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A NOVEL LIGHT SHIELD CUM GAP FILL SCHEME FOR MICRODISPLAY BACKPLANE FABRICATION

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FIELD OF THE INVENTION

The present claimed invention relates to the field of display device technology. More particularly, the present claimed invention relates to a display device formation method and apparatus for reducing ambient light penetration into a display device.

BACKGROUND ART

Liquid crystal display devices (LCDs) are well known in the art. In particular, microdisplays are the finest panel displays which offer low power, high resolution and greater functional integration. Common to many microdisplay concepts is the use of CMOS (complementary metal oxide silicon) backplane upon which a light modulating layer is placed. Typically in microdisplays, the topmost level fabricated on the bottom substrate (sometimes referred to as the "backplane") is an array of metal pixels which are coupled to underlying transistors. A layer of liquid crystal material is disposed over the metal pixels. By selectively controlling the underlying transistors, an electric field can be generated at the array of metal pixels. This electric field, in turn, causes the liquid crystal material to selectively allow for the transmission of light therethrough. In so doing, the display is controlled to produce an image. For a microdisplay based on liquid crystal on silicon (LCOS) technology, the backplane is subjected to strong incident light in order to project a produced image onto a focal plane.



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Unfortunately, subjecting a LCOS microdisplay to strong incident light can have deleterious consequences. Specifically, such strong incident light poses a potential threat to device operation due to photoelectron generation and interference. That is, in some conventional displays
5 incident light can penetrate through the upper portion of the backplane and affect the operation of underlying active devices.

As yet another drawback to some conventional microdisplay devices, a thin passivation layer is required on top of the metal pixel to achieve
10 optimal reflectance and a reduced voltage drop across the passivation layer.

In addition, excessive step height differences between pixels can occur. Such step height differences are caused, for example, by a need to overetch the metal layer comprising the array of metal pixels. Such
15 excessive step height coupled with a thin passivation layer can result in poor sidewall coverage and may ultimately compromise passivation integrity. In all LC devices, the LC optic axis needs to be uniformly aligned to deliver desired optical performance. This is usually accomplished with an oriented alignment layer (e.g. polyimide) that aligns LC after fill.
20 Excessive gouging between the pixel cases difficulty during the LC alignment process due to nonuniformity of the spin coated polyimide.

Thus, a need exists for a display device formation method and apparatus which reduces the penetration of incident ambient light into the
25 backplane. Still another need exists for a display device formation method and apparatus which meets the above need and reduces the excessive step

height between pixels thus reducing liquid crystal alignment difficulty and improving passivation integrity.

SUMMARY OF INVENTION

The present invention provides a display device formation method and apparatus which reduces the penetration of incident ambient light into the backplane. The present invention further provides a display device
5 formation method and apparatus which achieves the above accomplishment and reduces the excessive step height between pixels thus reducing liquid crystal alignment difficulty and improving passivation integrity.

10 In one embodiment, the present invention recites forming a plurality of metal pixels wherein adjacent ones of the plurality of metal pixels have a gap region disposed therebetween. The present embodiment then recites depositing a light absorbing antireflective coating (ARC) material within the gap region to form a light shield such that transmission of incident
15 light through the gap region towards underlying active devices is reduced. Next, the present embodiment deposits a passivation layer above the plurality of metal pixels and the ARC material to passivate the backplane. As a result, the ARC material disposed in the gap region reduces the transmission of incident light between the metal pixels and towards the
20 active devices of the display.

In yet another embodiment, the present invention includes the steps of the above-described embodiment and further comprises depositing a layer of liner material prior to depositing a conductive layer of antireflective
25 coating material.

These and other objects and advantages of the present invention will no doubt become obvious to those of ordinary skill in the art after having read the following detailed description of the preferred embodiments which are illustrated in the various drawing figures.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and form a part of this specification, illustrates embodiments of the invention and, together with the description, serve to explain the principles of the

5 invention:

PRIOR ART FIGURE 1 is a side sectional view of a portion of a CMOS backplane of a LCOS microdisplay formed according to conventional methods.

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FIGURE 2A is a side sectional view of a portion of a CMOS backplane of a microdisplay having a metal pixels formed thereon in accordance with one embodiment of the present claimed invention.

