US 20080158481A1

(19) **United States**

(12) **Patent Application Publication**

LEE et al.

(10) **Pub. No.: US 2008/0158481 A1**

(43) **Pub. Date: Jul. 3, 2008**

(54) **SENSOR, THIN FILM TRANSISTOR ARRAY PANEL, AND DISPLAY PANEL INCLUDING THE SENSOR**

(75) Inventors: **Ki-Chan LEE**, Suwon-si (KR); **Hyun-Seok KO**, Seoul (KR); **Yun-Jae PARK**, Yongin-si (KR); **Seung-Hwan MOON**, Yongin-si (KR)

Correspondence Address:
CANTOR COLBURN, LLP
20 Church Street, 22nd Floor
Hartford, CT 06103

(73) Assignee: **SAMSUNG ELECTRONICS CO., LTD.**, Suwon-si (KR)

(21) Appl. No.: **12/045,963**

(22) Filed: **Mar. 11, 2008**

Related U.S. Application Data

(62) Division of application No. 11/267,000, filed on Nov. 4, 2005.

(30) **Foreign Application Priority Data**

Jan. 19, 2005 (KR) 10-2005-0004879

Publication Classification

(51) **Int. Cl.**

G02F 1/1333	(2006.01)
G01N 27/04	(2006.01)
H01L 29/00	(2006.01)

(52) **U.S. Cl.** **349/72**; 324/71.5; 257/72

(57) **ABSTRACT**

A sensor is provided, which includes a substrate, an insulating layer formed on the substrate, a semiconductor formed on the insulating layer, an ohmic contact formed on the semiconductor, a sensor input electrode and a sensor output electrode formed on the ohmic contact, and a passivation layer formed on the sensor input electrode and the sensor output electrode. A sensor control electrode may also be formed between the substrate and the insulating layer. A thin film transistor array panel including the sensor and a liquid crystal display panel including the sensor are further provided.

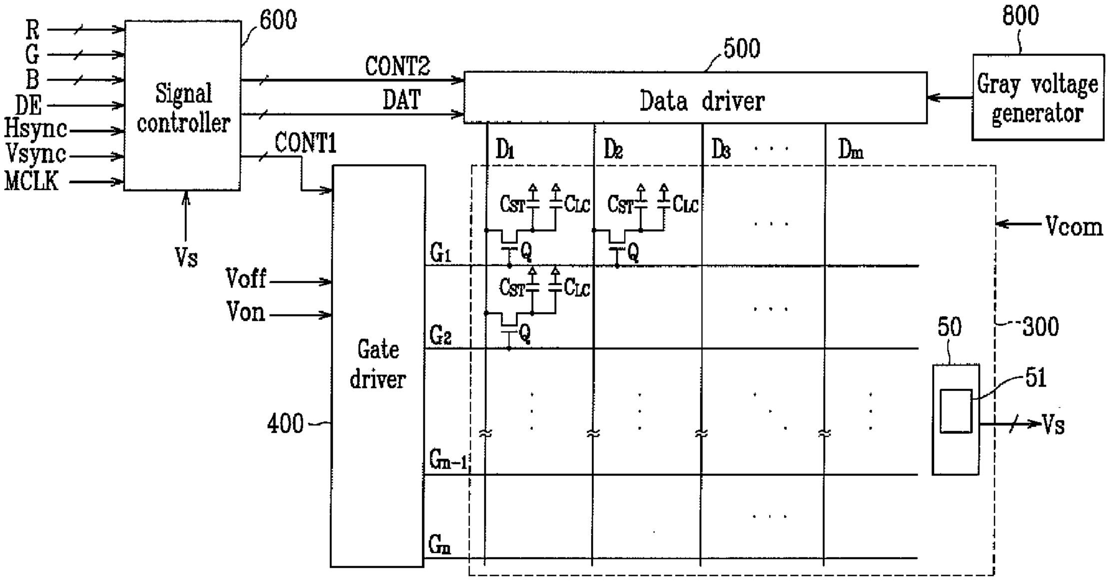


FIG. 1

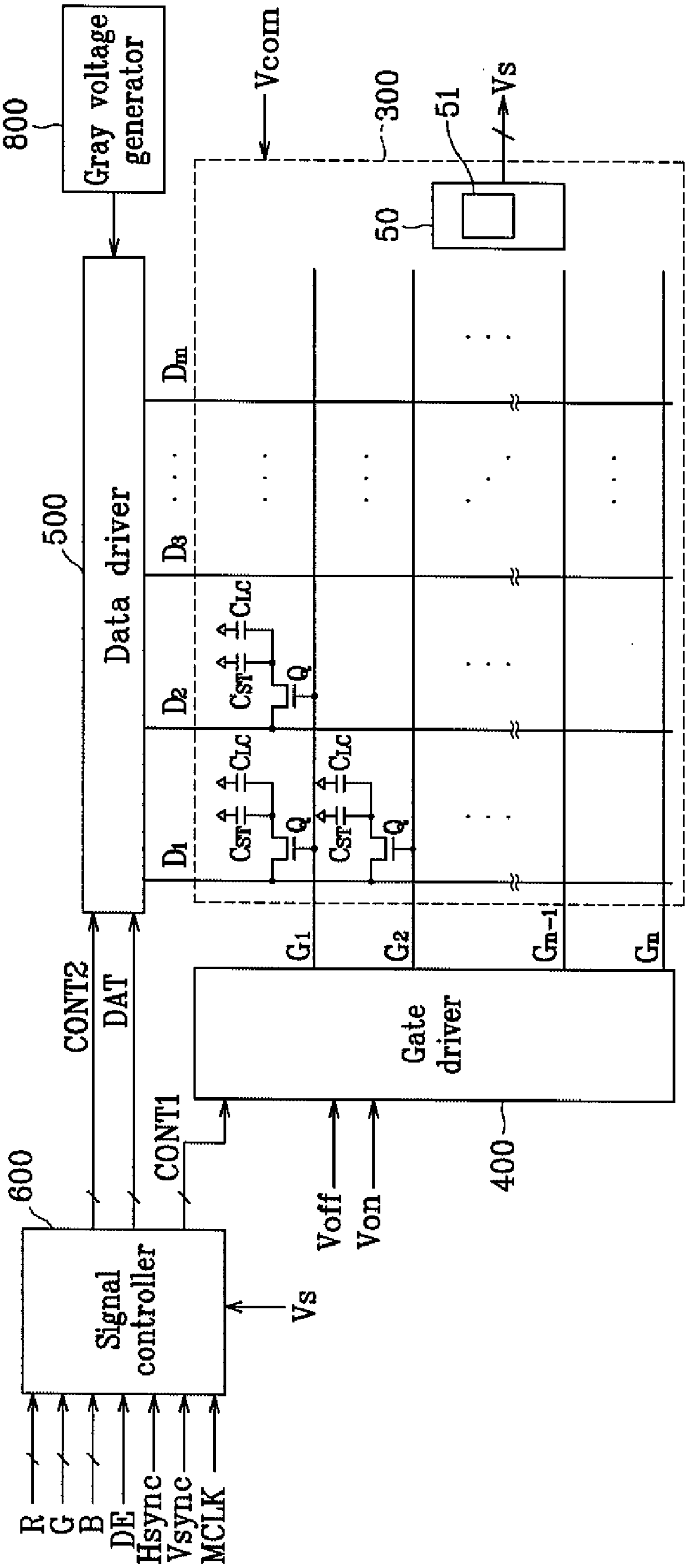

800
Gray voltage generator
500
Data driver
Vcom
300
51
Vs
50
D1
D2
D3
Dm
CST
CLC
Q
G1
G2
Gn-1
Gn
Gate driver
400
CONT2
DAT
CONT1
Voff
Von
600
Signal controller
Vs
R
G
B
DE
Hsync
Vsync
MCLK

