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16/132,059	09/14/2018	Rebecca Elizabeth JONES-ALBERTUS	4204.0020002	4074

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STERNE, KESSLER, GOLDSTEIN & FOX P.L.L.C.  
1100 NEW YORK AVENUE, N.W.  
WASHINGTON, DC 20005

EXAMINER
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CHERN, CHRISTINA

ART UNIT	PAPER NUMBER
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1721

NOTIFICATION DATE	DELIVERY MODE
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06/05/2019

ELECTRONIC

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

e-office@sternekessler.com



## **DETAILED ACTION**

### ***Notice of Pre-AIA or AIA Status***

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

### ***Status of Application***

2. Applicant's request for reconsideration of the finality of the rejection of the last Office action is persuasive and, therefore, the finality of that action is withdrawn.

### ***Priority***

3. Applicant's claim for the benefit of a prior-filed application under 35 U.S.C. 119(e) or under 35 U.S.C. 120, 121, 365(c), or 386(c) is acknowledged. Applicant has not complied with one or more conditions for receiving the benefit of an earlier filing date under 35 U.S.C. 119 (e) and 120 as follows:

The later-filed application must be an application for a patent for an invention which is also disclosed in the prior application (the parent or original nonprovisional application or provisional application). The disclosure of the invention in the parent application and in the later-filed application must be sufficient to comply with the requirements of 35 U.S.C. 112(a) or the first paragraph of pre-AIA 35 U.S.C. 112, except for the best mode requirement. See *Transco Products, Inc. v. Performance Contracting, Inc.*, 38 F.3d 551, 32 USPQ2d 1077 (Fed. Cir. 1994)

The disclosures of the prior-filed applications, Application No. 12/914,710, 14/935,145, 62/564,124, 13/894,245, 13/678,389, 61/559,982, 14/614,601, and 61/936,222, fail to provide

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adequate support or enablement in the manner provided by 35 U.S.C. 112(a) or pre-AIA 35 U.S.C. 112, first paragraph for one or more claims of this application.

While some of the prior-filed applications contain support for various desired band gap ranges and desired ranges for the values of  $x$ ,  $y$ , and  $z$  in the dilute nitride composition, the specifications do not outline ranges of  $x$ ,  $y$ , and  $z$  that would directly result in the band gap ranges as claimed nor do they disclose any desired In/Sb ratio or carrier concentration for the dilute nitride composition. Therefore, the specifications would not enable one of ordinary skill in the art to make and/or use the invention because the exact ranges for the values of  $x$ ,  $y$ , and  $z$  of the claimed  $\text{Ga}_{1-x}\text{In}_x\text{N}_y\text{As}_{1-y-x}\text{Sb}_z$  composition that would provide the claimed band gap ranges while also satisfying the claimed In/Sb ratio and carrier concentration have not been established.

It is further noted that none of the prior-filed applications disclose the claimed subject matter of a dilute nitride composition comprising  $\text{In}_x\text{Ga}_{1-x}\text{N}_y\text{As}_{1-y-z}\text{Sb}_z$  ( $0.1232 \leq x \leq 0.1568$ ;  $0.0318 \leq y \leq 0.0352$ ;  $0.0067 \leq z \leq 0.0126$ ), an In/Sb ratio of at least approximately 10, a band gap between approximately 0.935 eV and 0.963 eV, and a carrier concentration between approximately  $8 \times 10^{15}\text{cm}^{-3}$  and approximately  $1 \times 10^{17}\text{cm}^{-3}$  at room temperature or a dilute nitride composition comprising  $\text{In}_x\text{Ga}_{1-x}\text{N}_y\text{As}_{1-y-z}\text{Sb}_z$  ( $0 \leq x \leq 1$ ;  $0 \leq y \leq 0.1$ ;  $0 \leq z \leq 0.1667$ ), an In/Sb ratio of at least approximately 6, a band gap between approximately 0.7 eV and 0.95 eV, and a carrier concentration less than approximately  $1 \times 10^{16}\text{cm}^{-3}$  at room temperature.

**Accordingly, claims 1-3, 5-11, and 13-30 are not entitled to the benefit of the prior applications and the effective filing date is 9/14/2018.**

***Claim Rejections - 35 USC § 103***

4. In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

5. This application currently names joint inventors. In considering patentability of the claims the examiner presumes that the subject matter of the various claims was commonly owned as of the effective filing date of the claimed invention(s) absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and effective filing dates of each claim that was not commonly owned as of the effective filing date of the later invention in order for the examiner to consider the applicability of 35 U.S.C. 102(b)(2)(C) for any potential 35 U.S.C. 102(a)(2) prior art against the later invention.

