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Farmer

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(54) **GRADIENT OPTICS FOR CONTROLLABLE LIGHT DISTRIBUTION FOR LED LIGHT SOURCES**

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F21V 11/00	(2006.01)
F21V 13/04	(2006.01)
F21V 5/00	(2006.01)
G02B 5/02	(2006.01)
G02B 5/20	(2006.01)
F21Y 101/02	(2006.01)
G02B 3/00	(2006.01)

(52) **U.S. Cl.**

CPC ***G02B 5/021*** (2013.01); ***F21V 13/04*** (2013.01); ***F21V 5/00*** (2013.01); *F21Y 2101/02* (2013.01); ***G02B 5/205*** (2013.01); *G02B 3/0087* (2013.01)

USPC **362/223**; 362/311.01; 362/311.06; 362/311.14; 362/317

(58) **Field of Classification Search**

CPC F21V 5/00; F21V 13/04; F21V 2105/02; G02B 5/02; G02B 5/205; G02B 3/0087

USPC 362/233, 311.06, 311.01, 311.14, 317, 362/223

See application file for complete search history.

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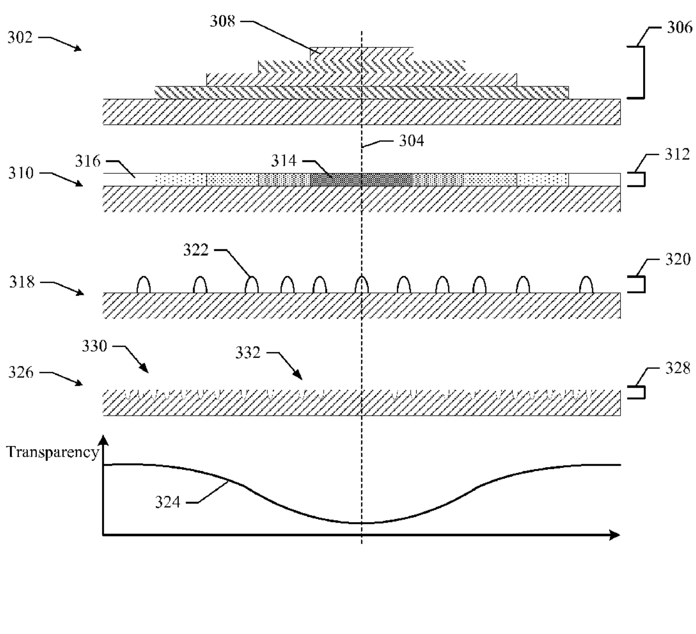
(57) **ABSTRACT**

Gradient optics for controllable light distribution for LED light sources. In an aspect, an apparatus is provided that includes a panel coupled to receive light emitted from a light source and gradient optics disposed on the panel. The gradient optics providing a transparency gradient that filters the light to achieve a selected emitted light intensity variation across a selected surface of the panel.