FIG. 2

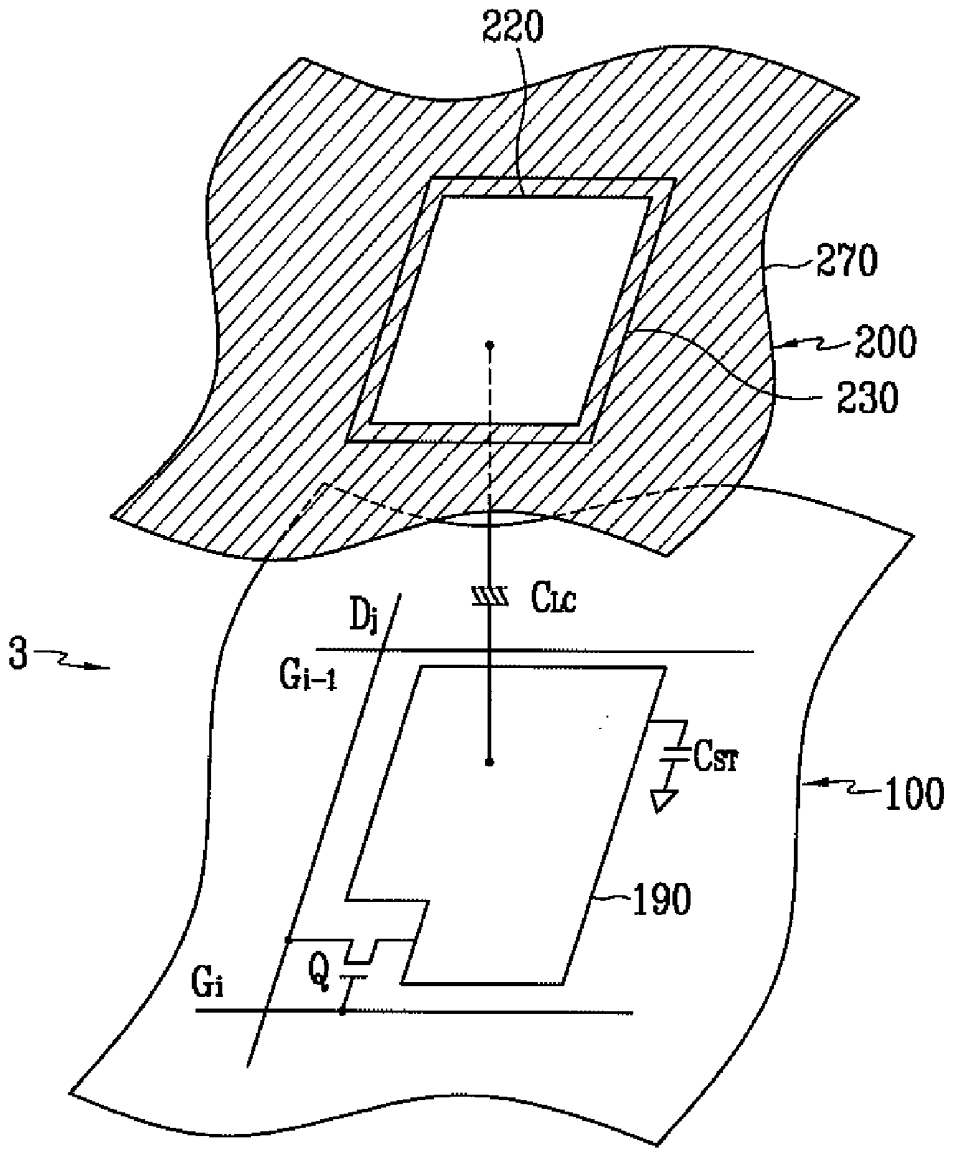


FIG. 3

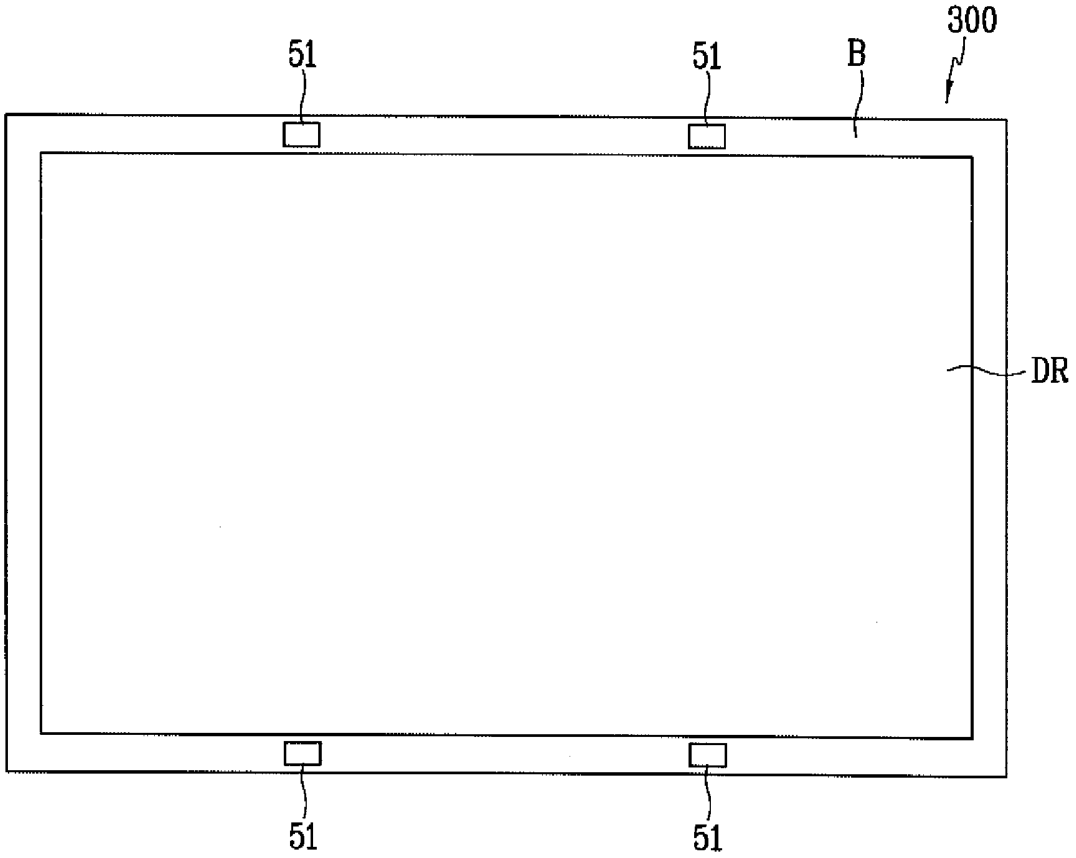


FIG. 4

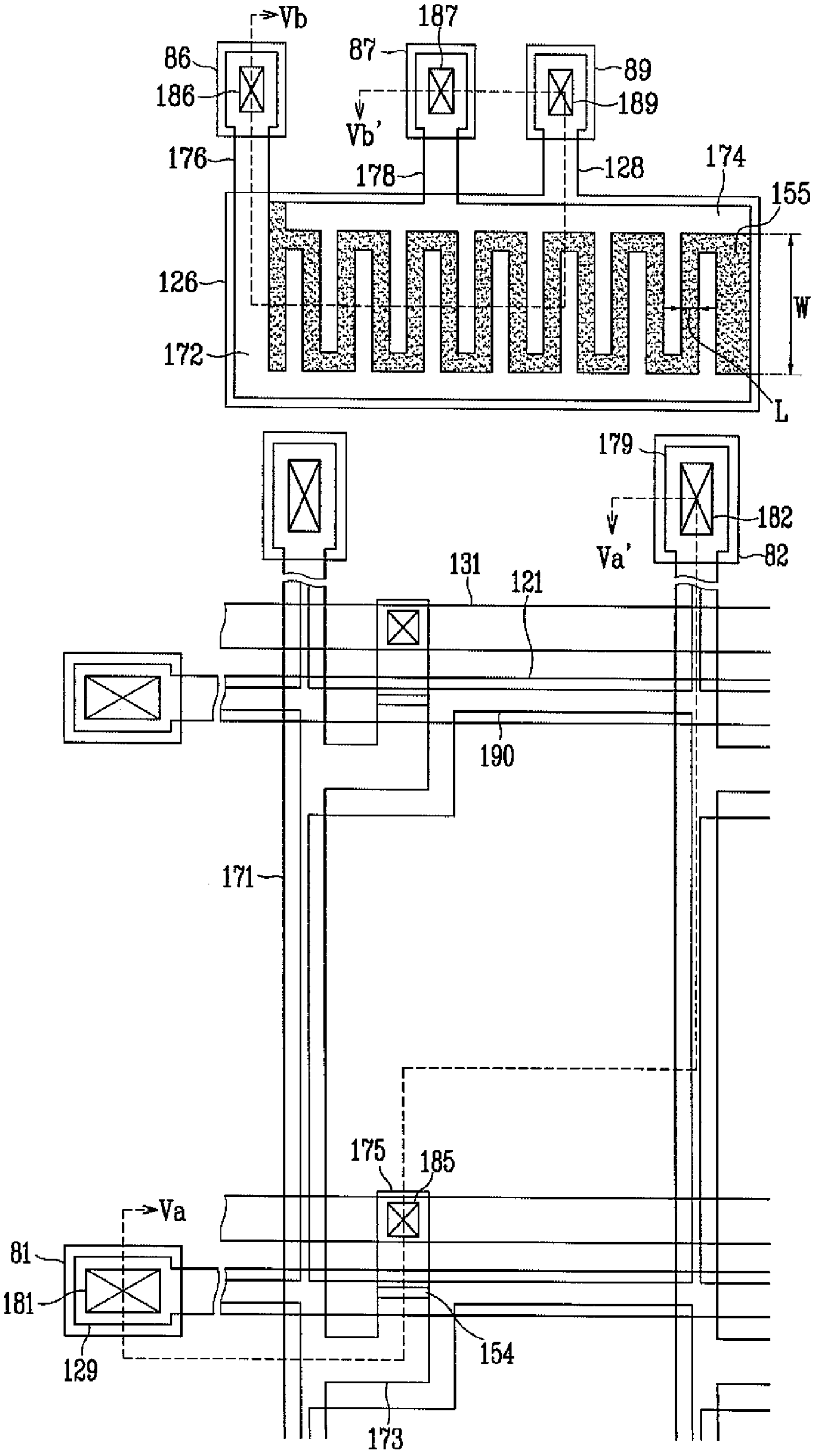

Vb
86
186
187
87
Vb'
89
189
176
178
128
174
155
126
W
172
L
179
182
Va'
82
131
121
190
171
175
185
Va
81
181
129
154
173

FIG. 5A

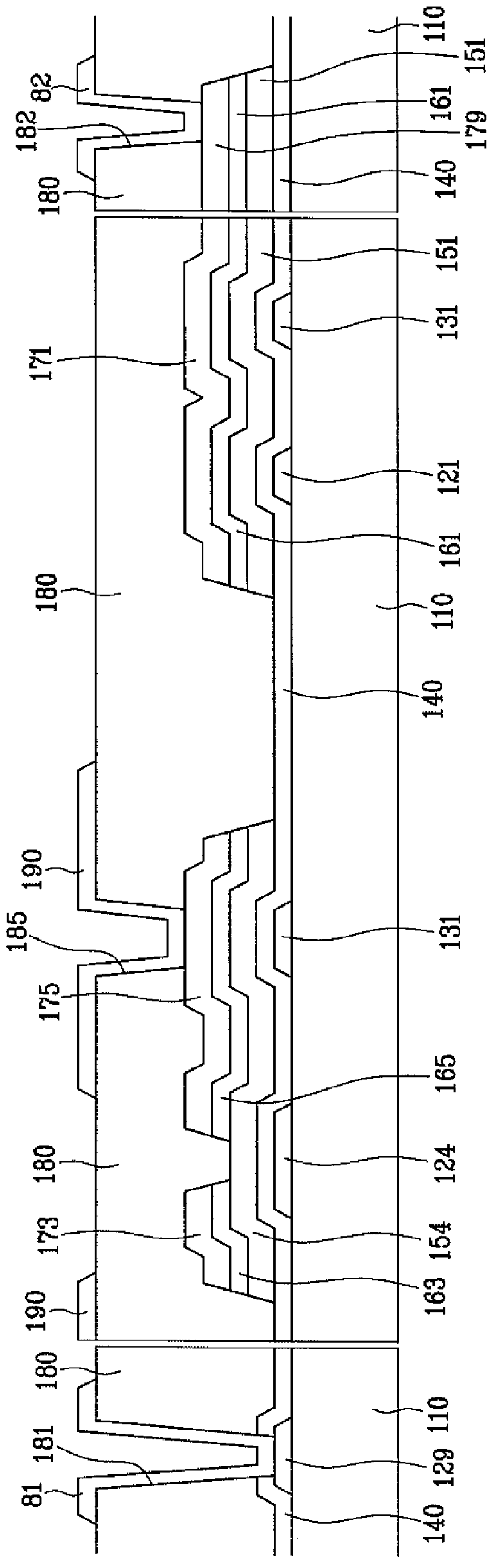

81
181
180
140
129
110
190
173
163
154
180
124
165
175
185
131
190
140
110
180
161
121
131
171
151
180
182
82
140
179
161
151
110

