IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re *Ex Parte* Reexamination of:

U. S. Patent No. 8,952,405

Issue Date: Feb. 10, 2015

Inventor: Mordehai Margalit

Appl. No. 13/413,293

Filing Date: Mar. 6, 2012

For: LIGHT EMITTING DIODE
PACKAGE AND METHOD OF
MANUFACTURE

Control No.: *To be assigned*

Group Art Unit: *To be assigned*

Examiner: *To be assigned*

Confirmation No.: *To be assigned*

Mail Stop *Ex Parte* Reexam
Attn: Central Reexamination Unit
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Commissioner:

REQUEST FOR *EX PARTE* REEXAMINATION OF U.S. PATENT NO. 8,952,405

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I. Introduction

An *ex parte* reexamination is requested on claims 1-17 ("the challenged claims") of U.S. Patent No. 8,952,405, which issued on November 22, 2016, to Margalit ("the '405 patent," Ex. PAT-A), for which the U.S. Patent and Trademark Office ("Office") files identify LED Wafer Solutions LLC ("LED Wafer" or "Patent Owner") as the assignee. In accordance with 37 C.F.R. § 1.510(b)(6), Requester Samsung Electronics Co., Ltd. ("Requester") hereby certifies that the statutory estoppel provisions of 35 U.S.C. § 315(e)(1) and 35 U.S.C. § 325(e)(1) do not prohibit it from filing this *ex parte* reexamination request.

This request raises substantial new questions of patentability based on prior art that the Office did not have before it or did not fully consider during the prosecution of the '405 patent, and which discloses or suggests the features recited in the challenged claims. Requester respectfully urges that this Request be granted and that reexamination be conducted with "special dispatch" pursuant to 35 U.S.C. § 305. The Office should find the claims unpatentable over this art.

In accordance with 37 C.F.R. § 1.20(c), the fee for *ex parte* reexamination (non-streamlined) is submitted herewith. If this fee is missing or defective, please charge the fee as well as any additional fees that may be required to Deposit Account No. 50-2613.

II. Related Proceedings

On March 25, 2021, Patent Owner filed suit against Requester asserting, *inter alia*, infringement of the '405 patent in *LED Wafer Solutions LLC v. Samsung Electronics Co., Ltd.*, No 6-21-CV-00292 (W.D. Tex.). (Ex. LIT-1.) Thereafter, on August 22, 2022, the case was transferred to *LED Wafer Solutions LLC v. Samsung Electronics Co., Ltd.*, No 3-22-CV-04809 (N.D. Cal.). (Ex. LIT-4.)

Requester filed an *inter partes* review petition against the '405 patent on September 3, 2021. IPR2021-01491, Paper 1. The Patent Trial and Appeal Board ("the PTAB") denied that petition on March 15, 2022. IPR2021-01491, Paper 9. Seoul Semiconductor Co, Ltd. separately filed an *inter partes* review petition against the '405 patent on September 7, 2021. IPR2021-01479, Paper 1. The PTAB denied that petition on March 15, 2022. IPR2021-01479, Paper 11. Seoul Semiconductor Co, Ltd. also filed an ex parte reexamination request (Control No. 90/015,090) with respect to the '405 patent on August 11, 2022. That request was denied September 27, 2022.

During prosecution, the Examiner indicated in an interview summary that "suggestions were made regarding Applicant's Fig. 10 to include additional limitations to describe the relationship of the passivation layer with the surrounding/contacting layers (e.g. the LED, sapphire substrate, and layer 1030) as well as the angled shape of the passivation layer" and that "[i]f amended to more clearly describe features of the passivation layer (1070) shown in Fig. 10, this would overcome the applied prior art (Yoo and Chakraborty)." (Ex. PAT-B, 74 (Applicant-Initiated Interview Summary).) Subsequently, Applicant amended the independent claims to recite that the passivation layer is "in direct contact with said metallization layer, said sapphire layer, a surface of said optically permissive layer, and said [semiconductor] LED." (*Id.*, 49-52 claims 1 and 9.) Applicant argued that the prior art did not disclose such a passivation layer (*id.*, 56-60), and, in response to the amendment and arguments, the Examiner issued a Notice of Allowance (*id.*, 11-15). This request does not rely on prior art relied upon by the Examiner during prosecution. As discussed below in Section VI, Sugizaki (Ex. PA-1) provides substantially different disclosure with respect to the "passivation layer" elements that Applicant argued were not present in the prior art. Thus, this request raises substantial new questions of patentability with respect to the "passivation layer" limitation.

In IPR2021-01491, the PTAB denied institution because it determined that Petitioner had not demonstrated sufficiently that it would have been obvious to include an intrinsic layer or region in the LED device of Sugizaki (U.S. Patent Publication No. 2010/0148198) based on Camras (U.S. Patent 7,419,839) or the Applicant Admitted Prior Art (AAPA). IPR2021-01491, Paper 9 at 15-25 (P.T.A.B. Mar. 15, 2022). The Board reached this determination based on its finding that "Petitioner has not adequately shown in the Petition a motivation to combine with a reasonable expectation of success the teachings of Sugizaki as to a light emitting layer with the teaching of Camras as to the use of an intrinsic (undoped) region or layer in an LED." *Id.* at 21. With respect to the AAPA, the Board found that "the Petition does not provide an adequate explanation or showing that an LED with a 3-layer structure including an intrinsic layer should be considered as AAPA based on the disclosure of the '405 patent." *Id.* at 25. Therefore, the Board's denial of institution was based on its determination that Petitioner had not demonstrated that it would have been obvious to include an intrinsic layer in Sugizaki's LED.

Regarding IPR2021-01479, the PTAB also denied institution based on a determination that Petitioner had not demonstrated that it would have been obvious to include an intrinsic layer/region in the LED disclosed by Sugizaki. (IPR2021-01479, Paper 11 at 17-25.) The Board determined that Schubert did not "recommend the use of an intrinsic (undoped) active or light emitting layer in an LED" (*id.* at 20-21); and that the Nakamura reference (U.S. Patent No. 5,777,350) did "not show that the light emitting layers of LEDs were conventionally or commonly undoped" (*id.* at 22.). In all, the PTAB found that the petition did not adequately explain why a skilled artisan would have chosen to use an undoped ("intrinsic") layer as the light emitting layer of an LED based on the teachings of the cited prior art. (*Id.* at 18-21.)

Requester respectfully disagrees with the Board's decisions, and on April 14, 2022, Requester filed a Request for Rehearing in IPR2021-01491 (Paper 10) that was denied October 26, 2022 (Paper 11). Notably, the Board's decisions never reached the question as to whether Sugizaki, alone or in the combinations presented, discloses or suggests the remaining features of the claims. For example, the Board made no determination regarding Sugizaki's disclosure of the "passivation layer" feature that was flagged by the Examiner during prosecution as apparently not being disclosed in the prior art. The Board's decisions rest solely on the question as to whether it was obvious to include an intrinsic layer in the LED device disclosed by Sugizaki. While, as set forth in the Request for Rehearing, Requester believes the Board erred in its findings, the present Request demonstrates that an intrinsic layer—the claim feature that the Board found lacking in the combinations presented in both requests—would have been obvious to include in Sugizaki's LED. Indeed, LEDs with such an intrinsic layer were conventional and widely-known at the time of the alleged invention.

With respect to the "intrinsic layer" as recited in the claims, this request does not rely on any of the references relied on in the IPR petitions for the disclosure or suggestion to include such a feature. In other words, the references relied on for the inclusion of the intrinsic layer in Sugizaki in this request were not previously before the Office during prosecution of the application leading to the '405 patent and not previously before the Office in either of the IPR petitions. Because the Board went no further than determining that Petitioners had not demonstrated that it would have been obvious to include an "intrinsic layer" in Sugizaki's LED, Sugizaki was not fully considered. Therefore, this request raises substantial new questions (SNQs) of patentability, as the primary reference (Sugizaki) was not previously considered by the Office for the disclosure of any of the features for which Sugizaki is demonstrated to disclose or suggest in the present request. For example, Sugizaki discloses the "passivation layer" feature, which was argued during prosecution as not being present in the prior art. Therefore, the combinations presented in this request, which were not previously considered by the Office, raise substantial new questions of patentability as they address the very features that the Office previously determined where not disclosed or suggested by the prior art. The Office erred in a manner material to patentability by not considering the teachings, arguments, obviousness combinations, and evidence presented in this request (Section VI).

III. Identification of Claims and Citation of Prior Art Presented

Requester respectfully requests reexamination of claims 1-17 of the '405 patent in view of the following prior art references, which are also listed on the attached PTO Form SB/08.

Ex. PA-1	U.S. Patent Publication No. 2010/0148198 to Sugizaki *et al*. ("Sugizaki")
Ex. PA-2	Japanese Unexamined Patent Application Publication No. 2004-327636 (Nov. 18 2004) (English translation) to Hanaoka *et al.* ("*Hanaoka*")
Ex. PA-3	Japanese Patent Publication No. 2005-123560 to Izumino *et al.* ("Izumino") (English translation)
Ex. PA-4	U.S. Patent No. 7,419,839 to Camras *et al*. ("Camras")
Ex. PA-5	U.S. Patent Publication No. 2009/0001869 to Tanimoto *et al*. ("Tanimoto")
Ex. PA-6	U.S. Patent Publication No. 2008/0031295 to Tanaka ("Tanaka")
Ex. PA-7	U.S. Patent Publication No. 2008/0251781 to Han *et al.* ("Han")
Ex. PA-8	U.S. Patent No. 7,105,857 to Nagahama *et al.* ("*Nagahama*")

Ex. PA-9	U.S. Patent Application Publication No. 2009/0173958 to Chakraborty et al. ("Chakraborty")

A copy of each of the above-listed references is attached to this request pursuant to 37 C.F.R. § 1.510(b)(3). A copy of the '405 patent is also attached to this request as Exhibit PAT-A pursuant to 37 C.F.R. § 1.510(b)(4).

IV. Overview of the '405 Patent

A. Specification and Drawings of the '405 Patent

The '405 patent is entitled "Light Emitting Diode Package and Method of Manufacture" and describes the structure and formation of LED devices. (Ex. PAT-A, Title; Ex. PA-DEC, ¶¶31-39.) The '405 patent "is directed to a light emitting diode (LED) device implemented on a wafer cover layer and provided with features permitting efficient and repeatable manufacture of the same." (Ex. PAT-A, 1:13-16.) The '405 patent states that conventional LED packaging includes silicon or ceramic carrier substrates, which can increase the manufacturing costs for such LEDs. (*Id.*, 1:55-63.) According to the '405 patent, the carrier substrate can also adversely affect the heat removal characteristics for the LED. (*Id.*, 1:63-65.) In attempting to overcome these issues, the '405 patent discloses embodiments where "the LED is manufactured by epitaxial growth or other chemical or physical deposition techniques of a plurality of layers," where "[c]ertain layers act to promote mechanical, electrical, thermal, or optical characteristics of the device." (*Id.*, 2:2-8.)

Figures 1 and 2 of the '405 patent illustrate prior art gallium nitride (GaN) LEDs that "are typically grown on a sapphire substrate." (*Id.*, 3:10-13, 3:34-36, 3:44-46.) According to the '405 patent, "[t]hese LEDs comprise a P-I-N junction device having an intrinsic (I) layer disposed between an N-type doped layer and a P-type doped layer." (*Id.*, 3:13-16.) Figure 2 illustrates a prior art LED device "like the one shown in FIG. 1 where a GaN layer 200 is disposed above a sapphire layer 210" and "a recess or groove or channel 202 is etched into a portion of the GaN layer 200." (*Id.*, 3:44-47.)

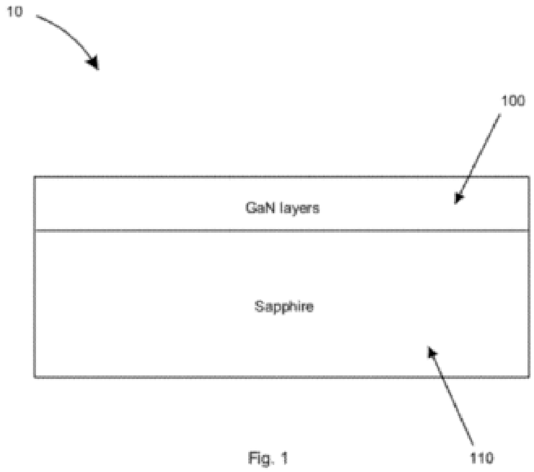

Fig. 1
(Prior Art)

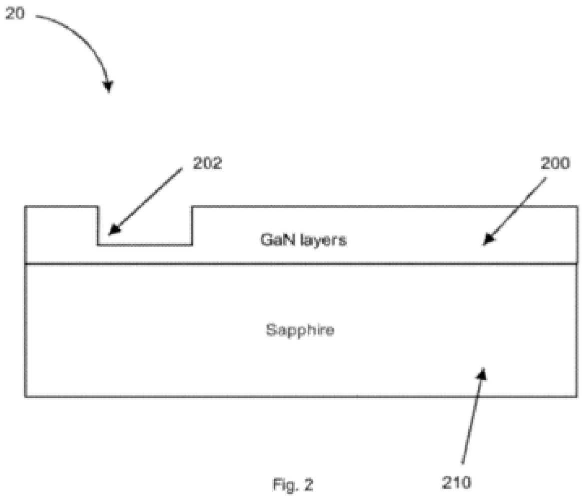

Fig. 2
(Prior Art)

(*Id.*, FIGs. 1, 2.)

Building on the basic prior art structure of the LED, figure 3 shows "the result of metallization of the surface of the GaN layer 200 of the device of FIG. 2," where "the GaN layer 300 comprises a P-I-N junction having strata therein including a P-type doped layer 301 that is proximal to the bulk surface of the GaN layer 300 and distal from the sapphire layer 310, a N-type doped layer 303 within GaN layer 300 that is proximal to the sapphire layer 310, and an intrinsic (I) semiconductor layer 305 in the middle, between the P and N type layers 301 and 303." (*Id.*, 3:64-4:8.).

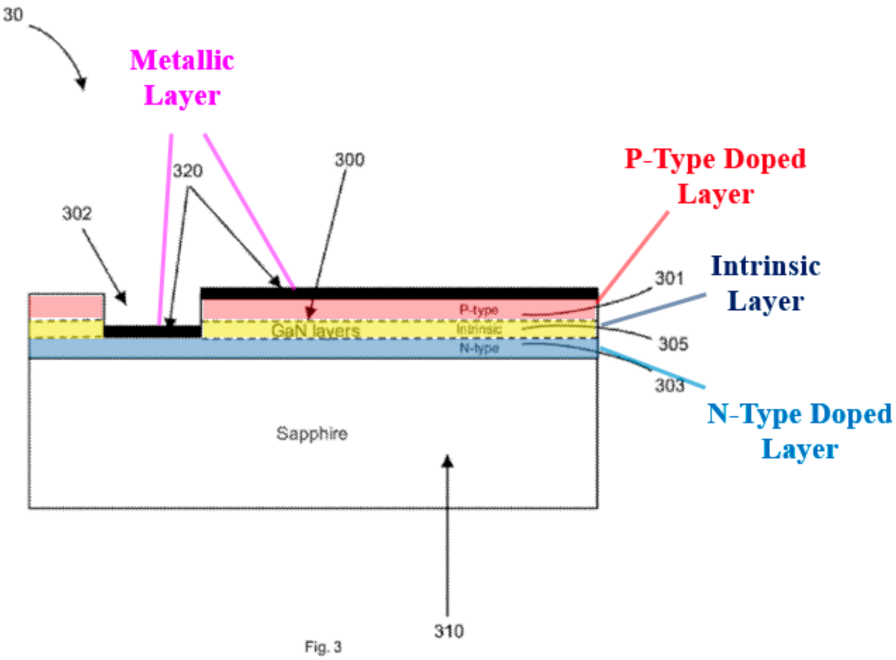

Fig. 3

(*Id.*, FIG.3 (annotated); Ex. PA-DEC, ¶34.)

The metallization is provided in order to provide contacts to the P- and N-type regions such that current flows through the LED to cause photon emission from the intrinsic layer 305. (Ex. PAT-A, 4:8-10 ("In operation, electrical biasing of the P-type layer 301 against the N-type layer 303 causes photon emission from intrinsic layer 305."), 4:22-27 ("In this way, a set of contacts can be applied to the N-type layer 303 and the P-type layer 301 to drive or excite the LED device 30. Current can thus generally flow from a conducting electrode coupled to the N-type layer 303 to another conducting electrode coupled to the P-type layer 301.").)

Figure 5 of the '405 patent provides a cross sectional view of an LED device 50 that includes the LED shown in figure 3 above, where the figure 3 structure has been flipped vertically so that the sapphire substrate is on the top of the LED. (*Id.*, 4:65-5:2, FIGs. 3, 5.)

