US008896921B2

(12) **United States Patent**
Lee

(10) **Patent No.: US 8,896,921 B2**
(45) **Date of Patent: Nov. 25, 2014**

(54) **WIRE GRID TYPE POLARIZATION STRUCTURES, METHODS OF MANUFACTURING WIRE GRID TYPE POLARIZATION STRUCTURES, AND ORGANIC LIGHT EMITTING DIODE (OLED) DISPLAYS HAVING WIRE GRID TYPE POLARIZATION STRUCTURES**

(71) Applicant: **Samsung Display Co., Ltd.**, Yongin, Gyeonggi-do (KR)

(72) Inventor: **Hyun-Shik Lee**, Yongin (KR)

(73) Assignee: **Samsung Display Co., Ltd.**, Gyeonggi-do (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/866,952**

(22) Filed: **Apr. 19, 2013**

(65) **Prior Publication Data**

US 2014/0027738 A1 Jan. 30, 2014

(30) **Foreign Application Priority Data**

Jul. 27, 2012 (KR) 10-2012-0082227

(51) **Int. Cl.**

G02B 27/28 (2006.01)
H01L 51/52 (2006.01)
H01L 33/58 (2010.01)
G02B 5/30 (2006.01)

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

CPC ***H01L 33/58*** (2013.01); ***G02B 5/3058*** (2013.01); *H01L 51/5271* (2013.01)
USPC **359/486.01**; 257/40; 257/98; 313/504; 313/506; 349/85; 349/96; 349/97; 359/485.02; 359/485.05; 359/486.02

(58) **Field of Classification Search**

CPC ... G02B 5/3058; H01L 51/5271; H01L 33/58
USPC 257/40, 98; 313/504, 506; 349/85, 96, 349/97; 359/485.02, 485.05, 486, 486.01, 359/486.02
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,772,768	B2 *	8/2010	Oh et al.	313/506
2008/0117510	A1	5/2008	Cheong et al.	
2008/0225389	A1 *	9/2008	Oh et al.	359/486
2008/0258614	A1 *	10/2008	Ha et al.	313/504
2009/0074992	A1	3/2009	Lee et al.	
2009/0168171	A1 *	7/2009	Perkins et al.	359/486
2013/0320320	A1 *	12/2013	Kwon et al.	257/40

FOREIGN PATENT DOCUMENTS

KR	10-2008-0046017	A	5/2008
KR	10-2009-0028334	A	3/2009
KR	10-2010-0123977	A	11/2010

* cited by examiner

Primary Examiner — Dao H Nguyen
(74) *Attorney, Agent, or Firm* — Knobbe, Martens, Olson & Bear, LLP

(57) **ABSTRACT**

A wire grid type polarization structure is disclosed. In one aspect, the polarization structure includes a retardation layer and a plurality of nanowires formed on the retardation layer. Each of the nanowires includes a wire core and a shell enclosing the wire core. The wire cores include metal nanoparticles embedded therein. The metal nanoparticles may absorb the visible lights effectively, so that the wire grid type polarization structure may have a desired polarization characteristic.

