

Description

This invention relates to liquid-crystal display devices and, more particularly, to an active matrix substrate for use in such a device.

As known in the art, such a substrate may have formed thereon:

- a set of data lines;
- a set of select lines crossing the data lines;
- a matrix of display electrodes each adjacent a respective crossing of a respective data line and a respective select line so that the display electrodes are formed in columns corresponding to the data lines and rows corresponding to the select lines; and
- a respective field-effect driver-transistor for each display electrode, each driver-transistor having a drain coupled to the respective display electrode, a source coupled at a respective coupling location to the respective data line, and a gate situated between the respective drain and source and coupled to the respective select line.

It is apparent from the above that the proportion of the display area of a liquid-crystal two-dimensional active dot-matrix display structure occupied by (1) the respective driver-transistors, (2) the respective data lines and (3) the respective select lines increases as the line density of the rows and/or columns increases.

As is known in the art, a liquid-crystal two-dimensional active dot-matrix display structure is usually implemented as an integrated-circuit on a chip. Conventional liquid-crystal two-dimensional active dot-matrix displays generally exhibit a line density in each dimension of the order of 80 lines per inch. In this case, the respective driver-transistors, data lines and select lines occupy only a few percent of the total display area. Thus, the brightness of such a conventional display is limited only to a small extent by the non-optically-active display area occupied by the respective driver-transistors, data lines and select lines of the display. However, the situation is different for a high-density display, such as a display having a density of the order of 1,000 lines per inch in each dimension. The use of the same type of spatial configuration of the display components that is employed for conventional low-density displays would result in the display electrodes occupying only a relatively small proportion (e.g. 30% in the case of a 40 lines per mm, or 1,000 lines per inch display) of the display area, thereby severely reducing the brightness of the display.

As is known, a liquid-crystal element constitutes a capacitance which is shunted by a parasitic capacitance that includes the capacitance of the liquid-crystal-element of each individual pixel to the particular data and select lines that are coupled to the driver-transistor associated with that individual pixel cell. This parasitic capacitance, which is undesirable, increases significantly as the line density of the display

increases.

The present invention is directed to a new spatial configuration of the components of the substrate that (1) permits the proportion of the total display area occupied by the display electrodes of a relatively high-density active dot-matrix display to be significantly increased, and (2) significantly reduces the undesirable parasitic capacitance normally exhibited by such a high density active dot-matrix display.

The present invention is characterised in that: each coupling location (source to data line) and the respective source are situated on the opposite side of the respective select line to the location of the respective drain whereby the respective driver-transistor has a given portion between its source and drain crossing the respective select line; and the gate of each transistor is situated at the respective given portion crossing the respective select line.

A specific embodiment of the present invention will now be described by way of example with reference to the accompanying drawings, in which:

FIGURE 1 illustrates an example of a prior-art display structure for a relatively low-density liquid-crystal two-dimensional active dot-matrix display;

FIGURE 2 illustrates an example of the display structure of a prior-art relatively high-density liquid-crystal two-dimensional active dot-matrix display; and

FIGURE 3 illustrates a preferred embodiment of the display structure of a relatively high-density liquid-crystal two-dimensional active dot-matrix display incorporating the present invention.

Reference is made to FIGURE 1, which shows a typical example of the spatial configuration of a conventional two-dimensional active dot-matrix display structure exhibiting a relatively low line density of pixel cells (e.g. about 80 lines per inch). Such conventional display structures are primarily employed for direct-view displays of pictures and alphanumeric characters, such as are used in portable television sets and lap-top computers, for instance. In such cases, if a high-resolution capability (i.e., a large number of pixels) is required of such a display, it is obtained by increasing the total area of the display structure, rather than by increasing the line density (i.e., the number of pixels per unit length in each of the two dimensions) of the display structure.