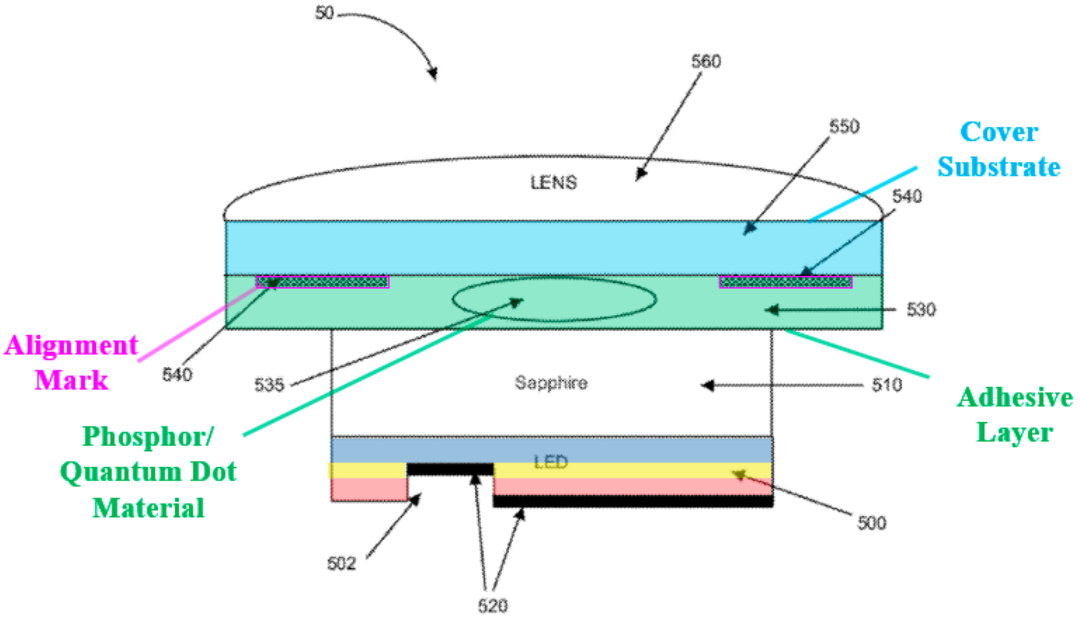

Fig. 5

(*Id*., FIG. 5 (annotated); Ex. PA-DEC, ¶36.)

As shown in annotated figure 5 above, the LED device 50 includes "an optically transparent or transmissive adhesive layer 530," where "[w]ithin, or contiguous to transparent adhesive layer 530 is a region containing phosphor and/or quantum dot material (QD) 535." (Ex. PAT-A, 5:3-8, 5:15-17.) The LED device 50 also includes alignment marks 540 on the adhesive layer 530 that are used to align the LED body over a cover substrate 550. (*Id*., 5:24-27.) The cover substrate 550 is "transparent or optically transmissive to light in the wavelength emitted by LED layer 500 or by the combination of the LED layer 500 and the phosphor material." (*Id*., 5:29-32.) An optical lens 560 on the cover substrate 550 "can act to spread, diffuse, collimate, or otherwise redirect and form the output of the LED." (*Id*., 5:33-37.)

Figure 11 illustrates another embodiment of an LED device that also includes passivation layer 1170 and a metal seed layer 1177 applied to the passivation layer. (*Id*., 7:24-26, FIG. 11.

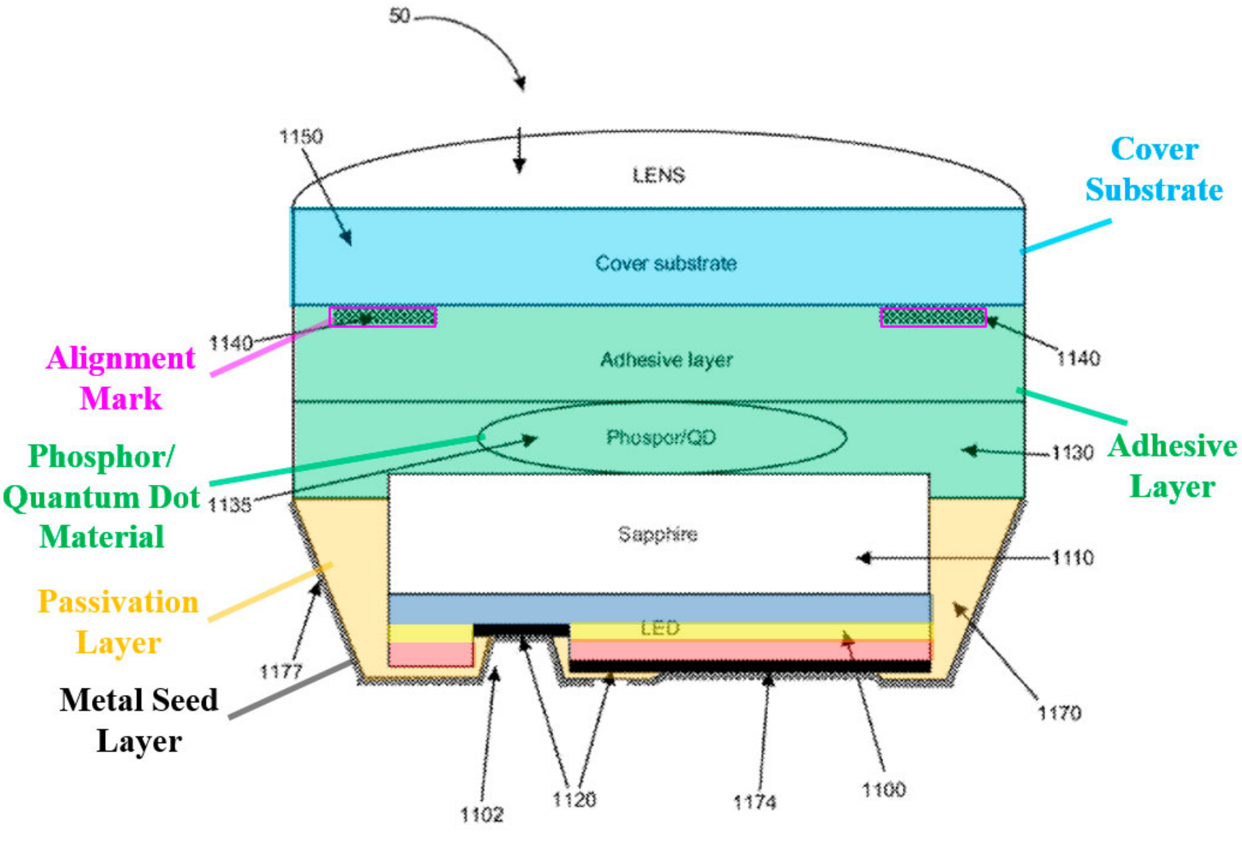

Fig. 11

(*Id*., FIG. 11 (annotated); Ex. PA-DEC, ¶38.)

The ’405 patent discloses that the passivation layer can be a non-conductive layer such as SiO_2, SiN, AlN, Al_2O_3 or an organic material such as epoxy or electrophoretic deposited paint. (Ex. PAT-A, 6:14-20.) The passivation layer is shown in figure 11 to be shaped to provide optical reflectivity. (*Id*., 6:33-38.) The contact holes can be drilled or etched through the passivation layer. (*Id*., 6:47-59.) The metal seed layer 1177 provides enhanced electrical conductivity, heat removal, and reflectivity of light. (*Id*., 7:43-47.)

As explained below and in the accompanying declaration of Dr. Baker, all of the limitations in the challenged claims were known in the prior art. (*See infra* Section VI; Ex. PA-DEC, ¶¶66-242.)

B. Prosecution History of the ’405 patent

As discussed above in Section II, the claims were allowed over the Yoo and Chakraborty after the Examiner suggested “additional limitations to describe the relationship of the passivation layer with the surrounding/contacting layers (e.g. the LED, sapphire substrate, and layer 1030)” that were added by the Applicant and argued to not be present in the prior art. (*Supra*, Section II; (Ex. PAT-B, 74 (Applicant-Initiated Interview Summary).), 49-52 (amended claims 1 and 9), 56-60 (Patent Owner's arguments).) Sugizaki, Hanaoka, Izumino, Camras, Tanimoto, Tanaka, Han, and Nagahama were not considered during prosecution of the '405 patent. (*See generally* Ex. PAT-B.)

C. The Effective Priority Date of the '405 Patent

The '405 patent issued February 10, 2015, from U.S. App. No. 13/413,293 ("the '293 application"), filed March 6, 2012. The '405 patent claims priority to U.S. Provisional Patent Application Nos. 61/449,685 (Ex. PAT-C) and 61/449,686 (Ex. PAT-D) ("the provisional applications"), both of which were filed March 6, 2011. However, the claims of the '405 patent are not entitled to priority to the provisional applications, as the only independent claims, claims 1 and 12, recite "an intrinsic region" where the positioning of the intrinsic region is specified in claim 1 as being between a positively-doped region and a negatively-doped region and specified in claim 12 as "between said positively-doped layer and a first surface of said LED." (Ex. PAT-A, 8:8-10, 9:27-30.) Neither of the provisional applications provides written description support for these features (*See* Exs. PAT-C, PAT-D), and therefore the earliest possible priority date for the '405 patent is the March 6, 2012 filing date of the '293 application. While the provisional applications mention an intrinsic layer, they do not provide any specificity as to where the intrinsic layer is positioned relative to other layers in the light emitting diode (LED) structure disclosed. (*Id.*)

Sugizaki published June 17, 2010, Hanaoka published November 18, 2004, Izumino published May 12, 2005, Camras issued September 2, 2008, Tanimoto published January 1, 2009, Tanaka published Feb. 7, 2008, Han published October 16, 2008, Nagahama issued September 12, 2006, and Chakraborty published July 9, 2009. Thus, based on the March 6, 2012 filing date of the '293 application, which is the earliest possible priority date for the '405 patent, all of these references qualify as prior art to the '405 patent under at least pre-AIA 35 U.S.C. § 102(b). Even if the March 6, 2011 filing date of the provisional applications is taken as the priority date for the '405 patent, Hanaoka, Izumino, Camras, Tanimoto, Tanaka, Han, Nagahama, and Chakraborty are still prior art under at least pre-AIA 35 U.S.C. § 102(b), while Sugizaki is prior art at least under pre-AIA 35 U.S.C. § 102(a).

V. Claim Construction

"During patent examination, the pending claims must be 'given their broadest reasonable interpretation consistent with the specification.'" MPEP § 2111; *see also* MPEP § 2258. Limitations in the specification are not read into the claims. MPEP § 2258. The standard of claim interpretation in reexamination is different than that used by the courts in patent litigation and the Board in *inter partes* review proceedings.[1] Therefore, any claim interpretations submitted or implied herein for the purpose of this reexamination do not necessarily correspond to the appropriate construction under the legal standards mandated in litigation. MPEP § 2686.04.11; *see also In re Zletz*, 893 F.2d 319, 322, 13 USPQ2d 1320, 1322 (Fed. Cir. 1989). For purposes of this request, Requester believes that no constructions of the challenged claims are needed. (Ex. PA-DEC, ¶¶40-41.)

For certain claim terms that may be unclear in scope, this request assumes an interpretation consistent with that advanced by the Patent Owner in litigation. (Ex. LIT-2, 2, 3.)[2] Nonetheless, the claims would be unpatentable under any reasonable construction of this term and the other terms given how closely the prior art maps to the claims. This is particularly true given that the broadest reasonable interpretation standard governs this request.

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[1] Requester reserves all rights and defenses available including, without limitation, defenses as to invalidity, unenforceability, and non-infringement regarding the '405 patent. Further, because the claim interpretation standard used by courts in patent litigation is different from the appropriate standard for this reexamination, any claim constructions submitted or implied herein for the purpose of this reexamination are not binding upon Requester in any litigation related to the '405 patent. Specifically, any interpretation or construction of the claims presented herein or in Dr. Baker's declaration for reexamination, either implicitly or explicitly, should not be viewed as constituting, in whole or in part, the Requester's own interpretation or construction of such claims.

[2] Requester reserves all rights to raise claim constructions in other venues. For example, Requester has not necessarily raised all challenges to the '405 patent in this proceeding, including those under 35 U.S.C. § 112, given the limitations placed by the Rules governing this proceeding. For example, Requester has alleged some terms are indefinite in district court proceedings. But given how closely the prior art maps to the claims (as explained below), those issues do not need to be resolved to assess patentability in this proceeding. In addition, a comparison of the claims to any accused products in litigation may raise controversies that need to be resolved through claim construction that are not presented here given the similarities between the references and the '405 patent. Thus, the SNQs presented herein should not be interpreted to (and do not) conflict with Requester's indefiniteness positions in other proceedings regarding the '405 patent (and how the Court ruled on such positions) (Ex. LIT-2).

VI. Statement of Substantial New Questions of Patentability

As mentioned above, Sugizaki, Hanaoka, Izumino, Camras, Tanimoto, Tanaka, Han and Nagahama were never made of record or considered by the Office during original prosecution of the ’405 patent. However, the references (in various combinations for respective claims) disclose or suggest all of the features of claims 1-17 of the ’405 patent.

SNQ1: Sugizaki, Hanaoka, and Izumino raise a substantial new question of patentability (SNQ1) with respect to claims 1, 3, and 8-16 of the ’405 patent.

SNQ2: Sugizaki, Hanaoka, Izumino, and Camras raise a substantial new question of patentability (SNQ2) with respect to claims 2, 5, and 6 of the ’405 patent.

SNQ3: Sugizaki, Hanaoka, Izumino, and Tanimoto raise a substantial new question of patentability (SNQ3) with respect to claim 4 of the ’405 patent.

SNQ4: Sugizaki, Hanaoka, Izumino, and Tanaka raise a substantial new question of patentability (SNQ4) with respect to claims 7 and 17 of the ’405 patent.

SNQ5: Sugizaki, Hanaoka, Izumino, and Chakraborty raise a substantial new question of patentability (SNQ5) with respect to claims 1-3 and 8-16 of the ’405 patent.

SNQ6: Sugizaki, Hanaoka, Izumino, Chakraborty, and Camras raise a substantial new question of patentability (SNQ6) with respect to claims 2, 5, and 6 of the ’405 patent.

SNQ7: Sugizaki, Hanaoka, Izumino, Chakraborty, and Tanimoto raise a substantial new question of patentability (SNQ7) with respect to claim 4 of the ’405 patent.

SNQ8: Sugizaki, Hanaoka, Izumino, Chakraborty, and Tanaka raise a substantial new question of patentability (SNQ8) with respect to claims 7 and 17 of the ’405 patent.

SNQ9: Sugizaki, Han, and Izumino raise a substantial new question of patentability (SNQ9) with respect to claims 1, 3, and 8-16 of the ’405 patent.

SNQ10: Sugizaki, Han, Izumino, and Camras raise a substantial new question of patentability (SNQ10) with respect to claims 2, 5, and 6 of the ’405 patent.

SNQ11: Sugizaki, Han, Izumino, and Tanimoto raise a substantial new question of patentability (SNQ11) with respect to claim 4 of the ’405 patent.

SNQ12: Sugizaki, Han, Izumino, and Tanaka raise a substantial new question of patentability (SNQ12) with respect to claims 7 and 17 of the ’405 patent.

SNQ13: Sugizaki, Han, Izumino, and Chakraborty raise a substantial new question of patentability (SNQ13) with respect to claims 1-3 and 8-16 of the ’405 patent.

SNQ14: Sugizaki, Han, Izumino, Chakraborty, and Camras raise a substantial new question of patentability (SNQ14) with respect to claims 2, 5, and 6 of the ’405 patent.

SNQ15: Sugizaki, Han, Izumino, Chakraborty, and Tanimoto raise a substantial new question of patentability (SNQ15) with respect to claim 4 of the ’405 patent.

SNQ16: Sugizaki, Han, Izumino, Chakraborty, and Tanaka raise a substantial new question of patentability (SNQ16) with respect to claims 7 and 17 of the ’405 patent.

SNQ17: Sugizaki, Nagahama, and Izumino raise a substantial new question of patentability (SNQ17) with respect to claims 1, 3, and 8-16 of the ’405 patent.

SNQ18: Sugizaki, Nagahama, Izumino, and Camras raise a substantial new question of patentability (SNQ18) with respect to claims 2, 5, and 6 of the ’405 patent.

SNQ19: Sugizaki, Nagahama, Izumino, and Tanimoto raise a substantial new question of patentability (SNQ19) with respect to claim 4 of the ’405 patent.

SNQ20: Sugizaki, Nagahama, Izumino, and Tanaka raise a substantial new question of patentability (SNQ20) with respect to claims 7 and 17 of the ’405 patent.

SNQ21: Sugizaki, Nagahama, Izumino, and Chakraborty raise a substantial new question of patentability (SNQ22) with respect to claims 1-3 and 8-16 of the ’405 patent.

SNQ22: Sugizaki, Nagahama, Izumino, Chakraborty, and Camras raise a substantial new question of patentability (SNQ22) with respect to claims 2, 5, and 6 of the ’405 patent.

SNQ23: Sugizaki, Nagahama, Izumino, Chakraborty, and Tanimoto raise a substantial new question of patentability (SNQ23) with respect to claim 4 of the ’405 patent.

SNQ24: Sugizaki, Nagahama, Izumino, Chakraborty, and Tanaka raise a substantial new question of patentability (SNQ24) with respect to claims 7 and 17 of the ’405 patent.