21 Claims, 4 Drawing Sheets



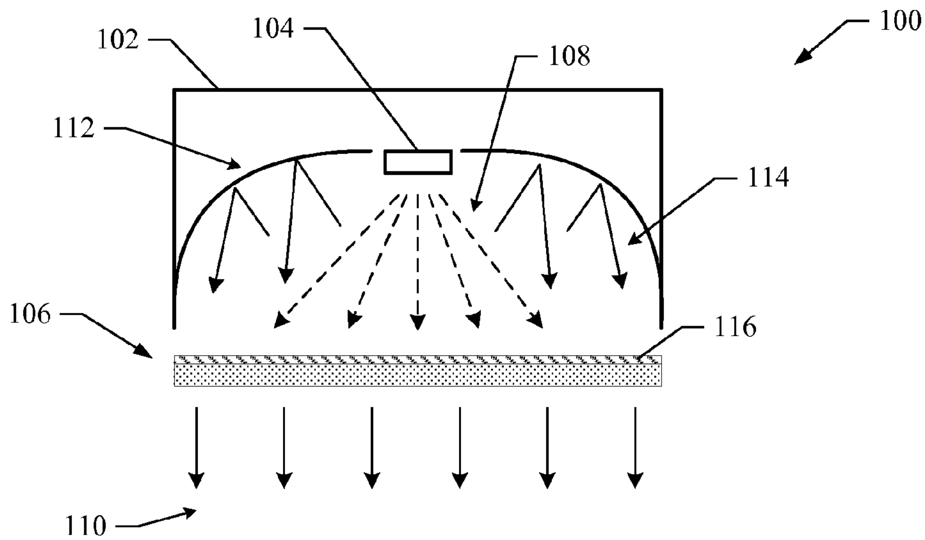

100
102
104
108
112
114
106
116
110

FIG. 1

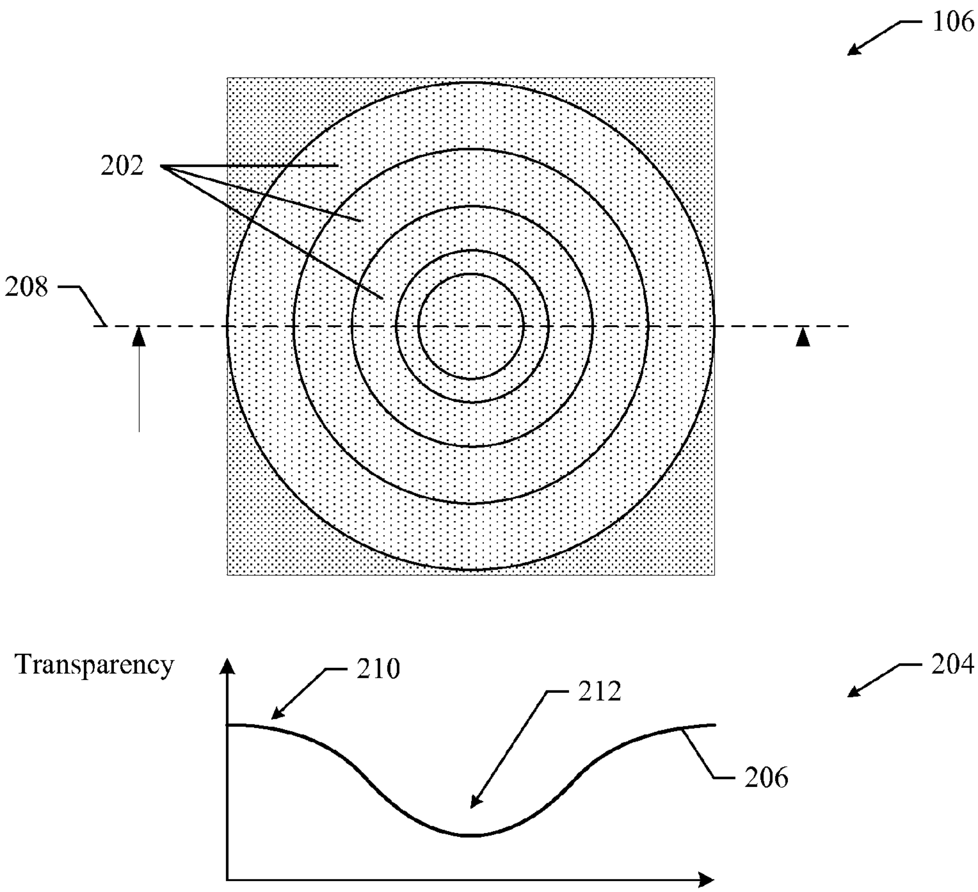

106
202
208
Transparency
210
212
204
206

FIG. 2

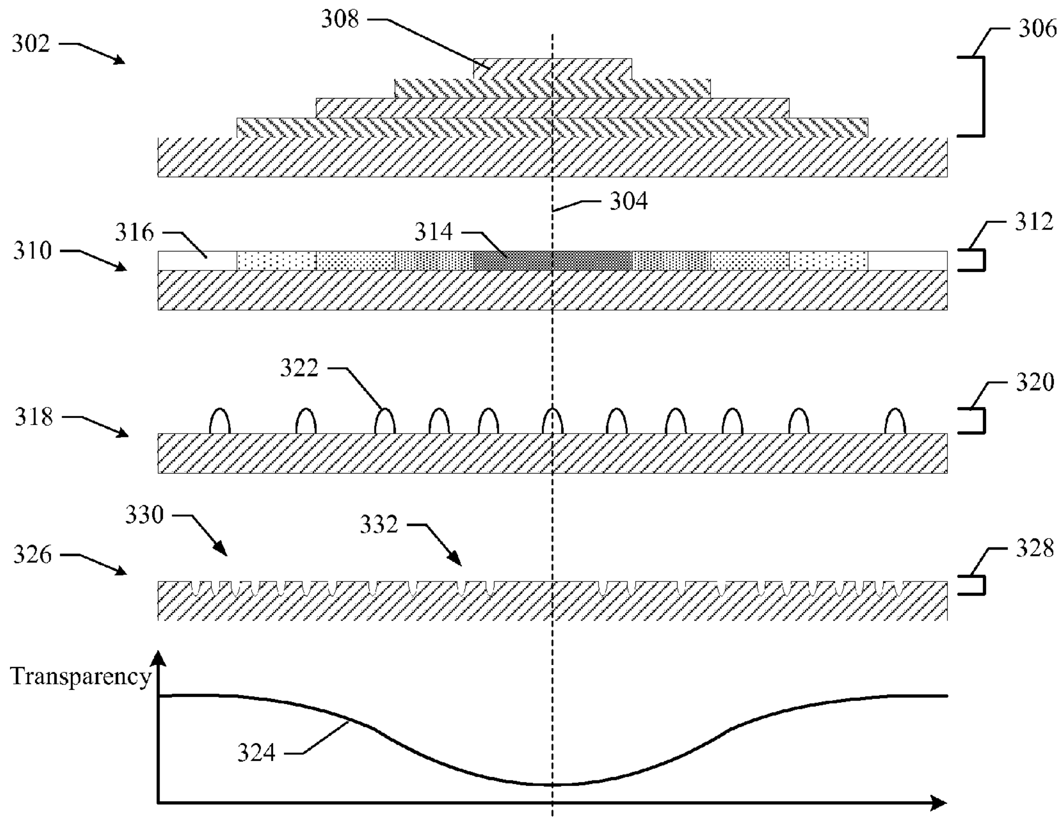

308
306
302
304
316
314
312
310
322
320
318
330
332
328
326
Transparency
324

FIG. 3

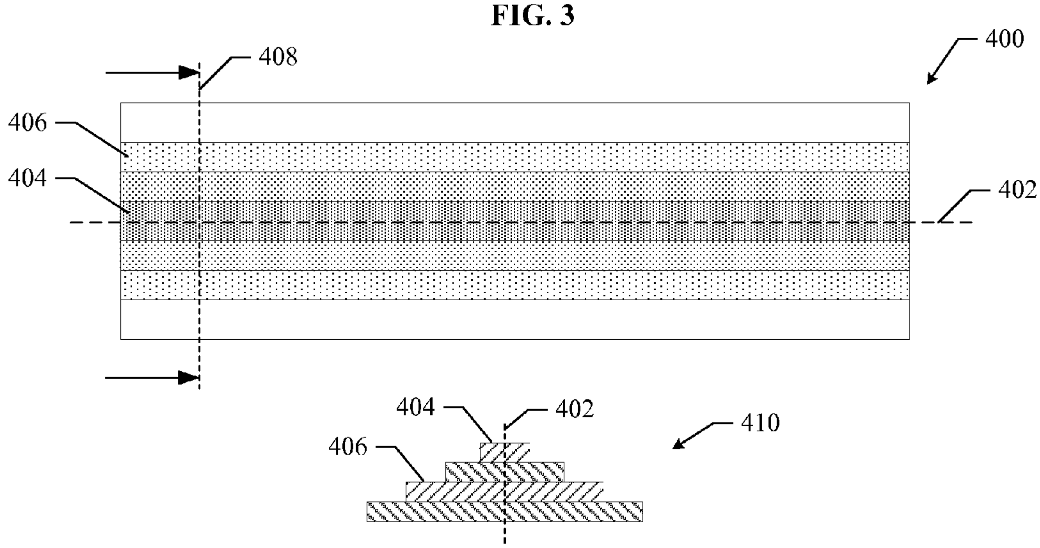

408
400
406
404
402
404
402
410
406

FIG. 4

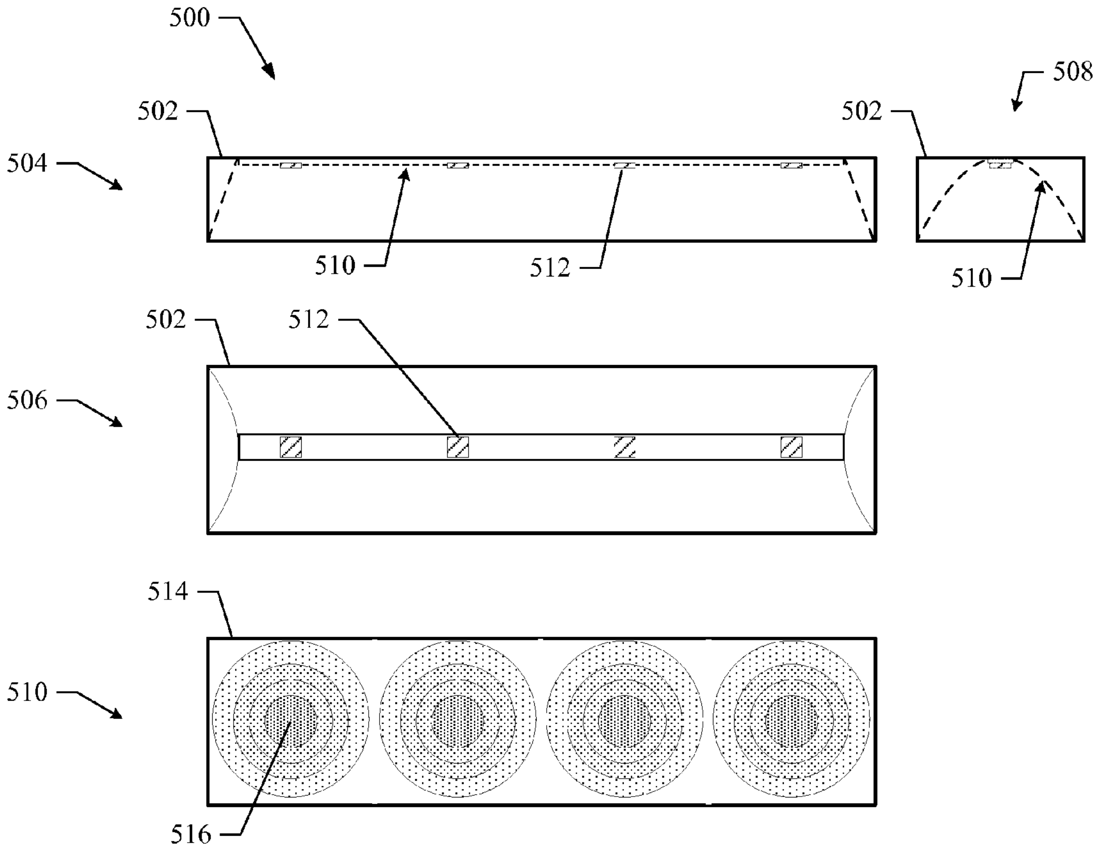

500
508
502
502
504
510
512
510
502
512
506
514
510
516

FIG. 5

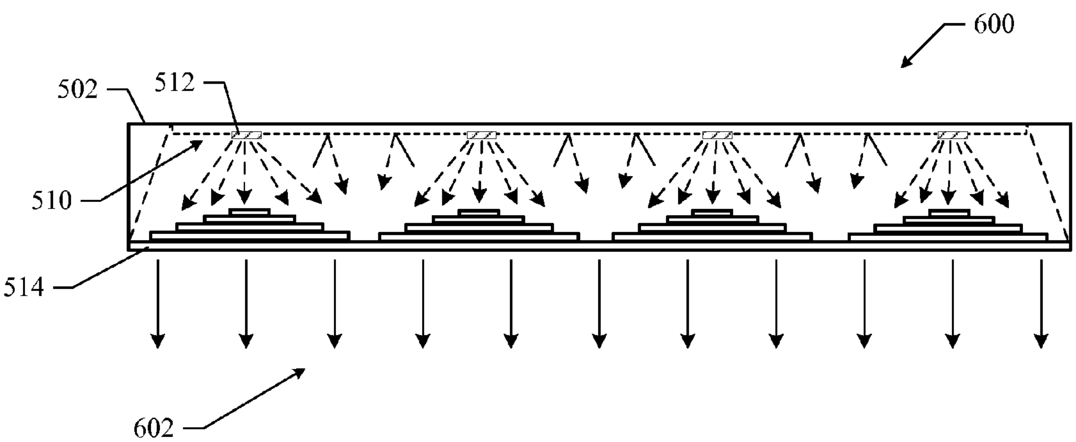

600
502
512
510
514
602

FIG. 6

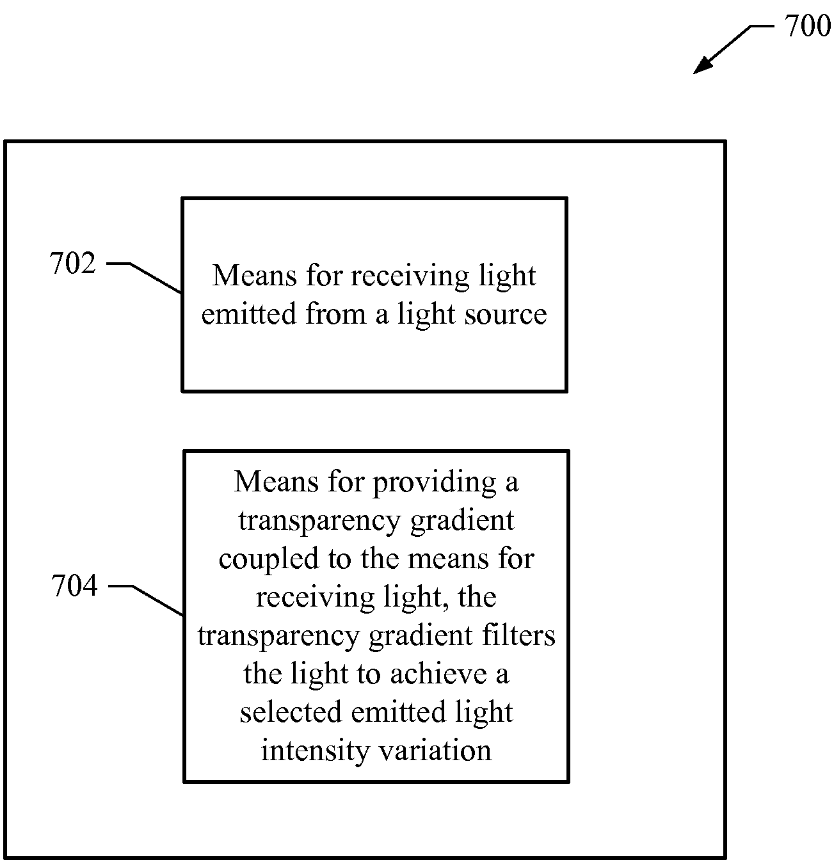

700
702
Means for receiving light emitted from a light source
704
Means for providing a transparency gradient coupled to the means for receiving light, the transparency gradient filters the light to achieve a selected emitted light intensity variation

FIG. 7

GRADIENT OPTICS FOR CONTROLLABLE LIGHT DISTRIBUTION FOR LED LIGHT SOURCES

CLAIM OF PRIORITY UNDER 35 U.S.C. §119

This patent application claims the benefit of priority from U.S. Provisional Patent Application No. 61/427,740, entitled "Gradient Optics for Even Light Distribution of LED Light Sources" filed on Dec. 28, 2010, and assigned to the assignee hereof and hereby expressly incorporated by reference herein.

BACKGROUND