The display structure shown in FIGURE 1 is comprised of an array of pixel cells arranged in rows and columns defined by the grid of data lines 102 and select lines 104. In FIGURE 1, data lines 102 happen to be oriented in the column direction and select lines 104 happen to be oriented in the row direction. However, this is immaterial. The data lines could just as well be oriented in the row direction and select lines 104 in the column direction. In any event, each of data

lines 102 and each of select lines 104, is a straight line. As indicated in FIGURE 1, the line spacing of both data lines 102 and select lines 104 is 290 micrometers (μm), which corresponds to a line density of about 80 lines per inch in both the row and column directions. Pixel cell 100 which occupies the area enclosed by each pair of adjacent data lines 102 and each pair of adjacent select lines 104, has a symmetrical square shape.

Any one of various known integrated-circuit photolithographic processes may be employed for implementing a liquid-crystal two-dimensional active dot-matrix display structure having the above described spatial configuration. However, for illustrative purposes, it is assumed, in FIGURE 1, that (1) all of the data lines 102 are comprised of a metal (e.g. aluminum) strips; (2) respective sections 104a of select lines 104 (each of which is separately associated with a corresponding individual pixel cell) are also comprised of metal strips; (3) adjacent ones of select-line sections 104a are electrically interconnected to one another at each intersection of a select line 104 with a data line 102 by a layer of polysilicon 104b (in a manner known in the art); and (4) such layer of polysilicon 104b is covered with an insulating layer of silicon dioxide (not shown) at its intersection with a data line 102, thereby preventing a short circuit between that data line 102 and that select line 104 (as is also known in the art).

As shown in FIGURE 1, most of the area of each individual pixel cell 100 is occupied by its liquid-crystal element 106. Each pixel cell 100 further includes an associated field-effect driver-transistor 108 comprised of a source 108a, a drain 108b and a channel 108c interconnecting source 108a and drain 108b thereof. Drain 108b is electrically connected directly to the liquid-crystal element 106 of each pixel cell 100. Source 108a is electrically connected directly to the data line 102 that is associated with the individual pixel cell that includes that driver-transistor 108. The extension 104c of polysilicon 104b is capacitively coupled to the channel 108c of each driver-transistor 108 to form a gate electrode for that driver-transistor, which results in channel 108c electrically connecting source 108a to drain 108b of that driver-transistor 108 only in response to the energization of that select line 104 associated with the individual pixel cell 100 which includes that driver-transistor 108. As used herein, extension 104c is to be construed structurally as a separate and distinct element from select line 104 itself.

It will be noted that in the relatively low-density display structure shown in FIGURE 1, the proportion of the total area of the display occupied by the liquid-crystal elements 106 of all of the pixel cells 100 of the display is much larger than that occupied by both the driver-transistors 108 of all the pixel cells 100 of the display and all the data lines 102 and select lines 104

of the display. This results in a bright display. It is further noted that because each liquid-crystal element 106 is relatively large, and the density of data lines and select lines is relatively low, the parasitic capacitance of the liquid-crystal elements 106 to the data lines and to the select lines is relatively small compared to the capacitance of the optically-active liquid-crystal elements 106 themselves, which is desirable.

Reference is now made to FIGURE 2, which is directed to a high-density liquid-crystal two-dimensional active dot-matrix display structure, which employs a spatial configuration similar to that shown by the low-density display structure of FIGURE 1, although the integrated-circuit processes used in implementing the display structure of FIGURE 2 are slightly different from those used in implementing the display structure of FIGURE 1. Each of square symmetric pixel cells 200 of the display structure is defined by each pair of adjacent data lines 202 and each pair of adjacent select lines 204. Specifically, in the display structure of FIGURE 2 liquid crystal element 206 and driver transistor 208 are both formed from a single layer of polysilicon which is thin enough to be optically transparent. This single layer of polysilicon, which forms the electrically portions of source 208a, drain 208b and channel 208c of the driver transistor 208 of FIGURE 2, is electrically isolated from all other layers of the integrated circuit by a gate oxide except at the contact area 208a. In addition, the difference between the displays shown in FIGURES 1 and 2 is that the spacing distance between adjacent data lines 202 and the spacing distance between select lines 204 in FIGURE 2 are each 25 μm (i.e., about 1000 lines per inch).