Thus, for these reasons and the reasons discussed below and supporting declaration of Dr. Baker (Ex. PA-DEC), Sugizaki, Hanaoka, and Izumino raise a substantial new question of patentability (SNQ1) with respect to claims 1, 3, and 8-16 of the ’405 patent; Sugizaki, Hanaoka, Izumino, and Camras raise a substantial new question of patentability (SNQ2) with respect to claims 2, 5, and 6 of the ’405 patent; Sugizaki, Hanaoka, Izumino, and Tanimoto raise a substantial new question of patentability (SNQ3) with respect to claim 4 of the ’405 patent; Sugizaki, Hanaoka, Izumino, and Tanaka raise a substantial new question of patentability (SNQ4) with respect to claims 7 and 17 of the ’405 patent; Sugizaki, Hanaoka, Izumino, and Chakraborty raise a substantial new question of patentability (SNQ5) with respect to claims 1-3 and 8-16 of the ’405 patent; Sugizaki, Hanaoka, Izumino, Chakraborty, and Camras raise a substantial new question of patentability (SNQ6) with respect to claims 2, 5, and 6 of the ’405 patent; Sugizaki, Hanaoka, Izumino, Chakraborty, and Tanimoto raise a substantial new question of patentability (SNQ7) with respect to claim 4 of the ’405 patent; Sugizaki, Hanaoka, Izumino, Chakraborty, and Tanaka raise a substantial new question of patentability (SNQ8) with respect to claims 7 and 17 of the ’405 patent; Sugizaki, Han, and Izumino raise a substantial new question of patentability (SNQ9) with respect to claims 1, 3, and 8-16 of the ’405 patent; Sugizaki, Han, Izumino, and Camras raise a substantial new question of patentability (SNQ10) with respect to claims 2, 5, and 6 of the ’405 patent; Sugizaki, Han, Izumino, and Tanimoto raise a substantial new question of patentability (SNQ11) with respect to claim 4 of the ’405 patent; Sugizaki, Han, Izumino, and Tanaka raise a substantial new question of patentability (SNQ12) with respect to claims 7 and 17 of the ’405 patent; Sugizaki, Han, Izumino, and Chakraborty raise a substantial new question of patentability (SNQ13) with respect to claims 1-3 and 8-16 of the ’405 patent; Sugizaki, Han, Izumino, Chakraborty, and Camras raise a substantial new question of patentability (SNQ14) with respect to claims 2, 5, and 6 of the ’405 patent; Sugizaki, Han, Izumino, Chakraborty, and Tanimoto raise a substantial new question of patentability (SNQ15) with respect to claim 4 of the ’405 patent; Sugizaki, Han, Izumino, Chakraborty, and Tanaka raise a substantial new question of patentability (SNQ16) with respect to claims 7 and 17 of the ’405 patent; Sugizaki, Nagahama, and Izumino raise a substantial new question of patentability (SNQ17) with respect to claims 1, 3, and 8-16 of the ’405 patent; Sugizaki, Nagahama, Izumino, and Camras raise a substantial new question of patentability (SNQ18) with respect to claims 2, 5, and 6 of the ’405 patent; Sugizaki, Nagahama, Izumino, and Tanimoto raise a substantial new question of patentability (SNQ19) with respect to claim 4 of the ’405 patent; Sugizaki, Nagahama, Izumino, and Tanaka raise a substantial new question of patentability (SNQ20) with respect to claims 7 and 17 of the ’405 patent; Sugizaki, Nagahama, Izumino, and Chakraborty raise a substantial new question of patentability (SNQ22) with respect to claims 1-3 and 8-16 of the ’405 patent; Sugizaki, Nagahama, Izumino, Chakraborty, and Camras raise a substantial new question of patentability (SNQ22) with respect to claims 2, 5, and 6 of the ’405 patent; Sugizaki, Nagahama, Izumino, Chakraborty, and Tanimoto raise a substantial new question of patentability (SNQ23) with respect to claim 4 of the ’405 patent; and Sugizaki, Nagahama, Izumino, Chakraborty, and Tanaka raise a substantial new question of patentability (SNQ24) with respect to claims 7 and 17 of the ’405 patent.

A. SNQ1: Sugizaki in View of Hanaoka and Izumino Discloses or Suggests Claims 1, 3, and 8-16

As explained below and in the attached declaration of Dr. Baker (Ex. PA-DEC), Sugizaki in view of Hanaoka and Izumino discloses or suggests the limitations of claims 1, 3, and 8-16 of the ’405 patent. (Ex. PA-DEC, ¶¶66-159.)

1. Overview of Sugizaki

Sugizaki is entitled “Light Emitting Device and Method for Manufacturing Same” and discloses a “method for manufacturing a light emitting device . . . .” (Ex. PA-1, Title, ¶[0007]; Ex. PA-DEC, ¶¶42-46.) Figures 1A and 18 of Sugizaki, replicated below, show light emitting devices according to Sugizaki’s first and fourth embodiments, respectively. (Ex. PA-1, ¶¶[0031], [0027], [0092], FIGs. 1A, 18B.)

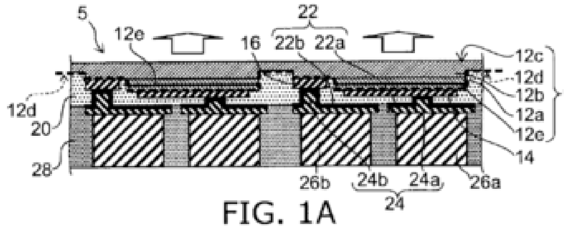


FIG. 1A

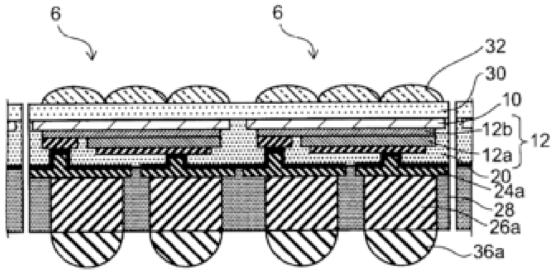


FIG. 18B

(*Id.*, FIGs. 1A, 18B.)

Each of Sugizaki’s embodiments includes a multilayer body 12 that “has an upper layer 12a, including a light emitting layer 12e, and a lower layer 12b.” (*Id.*, ¶[0032].) The upper and lower layers are doped such that they are p-type and n-type, respectively. (*Id.*) As described by Sugizaki, “light from the light emitting layer 12e can be emitted primarily from the first surface 12c of the multilayer body 12 in the upward direction of figure 1A.” (*Id.*, ¶[0039].) The multilayer body 12 is initially formed on a substrate such as a sapphire substrate. (*Id.*, ¶[0047].)

As shown in annotated figure 18B below, Sugizaki further includes p- and n-side electrodes that are formed of metal and provide electrical contact to the p- and n-doped portions of the multilayer structure. (*Id.*, ¶¶[0033], [0048], [0049].)

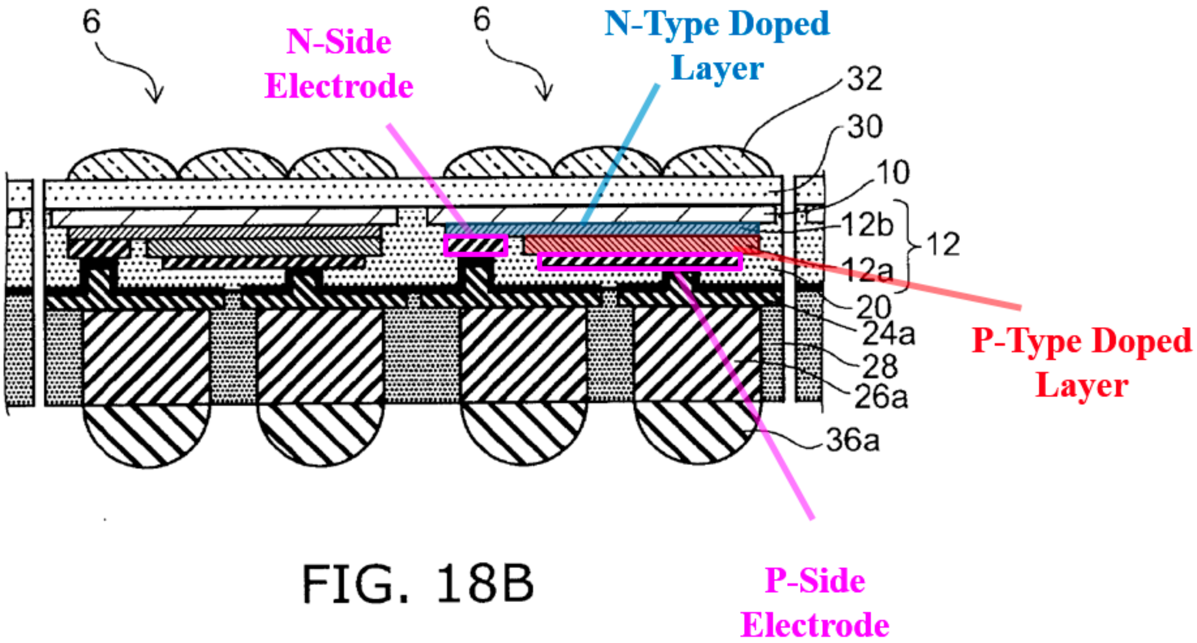


FIG. 18B

(*Id.*, FIG. 18B (annotated); Ex. PA-DEC, ¶44.)

Sugizaki discloses that, in some embodiments, the sapphire layer is removed prior to formation of other aspects of the light emitting device, whereas in other embodiments, the sapphire layer remains. (Ex. PA-1, ¶[0044].) For example, in the embodiment shown in annotated figure 18B below, the sapphire layer 10 remains, but has had its thickness reduced. The LED device shown in figure 18B of Sugizaki also includes a phosphor layer 30 that overlies the sapphire layer, where the phosphor layer absorbs some of the light from the LED and changes the wavelength of the light. (*Id.*, ¶[0061].) Sugizaki further discloses that a convex or concave lens can be provided on the phosphor layer to converge or diverge the light generated by the LED. (*Id.*, ¶¶[0063], [0065].)

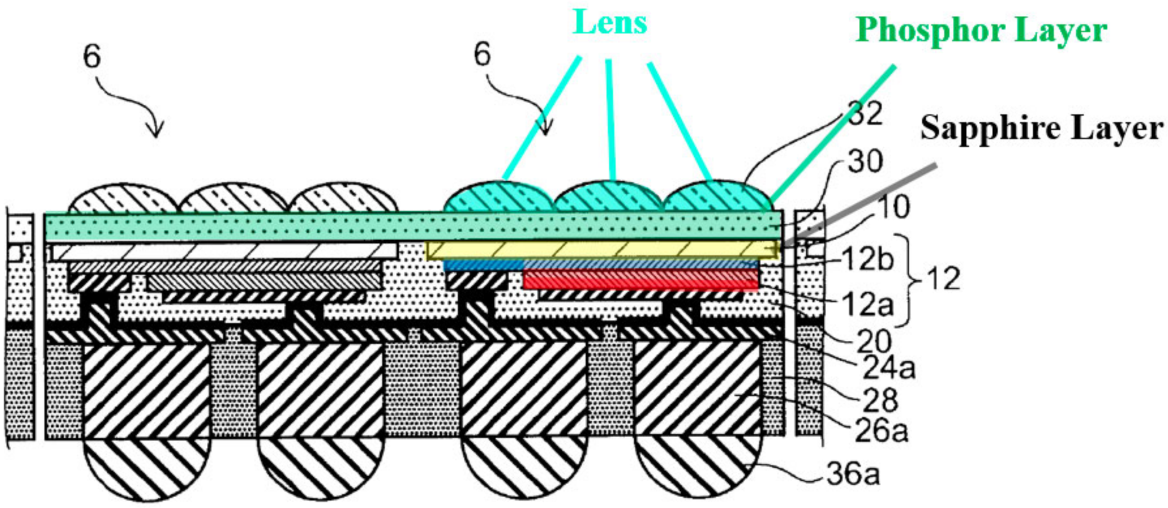


FIG. 18B

(*Id.*, FIG. 18B (annotated); Ex. PA-DEC, ¶45.)

During formation of the LED device, Sugizaki discloses that a dielectric film 20 is deposited to cover the p-side electrode 14 and the n-side electrode 16, and then openings 20a, 20b are formed to expose and allow electrical access to each of the p-side electrode 14 and n-side electrode 16. (Ex. PA-1, ¶[0048].) Sugizaki discloses depositing a seed metal layer 22 on the dielectric film as well as on the exposed surfaces of the n-side electrode and p-side electrode. (*Id.*, ¶¶[0007]-[0008], [0033], [0048].) After forming the seed metal, etching is performed to separate the seed metal into a p-side seed metal portion 22a and an n-side seed metal portion 22b, where each portion of the seed metal provides an electrical connection to the respective n- or p- contact. (*Id.*, ¶[0054].) Subsequently, copper interconnect layers 24a and 24b are formed, followed by a p-side copper pillar 26a connected to the p-side electrode 14 and an n-side copper pillar 26b connected to the n-side electrode 16. (*Id.*, ¶[0053].)

2. Claim 1

a. A light emitting device, comprising:

To the extent the preamble of claim 1 is limiting, Sugizaki discloses the limitations therein. (Ex. PA-DEC, ¶67.) For instance, Sugizaki is entitled "Light Emitting Device and Method for Manufacturing Same" and discloses a "method for manufacturing a light emitting device . . . ." (Ex. PA-1, Title, ¶[0007].) The light emitting device shown in figure 18B below constitutes a "light emitting device" as recited in claim 1. (*Id.*, ¶¶[0031], [0027], [0092], FIG. 18B, Ex. PA-DEC, ¶67.)

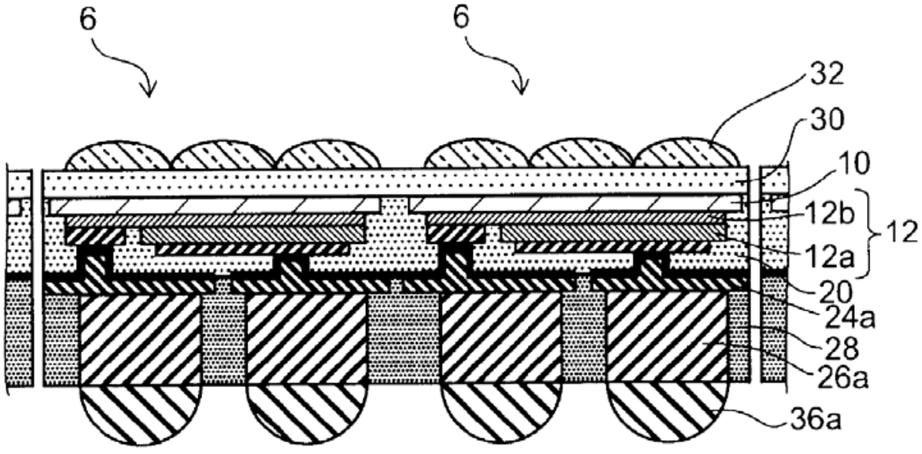


FIG. 18B

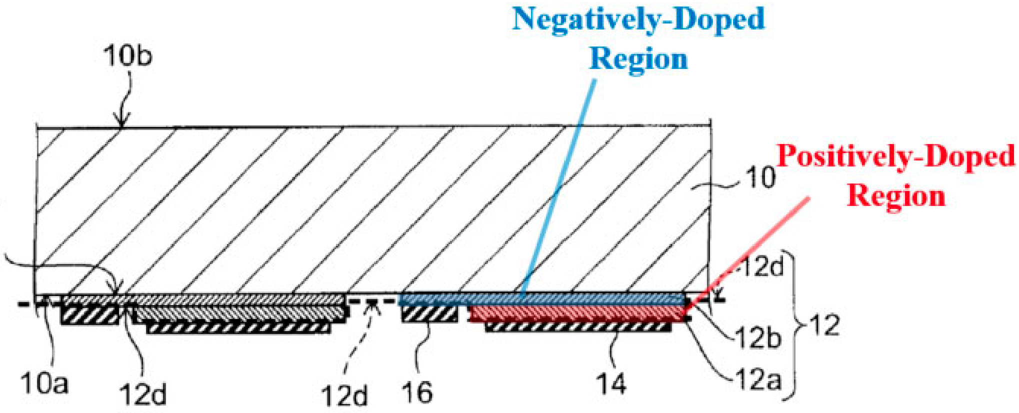
(Ex. PA-1, FIG. 18B.)

b. a semiconductor LED including a positively-doped region, an intrinsic region, and a negatively-doped region, wherein said intrinsic region is between said positively-doped region and said negatively-doped region, said semiconductor LED defining a first recess to expose a negatively-doped surface of said negatively-doped region;

Sugizaki in view of Hanaoka discloses or suggests these limitations. (Ex. PA-DEC, ¶¶68-86.) For example, Sugizaki discloses that the light emitting device in figure 18B includes a multilayer body 12 ("semiconductor LED"), where details of the multilayer body 12 that are also applicable to figure 18B are described in the context of figures 1A and 1B of Sugizaki. Sugizaki discloses that the multilayer body "has an upper layer 12a, including a light emitting layer 12e, and a lower layer 12b." (Ex. PA-1, ¶[0032].) Sugizaki further discloses that "[t]he upper layer 12a may include a p-type cladding layer, a light emitting layer 12e, and an n-type cladding layer" and "[t]he lower layer 12b may be of n-type and serve as a lateral path of current." (*Id.*) As described by Sugizaki, "light from the light emitting layer 12e can be emitted primarily from the first surface 12c of the multilayer body 12 in the upward direction of figure 1A." (*Id.*, ¶[0039]; Ex. PA-DEC, ¶68.)

