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UK CL (Edition K) **H1K KBJ KDE KFX**
INT CL[5] **H01L**
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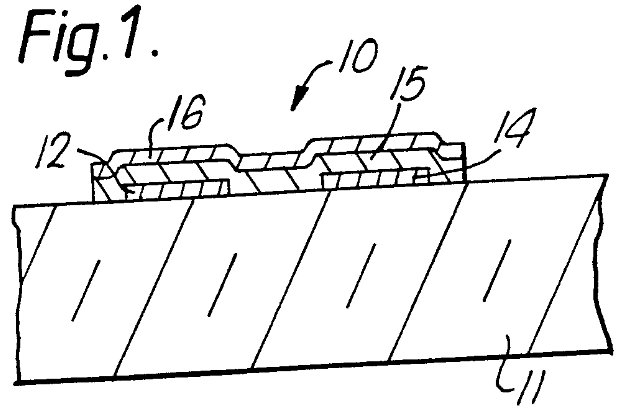
(54) **MIM type devices for displays**

(57) A MIM type non-linear device (10) comprises two conductive layers (12, 14) serving as terminals laterally spaced on the surface of a support (11), an insulating layer (15) e.g. of silicon nitride, extending over and between the layers (12, 14) and a resistive layer (16), e.g. of doped a-Si, on and co-extensive with the insulating layer (15). A further conductive layer (17) may be provided over the resisitive layer. The device exhibits substantially symmetric non-linear behaviour in operation and the series resistance afforded by the layer (16) provides protection against static discharges. An array of such devices formed on a common support is used in an active matrix display device, e.g. a liquid crystal display. The devices are connected in series between picture element electrodes and address conductors.

Fig.1.



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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Fig.1.

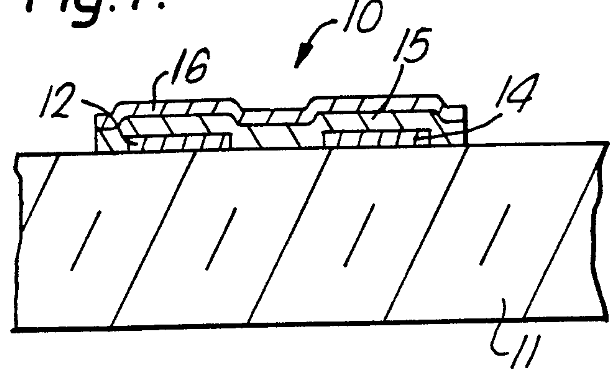

Fig.2.

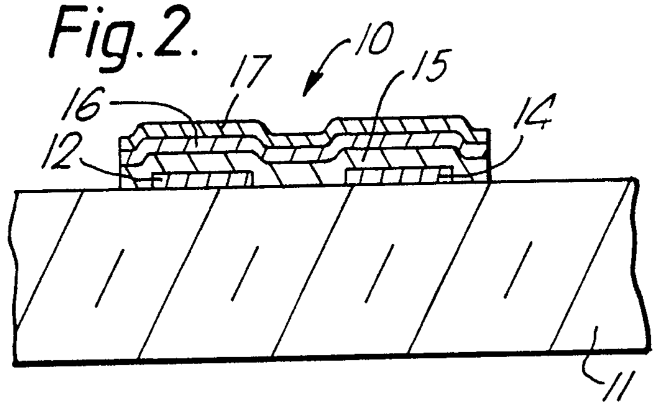

Fig.3.

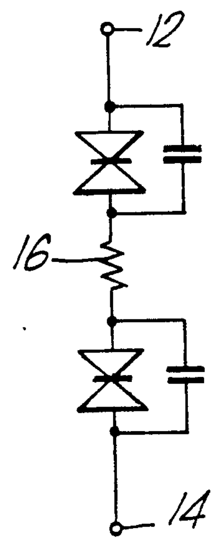

Fig.4.