A further difference between the implementing integrated circuit of FIGURE 2 and of FIGURE 1 is that, in FIGURE 2, each select line 204 is completely comprised of a polysilicon layer, (rather than the combination of metal strips 104a and a polysilicon layer 104b of the display structure of FIGURE 1). However, in FIGURE 2, although each of its components 200, 202, 204, 204c, 206, 208, 208a, 208b and 208c, respectively, corresponds in all functional respects with each of components 100, 102, 104, 104c, 106, 108, 108a, 108b and 108c, respectively, of FIGURE 1, structurally, extension 204c is to be construed as a separate and distinct element from select line 204 itself.

High-density liquid-crystal active dot-matrix display structures are required in such applications as (1) liquid-crystal projection displays, (2) electronic viewfinder displays, and (3) so-called "heads up" type displays. Such displays, because they require small-area display structures, need to provide a relatively high brightness per unit area. However, the fact is that scaling the line density from about 80 lines per inch to 1000 lines per inch in each dimension of the display inherently reduces the proportion of the total display

structure area that is occupied by the optically active liquid-crystal elements of the structure. Employing the prior-art spatial configuration shown in FIGURE 2 for the high-density display structure results in the area occupied by the liquid-crystal element 206 of each pixel cell 200 being only $191 \mu\text{m}^2$ and the area occupied by the liquid-crystal elements 206 of all of the pixel cells 200 of the display structure being reduced to substantially only 30% of the total area of the display. This is because of the relatively large amount of the display-structure per unit area thereof taken up by the much greater number of data lines 202, select lines 204 and driver-transistors 208 of FIGURE 2 with respect to the corresponding components of FIGURE 1. Further, this greater number of components, which results in smaller individual pixel cells 200 and smaller liquid-crystal elements, significantly increases the ratio of the parasitic capacitance of the display structure with respect to the capacitance of the liquid-crystal elements 206 themselves of the display structure. This increase in parasitic capacitance is undesirable.

FIGURE 3, which illustrates a high-density liquid-crystal two-dimensional active dot-matrix display structure incorporating the present invention, is similar to the prior-art high-density liquid-crystal two-dimensional active dot-matrix display structure shown in FIGURE 2 to the extent that they both are implemented by the same integrated circuit processes and that the respective spacing distance between adjacent data lines and between adjacent select lines of both of them is $25 \mu\text{m}$ (about 1000 lines per inch). However, the spatial configuration of the respective components of the display structure shown in FIGURE 3 is significantly different from the prior-art spatial configuration of the corresponding respective components shown in FIGURE 1 or in FIGURE 2.

Specifically, components 300, 302, 304, 306, 308, 308a, 308b and 308c of FIGURE 3 functionally correspond respectively with components 200, 202, 204, 206, 208, 208a, 208b and 208c of FIGURE 2. However, in the spatial configuration of the display structure shown in FIGURE 3, the driver-transistor 308 associated with each individual pixel cell 300 has its source 308a situated outside of the area of that individual pixel cell. Specifically, the source 308a of each driver-transistor 308 is located on the opposite side of the particular select line 304 that controls the operation of that driver-transistor 308. The liquid-crystal element 306 and the drain 308b connected thereto of the driver-transistor 308 associated with each individual pixel cell 300 is located inside of the area of that individual pixel cell, so that channel 308c of that driver-transistor 308, which interconnects the source 308a and the drain 308b thereof, must cross the aforesaid particular select line 304, as indicated in FIGURE 3. Thus a capacitively-coupled gate for operating each driver-transistor 308 is inherently produced at the intersection of the channel 308c of that

driver-transistor with the particular select line 304 that crosses the channel 308c of that driver-transistor 308.

As indicated in FIGURE 3, the source 308a of each driver-transistor 308 and the particular data line 302 to which that source 308a is electrically coupled are spatially oriented in a substantially wholly overlapping relationship with one another. Further, in the spatial configuration of the display structure shown in FIGURE 3, each select line 304 is preferably not a straight line, but includes a plurality of V-shaped portions 310, each of which crosses a separate one of the respective data lines 302. This permits the source 308a of each driver-transistor 308 to be disposed within the notch of the V-shaped portion 310 and also permits the channel 308c of the driver-transistor 308 to intersect one arm of that V-shaped portion 310 at a substantially right angle, as indicated in FIGURE 3.