6. The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

7. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103 are summarized as follows:

1. Determining the scope and contents of the prior art.

2. Ascertaining the differences between the prior art and the claims at issue.
  3. Resolving the level of ordinary skill in the pertinent art.
  4. Considering objective evidence present in the application indicating obviousness or nonobviousness.
8. **Claims 1-2, 5-10, and 13-30** is/are rejected under 35 U.S.C. 103 as being unpatentable over Jones et al. (US 2011/0232730) as evidenced by Bedell et al. (US 2012/0255600) and as evidenced by Hieslmair et al. (US 2007/0212510).

Regarding **claims 1-2 and 9-10**, Jones discloses a method of forming a semiconductor (12; see Figure 2A), comprising:

a substrate (it is disclosed the dilute nitride material is suitable for lattice matching to a substrate such as GaAs; [0009] and claims 1 and 2) with a lattice parameter matching or nearly matching GaAs (the substrate can be GaAs, as set forth above, such that it would have a lattice parameter matching GaAs);

a first doped III-V layer (30 made of GaAs) over the substrate (see Figure 2A);

an absorber layer (220) over the first doped III-V layer (see Figure 2A); and

a second doped III-V layer (26 GaAs) over the absorber layer (see Figure 2A).

Jones further discloses the absorber layer comprises a dilute nitride composition comprising  $\text{In}_x\text{Ga}_{1-x}\text{N}_y\text{As}_{1-y-z}\text{Sb}_z$  ( $0.07 \leq x \leq 0.18$ ;  $0.025 \leq y \leq 0.04$ ;  $0.001 \leq z \leq 0.03$ ) and that the band gap is tunable in the range of 0.9-1.1 eV ([0009]), but the reference does not expressly disclose the dilute nitride composition comprising  $\text{In}_x\text{Ga}_{1-x}\text{N}_y\text{As}_{1-y-z}\text{Sb}_z$  ( $0.1232 \leq x \leq 0.1568$ ;  $0.0318 \leq y \leq 0.0352$ ;  $0.0067 \leq z \leq 0.0126$ ) and more specifically, the dilute nitride composition

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comprising  $\text{In}_x\text{Ga}_{1-x}\text{N}_y\text{As}_{1-y-z}\text{Sb}_z$  ( $0.1232 \leq x \leq 0.1568$ ;  $0.0318 \leq y \leq 0.0352$ ;  $0.0067 \leq z \leq 0.008$ ), and an In/Sb ratio of at least approximately 10.

It is noted that it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to have selected the overlapping portion of the ranges disclosed by the reference because selection of overlapping portion of ranges has been held to be a *prima facie* case of obviousness. *In re Wertheim*, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990); *In re Geisler*, 116 F.3d 1465, 1469-71, 43 USPQ2d 1362, 1365-66 (Fed. Cir. 1997). It is further noted that the In/Sb ratio will be at least approximately 10 with the selection of the x and z values in the claimed composition.

While modified Jones does not expressly disclose a band gap is between approximately 0.935 eV and 0.963 eV, it is noted that once a photovoltaic cell comprising the above recited composition and structure is disclosed, as set forth above, and therefore is substantially the same as the photovoltaic cell as recited in claims 1 and 9, it will, inherently, display the recited properties. See MPEP § 2112 III and V.

While modified Jones does not expressly disclose a carrier concentration between approximately  $8 \times 10^{15}\text{cm}^{-3}$  and approximately  $1 \times 10^{17}\text{cm}^{-3}$  at room temperature, the reference discloses the absorber layer having a dilute nitride composition can be p-type or n-type ([0024]), such that a doped semiconductor material inherently possesses a carrier concentration.

It is evidenced by Bedell that it is well known in the art before the effective filing date of the claimed invention that p-type or n-type semiconductor layers within a solar cell have a

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carrier concentration ranging from  $1 \times 10^{14}\text{cm}^{-3}$  to  $1 \times 10^{20}\text{cm}^{-3}$  ([0040] and [0041]) and

Hieslmair that it is well known in the art before the effective filing date of the claimed invention that p-type or n-type semiconductor layers within a solar cell have a carrier concentration ranging from  $1 \times 10^{14}\text{cm}^{-3}$  to  $1 \times 10^{18}\text{cm}^{-3}$  ([0182] and [0237]) depending on the desired properties.

