**EUROPEAN PATENT SPECIFICATION**

**Date of publication and mention of the grant of the patent:**
04.04.2018 Bulletin 2018/14

**Application number:** 11179031.7

**Date of filing:** 26.08.2011

**Backlight unit and display apparatus comprising the backlight unit**
Rückbeleuchtungseinheit und deren Anzeigevorrichtung
Dispositif de rétro-éclairage et dispositif d'affichage le comprenant

**Designated Contracting States:**
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

**Priority:** 02.11.2010 KR 20100108139

**Date of publication of application:**
02.05.2012 Bulletin 2012/18

**Proprietor:** LG Innotek Co., Ltd.
Seoul, 04637 (KR)

**Inventors:**
- Kim, Min Sang
  100-714 Seoul (KR)
- Yun, Duk Hyun
  100-714 Seoul (KR)
- Kim, Moon Jeong
  100-714 Seoul (KR)
- Seo, Jung In
  100-714 Seoul (KR)
- Kim, Jeong Hwan
  100-714 Seoul (KR)
- Jang, Ji Won
  100-714 Seoul (KR)

**Representative:** Zardi, Marco
M. Zardi & Co. SA
Via Pioda 6
6900 Lugano (CH)

**References cited:**
JP-B2- 3 043 996
US-B1- 6 313 891

---

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).
Description

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of Korean Patent Application No. 10-2010-0108139, filed on November 2, 2010.

FIELD

[0002] Embodiments relate to a backlight unit and a display apparatus using the same.

BACKGROUND

[0003] Generally, representative large-scale display apparatuses include liquid crystal displays (LCDs), plasma display panels (PDPs), etc.

[0004] Unlike self-luminous type PDPs, LCDs require a separate backlight unit because they cannot generate light by themselves.

[0005] Backlight units for use in LCDs are classified into edge type backlight units and direct type backlight units according to positions of light sources. In an edge type backlight unit, light sources are arranged at left and right edges or upper and lower edges of an LCD panel and a light guide plate is provided to uniformly distribute light throughout a surface of the LCD panel. Such an edge type backlight unit ensures uniform brightness and enables production of an extremely thin display panel.

[0006] A direct type backlight unit is generally applied to displays of 20 inches or more. The direct type backlight unit advantageously has greater light efficiency than the edge type backlight unit by virtue of a plurality of light sources arranged below a panel. Accordingly, such a direct type backlight unit is mainly used in a large-scale display requiring high brightness.

[0007] Conventional edge type or direct type backlight units use cold cathode fluorescent lamps (CCFL) as light sources thereof.

[0008] Such backlight units, which use CCFLs, however, have several disadvantages, such as consumption of a great quantity of electric power because voltage should always be applied to the CCFLs, low color reproduction efficiency (about 70% that of a cathode ray tube (CRT)), and environmental pollution caused by use of mercury.

[0009] Currently, research is being conducted into backlight units using light emitting diodes (LEDs) as a solution to the above described problems.

[0010] In the case of backlight units using LEDs, turning on or off a part of an LED array is possible, so that it may be possible to achieve remarkable reduction in power consumption. In particular, RGB LEDs exhibit color reproduction exceeding a color reproduction range of 100% specified by the National Television System Committee (NTSC) and can provide more vivid images to consumers.

SUMMARY

[0011] Further, LEDs fabricated through semiconductor processes are environmentally friendly.

[0012] Although LCD products using LEDs having the above-mentioned advantages have been introduced, these LCD products require expensive drivers, PCBs, etc. because LEDs have a driving mechanism different from conventional CCFLs. For this reason, LED backlight units are applied only to high-price LCD products at present. US 5477422 discloses a back-lit LCD apparatus comprises a LCD (1), one or more LEDs (3) (or other light sources), and a plate-like light guide (2) behind the LCD (1), and that an attenuating member (5) is included in front or behind the light guide (5). EP1978300 discloses a thin, lightweight planar lighting device capable of emitting uniform illumination light free from brightness unevenness and enabling increase in dimensions. US 6313891 B1 and JP 3043996 B2 also disclose backlight units of the state of arts.

[0013] In accordance with an embodiment, there is provided a backlight unit including absorption patterns formed on a reflection layer around a light source to partially absorb light, and a light shield layer having light shield patterns to partially shield light, thereby being capable of removing a hot spot phenomenon occurring around the light source and obtaining uniform brightness.

[0014] In accordance with another embodiment, there is provided a backlight unit wherein a groove is formed at a light guide plate to partially receive a light source, thereby reducing the thickness of the backlight unit.

[0015] Additional advantages, objects, and features of the embodiments will be set forth in part in the description which follows and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention. The objectives and other advantages of the embodiments may be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

[0016] To achieve the objects and other advantages and in accordance with the embodiments, as broadly described herein, a backlight unit according to claim 1 comprises: a first layer; a plurality of light sources on the first layer; a reflection layer for reflecting light emitted from the light source, the reflection layer disposed on the first layer in a region other than the regions where the light sources are disposed; and a plurality of absorption patterns for partially absorbing the light emitted from the light sources. This provides a backlight unit wherein the plurality of light sources emits light in an extension direction of the first layer, wherein the absorption patterns are arranged in absorption pattern groups, and...
each of the absorption pattern groups corresponds to each of the light sources, respectively, wherein the number of the absorption patterns arranged in a first direction in each of absorption pattern groups is increased and then reduced with increasing interval between absorption patterns in each of absorption pattern groups and corresponding light source, wherein the first direction is perpendicular to a second direction, and the second direction is a direction from each of light sources to corresponding absorption pattern group.