14 Claims, 5 Drawing Sheets

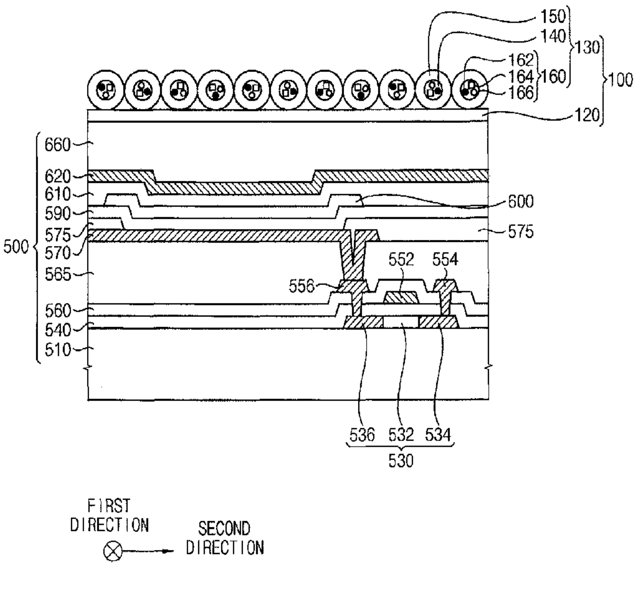


FIG. 1

100

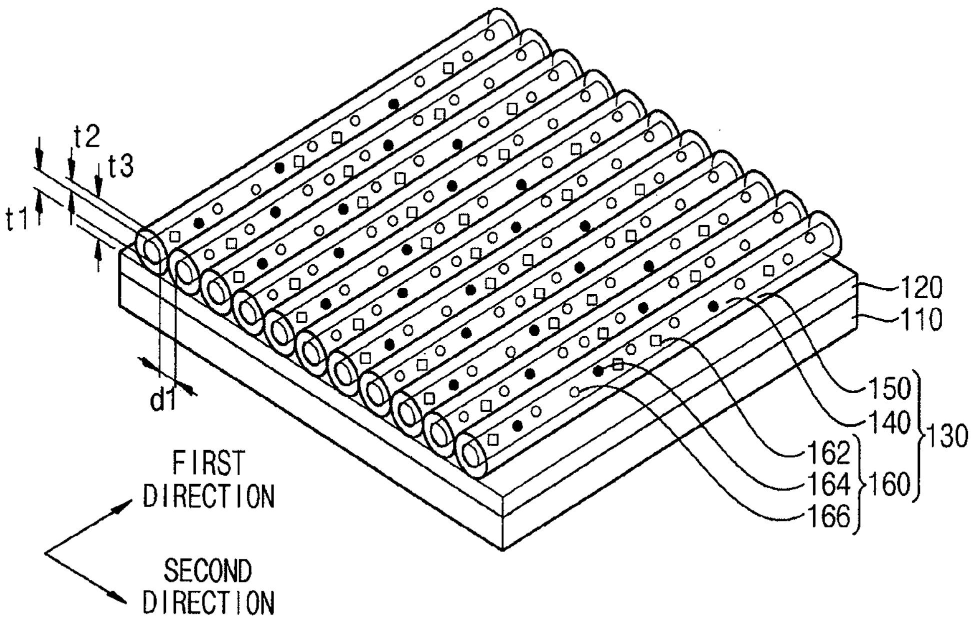


FIG. 2

200

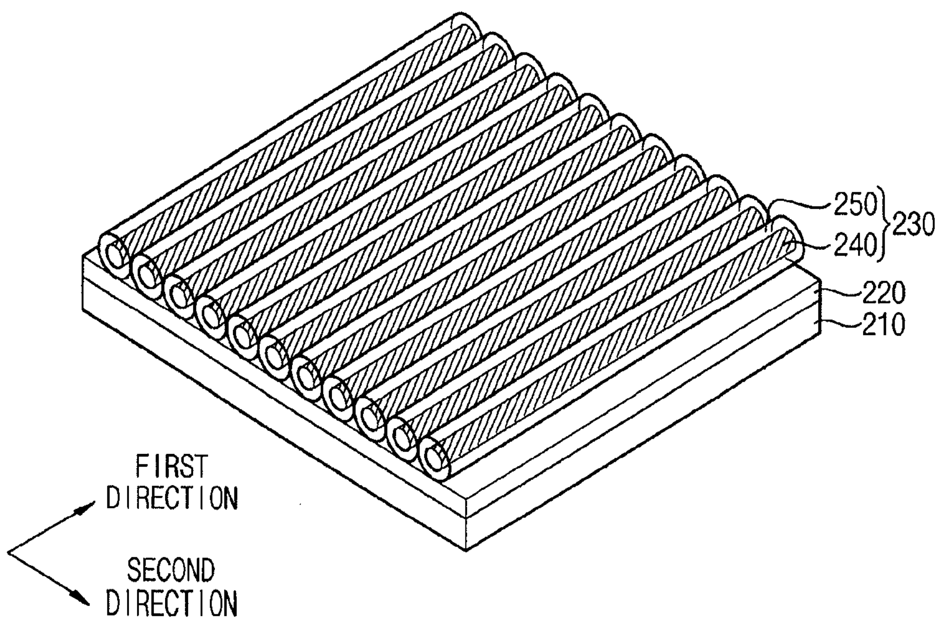


FIG. 3

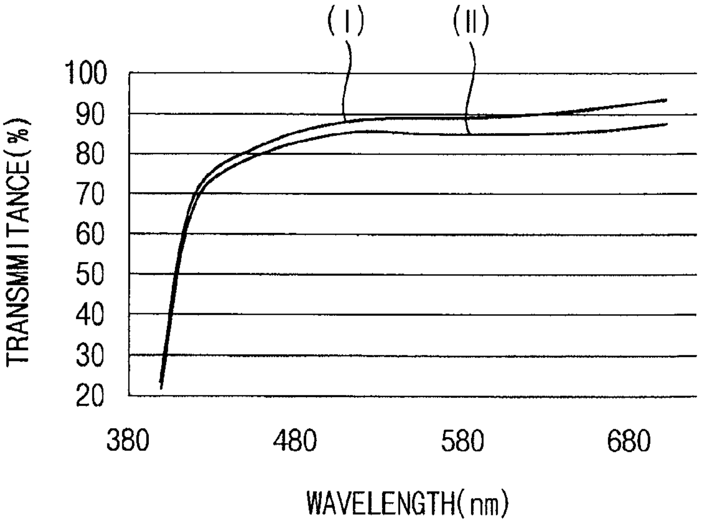

(I)
(II)
100
90
80
70
60
50
40
30
20
TRANSMMITANCE(%)
380
480
580
680
WAVELENGTH(nm)