Therefore, the doped absorber layer would inherently possess a carrier concentration ranging from at least  $1 \times 10^{14}\text{cm}^{-3}$  to  $1 \times 10^{18}\text{cm}^{-3}$ , as evidenced above, such that it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to have selected the overlapping portion of the ranges for the carrier concentration because selection of overlapping portion of ranges has been held to be a *prima facie* case of obviousness. *In re Wertheim*, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990); *In re Geisler*, 116 F.3d 1465, 1469-71, 43 USPQ2d 1362, 1365-66 (Fed. Cir. 1997).

Regarding **claims 5 and 13**, modified Jones discloses all the claim limitations as set forth above, and further discloses a thickness of the absorber layer is approximately 2 micrometers (see Figure 2B).

Regarding **claims 6 and 14**, modified Jones discloses all the claim limitations as set forth above, and further discloses a thickness of the absorber layer is approximately 2 micrometers (see Figure 2B), but the reference does not expressly disclose a thickness of the absorber layer is between approximately 3 micrometer and approximately 5 micrometers.

It is noted that a *prima facie* case of obviousness exists where the claimed ranges and prior art ranges do not overlap but are close enough that one skilled in the art would have



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expected them to have the same properties. *Titanium Metals Corp. of America v. Banner*, 778 F.2d 775, 227 USPQ 773 (Fed. Cir. 1985) and *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955). Therefore, the disclosed 2 micrometers by modified Jones and the claimed approximately 3 micrometers are close enough such that the claimed approximately 3 micrometers is *prima facie* obvious based on the teaching of modified Jones.

Regarding **claims 7 and 15**, modified Jones discloses all the claim limitations as set forth above, and further discloses the substrate comprises GaAs (as set forth above).

Regarding **claims 8 and 16**, modified Jones discloses all the claim limitations as set forth above, and further discloses the absorber layer is p-type (see 220 in Figure 2B).

Regarding **claims 17, 18, 24, and 25**, Jones discloses a method of forming a semiconductor (12; see Figure 2A), comprising:

a substrate (it is disclosed the dilute nitride material is suitable for lattice matching to a substrate such as GaAs; [0009] and claims 1 and 2) with a lattice parameter matching or nearly matching GaAs (the substrate can be GaAs, as set forth above, such that it would have a lattice parameter matching GaAs);

a first doped III-V layer (30 made of GaAs) over the substrate (see Figure 2A);

an absorber layer (220) over the first doped III-V layer (see Figure 2A), the absorber layer having:

a dilute nitride composition comprising  $\text{In}_x\text{Ga}_{1-x}\text{N}_y\text{As}_{1-y-z}\text{Sb}_z$  ( $0 \leq x \leq 1$ ;  $0 \leq y \leq 0.1$ ;  $0 \leq z \leq 0.1667$ ) and more specifically, the dilute nitride composition comprising  $\text{In}_x\text{Ga}_{1-x}\text{N}_y\text{As}_{1-y-z}\text{Sb}_z$  ( $0 \leq x \leq 0.55$ ;  $0 \leq y \leq 0.1$ ;  $0 \leq z \leq 0.1$ ) (the dilute nitride composition is disclosed to be  $\text{In}_x\text{Ga}_{1-x}\text{N}_y\text{As}_{1-y-z}\text{Sb}_z$  ( $0.07 \leq x \leq 0.18$ ;  $0.025 \leq y \leq 0.04$ ;  $0.001 \leq z \leq 0.03$ ); [0009]),

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an In/Sb ratio of at least approximately 6 (the In/Sb ratio will be at least approximately 6 with the x and z values in the claimed composition); and

a second doped III-V layer (26 GaAs) over the absorber layer (see Figure 2A).

While Jones does not expressly disclose a band gap is between approximately 0.7 eV and 0.95 eV, it is noted that once a photovoltaic cell comprising the above recited composition and structure is disclosed, as set forth above, and therefore is substantially the same as the photovoltaic cell as recited in claims 17 and 24, it will, inherently, display the recited properties. See MPEP § 2112 III and V.

While Jones does not expressly disclose a carrier concentration less than approximately  $1 \times 10^{16} \text{cm}^{-3}$  at room temperature, the reference discloses the absorber layer having a dilute nitride composition can be p-type or n-type ([0024]), such that a doped semiconductor material inherently possesses a carrier concentration.