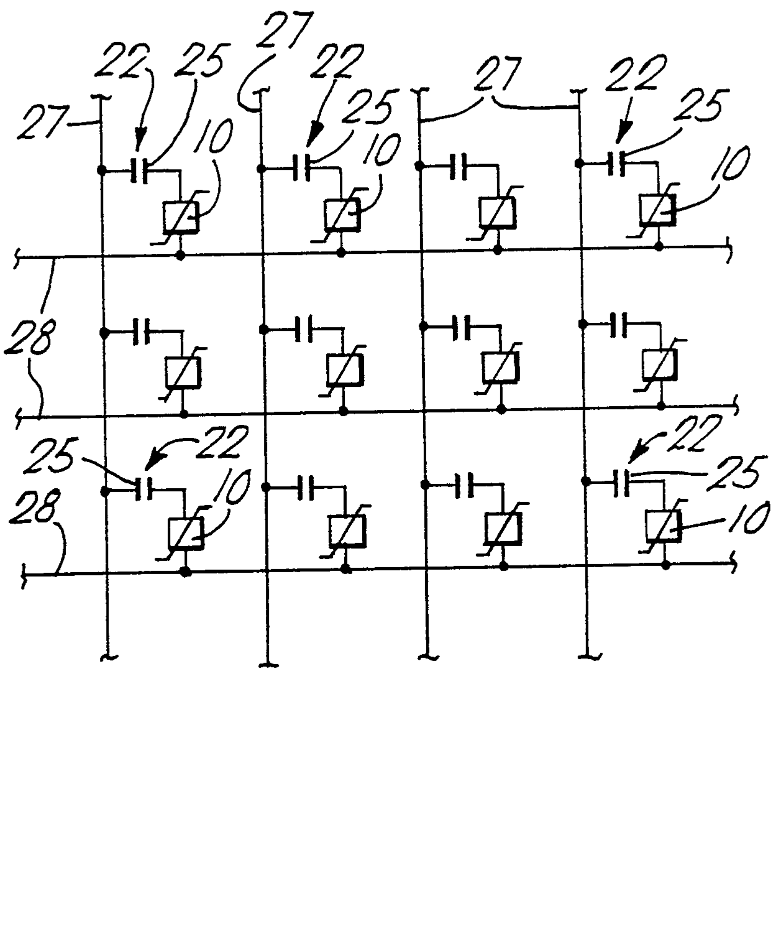

Fig.5.

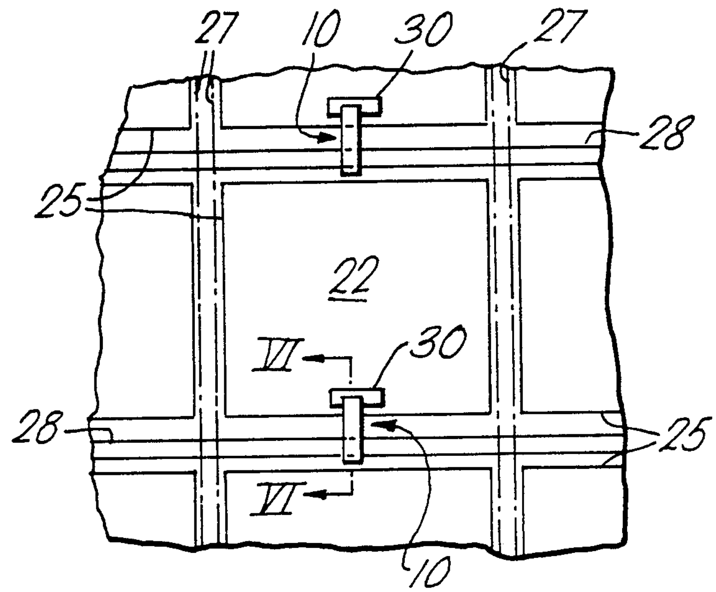
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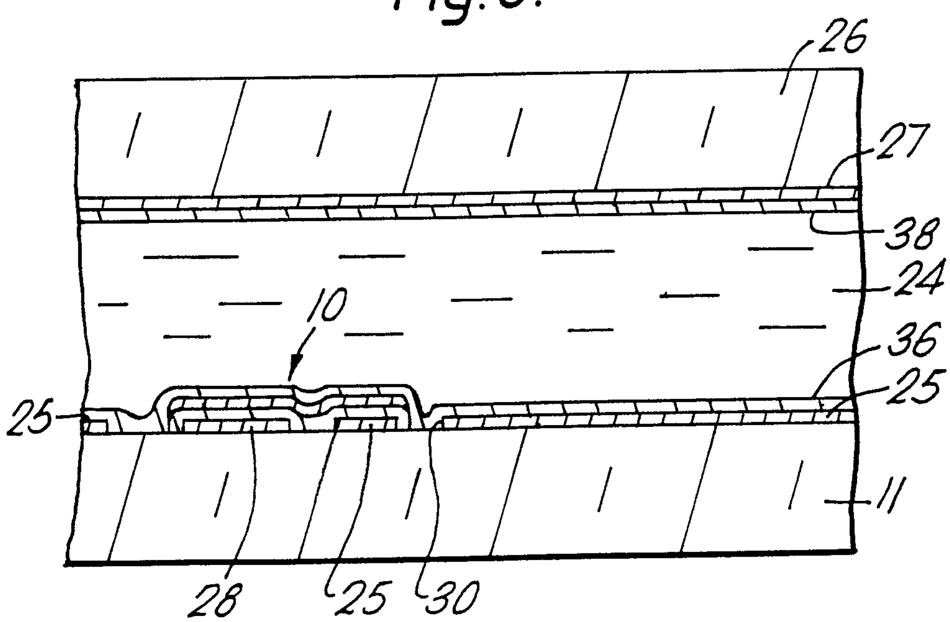
Fig.6.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DESCRIPTION

