned on.

A data signal from the data line Dm is supplied to the first terminal of the second capacitor C**2**, when the second transistor M**2** is turned on. The voltage of the first terminal of the second capacitor C**2** drops from the voltage of the reference power supply Vsus to the voltage of the data signal and the voltage of the first node N**1** also drops in accordance with the voltage drop of the first terminal of the second capacitor C**2**. As the first compensating transistor Mc**1** is turned on, the on-voltage of the organic light emitting diode OLED is supplied to the first terminal of the compensating capacitor Cc.

Thereafter, the first scan signal is supplied to the n+1-th first scan line **S1***n*+1, such that the second compensating transistor Mc**2** is turned on and the emission control signal is supplied to the emission control line En. As the emission control signal is supplied to the emission control line En, the third transistor M**3** is turned off.

As the second compensating transistor Mc2 is turned on, the off-voltage of the organic light emitting diode OLED is supplied to the first terminal of the compensating capacitor Cc. The compensating capacitor Cc controls voltage of the first terminal of the second capacitor C2, that is, the voltage of the first node, in accordance with voltage changes of the organic light emitting diode OLED. In other words, the compensating capacitor Cc controls the voltage of the first node N1 in accordance with the deterioration of the organic light emitting diode OLED, and accordingly, it is possible to compensate for the deterioration of the organic light emitting diode OLED.

Although a few embodiments of the present invention have been shown and described, it would be appreciated by those skilled in the art that changes may be made in this embodiment without departing from the principles and spirit of the invention, the scope of which is defined in the claims and their equivalents.

What is claimed is:

1. A pixel comprising:

an organic light emitting diode;

a pixel circuit including a driving transistor controlling an amount of current supplied to the organic light emitting diode; and

a compensator compensating for the deterioration of the organic light emitting diode by using on-voltage applied when current flows in the organic light emitting diode and off-voltage applied when current does not flow in the organic light emitting diode;

wherein the compensator includes:

a compensating capacitor having a second terminal connected to a gate electrode of the driving transistor; and

a first compensating transistor connected between a first terminal of the compensating capacitor and an anode electrode of the organic light emitting diode, wherein the on-voltage is supplied to the first terminal of the compensating capacitor while the first compensating transistor is turned on.

2. The pixel as claimed in claim **1**, wherein the driving transistor controls the current flowing to the organic light emitting diode in response to a data signal transmitted when a first scan signal is supplied to an i-th (i is a natural number) first scan line.

3. The pixel as claimed in claim **2**, wherein the first compensating transistor is turned on for a first period and a second period after the first period of one frame period, in response to a second scan signal supplied to an i-th second scan line.

4. The pixel as claimed in claim **3**, wherein the first period is a period when the first scan signal is supplied to the i-th first scan signal and the second period is a period when the first scan signal is supplied to an i+1-th first scan line.

5. The pixel as claimed in claim **3**, wherein the on-voltage is supplied to the first terminal of the compensating capacitor for the first period and the off-voltage is supplied to the first terminal of the compensating capacitor for the second period.

6. The pixel as claimed in claim **2**, wherein the compensator further includes a second compensating transistor that is connected between the first terminal of the compensating capacitor and the anode electrode of the organic light emitting diode and is turned on at a different time from the first compensating transistor.

7. The pixel as claimed in claim **6**, wherein the first compensating transistor is turned on when the first scan signal is supplied to the 1-th first scan line and the second compensating transistor is turned on when the first scan signal is supplied to the i+1-th first scan line.

8. The pixel as claimed in claim **7**, wherein the off voltage is supplied to the first terminal of the compensating capacitor when the second compensating transistor is turned on.

9. The pixel as claimed in claim **2**, wherein the pixel circuit includes:

a first capacitor connected between a gate electrode of the driving transistor and a first power supply;

a second transistor connected between the gate electrode of the driving transistor and a data line and turned on when the first scan signal is supplied to the i-th first scan line; and

a third transistor connected between a second electrode of the driving transistor and the organic light emitting diode and turned off when an emission control signal is supplied to an i-th emission control line.

10. The pixel as claimed in claim **9**, wherein the emission control signal supplied to the i-th emission control line overlaps the first scan signal supplied to an i+1-th first scan line.

11. The pixel as claimed in claim **9**, wherein the pixel circuit further includes:

a fourth transistor connected between the gate electrode and the second electrode of the driving transistor and turned on when the first scan signal is supplied to the i-1-th scan line;

a fifth transistor connected between the second electrode of the second transistor and a reference power supply and turned on when the first scan signal is supplied to the i-1-th first scan line; and

a sixth transistor connected between the gate electrode of the driving transistor and an initial power supply and turned on when the first scan signal is supplied to the i-2-th first scan line.

12. The pixel as claimed in claim **11**, wherein the reference power supply is set to a voltage higher than the data signal.

13. The pixel as claimed in claim **11**, wherein the initial power supply is set to a voltage lower than the data signal.