Sugizaki discloses the formation of the multilayer body 12 of figure 18B in conjunction with figure 3A, which is replicated in annotated form below. As shown in figure 3A, the multilayer body 12 is formed to have a lower layer 12b "including a buffer layer and an n-type layer, and an upper layer 12a." (Ex. PA-1, ¶[0047].) Therefore, Sugizaki discloses that the multilayer body 12 ("semiconductor LED") includes a lower layer 12b ("negatively doped region") and an upper layer 12a that includes a p-type cladding layer ("positively doped region"), a light emitting layer 12e, and an n-type cladding layer.[3] (Ex. PA-DEC, ¶¶69-71.)

FIG. 3A



(Ex. PA-1, FIG. 3A (annotated); Ex. PA-DEC, ¶71.)

Sugizaki does not explicitly disclose "an intrinsic region" where the "intrinsic region is between said positively-doped region and said negatively-doped region" as recited in claim 1. However, Hanaoka discloses an LED with an intrinsic region between a positively-doped region and a negatively-doped region, and it would have been obvious to form an LED as disclosed by Sugizaki such that an undoped layer ("intrinsic region") is included between the positively-doped (p-type) and negatively-doped (n-type) regions. (Ex. PA-DEC, ¶¶72-81).

Conventional light emitting devices of the time of the alleged invention comprised doped and intrinsic (undoped) regions. For example, LEDs were well-understood and "predominantly expected to replace existing light sources such as incandescent lamps, fluorescent lamps and mercury lamps." (Ex. PA-17[U.S. Publication No. 2008/0006836 (Lee)], ¶[0002].) The typical

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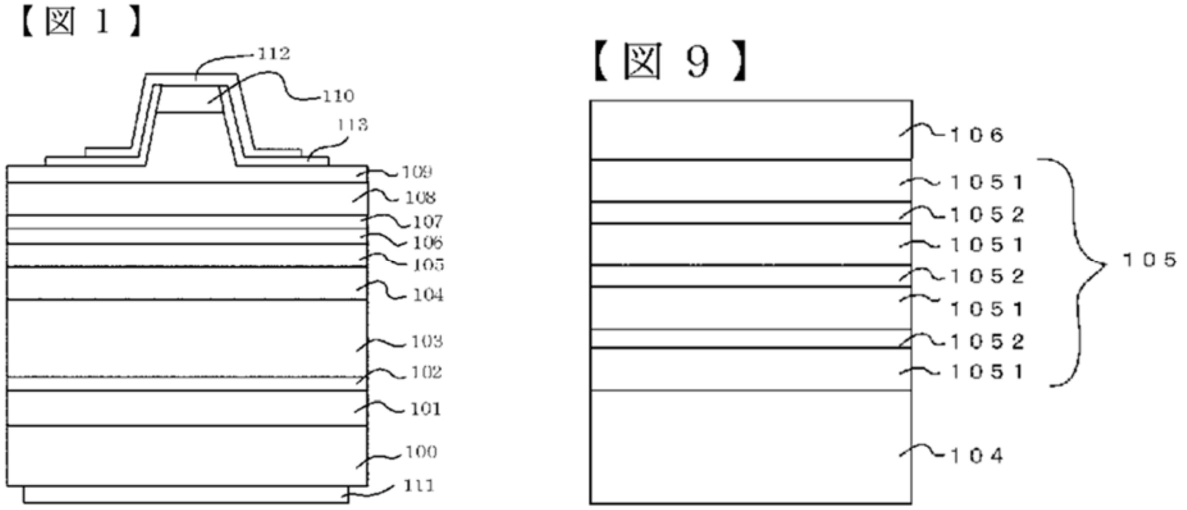
[3] In its decision denying rehearing in IPR2021-01491, the Board states that Sugizaki's LED includes a "2-layer P-N LED structure." (IPR-2021-01491 (Paper 11), 12-13. Not so. Sugizaki discloses a multi-layer body 12 that includes *more than two layers*, including a p-type layer, an n-type layer, and a light emitting layer (Ex. PA-1, ¶[0032]), but does not disclose additional details regarding the composition of the multilayer body 12, including the composition of the light emitting layer.

LED included an "undoped InGaN (an active layer . . .)" that was sandwiched between an n-type and a p-type layer (i.e., doped layers). (*Id.*, ¶[0002], FIGs. 1-2; *see also* Ex-PA-8[U. S. Patent No. 7,105,857 (Nagahama)], 11:58-12:23) (discussing LEDs with doped regions 5 and 7 and active region 6 with reference to Figure 1), 20:4-21:9 (describing active region being undoped); Ex. PA-19[U.S. Patent No. 7,358,522 (Yanamoto)], 14:4-53 (discussing an LED with doped p-type and n-type regions and an undoped active region).) Indeed, the '405 patent itself acknowledges that prior art LEDs "comprise a P-I-N junction device having an intrinsic (I) layer disposed between a N-type doped layer and a P-type doped layer." (Ex. PAT-A, 3:14-16; Ex. PA-DEC, ¶73.)

Hanaoka discloses one such conventional LED comprising doped and intrinsic regions. For instance, Hanaoka discloses a "nitride semiconductor light emitting element whose operating life time is improved by reducing an oscillation threshold and which has an undoped active layer." (Ex. PA-2, Abstract.) With reference to figures 1 and 9, Hanaoka discloses a semiconductor device includes a GaN substrate 100 on which is formed a semiconductor light emitting element including doped and intrinsic regions. (*Id.*, ¶[0029], FIGS. 1, 9; Ex. PA-DEC, ¶74.)[4]



(*Id.*, FIG. 1 (left); FIG. 9 (right).)

In particular, the doped regions include an n-type GaN light guide layer 104 and a p-type GaN light guide layer 108. (*Id.*, ¶[0029], FIG. 1.) The intrinsic region includes the active layer

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[4] While the exemplary embodiments in Hanaoka are directed to a laser diode (LD), Hanaoka discloses that its invention is directed more generally to light emitting diodes (LEDs) and LDs. (Ex. PA-7, [0001]-[0002].) Thus, a POSITA would have understood that Hanaoka's disclosures in the context of LD structures are equally applicable to LED structures.

105, which Hanaoka discloses includes an undoped well layer and an undoped barrier layer. (*Id.*, ¶¶[0029], [0033], FIGS. 1, 9.) The undoped layer 105 ("intrinsic region") is between the n-type layer 104 ("negatively-doped region") and the p-type layer 108 ("positively-doped region"). (Ex. PA-DEC, ¶75.)

A POSITA would have understood that an undoped region is an intrinsic region, because it is not negatively or positively doped. Such an undoped active layer, often referred to as an "intrinsic" region (*see, e.g.*, Ex. PA-11[U.S. Publication No. 2010/0301307 (Fattal)], ¶[0004]), was well understood in the art. (*See*, e.g.*,* Ex. PA-12[U.S. Patent No. 2011/0037086 (Kim)], ¶[0004], ¶[0007] ("an undoped active layer . . . . The active layer 5 may have a multiple quantum well structure in which a plurality of GaN quantum barrier layers and a plurality of InGaN quantum well layers are alternately laminated"); Ex. PA-13[U.S. Patent No. 6,657,234 (Tanizawa)], 1:14-45; Ex. PA-14[U.S. Publication No. 2008/0286894 (Chae)], Abstract, ¶[0054]; Ex. PA-15[U.S. Publication No. 2002/0050600 (Hayakawa)], ¶[0028]; Ex. PA-DEC, ¶76.)

Hanaoka further discloses that an advantage of leaving the active layer undoped is that the operating life of the semiconductor device is extended: "if the active layer is doped with impurities, the light emitting element is likely to be deteriorated, and therefore, in order to extend the life of the element, it is important that the barrier layer and the well layer are undoped layers that are not doped with impurities." (Ex. PA-2, ¶[0034]; Ex. PA-DEC, ¶77.)[5] Indeed, in the Ex Parte Reexamination having Control No. 90/015,092, the Office recognized that Hanaoka[6] "discloses a semiconductor LED including [three] layers, first and second doped layers and an active layer that is undoped." (Ex. PAT-E, Order Granting Request for Ex Parte Reexamination for Control No. 90/015,092, 9.) The Office further states that "Sharp [Hanaoka] further discloses that this type of combination, the life of a semiconductor LED is prolonged. Sharp [Hanaoka] at paragraph 34." (*Id.*)

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[5] Hanaoka further discloses another undoped region in its device in the form of the impurity diffusion prevention layer 114. (Ex. PA-2, ¶¶[0014]-[0015], [0083]-[0084], [0102], FIGS. 5, 6, 9.) Hanaoka discloses that this undoped region 114 also provides several advantages including suppression of electrical resistance, efficiency of carrier injection into the active layer, and increase in operating life of the device. (*Id.*, ¶¶[0015], [0102].)

[6] In Reexamination 90/015,092, Japanese Unexamined Patent Application Publication No. 2004-327636 ("Hanoaka") is referred to as "Sharp," as the Applicant listed on the face of the publication is the Sharp Corporation.

Thus, it would have been obvious to configure Sugizaki's multilayer body 12 in the LED structure such that it includes doped regions, such as p-type and n-type layers, and an intrinsic region such as an undoped activation layer, as taught by Hanaoka and well-known in the art. For example, both Sugizaki and Hanaoka disclose the use of light emitting devices (Ex. PA-1, Title, ¶¶[0007], [0031], [0027], [0092], FIG. 18B; Ex. PA-2, Abstract, ¶¶[0001], [0007]-[0008], [0034], FIGS. 1, 9.) Hanaoka further explains the light emitting device structure, which was well-known in the art: e.g., the LED structure including doped n-type and p-type layers and an undoped (i.e., intrinsic) activation layer between the n-type and p-type layers, along with the advantage of keeping the activation layer undoped, as discussed above. Based on Hanaoka's teachings and the knowledge of a POSITA regarding the conventional structure of LEDs, and given Sugizaki discloses an LED device in figure 18B, a POSITA would have had good reason to implement the multilayer body 12 in the LED of Sugizaki such that it included p-and n-type layers (doped regions) and an undoped active region (intrinsic region) between the doped regions, similar to as taught by Hanaoka. (Ex. PA-DEC, ¶78.) Such a multilayer body with p- and n-type layers and a light emitting active layer is consistent with Sugizaki's disclosure regarding the multilayer body 12. A POSITA would have been so motivated because, for example, using such an LED structure would have improved the operating life of the Sugizaki device. (Ex. PA-2, ¶[0034]; *see also* Ex-PA-13[U.S. Patent No. 6,657,234 (Tanizawa)], 1:14-33 (describing improvements in device efficiency with the used of an undoped active layer); Ex. PA-DEC, ¶¶78-79.) As a POSITA would have appreciated, such a modification to Sugizaki would have been an application of a known technique (Hanaoka's LED structure configuration) to a known device (Sugizaki's LED) to yield predictable results (a functional LED with an increase in operating life and improved device efficiency). (Ex. PA-DEC, ¶80.) Indeed, "when a patent simply arranges old elements with each performing the same function it had been known to perform and yields no more than one would expect from such an arrangement, the combination is obvious." *See KSR Intern. Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007) (citation and internal quotation marks omitted).

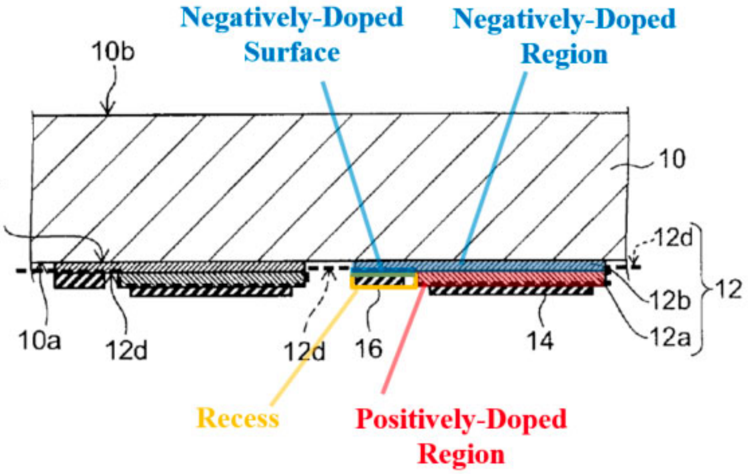
A POSITA would have had a reasonable expectation of success in modifying Sugizaki based on the teachings of Hanaoka, at least because the LED configuration was well understood in the art, as discussed above. (*See, e.g.*, Ex. PA-12[U.S. Patent No. 2011/0037086 (Kim)], ¶[0004], ¶[0007]; Ex. PA-13[U.S. Patent No. 6,657,234 (Tanizawa)]; Ex PA-15[U.S. Patent Application Publication No. 2002/0050600 (Hayakawa)], ¶¶[0028], [0033]-[0034]; Ex. PA-

14[U.S. Publication No. 2008/0286894 (Chae)], Abstract, ¶[0054]; Ex. PA-DEC, ¶80.) And, as noted above, both Sugizaki and Hanaoka disclose semiconductor LED devices. Thus, the modification would have been the use of a known technique (Hanaoka's LED structure configuration) to improve a similar device (Sugizaki's LED) in the same way (the benefits disclosed by Hanaoka for using its LED structure would have similarly benefited Sugizaki's device). *See KSR*, 550 U.S. at 416.

Accordingly, the Sugizaki-Hanaoka combination discloses or suggests "a semiconductor LED including a positively-doped region, an intrinsic region, and a negatively-doped region, wherein said intrinsic region is between said positively-doped region and said negatively-doped region" as recited in claim element 1[b]. (Ex. PA-DEC, ¶81.)

The Sugizaki-Hanaoka combination also discloses or suggests a first recess that exposes a negatively-doped surface of the negatively-doped region as recited in claim 1. (Ex. PA-DEC, ¶¶82-86.) For example, Sugizaki discloses that a portion of the positively-doped region 12a is removed to expose the surface of the negatively-doped region 12b. (Ex. PA-1, ¶[0047]; FIG. 3A.) In the Sugizaki-Hanaoka combination, in order to expose the negatively-doped surface, the portion removed would include a portion of the intrinsic layer ("intrinsic region"). (Ex. PA-DEC, ¶82.) The exposure of the negatively-doped region results in the second surface of the multilayer body having a step difference ("said semiconductor LED defining a first recess to expose a negatively-doped surface of said negatively-doped region") shown in figures 3A and 18B below. (Ex. PA-1, ¶47.)

FIG. 3A



(Ex. PA-1, FIG. 3A (annotated); Ex. PA-DEC, ¶83.)

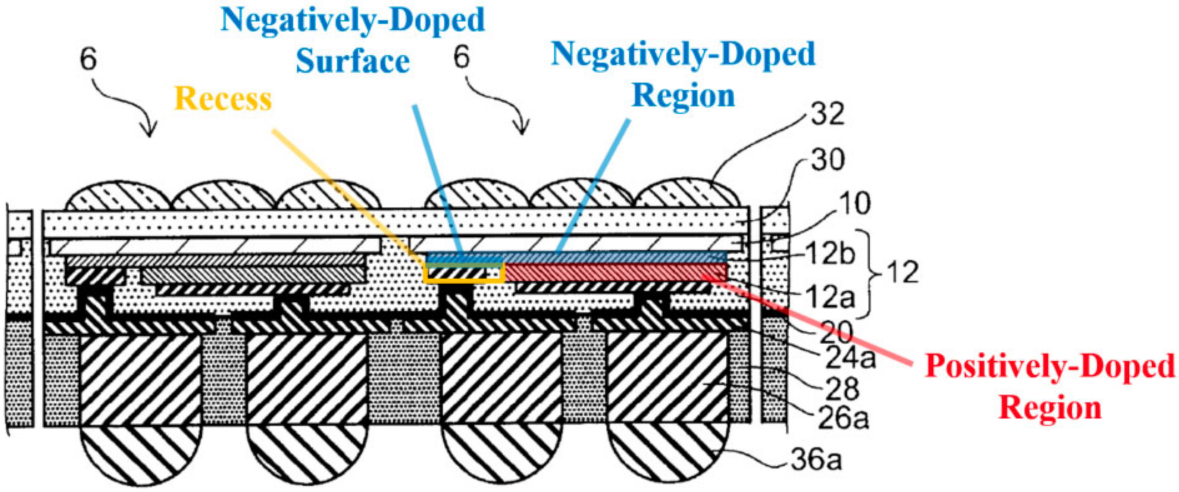


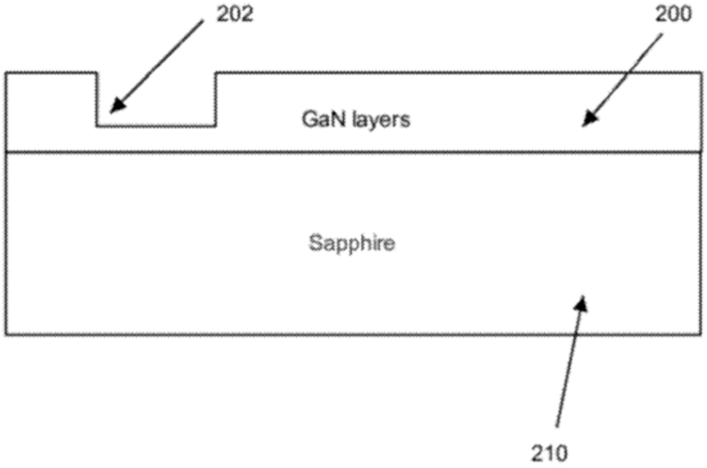
FIG. 18B

(Ex. PA-1, FIG. 18B (annotated); Ex. PA-DEC, ¶84.)

