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(54) **METHOD OF MAKING AN OPTOELECTRONIC ORGANIC LIGHT EMITTING DIODE DISPLAY**

VERFAHREN ZUR HERSTELLUNG EINER OPTOELEKTRONISCHEN ORGANISCHEN LEUCHTDIODENANZEIGE

METHODE DE FABRICATION D'UN AFFICHEUR OPTOELECTRONIQUE A DIODES ELECTROLUMINESCENTES ORGANIQUES

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- **YAP D: "SEE-THROUGH, MULTI-PIXEL ORGANIC EMISSIVE DISPLAY" ELECTRONICS LETTERS,GB,IEE STEVENAGE, vol. 34, no. 9, 30 April 1998 (1998-04-30), pages 915-916, XP000799162 ISSN: 0013-5194**

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Description

BACKGROUND TO THE INVENTION

[0001] The present invention relates to a method of making an optoelectronic organic light emitting diode display.

[0002] Organic light emitting diodes (OLEDs) comprise certain organic materials which are known to emit light under electrical stimulation. The materials can either be small molecules or polymer materials (in polymer light emitting diodes, PLEDs). These materials require different processes for practical manufacture into display devices. Small molecule materials are deposited onto a substrate by vapour deposition whilst polymers are cast onto a substrate from a solution by spin-coating, printing, doctor blading or a reel to reel process. In a typical polymer LED, a polymer layer is deposited, by spin coating, onto indium tin oxide (ITO) coated glass. This is followed by heat treatment to drive off residual solvent and a reflective metal electrode is then evaporated onto the top surface of the polymer layer. The ITO, which is transparent, forms the other electrode and the polymer emits light through the ITO coated glass when a voltage is applied between the electrodes. Current and voltage control of the light emission is known.

[0003] Both types of materials and processes have been used to fabricate arrays on a number of different transparent and non-transparent surfaces. Methods known in the art for creating full colour displays include ink-jet printing of polymer solutions and vapour deposition of small molecule materials. Other known methods include the use of monochrome displays fitted with individual absorptive filters or colour changing media filters. Whilst both materials appear compatible with photo-resist technology, in practice the processing has reduced the efficiency and lifetime of the devices to unacceptable levels. High resolution colour and monochrome displays have been demonstrated for small molecules by depositing them into microcavities. In EP-0,774,787, a full colour OLED array is fabricated on a CMOS substrate by this method. The drivers for the diode array are formed in the substrate. The diodes are addressed by a passive matrix of conductive strips. For high resolution displays active matrix address schemes are preferable as they are more efficient.

[0004] Several different types of flat panel displays have been fabricated with active matrix address schemes. For instance, various types of liquid crystal display have been fabricated on crystalline silicon (LCOS) and other silicon materials such as polysilicon on glass. The silicon material provides the active matrix drive circuitry as well as the substrate. Similarly, a vacuum fluorescent display has been fabricated on crystalline silicon.

[0005] The manufacture of arrays of OLEDs on non-transparent substrates such as CMOS or bi-CMOS is hindered by the need to fabricate an (at least semi-) transparent electrode on top of the organic layers to allow light emission and viewing. Deposition of indium tin oxide directly onto the organic layers can cause unacceptable deterioration in the device performance. Another consideration is the need to carefully select the choice of metal electrode material directly in contact with the substrate so that it is fully compatible with microelectronic manufacturing equipment.

[0006] European Patent application EP-A-0 883 190 discloses a method of making an OLED wherein the organic light emitting layer is formed by depositing an organic light emitting donor coating on a donor support, heating the donor coating at determined locations for evaporating it through a mask to deposit it on to the lower electrode. Documents WO 98 21755 and YAP D: 'SEE-THROUGH, MULTI-PIXEL ORGANIC EMISSIVE DISPLAY' ELECTRONICS LETTERS ,GB, IEE STEVENAGE, vol. 34, no. 9, pages 915-916. disclose in an OLED a deposition of a top electrode of electrically conductive polymer and patterning.

SUMMARY OF THE INVENTION

[0007] According to the present invention there is provided a method of making an optoelectronic OLED display as recited in appended claim 4.

[0008] Preferably, the substrate is of crystalline silicon and the surface of the substrate may be polished or smoothed to produce a flat surface prior to the deposition of elctrode, or organic, materials of each OLED. Alternatively a non-planarised silicon substrate can be coated with a layer of conducting polymer to provide a smooth, flat surface prior to deposition of further materials.

[0009] In one embodiment, each OLED pixel comprises a metal electrode in contact with the substrate. Depending on the relative work functions of the metal and transparent electrodes, either may serve as the anode with the other constituting the cathode.

[0010] The metal electrode may consist of a plurality of metal layers, for example a higher work function metal such as aluminium deposited on the substrate and a lower work function metal such as calcium deposited on the higher work function metal. In another example, a further layer of conducting polymer lies on top of a stable metal such as aluminium. Preferably, the electrode also acts as a mirror behind each pixel and is either deposited on, or sunk into, the planarised surface of the substrate. However, there may alternatively be a light absorbing black layer adjacent to the substrate.

[0011] In still another embodiment, selective regions of a bottom conducting polymer layer are made non-conducting by exposure to a suitable aqueous solution allowing formation of arrays of conducting pixel pads which serve as the bottom contacts of the pixel electrodes.