It is evidenced by Bedell that it is well known in the art before the effective filing date of the claimed invention that p-type or n-type semiconductor layers within a solar cell have a carrier concentration ranging from  $1 \times 10^{14} \text{cm}^{-3}$  to  $1 \times 10^{20} \text{cm}^{-3}$  ([0040] and [0041]) and Hieslmair that it is well known in the art before the effective filing date of the claimed invention that p-type or n-type semiconductor layers within a solar cell have a carrier concentration ranging from  $1 \times 10^{14} \text{cm}^{-3}$  to  $1 \times 10^{18} \text{cm}^{-3}$  ([0182] and [0237]) depending on the desired properties.

Therefore, the doped absorber layer would inherently possess a carrier concentration ranging from at least  $1 \times 10^{14} \text{cm}^{-3}$  to  $1 \times 10^{18} \text{cm}^{-3}$ , as evidenced above, such that it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed

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invention to have selected the overlapping portion of the ranges for the carrier concentration because selection of overlapping portion of ranges has been held to be a *prima facie* case of obviousness. *In re Wertheim*, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990); *In re Geisler*, 116 F.3d 1465, 1469-71, 43 USPQ2d 1362, 1365-66 (Fed. Cir. 1997).

Regarding **claims 19, 20, 26, and 27**, modified Jones discloses all the claim limitations as set forth above.

While modified Jones does not expressly disclose the carrier concentration of the absorber layer is less than approximately  $5 \times 10^{15} \text{cm}^{-3}$  or  $1 \times 10^{15} \text{cm}^{-3}$ , it would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to have selected the overlapping portion of the ranges for the carrier concentration disclosed by the above references because selection of overlapping portion of ranges has been held to be a *prima facie* case of obviousness. *In re Wertheim*, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990); *In re Geisler*, 116 F.3d 1465, 1469-71, 43 USPQ2d 1362, 1365-66 (Fed. Cir. 1997).

Regarding **claims 21 and 28**, modified Jones discloses all the claim limitations as set forth above, and further discloses a thickness of the absorber layer is between approximately 2 micrometers and approximately 10 micrometers (see Figure 2B).

Regarding **claims 22 and 29**, modified Jones discloses all the claim limitations as set forth above, and further discloses a thickness of the absorber layer is approximately 2 micrometers (see Figure 2B), but the reference does not expressly disclose a thickness of the absorber layer is between approximately 3 micrometer and approximately 5 micrometers.

It is noted that a *prima facie* case of obviousness exists where the claimed ranges and prior art ranges do not overlap but are close enough that one skilled in the art would have expected them to have the same properties. *Titanium Metals Corp. of America v. Banner*, 778 F.2d 775, 227 USPQ 773 (Fed. Cir. 1985) and *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955). Therefore, the disclosed 2 micrometers by modified Jones and the claimed approximately 3 micrometers are close enough such that the claimed approximately 3 micrometers is *prima facie* obvious based on the teaching of modified Jones.

Regarding **claims 23 and 30**, modified Jones discloses all the claim limitations as set forth above, and further discloses the absorber layer is p-type (see 220 in Figure 2B).

#### ***Response to Arguments***

9. It is noted that while applicant disagrees with the priority issue raised in the previous Office Action, no argument was presented.

10. Applicant's arguments, see page 8 of Remarks, filed 5/14/2019, with respect to Yanka et al. (US 2016/0372624) have been fully considered and are persuasive. The rejections of claims 17-30 under 35 USC 102(a)(1) as being anticipated by Yanka and the rejections of claims 1-3, 5-11, and 13-16 under 35 USC 103 as being unpatentable over Yanka have been withdrawn.

With respect to the rejections of claims 1-3, 5-11, and 13-30 under 35 USC 103 as being unpatentable over Jones as evidenced by Yanka, new evidentiary references are being cited in the current Office Action to support the rejection under Jones.

11. Applicant's additional arguments with respect to claims 1-3, 5-11, and 13-30 have been considered but are moot because the arguments do not apply to the current rejection.

***Conclusion***

12. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to CHRISTINA CHERN whose telephone number is (408)918-7559. The examiner can normally be reached on Monday-Friday, 6:00-10 AM PST.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at <http://www.uspto.gov/interviewpractice>.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jennifer Michener can be reached on 571-272-1424. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/CHRISTINA CHERN/

Primary Examiner, Art Unit 1721