MIM TYPE DEVICES AND DISPLAY DEVICES INCORPORATING SUCH DEVICES

This invention relates to MIM (Metal-Insulator-Metal) type non-linear devices and their fabrication. The invention relates also to display devices incorporating such MIM type devices.

Known MIM devices generally comprise on a substrate a thin film insulating layer sandwiched between two conductive layers across which, in use, a voltage is applied, the device exhibiting a non-linear resistive characteristic in operation. Such devices can be regarded as a kind of diode structure. They have been used in active matrix addressed liquid crystal display devices as switching elements for controlling operation of the device's picture elements. These two terminal, non-linear devices offer advantages over TFTs also used for such purposes in that they are comparatively simple to fabricate and require fewer address lines, with no cross-overs, on their supporting substrate.

A typical MIM addressed display device consists of first and second glass substrates carrying respectively a set of row address conductors and a set of column address conductors with individual picture elements being provided at the region of the intersections of the crossing row and column conductors and comprising a picture element electrode carried on the first substrate, an opposing portion of one of the column conductors on the second substrate, together with the liquid crystal material therebetween, and is connected electrically in series with at least one MIM device between respective row and column conductors with the at least one MIM device also being carried on the first substrate adjacent to, and connected between, its respective electrode and row conductor.

The MIM devices act as bidirectional switches to control operation of their associated picture elements. By virtue of their non-linear resistance behaviour, the devices exhibit threshold characteristics and in operation turned on in response to a sufficiently high applied field to allow video data signal voltages to be transferred to the picture elements to cause the desired display response.

Although generally referred to as a Metal-Insulator-Metal device, conductive materials such as indium tin oxide (ITO) can be used as one or both of the "metal" layers and the acronym should be construed accordingly. Moreover, the term "insulator" and "insulating layer" as used herein are intended to be construed in the wider sense to include semi-insulators and non-stoichiometric materials known in the field of MIM devices.

It is important to the successful operation of MIM devices that they have good insulation properties under low applied field conditions so as to provide a high resistance and that they become conductive at higher applied fields in a controlled manner. They need to have, therefore, appropriate non-linear characteristics suited to the operational criteria existing in a liquid crystal display device. These characteristics are dependent on the composition and thickness of the insulative layer and are determined by the charge transfer mechanisms involved. The switching behaviour of many MIM devices results from tunnelling or hopping of carriers in the thin film insulating layer and in this respect the voltage/resistance characteristic of the device is dependent on the magnitude of the electric field and thus the nature and thickness of the insulating layer. In some forms of MIM devices the mechanism is controlled by the barrier between the metal and the (semi-) insulator. The thickness of the insulating layer may typically range between 50 and 100nm, depending on the kind of material and the mechanism involved.

In known types of MIM structures used in an LC display devices, as described for example in US-A-4413883 and US-A-4683183, the insulating layer may comprise tantalum pentoxide formed by partly anodising a tantalum layer constituting one of the conductive layers. The insulative tantalum pentoxide is covered by a conductive layer of nickel, chromium, tantalum, aluminium or other metal.