FIG. 4

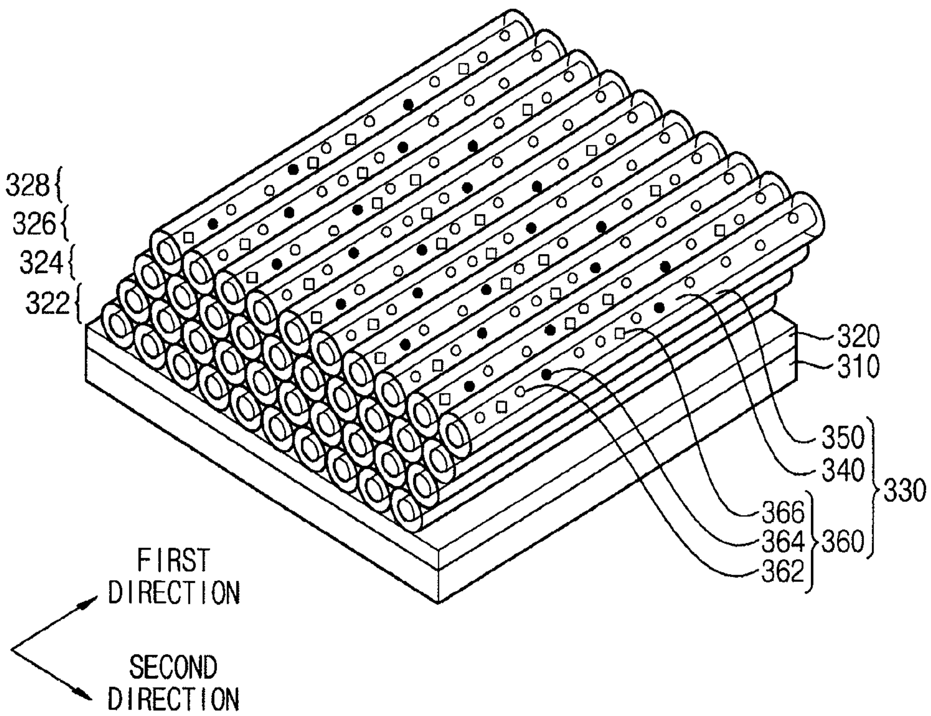

328
326
324
322
320
310
350
340
330
366
364
360
362
FIRST DIRECTION
SECOND DIRECTION

FIG. 5

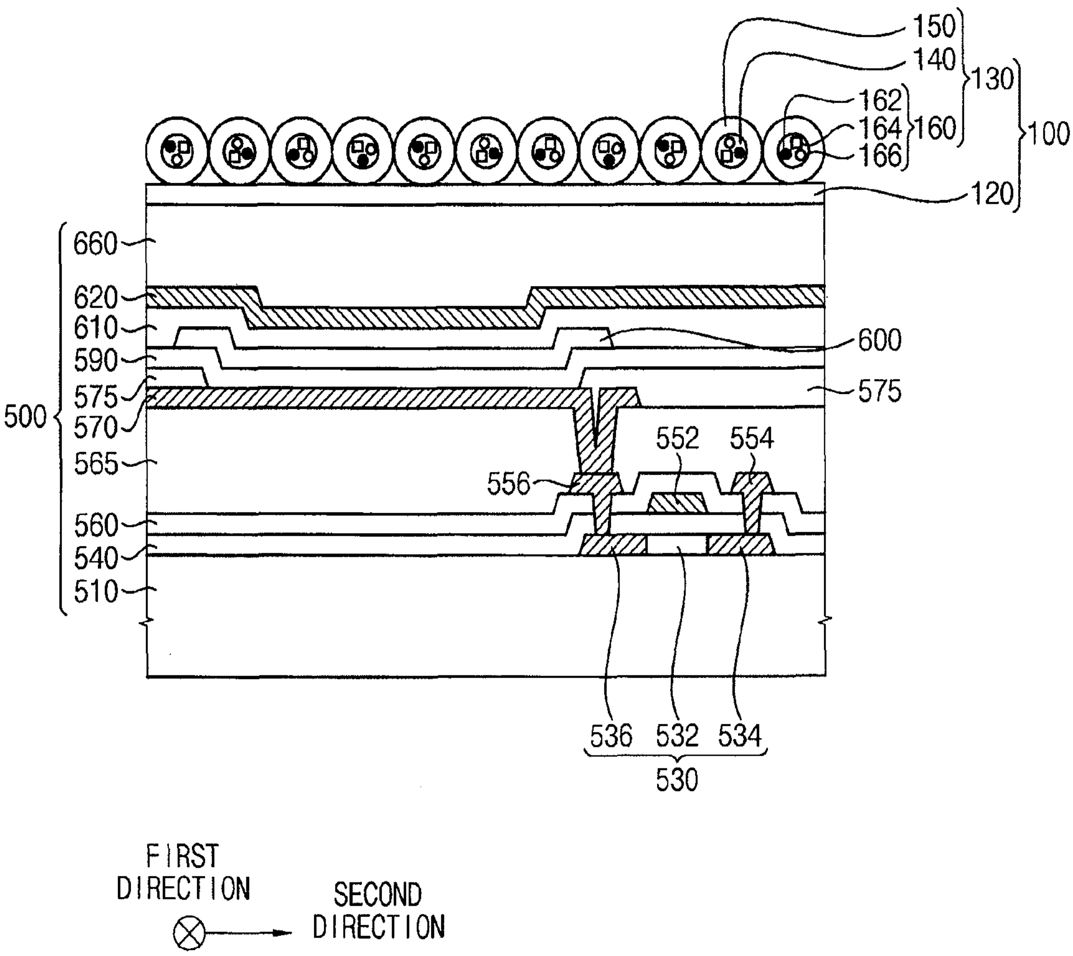

150
140
130
162
164
160
166
100
120
660
620
610
600
590
575
575
500
570
565
552
554
556
560
540
510
536
532
534
530
FIRST DIRECTION
SECOND DIRECTION

FIG. 6

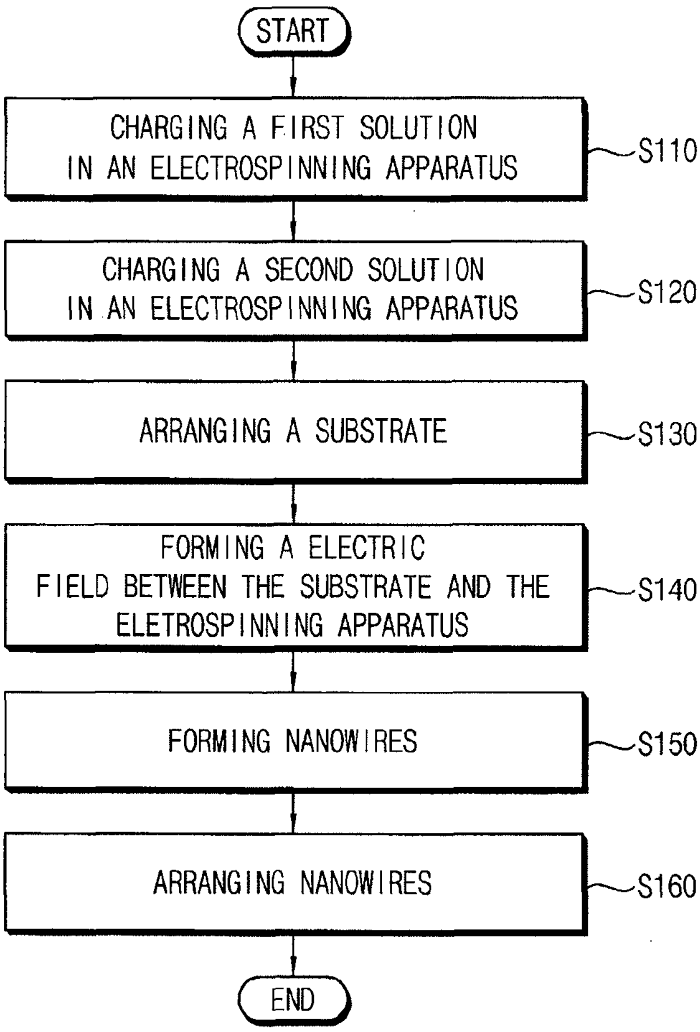
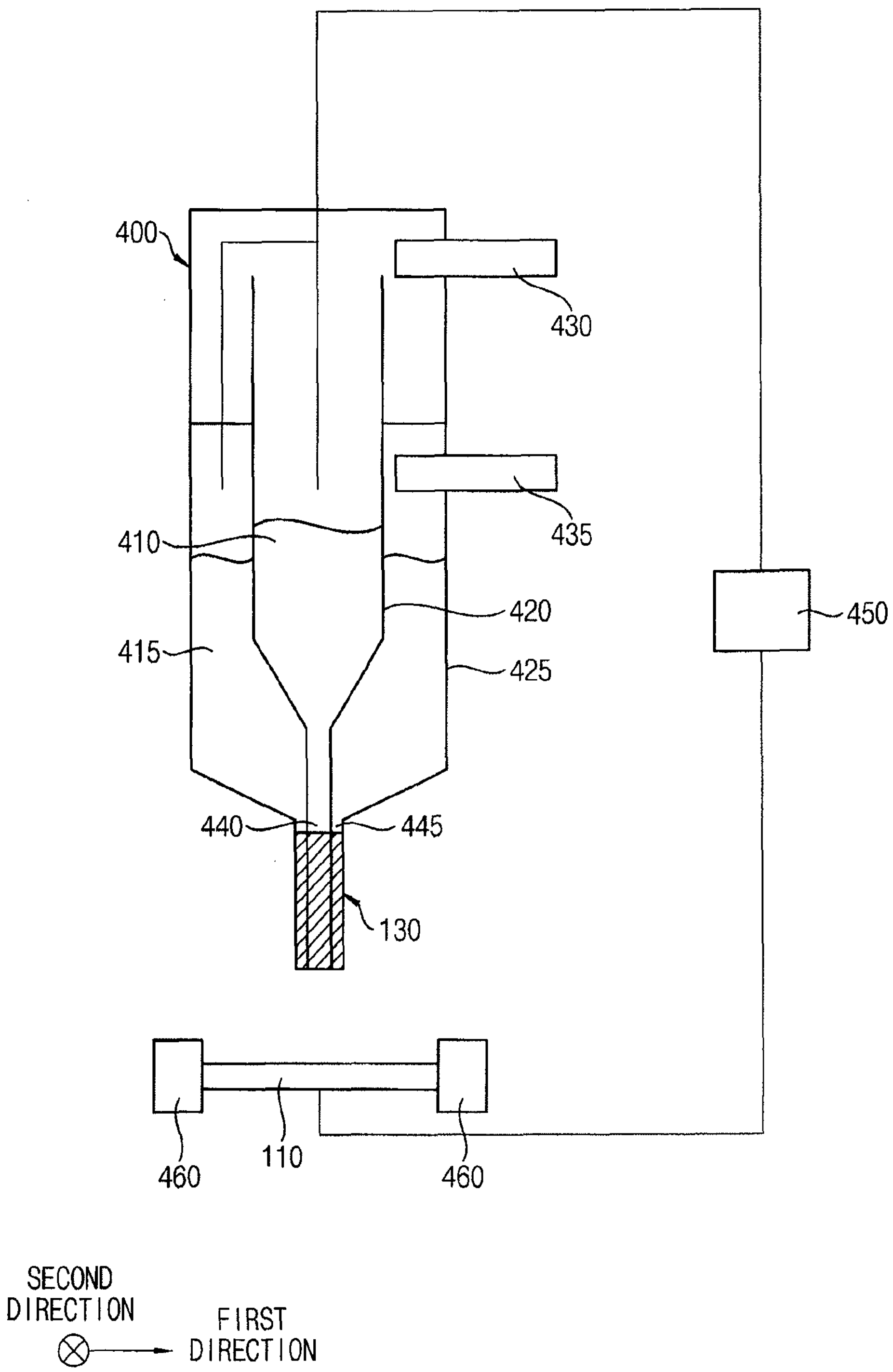