Therefore, the Sugizaki-Hanaoka combination discloses or suggests the features of claim element 1[b]. (Ex. PA-DEC, ¶85.)

Patent Owner has previously argued in a Patent Owner Preliminary Response filed in Inter Partes Review proceedings that Sugizaki's removal of part of a positively-doped region to expose the surface of the negatively-doped region (as shown in annotated figure 3A of Sugizaki above) does not constitute a "recess" as claimed. (IPR2021-01491, (Paper 6), 34-35.) For example, Patent Owner alleged that "Sugizaki's disclosure of a step down from the upper layer to the lower layer does not teach or suggest a recess.") (*Id.*, 34.)

Patent Owner's argument appears to be based on a narrow reading of "recess" to require a "channel" or "groove" that is not on an end of the LED, but at point part way along one surface of the LED as shown in figure 2 of the '405 patent below. (IPR2021-01491 (Paper 6), 35 ("In contrast, the '405 Patent's recess 202 shown above displays a channel or grove [sic] etched into the upper layer and not a step difference configuration.").)



(*Id*., 34.)

A POSITA would have understood that under the broadest reasonable interpretation (BRI), which is the appropriate standard for reexamination proceedings, a "recess" as recited in claim 1 encompasses the indentation in the LED highlighted in figure 18B of Sugizaki above. (Ex. PA-DEC ¶86.) Such a "recess" does not require a "groove" or "channel" formed at some point not at the end of the LED structure as Patent Owner argues.

Moreover, during prosecution and in response to a rejection based on the Yoo reference (U.S. Patent Application Publication 2010/0207145) (Ex. PA-18), Applicant did not argue that the same type of recessed area in an LED was not a "recess" as recited in the claims. (Ex. PAT-B, 56-60.) As shown below and as previously acknowledged by Patent Owner, Yoo's LED structure includes the same "recess" presented by Sugizaki. (IPR2021-01491 (Paper 6), 29 ("Sugizaki's design showing removal of part of the upper layer 12a which creates a step down to the lower layer 12b is the same design as Yoo.").)

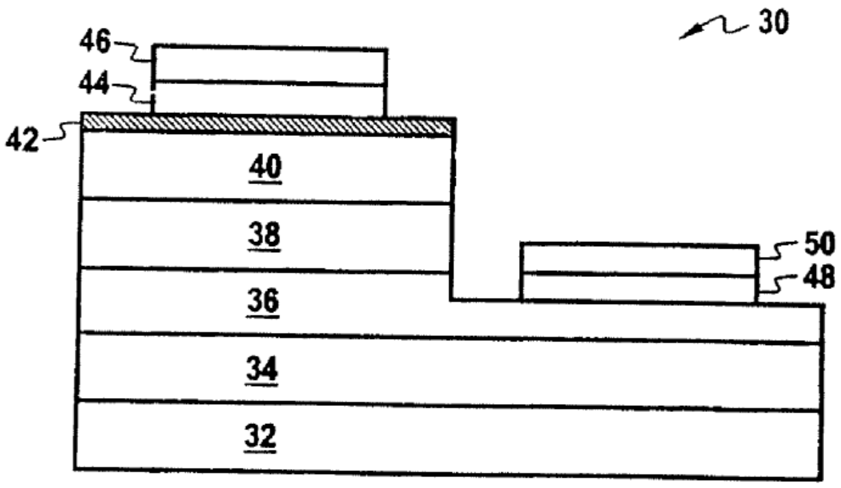


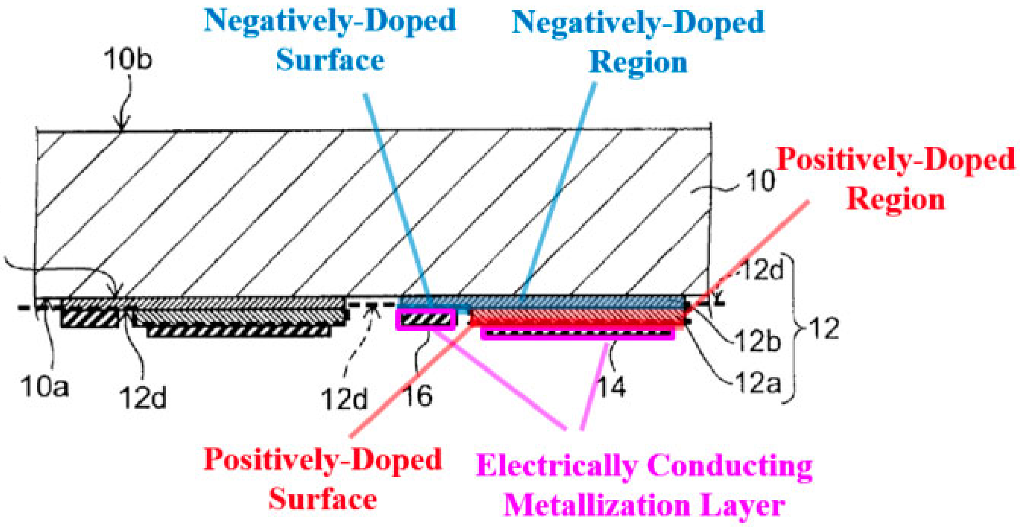
Figure 2

(Ex. PA-18, FIG. 2.)

c. an electrically conducting metallization layer in direct contact with at least a portion of each of a positively-doped surface and said negatively-doped surface of said semiconductor LED, wherein said positively-doped surface is on an exposed portion of said positively-doped region of said semiconductor LED and said negatively-doped surface and said positively-doped surface are parallel with each other;

The Sugizaki-Hanaoka combination in further view of Izumino discloses or suggests these limitations. (Ex. PA-DEC, ¶¶87-98.) For instance, Sugizaki describes formation of "an electrically conducting metallization layer" that includes a p-side electrode 14 and an n-side electrode 16 in conjunction with figure 3A below. (Ex. PA-DEC, ¶87.)

FIG. 3A



(Ex. PA-1, FIG. 3A (annotated); Ex. PA-DEC, ¶87.)

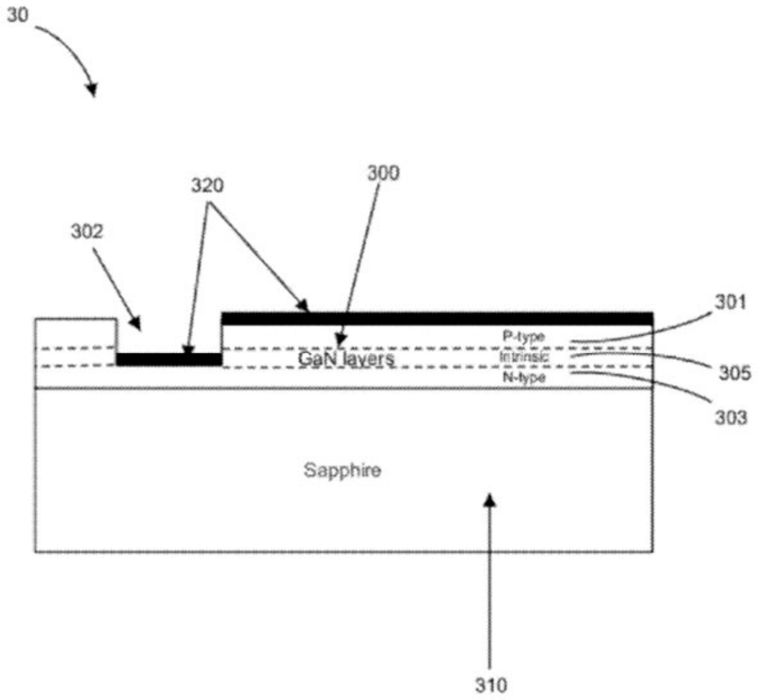
The p-side electrode 14 of the metallization layer is "provided on the surface of the upper layer 12a of the multilayer body" (Ex. PA-1, ¶[0033]), and therefore is "in direct contact with at least a portion of . . . a positively-doped surface . . . of said semiconductor LED" as recited in claim element 1[b]. (*Id.*, ¶[0048]; *see also id.*, ¶[0033]; Ex. PA-DEC, ¶88.) Similarly, "the n-side electrode is formed on the surface of the lower layer 12b" (Ex. PA-1, ¶[0048]), and therefore constitutes a portion of the metallization layer that is "in direct contact with at least a portion of . . . said negatively-doped surface of said semiconductor LED." (Ex. PA-DEC, ¶88.)

Sugizaki discloses that the electrodes 14 and 16 are made using metal. (Ex. PA-1, ¶[0049].) In the Patent Owner Preliminary Responses (POPRs) filed by Patent Owner in response to Inter Partes Review Petitions, Patent Owner argued that "[a]n electrode is not a metallized layer as the two are described differently in the '405 patent." (IPR2021-01491, (Paper 6), 36.) As evidenced by the Examiner's rejections during prosecution, under the Broadest Reasonable Interpretation standard, electrodes and other conductive metal layers constitute a "metallization layer" as recited in the claims of the '405 patent. (Ex. PAT-B, 98 (Examiner asserting the "a first surface of said semiconductor LED being metallized with an electrically conducting metallization layer over at least a portion of said first surface" is disclosed by "Fig. 2, metals are electrically conducting an any of 44, 46, 48, 50 are formed on a portion of said first surface, paragraph [0038];"), 106 ("metallization layers 44, 46, 48, 50)"; *see also* Ex. PA-18 ("Yoo") ¶[0038], ("A p-type electrode

44 is then formed on one side of the transparent conductive layer 42. Suitable p-type electrode materials include Ni/Au, Pd/Au, Pd/Ni and Pt. A p contact pad 46 is Au. The transparent conductive layer 42, the p-GaN layer 40, the active layer 38 and part of the n-GaN layer 40 are then etched to form a step. Because of the difficulty of wet etching GaN, a dry etch is beneficially usually used to form the step. The LED 30 is then completed by forming an n-electrode pad 48 (such as Cr or Au) and an n contact pad 50 (such as Au) on the step.").)

Also during prosecution of the '405 patent, Applicant argued that two electrodes comprised of different materials are not the same "layer," and therefore cannot be the claimed "metallization layer." (Ex. PAT-B, 58 ("Also if the electrode 140 is considered to be the metallization layer recited in claim 1, the electrode 140 is not in direct contact with p-GaN contact layer 108. … Moreover, the electrode 120 and electrode 140 are comprised of different materials and, therefore, they are not the same layer.").)

Similarly, in the Patent Owner Preliminary Responses filed by Patent Owner in response to Inter Partes Review Petitions, Patent Owner argued that electrodes formed of different materials are not the same layer. (IPR2021-01491 (Paper 6), 37 ("Sugizaki's electrodes are comprised of different materials and therefore not the same layer."); IPR2021-01479 (Paper 7), 42 ("the electrodes are comprised of different materials and therefore not the same layer.").) Instead, Patent Owner asserts that the disclosure of the '405 patent indicates that the metallization layer can be the same layer disposed on two different surfaces. (*Id.*, 42 ("As shown in Figure 3 below, metallization layer [320], is not a continuous layer, but is the same layer, just disposed on two different surfaces.").)



(*Id.*, 42.)

While Sugizaki does not explicitly disclose forming the two electrodes using the same material, Izumino discloses forming p-side and n-side electrodes for an LED simultaneously and using the same material in order to reduce the number of steps required for device formation, and a POSITA would have found it obvious to apply Izumino's teachings regarding electrode formation to Sugizaki. (Ex. PA-DEC, ¶¶89-97.)

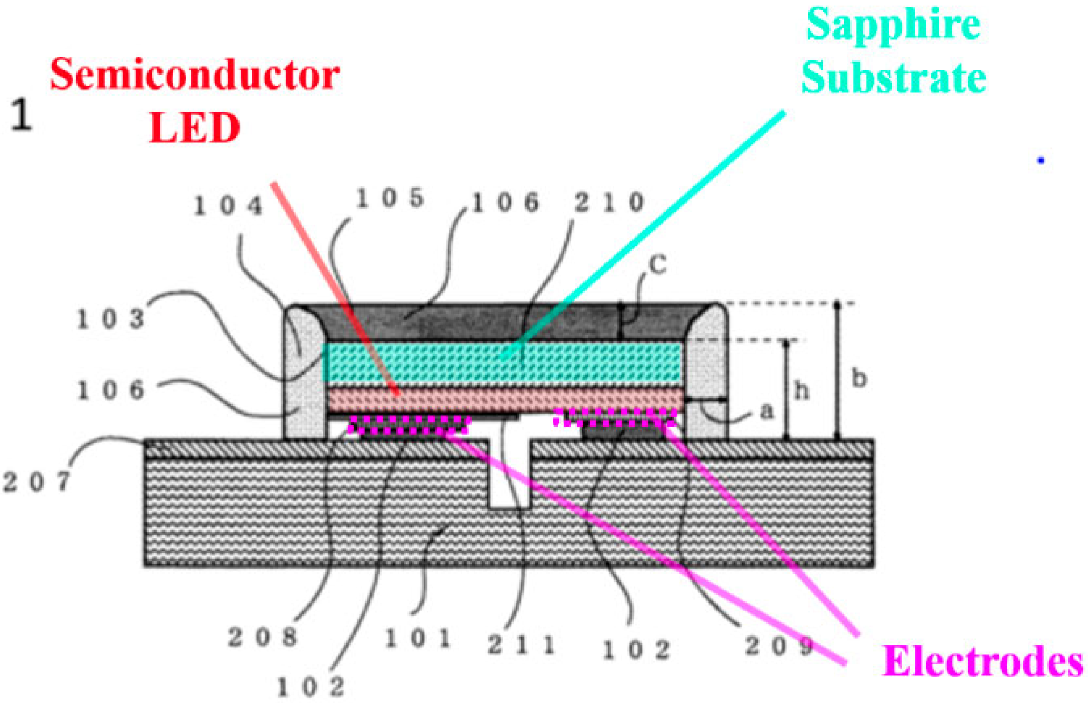
Izumino, like Sugizaki and Hanaoka, is directed to LED devices and methods for forming such LED devices. (Ex. PA-3, Title ("Light Emitting Device and Formation Method").) Also like Hanaoka, Izumino discloses an LED device that includes doped and intrinsic layers. (*Id.*, ¶[0114].)

> The element structure of the LED chip 103 in the present Embodiment is an undoped nitride semiconductor on a sapphire substrate GaN layer, **an n-type GaN layer** that serves as an n-type contact layer with a Si-doped n-type electrode formed thereon, and **a GaN layer that is an undoped** nitride semiconductor laminated together. Additionally, five sets, with a GaN layer serving as a barrier layer and an InGaN layer serving as a well layer as one set, were laminated thereon, and lastly a GaN layer serving as a barrier layer was laminated as an active layer, and this active layer has a multiple quantum well structure. Furthermore, the active layer is configured with an AlGaN layer as a p-type cladding layer doped with Mg and **a p-type GaN layer** that is a p-type contact layer doped with Mg laminated sequentially.

(*Id.*, ¶[0114] (emphasis added).)

Also like Sugizaki, after formation of the layers of the LED, Izumino removes a portion of the LED layers in order to expose surfaces of the p-type and n-type layers of the LED so that electrical contact to the p-type and n-type portions of the LED can be provided on those exposed surfaces of the LED, where the exposed surfaces are opposite a sapphire substrate. (*Id.*, ¶[0114].) Annotated figure 1 of Izumino below shows the p-side electrode 208 and the n-side electrode 209. (*Id.*, ¶[0115], FIG. 1.)

FIG. 1



(*Id.*, FIG. 1 (annotated); Ex. PA-DEC, ¶92.)

As previously noted, Izumino discloses that by forming the electrodes 208 and 209 simultaneously using the same material, the number of process steps required for forming the electrodes is reduced. (Ex. PA-3, ¶¶[0099], [0115]; Ex. PA-DEC, ¶93.)

> Furthermore, sputtering using materials W, Pt, and Au in this order was performed, and a p-side pedestal electrode 208 and an n-side pedestal electrode 209 are simultaneously formed on a part of the diffusion electrode 211 and the n-type contact layer. Here, **by forming the p-side pedestal electrode 208 and the n-side pedestal electrode 209 simultaneously, the number of steps required for forming an electrode can be reduced**.