[0012] The organic light emitting material is preferably a polymer but may alternatively be a monomer or a transition metal chelate. Apart from the light emitting material, organic layers in the pixel elements may include an electron transport material layer, a hole transport material layer, a protective cap material laver and a conducting polymer material layer.

[0013] As well as a conducting polymer, the light permeable electrode may comprise further layers, e.g. of indium tin oxide (ITO) or other transparent or semitransparent metal oxides or low or high work function metals, or conducting epoxy resin, deposited onto the organic layer furthest from the substrate. A glass or plastic sheet coated with the light permeable electrically conducting polymer is bonded to said furthest organic light emitting to form the electrode and serve as a barrier to the ingress of oxygen and water. The viewing surface of the display may be completed by encapsulation with a further layer of polymer or glass..

[0014] The preferred conducting polymer is poly(ethlyendioxythiophene), sold by Bayer AG under the trade mark PEDOT. Other molecularly altered poly(thiophenes) are also conducting and could be used, as could the emaraldine salt form of polyaniline. To improve the adherence of PEDOT to certain smooth substrates a polymer blend with a non-conducting polymer, preferably poly (vinyl alcohol) (PVA), can be made. For example, a 9 wt% solution of PVA with PEDOT in a 10(PVA): 6 volume ratio can be used. A wide range of molecular weights of PVA can be used without much difference in the resultant film or its conductivity.

[0015] High work function metals that could be used include tungsten, nickel, cobalt, platinum, palladium and their alloys, and possibly niobium, selenium, gold, chromium, tantalum, hafnium, technetium and their alloys.

[0016] The brightness of light emitted from each pixel is preferably controllable in an analogue manner by adjusting the voltage or current applied by the matrix circuitry or by inputting a digital signal which is converted to an analogue signal in each pixel circuit. The substrate preferably also provides data drivers, data converters and scan drivers for processing information to address the array of pixels so as to create images.

[0017] In one embodiment, each pixel is controlled by a switch comprising a voltage controlled element and a variable resistance element, both of which are conveniently formed by metal-oxide-semiconductor field effect transistors (MOSFETs). In an alternative embodiment, also preferably comprising MOSFET switches, the apparent intensity of light output from a pixel is controlled by varying the mark/space ratio of the duty cycle for which the LED is switched on, preferably by means of an analogue voltage value. This relies on the fact that for duty cycles less than about 40 ms, the eye perceives only the average brightness of the pixel during its entire duty cycle.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] In order that the present invention may be more readily understood, reference will now be made, by way of example only, to the accompanying drawings, in which:-

Figure 1 is a schematic circuit diagram of an active matrix array of pixel circuits formed by the method of the present invention;

Figure 2 shows a generic pixel circuit;

Figure 3 shows a specific pixel circuit implementing the generic pixel circuit of Figure 2;

Figure 4 is a schematic cross section of a single pixel of a planarised substrate;

Figure 5 is a schematic cross section of an alternative substrate, showing a deposited polymer LED, and

Figure 6 is a schematic, fragmentary side view of an array of polymer LEDs.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0019] Figure 1 shows a rectangular array of pixel circuits 2 and circuitry for addressing them. The intensity of light to be emitted by a polymer or other organic LED is controlled by varying the current flowing through it. This is done by applying analogue signals, provided by column lines 4 and set up by a column (data arrange) circuit 6, to the pixel circuits 2 on a row-by-row basis. The required row 8 is briefly selected by a row select circuit 10 and then deselected. During the selection time slot, the data from the column lines 4 flows into the pixel of the selected row. When deselected, each pixel circuit 2 is isolated from its column line 4 and stores the data that was input. Another set of data is assembled on the column lines 4 and another row 8 is selected. Rows may be selected sequentially or in any desired order.

[0020] Figure 2 shows a generic form of the pixel circuit 2 indicating its operating principle. The signal on row 8 operates a voltage-controlled switch 12 to close the switch during the brief selection period and connect column bus line 4 with a node in the circuit whose signal controls an electronically programmable variable resistance 14. Thus, data flows from the column bus 4 into the pixel circuit 2, current from a global power source 16 flowing through a LED 18 at a value set by the resistance 14. The intensity of light output by the LED is controlled in turn by that current. Different light intensities can be set very effectively in the different pixels in this manner.

[0021] When the switch 12 opens, the data is maintained with the pixel circuit until different data is presented when the switch closes at the next selection of the row 8.

[0022] Figure 3 shows how the circuit of Figure 2 implemented using MOS (metal-oxide-semiconductor) transistors. The voltage controlled switch is formed by a first transistor M1, the gate of which is connected to the row 8. The variable resistance is formed by the channel of a second transistor M2, which capacitatively stores charge at its gate to vary the channel resistance depending on the analogue value of the voltage generated by the stored charge. This controls the current in the LED 18 and its light output.

[0023] This is a simple but effective active pixel circuit. If it is found to suffer from pixel-to-pixel performance variations (for example due to variations in transistor threshold voltage) additional active elements can be used. Thus, for example, current mode line drivers 20 (instead of voltage mode line drivers) can be used to drive the column lines 4 shown in Figure 1. Adding the additional elements to the column lines as shown is preferable to adding them to the pixel circuits, since if the array is square and contains n^2 pixel circuits, only n additional sets of elements (e.g. 128) will be required rather than n^2 (e.g. 16,384).

[0024] Once the active matrix circuitry has been fabricated in the semiconductor substrate, for example using CMOS technology, the surface of the substrate is planarised. This planarisation either takes place as part of the manufacturing process of the integrated circuit or as a subsequent customising step.