START
CHARGING A FIRST SOLUTION IN AN ELECTROSPINNING APPARATUS
S110
CHARGING A SECOND SOLUTION IN AN ELECTROSPINNING APPARATUS
S120
ARRANGING A SUBSTRATE
S130
FORMING A ELECTRIC FIELD BETWEEN THE SUBSTRATE AND THE ELETROSPINNING APPARATUS
S140
FORMING NANOWIRES
S150
ARRANGING NANOWIRES
S160
END

FIG. 7


400
430
435
410
420
450
415
425
440
445
130
110
460
460
SECOND DIRECTION
FIRST DIRECTION

WIRE GRID TYPE POLARIZATION STRUCTURES, METHODS OF MANUFACTURING WIRE GRID TYPE POLARIZATION STRUCTURES, AND ORGANIC LIGHT EMITTING DIODE (OLED) DISPLAYS HAVING WIRE GRID TYPE POLARIZATION STRUCTURES

CROSS-REFERENCE TO RELATED APPLICATION(S)

This application claims priority under 35 USC §119 to Korean Patent Applications No. 10-2012-0082227, filed on Jul. 27, 2012 in the Korean Intellectual Property Office (KIPO), the contents of which are incorporated herein in its entirety by reference.

BACKGROUND

1. Technical Field

The described technology generally relate to a wire grid type polarization structure, a method of manufacturing a wire grid type polarization structure, and an OLED display including a wire grid type polarization structure.

2. Description of the Related Technology

Organic light emitting diode (OLED) displays display information of images or characters by using light generated as holes and electrons, which are provided from an anode and a cathode, respectively, are combined with each other at an organic light emitting layer interposed between the anode and the cathode. The OLED displays have been spotlighted as next-generation display devices because they have various advantages such as a wide viewing angle, a rapid response speed, slimness, and low power consumption. The OLED displays may additionally include a polarization structure to prevent a reflection of an external light.

SUMMARY

One inventive aspect is a wire grid type polarization structure having a reduced thickness and an improved optical characteristic.

Another aspect is a method of manufacturing a wire grid type polarization structure having a reduced thickness and an improved optical characteristic.

Another aspect is an OLED display having a wire grid type polarization structure that has a reduced thickness and an improved optical characteristic.

Another aspect is a wire grid type polarization structure which includes a retardation layer and a plurality of nanowires formed on the retardation layer. Each of the nanowires includes a wire core and a shell enclosing the wire core. The wire cores include metal nanoparticles embedded therein.

In some example embodiments, the metal nanoparticles may include at least three different types of metal nanoparticles.

In some example embodiments, the metal nanoparticles may include first nanoparticles, second nanoparticles and third nanoparticles. The first nanoparticles may include rod-shaped particles containing gold which are configured to absorb a red color of light, the second nanoparticles may include sphere-shaped particles containing gold which are configured to absorb a green color of light, and the third nanoparticles may include sphere-shaped particles containing silver or an alloy of silver which are configured to absorb a blue color of light.

In some example embodiments, the wire core may include polymethylmethacrylate, polyvinylidene fluoride, polyethylene oxide, polysulfone, poly(dodecylthiophene), poly 4-vinylphenol, poly-urethane, polyacrylonitrile, polycarbonate or cycloolefin polymer.

In some example embodiments, a cross-section of each wire core may be circular, elliptical, or square-shaped.

In some example embodiments, each of the wire cores may have a thickness above about 100 nm, and each of the nanowires may have a thickness below about a quarter of wavelengths of the visible lights.

In some example embodiments, the metal nanoparticles may absorb the visible lights which have wavelengths in a range of about 370 nm to about 1000 nm.

In some example embodiments, the plurality of the nanowires may extend in a first direction, and may form a single layer structure

In some example embodiments, the plurality of the nanowires may extend in a first direction, and may form a multi layer structure.

In some example embodiments, the retardation layer may cause a phase difference between two polarization components of an incident light, and the phase difference may correspond to a quarter wavelength of the incident light.

According to some example embodiments, a wire grid type polarization structure includes a retardation layer and a plurality of nanowires on the retardation layer. Each of the nanowires includes a wire core and a shell enclosing the wire core. The wire cores include a dye which absorbs an incident light

In some example embodiments, each of the wire cores may include polyvinylalcohol, and the dye may include divalent iodine or trivalent iodine substituted with a functional group of polyvinylalcohol.

Another aspect is an OLED display which includes a display panel and a wire grid type polarization structure. The display panel includes a switching structure, a first electrode, a light emitting structure and a second electrode. The wire grid type polarization structure includes a retardation layer and a plurality of nanowires on the retardation layer. Each of the nanowires includes a wire core and a shell enclosing the wire core. The wire cores include metal nanoparticles embedded therein.

According to some example embodiments, a first source is filled in a first syringe of an electrospinning apparatus. A second source is filled in a second syringe which surrounds an outer circumference of the first syringe. A substrate is arranged to face the electrospinning apparatus. Nanowires may be formed by pressurizing the first syringe and the second syringe. The nanowires may be arranged on the substrate. The first source may include a first polymer solution and metal nanoparticles, and the second source may include a second polymer solution.

Another aspect is a wire grid type polarization structure which includes nanowires having shells and wire cores in which metal nanoparticles or dye may be embedded. The metal nanoparticles or the dye may absorb the visible lights effectively, so that the wire grid type polarization structure may have a desired polarization characteristic. Also, the wire grid type polarization structure may include the nanowires and a retardation layer, such that the wire grid type polarization structure may have a relatively small thickness. Additionally, a protection layer including cellulose triacetate (TAC) may be omitted, so that the wire grid type polarization structure may have an improved flexibility to be used at a flexible display.

BRIEF DESCRIPTION OF THE DRAWINGS

Illustrative, non-limiting example embodiments will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings.

FIG. **1** is a perspective view illustrating a wire grid type polarization structure in accordance with example embodiments.

FIG. **2** is a perspective view illustrating a wire grid type polarization structure in accordance with some example embodiments.

FIG. **3** is a graph showing polarization characteristics of a wire grid type polarization structure in accordance with some example embodiments.

FIG. **4** is a perspective view illustrating a wire grid type polarization structure in accordance with some example embodiments.

FIG. **5** is a cross sectional view illustrating an OLED display including a wire grid type polarization structure in accordance with example embodiments.

FIG. **6** is a flow chart illustrating a method of manufacturing a wire grid type polarization structure.

FIG. **7** is a cross sectional view illustrating a method of manufacturing a wire grid type polarization structure.