From the foregoing discussion of the spatial configuration of the structure shown in FIGURE 3, it is apparent that much of the area of the display structure taken up by the respective driver-transistors thereof overlaps areas of the display structure already taken up by the respective data lines 302 and select lines 304 thereof. Of particular significance, is the fact that the gate electrode of each driver-transistor 308 takes up no additional area at all, since it is entirely located at the intersection of a particular select line 304 and the channel 308c of each driver-transistor 308. This differs markedly from the spatial configuration of the prior-art display structure shown in FIGURES 1 and 2, wherein substantially all of each driver-transistor occupies space within the area of each individual symmetrical (square) pixel cell thereof (which is the area of the display structure that is in addition to the area occupied by the data lines and select lines thereof). Furthermore, the area of the display structures shown in FIGURES 1 and 2 that is occupied by extension 104c from select line 104 and extension 204c from select line 204 is entirely eliminated in the spatial configuration of the display structure shown in FIGURE 3.

The result of the above-discussed spatial configuration of the high-density liquid-crystal two-dimensional dot-matrix display structure shown in FIGURE 3, wherein the shape of the area occupied by each individual pixel cell together with its associated driver-transistor is asymmetric, is to provide substantially more area within each individual pixel cell for its optically-active liquid-crystal element 306. Specifically, as indicated in FIGURE 3, solely the drain 308b of the driver-transistor 308 associated with each individual pixel cell 300, which is coupled to the liquid-crystal element 306 of that individual pixel cell 300, extends into a spacing area surrounding the liquid-crystal element 306 that separates it from the particular data line 302 and the particular select line 304 associated with that individual pixel cell 300. This permits each

liquid-crystal element 306 to occupy an area of 239 μm^2 , rather than only 191 μm^2 occupied by the liquid-crystal element 206 of each individual pixel cell in the spatial configuration of the display structure shown in FIGURE 2 for the same 25 μm spacing between the select lines or between data lines. In FIGURE 3, the proportion of the total area of the display structure occupied by the liquid-crystal element 306 thereof is substantially 38%, while the liquid-crystal elements 206 occupy only substantially 30% of the total area of the display structure shown in FIGURE 2. Therefore, the spatial configuration of the display structure shown in FIGURE 3 will be about 25% brighter than the display structure shown in FIGURE 2.

In addition to being brighter, the spatial configuration of the display structure shown in FIGURE 3 exhibits substantially lower parasitic capacitance than that exhibited by the display structure of FIGURE 2. In addition, the capacitance exhibited by the relatively larger-area liquid-crystal elements 306 themselves is significantly greater than the capacitance exhibited by the relatively smaller-area liquid elements 206 themselves. Thus, the ratio of parasitic capacitance to liquid-crystal element capacitance is substantially smaller. For these reasons, the undesirable effects of parasitic capacitance is materially reduced by the spatial configuration of the display structure of the present invention.

For illustrative purposes, it has been assumed that particular known integrated-circuit processes were employed in the manufacture of the display structure shown in FIGURE 3. However, the present invention is directed to the spatial configuration of the display structure, and not to the particular processes or materials employed in its manufacture. Therefore, other integrated-circuit processes known in the art may be employed to manufacture a liquid-crystal two-dimensional active dot-matrix display structure having a spatial configuration that incorporates the principles of the present invention.

Claims

1. An active matrix substrate for use in a liquid-crystal display device, said substrate having formed thereon:
 - a set of data lines (302);
 - a set of select lines (304) crossing the data lines;
 - a matrix of display electrodes (306) each adjacent a respective crossing of a respective data line and a respective select line so that the display electrodes are formed in columns corresponding to the data lines and rows corresponding to the select lines; and
 - a respective field-effect driver-transistor (308) for each display electrode, each driver-

transistor having a drain (308b) coupled to the respective display electrode, a source (308a) coupled at a respective coupling location to the respective data line, and a gate situated between the respective drain and source and coupled to the respective select line;

characterised in that:

each coupling location and the respective source are situated on the opposite side of the respective select line to the location of the respective drain whereby the respective driver-transistor has a given portion (308c) between its source and drain crossing the respective select line; and the gate of each transistor is situated at the respective given portion crossing the respective select line.