15 FIGURE 2B is a side sectional view of the structure of FIGURE 2A having a Si_3N_4 liner layer deposited thereover in accordance with one embodiment of the present claimed invention.

20 FIGURE 2C is a side sectional view of the structure of FIGURE 2B wherein a conductive light absorbing antireflective coating material is deposited thereover in accordance with one embodiment of the present claimed invention.

25 FIGURE 2D is a side sectional view of the structure of FIGURE 2C wherein a layer of photosensitive material is deposited thereover in accordance with one embodiment of the present claimed invention.

FIGURE 2E is a side sectional view of the structure of FIGURE 2D wherein the layer of photosensitive material has been patterned in accordance with one embodiment of the present claimed invention.

5 FIGURE 2F is a side sectional view of the structure of FIGURE 2E wherein the antireflective coating material has been patterned in accordance with one embodiment of the present claimed invention.

 FIGURE 2G is a side sectional view of the structure of FIGURE 2F
10 wherein the remaining portions of the layer of photosensitive material have been removed in accordance with one embodiment of the present claimed invention.

 FIGURE 2H is a side sectional view of the structure of FIGURE 2G
15 wherein a thin composite passivation layer (ON) has been deposited thereover in accordance with one embodiment of the present claimed invention.

 FIGURE 3A is a side sectional view of portion of backplane of a
20 display device having a metal pixels formed thereon in accordance with one embodiment of the present claimed invention.

 FIGURE 3B is a side sectional view of the structure of FIGURE 3A wherein a non-conductive, light absorbing, antireflective coating material
25 is deposited thereover in accordance with one embodiment of the present claimed invention.

FIGURE 3C is a side sectional view of the structure of FIGURE 3B wherein a layer of photosensitive material is deposited thereover in accordance with one embodiment of the present claimed invention.

5 FIGURE 3D is a side sectional view of the structure of FIGURE 3C wherein the layer of photosensitive material has been patterned in accordance with one embodiment of the present claimed invention.

10 FIGURE 3E is a side sectional view of the structure of FIGURE 3D wherein the antireflective coating material has been patterned in accordance with one embodiment of the present claimed invention.

15 FIGURE 3F is a side sectional view of the structure of FIGURE 3E wherein the remaining portions of the layer of photosensitive material have been removed in accordance with one embodiment of the present claimed invention.

20 FIGURE 3G is a side sectional view of the structure of FIGURE 3F wherein a thin composite nitride/oxide/nitride (NON) passivation layer has been deposited thereover in accordance with one embodiment of the present claimed invention.

25 FIGURE 4 is a flow chart of steps performed in accordance with one embodiment of the present claimed invention.

 FIGURE 5 is a flow chart of steps performed in accordance with another embodiment of the present claimed invention.

The drawings referred to in this description should be understood as not being drawn to scale except if specifically noted.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference will now be made in detail to the preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings. While the invention will be described in conjunction with the preferred embodiments, it will be understood that they are not intended to limit the invention to these embodiments. On the contrary, the invention is intended to cover alternatives, modifications and equivalents, which may be included within the spirit and scope of the invention as defined by the appended claims. Furthermore, in the following detailed description of the present invention, numerous specific details are set forth in order to provide a thorough understanding of the present invention. However, it will be obvious to one of ordinary skill in the art that the present invention may be practiced without these specific details. In other instances, well known methods, procedures, components, and circuits have not been described in detail as not to unnecessarily obscure aspects of the present invention.

Figures 2A-2H and 3A-3G provide side sectional views of the structure created according to embodiments of the method of the present invention as set forth in the flow charts of Figures 4 and 5. For purposes of clarity, the following discussion will utilize the side sectional views of Figures 2A-2H and 3A-3G in conjunction with the flow charts of Figures 4 and 5 to clearly describe the embodiments of the present invention. As will be described in detail below, the present embodiments provide a light shield structure for reducing the transmission of incident light through a gap region located between adjacent ones of a plurality of metal pixels such that transmission of incident light through the gap region towards underlying

active devices is reduced. Another objective is to act as a gap fill material to improve thin passivation integrity and LC alignment problem.