(Ex. PA-1, ¶[0115] (emphasis added).)

A POSITA would have looked to Izumino for guidance regarding implementing LED devices according to the Sugizaki-Hanaoka combination, particularly because Izumino, Sugizaki, and Hanaoka are references in the same field and disclose LED devices with many common features. (Ex. PA-DEC, ¶94.) Having looked to Izumino, such a POSITA would have found it obvious to form the p-side electrode 14 and n-side electrode 16 in an LED device as disclosed by Sugizaki simultaneously as disclosed by Izumino, where such simultaneous formation results in electrodes made of the same metal. (*Id.*)

As discussed above, Izumino discloses forming the p-side and n-side electrodes simultaneously and using the same material in order to reduce the number of steps required to form the contacts, which reduces the number of steps to form the overall LED structure. A POSITA would have understood that such simultaneous electrode formation could also be applied to Sugizaki, and would have been motivated to form the p-side and n-side electrodes in Sugizaki simultaneously in order to reduce the number of steps required to produce the LED devices. (Ex. PA-DEC, ¶95.)

Indeed, such simplification of device manufacture is consistent with other optimizations discussed by Sugizaki. For example, Sugizaki discloses that the electrical interconnect that includes metal interconnect layers 24a and 24b as well as metal pillars 26a and 26b (as shown in annotated figure 2A below) can be replaced with thick copper interconnect layers 24c and 24d (as shown in annotated figure 2B below), where "[t]his can simplify the structure and manufacturing process." (Ex. PA-1, ¶¶ [0034]-[0035], [0045], FIGs. 2A, 2B; see also id., ¶[0086] ("simplify . . . the manufacturing process"); Ex. PA-DEC, ¶96.)

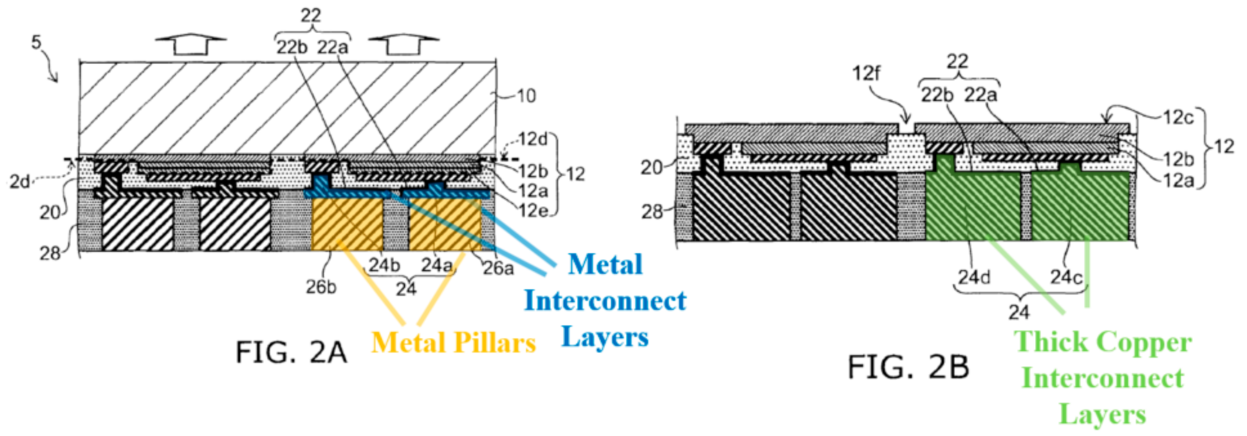


FIG. 2A

FIG. 2B

(Ex. PA-1, FIGs. 2A, 2B (annotated); Ex. PA-DEC, ¶96.)

A POSITA would have found it straightforward to form the electrodes for the LED device in Sugizaki simultaneously as disclosed by Izumino because Izumino discloses forming similar electrodes simultaneously in an LED device like that disclosed by Sugizaki. (Ex. PA-DEC, ¶97.) Such an implementation would have been a straightforward combination of well-known technologies using known methods and would have had predictable results. (*Id.*) *See KSR*, 550 U.S. at 417. Moreover, such a skilled person would have had a reasonable expectation of success because, as demonstrated by Izumino, LEDs with simultaneously-formed electrodes were known in the art. (Ex. PA-DEC, ¶97.) *See Pfizer, Inc. v. Apotex, Inc.*, 480 F.3d 1348, 1364 (Fed. Cir. 2007) ("only a reasonable expectation of success, not a guarantee, is needed" in an obviousness analysis).)

Therefore, the Sugizaki-Hanaoka-Izumino combination discloses or suggests electrodes 14 and 16 formed using the same material, which constitutes an "electrically conducting metallization layer." (Ex. PA-DEC, ¶98.) Annotated figure 18B below shows the same features discussed above with respect to figure 3A, where the description in Sugizaki does not repeat the formation details of the electrodes that are also applicable to figure 18B. In other words, the description of the layers and formation of layers shown in figure 3A is also applicable to figure 18B. (*Id.*)

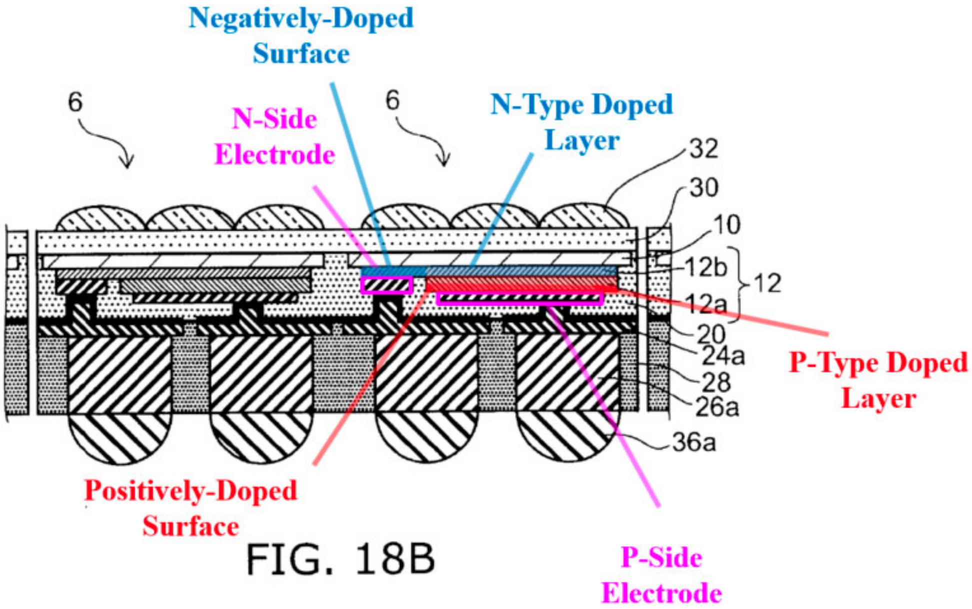


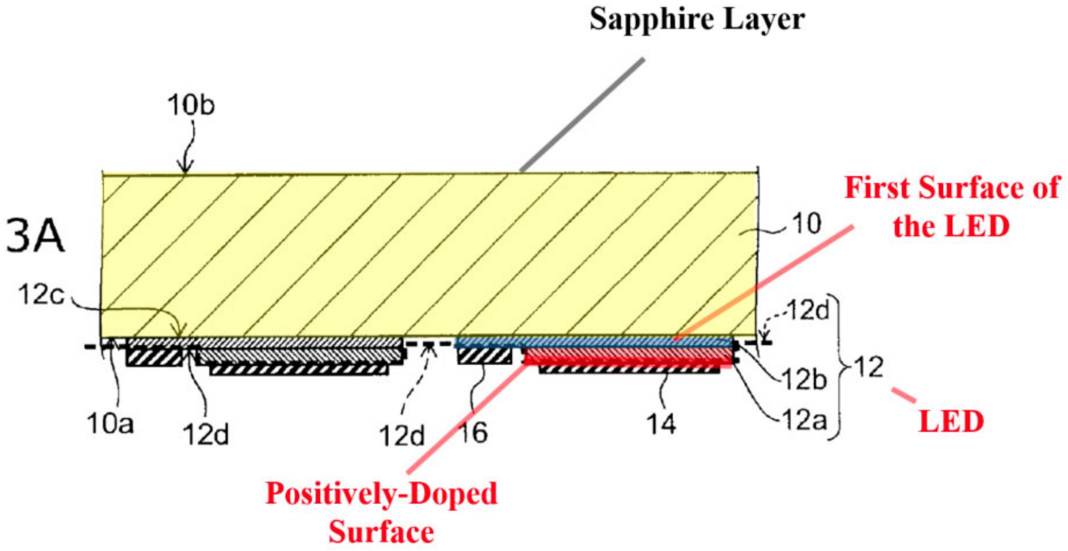
FIG. 18B

(Ex. PA-1, FIG. 18B (annotated); Ex. PA-DEC, ¶98.)

d. a sapphire layer in direct contact with a first surface of said semiconductor LED, said positively-doped surface and said first surface of said semiconductor LED being parallel with one another and on opposing faces of said semiconductor LED;

The Sugizaki-Hanaoka-Izumino combination discloses or suggests these limitations. (Ex. PA-DEC, ¶¶99-102.) As shown in annotated figures 3A and 18B below, Sugizaki discloses that the layers of the LED 12 are formed on a translucent substrate 10 that is sapphire. (Ex. PA-1, ¶[0047] ("translucent substrate 10 illustratively made of sapphire."); Ex. PA-DEC, ¶¶99-102.)

FIG. 3A



(Ex. PA-1, FIG. 3A (annotated); Ex. PA-DEC, ¶99.)

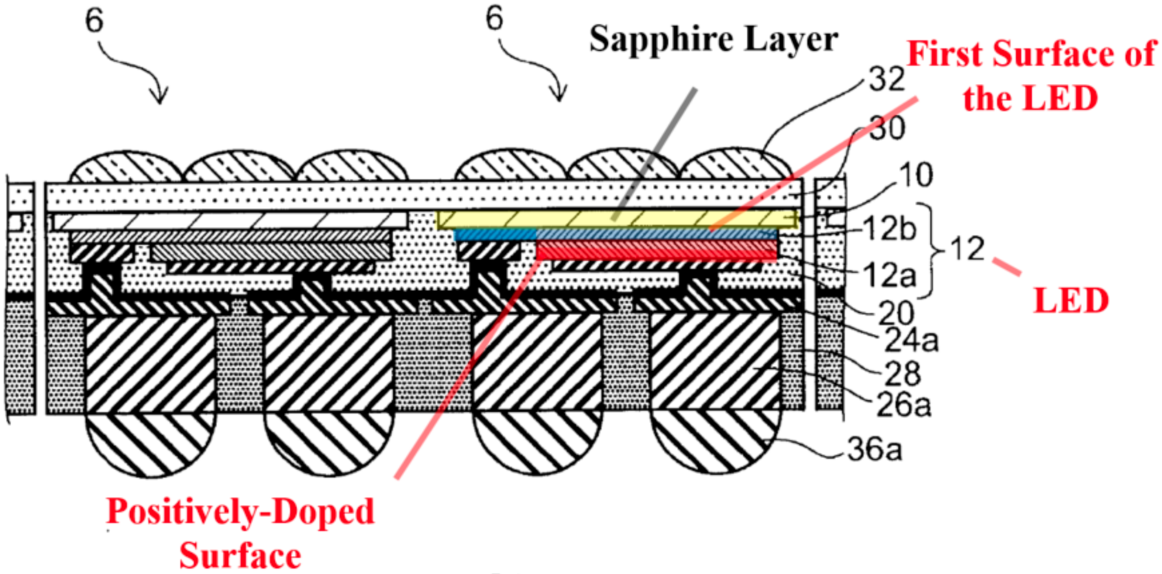


FIG. 18B

(Ex. PA-1, FIG. 18B (annotated); Ex. PA-DEC, ¶102.)

In figure 18B, the thickness of the sapphire substrate has been reduced by, for example grinding. (Ex. PA-1, ¶[0044], FIG. 18B; Ex. PA-DEC, ¶102.) As shown in figures 3A and 18B, the sapphire layer 10 is in "direct contact" with a first surface of the LED and, consistent with the understanding of a POSITA, the top face 12c of the LED in figure 3A ("first surface of said semiconductor LED") is parallel to the positively-doped surface of the LED, which is the bottom face the LED. (Ex. PA-1, ¶[0047], FIG. 3A; Ex. PA-DEC, ¶102.) Therefore, Sugizaki discloses "said positively-doped surface and said first surface of said semiconductor LED being parallel with one another and on opposing faces of said semiconductor LED." (Ex. PA-DEC, ¶102.)

e. **an optically permissive layer in direct contact with said sapphire layer, said optically permissive layer comprising an optically definable material containing quantum dots and/or phosphor, said optically definable material adapted to change the frequency of at least some of emitted light passing therethrough;**

The Sugizaki-Hanaoka-Izumino combination discloses or suggests this limitation. (Ex. PA-DEC, ¶¶103-104.) As shown in annotated figure 18B below, Sugizaki discloses that a phosphor layer 30 is deposited on the surface of the sapphire layer 10. (Ex. PA-1, ¶¶[0061], [0081], FIGs. 6A, 12A-12E, 18B.) Sugizaki further discloses that "the phosphor layer 30 can be formed to a thickness in the range from several to several hundred μm illustratively by a sputtering method, an ink-jet method, a method of applying a silicon resin mixed with phosphor particles, and a method of applying a liquid glass mixed with phosphor particles (FIG. 7B)." (*Id.*, ¶[0068]; Ex. PA-DEC, ¶103.)

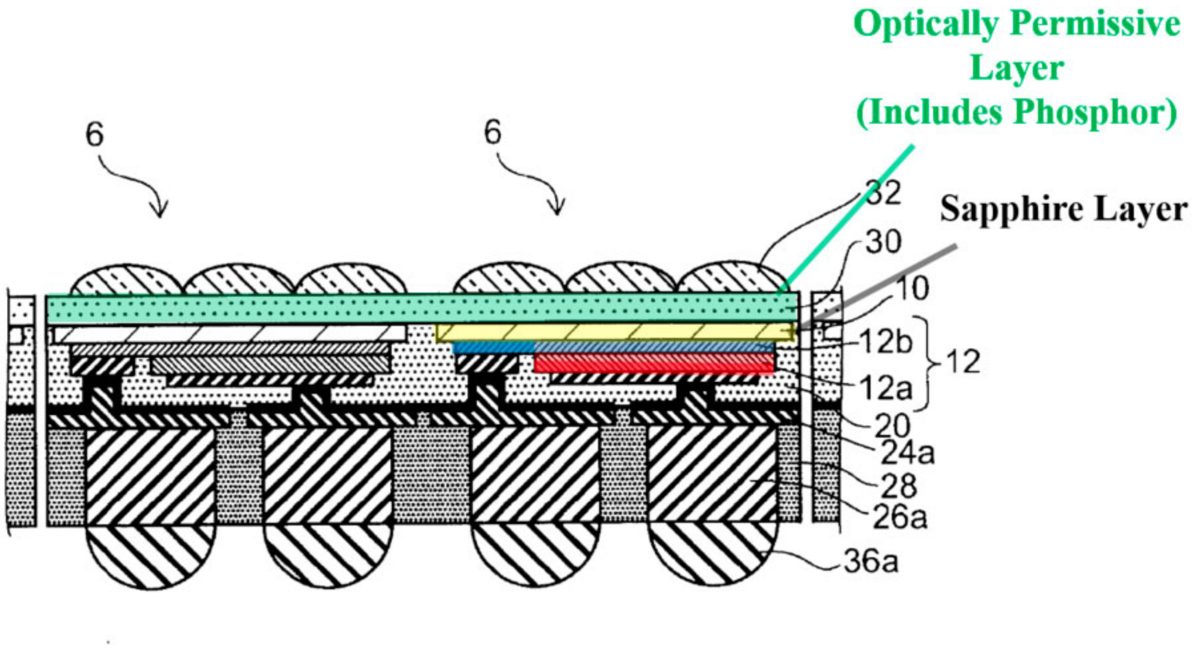


FIG. 18B

(Ex. PA-1, FIG. 18B (annotated); Ex. PA-DEC, ¶103.)

