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(71) Applicant: SEOUL VIOSYS CO., LTD. [KR/KR]; 65-16, Sandan-ro 163beon-gil, Danwon-gu, Ansan-si, Gyeonggi-do 15609 (KR).

(72) Inventors: PARK, Ki Yon; 65-16, Sandan-ro 163beon-gil, Danwon-gu, Ansan-si, Gyeonggi-do 15609 (KR).
HAN, Yu Dae; 65-16, Sandan-ro 163beon-gil, Danwon-gu, Ansan-si, Gyeonggi-do 15609 (KR).

(74) Agent: AIP PATENT & LAW FIRM; 30-1, Teheran-ro 14-gil, Gangnam-gu, Seoul 06239 (KR).

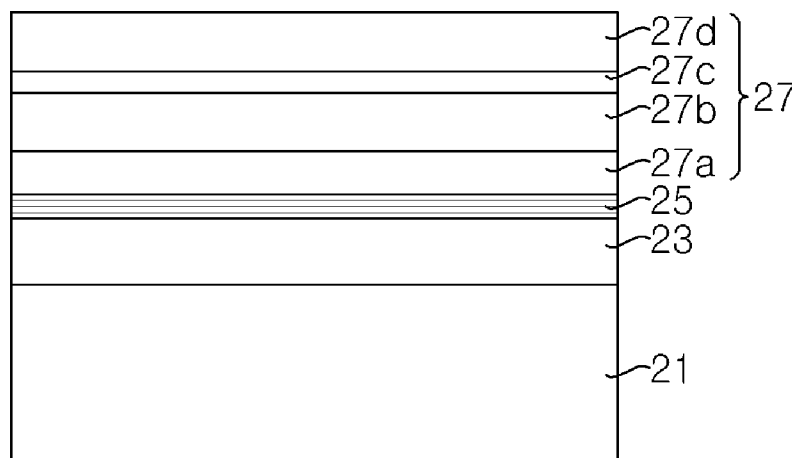
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(54) Title: VERTICAL ULTRAVIOLET LIGHT EMITTING DEVICE



(57) Abstract: A UV light emitting device is disclosed. The UV light emitting device includes: a substrate; an n-type semiconductor layer disposed on the substrate; an active layer disposed on the n-type semiconductor layer; a hole injection layer disposed on the active layer and comprising Al; an Al-delta layer disposed on the hole injection layer and comprising Al; and a first p-type contact layer disposed on the Al-delta layer and having a higher doping concentration of p-type dopants than the hole injection layer, wherein the first p-type contact layer has a lower Al content than the hole injection layer, a band-gap of the first p-type contact layer is lower than or equal to energy of light emitted from the active layer, and the Al-delta layer has a higher Al content than the hole injection layer and allows holes to enter the active layer by tunneling therethrough.



Description

Title of Invention: VERTICAL ULTRAVIOLET LIGHT EMITTING DEVICE

Technical Field

- [1] The present invention relates to an ultraviolet (UV) light emitting device, and more particularly to a UV light emitting device that emits UV light and includes a hole distribution layer in the middle of a p-type semiconductor layer to improve hole injection efficiency into an active layer.

Background Art

- [2] A light emitting device is an inorganic semiconductor device that emits light through recombination of electrons and holes. A UV light emitting device emits UV light and can be used in various fields including curing of polymer materials, sterilization of medical equipment, device components, light sources for generation of white light, and the like. As such, UV light emitting devices have been increasingly used in various fields.
- [3] Like typical light emitting devices, the UV light emitting device includes an active layer interposed between an n-type semiconductor layer and a p-type semiconductor layer. The UV light emitting device emits light having relatively short peak wavelengths (generally, peak wavelengths of 400 nm or less). Thus, in fabrication of the UV light emitting device using a nitride semiconductor, there can be a problem of absorption of UV light emitted from the active layer into n-type and p-type nitride semiconductor layers when the n-type and p-type nitride semiconductor layers have smaller band-gaps than energy of UV light. As a result, the UV light emitting device suffers from significant deterioration in luminous efficacy.
- [4] Thus, in order to prevent deterioration in luminous efficacy, the UV light emitting device contains a certain amount of Al in the active layer and a nitride semiconductor layer at a UV light emitting side. However, since GaN has a band-gap of about 3.4 eV and absorbs light having a wavelength of about 360 nm or less, Al must be contained in the nitride semiconductor layer in order to emit light having a shorter wavelength than this wavelength. As the band-gap increases due to the presence of Al, ionization energy of holes increases together with decrease in activation rate, such that hole injection efficiency into the active layer is reduced. In order to solve this problem, although there is a conventional technique wherein plural layers having different concentrations of p-type dopants are alternately stacked one above another to provide lateral hole dispersion based on a difference in doping concentration between the layers, this technique provide insignificant hole dispersion and cannot sufficiently