First, referring briefly to Prior Art Figure 1 for background information, a side sectional view of a portion of a conventional CMOS backplane structure for a microdisplay is shown. The structure of Prior Art Figure 1 is presented here for purposes of illustration of the elements of certain conventional display devices. The embodiments of the present invention are not limited to use solely with such a structure and such elements. Specifically, the embodiments of the present invention are well suited to use with display device structures: which are comprised of a lessor or greater number of metal layers; which contain additional elements; or which contain fewer elements. Furthermore, although portions of the following discussion may specifically recite the use of various embodiments of the present invention in conjunction with a microdisplay, the present invention is well suited to use with various types of display devices other than microdisplays. Referring again to Prior Art Figure 1, there is shown a semiconductor substrate 10, preferably composed of monocrystalline silicon. Semiconductor device structures which may include polysilicon gate electrodes 14 and source and drain regions 16 are shown which in combination comprise the active devices of the display device. An insulating layer 18 is formed overlying the semiconductor device structures. Between the polysilicon gate electrodes and the top mirror layer, there can be one or more (up to five) metal layers for interconnection purposes having intermetal dielectric layers therebetween.

A barrier/glue layer 20, comprising titanium/titanium nitride is deposited over a contact hole and tungsten (W) is deposited and etched back or polished away so that a W plug is formed. Another barrier/glue material such as Ti/TiN, is then deposited before a layer of conducting material, such as aluminum or an aluminum alloy, is deposited over the barrier/glue layer and patterned to form metal lines 22. An anti-reflective coating (ARC) layer 24 may be deposited over the metal layer before patterning. An insulating layer 26, such as silicon dioxide, undoped silicate glass (USG), a tetraethoxysilane (TEOS) oxide, or the like, is deposited over the metal lines. Openings are etched through the insulating layer 26 to the metal lines, and a barrier material is deposited into the via opening. A tungsten layer is deposited over the insulating layer and within the opening and then etched back to form tungsten plugs 28. Another barrier layer and metal layer is deposited over the insulating layer 26. The top metal layer is typically aluminum or an aluminum alloy, such as AlCu or AlCuSi, with a TEOS hardmask layer.

With reference still to Prior Art Figure 1, composite passivation layer of an oxide/nitride stack oxide (can be as many as six layers) is deposited over the top metal pixel layer, optimized for reflectance. In one embodiment, the oxide/nitride stack is comprised of oxide (O), or oxide/nitride (ON), or oxide/nitride/oxide (ONO). In another embodiment, the oxide/nitride stack is comprised of nitride (N), or nitride/oxide (NO), nitride/oxide/nitride (NON). In one embodiment, the O, ON, ONO, N, NO, or NON layers will have a total thickness of between about 500 and 4,000 Angstroms. The thinner top metal stack (approximately 2000-3000 Angstroms) including the TEOS cap is patterned to form the reflective

metal pixels 32. As mentioned above, the structure of Prior Art Figure 1 is presented here for purposes of illustration of certain conventional display device characteristics, and the embodiments of the present invention are not limited solely to use with a display device having precisely the same structure and elements shown in Prior Art Figure 1.

With reference now to Figure 2A, a side sectional view of a portion of a backplane of an LCD structure is shown. The structure of Figure 2A shows a plurality of metal pixels formed above a substrate. For purposes of clarity, many of the underlying elements (such as, for example, those shown in Prior Art Figure 1) are not shown in Figure 2A. Furthermore, although not shown in Figure 2A, for purposes of clarity, it will be understood that metal pixels 202a and 202b are electrically coupled to underlying structures which extend into substrate 200 (e.g. active devices 14). Additionally, the present embodiment is well suited to use with a plurality of metal pixels which are formed at a metal layer other than the metal layer of Figure 2A. That is, the present embodiments are not limited to use with metal pixels formed using a specific one of the many metal layers used in the formation of conventional LCD devices. Also, although only two metal pixels 202a and 202b are shown in Figure 2A, it will be understood that such a limited number of metal pixels is shown for purposes of clarity.