1. Field

The present application relates generally to light emitting diodes, and more particularly, to gradient optics for controllable light distribution for LED light sources.

2. Background

A light emitting diode comprises a semiconductor material impregnated, or doped, with impurities. These impurities add "electrons" and "holes" to the semiconductor, which can move in the material relatively freely. Depending on the kind of impurity, a doped region of the semiconductor can have predominantly electrons or holes, and is referred to as an n-type or p-type semiconductor region, respectively.

In LED applications, an LED semiconductor chip includes an n-type semiconductor region and a p-type semiconductor region. A reverse electric field is created at the junction between the two regions, which causes the electrons and holes to move away from the junction to form an active region. When a forward voltage sufficient to overcome the reverse electric field is applied across the p-n junction, electrons and holes are forced into the active region and combine. When electrons combine with holes, they fall to lower energy levels and release energy in the form of light. The ability of LED semiconductors to emit light has allowed these semiconductors to be used in a variety of lighting devices. For example, LED semiconductors may be used in general lighting devices for interior or exterior applications.

A troffer is a light fixture resembling an inverted trough that is either recessed in, or suspended from, the ceiling. Troffers are typically designed to emit light using fluorescent lighting tubes. The fluorescent tubes emit light along the entire length of the troffer to produce a desirable light distribution pattern. Unfortunately, fluorescent lighting tubes may be expensive, require a warm up period, and produce flicker that people may find undesirable. Thus, LEDs are attractive candidates for replacing fluorescent lighting tubes in troffers. For example, LEDs have no warm up time, are long lasting and power efficient, and do not flicker. However, LEDs are considered to be a point light source in that the light is emitted from a relatively small region. Thus, utilizing LEDs in troffers present various design challenges since it is desirable to control how light emitted from an LED light source is distributed across the length of the troffer. One technique for using LEDs to obtain uniformly distributed light across the length of the troffer is to use a large number of LEDs that are distributed throughout the troffer. Unfortunately, this technique results in a complex troffer design and the cost of utilizing a large number of LEDs may be prohibitive.