[0017] The at least one light source may include two or more light sources, and the absorption patterns may be arranged in groups such that the absorption pattern groups correspond to the light sources, respectively. The absorption patterns may be formed in a region spaced apart from the light source by 1 to 5mm.

[0018] The absorption patterns may have a density decreasing with increasing interval between the absorption patterns and the light source.

[0019] The absorption patterns may have a size reduced with increasing interval between the absorption patterns and the light source, and may be arranged such that a interval between adjacent ones of the absorption patterns increases with increasing interval between the absorption patterns and the light source.

[0020] The absorption patterns may have a size, which is constant irrespective of a interval between the absorption patterns and the light source, and may be arranged such that a interval between adjacent ones of the absorption patterns increases with increasing interval between the absorption patterns and the light source. The absorption patterns may have a size reduced with increasing interval between the absorption patterns and the light source, and may be arranged such that a interval between adjacent ones of the absorption patterns is constant irrespective of a interval between the absorption patterns and the light source.

[0021] The absorption patterns in each of the absorption pattern groups arranged to respectively correspond to the light sources may be distributed in a pentagonal shape. The absorption patterns may have a circular shape, an oval shape, or a polygonal shape.

[0022] Adjacent groups of the absorption patterns respectively arranged to correspond to adjacent ones of the light sources may be spaced apart from each other by a predetermined interval.

[0023] The absorption patterns may be made of a mixture of white ink and black ink. The white ink may include at least one of a metal, TiO₂, SiO₂, CaCO₃, and ZnO, and the black ink may include a carbon-based material.

[0024] The black ink may have a mixing ratio of 1 to 50%.

[0025] The backlight unit may further include a light guide plate to guide light emitted from the light source, and light shield patterns supported by the light guide plate while being in contact with the light guide plate or arranged to be spaced apart from the light guide plate while defining a predetermined space between the light shield patterns and the light guide plate, to partially shield the light.

[0026] The light guide pattern may have a multilayer structure having layers made of different materials. An upper one of the layers in the light guide pattern may have a larger area than a lower one of the layers. The lower layer may have a higher reflectance than the upper layer.

[0027] The light guide plate may include at least one groove to receive a portion of the at least one light source or the entirety of the at least one light source.

[0028] It is to be understood that both the foregoing general description and the following detailed description of the embodiments are exemplary and explanatory and are intended to provide further explanation of the embodiments as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] Arrangements and embodiments may be described in detail with reference to the following drawings in which like reference numerals refer to like elements and wherein:

FIGs. 1A and 1B are schematic views illustrating backlight units according to exemplary embodiments, respectively;

FIG. 2 is a plan view illustrating arrangement of the absorption patterns;

FIGs. 3A to 3C are sectional views illustrating different arrangements of absorption patterns, respectively;

FIGs. 4A to 4C are sectional views illustrating different arrangements of light shield patterns, respectively;

FIG. 5 is a sectional view illustrating light shield patterns having a multilayer structure;

FIGs. 6A to 6C are sectional views illustrating different positions of light shield patterns, respectively;

FIGs. 7 and 8 are sectional views each illustrating one light source disposed on a light guide plate;

FIG. 9 is a graph depicting the brightness of the backlight unit varying depending on whether or not absorption patterns are present;

FIG. 10 is a sectional view illustrating a display module having the backlight unit according to one of the above-described embodiments; and

FIGs. 11 and 12 are exploded perspective views each illustrating a display apparatus according to an exemplary embodiment.

DETAILED DESCRIPTION

[0030] Reference will now be made in detail to the preferred embodiments, examples of which are illustrated in the accompanying drawings.

[0031] In the following description of the embodiments, it will be understood that, when an element such as a
layer (film), region, pattern, or structure is referred to as being "on" or "under" another element, it can be "directly" or "indirectly" formed such that an intervening element is also present. Also, terms such as "on" or "under" should be understood on the basis of the drawings.

Furthermore, the expression "on" or "under" may be used herein to represent the relationship of one element to another element as illustrated in the figures. It will be understood that this expression is intended to encompass different orientations of the elements in addition to the orientation depicted in the figures, namely, to encompass both "on" and "under".

FiGs. 1A and 1B are schematic views illustrating backlight units according to exemplary embodiments, respectively. FIG. 1A illustrates a backlight unit including an edge type optical system, whereas FIG. 1B illustrates a backlight unit including a direct type optical system, not according to the invention.

As shown in FiGs. 1A and 1B, each backlight unit, which is designated by reference numeral 200, includes a first layer 210, light sources 220, a second layer 230, a reflection layer 240, and absorption patterns 260.

The plural light sources 220 are formed on the first layer 210. The reflection layer 240 is also formed over the first layer 210 to encompass the plural light sources 220.

The first layer 210 may be a substrate on which the plural light sources 220 are mounted. In this case, electrode patterns (not shown) to connect the light sources 220 to an adapter (not shown) to supply electric power may also be formed on the substrate.

For example, carbon nanotube electrode patterns (not shown) may be formed on an upper surface of the substrate to connect the light sources 220 to the adapter (not shown).

The first layer 210 may be a printed circuit board (PCB) made of polyethylene terephthalate (PET), glass, polycarbonate (PC), silicon (Si), or the like, on which the plural light sources 220 are mounted, or may take the form of a film.

Each light source 220 may be a light emitting diode (LED) chip or an LED package including at least one LED chip.

The following description associated with the illustrated embodiments will be given in conjunction with the case in which an LED package is used for each light source 220.

The LED packages, which constitute the light sources 220, may be classified into a side view type LED package and a top view type LED package in accordance with the direction of the light emitting surface thereof. The light sources 220 of FIG. 1A are side view type LED packages having light emitting surfaces to be directed to a lateral side, whereas the light sources 220 of FIG. 1B are top view type LED packages having light emitting surfaces to be directed to a top side.