The I-V characteristics of these MIM devices tend to be asymmetric. In order to provide symmetrical characteristics, which readily permits the desirable polarity reversal of addressing signals when driving the display devices, it has been proposed, as described in US-A-4413883 for example, that a pair of MIM devices be used for each picture element, the MIM devices being connected in series back to back configuration or in parallel opposition configuration whereby substantially symmetrical I-V characteristics are obtained. In a described embodiment, the two MIM devices of a pair are disposed side by side on a support with respective first terminals of each device being interconnected through, and comprising portions of, a single layer defined on the support. The particular method of fabricating the pairs of MIM devices together with display element electrodes and addressing conductors on a common substrate described in this specification entails a large number of process operations which involve numerous masks and in consequence can easily lead to poor yields being obtained.

In alternative known types of MIM structures also described, materials such as silicon nitride, silicon dioxide, silicon oxynitride, silicon monoxide and zinc oxide may be used for the insulator. Further examples of MIM structures used in display devices, comprising non-stoichiometric materials, are described in EP-A-0182484.

While active matrix substrates of display devices employing MIM devices are generally simpler to construct than those using TFTs, it has been found that during the fabrication of display devices the MIM devices are susceptible to static discharge and can easily be damaged or destroyed by the effects of static electricity. Damage by static electricity is most likely to occur after the MIM devices have been fabricated on a substrate and during subsequent manufacturing or assembly processes in which the substrate is used. In a display device using an array of MIM devices as switching elements the substrate carrying the array is required to undergo various processing and assembly operations which can result in static charges being generated.

It is known to provide in the finished display device means for protecting against static discharge during subsequent operation of the display device but such means do not provide protection during manufacture and assembly.

It is one object of the present invention to provide MIM type devices suitable for use as active elements in an LC display device and exhibiting substantially symmetrical electrical characteristics.

It is another object of the present invention to provide such MIM type devices of simple construction and capable of being fabricated in arrays so that display devices incorporating the arrays can be produced in a convenient and inexpensive manner involving few process operations.

It is a further object of the invention to provide MIM type devices which are inherently less susceptible to damage by static discharge.

According to one aspect of the invention, a MIM type device comprising on a support first and second conductive layers and an insulating layer is characterised in that the first and second conductive layers are laterally spaced and substantially co-planar on the surface of the support with the insulating layer extending over and between the conductive layers, and in that a layer of resistive material is provided on the insulating layer overlying the first and second conductive layers and the region of the support surface therebetween.

This device, which is of a lateral structure form, exhibits substantially symmetrical behaviour in operation, that is substantially symmetric I-V characteristics are obtained for both polarities of voltage applied to the two conductive layers which act as terminals. When used as a switching element in an active matrix-addressed LC display device for example, this symmetrical behaviour enables the periodic reversal of drive voltage polarity in accordance with conventional practice to be accomplished conveniently and without risk of any significant DC component being present across the LC material. For simplification of understanding its structure and behaviour, the device could be regarded as equivalent to a pair of series-connected, bi-directional, non-linear elements arranged back to back, each element being constituted by a respective one of the two conductive layers and the regions of the insulator and resistive layers immediately overlying that layer with the conductive layer and the respective overlying region of the resistive layer serving as first and second terminals of the non-linear element. The respective second terminals of the two elements are interconnected through the bridging portion of the resistive layer.

The resistive layer in the device structure introduces an effective series resistance which protects the device from static damage whilst allowing the device to behave much the same as a conventional MIM device in normal operation. The resistive layer serves to limit current flow at higher applied voltages, i.e. above the normal operating range. This layer only has an appreciable effect when a high voltage is applied, that is the kind of voltage levels associated with static electricity. At comparatively low voltage levels around those normally used for driving MIM devices in active matrix addressed display devices and with which the MIM device is designed to operate, the resistive layer has practically no effect on the non-linear, switching, characteristic of the device.

A further layer of conductive material, for example a metal, may be provided on the surface of the resistive layer remote from the insulating layer overlying the first and second conductive layers and said region of the support surface. In the above-described analogous model of the device structure as two series-connected non-linear elements, this further conductive layer serves as an interconnection, in conjunction with the resistive layer, between the two elements whilst the underlying resistive layer, separating this conductive layer from the insulating layer, fulfills its intended function of protection against static discharges.

The MIM type device offers the further important advantage in that its structural configuration lends itself to a considerably simplified fabrication approach for active matrix addressed LC display devices, as will be described subsequently.

The resistive layer may comprise amorphous silicon material. Such material can conveniently be deposited in a simple manner using commonly known techniques to the required thickness when forming the MIM type device structures. Moreover, this material can be selectively doped to tailor the resistivity of the layer for optimum performance. Alternatively, oxygen-doped polycrystalline silicon material or other suitable resistive materials, such as doped silicon carbide, may be employed for this layer.