[0025] As shown in Figure 4, the planarisation is effected by depositing a dielectric 30, for example a polymeric material, on the surface of the substrate 32. A conducting polymer that can be patterned to create areas of insulation can be used instead for this purpose. A metal mirror/electrode 34, which may be of aluminium, for connecting the LED to the appropriate point in the circuit, is then deposited, the connection to the circuit being established by a metallic conducting via 36. Metallised portions of the CMOS circuit are designated 38.

[0026] Figure 5 shows an alternative arrangement in which the electrode/mirror 34 is sunk into the dielectric surface, i.e. full planarisation is achieved.

[0027] Appropriate layers 40 of the OLED (e.g. polymer or other organic light emitting substance, conducting polymer and the like) are deposited and the display is sealed by coating with a glass plate 42.

[0028] Figure 6 shows an alternative display. On the substrate 32 there are deposited, in turn, the planarised aluminium electrode/mirror 34, optionally an electron or hole transport layer 44, a light emitting polymer 46, and a transparent electrode 48. The transparent electrode include a layer of conducting polymer 50 and may also include a thin layer of high work function metal 49, of a thickness to be adequately transparent, and a layer of ITO 51. An encapsulation layer/barrier 52 which seals all of the LEDs of the array, including their sides, completes this example of the display construction, three pixels of which are shown in Figure 6.

[0029] In manufacturing the display shown in Figure 6, the flat metal mirrors 34 are applied to the surface of the substrate 32 (preferably a CMOS or bi-CMOS backplane) so as to cover most of the area of each pixel with minimal gaps between the mirrors. Chemical Mechanical Polishing may be used to enhance the global and local planarisation.

[0030] The layers of the organic light emitting polymer can be deposited by an automated technique using equipment currently used for applying photo-resists used for the patterning of integrated circuit layers. This gives precise control and a highly uniform thickness for each layer. Alternatively, they could be ink-jet printed. Rare earth organic light emitting chelates can be vacuum deposited.

[0031] The encapsulation layer 52 is applied after making the connections to the transparent electrode in each pixel. Encapsulation, and also possibly the assembly of the pixel, are carried out in clean, dry conditions under a partial vacuum, or a suitable inert or controlled atmosphere.

[0032] The display of the invention may be monochromatic. However, monomeric and polymeric substances are now available which will emit either red, green, blue or white light and can therefore be used to form OLEDs emitting those colours. Thus, a full colour display can be formed by arranging three individual backplanes, each emitting a different primary monochrome colour, on different sides of an optical system, from another side of which a combined colour image can be viewed. Alternatively, polymers or other organic substances emitting different colours can be fabricated so that adjacent diode pixels in groups of three neighbouring pixels produce red, green and blue light. In a further alternative, field sequential colour filters can be fitted to a white light emitting display.

[0033] Optical systems can also be used for increasing the apparent size of the displayed image, since the physical size of display is limited by the size of the silicon substrate. For example, the image can be projected on to a screen.

[0034] The display of the invention is robust, the organic LEDs being well protected, but has simplified manufacture and encapsulation. The power generated as heat should be manageable but could be decreased by reducing the current or voltage used to drive each LED. If current routing problems arise, multiple power supply bond pads can be used on the silicon chip.

Claims

1. A method of making an optoelectronic organic light emitting diode display, the optoelectronic display comprising a substrate (32) of semiconducting material and an array of organic light emitting diode (OLED) pixels arranged on the substrate, wherein the substrate (32) comprises an active circuit for controlling the light emitted from each pixel, and

each pixel comprises at least one layer of organic light emitting material (46), and a light permeable electrode (43, 48) in contact with the organic layer on a side thereof remote from the substrate (32), said light permeable electrode (43, 48) comprising an electrically conducting polymer (50), **characterised in that** said electrically conducting polymer is coated on to a glass or plastics sheet (42, 52) which is then bonded to the layer of organic light emitting material (46) furthest from the substrate (32).

2. A method according to claim 1, wherein the substrate (32) is of crystalline silicon.

3. A method according to claim 1 or 2, wherein the substrate (32) has a flat planarised surface.

4. A method according to claim 1 or 2, wherein the substrate (32) has a non-planarised surface.

5. A method according to claim 1, 2 or 3, comprising providing a metal electrode (34) in contact with the substrate (32), which metal electrode also serves as a mirror behind the pixel.

6. A method according to claim 1, 2 or 3, comprising providing a light absorbing black layer adjacent to the substrate (32).

7. A method according to any preceding claim, wherein the light permeable electrode (48) includes a layer of indium tin oxide (ITO) (51).

8. A method according to any preceding claim, wherein the light permeable electrode (48) includes a layer of low work function metal.

9. A method according to any one of claims 1 to 7, wherein the light permeable electrode (48) includes a layer of high work function metal (49).

10. A method according to claim 7, wherein said ITO layer (51) is also provided as a coating on said sheet (52).

11. A method according to any preceding claim, wherein the light permeable electrode (48) includes a layer of conducting epoxy based resin.

12. A method according to any preceding claim, wherein each pixel includes a bottom electrode comprising a layer of conducting polymer.

13. A method according to any preceding claim, wherein each pixel includes a bottom electrode comprising a layer of metal oxide, such as ITO.

14. A method according to any preceding claim, wherein each pixel includes an organic electron transport layer (44) in contact with the layer of light emitting material (46).