In an exemplary embodiment, at least one of the side view type light source and top view type light source may be used.

In the case in which each light source 220 is a side view type LED package, the light source 220 has a light emitting surface at a side surface thereof, as shown in FIG. 1A. In this case, the light source 220 emits light in a lateral direction, namely, in an extension direction of the first layer 210 or reflection layer 240.

On the other hand, in the case in which each light source 220 is a top view type LED package, the light source 220 has a light emitting surface at a top surface, as shown in FIG. 1B. In this case, the light source 220 emits light in an upward direction, namely, in a direction toward an upper surface of the second layer 230.

Each light source 220 may include a color LED emitting light of at least one color selected from red, blue, green, etc., or a white LED.

The color LED may include at least one of red, blue, and green LEDs. Arrangement of such LEDs and colors of light emitted from the LEDs may be varied.

Meanwhile, the second layer 220, which is formed over the first layer 210 to encompass the plural light sources 220, transmits light emitted from the light sources therethrough while diffusing the light, in order to uniformly distribute the light emitted from the light sources 220 over the display panel.

The reflection layer 240 may be disposed on the first layer 210, to reflect the light emitted from the light sources 220.

The reflection layer 240 may be formed on the first layer 210 in a region other than the regions where the light sources 220 are formed.

If necessary, the reflection layer 240 may also be formed under the light sources 220.

The reflection layer 240 reflects the light emitted from the light sources 220. The reflection layer 240 also reflects light fully reflected from a boundary of the second layer 230. Thus, the reflection layer 240 may spread the light over a wider region.

The reflection layer 240 may include at least one of metals and metal oxides as reflective materials. For example, the reflection layer 240 may include a metal or a metal oxide, which has high reflectance, such as aluminum (Al), silver (Ag), or titanium dioxide (TiO2).

In this case, the reflection layer 240 may be formed by depositing or coating a metal or a metal oxide on the first layer 210. Alternatively, the reflection layer 240 may be formed by printing a metal ink on the first layer 210.

For deposition, a vacuum deposition method such as a thermal deposition method, an evaporation method, or a sputtering method may be used. For coating or printing, a printing method, a gravure coating method, or a silk screen method may be used.

Meanwhile, the second layer 230, which is disposed on the first layer 210, may be made of a transmissive material, for example, silicon or acryl-based resin.

The second layer 230 may be made of various
resin materials without being limited to the above-described material.

In order to allow light emitted from the light sources 220 to be diffused, and thus to enable the backlight unit 220 to exhibit uniform brightness, the second layer 230 may be made of a resin having a reflectance of about 1.4 to 1.6.

For example, the second layer 230 may be made of a material selected from the group consisting of polyethylene terephthalate (PET), polycarbonate (PC), polypropylene (PP), polyethylene (PE), polystyrene (PS), polyepoxy, silicon, and acryl.

The second layer 230 may include a polymer resin having sufficient adhesiveness to be firmly bonded to the light sources 220 and reflection layer 240.

For example, the second layer 230 may include unsaturated polyester, methyl methacrylate, ethyl methacrylate, isobutyl methacrylate, n-butyI metacrylate, acrylic acid, methacrylic acid, hydroxyl ethyl methacrylate, hydroxyl propyl methacrylate, hydroxyl ethyl acrylate, acrylamide, ethyl acrylate, isobutyl acrylate, and n-butyl acrylate.

The second layer 230 may be formed by coating a liquid or gel resin over the first layer 210, on which the plural light sources 220 and reflection layer 240 are formed, and then curing the coating. Alternatively, the second layer 230 may be formed by coating a resin over a support sheet, partially curing the coating, and then bonding the coating to the first layer 210.

The second layer 230 may also function as a light guide plate to guide light emitted from the light sources 220.

The absorption patterns 260 are formed in groups on portions of the reflection layer 240 adjacent to the respective light emitting surfaces of the light sources 220. The absorption patterns 260 may perform a function to partially absorb light emitted from the light sources 220.

The reason why absorption patterns 260 are formed on the reflection layer 240 in regions adjacent to the light sources 220 is as follows.

The recent tendency of backlight units is to reduce the thickness thereof, namely, to provide a slim structure. However, as the thickness of such a backlight unit is reduced, the uniformity of light emitted by the backlight unit is degraded, so that a phenomenon such as a hot spot may occur in regions adjacent to light sources.

To this end, in the illustrated embodiments, the absorption patterns 260 are provided to partially absorb light of high brightness in regions corresponding to portions of the reflection layer 240 adjacent to the light sources 220. Thus, it may be possible not only to remove a hot spot phenomenon, but also to maintain uniform brightness.

In the edge type optical system as shown in FIG. 1A, the absorption patterns 260 may be disposed to be directed to the light emitting surfaces of the light sources 220. On the other hand, in the direct type optical system not according to the invention as shown in FIG. 1B, the absorption patterns 260 may be disposed to encompass the light sources 220.

Where a plurality of light sources 220 are aligned together, it is preferred that the absorption patterns 260 be arranged in groups such that the absorption pattern groups correspond to the light sources 220, respectively.

FIG. 2 is a plan view illustrating arrangement of the absorption patterns.

Where the light sources 220 are disposed on the reflection layer 240 so as to be aligned, as shown in FIG. 2, the absorption patterns 260 may be arranged in groups such that the absorption pattern groups correspond to respective light sources 220 while being spaced apart from the corresponding light sources 220 by a predetermined interval d2, respectively.