The conductive and insulating layers may comprise any materials commonly used in the art. For example, the first and second conductive layers may be of a metal such as chromium, tungsten, tantalum, nichrome, aluminium or titanium, or other conductive materials such as ITO or tin oxide. The further conductive layer overlying the insulating layer, if used, may also be of such materials. The insulating layers may be of various different materials such as silicon dioxide, silicon monoxide, silicon nitride, silicon carbide, non-stoichiometric, for example, silicon rich, mixtures of these materials, such as non-stoichiometric silicon nitride or silicon oxynitride, or tantalum oxynitride.

According to another aspect of the invention there is provided an active matrix addressed display device having a matrix array of picture elements comprising first and second opposing electrodes carried on two spaced supports with electro-optical display material, for example liquid crystal material, therebetween, the first electrode of each picture element being connected to an associated one of a plurality of address conductors on one support via a respective switching element carried on the one support, which is characterised in that each switching element comprises a MIM type device in accordance with the first aspect of the invention. It is envisaged that electro-optical material other than liquid crystal may be employed.

Preferably, the first and second conductive layers of each MIM type device comprise respectively a portion of a layer constituting the first picture element electrode and a portion of a layer constituting the associated address conductor. The two layers constituting the picture element electrode and the address conductor may both be formed from a single deposited layer or from separately deposited layers. As with liquid crystal display devices incorporating known MIM structures as switching elements, the matrix array of MIM devices in the display device of the present invention can be formed simultaneously on the one substrate using large scale photo-etching techniques to define discrete areas from common layers. Thus, in an example of the fabrication of such a display device, the picture element first electrodes and the address conductors are defined first on the surface of the support using one or more masks. Thereafter layers of insulating and resistive material, and further conductive material if desired, are deposited consecutively completely over the support covering the array of electrodes and address conductor and exposed regions of the support surface. Unwanted areas of these layers are removed by selective etching using an appropriate mask so as to leave individual islands of superposed layers at each picture element location bridging the portions of the picture element electrodes and the address conductors forming the MIM type device connecting the picture element electrode with its address conductor. If the picture element electrodes and address conductors are formed of common material, for example a metal, then these components can be defined from a single deposited layer by selective etching using one mask. Hence the structure comprising picture element electrodes, row conductors and MIM type devices on the support is fabricated using only two masking operations which is of considerable benefit in simplifying manufacture, reducing costs and increasing yields. If transparent conductive material such as ITO is desired for the picture element electrodes, it may be found that this material is not sufficiently conductive for the requirements of the address conductors. In this event, a metal layer may be provided over the transparent conductive material to form a composite address conductor structure. Alternatively, the address conductors may be fabricated solely from deposited metal, separately from the picture element electrodes. Both the above approaches to providing more highly conducting address conductors entail a further masking operation.

MIM type devices, and active matrix addressed liquid crystal display devices incorporating such devices as switching elements, in accordance with the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:-

Figures 1 and 2 show schematic cross-sectional views through two embodiments of MIM type devices according to the present invention;

Figure 3 illustrates in simplified form the equivalent circuit of the devices of Figures 1 and 2;

Figure 4 is a schematic circuit diagram of part of a liquid crystal display device according to the invention showing a number of picture elements each connected in series with a respective non-linear switching element in the form of a MIM type device between row and column address conductors;

Figure 5 is a plan schematic view of part of the display device; and

Figure 6 is a schematic cross-section through a portion of the display device.

It should be understood that the Figures are merely schematic and are not drawn to scale. In particular certain dimensions such as the thickness of layers or regions may have been exaggerated whilst other dimensions may have been reduced. It should also be understood that the same reference numerals have been used throughout the Figures to indicate the same or similar parts.

The MIM type devices of Figures 1 and 2 comprise two spaced conductive layers, serving as device terminals, and superposed insulating and resistive layers extending over and between the conductive layers. The MIM type devices exhibit substantially symmetrical behaviour in operation. The devices provide a switching characteristic by virtue of their non-linear current/voltage property whereby they exhibit a high resistance at low applied voltage and at higher applied voltages the devices' resistance drops significantly to allow comparatively high current flow therethrough. Because of their symmetry the devices demonstrate substantially identical switching characteristics in response to opposing polarity voltages of the same magnitude being applied.