Sugizaki discloses that the phosphor layer 30, which is in direct contact with the sapphire layer, permits the light from the LED to pass through the phosphor layer and therefore is "optically permissive." (Ex. PA-1, ¶[0061]; Ex. PA-DEC, ¶104.) The phosphor layer 30 includes phosphor ("optically definable material containing quantum dots and/or phosphor") that is "adapted to change the frequency of at least some of emitted light passing therethrough" as recited in claim element 1[e]. (Ex. PA-1, ¶[0061]; Ex. PA-DEC, ¶104.) A POSITA would have understood that wavelength-converted light is light that has had its frequency changed. (Ex. PA-DEC, ¶104.) Sugizaki discloses that a mixture of light from the LED and wavelength-converted light is emitted (Ex. PA-1, ¶[0061]) such that "at least some of the emitted light" has its frequency changed. (Ex. PA-DEC, ¶104.) Therefore, Sugizaki discloses the "optically permissive layer" recited in claim element 1(e). (*Id.*)

f. an optically permissive cover substrate covering at least a portion of the above components; and;

The Sugizaki-Hanaoka-Izumino combination discloses or suggests this limitation.[7] (Ex. PA-DEC, ¶¶105-109.) For instance, Sugizaki discloses covering the LED structure with translucent material that includes a lens ("optically permissive cover substrate") to converge or diverge the light generated by the LED. (Ex. PA-1, ¶¶[0063]-[0065]; Ex. PA-DEC, ¶105.) As shown below, Sugizaki's Figure 18B LED device includes an array lens 32 with multiple convex lenses.

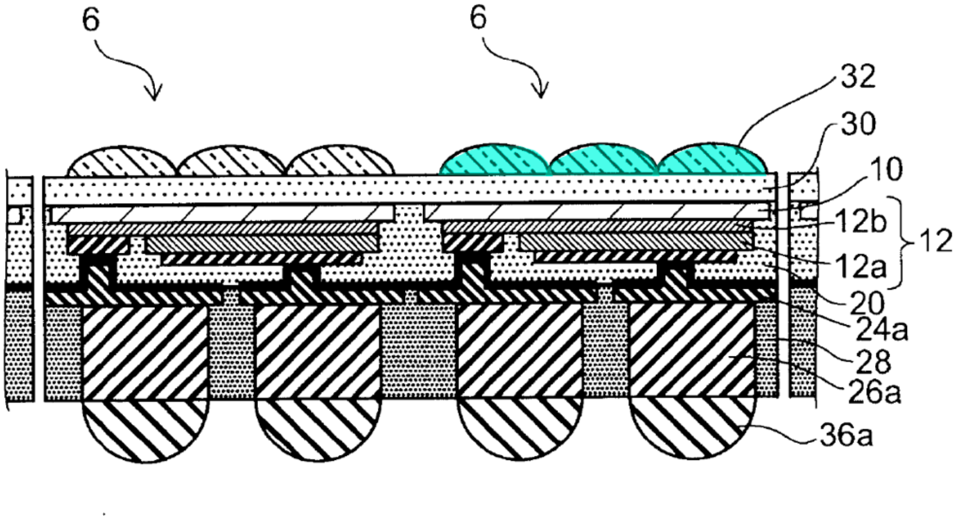


FIG. 18B

(Ex. PA-1, FIG. 18B (annotated); Ex. PA-DEC, ¶105.)

Sugizaki, however, discloses that a single lens can be used instead of an array lens like that shown in figure 18B. (Ex. PA-1, ¶[0086] ("[u]se of a single lens can simplify the optical design and manufacturing process."); Ex. PA-DEC, ¶106.) Sugizaki discloses an example technique for forming such a lens in figures 10A-10C that includes depositing a layer of spin on glass or similar material and then stamping the layer with a mold in order to produce the desired lens shape. (Ex. PA-1, ¶¶[0075]-[0076], claim 7 ("applying a liquid glass on the first surface side of the multilayer body, and forming a lens by mold press."), FIGs. 10A-10C; Ex. PA-DEC, ¶¶107-108.)

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[7] For this proceeding, Requester assumes "the above components" refers to claim elements 1[b]-[e], but does not concede that claim 12 is not indefinite.

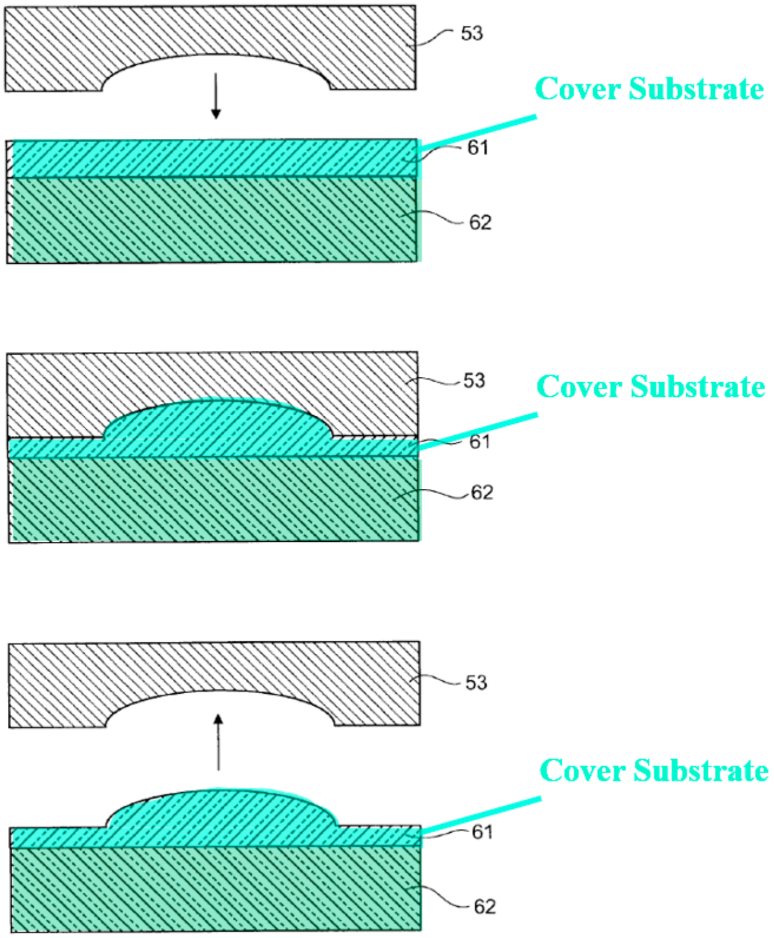


FIG. 10A

FIG. 10B

FIG. 10C

(Ex. PA-1, FIGs. 10A-10C (annotated); Ex. PA-DEC, ¶108.)

Modified figure 18B of Sugizaki below illustrates a non-limiting example of an LED device according to the Sugizaki-Hanaoka-Izumino combination with a single lens. (Ex. PA-DEC, ¶109.) As is apparent from modified figure 18B below, the lens, which constitutes "an optically permissive cover substrate" covers "at least a portion" of the components recited in claim features 1[b]-1[e]. (*Id.*)

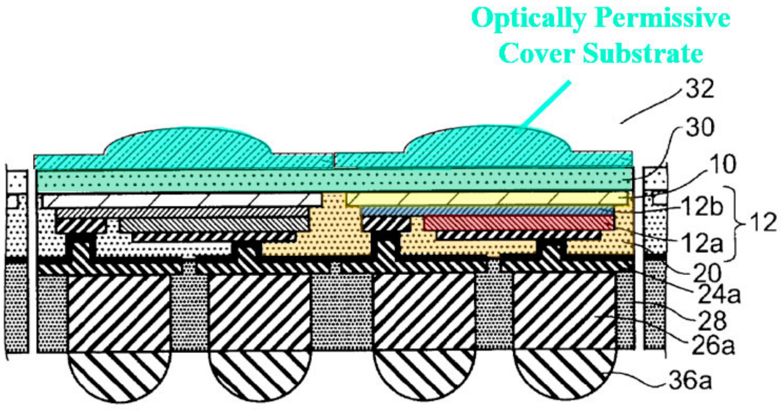


FIG. 18B

(Ex. PA-1, FIG. 18B (modified, annotated); Ex. PA-DEC, ¶109.)

Patent Owner argued in its POPR in IPR proceedings that "a substrate is typically known in the art to support epitaxial growth or circuit foundation" and that "the purpose of the optically permissive flat cover substrate recited in Claim 1 of the '405 Patent is to 'provide [] structural presence and mechanical coupling for elements of the LED device." (IPR2021-01491 (Paper 6), 40.) Claim 1 simply recites "optically permissive cover substrate covering at least a portion of the above components" and does not require epitaxial growth or circuit foundation, which are not mentioned or described in the '405 patent. Moreover, the translucent material of Sugizaki that includes a lens ("optically permissive cover substrate") to converge or diverge the light generated by the LED, provides a "structural presence" in the LED and is mechanically coupled to the phosphor layer 30.

Indeed, Patent Owner's assertions in the IPR proceeding conflict with the prosecution history of the '405 patent as well as Patent Owner's assertions in litigation. For example, during prosecution of the application leading to the '405 patent, the Examiner recognized that the "optically permissive cover substrate" was claimed very broadly, and, as such, was a claim feature that was readily disclosed in the prior art:

> Since this limitation regarding a cover substrate is claimed so broadly, placing the device into a Petri dish and placing the lid onto the dish would also meet this limitation, and placing devices into such containers for storage, protection, or simply keeping dust off would be well within the purview of a skilled artisan as well.

(Ex. PAT-B, 100-101.)

In rejecting the pending claims, the Examiner mapped the "optically permissive cover substrate" to the transparent layer 27 of Ibbetson (Ex. PA-23), which, as described by Ibbetson, is "a drop of transparent resin encapsulating 27 as shown in FIG. 5I which may provide environmental and mechanical protection to the chip while also acting as a lens." (Ex. PAT-B, 250; Ex. PA-23, ¶[0069].)

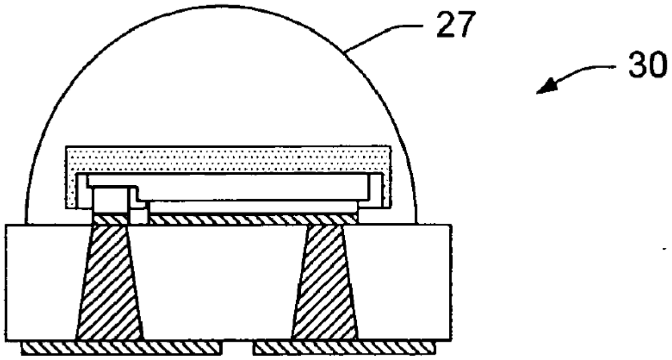


FIGURE 5I

(Ex. PA-23, FIG 5I.)

Notably, Applicant did not contest the Examiner's assertions regarding how broadly the "optically permissive cover substrate" was claimed or the Examiner's mapping of the recited feature to the material that acts as a lens in Ibbetson.

Patent Owner's assertions in IPR proceedings also conflict with Patent Owner's broad interpretation of "optically permissive cover substrate" in litigation. (*See* Ex. LIT-3, 12 ("the Samsung Galaxy A51 comprises an optically permissive cover substrate such as glass which covers the LED chip and other components.").) Patent Owner provides no explanation as to how the "glass" supports epitaxial growth or circuit foundation. (*Id.*)

g. a passivation layer in direct contact with said metallization layer, said sapphire layer, a surface of said optically permissive layer, and said semiconductor LED,

The Sugizaki-Hanaoka-Izumino combination discloses or suggests these limitations. (Ex. PA-DEC, ¶¶110-112.) Notably, the positioning of the passivation layer with respect to the other layers as recited in claim 1 was a feature the Examiner identified as being absent in the prior art during prosecution. (Ex. PAT-B, 74 (Interview summary noting that the Examiner offered suggestions "regarding Applicant's Fig. 10 to include additional limitations to describe the relationship of the passivation layer with the surrounding/contacting layers (e.g. the LED, sapphire substrate, and layer 1030).").) Indeed, the Examiner noted that "[i]f amended to more clearly describe features of the passivation layer 1070 shown in Fig. 10, this would over come the applied prior art." (*Id.*) Applicant subsequently amended the claims as suggested by the Examiner, and the claims were then allowed. (*Id.*, 49-50, 57-58, 11-12.) As demonstrated below, Sugizaki discloses the recited features regarding the passivation layer positioning that the Examiner believed were absent from the prior art. (Ex. PA-DEC, ¶110.)

For instance, Sugizaki discloses depositing a "dielectric film 20 made of an organic or inorganic material" (Ex. PA-1, ¶[0033]) that constitutes a "passivation layer" as recited in claim element 1[g]. (Ex. PA-DEC, ¶111.) Dielectric films were commonly used to isolate electrically conductive elements from each other, to provide mechanical and chemical protection for certain circuit components or features of circuit components both during and after fabrication, and for masking during semiconductor device formation. (*Id.*) Such dielectric films are non-conductive, which is confirmed by Sugizaki's formation of openings in the dielectric film to allow electrical contact to the electrodes. (*Id.*; *see infra* Sections VI.A.2(h)-(i).)

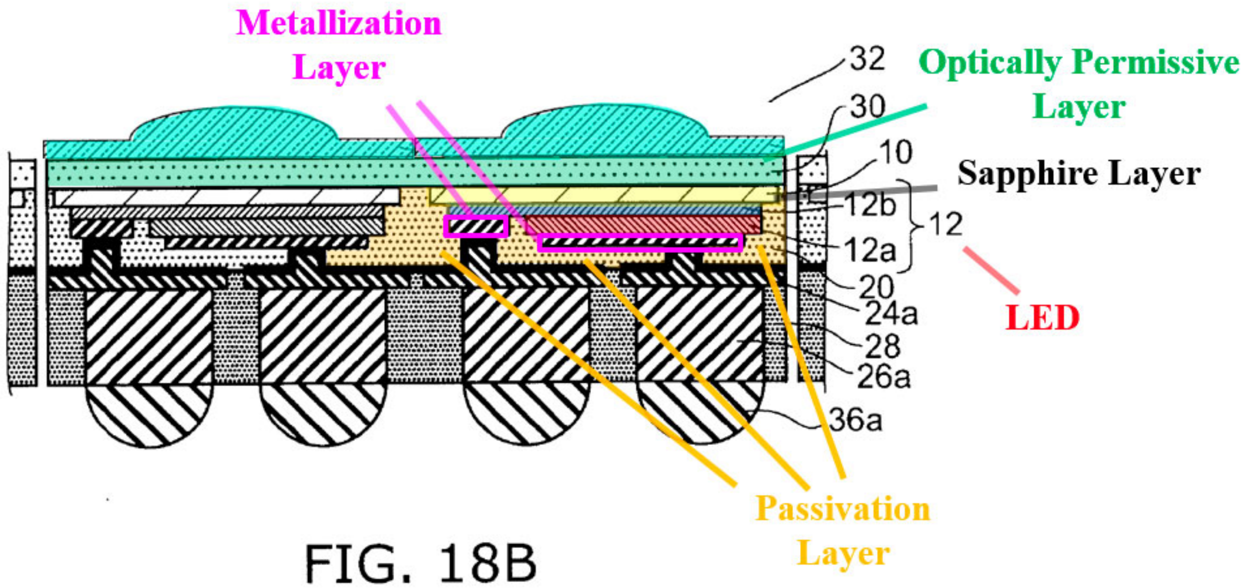


FIG. 18B

(Ex. PA-1, FIG. 18B (annotated); Ex. PA-DEC, ¶111.)