FIG.5B

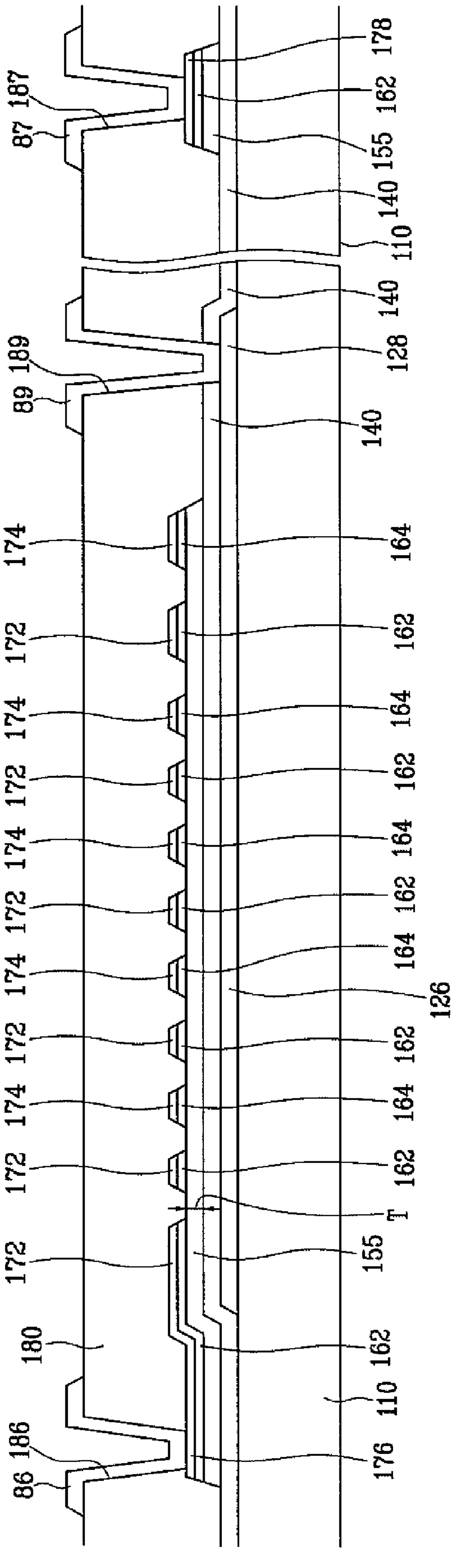

86
186
180
172
172
174
172
174
172
174
172
174
172
174
89
189
87
187
176
110
162
155
T
162
164
162
164
126
162
164
162
164
162
164
140
128
140
110
140
155
162
178

FIG. 6A

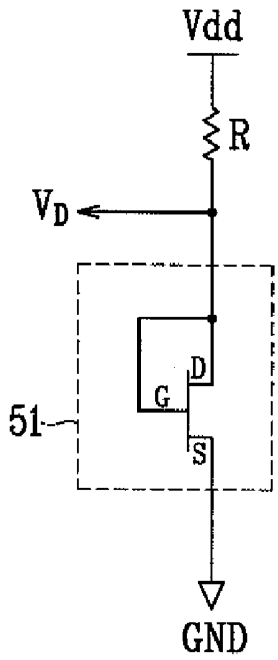


FIG. 6B

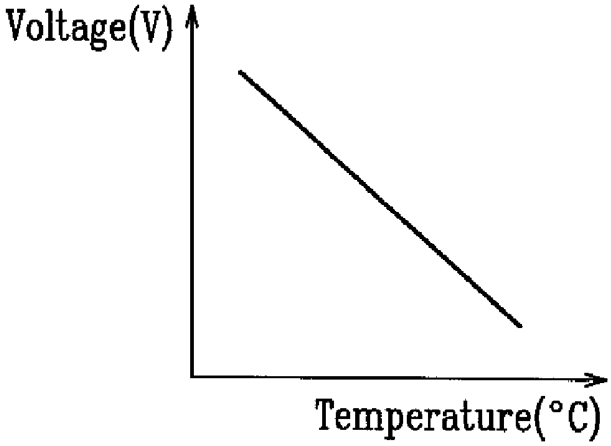


FIG. 7A

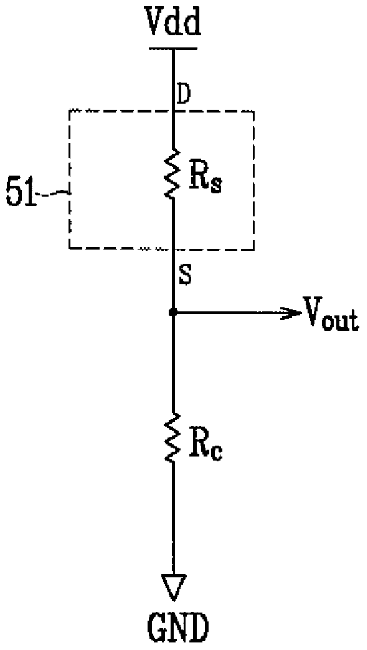


FIG. 7B

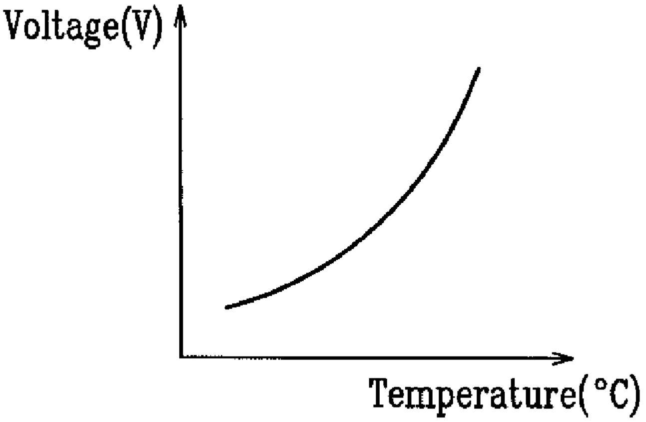


FIG. 8A

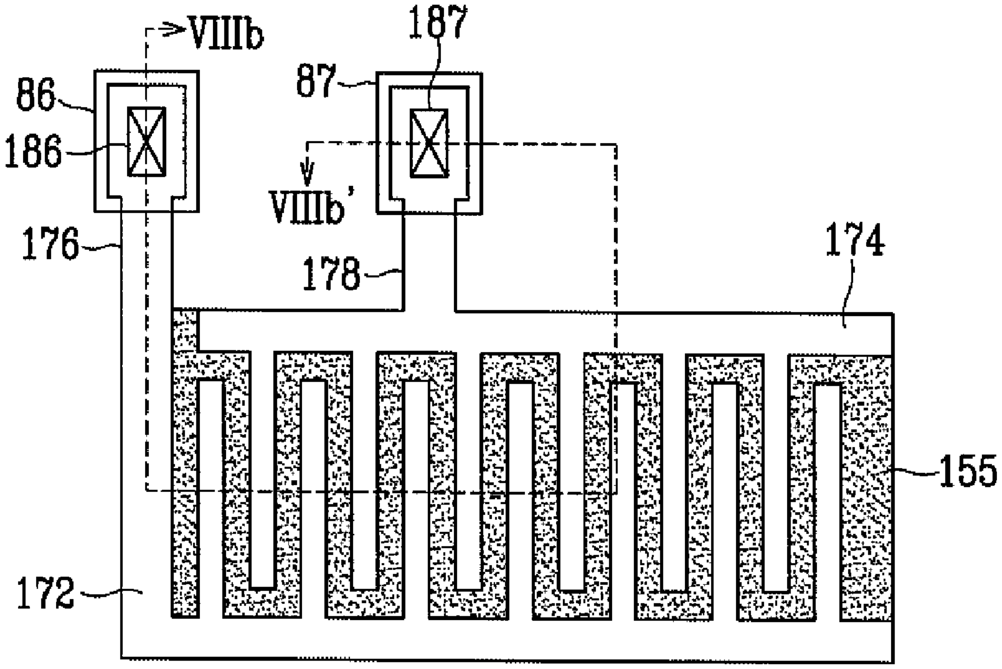


FIG.8B

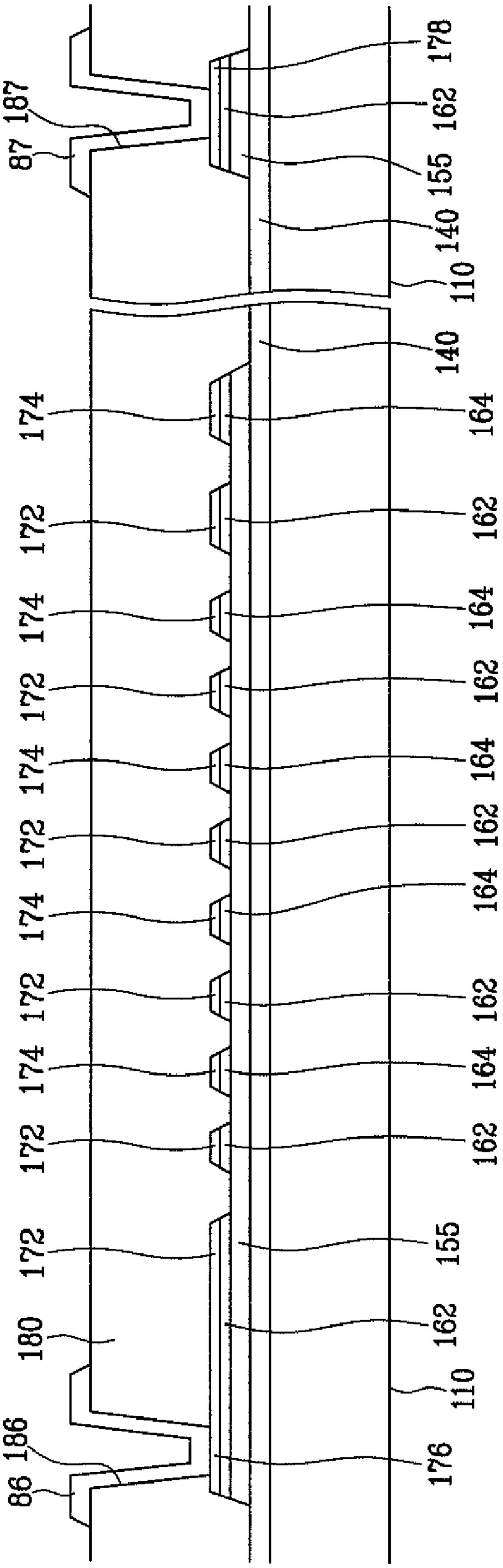

86
186
180
172
172
174
172
174
172
174
172
174
172
174
87
187
176
110
162
155
162
164
162
164
162
164
162
164
162
164
140
110
140
155
162
178