15. A method according to any preceding claim, wherein each pixel includes an organic hole transport layer (44) in contact with the layer of light emitting material (46).

16. A method according to any preceding claim, wherein the conducting polymer (50) is deposited from a polymer blend solution including at least one non-conducting polymer.

17. A method according to any preceding claim, comprising providing a transparent, oxygen- and water-impermeable, encapsulating outer layer.

18. A method according to any preceding claim, wherein the light emitting material is monomeric.

19. A method according to any one of claims 1 to 17, wherein the light emitting material (46) is polymeric.

20. A method according to any preceding claim, wherein each OLED comprises a transition metal chelate.

21. A method according to any preceding claim, comprising providing means (12, 14) for controlling the apparent brightness of light emitted from each pixel in an analogue manner.

22. A method according to claim 21, comprising providing means by which an analogue signal varies the mark/space ratio of the duty cycle for which the OLED of each pixel is switched on.

23. A method according to claim 22, wherein the controlling means comprises a variable resistance element in each pixel circuit (2) for varying the current through the OLED and hence its light intensity output.

24. A method according to claim 23, wherein said variable resistance element comprises the channel of a metal-oxide-semiconductor field effect transistor (MOSFET) (M2).

25. A method according to claim 23 or 24, wherein each pixel circuit (2) includes a voltage-controlled switch (12, M1) for connecting a data signal to said variable resistance element (14, M2) so as to adjust its resistance.

26. A method according to claim 25, wherein said switch comprises a transistor (M1).

27. A method according to any preceding claim, comprising providing repeated groups of red-, blue- and green-emitting pixels for forming a colour image.

28. A method according to any preceding claim, wherein the display is arranged to emit white light, comprising fitting the display with field sequential colour filters for creating a colour image.

29. A method of making a colour display unit, comprising making three optoelectronic displays, in each case using the method of any one of claims 1 to 26 and each displaying an image in a different primary mono-chromatic colour, and providing an optical system for combining the three images into a colour image.

Patentansprüche

1. Verfahren zum Herstellen eines optoelektronischen Displays mit organischen Leuchtdioden, wobei das optoelektronische Display ein Substrat (32) aus halbleitendem Material und ein auf dem Substrat angeordnetes Array aus organischen Leuchtdioden-(OLED)-Pixeln enthält, wobei das Substrat (32) eine aktive Schaltung zum Steuern des von jedem Pixel emittierten Lichts umfaßt und jedes Pixel mindestens eine Schicht aus organischem lichtemittierendem Material (46) und eine lichtdurchlässige Elektrode (43, 48) in Kontakt mit der organischen Schicht auf einer vom Substrat (32) entfernten Seite davon umfaßt, wobei die lichtdurchlässige Elektrode (43, 48) ein stromleitendes Polymer (50) umfaßt, **dadurch gekennzeichnet, daß** das stromleitende Polymer auf eine Glas- oder Kunststoffplatte (42, 52) aufgetragen ist, die dann auf die am weitesten vom Substrat (32) entfernte Schicht aus organischem lichtemittierendem Material geklebt wird.

2. Verfahren nach Anspruch 1, wobei das Substrat (32) aus kristallinem Silizium besteht.

3. Verfahren nach Anspruch 1 oder 2, wobei das Substrat (32) eine flache planarisierte Oberfläche aufweist.

4. Verfahren nach Anspruch 1 oder 2, wobei das Substrat (32) eine nichtplanarisierte Oberfläche aufweist.

5. Verfahren nach Anspruch 1, 2 oder 3, mit dem Bereitstellen einer das Substrat (32) kontaktierenden Metallelektrode (34), die auch als ein Spiegel hinter dem Pixel dient.

6. Verfahren nach Anspruch 1, 2 oder 3, mit dem Bereitstellen einer lichtabsorbierenden schwarzen Schicht neben dem Substrat (32).

7. Verfahren nach einem der vorhergehenden Ansprüche, wobei die lichtdurchlässige Elektrode (48) eine Schicht aus Indium-Zinnoxid (ITO) (51) enthält.

8. Verfahren nach einem der vorhergehenden Ansprüche, wobei die lichtdurchlässige Elektrode (48) eine Schicht aus einem Metall mit einer geringen Austrittsarbeit enthält.

9. Verfahren nach einem der Ansprüche 1 bis 7, wobei die lichtdurchlässige Elektrode (48) eine Schicht aus einem Metall (49) mit hoher Austrittsarbeit enthält.

10. Verfahren nach Anspruch 7, wobei die ITO-Schicht (51) auch als eine Beschichtung auf der Platte (52) vorgesehen ist.

11. Verfahren nach einem der vorhergehenden Ansprüche, wobei die lichtdurchlässige Elektrode (48) eine Schicht aus leitendem Harz auf Epoxidbasis enthält.

12. Verfahren nach einem der vorhergehenden Ansprüche, wobei jedes Pixel eine Bodenelektrode enthält, die eine Schicht aus leitendem Polymer umfaßt.

13. Verfahren nach einem der vorhergehenden Ansprüche, wobei jedes Pixel eine Bodenelektrode enthält, die eine Schicht aus Metalloxid wie etwa ITO umfaßt.

14. Verfahren nach einem der vorhergehenden Ansprüche, wobei jedes Pixel eine organische Elektronentransportschicht (44) in Kontakt mit der Schicht aus lichtemittierendem Material (46) enthält.