2. A substrate as claimed in claim 1, wherein the source, drain and gate of each driver-transistor are formed by respective portions of a single layer of semiconductor material.
3. A substrate as claimed in claim 2, wherein each display electrode and its respective driver-transistor are comprised of a single layer of polysilicon.
4. A substrate as claimed in any preceding claim, wherein each source overlaps and directly contacts the respective data line.
5. A substrate as claimed in any preceding claim, wherein the crossing of each given portion and its respective select line is in substantially the same area as the crossing of that select line and the respective data line.
6. A substrate as claimed in any preceding claim, wherein each select line includes V-shaped portions (310) situated at respective crossings with the data lines; and a part of the given portion of each driver transistor is disposed within the notch of the respective V-shaped portion.
7. A substrate as claimed in claim 6, wherein each gate intersects its respective select line along the V-shaped portion.
8. A substrate as claimed in any preceding claim, wherein the densities of said data lines and said select lines are each substantially greater than 3.15 lines per mm (80 lines per inch).
9. A substrate as claimed in claim 8, wherein the densities of said data lines and said select lines are each of the order of 39.4 lines per mm (1000 lines per inch).



liquid-crystal element 306 to occupy an area of 239 μm^2 , rather than only 191 μm^2 occupied by the liquid-crystal element 206 of each individual pixel cell in the spatial configuration of the display structure shown in FIGURE 2 for the same 25 μm spacing between the select lines or between data lines. In FIGURE 3, the proportion of the total area of the display structure occupied by the liquid-crystal element 306 thereof is substantially 38%, while the liquid-crystal elements 206 occupy only substantially 30% of the total area of the display structure shown in FIGURE 2. Therefore, the spatial configuration of the display structure shown in FIGURE 3 will be about 25% brighter than the display structure shown in FIGURE 2.

In addition to being brighter, the spatial configuration of the display structure shown in FIGURE 3 exhibits substantially lower parasitic capacitance than that exhibited by the display structure of FIGURE 2. In addition, the capacitance exhibited by the relatively larger-area liquid-crystal elements 306 themselves is significantly greater than the capacitance exhibited by the relatively smaller-area liquid elements 206 themselves. Thus, the ratio of parasitic capacitance to liquid-crystal element capacitance is substantially smaller. For these reasons, the undesirable effects of parasitic capacitance is materially reduced by the spatial configuration of the display structure of the present invention.

For illustrative purposes, it has been assumed that particular known integrated-circuit processes were employed in the manufacture of the display structure shown in FIGURE 3. However, the present invention is directed to the spatial configuration of the display structure, and not to the particular processes or materials employed in its manufacture. Therefore, other integrated-circuit processes known in the art may be employed to manufacture a liquid-crystal two-dimensional active dot-matrix display structure having a spatial configuration that incorporates the principles of the present invention.