Accordingly, what is needed is a simple and cost efficient way to provide controllable light distribution for use with point light sources thereby facilitating the use of LED semiconductors in troffer devices.

SUMMARY

In various aspects, a distribution panel comprising gradient optics is provided that operates to control the intensity of light emitted across the surface of the panel. For example, the distribution panel is suitable for use in a troffer device to provide controllable distribution of light emitted from LED semiconductors. The gradient optics provides a matching transparency gradient that is matched to a light source to control the intensity of emitted light across the panel. In one implementation, the gradient optics are configured to provide even distribution of light emitted from the distribution panel, in other implementations, the gradient optics are configured to provide controllable light distribution so that any light intensity distribution pattern can be achieved. Thus, the distribution panel with gradient optics provides a simple and cost efficient way to utilize LED semiconductors in a troffer to produce controllable light distribution.

In one implementation, an apparatus is provided that includes a panel coupled to receive light emitted from a light source and gradient optics disposed on the panel. The gradient optics providing a transparency gradient that filters the light to achieve a selected emitted light intensity variation across a selected surface of the panel.

It is understood that other aspects of the present invention will become readily apparent to those skilled in the art from the following detailed description. As will be realized, the present invention includes other and different aspects and its several details are capable of modification in various other respects, all without departing from the spirit and scope of the present invention. Accordingly, the drawings and the detailed description are to be regarded as illustrative in nature and not as restrictive.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing aspects described herein will become more readily apparent by reference to the following Description when taken in conjunction with the accompanying drawings wherein:

FIG. **1** shows an exemplary apparatus that illustrates the operation of a distribution panel with matching gradient optics configured to provide controllable light distribution;

FIG. **2** shows a detailed top view of the distribution panel shown in the apparatus of FIG. **1**;

FIG. **3** shows various exemplary implementations of the distribution panel shown in FIG. **2** that are constructed in accordance with the present invention;

FIG. **4** shows an exemplary distribution panel with matching gradient optics configured to controllably distribute light in a troffer device that includes a fluorescent tube;

FIG. **5** shows exemplary troffer components comprising a distribution panel with matching gradient optics configured to controllably distribute light in a troffer device that includes four LED semiconductors;

FIG. **6** shows the troffer components illustrated in FIG. **5** in a completed LED troffer assembly; and

FIG. **7** shows an exemplary distribution apparatus with matching gradient optics configured for controllable light distribution.

DESCRIPTION

The present invention is described more fully hereinafter with reference to the accompanying drawings, in which various aspects of the present invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the various aspects of the present invention presented throughout this disclosure. Rather, these aspects are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the present invention to those skilled in the art. The various aspects of the present invention illustrated in the drawings may not be drawn to scale. Accordingly, the dimensions of the various features may be expanded or reduced for clarity. In addition, some of the drawings may be simplified for clarity. Thus, the drawings may not depict all of the components of a given apparatus (e.g., device) or method.

Various aspects of the present invention will be described herein with reference to drawings that are schematic illustrations of idealized configurations of the present invention. As such, variations from the shapes of the illustrations as a result, for example, manufacturing techniques and/or tolerances, are to be expected. Thus, the various aspects of the present invention presented throughout this disclosure should not be construed as limited to the particular shapes of elements (e.g., regions, layers, sections, substrates, etc.) illustrated and described herein but are to include deviations in shapes that result, for example, from manufacturing. By way of example, an element illustrated or described as a rectangle may have rounded or curved features and/or a gradient concentration at its edges rather than a discrete change from one element to another. Thus, the elements illustrated in the drawings are schematic in nature and their shapes may not be intended to illustrate the precise shape of an element and are not intended to limit the scope of the present invention.

It will be understood that when an element such as a region, layer, section, substrate, or the like, is referred to as being "on" another element, it can be directly on the other element or intervening elements may also be present. In contrast, when an element is referred to as being "directly on" another element, there are no intervening elements present. It will be further understood that when an element is referred to as being "formed" on another element, it can be grown, deposited, etched, attached, connected, coupled, or otherwise prepared or fabricated on the other element or an intervening element.

Furthermore, relative terms, such as "lower" or "bottom" and "upper" or "top," may be used herein to describe one element's relationship to another element as illustrated in the drawings. It will be understood that relative terms are intended to encompass different orientations of an apparatus in addition to the orientation depicted in the Drawings. By way of example, if an apparatus in the Drawings is turned over, elements described as being on the "lower" side of other elements would then be oriented on the "upper" sides of the other elements. The term "lower", can therefore, encompass both an orientation of "lower" and "upper," depending of the particular orientation of the apparatus. Similarly, if an apparatus in the drawing is turned over, elements described as "below" or "beneath" other elements would then be oriented "above" the other elements. The terms "below" or "beneath" can, therefore, encompass both an orientation of above and below.

Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and this disclosure.

As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof. The term "and/or" includes any and all combinations of one or more of the associated listed items

It will be understood that although the terms "first" and "second" may be used herein to describe various regions, layers and/or sections, these regions, layers and/or sections should not be limited by these terms. These terms are only used to distinguish one region, layer or section from another region, layer or section. Thus, a first region, layer or section discussed below could be termed a second region, layer or section, and similarly, a second region, layer or section may be termed a first region, layer or section without departing from the teachings of the present invention.