FIG. 9

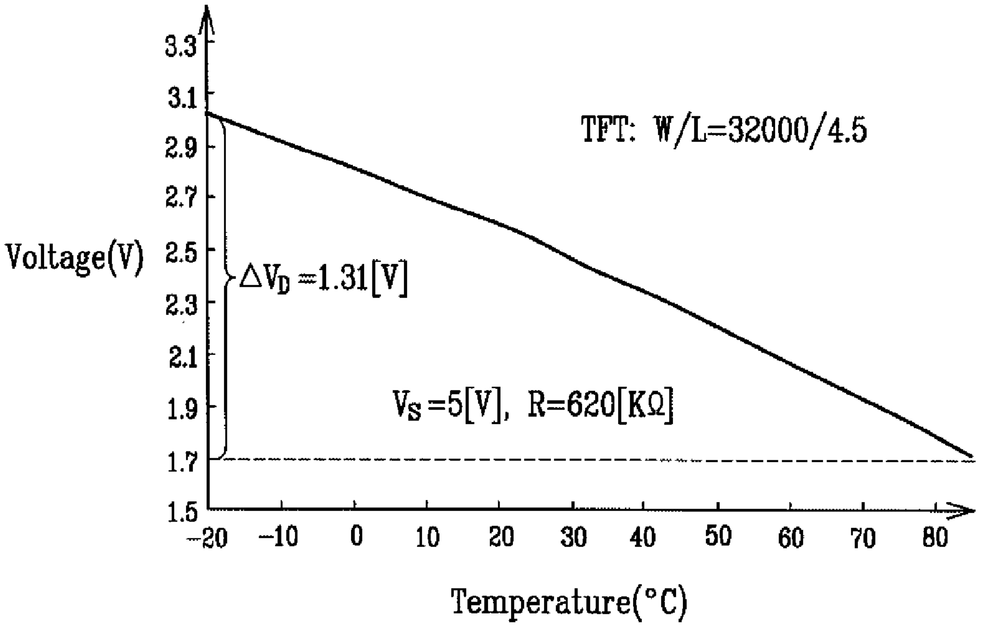
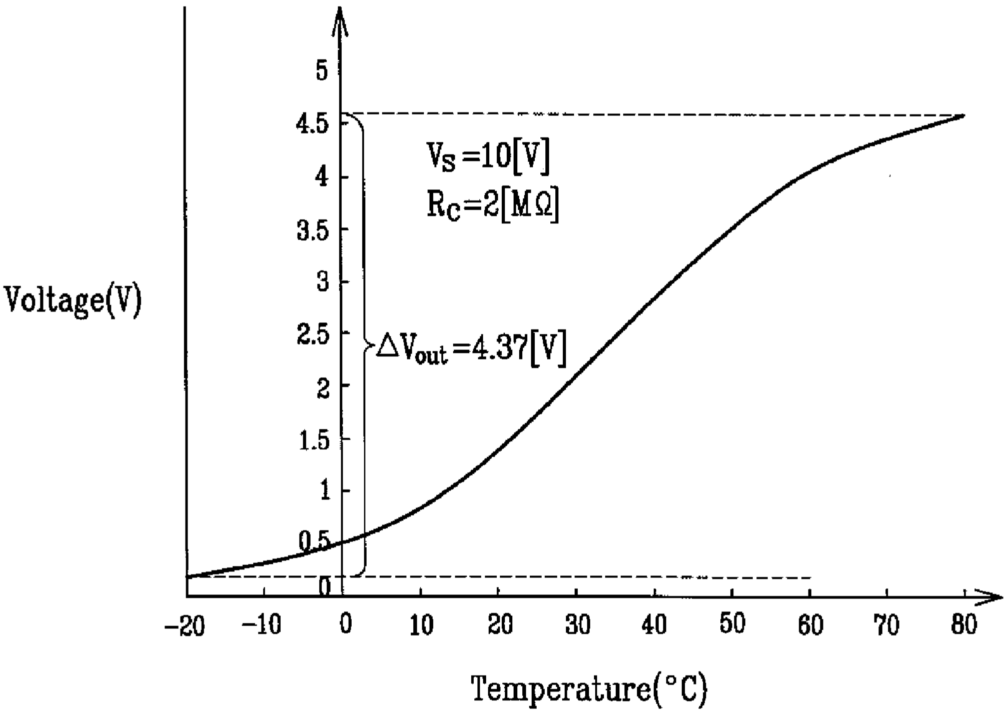

TFT: W/L=32000/4.5
Voltage(V)
3.3
3.1
2.9
2.7
2.5
2.3
2.1
1.9
1.7
1.5
ΔV_D =1.31[V]
V_S =5[V], R=620[KΩ]
-20
-10
0
10
20
30
40
50
60
70
80
Temperature(°C)

FIG. 10


Voltage(V)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
V_S =10[V]
R_C=2[MΩ]
ΔV_out=4.37[V]
-20
-10
0
10
20
30
40
50
60
70
80
Temperature(°C)

SENSOR, THIN FILM TRANSISTOR ARRAY PANEL, AND DISPLAY PANEL INCLUDING THE SENSOR

[0001] This application claims priority to Korean Patent Application No. 10-2005-0004879, filed on Jan. 19, 2005 and all the benefits accruing therefrom under 35 U.S.C. §119, and the contents of which in its entirety are herein incorporated by reference.

BACKGROUND OF THE INVENTION

[0002] (a) Field of the Invention

[0003] The present invention relates to a sensor, a thin film transistor array panel including the sensor, and a display panel including the sensor. More particularly, the present invention relates to an improved temperature sensor, a thin film transistor array panel including the temperature sensor, and a display panel including the temperature sensor.

[0004] (b) Description of the Related Art

[0005] Display devices used for monitors of computers and television sets generally include self-emitting display devices such as organic light emitting displays ("OLEDs"), vacuum fluorescent displays ("VFDs"), field emission displays ("FEDs"), and plasma panel displays ("PDPs"), and non-emitting display devices such as liquid crystal displays ("LCDs") requiring an external light source.

[0006] An LCD includes two panels provided with field-generating electrodes and a liquid crystal ("LC") layer having dielectric anisotropy interposed therebetween. The field-generating electrodes supplied with electric voltages generate an electric field across the LC layer, and the light transmittance of the LC layer varies depending on the strength of the applied field, which can be controlled by the applied voltages. Accordingly, desired images are displayed by adjusting the applied voltages.

[0007] The light for an LCD may be provided by lamps equipped at the LCD or may instead be natural light.

[0008] Since optical characteristics of the liquid crystal within the LC layer are changed based on temperature, a temperature variation of the LCD has to be considered for improving reliability thereof.

[0009] That is, since the optical characteristics such as refractive index, dielectric constant, coefficient of elasticity, and viscosity of the liquid crystal are in inverse proportion to thermalization energy of liquid crystal molecules within the LC layer, values of the optical characteristics decrease as the temperature of the liquid crystal becomes higher. Thus, to optimize a state of the liquid crystal for good driving of the LCD, the temperature variation of the LCD due to internal heating and temperature within the ambient environment has to be detected.

[0010] A temperature sensor is disposed on a printed circuit board ("PCB") mounted with a plurality of driving circuits to detect a temperature variation of the LCD. However, the PCB is generally disposed on a rear side of the LCD, on which the lamps and electric elements generating heat are disposed, instead of a front side thereof, on which the LC layer is installed, adjacent to the outside. Thus, the temperature sensor detects a temperature at the rear side which has a large temperature deviation caused by the heat. As a result, since the detected temperature by the temperature sensor has a large difference with respect to a temperature of the LC layer, temperature compensation of the LCD based on the temperature of the LC layer is not precisely achieved. In addition, since the temperature sensor is separately installed on the PCB, design redundancy of the LCD and manufacturing cost are increased.

BRIEF SUMMARY OF THE INVENTION

[0011] The present invention solves the problems of conventional techniques.

[0012] In an exemplary embodiment of the present invention, a sensor is provided, which includes a sensor control electrode formed on a substrate, an insulating layer formed on the sensor control electrode, a semiconductor formed on the insulating layer, an ohmic contact formed on the semiconductor, a sensor input electrode and a sensor output electrode formed on the ohmic contact, and a passivation layer formed on the sensor input electrode and the sensor output electrode.

[0013] The insulating layer may be further formed on portions of the substrate not covered by the sensor control electrode. The passivation layer may be further formed on portions of the semiconductor not covered by the ohmic contact, sensor input electrode, or sensor output electrode, and on portions of the insulating layer not covered by the semiconductor, ohmic contact, sensor input electrode, and sensor output electrode.

[0014] The sensor input electrode may include a plurality of first branches spaced by a predetermined distance and formed as a comb, and the sensor output electrode includes a plurality of second branches spaced by a predetermined distance and formed as a comb, wherein the first branches are engaged with the second branches through the semiconductor, respectively. The first branches may be alternately arranged with respect to the second branches.

[0015] The sensor may include a first signal line connected to the sensor control electrode, a second signal line connected to the sensor input electrode, and a third signal line connected to the sensor output electrode. The passivation layer may be further formed on the sensor control electrode and may include a first contact hole exposing a portion of the first signal line, a second contact hole exposing a portion of the second signal line, and a third contact hole exposing a portion of the third signal line.

[0016] The sensor may further include contact assistants connecting the first signal line and second signal line through the first and second contact holes, respectively, and the contact assistants may be made of indium tin oxide ("ITO") or indium zinc oxide ("IZO"). The second signal line may be connected to a voltage through the second contact hole, and the voltage may be a ground voltage. The third signal line may output a sensing signal, and the semiconductor may be made of amorphous silicon. The sensor may thus be a diode type of temperature sensor.

[0017] In a further embodiment of the present invention, a sensor is provided, which includes an insulating layer formed on a substrate, a semiconductor formed on the insulating layer, an ohmic contact formed on the semiconductor, a sensor input electrode and a sensor output electrode formed on the ohmic contact, and a passivation layer formed on the sensor input electrode and the sensor output electrode.

[0018] The insulating layer may be further formed on portions of the substrate not covered by the sensor control electrode. The passivation layer may be further formed on portions of the semiconductor not covered by the ohmic contact, sensor input electrode, or sensor output electrode, and on portions of the insulating layer not covered by the semiconductor, ohmic contact, sensor input electrode, and sensor output electrode.

[0019] The sensor input electrode may include a plurality of first branches spaced by a predetermined distance and formed as a comb and the sensor output electrode may include a plurality of second branches spaced by a predetermined distance and formed as a comb, wherein the first branches are engaged with the second branches through the semiconductor, respectively. The first branches may be alternately arranged with respect to the second branches.

[0020] The sensor may further include a sensor input line connected to the sensor input electrode and a sensor output line connected to the sensor output electrode, and the passivation layer may include a first contact hole exposing a portion of the sensor input line and a second contact hole exposing a portion of the sensor output line.

[0021] The sensor input line may be connected to a voltage through the first contact hole, and the voltage may be a ground. The sensor output line may output a sensing signal. The sensor may thus be a resistor type of temperature sensor.

[0022] In a still further embodiment of the present invention, a thin film transistor array panel is provided, which includes a gate line and a sensor control electrode formed on a substrate, an insulating layer formed on the gate line and the sensor control electrode, and a semiconductor formed on the insulating layer, an ohmic contact formed on the semiconductor. A data line, a drain electrode, a sensor input electrode, and a sensor output electrode are formed on the ohmic contact, and a passivation layer is formed on the data line, the drain electrode, the sensor input electrode, and the sensor output electrode.

[0023] The sensor input electrode may include a plurality of first branches spaced by a predetermined distance and formed as a comb and the sensor output electrode may include a plurality of second branches spaced by a predetermined distance and formed as a comb, wherein the first branches are engaged with the second branches through the semiconductor, respectively.

[0024] The panel may further include a sensor control line connected to the sensor control electrode, a sensor input line connected to the sensor input electrode, and a sensor output line connected to the sensor output electrode. The passivation layer may further be formed on the sensor control electrode and may include a first contact hole exposing a portion of the sensor control line, a second contact hole exposing a portion of the sensor input line, and a third contact hole exposing a portion of the sensor output line, and it may further include a fourth contact hole exposing a portion of the drain electrode.

[0025] The panel may further include a pixel electrode connected to the drain electrode through the fourth contact hole, and contact assistants connected to the sensor control line, the sensor input line, and the sensor output line through the first, second, and third contact holes, respectively. The contact assistants may be formed on the same layer as the pixel electrode.

[0026] The sensor control electrode, the sensor input electrode, and the sensor output electrode may be formed on a border of the panel. The sensor control electrode, sensor input electrode, and sensor output electrode form part of a diode type of temperature sensor.