Here, the interval d2 is about 0.1 to 1mm. The interval d2 may be varied in accordance with the interval between each light source 220 and a portion of the reflection layer 240 which light emitted from the light source 220 cannot reach.

Thus, each group of absorption patterns 260 may be formed in a region spaced apart from the corresponding light source 220 by a interval ranging from 1 mm to 5mm.

As shown in FIG. 2, the absorption patterns 260 of the absorption pattern group arranged in front of each light source 220 are distributed in a pattern distribution region 262. The pattern distribution region 262 may have a pentagonal shape.

The reason why the pattern distribution region 262 has a pentagonal shape is that it is desirable for the absorption patterns 260 to be arranged in a travel direction of light emitted from the light source 220 because the light travels while spreading horizontally.

When the pattern distribution region 262, in which absorption patterns 260 are distributed, is excessively wide, brightness may be degraded. Accordingly, it is preferred that the width of the pattern distribution region 262, which represents the number of absorption patterns 260, is reduced with increasing interval between the pattern distribution region 262 and the corresponding light source 220. In this regard, the pattern distribution region 262 may have a pentagonal shape.

If necessary, the pattern distribution region 262, in which absorption patterns 260 are distributed, may have a shape other than the pentagonal shape, for example, a circular shape, an oval shape, or a polygonal shape.

Adjacent groups of absorption patterns 260 respectively arranged to correspond to adjacent ones of the light sources 220 may be spaced apart from each other by a interval d1.

This is because, when the pattern distribution regions 262, in which absorption patterns 260 are distributed, are excessively wide, the brightness of light may be degraded.

The shape of the absorption patterns 260 is not
limited to a particular shape. For example, the absorption patterns 260 may have a circular shape, an oval shape, or a polygonal shape.

[0080] The density of absorption patterns 260 in each pattern distribution region 262 may be reduced with increasing interval between the absorption patterns 260 and the corresponding light source 220, without being limited thereto.

[0081] This is because the brightness of light reflected from a portion of the reflection layer adjacent to the light source 220 is higher than the brightness of light reflected from a portion of the reflection layer distant from the light source 220.

[0082] Accordingly, the number of absorption patterns 260 disposed in a region adjacent to the light source 220 may be greater than the number of absorption patterns 260 disposed in a region away from the light source 220.

[0083] FIGs. 3A to 3C are sectional views illustrating different arrangements of absorption patterns, respectively.

[0084] In the case of FIG. 3A, the absorption patterns 260 may have a size W1, which is increased with increasing interval between the absorption patterns 260 and the light source 220. In this case, the absorption patterns 260 may also be arranged such that the interval D1 between adjacent ones of the absorption patterns 260 increases with increasing interval between the absorption patterns 260 and the light source 220.

[0085] In the case of FIG. 3B, the absorption patterns 260 may have a size W1, which is constant irrespective of the interval between each absorption pattern 260 and the light source 220. In this case, the absorption patterns 260 may also be arranged such that the interval D1 between adjacent ones of the absorption patterns 260 increases with increasing interval between the absorption patterns 260 and the light source 220.

[0086] In the case of FIG. 3C, the absorption patterns 260 may have a size W1, which is reduced with increasing interval between the absorption patterns 260 and the light source 220. In this case, the absorption patterns 260 may also be arranged such that the interval D1 between adjacent ones of the absorption patterns 260 is constant irrespective of the interval between each absorption pattern 260 and the light source 220.

[0087] The absorption patterns 260 arranged as described above may be made of a mixture of white ink and black ink.

[0088] The white ink may be at least one of a metal, TiO2, SiO2, CaCO3, and ZnO. The black ink may include a carbon-based material.

[0089] In the mixture of white ink and black ink, the rate of the black ink may be about 3 to 15%. The rate of the black ink may also be about 1 to 50%. The rate of the black ink may be excessively higher than the above-described reference value, a dark region may be generated in a region adjacent to the light source 220. On the other hand, when the rate of black ink is excessively lower than the reference value, a hot spot may be generated in a region adjacent to the light source 220.

[0091] Although a hot spot phenomenon may be reduced in the backlight unit, which has absorption patterns, light shield patterns may be additionally formed to obtain uniform brightness.

[0092] The light shield patterns reduce the brightness of light emitted from a region adjacent to the light source, in order to enable the backlight unit to emit light of uniform brightness.

[0093] FIGs. 4A to 4C are sectional views illustrating different arrangements of light shield patterns, respectively.

[0094] As shown in FIGs. 4A to 4C, light shield patterns 250 are supported by the second layer 230 while being in contact with the second layer 230. Alternatively, the light shield patterns 250 may be spaced apart from the second layer 230 by a predetermined spacing. The light shield patterns 250 may shield a portion of light emitted from the light sources 220.

[0095] The light shield pattern 250 may have a single layer structure or a multi-layer structure.

[0096] The light shield patterns 250 may have a width, which is constant irrespective of the interval between each light shield pattern 250 and the light emitting surface of the corresponding light source 220, or is reduced with increasing interval between the light shield patterns 250 and the corresponding light source 220.

[0097] The light shield patterns 250 may also have a thickness, which is constant irrespective of the interval between each light shield pattern 250 and the light emitting surface of the corresponding light source 220, or is reduced with increasing interval between the light shield patterns 250 and the corresponding light source 220.

[0098] The light shield patterns 250 may be made of at least one of a metal, Al, TiO2, SiO2, CaCO3, and ZnO.

[0099] Thus, the light shield patterns 250 may have a size and a density, which are varied in accordance with the interval between each light shield pattern 250 and the corresponding light source 220, in order to uniformly control brightness.