DETAILED DESCRIPTION

Generally, a polarization structure includes a film type polarizer including a stretch-aligned polyvinylalcohol (PVA). The polarization structure typically includes a protection layer such as a triacetyl-cellulose (TAC) layer on both surfaces of the polarizer film to prevent a distortion of the polarizer film. Therefore, the above polarization structure may have a relatively large thickness and a relatively low flexibility, and it may be hard to apply the polarization structure to a flexible display.

Various example embodiments will be described more fully hereinafter with reference to the accompanying drawings, in which some example embodiments are shown. The present inventive concept may, however, be embodied in many different forms and should not be construed as limited to the example embodiments set forth herein. Rather, these example embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the present inventive concept to those skilled in the art. In the drawings, the sizes and relative sizes of layers and regions may be exaggerated for clarity. Like numerals refer to like elements throughout.

It will be understood that, although the terms first, second, third etc. may be used herein to describe various elements, these elements should not be limited by these terms. These terms are used to distinguish one element from another. Thus, a first element discussed below could be termed a second element without departing from the teachings of the present inventive concept. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items.

It will be understood that when an element is referred to as being "connected" or "coupled" to another element, it can be directly connected or coupled to the other element or intervening elements may be present. In contrast, when an element is referred to as being "directly connected" or "directly coupled" to another element, there are no intervening elements present. Other words used to describe the relationship between elements should be interpreted in a like fashion (e.g., "between" versus "directly between," "adjacent" versus "directly adjacent," etc.).

The terminology used herein is for the purpose of describing particular example embodiments only and is not intended to be limiting of the present inventive concept. 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.

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 inventive concept 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 will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

FIG. **1** is a perspective view illustrating a wire grid type polarization structure in accordance with example embodiments.

Referring to FIG. **1**, the wire grid type polarization structure **100** may include a substrate **110**, a retardation layer **120**, a plurality of nanowires **130**, etc.

The substrate **110** may include a transparent insulating substrate. For example, the substrate **110** may include a glass substrate, a quartz substrate, a transparent resin substrate, a transparent ceramic substrate, etc. In some example embodiments, the substrate **110** may serve as a first substrate, a second substrate or a window of a display panel. The substrate **110** may support the retardation layer **120** and the nanowires **130**.

The retardation layer **120** may be disposed on the substrate **110**. For example, the retardation layer **120** may include a birefringent film containing a polymer such as polystyrene, polycarbonate, polyvinylalcohol, polypropylene, polymethylmethacrylate, polyolefine, polyarylate, polyamide, cyclo-olefin polymer, cyclo-olefin copolymer, etc., an alignment film of liquid crystal polymer and/or an alignment layer containing liquid crystal polymer.

The retardation layer **120** may ensure a phase difference between two polarization components of light incident thereto. The retardation layer **120** may cause a predetermined phase difference between two polarization components which are substantially perpendicular to each other. For example, the predetermined phase difference corresponds to a quarter wavelength of the incident light. In some example embodiments, the retardation layer **120** includes a uni-axially stretched film, a bi-axially stretched film or an inverse wavelength dispersion type retardation film. Accordingly, the retardation layer **120** may convert a linearly polarized light into a circularly polarized light or may convert a circularly polarized light into a linearly polarized light.

Each of the nanowires **130** may include a wire core **140** and a shell **150** which may be disposed on the retardation layer **120**. Each of the wire cores **140** may include metal nanoparticles **160** therein, and each of the shells **150** may substantially enclose each of the wire cores **140**. The plurality of nanowires **130** may be arranged in a second direction, and each of the nanowires **130** may extend in a first direction which is substantially perpendicular to the second direction. Therefore, the nanowires **130** may form a single nanowire layer.

The wire cores **140** may be disposed above the retardation layer **120**, and may extend in the first direction. Also, a plurality of wire cores **140** may be arranged in the second direction, and may be spaced apart with a first distance (D**1**) from one another. In this case, each of the wire cores **140** may have substantially circular cross-section having a first thickness (T**1**). The wire cores **140** may include a transparent polymer. For example, the transparent polymer may include polymethylmethacrylate (PMMA), polyvinylidene fluoride (PVDF), polyethylene oxide (PEO), polysulfone (PSU), poly(dodecylthiophene) (PDT), poly 4-vinylphenol (PVP), poly-urethane (PU), polyacrylonitrile (PAN), polycarbonate (PC), cycloolefin polymer (COP), etc.

The metal nanoparticles **160** may include at least three different types of metal nanoparticles which may be embedded in the wire cores **140**. For example, the metal nanoparticles **160** may include first nanoparticles **162**, second nanoparticles **164** and third nanoparticles **166**. In this case, the first nanoparticles **162** may absorb a light adjacent to a red color, the second nanoparticles **164** may absorb a light adjacent to a green color, and the third nanoparticles **166** may absorb a light adjacent to a blue color. Accordingly, the wire cores **140** including the first, the second and the third nanoparticles **162**, **164** and **166** may absorb the visible lights which have wavelengths in the range of about 370 nm to about 1000 nm.

Materials, sizes and shapes of the first, the second and the third nanoparticles **162**, **164** and **166** may be adjusted depending on the wavelength of light which may be absorbed. For example, each of the nanoparticles **162**, **164** and **166** may include at least one of the following: gold (Au), silver (Ag), copper (Cu) and silicon oxide. The first, the second and the third nanoparticles **162**, **164** and **166** may include sphere-shaped particles, rod-shaped particles, core/shell shaped particles, etc.

In some example embodiments, the first nanoparticles **162** may include rod-shaped particles containing gold (Au), a ratio between lengths and widths of the rod-shaped particles may be in the range of about 1.5:1 to about 2.5:1, and widths of the rod-shaped particles may be in the range of about 20 nm to about 30 nm. The second nanoparticles **164** may include sphere-shaped particles containing silver (Ag) or core/shell shaped particles having the core containing silicon oxide and the shell containing gold (Au), and diameters of the sphere-shaped particles may be in the range of about 20 nm to about 50 nm. The third nanoparticles **166** may include sphere-shaped particles containing silver (Ag), or an alloy of silver, and diameters of the sphere-shaped particles may be in the range of about 20 nm to about 50 nm.

In an example embodiment, the first nanoparticles **162** includes rod-shaped particles containing gold (Au), a ratio between lengths and widths of the rod-shaped particles may be about 2:1, and widths of the rod-shaped particles may be about 30 nm. The second nanoparticles **164** may include sphere-shaped particles containing gold, and diameters of the sphere-shaped particles may be about 30 nm. The third nanoparticles **166** may include sphere-shaped particles containing silver, and diameters of the sphere-shaped particles may be about 30 nm. Therefore, the first nanoparticles **162** may absorb the lights which have the wavelengths in the range of about 600 nm to about 1000 nm, the second nanoparticles **164** may absorb the lights which have the wavelengths in the range of about 480 nm to about 600 nm, and the third nanoparticles **166** may absorb the lights which have the wavelengths in the range of about 370 nm to about 480 nm. Accordingly, the nanoparticles **162**, **164** and **166** may absorb the visible lights which have the wavelengths in the range of about 370 nm to about 1000 nm.

Each of the shells **150** may substantially enclose each of the wire cores **140**, and may have a second thickness (T**2**). The shells **150** may include a polymer which may substantially the same as or substantially similar to that of the wire cores **140**. Therefore, each of the nanowires **130** including the wire core **140** and the shell **150** may have a third thickness (T**3**).