suppress deterioration in hole dispersibility of the UV light emitting device.

Disclosure of Invention

Technical Problem

- [5] Exemplary embodiments provide a UV light emitting device which includes an Al-delta layer having a higher band-gap in a hole injection direction than other directions in order to prevent deterioration in hole dispersibility, thereby improving hole injection efficiency into an active layer and lateral hole dispersibility based on a two-dimensional hole gas effect.

Solution to Problem

- [6] In accordance with one exemplary embodiment, a UV light emitting device includes: a substrate; an n-type semiconductor layer disposed on the substrate; an active layer disposed on the n-type semiconductor layer; a hole injection layer disposed on the active layer and including Al; an Al-delta layer disposed on the hole injection layer and including Al; and a contact layer disposed on the Al-delta layer, wherein the contact layer has a lower Al content than the hole injection layer, a band-gap of the first p-type contact layer is lower than or equal to energy of light emitted from the active layer, and the Al-delta layer has a higher Al content than the hole injection layer and a higher doping concentration than the hole injection layer. The Al-delta layer may have a thickness allowing holes to enter the active layer by tunneling therethrough, preferably 20 nm or less.
- [7] The UV light emitting device may further include an electron blocking layer interposed between the active layer and the hole injection layer. Here, the hole injection layer may have a band-gap higher than or equal to energy of light emitted from the active layer.
- [8] The Al content of the Al-delta layer may gradually increase from the hole injection layer to the contact layer. In addition, the Al-delta layer may include a first Al-delta layer disposed on the hole injection layer and having a higher Al content than the hole injection layer; and a second Al-delta layer disposed on the first Al-delta layer and having a higher Al content than the first Al-delta layer.
- [9] The Al-delta layer may be an undoped layer and may be doped with p-type dopants in order to reduce forward voltage. The p-type dopants may include Mg and the Al-delta layer may have a higher Mg doping concentration than the hole injection layer.

Advantageous Effects of Invention

- [10] According to exemplary embodiments, in the UV light emitting device, a hole injection layer and an Al-delta layer are provided to a p-type semiconductor layer to increase a difference in band-gap between the Al-delta layer and the p-type semiconductor layer such that holes can be more uniformly injected into an active layer in

the vertical direction through a two-dimensional gas effect at a confinement interface, thereby improving lateral hole dispersion through the Al-delta layer having a high concentration of Al. Further, the UV light emitting device can have low forward voltage and has high hole injection efficiency into the active layer by doping a high concentration of dopants into the Al-delta layer.

Brief Description of Drawings

- [11] Figure 1 is a sectional view of a UV light emitting device according to one exemplary embodiment.
- [12] Figure 2 is a sectional view of a UV light emitting device according to another exemplary embodiment.
- [13] Figure 3 is a diagram illustrating band-gaps of the UV light emitting device according to the exemplary embodiment.