[0100] In the case of FIG. 4A, the light shield patterns 250 may have a spacing D2, which increases with increasing interval between the light shield patterns 250 and the corresponding light source 220. In this case, the light shield patterns 250 may also have a size W2, which is constant irrespective of the interval between each light shield pattern 250 and the corresponding light source 220.

[0101] In the case of FIG. 4B, the light shield patterns 250 may have a spacing D2, which increases with increasing interval between the light shield patterns 250 and the corresponding light source 220. In this case, the light shield patterns 250 may also have a size W2, which decreases with increasing interval between the light shield patterns 250 and the corresponding light source 220.

[0102] In the case of FIG. 4C, the light shield patterns
250 may have a spacing D2, which is constant irrespec-
tive of the interval between each light shield pattern 250
and the corresponding light source 220. In this case, the
light shield patterns 250 may also have a size W2, which
decreases with increasing interval between the light
shield patterns 250 and the corresponding light source
220.
[0103] The light shield patterns 250, which are ar-
ranged as described above, may have a single layer
structure or a multilayer structure, which exhibits different
light transmittances at different regions thereof.
[0104] When each light shield pattern 250 has a mul-
tilayer structure, the materials of the layers thereof may
be different.
[0105] FIG. 5 is a sectional view illustrating light shield
patterns having a multilayer structure.
[0106] As shown in FIG. 5, each light shield pattern
250 may include a lower layer 252, and an upper layer
254 to cover the lower layer 252.
[0107] In this case, the light shield pattern 250 may be
formed such that the upper layer 254 has a larger area
than the lower layer 252.
[0108] Also, in each light shield pattern 250, the lower
layer 252 exhibits a higher reflectance than the upper
layer 254.
[0109] For example, the lower layer 252 of each light
shield pattern 250 may include Al, whereas the upper
layer 252 of the light shield pattern 250 may include TiO2
or SiO2.
[0110] The reason why each light shield pattern 250 is
formed to have a multilayer structure, as described
above, is as follows. When each light shield pattern 250
has a single layer structure, reflected light may leak
around the light shield pattern 250. It may possible to
scatter the light leaking around the light shield pattern
250 by constituting the light shield pattern 250 of a lower
layer 252 and an upper layer 254 having a lower reflect-
ance than the lower layer 252. In this case, accordingly,
it may be possible to control brightness.
[0111] It is also preferred that the total thickness t of
each light shield pattern 250 be about 3 to 5μm.
[0112] When the thickness of each light shield pattern
250 exceeds the above-described reference value, light
may be completely shielded, so that a dark region may
be generated. In this case, the total thickness of the back-
light unit may also be increased. On the other hand, when
the thickness of each light shield pattern 250 does not
exceed the reference value, light exhibits wavelength
shift while passing through the light shield pattern 250,
so that color variation to yellow may occur.
[0113] FIGs. 6A to 6C are sectional views illustrating
different positions of light shield patterns, respectively.
[0114] In the case of FIG. 6A, the light shield pattern
250 may be formed beneath a diffusion layer 270.
[0115] That is, the diffusion layer 270 may be disposed
over the light shield pattern 250 to upwardly diffuse light.
In this case, the diffusion layer 270 may be directly bond-
ed to the light shield pattern 250 or may be bonded to
the light shield pattern 250 by a separate bonding mem-
er.
[0116] In this case, the diffusion layer 270 diffuses light
incident thereupon, thereby preventing light emerging
from the light shield pattern 250 from being locally con-
centrated. Thus, it may be possible to obtain more uni-
form brightness of light.
[0117] As shown in FIG. 6B, the light shield pattern 250
may be spaced apart from the second layer 230, which
is made of a transmissive material, by a space 280 filled
with air or gas. As shown in FIG. 6C, a buffer layer 290
may also be formed between the light shield pattern 250
and the second layer 230.
[0118] The buffer layer 290 may be the diffusion layer
270 of FIG. 6A or may be a layer having a different re-
fractive index than the second layer 230. Alternatively,
the buffer layer 290 may be an adhesive layer to enhance
the bonding force between the light shield pattern 250
and the second layer or a heat absorption layer remaining
after formation of the light shield pattern 250.
[0119] FIGs. 7 and 8 are sectional views each illustrat-
ing one light source disposed on a light guide plate.
[0120] As shown in FIGs. 7 and 8, when the second
layer 230 is a light guide plate, this light guide plate may
have at least one groove 310 to insert a portion of the
light source or the entirety of the light source.
[0121] The groove 310 may be formed at the light guide
plate to a predetermined depth in a region where the light
source 220 will be disposed.
[0122] After formation of the groove 310, the light
source 220 is arranged to be inserted into the groove
310. Thus, it may be possible to reduce the total thickness
of the backlight unit.
[0123] As shown in FIG. 7, a support portion 221 of the
light source 220 may be partially protruded from the
groove 310 of the light guide plate. Alternatively, the en-
tire portion of the light source 220 including the support
portion 221 may be completely inserted into the groove
310 of the light guide plate.
[0124] FIG. 9 is a graph depicting the brightness of the
backlight unit varying depending on whether or not ab-
sorption patterns are present.
[0125] When a variation in the brightness of light de-
pending on a variation in the interval from the light source
is measured, high brightness is exhibited in a region adja-
cent to the light source in the case of a backlight unit
having no absorption pattern, as shown in FIG. 9. On the
other hand, in the case of a backlight unit having absorp-
tion patterns, uniform brightness is exhibited even in the
region adjacent to the light source, as shown in FIG. 9.
[0126] In the backlight unit, which has absorption pat-
terns, there is no hot spot phenomenon occurring in the
region adjacent to the light source. In this case, it may
also be possible to obtain uniform brightness throughout
the backlight unit.
[0127] That is, the absorption patterns, which are
formed on the reflection layer around the light source,
partially absorb light, thereby removing a hot spot phe-
In one exemplary embodiment as described above, light shield patterns, each of which has a multilayer structure, are formed around respective light sources, to adjust the transmittance of light. Accordingly, it may be possible to reduce the transmittance of light in a region adjacent to the light source while minimizing color variation of the transmitted light.