Claims

1. An active matrix substrate for use in a liquid-crystal display device, said substrate having formed thereon:
 - a set of data lines (302);
 - a set of select lines (304) crossing the data lines;
 - a matrix of display electrodes (306) each adjacent a respective crossing of a respective data line and a respective select line so that the display electrodes are formed in columns corresponding to the data lines and rows corresponding to the select lines; and
 - a respective field-effect driver-transistor (308) for each display electrode, each driver-
- transistor having a drain (308b) coupled to the respective display electrode, a source (308a) coupled at a respective coupling location to the respective data line, and a gate situated between the respective drain and source and coupled to the respective select line;
 - characterised in that:
 - each coupling location and the respective source are situated on the opposite side of the respective select line to the location of the respective drain whereby the respective driver-transistor has a given portion (308c) between its source and drain crossing the respective select line; and
 - the gate of each transistor is situated at the respective given portion crossing the respective select line.
2. A substrate as claimed in claim 1, wherein the source, drain and gate of each driver-transistor are formed by respective portions of a single layer of semiconductor material.
3. A substrate as claimed in claim 2, wherein each display electrode and its respective driver-transistor are comprised of a single layer of polysilicon.
4. A substrate as claimed in any preceding claim, wherein each source overlaps and directly contacts the respective data line.
5. A substrate as claimed in any preceding claim, wherein the crossing of each given portion and its respective select line is in substantially the same area as the crossing of that select line and the respective data line.
6. A substrate as claimed in any preceding claim, wherein each select line includes V-shaped portions (310) situated at respective crossings with the data lines; and a part of the given portion of each driver transistor is disposed within the notch of the respective V-shaped portion.
7. A substrate as claimed in claim 6, wherein each gate intersects its respective select line along the V-shaped portion.
8. A substrate as claimed in any preceding claim, wherein the densities of said data lines and said select lines are each substantially greater than 3.15 lines per mm (80 lines per inch).
9. A substrate as claimed in claim 8, wherein the densities of said data lines and said select lines are each of the order of 39.4 lines per mm (1000 lines per inch).



10. A liquid-crystal display device having a substrate as claimed in any preceding claim.

Patentansprüche

1. Substrat mit aktiver Matrix für die Verwendung in einer Flüssigkristall-Anzeigevorrichtung, wobei auf dem Substrat ausgebildet sind:
Ein Satz von Datenleitungen (302),
ein Satz von Auswahlleitungen (304), welche die Datenleitungen kreuzen,
eine Matrix aus Anzeigeelektroden (306) jeweils an einem jeweiligen Kreuzungspunkt einer Datenleitung und einer Auswahlleitung, so daß die Anzeigeelektroden in Spalten ausgebildet sind, welche den Datenleitungen entsprechen und in Reihen, welche den Auswahlleitungen entsprechen, und
jeweils ein Feldeffekttreibertransistor (308) für jede Anzeigeelektrode, wobei jeder Treibertransistor eine Senke (308b) hat, die mit der jeweiligen Anzeigeelektrode verbunden ist, eine Quelle (308a) hat, die an je einer Verbindungsstelle mit der betreffenden Datenleitung verbunden ist, und ein Gatter hat, welches zwischen der jeweiligen Senke und Quelle liegt und mit der jeweiligen Auswahlleitung verbunden ist,
dadurch gekennzeichnet, daß
jede Verbindungsstelle und die betreffende Quelle bezüglich der Auswahlleitung auf der der jeweiligen Senke gegenüberliegenden Seite angeordnet sind, wodurch der jeweilige Treibertransistor einen gegebenen Abschnitt (308c) zwischen seiner Quelle und Senke hat, welcher die jeweilige Auswahlleitung kreuzt, und
daß das Gatter jedes Transistors an dem jeweils gegebenen Abschnitt angeordnet ist, der die jeweilige Auswahlleitung kreuzt.
2. Substrat nach Anspruch 1, wobei Quelle, Senke und Gatter jedes Treibertransistors durch entsprechende Bereiche einer einzelnen Schicht aus halbleitendem Material gebildet sind.
3. Substrat nach Anspruch 2, wobei jede Anzeigeelektrode und ihr entsprechender Treibertransistor aus einer einzelnen Schicht aus Polysilizium bestehen.
4. Substrat nach einem der vorstehenden Ansprüche, wobei jede Quelle die jeweilige Datenleitung überlappt und direkt kontaktiert.
5. Substrat nach einem der vorstehenden Ansprüche, wobei der Kreuzungspunkt zwischen jedem gegebenen Abschnitt und seiner entsprechenden Auswahlleitung im wesentlichen in dem gleichen

Bereich liegt wie der Kreuzungspunkt dieser Auswahlleitung und der entsprechenden Datenleitung.