Best Mode for Carrying out the Invention

- [14] Hereinafter, exemplary embodiments will be described in more detail with reference to the accompanying drawings.
- [15] Figure 1 is a sectional view of a UV light emitting device according to one exemplary embodiment. In description of the UV light emitting device according to this exemplary embodiment, band-gaps of the UV light emitting device will be described with reference to Figure 3.
- [16] Referring to Figure 1, a UV light emitting device according to one exemplary embodiment includes a substrate 21, a first conductive-type semiconductor layer, an active layer 25, and a second conductive-type semiconductor layer. Herein, the conductive type semiconductor layers are nitride semiconductor layers and may be formed by various methods, for example, metal organic chemical vapor deposition (MOCVD), molecular beam epitaxy (MBE), hydride vapor phase epitaxy (HVPE), and the like.
- [17] Referring to Figure 1, a buffer layer is formed on the substrate 21. The substrate 21 is a substrate for growing nitride semiconductor layers thereon, and may include a sapphire substrate, a silicon carbide substrate, a spinel substrate, a GaN substrate, an AlN substrate, or the like. In this exemplary embodiment, a sapphire substrate or an AlN substrate may be used.
- [18] The buffer layer may be formed to a thickness of about 20 nm on the substrate 21. The buffer layer may be a nitride layer including (Al, Ga, In)N and, particularly, may include AlN exhibiting good crystallinity at high temperature and less absorption of visible light. As needed, an AlN layer may be continuously grown to a high thickness of 2 μm on the buffer layer in order to reduce dislocation density.
- [19] When the substrate 21 is a nitride substrate such as a GaN substrate or an AlN

substrate, the buffer layer can be omitted.

- [20] Further, a super-lattice layer may be formed on the buffer layer. The super-lattice layer may include multiple layers consisting of AlGa_N layers having different concentrations of Al and alternately stacked one above another, for example, a superlattice layer of Al_xGa_(1-x)N/Al_yGa_(1-y)N.
- [21] The first conductive-type semiconductor layer may be formed on the super-lattice layer. In this exemplary embodiment, the first conductive-type semiconductor layer may be an n-type semiconductor layer 23 and may be grown by MOCVD or the like. The n-type semiconductor layer 23 may include AlGa_N and may contain n-type dopants such as Si. For example, the n-type semiconductor layer 23 may be represented by n-Al_xGa_(1-x)N (0 < x < 1).
- [22] The active layer 25 and the second conductive-type semiconductor layer may be sequentially formed on the n-type semiconductor layer 23. The active layer 25 emits light having certain energy through recombination of electrons and holes. The active layer may have a single quantum well structure or a multi-quantum well structure in which quantum barrier layers and quantum well layers are alternately stacked one above another. Among the quantum barrier layers, a quantum barrier layer nearest the n-type semiconductor layer may have a higher content of Al than other quantum barrier layers. In the structure wherein the quantum barrier layer nearest the n-type semiconductor layer 23 is formed to have a higher band-gap than the other quantum barrier layers, electron mobility is reduced, thereby effectively preventing overflow of electrons.
- [23] The p-type semiconductor layer 27 may be formed on the active layer 25. The p-type semiconductor layer 27 may be formed to a thickness of 50 nm to 300 nm by a process such as MOCVD. The p-type semiconductor layer 27 may include AlGa_N, and the Al content of the p-type semiconductor layer 27 is determined to have a higher band-gap than the well layers in the active layer 25 in order to prevent absorption of light emitted from the active layer 25.
- [24] The p-type semiconductor layer 27 includes an electron blocking layer 27a, a hole injection layer 27b, an Al-delta layer 27c, and a first p-type contact layer 27d.
- [25] The electron blocking layer 27a is formed on the active layer 25 and contains Al. The electron blocking layer 27a may have an Al content of 20 wt% to 40 wt% and an Mg doping concentration of 3E18/cm³ to 5E19/cm³. Further, the hole injection layer 27b may be formed on the electron blocking layer 27a. The hole injection layer 27b may have a lower Al content than the electron blocking layer 27a and has a lower band-gap than the energy of light emitted from the active layer 25, as shown in Figure 3(a). The doping concentration of the hole injection layer 27b may also be lower than that of the electron blocking layer 27a. In one exemplary embodiment, the hole injection layer

27b may have an Al content of 20 wt% to 30 wt%. In this exemplary embodiment, the hole injection layer 27b may have an Mg doping concentration of $1\text{E}18/\text{cm}^3$ to $5\text{E}19/\text{cm}^3$.

[26] The first p-type contact layer 27d may be formed on the hole injection layer 27b. The first p-type contact layer 27d may have an Al content lower than or equal to the Al content of the hole injection layer 27b and be grown to a thickness of 50 nm to 100 nm. The first p-type contact layer 27d may have an Mg doping concentration of $5\text{E}19/\text{cm}^3$ to $1\text{E}20/\text{cm}^3$.