In one exemplary embodiment, each light source is partially inserted into a corresponding one of the grooves formed at the light guide plate. Accordingly, it may be possible to reduce the total thickness of the backlight unit.

FIG. 10 is a sectional view illustrating a display module having the backlight unit according to one of the above-described embodiments.

As shown in FIG. 10, the display module 20 may include a display panel 100 and a backlight unit 200.

The display panel 100 may include a color filter substrate 110 and a thin film transistor (TFT) substrate 120, which are assembled to face each other while defining a uniform cell gap therebetween. A liquid crystal layer (not shown) may be interposed between the two substrates 110 and 120.

An upper polarizing plate 130 and a lower polarizing plate 140 are disposed on upper and lower surfaces of the display panel 100, respectively. In detail, the upper polarizing plate 130 is disposed on an upper surface of the color filter substrate 110, whereas the lower polarizing plate 140 is disposed on a lower surface of the TFT substrate 120.

Although not shown, gate and data drivers may be provided at a side surface of the display panel 100, in order to generate drive signals for driving the panel 100.

FIGS. 11 and 12 are exploded perspective views each illustrating a display apparatus according to an exemplary embodiment.

Referring to FIG. 11, the display apparatus, which is designated by reference numeral 1, includes a display module 20, front and back covers 30 and 35 for surrounding the display module 20, a driver unit 55 mounted to the back cover 35, and a driver cover 40 for surrounding the driver unit 55.

The front cover 30 may include a front panel (not shown) made of a transparent material to transmit light therethrough. The front panel is spaced apart from the display module 20 to protect the display module 20. The front panel also transmits light emitted from the display module 20, thereby allowing an image displayed by the display module 20 to be displayed to the outside of the display module 20.

The back cover 35 is coupled to the front cover 30 to protect the display module 20.

The driver unit 55 may be disposed on one surface of the back cover 35.

The driver unit 55 may include a drive controller 55a, a main board 55b, and a power supplier 55c.

The drive controller 55a may be a timing controller. The driver controller 55a is a driver to operation timing of each driver IC included in the display module 20. The main board 55b is a driver for transferring V-sync, H-sync, and R, G, and B resolution signals to the timing controller. The power supplier 55c is a driver for applying electric power to the display module 20.

The driver unit 55 may be mounted to the back cover 35, and may be surrounded by the driver cover 40.

A plurality of holes is provided at the back cover 35, to connect the display module 20 and the driver unit 55. A stand 60 to support the display apparatus 1 may be provided.

On the other hand, as shown in FIG. 12, the drive controller 55a of the driver unit 55 may be provided at the back cover 35. The main board 55b and power supplier 55c may be provided at the stand 60.

The driver cover 40 may surround only the driver 55, which is provided at the back cover 35.

Although the main board 55b and power supplier 55c are separately provided in the illustrated embodiment, they may be integrated on a single board, without being limited thereto.

In the above-described embodiments, absorption patterns may be formed on the reflection layer around each light source to partially absorb light. Accordingly, it may be possible to remove a hot spot phenomenon and to provide light of uniform brightness.

In the above-described embodiments, light shield patterns having a multilayer structure may be formed around each light source to adjust the transmittance of light. Accordingly, it may be possible to reduce the transmittance of light in a region adjacent to each light source, and to minimize color variation of the transmitted light.

In the above-described embodiments, each light source may be partially inserted into a corresponding one of the grooves formed at the light guide plate. Accordingly, it may be possible to reduce the total thickness of the backlight unit.

Although embodiments have been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the scope of the principles of this disclosure. More particularly, various variations and modifications are possible in the component parts and/or arrangements of the subject combination arrangement within the scope of the disclosure, the drawings and the appended claims. In addition to variations and modifications in the component parts and/or arrangements, alternative uses will also be apparent to those skilled in the art.
Claims

1. A backlight unit (200) comprising:
   a first layer (210);
   a plurality of light sources (220) on the first layer (210);
   a reflection layer (240) for reflecting light emitted from the light source (220), the reflection layer (240) disposed on the first layer (210) in a region other than the regions where the light sources (220) are disposed; and
   a plurality of absorption elements (260) for partially absorbing the light emitted from the light sources (220), the plurality of absorption elements (260) formed on a portion of the reflection layer (240) adjacent to a light emitting surface of the light sources (220),
   characterized by further comprising: a second layer (230) formed over the first layer (210) and covering the light sources (220) and the reflection layer (240),
   wherein the plurality of light sources (220) emits light in an extension direction of the first layer, wherein the absorption elements (260) are arranged in absorption element groups, and each of the absorption element groups corresponds to each of the light sources, respectively, wherein the number of the absorption elements arranged in a first direction in each of absorption element groups is increased and then reduced with increasing interval between absorption elements in each of absorption element groups and corresponding light source, wherein the first direction is perpendicular to a second direction, and the second direction is a direction from each of light sources to corresponding absorption element group.

2. The backlight unit (200) according to claim 1, wherein the second layer (230) is made of a resin having a reflectance of 1.4 to 1.6.

3. The backlight unit (200) according to claim 1 or 2, wherein the absorption elements (260) are formed in a region spaced apart from the light sources (220) by 1 to 5 mm.