[0027] In a still further embodiment of the present invention, a thin film transistor array panel is provided, which includes a gate line formed on a substrate, an insulating layer formed on the gate line, a semiconductor formed on the insulating layer, an ohmic contact formed on the semiconductor. A data line, a drain electrode, a sensor input electrode, and a sensor output electrode are formed on the ohmic contact, and a passivation layer is formed on the data line, the drain electrode, the sensor input electrode, and the sensor output electrode.

[0028] The sensor input electrode includes a plurality of first branches spaced by a predetermined distance and formed as a comb, and the sensor output electrode includes a plurality of second branches spaced by a predetermined distance and formed as a comb, wherein the first branches are engaged with the second branches through the semiconductor, respectively.

[0029] The panel may further include a sensor input line connected to the sensor input electrode and a sensor output line connected to the sensor output electrode, wherein the passivation layer comprises a first contact hole exposing a portion of the sensor input line and a second contact hole exposing a portion of the sensor output line. The passivation layer may further include a third contact hole exposing a portion of the drain electrode.

[0030] The panel may further include a pixel electrode connected to the drain electrode through the third contact hole. The panel may further include contact assistants connected to the sensor input line and the sensor output line through the first and second contact holes, respectively, and the contact assistants may be formed on the same layer as the pixel electrode.

[0031] The sensor input electrode and the sensor output electrode may be formed on a border of the panel. The sensor input electrode and the sensor output electrode form part of a resistor type of temperature sensor.

[0032] In yet a further embodiment of the present invention, a liquid crystal display panel includes a first panel, a second panel, a liquid crystal layer disposed between the first panel and the second panel, and a temperature sensor formed on a first surface of the first panel, the first surface of the first panel facing the liquid crystal layer.

[0033] The first panel may be a thin film transistor array panel. The temperature sensor may be formed on a non-display region of the first panel. A plurality of temperature sensors may be formed on the first surface of the first panel.

[0034] The first panel may include at least one data line, and the temperature sensor may include a sensor input electrode and a sensor output electrode formed within a same layer of the first panel as the data line. The first panel may include a substrate and at least one gate line formed on the substrate, and the temperature sensor may include a sensor control electrode formed on the substrate within a same layer of the first panel as the gate line.

BRIEF DESCRIPTION OF THE DRAWINGS

[0035] The present invention will become more apparent by describing preferred embodiments thereof in detail with reference to the accompanying drawings, in which:

[0036] FIG. **1** is a block diagram of an exemplary embodiment of an LCD according to the present invention;

[0037] FIG. **2** is an equivalent circuit diagram of an exemplary embodiment of a pixel of an LCD according to the present invention;

[0038] FIG. **3** is a plan view of an exemplary embodiment of an LCD according to the present invention;

[0039] FIG. **4** is a layout view of an exemplary embodiment of an LCD according to the present invention;

[0040] FIG. **5**A is a sectional view of the LCD shown in FIG. **4** taken along line VA-VA';

[0041] FIG. **5**B is a sectional view of the LCD shown in FIG. **4** taken along line VB-VB';

[0042] FIG. **6**A is an equivalent circuit diagram of one exemplary embodiment of a diode type of temperature sensor that may be used in an embodiment of the present invention;

[0043] FIG. **6**B is a graph showing a characteristic of an output voltage with respect to a temperature variation of the diode type of temperature sensor shown in FIG. **6**A;

[0044] FIG. **7**A is an equivalent circuit diagram of one exemplary embodiment of a resistor type of temperature sensor that may be used in an embodiment of the present invention;

[0045] FIG. **7**B is a graph showing a characteristic of an output voltage with respect to a temperature variation of the resistor type of temperature shown in FIG. **7**A;

[0046] FIG. **8**A is a layout view of another exemplary embodiment of a resistor type of temperature sensor according to the present invention;

[0047] FIG. **8**B is sectional view of the resistor type of temperature sensor shown in FIG. **8**A taken along line VIIIB-VIIIB';

[0048] FIG. **9** is a graph showing an output voltage with respect to a temperature variation in an exemplary embodiment of a diode type of temperature sensor according to the present invention; and

[0049] FIG. **10** is a graph showing an output voltage with respect to a temperature variation in an exemplary embodiment of a resistor type of temperature sensor according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0050] The present invention will be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein.

[0051] In the drawings, the thickness of layers and regions are exaggerated for clarity. Like numerals refer to like elements throughout. It will be understood that when an element such as a layer, film, region, substrate, or panel is referred to as being "on" another element, it can be directly on the other element or intervening elements may also be present. In contrast, when an element is referred to as being "directly on" another element, there are no intervening elements present.

[0052] Sensors and thin film transistor ("TFT") array panels having a sensor according to embodiments of the present invention will be described with reference to the drawings.

[0053] FIG. **1** is a block diagram of an exemplary embodiment of an LCD according to the present invention, FIG. **2** is an equivalent circuit diagram of an exemplary embodiment of a pixel of an LCD according to the present invention, and FIG. **3** is a plan view of an exemplary embodiment of an LCD according to the present invention.

[0054] Referring to FIG. **1**, an LCD includes an LC panel assembly **300**, a gate driver **400** and a data driver **500** that are connected to the LC panel assembly, a gray voltage generator **800** connected to the data driver **500**, a temperature sensing unit **50**, and a signal controller **600** controlling the above-described elements.

[0055] With additional reference to the circuital views of FIGS. **1** and **2**, the LC panel assembly **300** includes a lower panel **100** as a thin film transistor ("TFT") panel, an upper panel **200** as a color filter panel, where the panels **100** and **200** face each other, and a liquid crystal layer **3** interposed therebetween. The LC panel assembly **300** further includes a plurality of display signal lines G**1**-Gn and D**1**-Dm and a plurality of pixels connected thereto and arranged substantially in a matrix.

[0056] The display signal lines G**1**-Gn and D**1**-Dm are provided on the lower panel **100**, and include a plurality of gate lines G**1**-Gn transmitting gate signals (also referred to as "scanning signals") and a plurality of data lines D**1**-Dm transmitting data signals. The gate lines G**1**-Gn extend substantially in a row direction and are substantially parallel to each other, while the data lines D**1**-Dm extend substantially in a column direction and are substantially parallel to each other.

[0057] Each pixel includes a switching element Q connected to the display signal lines G**1**-Gn and D**1**-Dm, and an LC capacitor C_{LC} and a storage capacitor C_{ST} that are connected to the switching element Q. In an alternative embodiment, the storage capacitor C_{ST} may be omitted if it is unnecessary.

[0058] The switching element Q, such as a TFT, is provided on the lower panel **100** and has three terminals including a control terminal connected to one of the gate lines G**1**-Gn, an input terminal connected to one of the data lines D**1**-Dm, and an output terminal connected to the LC capacitor C_{LC} and the storage capacitor C_{ST}.

[0059] The LC capacitor C_{LC} includes a pixel electrode **190**, provided on the lower panel **100**, and a common electrode **270**, provided on the upper panel **200**, as two terminals. The LC layer **3**, interposed between the two electrodes **190** and **270**, functions as a dielectric of the LC capacitor C_{LC}. The pixel electrode **190** is connected to the switching element Q, and the common electrode **270** covers an entire surface, or substantially the entire surface, of the upper panel **200** and is supplied with a common voltage Vcom. Alternatively, the pixel electrode **190** and the common electrode **270** may both be provided on the lower panel **100**, and at least one of the pixel electrode **190** and the common electrode **270** may have shapes of bars or stripes.

[0060] The storage capacitor C_{ST} is an auxiliary capacitor for the LC capacitor C_{LC}. The storage capacitor C_{ST} includes the pixel electrode **190** and a separate signal line (not shown), which is provided on the lower panel **100**, overlaps the pixel electrode **190** via an insulator. The separate signal line is supplied with a predetermined voltage such as the common voltage Vcom. Alternatively, the storage capacitor C_{ST} includes the pixel electrode **190** and an adjacent gate line called a previous gate line, which overlaps the pixel electrode **190** via an insulator.

[0061] For color display, each pixel uniquely represents one of three colors such as red, green, and blue colors or sequentially represents the three colors in time, thereby obtaining a desired color. The three colors may be primary colors, or other colors not specifically described herein. FIG. **2** shows an example in which each pixel includes a color filter **230** representing one of the three colors in an area of the upper panel **200** facing an associated pixel electrode **190**. Alternatively, the color filter **230** may be provided on or under the pixel electrode **190** of the lower panel **100**.

[0062] As shown in FIG. **2**, a light blocking film **220**, such as a black matrix for preventing light loss, is formed on the upper panel **200** and has openings in areas corresponding to the pixel electrode **190** or the color filter **230**.

[0063] A pair of polarizers (not shown) polarizing the light emitted from a light source unit (not shown) is attached on the outer surfaces of the panels **100** and **200** of the panel assembly **300**, respectively. Alternatively, one or more polarizers may be provided.

[0064] The gray voltage generator **800** generates a plurality of gray scale voltages relating to the brightness of the LCD. The gray voltage generator **800** generates two sets of a plurality of gray voltages related to the transmittance of the pixels, and provides the gray voltages to the data driver **500**. The data driver **500** applies the gray voltages, which are selected for each data line D**1**-Dm, by control of the signal controller **600**, to the data line respectively as a data signal. The gray voltages in one set have a positive polarity with respect to the common voltage Vcom, while those in the other set have a negative polarity with respect to the common voltage Vcom.

[0065] The gate driver **400** is connected to the gate lines G**1**-Gn of the LC panel assembly **300**, synthesizes the gate-on voltage Von and the gate off voltage Voff input from an external device to generate gate signals having combinations of the gate-on voltage Von and the gate-off voltage Voff for application to the gate lines G**1**-Gn. The gate driver **400** may include a plurality of integrated circuits ("ICs").

[0066] The data driver **500** is connected to the data lines D**1**-Dm of the LC panel assembly **300**, applies data voltages selected from the gray voltages supplied from the gray voltage generator **800** to the data lines D**1**-Dm, and may also include a plurality of ICs.

[0067] The gate driving circuits of the gate driver **400** or the data driving circuit of the data driver **500** may be implemented as an integrated circuit ("IC") chip mounted on the LC panel assembly **300**, such as in a "chip on glass" ("COG") type of mounting, or on a flexible printed circuit ("FPC") film of a tape carrier package ("TCP") type, which are attached to the LC panel assembly **300**. Alternately, the drivers **400** and **500** may be integrated into the LC panel assembly **300** along with the display signal lines G_1-G_n and D_1-D_m and the TFT switching elements Q.

[0068] The temperature sensing unit **50** includes at least one temperature sensor **51**. The temperature sensor **51** generates a temperature sensing signal Vs corresponding to the temperature sensed by the temperature sensor **51** and outputs the sensing signal Vs to the signal controller **600**.

[0069] The signal controller **600** controls the gate driver **400** and the data driver **500**.