6. Substrat nach einem der vorstehenden Ansprüche, wobei jede Auswahlleitung V-förmige Abschnitte (310) aufweist, die an den jeweiligen Kreuzungspunkten mit den Datenleitungen liegen, und wobei ein Teil des gegebenen Abschnittes des Treibertransistors innerhalb der Kerbe des jeweiligen V-förmigen Abschnittes abgeordnet ist.
7. Substrat nach Anspruch 6, wobei jedes Gatter seine entsprechende Auswahlleitung entlang des V-förmigen Abschnittes schneidet.
8. Substrat nach einem der vorstehenden Ansprüche, wobei die Dichte der Datenleitungen und der Auswahlleitungen beträchtlich größer ist als 3,15 Leitungen pro Meter (80 Leitungen pro Zoll).
9. Substrat nach Anspruch 8, wobei die Dichte der Datenleitungen und der Auswahlleitungen jeweils in der Größenordnung von 39,4 Leitungen pro mm (1000 Leitungen pro Zoll) liegt.
10. Flüssigkristallanzeigevorrichtung, gekennzeichnet durch ein Substrat nach einem der vorstehenden Ansprüche.

Revendications

1. Substrat de matrice active pour utilisation dans un dispositif d'affichage à cristaux liquides, ledit substrat portant :
un ensemble de lignes de données (302) ;
un ensemble de lignes de sélection (304) croisant les lignes de données ;
une matrice d'électrodes d'affichage (306) chacune adjacente à une intersection respective d'une ligne de données respective et d'une ligne de sélection respective de sorte que les électrodes d'affichage sont formées en colonnes correspondant aux lignes de données et en rangées correspondant aux lignes de sélection ;
et
un transistor d'attaque à effet de champ (308) respectif pour chaque électrode d'affichage, chaque transistor d'attaque ayant un drain (308b) relié à l'électrode d'affichage respective, une source (308a) reliée au droit d'un emplacement de connexion respectif à la ligne de données respective et une grille située entre les drain et source respectifs et reliée à la ligne de sélection respective ;
caractérisé en ce que :



chaque emplacement de connexion et la source respective sont situés, par rapport à la ligne de sélection respective, du côté opposé à l'emplacement du drain respectif, ce par quoi le transistor d'attaque respectif a une certaine partie (308c) entre sa source et son drain qui croise la ligne de sélection respective ; et

en ce que la grille de chaque transistor est située au droit de ladite certaine partie respective croisant la ligne de sélection respective.

2. Substrat selon la revendication 1, dans lequel la source, le drain et la grille de chaque transistor d'attaque sont formés par des parties respectives d'une couche unique de matière semi-conductrice.

3. Substrat selon la revendication 2, dans lequel chaque électrode d'affichage et son transistor d'attaque respectif sont constitués d'une couche unique de silicium polycristallin.

4. Substrat selon l'une quelconque des revendications précédentes, dans lequel chaque source chevauche et contacte directement la ligne de données respective.

5. Substrat selon l'une quelconque des revendications précédentes, dans lequel l'intersection de chaque dite certaine partie et sa ligne de sélection respective est sensiblement dans la même zone que l'intersection de cette ligne de sélection et de la ligne de données respective.

6. Substrat selon l'une quelconque des revendications précédentes, dans lequel chaque ligne de sélection comprend des parties (310) en forme de V situées aux intersections respectives avec les lignes de données ; et dans lequel une portion de ladite certaine partie de chaque transistor d'attaque est disposée à l'intérieur de l'encoche de la partie en forme de V respective.

7. Substrat selon la revendication 6, dans lequel chaque grille coupe sa ligne de sélection respective le long de la partie en forme de V.

8. Substrat selon l'une quelconque des revendications précédentes, dans lequel les densités desdites lignes de données et desdites lignes de sélection sont chacune sensiblement plus grandes que 3,15 lignes par mm (80 lignes par pouce).

9. Substrat selon la revendication 8, dans lequel les densités desdites lignes de données et desdites lignes de sélection sont chacune de l'ordre de 39,4 lignes par mm (1.000 lignes par pouce).

10. Dispositif d'affichage à cristaux liquides comportant un substrat selon l'une quelconque des revendications précédentes.