Referring still to Figure 2A and now to step 402 of Figure 4, in the present embodiment, the plurality of metal pixels 202a and 202b are formed having a gap region 204 disposed therebetween. In some instances, the depth of gap region 204 may be exacerbated by overetching of the metal layer

from which metal pixels 202a and 202b are formed. As mentioned above, this gap depth (also referred to a step height) can result in poor sidewall coverage and may ultimately compromise the integrity of a subsequently deposited thin layer of passivation. In addition, it leads to LC alignment difficulty. As shown in Figure 2A, incident light, represented by arrows 205, may pass through gap region 204 between metal pixels 202a and 202b and ultimately impinge underlying active devices (e.g. active devices 14 of Prior Art Figure 1) after several reflections. Such impingement by incident light 205 poses a threat to device operation due to photoelectron generation/interference. As will be discussed below, the present invention provides a solution to the aforementioned problem. In one embodiment, a layer 34 (TEOS cap) is formed above metal pixels 202a and 202b.

With reference next to step 404 and Figure 2B, the present embodiment deposits a layer of liner material 206 above metal pixels 202a and 202b and into gap region 204. In one embodiment, layer of liner material 206 is comprised of a non-conductive material such as, for example, Si_3N_4 . In the present embodiment, layer of liner material 206 provides an insulating barrier between a subsequently deposited conductive ARC material such as TiN (to be discussed in detail below) and electrically conductive elements such as, for example, metal pixels 202a and 202b. However, the present invention is also well suited to an embodiment in which a layer of liner material is deposited even though material to be subsequently deposited is not conductive. Additionally, in one embodiment of the present invention, layer of liner material 206 is deposited with a thickness of approximately 500 Angstroms. Although such a thickness is recited for layer of liner material 206 in the present embodiment, the

present invention is well suited to the use with a layer of liner material which is deposited to a greater or lesser depth.

Referring now to Figure 2C, and to step 406, the present embodiment
5 then deposits a layer of light absorbing antireflective coating material 208
above layer of liner material 206, above plurality of metal pixels 202a and
202b and into gap region 204. In one embodiment, antireflective coating
material 208 is deposited within gap region 204 to a thickness of
approximately 6000-8000 Angstroms. Although such a thickness is recited
10 for the light absorbing antireflective coating material 208 in the present
embodiment, the present invention is well suited to the use with a light
absorbing antireflective coating material which is deposited to a greater or
lesser depth. Furthermore, in one embodiment, the light absorbing
antireflective coating material 208 is comprised of an organic antireflective
15 coating material such as, for example, organic bottom antireflective coating
(BARC) material. In yet another embodiment, antireflective coating
material 208 is comprised of an inorganic antireflective coating material
such as, for example, TiN or SiON. Although such materials are recited in
the present embodiment, the present embodiment is well suited to the use of
20 various other antireflective coating materials.

Referring still to step 406 and now to Figures 2D and 2E, in one
embodiment of the present invention, a layer of photosensitive material 210
such as, for example, photoresist is deposited above antireflective coating
25 material 208. As shown in Figure 2E, layer of photosensitive material 210 is
then patterned using a reverse of the top metal mask (see e.g. regions 210a,

210b, and 210c) so that the underlying antireflective coating material 208 is placed only above the gap region.

Referring now to step 408 and now to Figure 2F, using the mask
5 formed by regions 210a, 210b, and 210c of layer of photosensitive material 210, the present embodiment substantially removes layer of antireflective coating material 208 from above a huge portion of plurality of metal pixels 202a and 202b such that the antireflective coating material (see e.g. regions 208a, 208b, and 208c) remains primarily within the gap regions (e.g. gap
10 region 204) between the plurality of metal pixels 202a and 202b. That is, those portion of the antireflective coating material which were not covered by the photosensitive material are removed. The remaining portions 208a, 208b, and 208c of the antireflective coating material serve as a barrier to the incident light shown in Figure 2A. Thus, remaining portions 208a, 208b,
15 and 208c of the antireflective coating material reduce the transmission of incident light 205 through gap region 204 and towards active devices 14 of Prior Art Figure 1. As a result, the present invention reduces impingement by incident light 205 and alleviates the threat to device operation caused by photoelectron generation/interference.