Referring to Figure 1, the MIM type device, generally referenced at 10, is formed on an insulative supporting substrate 11, for example of glass, and comprises, directly on the substrate surface, a first conductive layer 12 acting as one terminal, and a second conductive layer 14 acting as the second terminal spaced laterally from, and co-planar with, the first conductive layer. In this particular embodiment, the layers 12 and 14 are of metal, such as tantalum, chromium or aluminium, although, as will be described, it may be desired to form one or both of the layers from transparent conductive material such at ITO.

Extending directly over the two layers 12 and 14 and the surface of the substrate 11 therebetween is a thin film insulating layer 15. The layer 15 in turn is covered by a co-extensive layer 16 of resistive material. In this embodiment, the layers 15 and 16 comprise respectively silicon nitride and hydrogenated amorphous silicon, a-Si:H. The layers 12, 14, 15 and 16 are each of substantially uniform thickness.

The device is fabricated by depositing sequentially the constituent layers in overlying relationship on the substrate 11. The metal layers 12 and 14 are formed from a metal film which is deposited using any suitable technique such as sputtering or evaporation and photo-lithographically defined to provide two generally rectangular pads around 10 micrometres square each having an integral lateral extension (not visible) for connection purposes. The silicon nitride and a-Si layers 15 and 16 are formed by depositing these materials as successive layers using plasma enhanced low pressure chemical vapour deposition processes, although sputtering could perhaps be used. Thereafter, unwanted portions of these layers 15 and 16 are removed by selective etching using a mask to leave a generally rectangular strip of superposed layers 15 and 16 completely covering and bridging the layers 12 and 14.

The thickness of the layers 12 and 14 is not critical but may each typically be in the order of 100 and 300 nanometres (nm) respectively in the case of tantalum and chromium. The composition and thickness of the insulating layer 15 is selected to give the required non-linear resistance characteristic and in this embodiment consists of semi-insulating, silicon-rich silicon nitride, comprising approximately 75 per cent silicon, to a thickness of around 30 to 60nm. The thickness of the resistive layer 15 is selected primarily in dependence on its resistivity. In this example heavily doped a-Si material having a resistivity of around 10^3ohm cm is deposited to a thickness of approximately 200nm. The resistivity of this layer may be varied but preferably is selected to be around 10^3 to 10^6ohm cm.

The MIM type device can be considered for simplicity as equivalent functionally to two non-linear, MIM like elements connected in series back to back, the two elements consisting of the layers 12 and 14 respectively together with their immediately overlying portions of the layers 15 and 16, which portions serve in effect as second terminals of the elements. These second terminals of the two elements are inter-connected via the intermediate part of the resistive layer 16. The spacing of the co-planar layers 12 and 14 is therefore chosen having regard to the resistivity of the layer 16 and is around 8 micrometres but could be varied for example between 3 and 10 micrometres.

The device embodiment of Figure 2 is basically identical to that of Figure 1 except that a metal layer, referenced at 17, is provided directly on, and co-extensive with, the resistive layer 16. The composition and thickness of the layer 15 is the same as before. The composition of the layer 16 is also the same but its thickness can be reduced to between 20 and 40nm. With this arrangement the portions of the layer 17 immediately overlying the first and second conductive layers 12 and 14 act as respective second terminals for the two individual non-linear elements in the above-described analogous model of the MIM type device and the part of the layer 17 bridging these two portions provides a more highly conductive interconnection between the two elements.

A simple equivalent circuit representation of the devices of Figure 1 and 2 is shown in Figure 3.

In operation of both the above-described embodiments the resistive layer introduces an effective series resistance which limits current flow at higher voltages and protects the devices from static damage. The MIM type devices function similarly to conventional MIM devices in subsequent use, for example as switching elements in a display device. Providing the layer thicknesses are suitably chosen, it can be expected that the devices will act in much the same manner, in terms of their electrical performance, as standard forms of MIM devices. The series resistance provided by the resistive layer will only have any appreciable effect when high voltages are present, as would be the case with static electricity. In the illustrative model discussed, an effective series resistance is present in each of the two non-linear elements. At normal voltage levels, that is voltages at which the devices are intended normally to be operated when used for example in a display device, typically between 5 and 20 volts, the devices behave substantially like a conventional MIM device.