15. Verfahren nach einem der vorhergehenden Ansprüche, wobei jedes Pixel eine organische Lochtransportschicht (44) in Kontakt mit der Schicht aus lichtemittierendem Material (46) enthält.

16. Verfahren nach einem der vorhergehenden Ansprüche, wobei das leitende Polymer (50) aus einer Polymermischungslösung abgeschieden wird, die mindestens ein nichtleitendes Polymer enthält.

17. Verfahren nach einem der vorhergehenden Ansprüche, mit dem Bereitstellen einer transparenten, sauerstoff- und wasserundurchlässigen verkapselnden Außenschicht.

18. Verfahren nach einem der vorhergehenden Ansprüche, wobei das lichtemittierende Material monomer ist.

19. Verfahren nach einem der Ansprüche 1 bis 17, wobei das lichtemittierende Material (46) polymer ist.

20. Verfahren nach einem der vorhergehenden Ansprüche, wobei jede OLED ein Übergangsmetallchelat umfaßt.

21. Verfahren nach einem der vorhergehenden Ansprüche, mit dem Bereitstellen von Mitteln (12, 14) zum Steuern der offensichtlichen Helligkeit von von jedem Pixel emittiertem Licht auf analoge Weise.

22. Verfahren nach Anspruch 21, mit der Bereitstellung von Mitteln, durch die ein analoges Signal das Impulslängenverhältnis der Impulsperiode variiert, während der die OLED jedes Pixels eingeschaltet ist.

23. Verfahren nach Anspruch 22, wobei das steuernde Mittel ein veränderliches Widerstandselement in jeder Pixelschaltung (2) zum Variieren des Stroms durch die OLED und somit ihre Lichtintensitätsausgabe umfaßt.

24. Verfahren nach Anspruch 23, wobei das variable Widerstandselement den Kanal eines Metalloxids-Halbleiter-Feldeffekttransistors (MOSFET) (M2) umfaßt.

25. Verfahren nach Anspruch 23 oder 24, wobei jede Pixelschaltung (2) einen spannungsgesteuerten Schalter (12, M1) zum Anschließen eines Datensignals an das veränderliche Widerstandselement (14, M2) zum Justieren seines Widerstands enthält.

26. Verfahren nach Anspruch 25, wobei der Schalter einen Transistor (M1) umfaßt.

27. Verfahren nach einem der vorhergehenden Ansprüche, mit der Bereitstellung wiederholter Gruppen von rot-, blau- und grünemittierenden Pixeln zum Ausbilden eines Farbbilds.

28. Verfahren nach einem der vorhergehenden Ansprüche, wobei das Display so angeordnet ist, daß es weißes Licht emittiert, mit dem Ausstatten des Displays mit Halbbildfolgefarbfiltern zum Herstellen eines Farbbilds.

29. Verfahren zum Herstellen einer Farbdisplayeinheit, mit dem Herstellen von drei optoelektronischen Displays, wobei in jedem Fall das Verfahren nach einem der Ansprüche 1 bis 26 verwendet wird und die jeweils ein Bild in einer anderen primären monochromatischen Farbe anzeigen, und Bereitstellung eines optischen Systems zum Verknüpfen der drei Bilder zu einem Farbbild.

Revendications

1. Méthode de fabrication d'un afficheur optoélectronique à diodes électroluminescentes organiques, l'afficheur optoélectronique comprenant un substrat (32) constitué d'une matière semi-conductrice et un réseau de pixels de diodes électroluminescentes organiques (DELO) arrangé sur le substrat, dans laquelle le substrat (32) comprend un circuit actif pour commander la lumière émise par chaque pixel, et chaque pixel comprenant au moins une couche de matière électroluminescente organique (46) et une électrode perméable à la lumière (43, 48) en contact avec la couche organique sur un côté de celle-ci distant du substrat (32), ladite électrode perméable à la lumière (43, 48) comprenant un polymère électriquement conducteur (50), **caractérisée en ce que** ledit polymère électriquement conducteur est déposé sur une feuille de verre ou de plastique (42, 52) qui est ensuite collée sur la couche de matière électroluminescente organique (46) la plus éloignée du substrat (32).

2. Méthode selon la revendication 1, dans laquelle le substrat (32) est constitué de silicium cristallin.

3. Méthode selon la revendication 1 ou 2, dans laquelle le substrat (32) présente une surface plane plate.

4. Méthode selon la revendication 1 ou 2, dans laquelle le substrat (32) présente une surface non plane.

5. Méthode selon la revendication 1, 2 ou 3, comprenant la fourniture d'une électrode métallique (34) en contact avec le substrat (32), ladite électrode métallique servant également de miroir derrière le pixel.

6. Méthode selon la revendication 1, 2 ou 3, comprenant la fourniture d'une couche noire d'absorption de la lumière adjacente au substrat (32).

7. Méthode selon l'une quelconque des revendications précédentes, dans laquelle l'électrode perméable à la lumière (48) comprend une couche d'oxyde d'étain et indium (ITO) (51).

8. Méthode selon l'une quelconque des revendications précédentes, dans laquelle l'électrode perméable à la lumière (48) comprend une couche de métal à travail d'extraction réduit.

9. Méthode selon l'une quelconque des revendications 1 à 7, dans laquelle l'électrode perméable à la lumière (48) comprend une couche de métal à travail d'extraction élevé (49).