[0070] Referring to FIG. **3**, the LC panel assembly **300** is divided into a display region DR on which the LC layer **3** is formed and a non-display region B. The non-display region B mainly corresponds to the border of the LC panel assembly **300**, adjacent an outermost periphery of the LC panel assembly **300**, and is covered by the light blocking film **220**, such as a black matrix. The temperature sensors **51** of the temperature sensing unit **50** are installed on the non-display region B. As shown in FIG. **3**, the temperature sensors **51** are installed two by two on an upper and a lower part of the LC panel assembly **300**, respectively. In other words, two temperature sensors **51** are installed on a first border portion of the LC panel assembly **300**, and two temperature sensors **51** are installed on a second border portion of the LC panel assembly **300**, where the first border portion is opposite the second border portion. However, the number of the temperature sensors **51** and the installed positions are not limited to the illustrated embodiment. For example, the temperature sensors **51** may be installed on a left and a right of the LC panel assembly **300** to sense a temperature of the LC panel assembly **300**, and other alternative arrangements and quantities of temperature sensors **51** would also be within the scope of these embodiments.

[0071] Now, the operation of the LCD will be described in detail.

[0072] The signal controller **600** is supplied with RGB image signals R, G, and B and input control signals controlling the display thereof such as a vertical synchronization signal Vsync, a horizontal synchronization signal Hsync, a main clock signal MCLK, a data enable signal DE, etc., from an external graphic controller (not shown). In response to the input image signals R, G, and B and the input control signals, the signal controller **600** processes the image signals R, G, and B suitably for the operation of the LC panel assembly **300** on the basis of the input control signals and a temperature sensing signals Vs, and generates gate control signals CONT**1** and data control signals CONT**2**. The signal controller **600** then provides the gate control signals CONT**1** to the gate driver **400**, and the processed image signals R', G', and B' and the data control signals CONT**2** to the data driver **500**.

[0073] The gate control signals CONT**1** include a vertical synchronizing start signal, a scanning start signal STV, for informing the beginning of a frame and having instructions to start scanning, and at least one gate clock signal for controlling the output time of the gate-on voltage Von. The gate control signals CONT**1** may further include an output enable signal OE for defining the duration of the gate-on voltage Von.

[0074] The data control signals CONT**2** include a horizontal synchronization start signal STH for informing the data driver **500** of the start of data transmission for a group of pixels, a load signal LOAD having instructions to apply the data voltages to the data lines D**1**-Dm, and a data clock signal HCLK. The data control signal CONT**2** may further include an inversion signal RVS for reversing the polarity of the data voltages (with respect to the common voltage Vcom).

[0075] In response to the data control signals CONT**2** from the signal controller **600**, the data driver **500** receives a packet of the image data DAT, the processed image signals, for the group of pixels from the signal controller **600**, converts the image data DAT into analog data voltages selected from the gray voltages supplied from the gray voltage generator **800**, and applies the data voltages to the data lines D**1**-Dm.

[0076] The gate driver **400** applies the gate-on voltage Von to the gate lines G**1**-Gn in response to the gate control signals CONT**1** from the signal controller **600**, thereby turning on the switching elements Q connected thereto. The data voltages applied to the data lines D**1**-Dm are supplied to the corresponding pixels through the activated switching elements Q.

[0077] The difference between the data voltage applied to the pixel and the common voltage Vcom is represented as a charged voltage across the LC capacitor C_{LC}, which is referred to as a pixel voltage. The LC molecules in the LC capacitor C_{LC} have orientations depending on the magnitude of the pixel voltage, and the molecular orientations determine the polarization of light passing through the LC layer **3**. The polarizer(s) converts the light polarization into light transmittance.

[0078] By repeating this procedure by a unit of the horizontal period (which is denoted by "1H" and equal to one period of the horizontal synchronizing signal Hsync, the data enable signal DE, and the gate clock signal CPV), all gate lines

G1-Gn are sequentially supplied with the gate-on voltage Von during a frame, thereby applying the data voltages to all pixels. When the next frame starts after finishing one frame, the inversion control signal RVS, part of the data control signals CONT2, applied to the data driver **500** is controlled such that the polarity of the data voltages is reversed (which is referred to as "frame inversion"). The inversion control signal RVS may also be controlled such that the polarity of the data voltages flowing in a data line in one frame is reversed (for example, line inversion and dot inversion), or the polarity of the data voltages in one packet is reversed (for example, column inversion and dot inversion).

[0079] Now, structures of an exemplary embodiment of a sensor and an exemplary embodiment of an LCD having the sensor according to the present invention will be described with reference to FIGS. **4** to **5**B.

[0080] FIG. **4** is a layout view of an exemplary embodiment of an LCD according to the present invention, FIG. **5**A is a sectional view of the LCD shown in FIG. **4** taken along line VA-VA', and FIG. **5**B is a sectional view of the LCD shown in FIG. **4** taken along line VB-VB'.

[0081] A plurality of gate lines **121**, a sensor control electrode **126**, a sensor control line **128**, and a plurality of storage electrode lines **131** are formed on an insulating substrate **110** such as transparent glass or other suitable transparent insulating material.

[0082] The gate lines **121** extend substantially in a transverse direction and are separated from each other and transmit gate signals. The gate lines **121** may extend substantially parallel to each other. Each gate line **121** includes a plurality of projections forming a plurality of gate electrodes **124** and an end portion **129** having a large area for contact with another layer or an external driving circuit. The gate lines **121** may extend to be connected to a driving circuit that may be integrated on the insulating substrate **110**.

[0083] The sensor control electrode **126** has a substantially rectangular shape having a horizontal side longer than a vertical side, where the horizontal side of the sensor control electrode **126** may extend along the transverse direction of the insulating substrate **110** and the vertical side of the control electrode **126** may extend along a longitudinal direction across the insulating substrate **110**. The sensor control line **128** may extend in the longitudinal direction, with respect to the sensor control electrode **126**. While a specific arrangement of the sensor control electrode **126** is illustrated, the sensor control electrode **126** may be positioned in alternate peripheral areas of the insulating substrate **110** as previously described with respect to FIG. **3**. The sensor control line **128** includes an end portion having a large area for contact with another layer or an external driving circuit.

[0084] Each of the storage electrode lines **131** which are separated from the gate lines **121** also extends substantially in the transverse direction and is disposed between two adjacent gate lines **121**. The storage electrode lines **131** are supplied with a predetermined voltage such as the common voltage of the other panel (not shown).

[0085] The gate lines **121**, the sensor control electrode **126**, the sensor control line **128**, and the storage electrode lines **131** are preferably made of an aluminum Al-containing metal such as Al and an Al alloy, a silver Ag-containing metal such as Ag and an Ag alloy, a copper Cu-containing metal such as Cu and a Cu alloy, a molybdenum Mo-containing metal such as Mo and a Mo alloy, chromium Cr, titanium Ti, or tantalum Ta. The gate lines **121**, the sensor control electrode **126**, the sensor control line **128**, and the storage electrode lines **131** may have a multi-layered structure including two films having different physical characteristics. If a two film structure is employed, one of the two films is preferably made of a low resistivity metal including an Al-containing metal for reducing signal delay or voltage drop in the gate lines **121**, the sensor control electrode **126**, the sensor control line **128**, and the storage electrode lines **131**. The other film is preferably made of a material such as Cr, Mo, a Mo alloy, Ta, or Ti, which has good physical, chemical, and electrical contact characteristics with other materials such as indium tin oxide (ITO) or indium zinc oxide (IZO). Some examples of the combination of the two films that provide an appropriate combination of preferable characteristics include a lower Cr film and an upper Al (Al—Nd alloy) film and a lower Al (Al alloy) film and an upper Mo film.

[0086] In addition, the lateral sides of the gate line **121**, the sensor control electrode **126**, the sensor control line **128**, and the storage line **131** are tapered, and the inclination angle of the lateral sides with respect to a surface of the substrate **110** is within a range of about 30 to about 80 degrees.

[0087] A gate insulating layer **140**, preferably made of silicon nitride (SiNx), is formed on the gate lines **121**, the sensor control electrode **126**, the sensor control line **128**, and the storage electrode lines **131** and is also formed on the portions of the insulating substrate **110** not covered by the gate lines **121**, the sensor control electrode **126**, the sensor control line **128**, and the storage electrode lines **131**.

[0088] A plurality of semiconductor stripes **151**, a plurality of semiconductor islands, and a semiconductor rectangle **155**, preferably made of hydrogenated amorphous silicon (abbreviated to "a-Si"), are formed on the gate insulating layer **140**. Each semiconductor stripe **151** extends substantially in a longitudinal direction, extending generally perpendicularly to the storage electrode lines **131** and the gate lines **121**, and has a plurality of projections **154** branched out toward the gate electrodes **124** and a plurality of protrusions disposed on the storage electrode lines **131**. The semiconductor rectangle **155** is separated from the semiconductor stripes **151** and has a shape substantially similar to that of the sensor control electrode **126**.

[0089] A plurality of ohmic contact stripes **161** and a plurality of ohmic contact islands **165** are formed on the semiconductor stripes **151**, and a plurality of ohmic contact islands **162** and **164** are formed on the semiconductor rectangle **155**. The ohmic contact stripes **161** and islands **165**, **162**, and **164** are preferably made of silicide or n+hydrogenated a-Si heavily doped with an n-type impurity. Each ohmic contact stripe **161** has a plurality of projections **163**, and the projections **163** and the ohmic contact islands **165** are located in pairs on the projections **154** of the semiconductor stripes **151**.

[0090] The ohmic contact islands **162** and **164** are located on the semiconductor rectangle **155**, respectively, and are separated from each other.

[0091] The lateral sides of the semiconductor stripes **151**, the semiconductor rectangle **155**, and the ohmic contact stripes **161** and islands **165**, **162**, and **164** are tapered, and the inclination angles thereof with respect to the insulating substrate **110** are preferably in a range between about 30 to about 80 degrees.

[0092] A plurality of data lines **171**, a plurality of drain electrodes **175**, a sensor input electrode **172**, a sensor input line **176**, a sensor output electrode **174**, and a sensor output line **178** are formed on the ohmic contact stripes **161** and islands **165** and the gate insulating layer **140**.

[0093] The data lines **171** for transmitting data voltages extend substantially in the longitudinal direction and cross over the gate lines **121** and the storage electrode lines **131**. Each data line **171** has an end portion **179** having a large area for contact with another layer or an external device. A plurality of branches of each data line **171**, which project toward the drain electrodes **175**, form a plurality of source electrodes **173**.

[0094] The sensor input line **176** substantially extends in a longitudinal direction, such as parallel to the sensor control line **128**, and the sensor input electrode **172** includes a connection portion connected to the sensor input line **176**, a transverse portion extending in the transverse direction substantially perpendicular to the longitudinal direction and connected to the connection portion, and a plurality of branches extending from the connection portion via the transverse portion, the branches extending in the longitudinal direction like a comb.

[0095] The sensor output line **178** substantially extends in the longitudinal direction, such as parallel to the sensor input line **176** and the sensor control line **128**, and the sensor output electrode **174** includes a connection portion connected to the sensor output line **178**, a transverse portion extending in the transverse direction substantially perpendicular to the longitudinal direction and connected to the connection portion, and a plurality of branches extending from the connection portion via the transverse portion, the branches extending in the longitudinal direction like a comb.

[0096] The branches of the sensor input electrode **172** and the sensor output electrode **174** are alternately engaged through the semiconductor rectangle **155**.

[0097] Each set of a gate electrode G **124**, a source electrode S **173**, and a drain electrode D **175** along with a projection **154** of a semiconductor stripe **151** form a TFT having a channel formed in the semiconductor projection **154** disposed between the source electrode S **173** and the drain electrode D **175**.