Although in the above embodiments particular materials have been described for the constituent layers, it will be appreciated that different materials may be used. For example oxygen-doped polycrystalline silicon or doped silicon carbide may be used for the resistive layer. When choosing a material for the resistive layer, it is to be borne in mind that for optimum performance this layer should have sufficient ionisable centres, or provide sufficient space charge when a predetermined voltage is applied to enable the field across the insulating layer to rise causing conduction. Silicon dioxide, silicon oxy-nitride, tantalum pentoxide, aluminium oxide, and particularly non-stoichiometric mixtures of these materials may be used for the insulating layer. The thicknesses of these layers is suitably selected according to the material so as to achieve the required non-linear resistance characteristics for the device. Furthermore, metals or other conductive materials, such as tungsten, nichrome or ITO, can be used for the layers 12, 14 and, if present, 17.

For use particularly in a display device, as will be described, large numbers of such MIM type devices are fabricated simultaneously on the substrate 11 from common layers using standard large scale deposition and photo-etching techniques. The devices are arranged in a row and column array following conventional practice. The devices of each row are connected to a respective common row address conductor extending as a strip of constant width, approximately 10 micrometres, alongside the row of devices. This row conductor may be formed by deposition separately from the layers 12 and 14 of the devices and interconnected therewith by integral extensions, or may be defined from the same deposited layer used to form the layers 12 and 14. In order to simplify fabrication, however, in a preferred arrangement portions of the row conductor are used as the first conductive layers 12 of respective MIM type devices associated with the row.

A liquid crystal display device using such an array of MIM type devices will now be described with reference to Figures 4, 5 and 6 which show respectively the circuit configuration of a part of the display device comprising a few, typical, picture elements and their associated MIM type devices, a plan view of a representative picture element, and a cross-section along the line VI-VI of Figure 5 illustrating its construction.

The display device has a row and column matrix array of individual picture elements 22, only twelve of which are shown in Figure 4. In practice there may be more than 100,000 elements.

Each element 22 is defined by a pair of electrodes carried on the facing surfaces of two, spaced, glass substrates 11 and 26 with TN liquid crystal material 24 therebetween. The substrate 11 carries the array of MIM type devices. In addition, the substrate 11 carries an array of individual, generally rectangular, picture element electrodes 25 arranged in rows and columns and defining individual picture elements 22.

The substrate 26, as is usual for such display devices, carries a set of spaced, parallel, column address conductors 27 of transparent ITO, portions of which, where they overlie picture element electrodes 25, constitute the other electrodes of the elements.

The picture element electrodes 25 of all picture elements in the same row are connected on the substrate 11 to one of a set of parallel row address conductors 28, extending at right angles to the column conductors 27, via their associated series-connected MIM type devices 10. Although only one device is shown for each picture element, two or more devices could be used with each picture element in known manner.

The individual picture elements 22 are addressed in conventional fashion by applying scanning signals to each row conductor 28 in turn and video data signals appropriately, in synchronism, to the column conductors 27 (or vice versa) to operate the picture elements and modulate light transmission there through in accordance with supplied video information. The elements are typically driven using an applied voltage of between 11 and 15 volts. They are energised on a row at a time basis so as to build up a display picture, e.g. a TV picture, over one field.

The display device and its operation are similar in many respects to known LC display devices using MIM non-linear switching elements. Accordingly, the foregoing general description of the device deliberately has been kept brief. For further information, reference is invited to the specifications mentioned earlier whose disclosure in this respect is incorporated herein by reference.

Referring particularly to Figures 5 and 6, each MIM device 10 is arranged laterally of its associated picture element. The layers, or pads, 12 and 14 of the devices 10 are constituted by portions of the row conductors 28 and picture element electrodes 25 respectively. The layers 15 and 16, and 17 if present, extend over and between these portions of the row conductors and picture element electrodes.

Depending on whether a reflective or transmissive mode of operation is required the picture element electrodes may be of opaque conductive material, e.g. a metal, or transparent conductive material, e.g. ITO.

For simplicity, particularly where the electrodes 25 comprise metal, the row conductors 28 and electrodes 25 are formed simultaneously by depositing metal e.g. by evaporation or sputtering, over the substrate surface and patterning the deposited layer by etching to produce the row conductor and electrode configuration using a single mask. This mask also defines rectangular windows 30 towards an edge of the electrodes 25 adjacent the associated row conductor to create a strip approximately 10 micrometres wide and spaced approximately 8 micrometres from the row conductor.