The first distance (D**1**) between the wire cores **140**, the first thickness (T**1**) of the wire core **140** and the third thickness (T**3**) of the nanowire **130** may be adjusted depending on the wavelengths of the incident lights, material characteristics (for example, refractive index) of the wire core **140** and the shell **150**, etc. For example, the first distance (D**1**) between the wire cores **140** must be smaller than a half wavelength of the incident light to improve the polarization characteristics of the wire grid type polarization structure **100**. Therefore, when the minimum wavelength of the visible light (that is, about 370 nm) is considered, the first distance (D**1**) between the wire cores **140** may be smaller than about 185 nm, and the second thickness (T**2**) of the shell **150** may be smaller than about 92.5 nm. Also, when the first thickness (T**1**) of the wire core **140** is smaller than about 100 nm, a back scattering phenomenon may be occurred by the Rayleigh scattering. Therefore, the first thickness (T**1**) of the wire core **140** may be larger than about 100 nm to prevent the back scattering phenomenon. In an example embodiment, the first thickness (T**1**) of the wire core **140** may be in the range of about 500 nm to about 800 nm, and the third thickness (T**3**) of the nanowire **130** may be in the range of about 700 nm to about 1000 nm.

The wire cores **140** are illustrated to have substantially circular cross-section in FIG. **1**. However, the inventive concept may not be limited to the above-described construction. For example, the cross-sections of the wire cores **140** may be elliptical or square-shaped.

According to example embodiments, the wire grid type polarization structure **100** includes the nanowires **130** having the shells **150** and the wire cores **140** in which the metal nanoparticles **160** may be embedded. The metal nanoparticles **160** may absorb the visible lights effectively, so that the wire grid type polarization structure **100** may have a desired polarization characteristic. Also, the wire grid type polarization structure **100** may include the nanowires **130** and the retardation layer **120**, such that the wire grid type polarization structure **100** may have a relatively small thickness. Additionally, a protection layer including cellulose triacetate (TAC) may be omitted, so that the wire grid type polarization structure **100** may have an improved flexibility to be used at a flexible display.

FIG. **2** is a perspective view illustrating a wire grid type polarization structure in accordance with some example embodiments.

Referring to FIG. **2**, the wire grid type polarization structure **200** may include a substrate **210**, a retardation layer **220**, a plurality of nanowires **230**, etc. The wire grid type polarization structure **200** may be substantially the same as or substantially similar to those described with reference to FIG. **1** except for the nanowires **230**.

The nanowires **230** may be disposed on the retardation layer **220**, and each of the nanowires **230** may include a wire core **240** and a shell **250** enclosing the wire core **240**. In this case, the nanowires **230** may form a single nanowire layer.

Each of the wire cores **240** may extend in a first direction on the retardation layer **220**. In this case, a plurality of wire cores **240** may be arranged in a second direction substantially perpendicular to the first direction, and may be spaced apart with a first distance (D**1**) from one another.

The wire cores **240** may include a polymer and a dye which absorb an incident light. The polymer may include polyvinyl alcohol (PVA), and the dye may be divalent iodine or trivalent iodine which may be substituted with a functional group of polyvinylalcohol.

The wire grid type polarization structure **200** may include the nanowires **230** having the shells **250** and the wire cores **240** in which the dye may be embedded. The dye may absorb the visible lights effectively, so that the wire grid type polarization structure **200** may have a desired polarization characteristic. Additionally, a protection layer including cellulose triacetate may be omitted, so that the wire grid type polarization structure **200** may have an improved flexibility to be used at a flexible display.

FIG. **3** is a graph showing polarization characteristics of a wire grid type polarization structure **200** in accordance with FIG. **2**.

Referring to FIG. **3**, the x-axis represents the wavelengths of the incident lights, while the y-axis represents the transmittance of the incident light in a direction parallel to the polarization axis (that is, parallel nicols). The polarization characteristic (I) of the wire grid type polarization structure **200** including the nanowires **230** having diameters of about 700 nm and the wire cores **240** having diameters of about 500 nm may be advantageously compared to the polarization characteristic (II) of a wire grid type polarization structure.

According to a calculated result, the wire grid type polarization structure **200** may have the improved transmittance at a relatively long wavelength compared to the wire grid type polarization structure having the polarization characteristic (II). Therefore, the wire grid type polarization structure **200** in accordance with example embodiments may have an improved polarization characteristic.

FIG. **4** is a perspective view illustrating a wire grid type polarization structure in accordance with some example embodiments.

Referring to FIG. **4**, the wire grid type polarization structure **300** may include a substrate **310**, a retardation layer **320**, a plurality of nanowire layers, etc. The wire grid type polarization structure **300** may be substantially the same as or substantially similar to those described with reference to FIG. **1** except for the plurality of nanowire layers.

In some example embodiments, the nanowire layers include a first nanowire layer **322**, a second nanowire layer **324**, a third nanowire layer **326** and a fourth nanowire layer **328**. The nanowire layers **322-328** may include a plurality of nanowires **330** which may be substantially the same as or substantially similar to the nanowures **130** described with reference to FIG. **1**

Each of the nanowire layers **322-328** may be arranged alternately and repeatedly. The nanowire layers **322-328** may be arranged such that cross sections of the nanowires **330** may form a triangle-lattice structure as illustrated in FIG. **4**. Alternatively, the nanowire layers **322-328** may be arranged such that cross sections of the nanowires **330** may form a rectangular-lattice structure.

According to example embodiments, the wire grid type polarization structure **300** may include the plurality of nanowire layers **322-328** to have an improved polarization characteristic. Each of the nanowire layers **322-328** may include the nanowires **330** having the shells **350** and the wire cores **340** in which the metal nano particles **360** may be embedded. The metal nano particles **360** may absorb the visible lights effectively, so that the wire grid type polarization structure **300** have an improved polarization characteristic.

FIG. **5** is a cross sectional view illustrating an OLED display including a wire grid type polarization structure in accordance with example embodiments.

Referring to FIG. **5**, the OLED display may include a display panel **500** and a wire grid type polarization structure **100** on the display panel **500**.

The display panel **500** may be formed to include a first substrate **510**, a switching structure, a first electrode **570**, a light emitting structure, a second electrode **620**, etc. Although the OLED display illustrated in FIG. **5** may have a bottom emission type, the OLED display may have a top emission type in accordance with materials included in the first and the second electrodes **570** and **620**.

The switching structure may be disposed on the first substrate **510**, and the first electrode **570** may be disposed on the switching structure to be electrically connected to the switching structure. The light emitting structure may be disposed between the first electrode **570** and the second electrode **620**.

The first substrate **510** may include a transparent insulation substrate. For example, the first substrate **510** may include a glass substrate, a transparent plastic substrate, etc. Alternatively, the first substrate **510** may include a flexible substrate.

When the OLED display has an active matrix type, the switching structure may be formed on the first substrate **510**. In some example embodiments, the switching structure may include a switching device, at least one insulation layer, a contact, a pad, a plug, etc. Here, the switching device may include a thin film transistor (TFT), an oxide semiconductor device, etc.