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As shown in Figure 2F, in one embodiment of the present invention, remaining portions 208a, 208b, and 208c of the antireflective coating material are made to extend slightly over the edges of metal pixels 202a and 202b by slightly underexposing the reverse top metal mask. That is, in one
25 embodiment of the present invention, remaining portions 208a, 208b, and 208c of the layer of antireflective coating material "wrap around" gap region 204 to provide a effective barrier against incident light.

Referring still to step 408 and now to Figure 2G, remaining portions 208a, 208b, and 208c of the layer of antireflective coating material are shown after remaining portions 210a, 210b, and 210c of the layer of photosensitive material have been removed therefrom. One significant benefit realized by the present invention, in addition to shielding underlying devices from incident light, is the gap filling aspect of remaining portions 208a, 208b, and 208c of the layer of antireflective coating material. That is, remaining portions 208a, 208b, and 208c of the layer of antireflective coating material serve to improve the topography of the structure such that any subsequently deposited overlying passivation layer is not subjected to the excessive step height found in conventional backplane structures. The present invention is also well suited to varying the thickness of remaining portions 208a, 208b, and 208c of the layer of antireflective coating material to compensate for step height differences between adjacent ones of the plurality of metal pixels and such that adherence of the passivation layer is improved. As a result, the present embodiment improves the integrity of a subsequently deposited thin composite passivation layer.

Referring now to step 410 and to Figure 2H, the present invention then deposits a thin composite passivation layer 210 above the structure of Figure 2G (e.g. the plurality of metal pixels 202a and 202b and remaining portions 208a, 208b, and 208c of the layer of antireflective coating material). In one embodiment, thin composite passivation layer 210 is comprised, for example, of an oxide (O), oxide/nitride (ON), oxide/nitride/oxide (ONO), or oxide/nitride/oxide/nitride (ONON) layer or the like (can be as many as six layers), optimized for reflectance. This together with layer 34 (TEOS and

cap) will form an optical interface and passivation layer on the reflective metal pixel. In one embodiment, this O, ON, ONO, or ONON or the like layer will have a total thickness of between about 500 and 10,000 Angstroms. Although such materials and thicknesses are recited in the present
5 embodiment, the present embodiment is well suited to the use of various other materials having various other respective thicknesses.

With reference now to Figure 5, a flow chart 500 is shown of steps performed in accordance with another embodiment of the present claimed
10 invention. With reference now to Figure 3A, a side sectional view of a portion of a backplane of a microdisplay structure is shown. The structure of Figure 3A shows a plurality of metal pixels formed above a substrate. For purposes of clarity, many of the underlying elements (such as, for example, those shown in Prior Art Figure 1) are not shown in Figure 3A.
15 Furthermore, although not shown in Figure 3A, for purposes of clarity, it will be understood that metal pixels 202a and 202b are electrically coupled to underlying structures which extend into substrate 200 (e.g. active devices 14). Additionally, the present embodiment is well suited to use with a plurality of metal pixels which are formed at a metal layer other than the
20 metal layer of Figure 3A. That is, the present embodiments are not limited to use with metal pixels formed using a specific one of the many metal layers used in the formation of conventional LCD devices. Also, although only two metal pixels 202a and 202b are shown in Figure 3A, it will be understood that such a limited number of metal pixels is shown for
25 purposes of clarity.

Referring still to Figure 3A and now to step 502 of Figure 5, in the present embodiment, the plurality of metal pixels 202a and 202b are formed having a gap region 204 disposed therebetween. In some instances, the depth of gap region 204 may be exacerbated by overetching of the metal layer from which metal pixels 202a and 202b are formed. As mentioned above, this gap depth (also referred to a step height) can result in poor sidewall coverage and may ultimately compromise the integrity of a subsequently deposited layer of thin passivation. As shown in Figure 3A, incident light, represented by arrows 205, may pass through gap region 204 between metal pixels 202a and 202b and ultimately impinge underlying active devices (e.g. active devices 14 of Prior Art Figure 1). Such impingement by incident light 205 poses a threat to device operation due to photoelectron generation/interference. As will be discussed below, the present invention provides a solution to the aforementioned problem.