10. Méthode selon la revendication 7, dans laquelle la-

dite couche ITO (51) est également prévue sous la forme d'un revêtement sur ladite feuille (52).

11. Méthode selon l'une quelconque des revendications précédentes, dans laquelle l'électrode perméable à la lumière (48) comprend une couche de résine conductrice à base d'époxy.

12. Méthode selon l'une quelconque des revendications précédentes, dans laquelle chaque pixel comprend une électrode inférieure comprenant une couche d'un polymère conducteur.

13. Méthode selon l'une quelconque des revendications précédentes, dans laquelle chaque pixel comprend une électrode inférieure comprenant une couche d'un oxyde de métal, tel que l'ITO.

14. Méthode selon l'une quelconque des revendications précédentes, dans laquelle chaque pixel comprend une couche de transport d'électrons organique (44) en contact avec la couche de matière électroluminescente (46).

15. Méthode selon l'une quelconque des revendications précédentes, dans laquelle chaque pixel comprend une couche de transport de trous organique (44) en contact avec la couche de matière électroluminescente (46).

16. Méthode selon l'une quelconque des revendications précédentes, dans laquelle le polymère conducteur (50) est déposé à partir d'une solution de mélange de polymères comprenant au moins un polymère non conducteur.

17. Méthode selon l'une quelconque des revendications précédentes, comprenant la fourniture d'une couche extérieure transparente enveloppante imperméable à l'eau et à l'oxygène.

18. Méthode selon l'une quelconque des revendications précédentes, dans laquelle la matière électroluminescente est monomère.

19. Méthode selon l'une quelconque des revendications 1 à 17, dans laquelle la matière électroluminescente (46) est polymère.

20. Méthode selon l'une quelconque des revendications précédentes, dans laquelle chaque DELO comprend un chélate de métal de transition.

21. Méthode selon l'une quelconque des revendications précédentes, comprenant la fourniture de moyens (12, 14) pour commander la brillance apparente de la lumière émise par chaque pixel d'une façon analogue.

22. Méthode selon la revendication 21, comprenant la fourniture de moyens par lesquels un signal analogique fait varier le rapport marque/espace du cycle opératoire pour lequel la DELO de chaque pixel est mise en circuit.

23. Méthode selon la revendication 22, dans laquelle les moyens de commande comprennent un élément à résistance variable dans chaque circuit de pixel (2) pour faire varier le courant à travers la DELO et par conséquent sa sortie d'intensité de lumière.

24. Méthode selon la revendication 23, dans laquelle ledit élément à résistance variable comprend le canal d'un transistor à effet de champ semiconducteur à oxyde métallique (MOSFET) (M2).

25. Méthode selon la revendication 23 ou 24, dans laquelle chaque circuit de pixel (2) comprend un commutateur à tension commandée (12, M1) pour connecter un signal de données audit élément à résistance variable (14, M2) de façon à régler sa résistance.

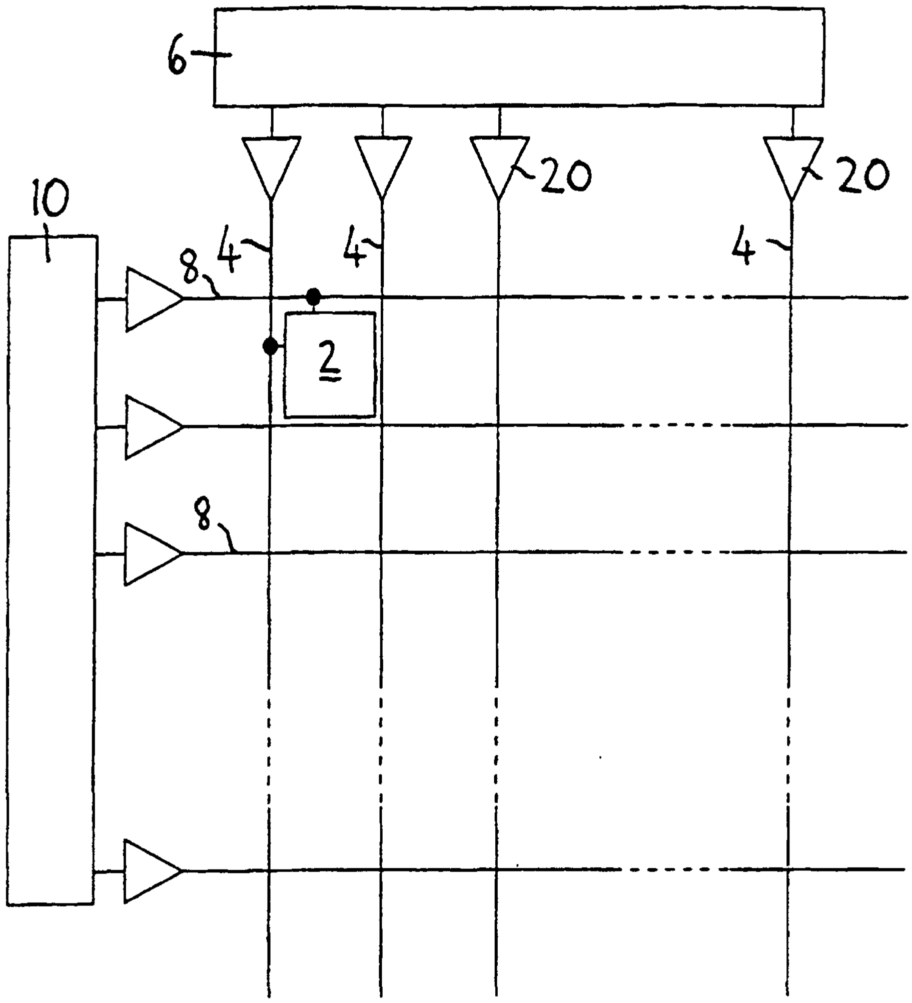
26. Méthode selon la revendication 25, dans laquelle ledit commutateur comprend un transistor (M1).