When the switching device in the switching structure includes the thin film transistor, the switching device may be obtained by forming a semiconductor layer **530**, a gate electrode **552**, a source electrode **554**, a drain electrode **556**, etc.

In some example embodiments, the semiconductor layer **530** may be disposed on the first substrate **510**, and the semiconductor layer **530** may be divided into a source region **534**, a drain region **536** and a channel region **532** through an ion implantation process. Then, a gate insulation layer **540** may be disposed to electrically isolate the semiconductor layer **530**.

A gate electrode **552** may be disposed on the gate insulation layer **540**, and then a first insulation layer **560** may be disposed on the gate insulation layer **540** and the gate electrode **552**.

The source electrode **554** and the drain electrode **556** may be disposed through the gate insulation layer **540** and the first insulation layer **560** to contact the source and the drain regions **534** and **536**, respectively. A gate signal may be applied to the gate electrode **552** and a data signal may be applied to the source electrode **554**. Then, a second insulation layer **560** may be disposed to electrically isolate the source electrode **554** and the drain electrode **556**.

In the OLED display illustrated in FIG. **5**, the switching device including the thin film transistor may have a top gate configuration in which the gate electrode **552** may be disposed over the semiconductor layer **530**, however, the configuration of the switching device may not be limited thereto. For example, the switching device may have a bottom gate configuration in which a gate electrode may be disposed under the semiconductor layer.

A second insulation layer **565** may be disposed on the first insulation layer **560** to substantially cover the source electrode **554** and the drain electrode **556**. In some example embodiments, the second insulation layer **565** has a substantially flat surface obtained by a planarization process, for example, a chemical mechanical polishing (CMP) process, an etch-back process, etc.

The first electrode **570** may be formed on the switching structure, and a pixel defining layer **575** may be formed in a region on the switching structure where the first electrode **570** is not positioned.

Referring to FIG. **5**, the light emitting structure may be obtained by forming a hole transfer layer **590**, by forming an organic light emitting layer **600**, by forming an electron transfer layer **610**, etc. The organic light emitting layer **600** may be formed using an organic material or a mixture of an organic material and an inorganic material for generating a red color of light (or red light), a green color of light (or green light) and/or a blue color of light (or blue light). The organic light emitting layer **600** may have a stacked structure that includes a plurality of light emitting films for generating the red color of light, the green color of light and the blue color of light to thereby provide a white color of light.

In some example embodiments, the organic light emitting layer **600** is formed in a display region, and the pixel defining layer **575** is formed in a peripheral region. Therefore, light generated from the organic light emitting layer **600** may be emitted in the display region whereas the light may not be emitted in the peripheral region.

In some example embodiments, the first electrode **570** serves as an anode for providing holes into the hole transfer layer **590** of the light emitting structure, and the second electrode **620** serves as a cathode for supplying electrons into the electron transfer layer **610**. Depending on an emission type of the OLED display, the first electrode **570** may be a transparent electrode or a semi-transparent electrode, and the second electrode **620** may be a reflective electrode. For example, the first electrode **570** may be formed using a transparent conductive material including at least one of the following: indium tin oxide (ITO), zinc tin oxide (ZTO), indium zinc oxide (IZO), zinc oxide (ZnOx), tin oxide (SnOx), gallium oxide (GaOx), etc. The second electrode **620** may be formed using a reflective material such as aluminum (Al), tungsten (W), copper (Cu), nickel (Ni), chromium (Cr), molybdenum (Mo), titanium (Ti), platinum (Pt), silver (Ag), tantalum (Ta), ruthenium (Ru), alloys thereof and nitrides thereof.

The second substrate **660** may be formed on the second electrode **620**. The second substrate **660** may be formed using a transparent substrate such as a glass substrate, a quartz substrate, a transparent resin substrate, etc. Alternatively, the second substrate **660** may be formed using a flexible material. The second substrate **660** may substantially oppose to the first substrate **510**.

The wire grid type polarization structure **100** may be substantially the same as or substantially similar to those described with reference to FIG. **1**, however the inventive concept may not be limited thereto. For example, the OLED display may include the wire grid type polarization structure **200** or **300** described with reference to FIG. **2** or FIG. **3**.

According to example embodiments, the OLED display may include the wire grid type polarization structure **100**, and the wire grid type polarization structure **100** may include the nanowires **130** having the shells **150** and the wire cores **140** in which the metal nanoparticles **160** may be embedded. The metal nanoparticles **160** may absorb the visible lights effectively, so that the wire grid type polarization structure **100** may have a desired polarization characteristic. Accordingly, the wire grid type polarization structure **100** may prevent or reduce a reflection of an external light, so that the OLED display may display improved quality of images.

FIG. **6** is a flow chart illustrating a method of manufacturing a wire grid type polarization structure, and FIG. **7** is a cross sectional view illustrating a method of manufacturing a wire grid type polarization structure.

Referring to FIGS. **6** and **7**, a first source **410** may be filled in a first syringe **420** of an electrospinning apparatus **400** (S**110**).

The electrospinning apparatus **400** may include the first syringe **420**, a first pressurizing part **430** at one end of the first syringe **420** and a first nozzle **440** at another end of the first syringe **420**. Also, the electrospinning apparatus **400** may include the second syringe **425** surrounding an outer circumference of the first syringe **420**, a second pressurizing part **435** at one end of the second syringe **425** and a second nozzle **445** at another end of the second syringe **425**. In this case, the second nozzle **445** may be disposed to surround an outer circumference of the first nozzle **440**.

The first source **410** may include a polymer solution such as PMMA, PVDF, PEO, PSU, PDT, PVP, PU, PAN, PC, COP, etc. The first source **410** may further include metal nano particles **160** dispersed in the polymer solution. The metal nano particles **160** may be substantially the same as or substantially similar to those described with reference to FIG. **1**. The first source **410** filled in the first syringe **420** may maintain a sol phase or a gel phase.

A second source **415** may be filled in the second syringe **425** (S**120**).

The second source **415** may include a polymer solution such as PMMA, PVDF, PEO, PSU, PDT, PVP, PU, PAN, PC, COP, etc. The second source **415** filled in the second syringe **425** may maintain a sol phase or a gel phase.

A substrate **110** may be arranged to face the electrospinning apparatus **400** (S130).

The substrate **110** may be substantially the same as or substantially similar to those described with reference to FIG. **1**. Also, a retardation layer (not shown) may be further disposed on the substrate **110**. In some example embodiments, the substrate **110** may be spaced apart from the electrospinning apparatus **400** with a predetermined distance to face the first and the second nozzles **440** and **445**.

Then, an electrical field may be formed between the electrospinning apparatus **400** and the substrate **110** (S**140**).

Using a power supply **450** which is connected to the electrospinning apparatus **400** and the substrate **110**, an electrical potential difference may be formed between the electrospinning apparatus **400** and the substrate **110**. For example, a voltage of about 1 kV to about 100,000 kV may be applied to the electrospinning apparatus **400**, and the substrate **110** may be grounded. The supplied voltage may be adjusted depending on the distance between the electrospinning apparatus **400** and the substrate **110**. Therefore, the first source **410** in the first syringe **420** and the second source **415** in the second syringe **425** may be electrified by the supplied voltage.