Referring now to Figure 3B, and to step 504, the present embodiment then deposits a layer of antireflective coating material 208 above layer of liner material 206, above plurality of metal pixels 202a and 202b and into gap region 204. In one embodiment, antireflective coating material 208 is deposited within gap region 204 to a thickness of approximately 6000-8000 Angstroms. Although such a thickness is recited for antireflective coating material 208 in the present embodiment, the present invention is well suited to the use with an antireflective coating material which is deposited to a greater or lesser depth. Furthermore, in one embodiment, antireflective coating material 208 is comprised of an organic antireflective coating material such as, for example, organic BARC. In yet another embodiment, antireflective coating material 208 is comprised of an

inorganic antireflective coating material such as, for example, SiON. Although such materials are recited in the present embodiment, the present embodiment is well suited to the use of various other antireflective coating materials.

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Referring still to step 504 and now to Figures 3C and 3D, in one embodiment of the present invention, a layer of photosensitive material 210 such as, for example, photoresist is deposited above antireflective coating material 208. As shown in Figure 3D, layer of photosensitive material 210 is then patterned using a reverse of the top metal mask to form a mask (see e.g. regions 210a, 210b, and 210c) so that the underlying antireflective coating material 208 is placed only above the gap region.

Referring now to step 506 and now to Figure 3E, using the mask formed by regions 210a, 210b, and 210c of layer of photosensitive material 210, the present embodiment substantially removes layer of antireflective coating material 208 from above a huge portion of plurality of metal pixels 202a and 202b such that the antireflective coating material (see e.g. regions 208a, 208b, and 208c) remains primarily within the gap regions (e.g. gap region 204) between the plurality of metal pixels 202a and 202b. That is, those portion of the antireflective coating material which were not covered by the photosensitive material are removed. The remaining portions 208a, 208b, and 208c of the antireflective coating material serve as a barrier to the incident light shown in Figure 3A. Thus, remaining portions 208a, 208b, and 208c of the antireflective coating material reduce the transmission of incident light 205 through gap region 204 and towards active devices 14 of Prior Art Figure 1. As a result, the present invention reduces

impingement by incident light 205 and alleviates the threat to device operation caused by photoelectron generation/interference. Although such a method for forming remaining portions 208a, 208b, and 208c of the antireflective coating material is recited in the present embodiment, the present invention is also well suited to use with an embodiment in which remaining portions 208a, 208b, and 208c of the antireflective coating material are formed using a different method.

As shown in Figure 3E, in one embodiment of the present invention, remaining portions 208a, 208b, and 208c of the antireflective coating material are made to extend slightly over the edges of metal pixels 202a and 202b by slightly under exposing the reverse top metal mask. That is, in one embodiment of the present invention, remaining portions 208a, 208b, and 208c of the layer of antireflective coating material "wrap around" gap region 204 to provide a effective barrier against incident light.

Referring still to step 506 and now to Figure 3F, remaining portions 208a, 208b, and 208c of the layer of antireflective coating material are shown after remaining portions 210a, 210b, and 210c of the layer of photosensitive material have been removed therefrom. One significant benefit realized by the present invention, in addition to shielding underlying devices from incident light, is the gap filling aspect of remaining portions 208a, 208b, and 208c of the layer of antireflective coating material. That is, remaining portions 208a, 208b, and 208c of the layer of antireflective coating material serve to improve the topography of the structure such that any subsequently deposited overlying passivation layer is not subjected to the excessive step height found in conventional backplane structures. The present invention

is also well suited to varying the thickness of remaining portions 208a, 208b, and 208c of the layer of antireflective coating material to compensate for step height differences between adjacent ones of the plurality of metal pixels and such that adherence of the passivation layer is improved. As a result,
5 the present embodiment improves the integrity of a subsequently deposited layer of thin composite passivation.

Referring now to step 508 and to Figure 3G, the present invention then deposits a thin composite passivation layer 210 above the structure of
10 Figure 3F (e.g. the plurality of metal pixels 202a and 202b and remaining portions 208a, 208b, and 208c of the layer of antireflective coating material). In one embodiment the composite passivation layer 210 is comprised, for example, of a nitride (N), nitride/oxide (NO), or nitride/oxide/nitride (NON) layer or the like (can be as many as six layers), optimized for reflectance.
15 This together with layer 35 (TEOS cap) will form an optical interface layer and passivation layer. In one embodiment, this N, NO, or NON or the like layer will have a total thickness of between about 500 and 4,000 Angstroms. Although such materials and thicknesses are recited in the present embodiment, the present embodiment is well suited to the use of various
20 other materials having various other respective thicknesses.