[27] The Al-delta layer 27c may be interposed between the hole injection layer 27b and the first p-type contact layer 27d. The Al-delta layer 27c is doped with Mg to have an Mg doping concentration higher than or equal to that of the first p-type contact layer 27d and has a higher Al content than the hole injection layer 27b. Here, an excessively thick thickness of the Al-delta layer 27c reduces hole injection efficiency into the active layer 25 and an excessively thin thickness of the Al-delta layer 27c provides an insufficient two-dimensional hole gas effect, thereby deteriorating lateral hole dispersibility. In one exemplary embodiment, the Al-delta layer 27c may have a thickness of 2 nm to 20 nm. Further, although the Al-delta layer 27c may be an undoped layer, the Al-delta layer 27c may be additionally doped with p-type dopants in order to improve hole injection efficiency while reducing forward voltage. The Al-delta layer 27c may have an Mg doping concentration of $5\text{E}20/\text{cm}^3$ or less.

[28] In the structure wherein the UV light emitting device includes the Al-delta layer 27c, when holes h are injected from the first p-type contact layer 27d to the hole injection layer 27b, the holes are two-dimensionally confined by the Al-delta layer 27c to form two-dimensional hole gas (2DHG), as shown in Figure 3(a), thereby improving lateral hole dispersibility. As a result, the holes can be efficiently injected into the active layer by tunneling. The Al-delta layer 27c may be doped with p-type dopants and have a higher doping concentration than the hole injection layer 27b, thereby improving lateral hole dispersibility and hole injection efficiency into the active layer 25 while reducing forward voltage.

[29] The Al-delta layer 27c may be composed of a single layer and have a gradually increasing Al content towards the first p-type contact layer 27d, as shown in Figure 3(b). In order to have the structure wherein the Al content of the Al-delta layer 27c varies in the vertical direction, an Al content of a source gas is intentionally increased such that the Al content of the Al-delta layer 27c gradually increases upwards in the vertical direction upon growth of the Al-delta layer 27c.

[30] The Al-delta layer 27c is grown after growth of the hole injection layer 27b and growth of the Al-delta layer 27c is performed after stopping supply of the Al source gas and performing heat treatment. As a result, the Al source remaining in a chamber is

adsorbed to a surface of the Al-delta layer 27c and reacts therewith such that the Al-delta layer 27c can be grown to have a gradually increasing Al content.

- [31] As such, as the Al content is gradually increased in the upward direction, the 2DHG effect caused by stress between the Al-delta layer 27c and the first p-type contact layer 27d is maintained while relieving stress caused by a difference in lattice parameter between the Al-delta layer 27c and the hole injection layer 27b, whereby holes having passed through the Al-delta layer 27c by tunneling can be more efficiently injected into the active layer 25.
- [32] Figure 2 is a sectional view of a UV light emitting device according to another exemplary embodiment. In description of the UV light emitting device according to this exemplary embodiment, band-gaps of the UV light emitting device will be described with reference to Figure 3.
- [33] In a UV light emitting device according to another exemplary embodiment, the Al-delta layer 27c may be composed of multiple layers. The Al-delta layer 27c composed of the multiple layers may be formed by growing an Al-delta layer 27c having a low Al content, followed by sequentially growing Al-delta layers 27c having higher Al contents thereon. In this way, the Al-delta layer 27c composed of the multiple layers is sequentially grown as shown in Figure 3(c), whereby the 2DHG effect caused by stress between the Al-delta layer 27c and the first p-type contact layer 27d can be further reinforced by counter stress generated between two Al-delta layers 27c while further relieving stress due to the difference in lattice parameter between the Al-delta layer 27c and the hole injection layer 27b.
- [34] The first p-type contact layer 27d may contain indium (In) and have a lower Al concentration than the hole injection layer 27b. Accordingly, the band-gap of the first p-type contact layer 27d may be lower than the hole injection layer 27b and may be lower than or equal to the energy of light emitted from the active layer 25. Further, the first p-type contact layer 27d may have a higher Mg doping concentration than the hole injection layer 27b. In one exemplary embodiment, the first p-type contact layer 27d may have an In content of 1 wt% to 20 wt%, a thickness of 0.5 nm to 20 nm, and an Mg doping concentration of $1 \times 10^{19}/\text{cm}^3$ or less.
- [35] As shown in Figure 2, the p-type semiconductor layer may further include a second p-type contact layer 27e between the first p-type contact layer 27d and the Al-delta layer 27c. The second p-type contact layer 27e may be formed of AlGaN and may have a lower doping concentration than the first p-type contact layer 27d and the Al content of the second p-type contact layer 27e may be determined such that the band-gap of the second p-type contact layer 27e is lower than the energy of light emitted from the hole injection layer 27b and the active layer 25. In one exemplary embodiment, the second p-type contact layer 27e may include p-type GaN. Since the first p-type contact layer