The first source **410** and the second source **415** may be emitted on the substrate **110** to form nanowires **130** (S**150**).

In some example embodiments, the first pressurizing part **430** may pressurize the first source **410** which may be electrified in the first syringe **420**, and the second pressurizing part **435** may pressurize the second source **415** which may be electrified in the second syringe **425**. Therefore, the first source **410** and the second source **415** may be emitted through the first nozzle **440** and the second nozzle **445**, respectively. Accordingly, a wire core may be formed from the first source **410**, and a shell enclosing the wire core may be formed from the second source **415**, thereby forming nanowires **130**.

The nanowires **130** may be arranged to extend in a direction (S **160**).

The nanowire **130** is electrified and then scattered on a substrate **110**. Plates **460** electrified with opposite charges to the nanowires **130** are provided beside both ends of the substrate **110**. For example, if the nanowires **130** is electrified with positive charges, the plates **460** electrified with negative charges are disposed beside the opposite ends of the substrate **110**.

Therefore, an electrostatic attractive force may act between surface charges of the nanowires **130** and the plates **460**. Thus, both ends of the nanowires **130** are respectively pulled toward the plates **460**. As a result, the nanowire **130** is tightly arranged on the substrate **110**. Also, a repulsive force acts between the nanowires **130** electrified with the same charges. Thus, a plurality of nanowires **130** are arranged at regular intervals.

According to at least one of the disclosed embodiments, a wire grid type polarization structure includes nanowires having shells and wire cores in which metal nanoparticles or dye may be embedded. The metal nanoparticles or the dye may absorb the visible lights effectively, so that the wire grid type polarization structure may have a desired polarization characteristic.

The present inventive concept may be applied to an electric device having a display device. For example, the present inventive concept may be applied to a monitor, a laptop, a PDA, a cellular phone, a smart phone, a smart pad, etc. The foregoing is illustrative of example embodiments and is not to be construed as limiting thereof. Although a few example embodiments have been described, those skilled in the art will readily appreciate that many modifications are possible in the example embodiments without materially departing from the novel teachings and advantages of the present inventive concept. Accordingly, all such modifications are intended to be included within the scope of the present inventive concept as defined in the claims. Therefore, it is to be understood that the foregoing is illustrative of various example embodiments and is not to be construed as limited to the specific example embodiments disclosed, and that modifications to the disclosed example embodiments, as well as other example embodiments, are intended to be included within the scope of the appended claims.

What is claimed is:

1. A wire grid type polarization structure comprising:

a retardation layer; and

a plurality of nanowires formed on the retardation layer, wherein each of the nanowires comprises a wire core and a shell enclosing the wire core, and wherein the wire cores comprise metal nanoparticles embedded therein.

2. The polarization structure of claim **1**, wherein the metal nanoparticles comprise at least three different types of metal nanoparticles.

3. The polarization structure of claim **2**, wherein the metal nanoparticles comprise first nanoparticles, second nanoparticles and third nanoparticles, and

wherein the first nanoparticles comprise rod-shaped particles containing gold which are configured to absorb red light, wherein the second nanoparticles comprise sphere-shaped particles containing gold which are configured to absorb green light, and wherein the third nanoparticles comprise sphere-shaped particles containing silver or an alloy of silver which are configured to absorb blue light.

4. The wire grid type polarization structure of claim **1**, wherein the wire core comprises at least one polymer selected from the group consisting of polymethylmethacrylate, polyvinylidene fluoride, polyethylene oxide, polysulfone, poly (dodecylthiophene), poly 4-vinylphenol, poly-urethane, polyacrylonitrile, polycarbonate and cycloolefin polymer.

5. The wire grid type polarization structure of claim **1**, wherein a cross-section of each wire core is circular, elliptical or square-shaped.

6. The wire grid type polarization structure of claim **1**, wherein each of the wire cores has a thickness of about 100 nm or greater, and wherein each of the nanowires has a thickness less than about a quarter of wavelengths of the visible lights.

7. The wire grid type polarization structure of claim **1**, wherein the metal nanoparticles are configured to absorb the visible lights which have wavelengths in the range of about 370 nm to about 1000 nm.

8. The wire grid type polarization structure of claim **1**, wherein the nanowires extend in a first direction, and form a single layer structure.

9. The wire grid type polarization structure of claim **1**, wherein the nanowires extend in a first direction, and form a multi layer structure.

10. The wire grid type polarization structure of claim **1**, wherein the retardation layer is configured to cause a phase difference between two polarization components of an incident light, and wherein the phase difference corresponds to a quarter wavelength of the incident light.

11. An organic light emitting diode (OLED) display comprising:

a display panel comprising a switching structure, a first electrode, a light emitting structure and a second electrode; and

a wire grid type polarization structure formed on the display panel,

wherein the wire grid type polarization structure comprises:

a retardation layer; and

a plurality of nanowires formed on the retardation layer, wherein each of the nanowires comprises a wire core and a shell enclosing the wire core, and wherein the wire cores comprise metal nanoparticles embedded therein.

12. The OLED display of claim **11**, wherein the metal nanoparticles comprise first nanoparticles, second nanoparticles and third nanoparticles, and

wherein the first nanoparticles comprise rod-shaped particles containing gold which are configured to absorb red light, wherein the second nanoparticles comprise sphere-shaped particles containing gold which are configured to absorb green light, and wherein the third nanoparticles comprise sphere-shaped particles containing silver or an alloy of silver which are configured to absorb blue light.

13. The OLED display of claim **11**, wherein a cross-section of each wire core is circular, elliptical or square-shaped.

14. The OLED display of claim **1**, wherein the wire core has a thickness of about 100 nm or greater, and wherein each of the nanowires has a thickness less than about a quarter of wavelengths of the visible lights.

* * * * *

专利名称(译)	线栅型偏振结构，制造线栅型偏振结构的方法，以及具有线栅型偏振结构的有机发光二极管（OLED）显示器		
公开(公告)号	US8896921	公开(公告)日	2014-11-25
申请号	US13/866952	申请日	2013-04-19
[标]申请(专利权)人(译)	三星显示有限公司		
申请(专利权)人(译)	SAMSUNG DISPLAY CO.LTD.		
当前申请(专利权)人(译)	三星DISPLAY CO.，LTD.		
[标]发明人	LEE HYUN SHIK		
发明人	LEE, HYUN-SHIK		
IPC分类号	H01L51/52 G02B5/30 G02B27/28 H01L33/58		
CPC分类号	G02B2207/101 B82Y20/00 G02B5/3058 H01L2924/0002 H01L33/58 H01L51/5271		
优先权	1020120082227 2012-07-27 KR		
其他公开文献	US20140027738A1		
外部链接	Espacenet USPTO		

摘要(译)

公开了一种线栅型偏振结构。在一个方面，偏振结构包括延迟层和形成在延迟层上的多个纳米线。每根纳米线包括线芯和包围线芯的壳。线芯包括嵌入其中的金属纳米颗粒。金属纳米颗粒可以有效地吸收可见光，使得线栅型偏振结构可以具有期望的偏振特性。