Thus, the present invention provides a display device formation method and apparatus which reduces the penetration of incident ambient light into the backplane. The present invention further provides a display
25 device formation method and apparatus which achieves the above accomplishment and reduces the excessive step height between pixels thus

reducing liquid crystal alignment difficulty and improving passivation integrity.

5 The foregoing descriptions of specific embodiments of the present invention have been presented for purposes of illustration and description. They are not intended to be exhaustive or to limit the invention to the precise forms disclosed, and obviously many modifications and variations are possible in light of the above teaching. The embodiments were chosen and described in order to best explain the principles of the invention and its
10 practical application, to thereby enable others skilled in the art to best utilize the invention and various embodiments with various modifications are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the Claims appended hereto and their equivalents.

CLAIMS

1. A method of forming a light shield for a microdisplay backplane, said method comprising the steps of:

- a) forming a plurality of metal pixels wherein adjacent ones of said plurality of metal pixels have a gap region disposed therebetween;
- b) depositing a layer of liner material above said plurality of metal pixels and into said gap region;
- c) depositing a layer of antireflective coating material above said plurality of metal pixels and into said gap region;
- d) substantially removing said layer of said antireflective coating material from above at least a portion of said plurality of metal pixels such that said antireflective coating material remains primarily within said gap region to form a light shield for said microdisplay wherein said light shield reduces transmission of incident light through said gap region towards underlying active devices, said antireflective coating material remaining primarily within said gap region having a sufficient thickness to compensate for step height differences between said adjacent ones of said plurality of metal pixels and such that adherence of a subsequently deposited overlying passivation layer will be improved; and
- e) depositing said passivation layer above said plurality of metal pixels and said antireflective coating material.

2. The method of forming a light shield for a microdisplay backbone as recited in Claim 1 wherein said step c) comprises:

- c1) depositing a layer of said antireflective coating material above said plurality of metal pixels and into said gap region;

c2) patterning and removing said antireflective coating material from above said plurality of metal pixels because said plurality of metal pixels are meant to be extremely reflective; and

c3) performing said step b2) such that said antireflective coating material remains primarily within said gap region.

3. The method of forming a light shield for a microdisplay backbone as recited in Claim 1 wherein said step c) comprises depositing said antireflective coating material within said gap region to a thickness of approximately 6000-8000 Angstroms.

4. The method of forming a light shield for a microdisplay backbone as recited in Claim 1 wherein said step c) comprises depositing an organic antireflective coating material within said gap region.

5. The method of forming a light shield for a microdisplay backbone as recited in Claim 4 wherein said step c) comprises depositing an organic antireflective coating material comprised of organic BARC within said gap region.

6. The method of forming a light shield for a microdisplay backbone as recited in Claim 1 wherein said step c) comprises depositing an inorganic antireflective coating material within said gap region.

7. The method of forming a light shield for a microdisplay backbone as recited in Claim 6 wherein said step c) comprises depositing an

inorganic antireflective coating material comprised of TiN or SiON within said gap region.

8. The method of forming a light shield for a microdisplay backbone
5 as recited in Claim 1 further comprising, prior to performing said step c):
depositing a layer of Si₃N₄ liner material above said plurality of
metal pixels and into said gap region, provided said antireflective coating
material to be deposited at said step c) is conductive.

10 9. The method of forming a light shield for a microdisplay backbone
as recited in Claim 8 comprising, prior to performing said step c):
depositing a layer of liner material selected from the group
consisting of: Si₃N₄ above said plurality of metal pixels and into said gap
region.

15 10. The method of forming a light shield for a microdisplay backbone
as recited in Claim 1 wherein said step c) comprises depositing said
antireflective coating material within said gap region at a sufficient
thickness to compensate for step height differences between said adjacent
20 ones of said plurality of metal pixels and such that adherence and integrity
of said thin passivation layer is improved.