[0098] The sensor control electrode **126**, the sensor input electrode **172**, and the sensor output electrode **174** along with the semiconductor rectangle **155** form a sensor transistor for a temperature sensor **51**. The specifications of the sensor transistor are defined by a width W and a length L of the electrodes **126** and **172**, and a thickness T of the semiconductor rectangle **155**.

[0099] The data lines **171**, the source electrode **173**, the drain electrode **175**, the sensor input line **176**, the sensor input electrode **172**, the sensor output line **178**, and the sensor output electrode **174** are preferably made of a refractory metal including Cr, Mo, TV Ta, or alloys thereof. They may have a multi-layered structure, preferably including a low resistivity film and a good contact film.

[0100] The semiconductor stripes **151** of the TFT array panel according to this embodiment have almost the same planar shapes as the data lines **171** and the drain electrodes **175** as well as the underlying ohmic contacts **161** and **165**. However, the projections **154** of the semiconductor stripes **151** include some exposed portions, which are not covered with the data lines **171** and the drain electrodes **175**, such as portions located between the source electrodes **173** and the drain electrodes **175**.

[0101] Similar to the gate lines **121**, the data lines **171**, the source electrode **173**, the drain electrodes **175**, the sensor input line **176**, the sensor input electrode **172**, the sensor output line **178**, and the sensor output electrode **174** have tapered lateral sides, and the inclination angles thereof are in a range of about 30 to about 80 degrees with respect to the insulating substrate **110**.

[0102] A passivation layer **180** is formed on the data lines **171**, the source electrodes **173**, the drain electrodes **175**, the sensor input line **176**, the sensor input electrode **172**, the sensor output line **178**, the sensor output electrode **174**, and the exposed portions of the semiconductor stripes **151** and semiconductor rectangle **155**, as well as any other exposed portions of the gate insulating layer **140**.

[0103] The passivation layer **180** is preferably made of a photosensitive organic material having a good flatness characteristic, a low dielectric insulating material such as a-Si:C:O and a-Si:O:F formed by plasma-enhanced chemical vapor deposition ("PECVD"), or an inorganic material such as silicon nitride and silicon oxide. The passivation layer **180** may have a double-layered structure including a lower inorganic film and an upper organic film.

[0104] The passivation layer **180** has a plurality of contact holes **182**, **185**, **186**, and **187** exposing the end portions **179** of the data lines **171**, the drain electrodes **175**, and end portions of the sensor input line **176** and the sensor output line **178**, respectively. The passivation layer **180** and the gate insulating layer **140** also have a plurality of contact holes **181** and **189** exposing the end portions **129** of the gate lines **121** and the end portion of the sensor control line **128**, respectively.

[0105] A plurality of pixel electrodes **190** and a plurality of contact assistants **81**, **82**, **86**, **87**, and **89**, which are preferably made of IZO or ITO, are formed on the passivation layer **180**. The contact assistants **81**, **82**, **86**, **87**, and **89** are formed with respect to the contact holes formed in the passivation layer **180**.

[0106] The pixel electrodes **190** are physically and electrically connected to the drain electrodes **175** through the contact holes **185** such that the pixel electrodes **190** receive the data voltages from the drain electrodes **175**.

[0107] The pixel electrodes **190** supplied with the data voltages generate electric fields in cooperation with the common electrode **270** on the upper panel **200**, which reorient liquid crystal molecules in the liquid crystal layer **3** disposed therebetween.

[0108] The pixel electrodes **190** may optionally overlap the gate lines **121** and the data lines **171** to increase the aperture ratio.

[0109] The contact assistants **81**, **82**, **86**, **87**, and **89** are connected to the exposed end portions **129** of the gate lines **121**, the exposed end portions **179** of the data lines **171**, the exposed end portion of the sensor input line **176**, the exposed end portion of the sensor output line **178**, and the exposed end portion of the sensor control line **128** through the contact holes **181**, **182**, **186**, **187**, and **189**, respectively. While not required, the contact assistants **81**, **82**, **86**, **87**, and **89** are preferred to protect the exposed end portions and to complement the adhesiveness of the exposed portion and external devices.

[0110] The contact assistant **81** plays a part in connecting the end portions **129** of the gate lines **121** and the gate driver **400** when the gate driver **400** to supply gate signals is integrated on the insulating substrate **110**, and may alternatively be omitted.

[0111] According to another embodiment of the present invention, the pixel electrodes **190** are made of a transparent conductive polymer. For a reflective LCD, the pixel electrodes **190** are made of an opaque reflective metal. In these cases, the contact assistants **81** and **82** may be made of a material such as IZO or ITO different from the pixel electrodes **190**.

[0112] A size of the temperature sensor **51** integrated along with the gate lines **121** and the data lines **171** upon the insulating substrate **110** and varying an operating state or a resistance value thereof based on the sensed temperature may be about 2 mm×2 mm or less. In addition, the sensor control electrode **126** formed on the substrate **110** functions to block light from a light source (not shown) disposed below a lower part of the LC panel assembly **300**. Such a feature does not limit light transmittance of the LC panel assembly **300**, however, since the positioning of the temperature sensor **51** is generally limited to the non-display region B.

[0113] Exemplary embodiments of the temperature sensor **51** formed with the gate lines **121** and the data lines **171** on the non-display region B of the LC panel assembly **300** include a diode type of temperature sensor and a resistor type of temperature sensor, as shown in FIGS. **6**A to **7**B, in accordance with the connection of the sensor control line **128**, the sensor input line **176**, and the sensor output line **178**, as further described below.

[0114] FIG. **6**A is an equivalent circuit diagram of an exemplary embodiment of a diode type of temperature sensor when a temperature sensor according to an exemplary embodiment of the present invention is the diode type of temperature sensor, and FIG. **6**B is a graph showing a characteristic of an output voltage with respect to a temperature variation of the diode type of temperature sensor shown in FIG. **6**A. FIG. **7**A is an equivalent circuit diagram of an exemplary embodiment of a resistor type of temperature sensor when a temperature sensor according to an exemplary embodiment of the present invention is the resistor type of temperature sensor, and FIG. **7**B is a graph showing a characteristic of an output voltage with respect to a temperature variation of the resistor type of temperature sensor shown in FIG. **7**A.

[0115] An exemplary embodiment of when lines **128**, **176**, and **178** of the temperature sensor **51** are connected as a diode type of temperature sensor will be described with reference to FIGS. **6**A and **6**B.

[0116] Referring to FIG. **6**A, a sensor control line G **128** of the temperature sensor **51** is connected to a sensor output line D **178**, and the sensor input line S **176** of the temperature sensor **51** is connected to a ground GND such that a sensor transistor, that is, the temperature sensor **51**, functions as a diode.

[0117] At this time, an output voltage V_D from the sensor output line D **178** is represented as:

$$V_D = V_{dd} - RI_D \qquad \text{[Equation 1]}$$

[0118] Here, I_D is a current flowing through the sensor output line D **178**, R is a resistor connected to an exterior of the temperature sensor **51**, and Vdd is an input voltage.

[0119] At this time, for a voltage between the sensor control line G **128** and sensor input line S **176** and a voltage between the sensor output line D **178** and the sensor input line S **176** by the connection between the sensor control line G **128** and the sensor output line D **178**, the I_D is expressed as:

$$I_D = \mu_n C_g \frac{W}{L}\left(\frac{V_D^2}{2} - V_{TH} V_D\right) \qquad \text{[Equation 2]}$$

[0120] Here, μ_n is electron mobility depending on a temperature variation, Cg is capacitance of the sensor input electrode **172**, W is a channel width, L is a channel length, where W and L are measured such as shown in FIG. **4**, and V_{TH} is a threshold voltage.

[0121] The electron mobility μ_n is represented as:

$$\mu_n = \mu_0 \frac{N_C kT}{n} e^{-E_a/kT} \qquad \text{[Equation 3]}$$

[0122] Here, μ_0 is extended state electron mobility, Nc is a state density at mobility edge, k is a Boltzmann constant, T is a temperature (K), n is total electron density, and Ea is activation energy. In one embodiment, μ_0 is ~6[cm^2/vs], Nc is ~2×10^{21}[cm^2/eV], k is 1.3805×10^{-23}[J/K], and Ea is 0.13 [eV].

[0123] As a result, with reference to [Equation 1] to [Equation 3], the output voltage V_D is varied based on a temperature variation.

[0124] The output voltage V_D of the temperature sensor **51** having the equivalent circuit shown in FIG. **6**A is linearly varied as a temperature is changed, as shown in FIG. **6**B.

[0125] An exemplary embodiment of when lines **128**, **176**, and **178** of the temperature sensor **51** are connected as a resistor type of temperature sensor will be described with reference to FIGS. **7**A and **7**B.

[0126] As shown in FIG. **7**A, a sensor control line G **128** is not supplied with any signals, a sensor input line S **176** is connected to a ground GND through a resistor Rc, and a sensor output line D **178** is supplied with an externally applied driving voltage Vdd. In this embodiment, since the sensor control line G **128** is not supplied with any signals, a temperature sensor **51**, that is, a sensor transistor, functions as a resistor Rs.

[0127] An output voltage Vout from the temperature sensor **51**, that is, a sensor transistor, is represented as:

$$Vout = \frac{Rc}{Rs + Rc} Vdd \qquad \text{[Equation 4]}$$

[0128] Rs is expressed as:

$$Rs = \rho \frac{L}{WD}$$

and σ is expressed as:

$$\sigma = ne\mu_n = \frac{1}{\rho}$$

[0129] Here, e is carrier capacitance amount.

[0130] As described above, since the electron mobility μ_n is represented as [Equation 3], the output voltage Vout is varied based on a temperature variation.

[0131] The output voltage Vout with respect to a temperature variation is varied as shown in FIG. **7**B. As shown in FIG. **7**B, though the output voltage Vout of the resistor type of temperature sensor is nonlinearly varied, the sensitivity of the temperature sensor **51** on the basis of characteristics of a resistor is good.

[0132] In the resistor type of temperature sensor, since the sensor control line G **128** is not supplied with any signal, a sensor control line G **176** and a sensor control electrode **126** may be unnecessary.

[0133] Another exemplary embodiment of a resistor type of temperature sensor according to the present invention will be described with reference to FIGS. **8**A and **8**B. A structure of an LCD including the resistor type of temperature sensor may be the same as that shown in FIGS. **4** and **5**A and is therefore omitted.

[0134] FIG. **8**A is a layout view of an exemplary embodiment of a resistor type of temperature sensor according to the present invention and FIG. **8**B is a sectional view of the resistor type of temperature sensor shown in FIG. **8**A taken along the VIIIB-VIIIB'.

[0135] As shown in FIGS. **8**A and **8**B, a structure of another exemplary embodiment of a resistor type of temperature sensor according to the present invention is similar to that shown in FIGS. **4** and **5**A except that a sensor control electrode **126** and a sensor control line **128** are not formed.

[0136] That is, a gate insulating layer **140** is formed on an insulating substrate **110** (with no sensor control electrode **126** and sensor control line **128** present), and a semiconductor rectangle **155**, having horizontal sides longer than vertical sides, is formed on the gate insulating layer **140**. A plurality of ohmic contacts **162** and **164** are formed on the semiconductor rectangle **155**. In addition, a sensor input line **176**, a sensor input electrode **172**, a sensor output electrode **174**, and a sensor output line **178** are formed on the ohmic contacts **162** and **164** and the gate insulating layer **140**.