4. The backlight unit (200) according to any one of claims 1 to 3, wherein the absorption elements (260) have a density decreasing with increasing interval between the absorption elements (260) and the light source (220).

5. The backlight unit (200) according to any one of claims 1 to 4, wherein the absorption elements (260) in each of the absorption element groups arranged to respectively correspond to the light sources (220) are distributed in a pentagonal shape.

6. The backlight unit (200) according to any one of claims 1 to 5, wherein adjacent groups of the absorption elements (260) respectively arranged to correspond to adjacent ones of the light sources (220) are spaced apart from each other by a predetermined interval.

7. The backlight unit (200) according to any one of claims 1 to 6, wherein the number of absorption elements (260) disposed in a region adjacent to the light source (220) is greater than the number of absorption elements (260) disposed in a region away from the light source (220).

8. The backlight unit (200) according to any one of claims 1 to 7, wherein the absorption elements are made of a mixture of white ink and black ink, and the black ink has a mixing ratio of 1 to 50% in the mixture of white ink and black ink.

9. The backlight unit (200) according to any one of claims 1 to 8, wherein the second layer (230) is a light guide plate, and the backlight unit (200) further comprises light shield elements (250) supported by the light guide plate while being in contact with the light guide plate or arranged to be spaced apart from the light guide plate while defining a predetermined space between the light shield elements (250) and the light guide plate.

10. The backlight unit (200) according to claim 9, wherein the light shield element has a multilayer structure having layers made of different materials.

11. The backlight unit (200) according to claim 10, wherein an upper one of the layers in the light shield element has a larger area than a lower one of the layers.

12. The backlight unit (200) according to claim 10, wherein a lower one of the layers in the light shield element has a higher reflectance than an upper one of the layers.

13. The backlight unit (200) according to claim 10, wherein the light shield elements (250) have a total thickness of 3 to 5 μm.

14. The backlight unit (200) according to claim 9, wherein the light guide plate includes grooves to receive a portion of the light sources (220) or the entirety of the light sources (220).

15. A display apparatus (1) comprising:
   a display panel (100); and
a backlight unit (200) for irradiating light upon the display panel (100) according to any one of claims 1 to 14.

**Patentansprüche**

1. Hintergrundbeleuchtungseinheit (200) umfassend:
   
eine erste Schicht (210);
   eine Vielzahl von Lichtquellen (220) an der ersten Schicht (210);
   eine Reflexionsschicht (240) zum Reflektieren von der Lichtquelle (220) emittiertem Licht, wobei die Reflexionsschicht (240) an der ersten Schicht (210) in einem anderen Bereich angeordnet ist als die Bereiche, wo die Lichtquellen (220) angeordnet sind; und
   eine Vielzahl von Absorptionselementen (260) zum teilweisen Absorbieren des von den Lichtquellen (220) emittierten Lichts, wobei die Vielzahl der Absorptionselemente (260) an einem an eine Lichtemitteroberfläche der Lichtquellen (220) angrenzenden Abschnitt der Reflexionsschicht (240) gebildet ist.

   

   dadurch gekennzeichnet, dass sie ferner umfasst: eine zweite Schicht (230), die über der ersten Schicht (210) gebildet ist und die Vielzahl der Lichtquellen (220) abdeckt, wobei die Vielzahl der Lichtquellen (220) Licht in einer Erstreckungsrichtung der ersten Schicht emittiert, wobei die Absorptionselemente (260) in Absorptionselementegruppen angeordnet sind, und jede der Absorptionselementegruppen jeweils jedem der Lichtquellen (220) entspricht, wobei die Anzahl der in einer ersten Richtung angeordneten Absorptionselemente (260) in jeder der Absorptionselementegruppen erhöht und dann mit zunehmendem Abstand zwischen Absorptionselementen (260) in jeder der Absorptionselementegruppen und einer entsprechenden Lichtquelle verringert ist, wobei die erste Richtung senkrecht zu einer zweiten Richtung ist und die zweite Richtung eine Richtung von jeder der Lichtquellen zu einer entsprechenden Absorptionselementegruppe ist.

2. Hintergrundbeleuchtungseinheit (200) nach Anspruch 1, wobei die zweite Schicht (230) aus einem Harz gefertigt ist, das einen Reflexionsgrad von 1,4 bis 1,6 aufweist.

3. Hintergrundbeleuchtungseinheit (200) nach Anspruch 1 oder 2, wobei die Absorptionselemente (260) in einem Bereich gebildet sind, der von den Lichtquellen (220) um 1 bis 5 mm beabstandet ist.

4. Hintergrundbeleuchtungseinheit (200) nach einem der Ansprüche 1 bis 3, wobei die Absorptionselemente (260) eine Dichte aufweisen, die mit zunehmendem Abstand zwischen den Absorptionselementen (260) und der Lichtquelle (220) abnimmt.

5. Hintergrundbeleuchtungseinheit (200) nach einem der Ansprüche 1 bis 4, wobei die Absorptionselemente (260) in jeder der Absorptionselementegruppen, die angeordnet sind, um den Lichtquellen (220) jeweils zu entsprechen, in einer fünfeckigen Form verteilt sind.

6. Hintergrundbeleuchtungseinheit (200) nach einem der Ansprüche 1 bis 5, wobei angrenzende Gruppen der Absorptionselemente (260), die jeweils angeordnet sind, um angrenzenden Lichtquellen der Lichtquellen (220) zu entsprechen, voneinander um einen vorgegebenen Abstand beabstandet sind.