27d and the second p-type contact layer 27e have lower band-gaps than the energy of light emitted from the active layer 25 and thus can absorb light, the first p-type contact layer 27d and the second p-type contact layer 27e are preferably formed as thin as possible by taking into account contact resistance with a p-type electrode (not shown) and hole injection efficiency. For example, a total thickness of the first p-type contact layer 27d and the second p-type contact layer 27e may range from 1 nm to 50 nm.

[36] The p-type electrode (not shown) is formed on an upper side of the first p-type contact layer 27d to inject current (holes) into the nitride semiconductor, and may be composed of a single layer formed of Ni, Ti, W or Au, or multiple layers thereof. In one exemplary embodiment, the p-type electrode is composed of an Ni layer having a thickness of 0.1 nm to 5 nm and an Au layer having a thickness of 1 nm to 20 nm.

[37] Although some exemplary embodiments are disclosed in conjunction with the drawings, it should be understood that these embodiments and the accompanying drawings are provided for illustration only and are not to be construed as limiting the present invention. The scope of the present invention should be interpreted according to the following appended claims as covering all modifications or variations derived from the appended claims and equivalents thereof.

[38] * List of Reference Numerals

[39] 21: Substrate 23: n-type semiconductor layer

[40] 25: Active layer 27: p-type semiconductor layer

[41] 27a: Electron blocking layer 27b: Hole injection layer

[42] 27c: Al-delta layer 27d: First p-type contact layer

[43] 27e: Second p-type contact layer

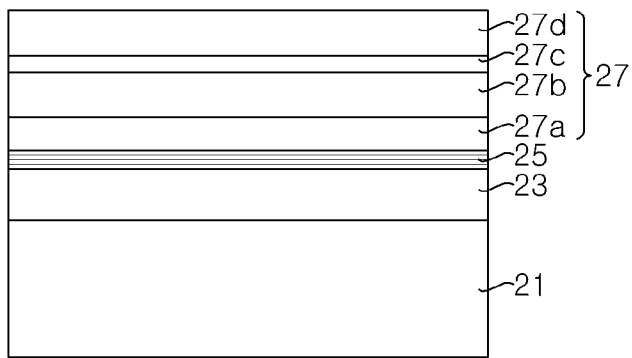
[44]