FIG. **1** shows an exemplary apparatus **100** that illustrates the operation of a distribution panel with matching gradient optics configured to provide controllable light distribution. The apparatus **100** comprises a housing **102**, LED light source **104** and distribution panel **106** with matching gradient optics **116** that provides a selected transparency gradient. The transparency gradient characterizes how well light passes through the gradient optics **116** and ultimately, through the panel **106**.

During operation, light emitted from the LED **104** strikes the distribution panel **106** and the selected transparency gradient provided by the gradient optics **116** controls how the emitted light passes through the panel **106** to produce a controllable emitted light intensity distribution, shown generally at **110**. For example, in one implementation, even emitted light intensity distribution is achieved.

The panel **106** is designed so that the gradient optics **116** provides a matching transparency gradient that is orientated, aligned and/or matched to the location of the LED **104**. For example, in one implementation, the gradient optics **116** provides less transparency at a center location directly below the LED **104** and increasing transparency corresponding to increasing distances from the center location. High intensity light emitted from the LED **104** strikes the center location of the panel **106** and lower intensity light emitted from the LED **104** strikes away from the center portion. The transparency gradient provided by the gradient optics **116** operates to adjust the intensity of the light that is emitted from the panel **106** so that controllable light intensity distribution can be achieved. A more detailed description of the distribution panel **106** is provided below.

In one implementation, to enhance the light distribution properties of the distribution panel **106**, the housing **102** comprises reflective surfaces, shown generally at **112**. The reflective surfaces **112** operate to reflect light back through the distribution panel to enhance its light distribution properties. For example, direct light **108** strikes the distribution panel and some of this direct light is reflected. This light then travels back up to the reflective surfaces **112** where is it reflected back through the distribution panel **106**. The light rays shown generally at **114** illustrate the path of the reflected light. Therefore, the apparatus **100** illustrates the operation of the distribution panel **106** and matching gradient optics **116** to provide controllable light intensity distribution from an LED light source.

FIG. **2** shows a detailed top view of the distribution panel **106** shown in FIG. **1**. The distribution panel **106** comprises gradient optics **116** that provide a transparency gradient to enable controllable distribution of light emitted from a point source, for example, even light intensity distribution emitted across the surface of the panel. In one embodiment, the distribution panel **106** is made from an acrylic, plastic, crystal, glass, polymer or other suitable material. In one implementation, the gradient optics **116** are formed by concentric circles **202** that have material density that varies as the distance from a center location directly below the LED **104** increases. The varying material densities of the concentric circles **202** provide different transparency characteristics so that a transparency gradient is formed such that greater transparency is provided by the outer circles than by the inner circles. For example, thicker material allows less light to pass through providing less transparency.

A graph **204** illustrates the transparency gradient provided by the gradient optics **116** of the distribution panel **106**. The graph **204** comprises a plot line **206** representing the transparency of the distribution panel **106** at any location on the indicator line **208**. As shown in the graph **204**, more transparency is provided at the outer circles indicated at **210** and less transparency is provided at the inner circles as indicated at **212**. Thus, the gradient optics **116** of the panel **106** provides less transparency for light having greater intensity at a location directly below the LED, and more transparency for light having less intensity as the distance from the center location increases. This configuration, results in even distribution of light intensity emitted from the surface of the panel.

FIG. **3** shows cross sectional views of various exemplary implementations of the distribution panel **106** and gradient optics **116** constructed in accordance with the present invention. For example, the cross sectional views are taken at indicator **208** shown in FIG. **2**. Each implementation comprises a panel with gradient optics disposed on one or both surfaces to achieve a transparency gradient **324**.

In a first implementation, a distribution panel **302** comprises a piece of acrylic and the gradient optics **306** comprise concentric circles of layered material (illustrated at **308**) of varying diameter whose centers are aligned and located on center line **304**. When in use, the center line **304** is aligned with the LED semiconductor whose emitted light is being distributed by the distribution panel. The concentric circles of material may have the same or different thicknesses. Thus, in one implementation, the thickness of the panel **302** decreases with increasing distance from the center line **304**. The varying thicknesses provide the transparency gradient illustrated at **324**. It should be noted that the gradient optics **306** are not limited to circles or any particular geometric shape.

It should be noted that although shown as increasing material thickness, the gradient optics **306** may comprise material of varying densities which do not change the overall material thickness but accomplish the same transparency result. In another implementation, material variations are used to provide the transparency gradient. The material variations comprise different types of material that are layered as illustrated at **308** to provide the desired transparency gradient. Thus, the gradient optics **306** can be provided by any combination of material thickness, material variation, material layering, and/or material density.

In a second implementation, a distribution panel **310** comprises a piece of acrylic and the gradient optics **312** comprise a surface coating that provides the transparency gradient. The surface coating may be formed using a variety of techniques. For example, the surface coating may be a diffuser film applied to the acrylic or a polymer material that is painted onto the acrylic. The surface coating is designed to provide less transparency near the center line **304**, as illustrated by the dark region **314**, and more transparency as the distance from the center line increases, as illustrated at the light region **316**. The different transparency regions of the surface coating provide the transparency gradient illustrated at **324**. In another implementation, the gradient optics **312** comprises sections of different materials and/or surface coatings, where each section provides a different transparency to achieve the transparency gradient **324**.

In a third implementation, a distribution panel **318** comprises a piece of acrylic and the gradient optics **320** comprise surface texturing that provides one or more surface features **322**. The surface features **322** may be ridges, bumps, or other surface features that are arranged in any desired pattern and/or spacing to provide the transparency gradient illustrated at **324**. For example, in one implementation, the surface texturing comprises rings of rib features that gradually decrease in concentration from the center line **304** outward to provide for increased transparency as the distance from the center line **304** increases.