7. Hintergrundbeleuchtungseinheit (200) nach einem der Ansprüche 1 bis 6, wobei die zweite Schicht (230) aus einem Harz gefertigt ist, das einen Reflexionsgrad von 1,4 bis 1,6 aufweist.

8. Hintergrundbeleuchtungseinheit (200) nach einem der Ansprüche 1 bis 7, wobei die Absorptionselemente (260) in einer fünfeckigen Form verteilt sind.

9. Hintergrundbeleuchtungseinheit (200) nach einem der Ansprüche 1 bis 8, wobei die zweite Schicht (230) aus einem Harz gefertigt ist, das einen Reflexionsgrad von 1,4 bis 1,6 aufweist.

10. Hintergrundbeleuchtungseinheit (200) nach einem der Ansprüche 1 bis 9, wobei die zweite Schicht (230) aus einem Harz gefertigt ist, das einen Reflexionsgrad von 1,4 bis 1,6 aufweist.
12. Hintergrundbeleuchtungseinheit (200) nach Anspruch 10, wobei eine untere der Schichten in dem Lichtabschirmungselement einen höheren Reflexionsgrad als eine obere der Schichten aufweist.

13. Hintergrundbeleuchtungseinheit (200) nach Anspruch 10, wobei die Lichtabschirmungselemente (250) eine Gesamtdicke von 3 bis 5 μm aufweisen.


15. Anzeigevorrichtung (1) umfassend:
   ein Anzeigefeld (100); und
   eine Hintergrundbeleuchtungseinheit (200) zum Einstrahlen von Licht auf das Anzeigefeld (100) nach einem der Ansprüche 1 bis 14.

Revidications

1. Une unité de rétroéclairage (200) comprenant :
   une première couche (210) ;
   une pluralité de sources de lumière (220) sur la première couche (210) ;
   une couche réfléchissante (240) pour réfléchir la lumière émise par la source de lumière (220),
   la couche réfléchissante (240) étant disposée sur la première couche (210) dans une zone autre que les zones dans lesquelles les sources de lumières (220) sont disposées ; et
   une pluralité d’éléments d’absorption (260) pour absorber partiellement la lumière émise par les sources de lumières (220), la pluralité d’éléments d’absorption (260) étant formée sur une partie de la couche réfléchissante (240) adjo- cente à une surface électroluminescente des sources de lumière (220),
   caractérisée en ce qu’elle comprend en outre :
   une deuxième couche (230) formée sur la première couche (210) et recouvrant les sources de lumière (220) et la couche de réflexion (240),
   la pluralité de sources de lumière (220) émettant de la lumière dans une direction d’extension de la première couche,
   les éléments d’absorption (260) étant agencés en des groupes d’éléments d’absorption, et chacun des groupes d’éléments d’absorption correspondant à chacune des sources de lumière, respectivement,
   le nombre des éléments d’absorption disposés dans une première direction dans chacun des groupes d’éléments d’absorption étant augmen-

2. L’unité de rétroéclairage (200) selon la revendication 1, dans laquelle la deuxième couche (230) est faite d’une résine ayant une réflectance allant de 1,4 à 1,6.

3. L’unité de rétroéclairage (200) selon la revendication 1 ou la revendication 2, dans laquelle les éléments d’absorption (260) sont formés dans une zone espacée des sources de lumière (220) de 1 à 5 mm.

4. L’unité de rétroéclairage (200) selon l’une quelconque des revendications 1 à 3, dans laquelle les éléments d’absorption (260) ont une densité qui décroît au fur et à mesure que croît un intervalle entre les éléments d’absorption (260) et la source de lumière (220).

5. L’unité de rétroéclairage (200) selon l’une quelconque des revendications 1 à 4, dans laquelle la deuxième couche (230) est une plaque de guidage.
de lumière et l’unité de rétroéclairage (200) comprend en outre des éléments (250) formant écran à la lumière supportés par la plaque de guidage de lumière tout en étant en contact avec la plaque de guidage de lumière ou disposés de manière à être espacés de la plaque de guidage de lumière, en définissant un espace prédéterminé entre les éléments (250) formant écran à la lumière et la plaque de guidage de lumière.

10. L’unité de rétroéclairage (200) selon la revendication 9, dans laquelle l’élément formant écran à la lumière a une structure multicouche ayant des couches faites de matériaux différents.

11. L’unité de rétroéclairage (200) selon la revendication 10, dans laquelle une couche supérieure parmi les couches dans l’élément formant écran à la lumière a une surface plus grande qu’une couche inférieure parmi ces couches.

12. L’unité de rétroéclairage (200) selon la revendication 10, dans laquelle une couche inférieure parmi les couches dans l’élément formant écran à la lumière a une réflectance plus élevée qu’une couche supérieure parmi ces couches.

13. L’unité de rétroéclairage (200) selon la revendication 10, dans laquelle les éléments (250) formant écran à la lumière ont une épaisseur totale allant de 3 à 5 \( \mu \text{m} \).

14. L’unité de rétroéclairage (200) selon la revendication 9, dans laquelle la plaque de guidage de lumière comprend des rainures pour recevoir une partie des sources de lumière (220) ou la totalité des sources de lumière (220).

15. Un appareil d’affichage (1) comprenant :

   un panneau d’affichage (100) ; et
   une unité de rétroéclairage (200) pour irradier de la lumière sur le panneau d’affichage (100) selon l’une quelconque des revendications 1 à 14.
FIG. 2
FIG. 6C
FIG. 7

FIG. 8
FIG. 10
REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader’s convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- KR 1020100108139 [0001]
- US 5477422 A [0012]
- EP 1978300 A [0012]

- US 6313891 B1 [0012]
- JP 3043996 B [0012]