Claims

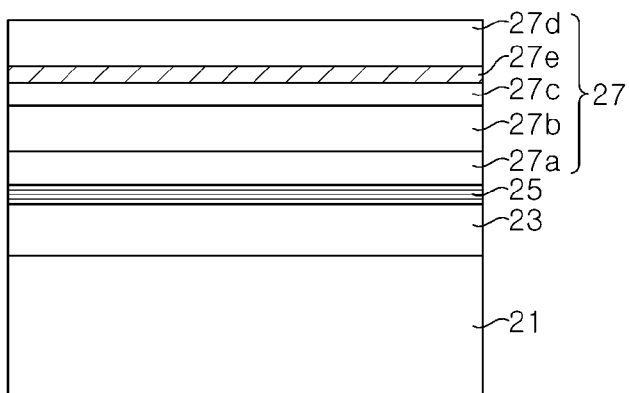
- [Claim 1] A UV light emitting device comprising:
a substrate;
an n-type semiconductor layer disposed on the substrate;
an active layer disposed on the n-type semiconductor layer;
a hole injection layer disposed on the active layer and comprising Al;
an Al-delta layer disposed on the hole injection layer and comprising Al; and
a first p-type contact layer disposed on the Al-delta layer and having a higher doping concentration of p-type dopants than the hole injection layer,
wherein the first p-type contact layer has a lower Al content than the hole injection layer, a band-gap of the first p-type contact layer is lower than or equal to energy of light emitted from the active layer, and the Al-delta layer has a higher Al content than the hole injection layer and allows holes to enter the active layer by tunneling therethrough.
- [Claim 2] The UV light emitting device according to claim 1, wherein the Al-delta layer is doped with p-type dopants and has a higher doping concentration of the p-type dopants than the hole injection layer.
- [Claim 3] The UV light emitting device according to claim 1, wherein the Al-delta layer has a thickness of 2 nm to 20 nm.
- [Claim 4] The UV light emitting device according to claim 1, further comprising:
a second p-type contact layer interposed between the Al-delta layer and the first p-type contact layer, the second p-type contact layer having a lower doping concentration of p-type dopants than the first p-type contact layer and a lower Al content than the hole injection layer.
- [Claim 5] The UV light emitting device according to claim 1, wherein the band-gap of the first p-type contact layer is lower than or equal to the energy of light emitted from the active layer.
- [Claim 6] The UV light emitting device according to claim 4, wherein the second p-type contact layer has a band-gap lower than or equal to the energy of light emitted from the active layer.
- [Claim 7] The UV light emitting device according to claim 1, wherein the first p-type contact layer contains indium (In).
- [Claim 8] The UV light emitting device according to claim 1, wherein the hole injection layer has a band-gap higher than or equal to the energy of light emitted from the active layer.

- [Claim 9] The UV light emitting device according to claim 1, wherein the Al content of the Al-delta layer gradually increases from the hole injection layer to the first p-type contact layer.
- [Claim 10] The UV light emitting device according to claim 1, wherein the Al-delta layer has an Al content increasing stepwise toward the contact layer.
- [Claim 11] The UV light emitting device according to claim 10, wherein the Al-delta layer has a thickness of 2 nm to 20 nm.
- [Claim 12] The UV light emitting device according to claim 2, wherein the Al-delta layer has a higher Mg doping concentration than the hole injection layer.

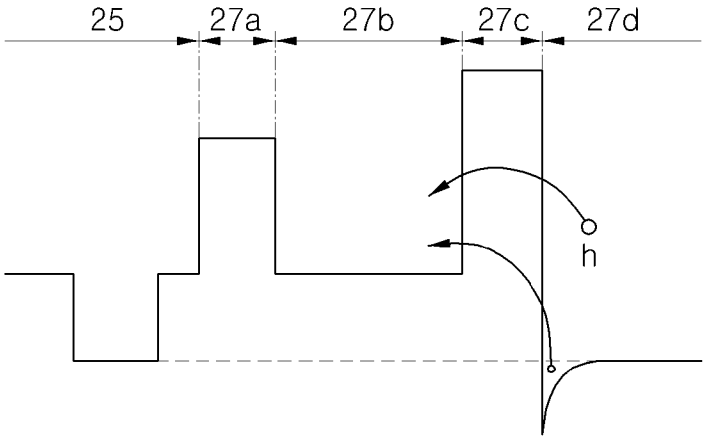
[Fig. 1]



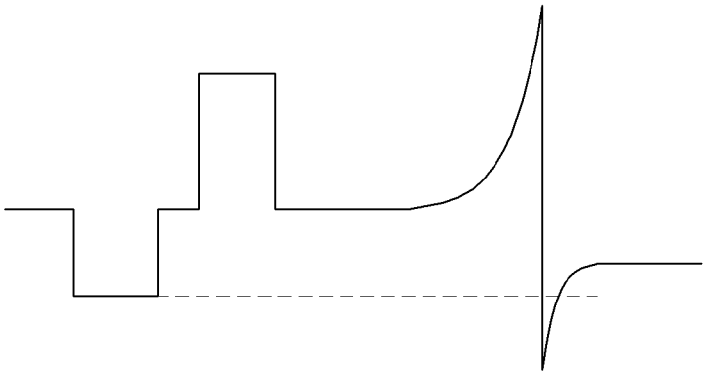
[Fig. 2]