11. In a display device, a light shield structure for reducing the
transmission of incident light through a gap region located between
25 adjacent ones of a plurality of metal pixels, said light shield structure
comprised of:

an antireflective coating material deposited primarily within said gap region to form a light shield such that transmission of incident light through said gap region towards underlying active devices is reduced; and

5 a composite passivation layer disposed above said plurality of metal pixels and said antireflective coating material.

12. The light shield structure for reducing the transmission of incident light through a gap region located between adjacent ones of a plurality of metal pixels of Claim 11 wherein said antireflective coating
10 material within said gap region has a thickness of approximately 6000-8000 Angstroms.

13. The light shield structure for reducing the transmission of incident light through a gap region located between adjacent ones of a
15 plurality of metal pixels of Claim 11 wherein said antireflective coating material is comprised of an organic material.

14. The light shield structure for reducing the transmission of incident light through a gap region located between adjacent ones of a
20 plurality of metal pixels of Claim 11 wherein said antireflective coating material is comprised of an inorganic material.

15. The light shield structure for reducing the transmission of incident light through a gap region located between adjacent ones of a
25 plurality of metal pixels of Claim 13 wherein said antireflective coating material is comprised of organic BARC.

16. The light shield structure for reducing the transmission of incident light through a gap region located between adjacent ones of a plurality of metal pixels of Claim 14 wherein said antireflective coating material is comprised of TiN or SiON.

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17. The light shield structure for reducing the transmission of incident light through a gap region located between adjacent ones of a plurality of metal pixels of Claim 11 further comprising:

10 a layer of liner material deposited above said plurality of metal pixels and into said gap region.

18. The light shield structure for reducing the transmission of incident light through a gap region located between adjacent ones of a plurality of metal pixels of Claim 17 wherein said layer of liner material is
15 selected from the group consisting of: Si₃N₄.

19. The light shield structure for reducing the transmission of incident light through a gap region located between adjacent ones of a plurality of metal pixels of Claim 17 wherein said antireflective coating
20 material is deposited within said gap region with sufficient thickness to compensate for step height differences between said adjacent ones of said plurality of metal pixels and to improve adherence and integrity of said thin composite passivation layer and ease an LC alignment process.

25 20. A method of forming a light shield for a microdisplay device, said method comprising the steps of:

a) forming a plurality of metal pixels wherein adjacent ones of said plurality of metal pixels have a gap region disposed therebetween;

b) depositing a layer of liner material above said plurality of metal pixels and into said gap region;

5 c) depositing a layer of light absorbing antireflective coating material above said plurality of metal pixels and into said gap region;

d) substantially removing said layer of said antireflective coating material from above at least a portion of said plurality of metal pixels such that said antireflective coating material remains primarily within said gap
10 region to form a light shield for said microdisplay wherein said light shield reduces transmission of incident light through said gap region towards underlying active devices, said antireflective coating material remaining primarily within said gap region having a sufficient thickness to compensate for step height differences between said adjacent ones of said
15 plurality of metal pixels and such that adherence and integrity of a subsequently deposited overlying thin passivation layer will be improved;
and

e) depositing said composite passivation layer above said plurality of metal pixels and said antireflective coating material.

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21. The method of forming a light shield for a microdisplay device as recited in Claim 20 wherein step b) comprises depositing a layer of liner material selected from the group consisting of: Si_3N_4 above said plurality of metal pixels and into said gap region.

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22. The method of forming a light shield for a microdisplay device as recited in Claim 20 wherein said step c) comprises depositing said layer of

antireflective coating material above said plurality of metal pixels and into said gap region to a thickness of approximately 6000-8000 Angstroms.

23. The method of forming a light shield for a microdisplay device as
5 recited in Claim 20 wherein said step c) comprises depositing an organic antireflective coating material within said gap region.

24. The method of forming a light shield for a microdisplay device as
recited in Claim 23 wherein said step c) comprises depositing an organic
10 antireflective coating material comprised of organic BARC within said gap region.

25. The method of forming a light shield for a microdisplay device as
recited in Claim 20 wherein said step c) comprises depositing an inorganic
15 antireflective coating material within said gap region.

26. The method of forming a light shield for a microdisplay device as
recited in Claim 25 wherein said step c) comprises depositing an inorganic
antireflective coating material comprised of TiN or SiON within said gap
20 region.