Thereafter, successive layers of silicon nitride and a-Si:H material are deposited by low pressure chemical vapour deposition onto the substrate 11 to cover completely the conductor/electrode pattern and intermediate surface regions of the substrate. Using a second mask, the silicon nitride and a-Si:H layers are selectively etched to leave at each picture element location a rectangular island of the combined layers extending across the row conductor 28 and the peripheral strip of the picture element electrode 25 determined by the window 30, the portions of the row conductor 28 and electrode strip immediately underlying this island constituting the conductive layers 12 and 14 respectively of the MIM type device. In this way, the fabrication of the picture element electrodes, row address conductors and MIM type devices on the substrate 11 is accomplished in a simple and convenient fashion with only two masking operations being required.

If transparent picture element electrodes 25 of ITO are used, the electrodes and row conductors 28 may be formed similarly from a common layer of deposited ITO material. However, it may be necessary in this case to metallise the row conductors in a further process operation to improve their conduction.

If a metal layer 17 is provided for the devices, this can be deposited over the silicon nitride and a-Si:H layers and defined in the same masking operation used for defining the islands from the latter two layers.

The exposed surface of the structure on the active matrix substrate 11 is coated with a liquid crystal orientation layer 36, for example of polyimide, in known manner. A similar orientation layer 38 is provided over the conductors 27 on the opposing substrate 26.

Various alternative techniques may be employed, as will be apparent to persons skilled in the art. For example, when forming the row conductors 28 of metal, metal pads separate from the row conductors may be defined alongside the conductors 28 at the same time by patterning a common deposited layer, to constitute the second conductive layers 14 of the MIM type devices. The picture element electrodes 25 can then be formed in a separate operation, either before or after formation of the pads and row conductors, and arranged such that part of each pad overlies a portion of its associated picture element electrode to achieve electrical interconnection. Also, the conductive layers 12 of the devices 10 could be formed by integral lateral projections of the row conductors 28. The MIM type devices are then completed by deposition and definition of the silicon nitride and a-Si:H as previously.

For a full colour display, a colour filter array may be provided on the substrate 26 in known manner.

It will be appreciated that MIM type devices can be associated with the column conductors rather than row conductors as described. References herein to row conductors should be construed accordingly.

From reading the present disclosure, other modifications will be apparent to persons skilled in the art. Such modifications may involve other features which are already known in the field of MIM devices and display devices using MIM devices and which may be used instead of or in addition to features already described herein.

CLAIM(S)

1. A MIM type device comprising on a support first and second conductive layers and an insulating layer, characterised in that the first and second conductive layers are laterally spaced and substantially co-planar on the surface of the support with the insulating layer extending over and between the conductive layers, and in that a layer of resistive material is provided on the insulating layer overlying the first and second conductive layers and the region of the support surface therebetween.

2. A MIM type device according to Claim 1, characterised in that a further conductive layer is provided on the surface of the resistive layer remote from the insulating layer overlying the first and second conductive layers and said region of the support surface.

3. A MIM type device according to Claim 1 or Claim 2, characterised in that the resistive layer comprises amorphous silicon material.

4. A MIM-type device according to Claim 1 or Claim 2, characterised in that the resistive layer comprises polycrystalline silicon material.

5. An active matrix addressed display device having a matrix array of picture elements comprising first and second opposing electrodes carried on two spaced supports with electro-optical display material therebetween, the first electrode of each picture element being connected to an associated one of a plurality of address conductors on one support via a respective switching element carried on the one support, characterised in that each switching element comprises a MIM type device in accordance with any one of Claims 1 to 4.

6. An active matrix addressed display device according to Claim 5, characterised in that the first and second conductive layers of each MIM type device comprise respectively a portion of layer constituting the picture element first electrode and a portion of a layer constituting the associated address conductor.

7. An active matrix addressed display device according to Claim 6, characterised in that the address conductors and the picture element first electrodes are formed from a common layer.

8. An active matrix addressed display device according to Claim 6, characterised in that the address conductors comprise metal and in that the picture element first electrodes comprise transparent conductive material.

9. An active matrix addressed display device according to any one of Claims 5 to 8, characterised in that the electro-optical material comprises liquid crystal material.

10. A MIM type device substantially as hereinbefore described with reference to, and as shown in, Figures 1 to 3 of the accompanying drawings.

11. An active matrix addressed display device substantially as hereinbefore described with reference to, and as shown in, the accompanying drawings.

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