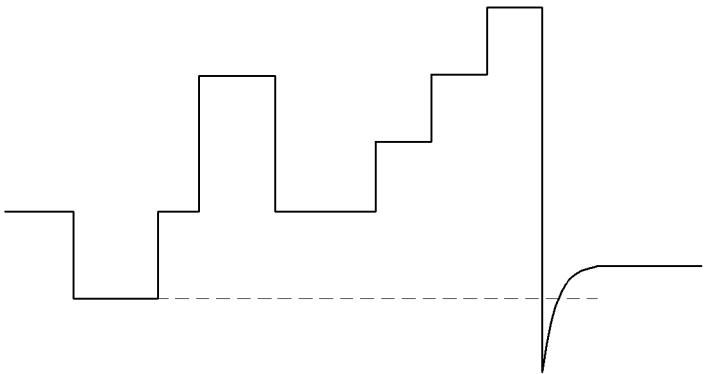
[Fig. 3]



(a)



(b)



(c)

A. CLASSIFICATION OF SUBJECT MATTER**H01L 33/14(2010.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H01L 33/14; H01S 5/343; H01L 33/30; H01L 33/02; H01L 33/04; H01L 33/22

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: hole injection, Al-delta, p-type semiconductor, band gap

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KR 10-0838196 B1 (SEOUL OPTO DEVICE CO., LTD.) 13 June 2008 See abstract, paragraphs 26-28, 36-41, claim 1 and figure 3.	1-12
A	US 2013-0082273 A1 (STEVE TING) 04 April 2013 See abstract, paragraph 73, claims 15-22 and figure 5.	1-12
A	KR 10-2006-0072446 A (LG INNOTEK CO., LTD.) 28 June 2006 See abstract, paragraphs 38-61, claims 1-2 and figures 4-5.	1-12
A	KR 10-2014-0059512 A (LG INNOTEK CO., LTD. et al.) 16 May 2014 See abstract, paragraphs 25-36, claims 1, 21 and figure 2.	1-12
A	JP 5125513 B2 (NICHIA CORP.) 23 January 2013 See paragraphs 28-48 and figures 1, 3-4.	1-12



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

12 January 2016 (12.01.2016)

Date of mailing of the international search report

13 January 2016 (13.01.2016)

Name and mailing address of the ISA/KR

International Application Division

Korean Intellectual Property Office

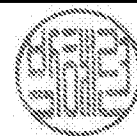
189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea

Facsimile No. +82-42-472-7140

Authorized officer

PARK, Hye Lyun

Telephone No. +82-42-481-3463



INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2015/010317

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
KR 10-0838196 B1	13/06/2008	EP 2017900 A2 EP 2017900 A3 US 2009-0020780 A1 US 8525220 B2	21/01/2009 05/05/2010 22/01/2009 03/09/2013
US 2013-0082273 A1	04/04/2013	CN 103460409 A JP 2014-518014 A KR 10-2014-0010064 A TW 201330315 A US 2014-0106493 A1 US 2015-0024531 A1 US 8698163 B2 US 8828752 B2 WO 2013-049415 A2 WO 2013-049415 A3	18/12/2013 24/07/2014 23/01/2014 16/07/2013 17/04/2014 22/01/2015 15/04/2014 09/09/2014 04/04/2013 11/07/2013
KR 10-2006-0072446 A	28/06/2006	CN 100555682 C CN 101069289 A CN 101577305 A CN 101577305 B EP 1829120 A1 EP 2306528 A2 EP 2306528 A3 EP 2306529 A2 EP 2306529 A3 JP 2008-526014 A JP 2012-195616 A US 2009-0166606 A1 US 2010-0289002 A1 US 2012-0313109 A1 US 2014-0183449 A1 US 7791062 B2 US 8278646 B2 US 8674340 B2 US 8969849 B2 WO 2006-068376 A1	28/10/2009 07/11/2007 11/11/2009 01/02/2012 05/09/2007 06/04/2011 03/04/2013 06/04/2011 10/04/2013 17/07/2008 11/10/2012 02/07/2009 18/11/2010 13/12/2012 03/07/2014 07/09/2010 02/10/2012 18/03/2014 03/03/2015 29/06/2006
KR 10-2014-0059512 A	16/05/2014	None	
JP 5125513 B2	23/01/2013	TW I402998 B US 2007-0096077 A1 US 7462884 B2 WO 2007-052628 A1	21/07/2013 03/05/2007 09/12/2008 10/05/2007