27. Méthode selon l'une quelconque des revendications précédentes, comprenant la fourniture de groupes répétés de pixels d'émission de rouge, de bleu et de vert pour former une image en couleurs.

28. Méthode selon l'une quelconque des revendications précédentes, dans laquelle l'afficheur est arrangé de manière à émettre une lumière blanche, comprenant le réglage de l'afficheur avec des filtres couleurs à séquences de trames pour créer une image en couleurs.

29. Méthode pour fabriquer une unité d'affichage en couleurs, comprenant la fabrication de trois afficheurs optoélectroniques, en utilisant dans chaque cas la méthode selon l'une quelconque des revendications 1 à 26, affichant chacun une image dans une couleur monochromatique primaire différente, et en fournissant un système optique pour combiner les trois images en une image en couleurs.

Fig. 1



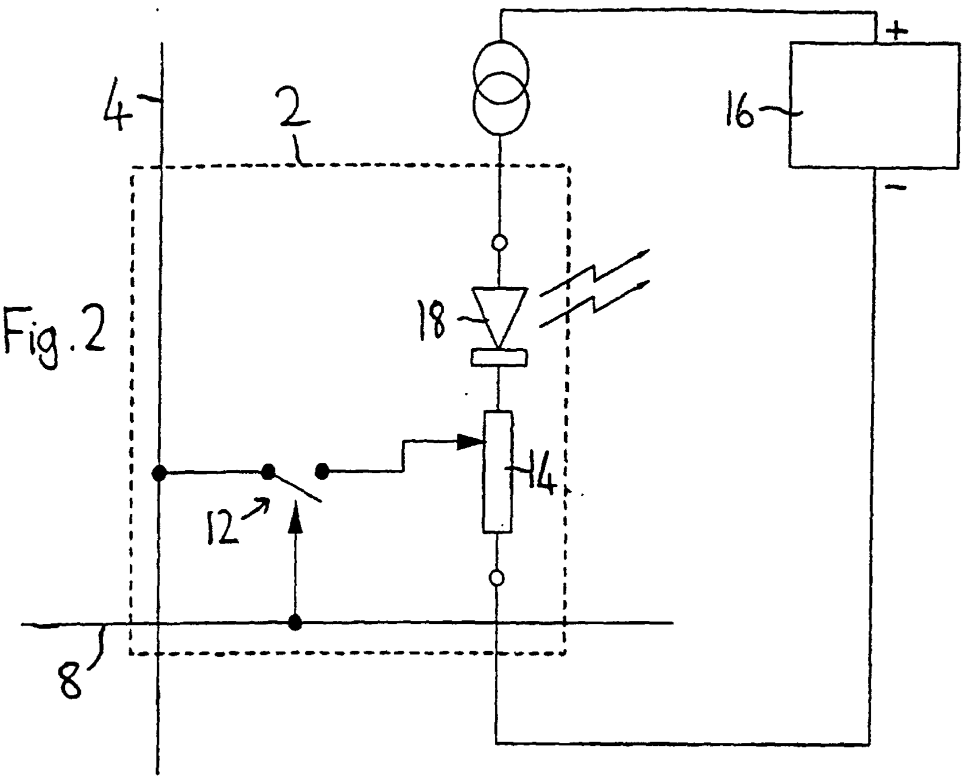


Fig. 2

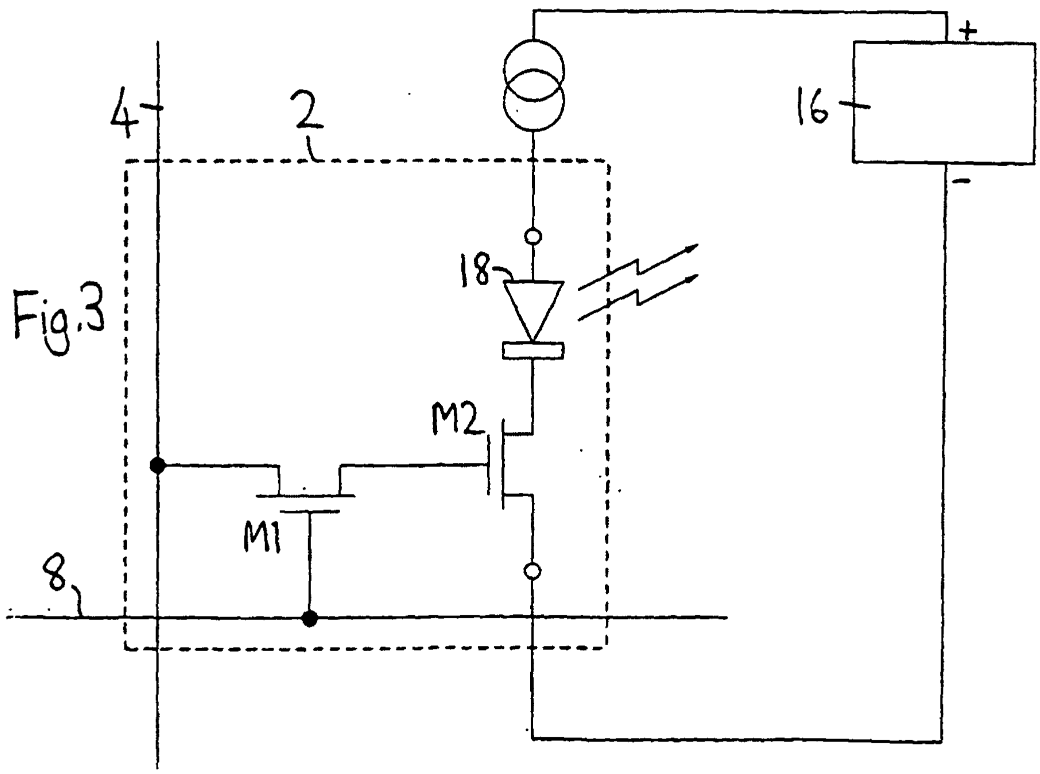


Fig. 3

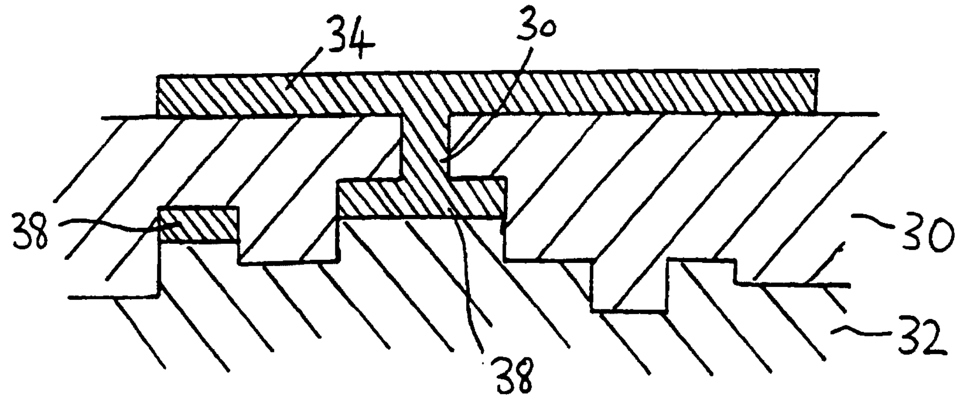


Fig. 4

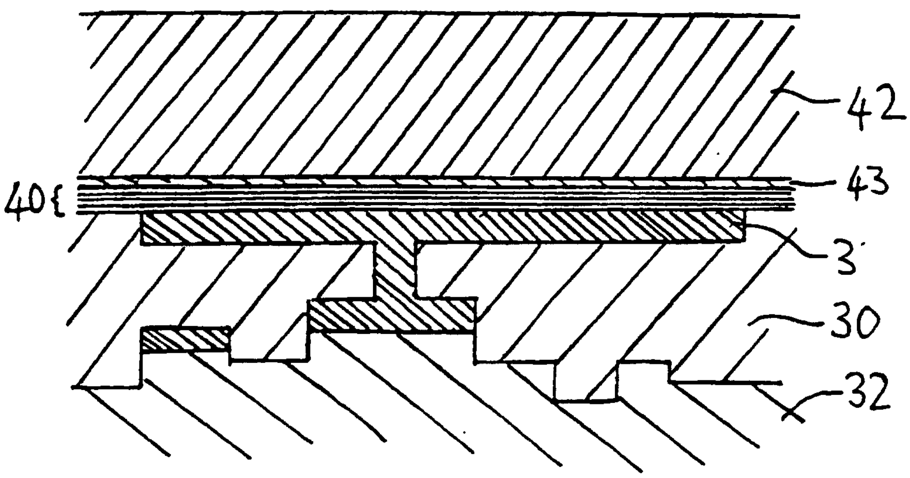


Fig. 5

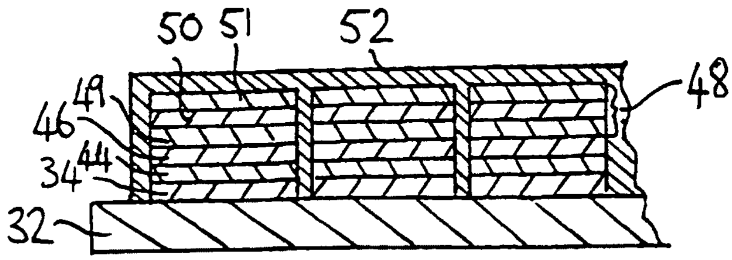


Fig. 6

专利名称(译)	制造光电有机发光二极管显示器的方法		
公开(公告)号	EP1177582B1	公开(公告)日	2004-11-03
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当前申请(专利权)人(译)	MICROEMISSIVE显示展示有限公司		
[标]发明人	WRIGHT JEFFREY PETER UNDERWOOD IAN		
发明人	WRIGHT, JEFFREY, PETER UNDERWOOD, IAN		
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外部链接	Espacenet		

摘要(译)

一种光电显示器，包括半导体材料的基板（32）和布置在基板上的有机发光二极管（OLED）像素阵列，其包括用于控制从每个像素发射的光的有源电路。每个像素包括至少一层有机发光材料（46），和在远离基板的一侧与有机层接触的（至少半透明）电极（48），该电极包括导电的聚合物（50）。

Fig. 1