[0137] A passivation layer **180** is formed on the sensor input line **176**, the sensor input electrode **172**, the sensor output electrode **174**, and the sensor output line **178**, as well as on any exposed portions of the gate insulating layer **140** and the semiconductor rectangle **155**. The passivation layer **180** has a plurality of contact holes **186** and **187** exposing end portions of the sensor input line **176** and the sensor output line **178**, respectively.

[0138] Contact assistants **86** and **87** may be formed on the passivation layer **180** in combination with the contact holes **186**, **187**, respectively.

[0139] As described above, a resistor type of temperature sensor is designed without the sensor control line **128** and the sensor control electrode **126** since they are not supplied with a signal.

[0140] For a diode type of temperature sensor and a resistor type of temperature sensor according to embodiments of the present invention, exemplary graphs of output voltages actually outputted therefrom with respect to a temperature variation are shown in FIGS. **9** and **10**, respectively.

[0141] For exemplary purposes only, in FIGS. **9** and **10**, a driving voltage Vdd is about 5V, and W/L is 3200/4.5. In FIG. **9**, a resistance value of the resistor R is about 620 kΩ, and in FIG. **10** a resistance value of the resistor Rc is about 2 kΩ.

[0142] As shown in FIGS. **9** and **10**, the range of the sensed temperature of an LCD was about −20° C. to 80° C. In FIG. **9**, temperatures were sensed by a unit of about 10° C., and in FIG. **10**, temperatures were sensed by a unit of about 2.5° C. In FIG. **9**, a voltage variation difference ΔV_D is about 1.31V and in FIG. **10**, a voltage variation difference ΔV_{out} is about 4.37V. Thus, since dynamic sensibility of the output voltages from the temperature sensors is large, the output voltages are directly used without separate signal processing such as filtering, amplifying, and so on.

[0143] The exemplary embodiments of temperature sensors according to the present invention sense an exact temperature corresponding to a temperature variation of an LC layer since the temperature sensors are directly integrated in the LC panel assembly along with the gate lines and the data lines.

[0144] According to the present invention, a temperature sensor is directly integrated in an LCD for sensing a temperature of the LCD, and thereby the temperature is exactly sensed without a large increment of a manufacturing cost. In addition, the controlling of a display device is achieved based on the exactly sensed temperature of the display device, and thereby an image quality of the display device is improved. The design is improved and manufacturing cost is decreased since a separate temperature sensor to be externally installed on the LCD is unnecessary.

[0145] Moreover, since driving characteristics of a temperature sensor are changed by changing a connection of the lines thereof and a temperature sensor having characteristics suitable for a display device and circumference environment thereof is realized, the driving efficiency of the temperature sensor and the display device is improved.

[0146] Additionally, since the size of an area of the temperature sensor contacting the surface of an LCD is increased due to the comb shape, while maintaining a small size of the temperature sensor, reliability of sensing is improved and additional circuits are unnecessary.

[0147] While the present invention has been described in detail with reference to the preferred 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. Moreover, the use of the terms first, second, etc. do not denote any order or importance, but rather the terms first, second, etc. are used to distinguish one element from another. Furthermore, the use of the terms a, an, etc. do not denote a limitation of quantity, but rather denote the presence of at least one of the referenced item.

1.-**13**. (canceled)

14. A sensor comprising:
an insulating layer formed on a substrate;
a semiconductor formed on the insulating layer;
an ohmic contact formed on the semiconductor;
a sensor input electrode and a sensor output electrode formed on the ohmic contact; and
a passivation layer formed on the sensor input electrode and the sensor output electrode.

15. The sensor of claim **14**, wherein the insulating layer is further formed on portions of the substrate not covered by the sensor control electrode.

16. The sensor of claim **15**, wherein the passivation layer is further formed on portions of the semiconductor not covered by the ohmic contact, sensor input electrode, or sensor output electrode, and on portions of the insulating layer not covered by the semiconductor, ohmic contact, sensor input electrode, and sensor output electrode.

17. The sensor of claim **14**, wherein the sensor input electrode comprises a plurality of first branches spaced by a predetermined distance and formed as a comb and the sensor output electrode comprises a plurality of second branches spaced by a predetermined distance and formed as a comb,

wherein the first branches are engaged with the second branches through the semiconductor, respectively.

18. The sensor of claim **17**, wherein the first branches are alternately arranged with respect to the second branches.

19. The sensor of claim **14**, further comprising:

a sensor input line connected to the sensor input electrode and a sensor output line connected to the sensor output electrode,

wherein the passivation layer comprises a first contact hole exposing a portion of the sensor input line and a second contact hole exposing a portion of the sensor output line.

20. The sensor of claim **19**, wherein the sensor input line is connected to a voltage through the first contact hole.

21. The sensor of claim **20**, wherein the voltage is a ground voltage.

22. The sensor of claim **20**, wherein the sensor output line outputs a sensing signal.

23. The sensor of claim **14**, wherein the sensor is a resistor type of temperature sensor.

24. A thin film transistor array panel comprising:

a gate line and a sensor control electrode formed on a substrate;

an insulating layer formed on the gate line and the sensor control electrode;

a semiconductor formed on the insulating layer;

an ohmic contact formed on the semiconductor;

a data line, a drain electrode, a sensor input electrode, and a sensor output electrode formed on the ohmic contact; and

a passivation layer formed on the data line, the drain electrode, the sensor input electrode and the sensor output electrode.

25. The panel of claim **24**, wherein the sensor input electrode comprises a plurality of first branches spaced by a predetermined distance and formed as a comb and the sensor output electrode comprises a plurality of second branches spaced by a predetermined distance and formed as a comb,

wherein the first branches are engaged with the second branches through the semiconductor, respectively.

26. The panel of claim **25**, further comprising:

a sensor control line connected to the sensor control electrode;

a sensor input line connected to the sensor input electrode; and

a sensor output line connected to the sensor output electrode,

wherein the passivation layer is further formed on the sensor control electrode and comprises

a first contact hole exposing a portion of the sensor control line,

a second contact hole exposing a portion of the sensor input line, and

a third contact hole exposing a portion of the sensor output line.

27. The panel of claim **26**, wherein the passivation layer further comprises a fourth contact hole exposing a portion of the drain electrode.

28. The panel of claim **27**, further comprising a pixel electrode connected to the drain electrode through the fourth contact hole.

29. The panel of claim **28**, further comprising contact assistants connected to the sensor control line, the sensor input line, and the sensor output line through the first, second, and third contact holes, respectively.

30. The panel of claim **29**, wherein the contact assistants are formed on the same layer as the pixel electrode.

31. The panel of claim **24**, wherein the sensor control electrode, the sensor input electrode, and the sensor output electrode are formed on a border of the panel.

32. The panel of claim **24**, wherein the sensor control electrode, sensor input electrode, and sensor output electrode form part of a diode type of temperature sensor.

33. A thin film transistor array panel comprising:

a gate line formed on a substrate;

an insulating layer formed on the gate line;

a semiconductor formed on the insulating layer;

an ohmic contact formed on the semiconductor;

a data line, a drain electrode, a sensor input electrode, and a sensor output electrode formed on the ohmic contact; and

a passivation layer formed on the data line, the drain electrode, the sensor input electrode, and the sensor output electrode.

34. The panel of claim **33**, wherein the sensor input electrode comprises a plurality of first branches spaced by a predetermined distance and formed as a comb and the sensor output electrode comprises a plurality of second branches spaced by a predetermined distance and formed as a comb,

wherein the first branches are engaged with the second branches through the semiconductor, respectively.

35. The panel of claim **34**, further comprising a sensor input line connected to the sensor input electrode and a sensor output line connected to the sensor output electrode;

wherein the passivation layer comprises a first contact hole exposing a portion of the sensor input line and a second contact hole exposing a portion of the sensor output line.

36. The panel of claim **35**, wherein the passivation layer further comprises a third contact hole exposing a portion of the drain electrode.

37. The panel of claim **36**, further comprising a pixel electrode connected to the drain electrode through the third contact hole.

38. The panel of claim **37**, further comprising contact assistants connected to the sensor input line and the sensor output line through the first and second contact holes, respectively.

39. The panel of claim **38**, wherein the contact assistant is formed on same layer as the pixel electrode.

40. The panel of claim **33**, wherein the sensor input electrode and the sensor output electrode are formed on a border of the panel.

41. The panel of claim **33**, wherein the sensor input electrode and the sensor output electrode form part of a resistor type of temperature sensor.

42. A liquid crystal display panel comprising:

a first panel;

a second panel;

a liquid crystal layer disposed between the first panel and the second panel; and,

a temperature sensor formed on a first surface of the first panel, the first surface of the first panel facing the liquid crystal layer.

43. The liquid crystal display panel of claim **42**, wherein the first panel is a thin film transistor array panel.

44. The liquid crystal display panel of claim **42**, wherein the temperature sensor is formed on a non-display region of the first panel.

45. The liquid crystal display panel of claim **42**, further comprising a plurality of temperature sensors formed on the first surface of the first panel.

46. The liquid crystal display panel of claim **42**, wherein the first panel includes at least one data line, and the temperature sensor includes a sensor input electrode and a sensor output electrode formed within a same layer of the first panel as the data line.

47. The liquid crystal display panel of claim **46**, wherein the first panel includes a substrate and at least one gate line formed on the substrate, and the temperature sensor includes a sensor control electrode formed on the substrate within a same layer of the first panel as the gate line.

* * * * *

专利名称(译)	传感器，薄膜晶体管阵列面板和包括传感器的显示面板		
公开(公告)号	US20080158481A1	公开(公告)日	2008-07-03
申请号	US12/045963	申请日	2008-03-11
[标]申请(专利权)人(译)	三星电子株式会社		
申请(专利权)人(译)	SAMSUNG ELECTRONICS CO.，LTD.		
当前申请(专利权)人(译)	SAMSUNG ELECTRONICS CO.，LTD.		
[标]发明人	LEE KI CHAN KO HYUN SEOK PARK YUN JAE MOON SEUNG HWAN		
发明人	LEE, KI-CHAN KO, HYUN-SEOK PARK, YUN-JAE MOON, SEUNG-HWAN		
IPC分类号	G02F1/1333 G01N27/04 H01L29/00 G01K1/14 G01K7/01 G01K7/16 G02F1/133 G02F1/1343 G02F1/1345 G02F1/1368		
CPC分类号	H01L27/13 H01L27/12		
优先权	1020050004879 2005-01-19 KR		
其他公开文献	US7719634		
外部链接	Espacenet USPTO		

摘要(译)

提供一种传感器，包括基板，形成在基板上的绝缘层，形成在绝缘层上的半导体，形成在半导体上的欧姆接触，传感器输入电极和形成在欧姆接触上的传感器输出电极，以及形成在传感器输入电极和传感器输出电极上的钝化层。传感器控制电极也可以形成在基板和绝缘层之间。还提供了包括传感器的薄膜晶体管阵列面板和包括传感器的液晶显示面板。