In a fourth implementation, a distribution panel **326** comprises a piece of acrylic and the gradient optics **328** comprise surface texturing that provides one or more surface defects, as illustrated at **330**. The surface defects **330** comprise scratched or sanded regions or other defects in the acrylic panel which affect light transmission. The surface defects are arranged in any desired pattern and/or spacing to provide the transparency gradient illustrated at **324**. For example, less surface defects are shown toward the center line **304**, as illustrated at **332**, to reduce transparency. More surface defects are provided as the distance from the center line **304** increases to increase transparency.

Therefore, the various implementations of a distribution panel provide a transparency gradient that provides controllable distribution of light from a light source. It should be noted that although four exemplary implementations of gradient optics are shown, other implementations of gradient optics may utilized to provide the transparency gradient **324**. Furthermore, implementations of the gradient optics can be configured to provide transparency gradients that are different from the transparency gradient **324**. For example, the gradient optics can be configured to provide any desirable transparency gradient to control the light intensity emitted across the surface of the panel **106**. Thus, the gradient optics may be formed individually or formed in any combination on the interior and/or exterior surface of the panel **106** to produce the transparency gradient **324** or other desired transparency gradients. In still another implementation, the gradient optics may be formed within the interior of the panel such that the exterior surfaces of the panel are smooth, yet the desired transparency gradient is still achieved.

Gradient Optics Performance

In various implementations, the gradient optics provide a transparency gradient that operates to control the light intensity emitted from the distribution panel. For example, the transparency gradient can be configured to provide uniformly distributed light intensity or other light intensity distribution patterns. The gradient optics may be formed and/or disposed on and/or within the distribution panel using one or more of the implementations discussed with respect to FIG. **3** to achieve a light output having a desired light intensity distribution.

Thus, in one implementation of the gradient optics, the variation in light intensity emitted from the distribution panel **106** is configured to vary by substantially 100 percent. In this implementation, the gradient optics are configured to provide at least one surface region where substantially no light is emitted from the panel, and at least one other surface region where a maximum amount of light is emitted from the panel.

This configuration results in substantially a 100 percent variation in the intensity of emitted light across the panel.

In other implementations of the gradient optics, the variation in light intensity emitted from the distribution panel is configured to vary by any amount less than 100 percent. For example, the gradient optics can be configured to provide any desired variation in light intensities across the surface regions of the panel **106** to achieve a desired emission distribution or corresponding illumination pattern.

FIG. **4** shows an exemplary distribution panel **400** with matching gradient optics configured to provide a transparency gradient that evenly distributes light in a troffer device that includes a fluorescent tube. The distribution panel **400** comprises gradient optics that provide a transparency gradient aligned along center line **402**, which matches a center line along the length of the fluorescent tube. For example, the gradient optics comprise less transparency at surface region **404** and increased transparency as the distance from the center line **402** increases, for instance, at surface region **406**.

Also shown in FIG. **4** is end view **410** of the distribution panel **400**. For example, the end view **410** is taken at cross section indicator **408**. The end view **410** illustrates how the gradient optics provide thicker material for less transparency at surface region **404**, and less material to provide greater transparency at surface region **406**. In various implementations, the material thickness is adjusted to provide a selected transparency gradient that operates to control the emitted light intensity distribution.

Thus, the distribution panel **400** comprises matching gradient optics to provide a transparency gradient configured to provide even light intensity distribution in a troffer device that includes a fluorescent tube. It should be noted that the panel **400** can also be configured to have other configurations of gradient optics to produce any desired light intensity distribution pattern across the surface of the panel.

FIG. **5** shows exemplary troffer components **500** that comprise a distribution panel with matching gradient optics to control light intensity distribution in a troffer device that includes four LED semiconductors. The troffer components **500** comprises a housing **502** that is illustrated in side **504**, bottom **506** and end **508** views. For example, the housing may be a 2'×4' housing typically used for fluorescent lighting.

Referring to the side view **504**, the housing **502** comprises an internal reflective surface **510** which is designed to reflected light to the bottom portion of the housing. Referring to the end view **508**, the reflective surface **510** is more clearly shown.

Referring now to the bottom view **506**, the housing **502** comprises four LED semiconductor devices **512** mounted therein. The LEDs **512** are spaced along the length of the housing **502** and are configured to emit light toward the bottom of the housing **502**.

The troffer components **500** also comprises a distribution panel **514** which is shown in the bottom view **510**. The distribution panel **514** comprises four regions having gradient optics **516** that are matched to align with each of the LEDs **512**. When assembled to the housing **502**, the four gradient optics **516** regions provide transparency gradients that operate to evenly distribute the intensity of light emitted from the LEDs **512**.

It is also possible that additional LEDs (or LED arrays) each associated with their own transparency gradient on the distribution panel **514** be added to the housing **502** to better spread out the light over larger areas. By way of example, the distribution panel **514** may be divided into any number of regions with an LED (or LED array) aligned at the center of each region. Each region having a matching gradient optic associated with each LED that is configured to provide a transparency gradient that operates to provide a selected light intensity distribution pattern.

FIG. **6** shows the troffer components **500** illustrated in FIG. **5** in a completed troffer assembly **600**. For example, the troffer assembly **600** is suitable for use as an internal lighting device, such as a ceiling light. In the troffer assembly **600**, the distribution panel **514** is mounted to the bottom portion of the housing **502**. It should be noted that the distribution panel **514** provides a matching transparency gradient for each LED by utilizing concentric circles of material to increase transparency as the distance from a center line through each LED increases.