14. The pixel as claimed in claim **11**, wherein the emission control signal supplied to the i-th emission control line overlaps the first scan signal supplied to an i-2-th first scan line, an i−1-th first scan line, and an i+1-th first scan line, except for the first scan line supplied to the i-th first scan line.

15. The pixel as claimed in claim **11**, wherein the second terminal of the compensating capacitor is connected to the second electrode of the second transistor.

16. The pixel as claimed in claim **1**, wherein as the on-voltage of the organic light emitting diode increases due to deterioration of the organic light emitting diode, a ratio of the on-voltage to the off-voltage also increases.

17. An organic light emitting display device, comprising:

a scan driver sequentially supplying first scan signals to first scan lines;

a data driver supplying data signals to data lines to be synchronized with the first scan signals; and

pixels positioned at intersections of the first scan lines and the data lines,

wherein the pixels positioned in an i-th (i is a natural number) horizontal line each include:

a pixel circuit including a driving transistor controlling an amount of current supplied to the organic light emitting diode; and

a compensator compensating deterioration of the Organic light emitting diode by using on-voltage applied when current flows in the organic light emitting diode and off-voltage applied when current does not flow in the organic light emitting diode, and the compensator includes:

a compensating capacitor having a second terminal connected to a gate electrode of the driving transistor; and

a first compensating transistor connected between a first terminal of the compensating capacitor and an anode electrode of the organic light emitting diode, wherein the on-voltage is supplied to the first terminal of the compensating capacitor while the first compensating transistor is turned on.

18. The organic light emitting display device as claimed in claim **17**, wherein second scan lines are formed in parallel with the first scan lines, and the first compensating transistor is turned on when a second scan signal is supplied to an i-th second scan line.

19. The organic light emitting display device as claimed in claim **18**, wherein the scan driver supplies a first second scan signal to the i-th second scan line to overlap with the first scan signal supplied to an i-th first scan line, and supplies a second second scan signal to the i-th second scan line to overlap the second scan signal supplied to an i+1-th scan line.

20. The organic light emitting display device as claimed in claim **17**, wherein the compensator further includes a second compensating transistor that is connected between the first terminal of the compensating capacitor and the anode electrode of the organic light emitting diode and is turned on at a different time from the first compensating transistor.

21. The organic light emitting display device as claimed in claim **17**, wherein the first compensating transistor is turned on when the first scan signal is supplied to the 1-th first scan line and the second compensating transistor is turned on when the first scan signal is supplied to the i+1-th first scan line.

22. The organic light emitting display device as claimed in claim **17**, wherein the pixel circuit includes:

a first capacitor connected between a gate electrode of the driving transistor and a first power supply;

a second transistor connected between the gate electrode of the driving transistor and a data line and turned on when the first scan signal is supplied to the i-th first scan line; and

a third transistor connected between a second electrode of the driving transistor and the organic light emitting diode and turned off when an emission control signal is supplied to an i-th emission control line.

23. The organic light emitting display device as claimed in claim **22**, wherein the scan driver supplies the emission control signal to the i-th emission control line to overlap the first scan signal supplied to the i+1-th first scan line.

24. The organic light emitting display device as claimed in claim **22**, wherein the pixel circuit further includes:

a fourth transistor connected between the gate electrode and the second electrode of the driving transistor and turned on when the first scan signal is supplied to the i−1-th scan line;

a fifth transistor connected between the second electrode of the second transistor and a reference power supply and turned on when the first scan signal is supplied to the i−1-th first scan line; and

a sixth transistor connected between the gate electrode of the driving transistor and an initial power supply and turned on when the first scan signal is supplied to the i−2-th first scan line.

25. The organic light emitting display device as claimed in claim **24**, wherein the scan driver supplies an emission control signal to the i-th emission control line to overlap the first scan signals supplied to the i−2-th first scan line, the i−1-th scan line, and the i+1-th first scan line.

26. The organic light emitting display device as claimed in claim **25**, wherein the scan driver supplies the emission control signal to the i-th emission control line not to overlap the first scan signal supplied to the i-th first scan line.

27. The organic light emitting display device as claimed in claim **17**, wherein as the on-voltage of the organic light emitting diode increases due to a deterioration of the organic light emitting diode, a ratio of the on-voltage to the off-voltage also increases.

* * * * *

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摘要(译)

一种像素，用于补偿有机发光二极管的劣化，该像素包括有机发光二极管;像素电路，包括控制提供给有机发光二极管的电流量的驱动晶体管;补偿器通过使用电流在有机发光二极管中流动时施加的导通电压和在电流不流入有机发光二极管时施加的截止电压来补偿有机发光二极管的劣化;其中补偿器包括：补偿电容器，具有连接到驱动晶体管的栅极的第二端子;第一补偿晶体管连接在补偿电容器的第一端和有机发光二极管的阳极之间。