During operation, each of the LEDs **512** emit light that passes through their associated matched transparency gradients provided by the distribution panel **514** to produce evenly distributed light illustrated at **602**. It should also be noted that the distribution panel **514** can be configured to provide other light intensity distribution patterns.

Light from the LEDs **512** also reflects off the reflective surface **510** to enhance the light distribution effects of the distribution panel **514**. Thus, the troffer assembly **600** operates to provide evenly distributed light from an LED light source that overcomes the problems associate with conventional fluorescent lighting.

FIG. **7** shows an exemplary distribution apparatus **700** with matching transparency gradient. For example, the apparatus **700** is suitable for use as the distribution panel **106** shown in FIG. **2**.

The distribution apparatus **700** comprises a first means (**702**) for receiving light emitted from a light source, which in an aspect comprises the panel **106**.

The distribution apparatus **700** also comprises a second means (**704**) for providing a transparency gradient coupled to the means for receiving light, the transparency gradient filters the light to achieve a selected emitted light intensity variation, which in an aspect comprises the gradient optics **306**.

Thus, the distribution apparatus **700** provides a matching transparency gradient to provide for controllable light intensity distribution.

The various aspects of this disclosure are provided to enable one of ordinary skill in the art to practice the present invention. Various modifications to aspects presented throughout this disclosure will be readily apparent to those skilled in the art, and the concepts disclosed herein may be extended to other applications. Thus, the claims are not intended to be limited to the various aspects of this disclosure, but are to be accorded the full scope consistent with the language of the claims. All structural and functional equivalents to the elements of the various aspects described throughout this disclosure that are known or later come to be known to those of ordinary skill in the art are expressly incorporated herein by reference and are intended to be encompassed by the claims.

Moreover, nothing disclosed herein is intended to be dedicated to the public regardless of whether such disclosure is explicitly recited in the claims. No claim element is to be construed under the provisions of 35 U.S.C. §112, sixth paragraph, unless the element is expressly recited using the phrase "means for" or, in the case of a method claim, the element is recited using the phrase "step for."

Accordingly, while aspects of a distribution panel with matching transparency gradient have been illustrated and described herein, it will be appreciated that various changes can be made to the aspects without departing from their spirit or essential characteristics. Therefore, the disclosures and descriptions herein are intended to be illustrative, but not limiting, of the scope of the invention, which is set forth in the following claims.

What is claimed is:

1. An apparatus, comprising:

a panel having a first surface area and coupled to receive light emitted from a light source; and

gradient optics having varying transparency disposed on the panel, the gradient optics for filtering the light to achieve even light distribution across the first surface area of the panel to distribute the light to illuminate a second surface area larger than the first surface area.

2. The apparatus of claim **1**, wherein the gradient optics is aligned with the light source.

3. The apparatus of claim **1**, wherein the gradient optics comprises material having varying thickness disposed on the panel so as to produce the varying transparency.

4. The apparatus of claim **1**, wherein the gradient optics comprises a coating that is disposed on the panel so as to produce the varying transparency.

5. The apparatus of claim **1**, wherein the gradient optics comprises surface texturing disposed on the panel so as to produce the varying transparency.

6. The apparatus of claim **5**, wherein the surface texturing comprises surface defects.

7. The apparatus of claim **1**, wherein the panel comprises at least one material selected from a set of materials comprising acrylic, plastic, crystal, glass, and polymer materials.

8. The apparatus of claim **1**, wherein the light source comprises one or more light emitting diodes (LEDs) and the gradient optics provides one or more matching transparency gradients, respectively, wherein each matching transparency gradient aligns with an associated LED.

9. The apparatus of claim **8**, wherein the one or more LEDs are mounted in a troffer and the panel is sized to fit the troffer to provide selected light intensity distribution.

10. The apparatus of claim **1**, wherein the light source comprises a fluorescent tube and the gradient optics provides a matching transparency gradient to align with the fluorescent tube.

11. The apparatus of claim **10**, wherein the fluorescent tube is mounted in a troffer and the panel is sized to fit the troffer to provide selected light intensity distribution.

12. The apparatus of claim **1**, wherein the gradient optics are formed by concentric circles having a transparency that varies as a distance from the center of the concentric circles increases.

13. An apparatus comprising:

means for receiving light at a first surface having a first surface area, the light emitted from a light source; and

means for providing a transparency gradient having varying transparency coupled to the means for receiving light, the means for providing the transparency gradient configured to filter the light to achieve even light distribution across the first surface area to distribute the light to illuminate a second surface area larger than the first surface area.

14. The apparatus of claim **13**, further comprising means for aligning the transparency gradient with the light source.

15. The apparatus of claim **13**, wherein the means for providing the transparency gradient comprises means for providing gradient optics comprising material having varying thickness to produce the varying transparency.

16. The apparatus of claim **13**, wherein the means for providing the transparency gradient comprises means for providing gradient optics comprising a coating configured to produce the varying transparency.

17. The apparatus of claim **13**, wherein the means for providing the transparency gradient comprises means for providing gradient optics comprising surface texturing configured to produce the varying transparency.

18. The apparatus of claim **13**, wherein the means for receiving comprises means for providing a panel for receiving the light, the panel comprising at least one material selected from a set of materials comprising acrylic, plastic, crystal, glass, and polymer materials.

19. The apparatus of claim **13**, wherein the light source comprises one or more light emitting diodes (LEDs).

20. The apparatus of claim **13**, wherein the light source comprises a fluorescent tube.

21. The apparatus of claim **13**, wherein the means for providing the transparency gradient comprises means for forming concentric circles having a transparency that varies as a distance from the center of the concentric circles increases.

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