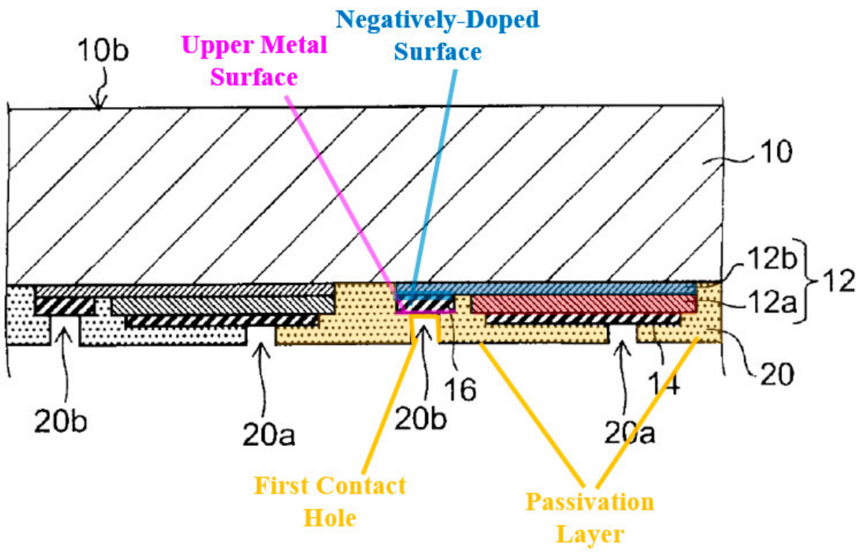
As is apparent from figure 18B above, the dielectric layer 20 ("passivation layer") in direct contact with: (1) the "metallization layer" that includes the p-side electrode and an n-side electrode,

(2) the sapphire layer 10, (3) the bottom surface of the phosphor layer ("optically permissive layer"), and (4) the LED 12, thereby disclosing the passivation layer positioning recited in claim 1 that the Examiner believed was not disclosed in the prior art. (Ex. PA-DEC, ¶112.)

h. wherein said passivation layer defines a first contact hole to expose a first portion of an upper metal surface of said metallization layer disposed on said negatively-doped surface and said passivation layer is in direct contact with a second portion of said upper metal surface of said metallization layer disposed on said negatively-doped surface,

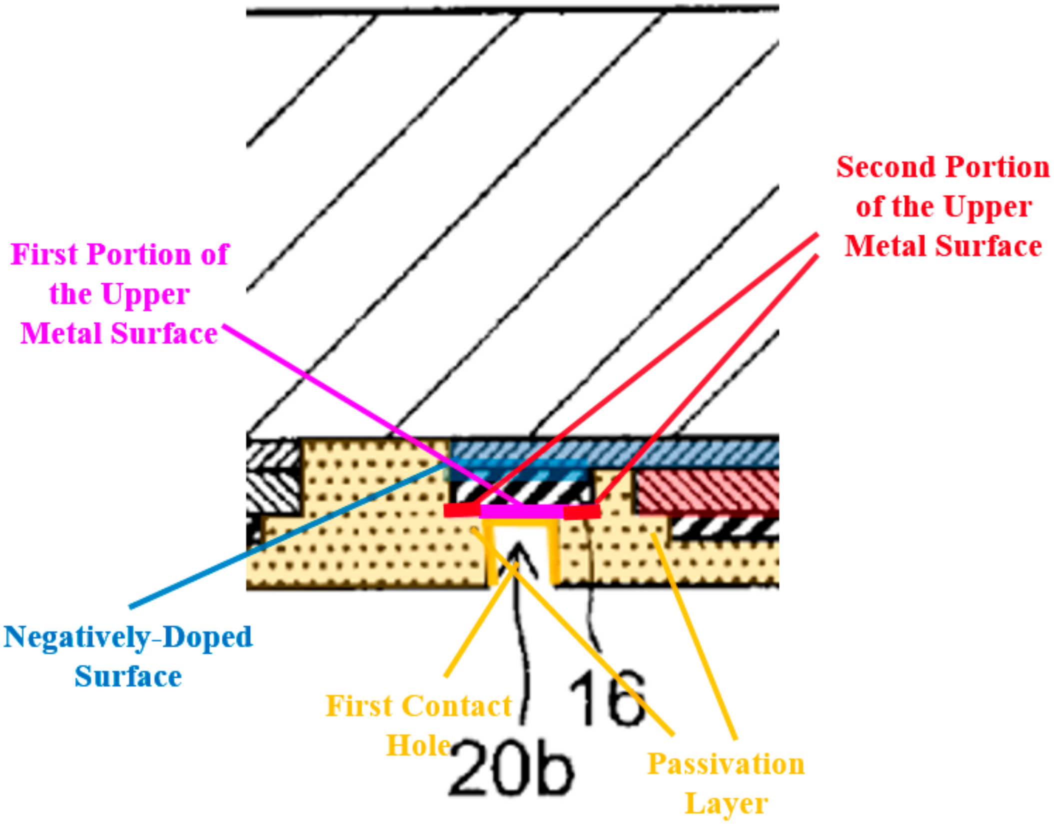
The Sugizaki-Hanaoka-Izumino combination discloses or suggests these limitations. (Ex. PA-DEC, ¶¶113-117.) As shown in annotated figure 3C below, Sugizaki discloses that, after deposition, a portion of the dielectric film ("passivation layer") is removed to expose the lower portion of the n-side electrode 16 ("an upper metal surface of said metallization layer"). (Ex. PA-1, ¶[0048] ("A dielectric film 20 is formed so as to cover the p-side electrode 14 and the n-side electrode 16, and openings (first opening and second opening) 20a, 20b are formed so as to expose part of the p-side electrode 14 and n-side electrode 16, respectively (FIG. 3C).").) In addition to defining a first contact hole that exposes a portion of the n-side electrode 16, the remaining dielectric is also in direct contact with the portion of the upper metal surface that is not exposed by the contact hole ("said passivation layer is in direct contact with a second portion of said upper metal surface of said metallization layer disposed on said negatively-doped surface"). (Ex. PA-DEC, ¶113.)

FIG. 3C



(Ex. PA-1, FIG. 3C (annotated); Ex. PA-DEC, ¶113.)

The enlarged portion of figure 3C below is annotated to show the "first portion" and the "second portion" of the "upper metal surface of said metallization layer." (Ex. PA-DEC, ¶114.)



(Ex. PA-1, FIG. 3C (excerpt, annotated); Ex. PA-DEC, ¶114.)

Similarly, as shown in annotated figure 18B and the excerpt of annotated figure 18B below, a portion of the dielectric layer 20 ("passivation layer") has been removed to define a first contact hole as recited in claim 1, where the dielectric layer is also in direct contact with the portion of the upper metal surface that is not exposed by the contact hole. (Ex. PA-1, Abstract, ¶¶[0007]-[0009], [0048], FIG. 18B, claims 1, 9, 10; Ex. PA-DEC, ¶115.)

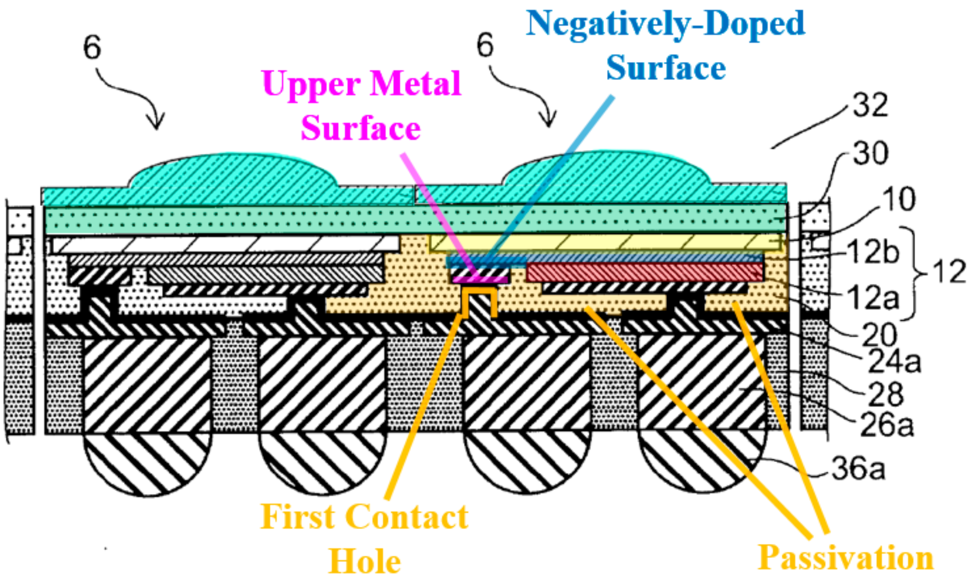
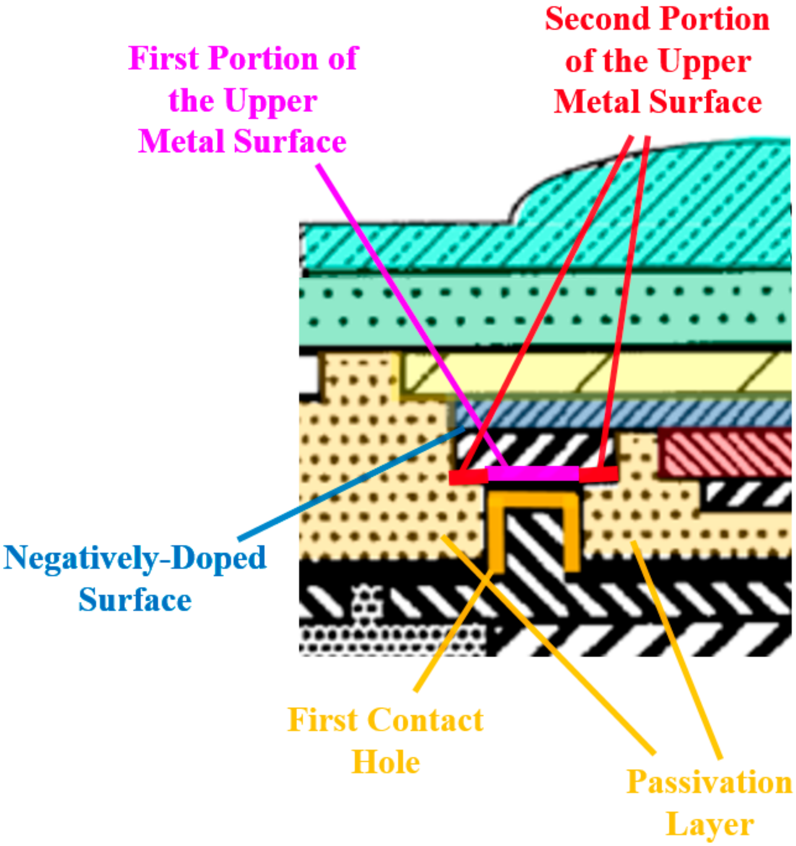


FIG. 18B

(Ex. PA-1, FIG. 18B (modified, annotated); Ex. PA-DEC, ¶115.)



(Ex. PA-1, FIG. 18B (excerpt, modified, annotated); Ex. PA-DEC, ¶115.)

Sugizaki further discloses a layer of seed metal formed in the contact hole to foster good electrical contact to the electrode. (Ex. PA-1, ¶[0048].) The inclusion of the seed metal layer, discussed in detail with respect to claim 8 below (*see infra* Section VI.A.4), is consistent with the disclosure of the ’405 patent and does not interfere with Sugizaki’s disclosure of claim feature 1(h). (Ex. PA-DEC, ¶116.)

Sugizaki’s disclosure of these claim features is consistent with the disclosure of the ’405 patent. (Ex. PA-DEC, ¶117.) For example, the recited features are shown in annotated figure 10 and the enlarged excerpt of figure 10 of the ’405 patent below. (Ex. PAT-A, 6:45-64, FIG. 10; Ex. PA-DEC, ¶117.)

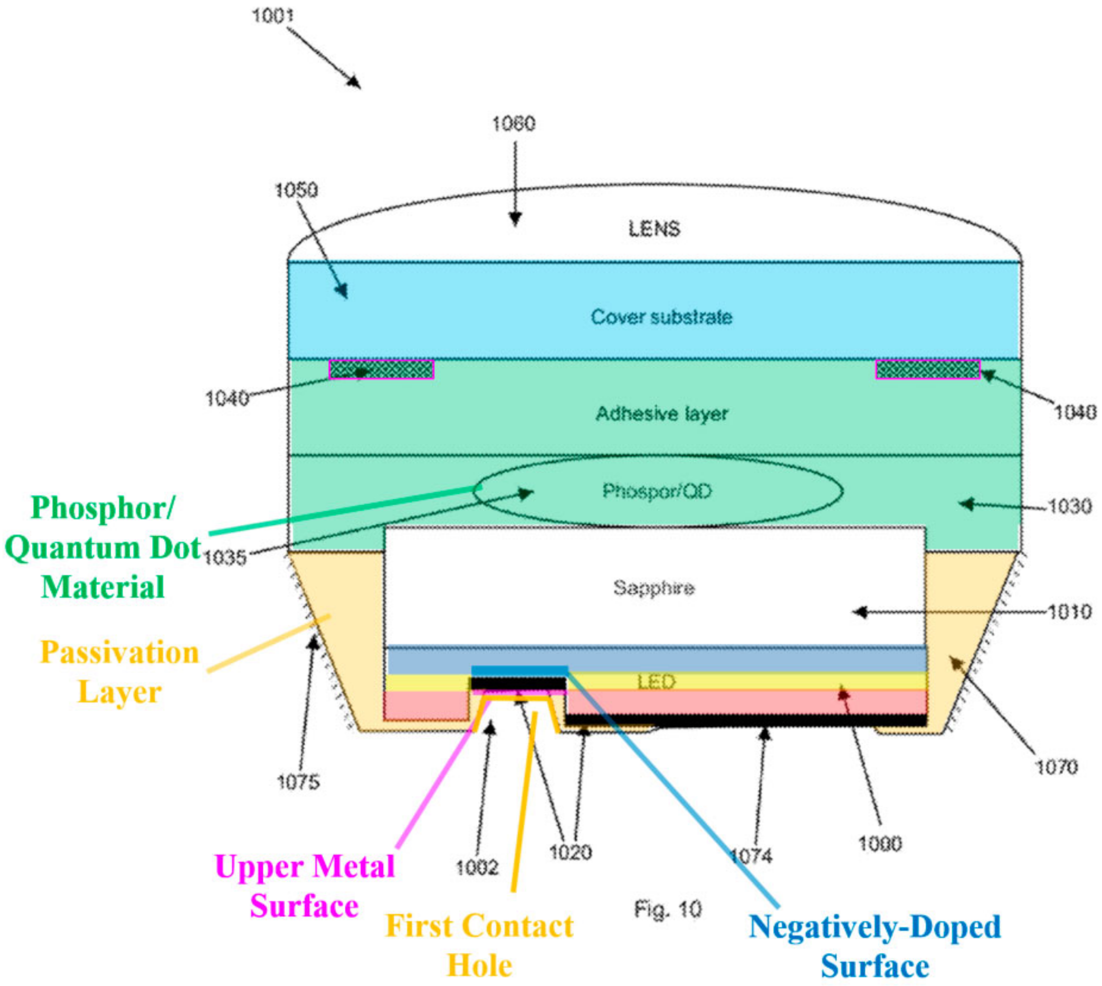
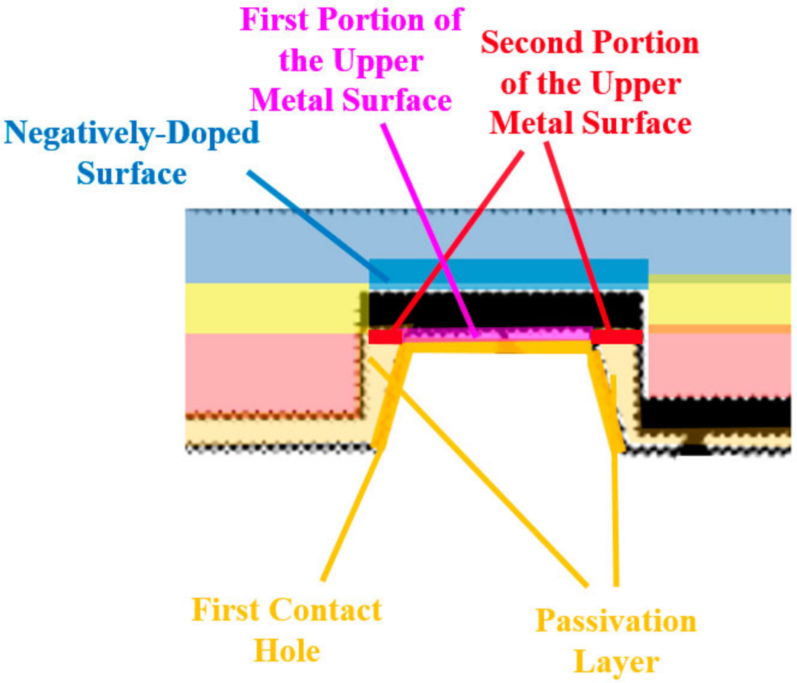


Fig. 10

(Ex. PAT-A, FIG. 10 (annotated); Ex. PA-DEC, ¶117.)

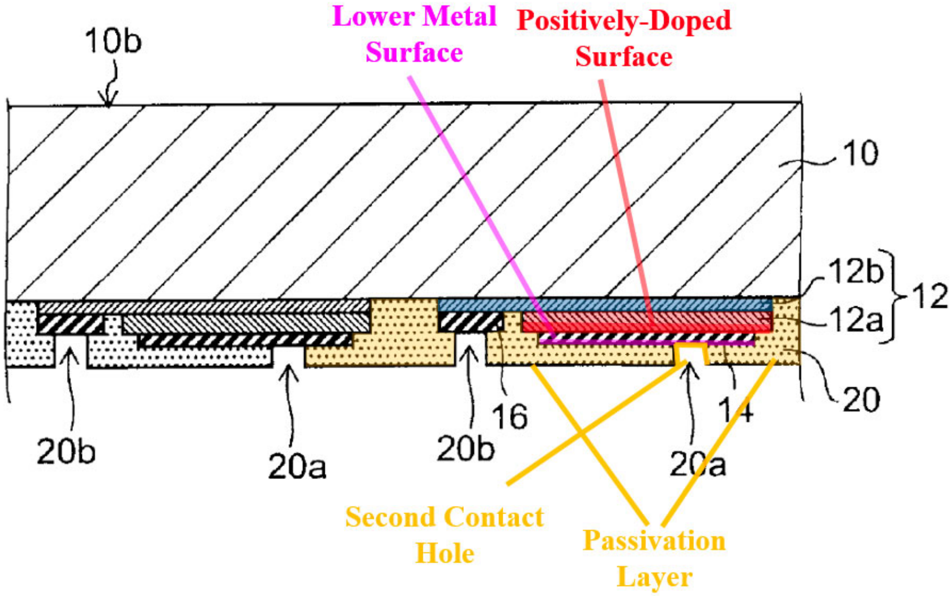


(Ex. PAT-A, FIG. 10 (exerpt, annotated); Ex. PA-DEC, ¶117.)

i. wherein said passivation layer defines a second contact hole to expose a first portion of a lower metal surface of said metallization layer disposed on said positively-doped surface and said passivation layer is in direct contact with a second portion of said lower metal surface of said metallization layer disposed on said positively-doped surface, and

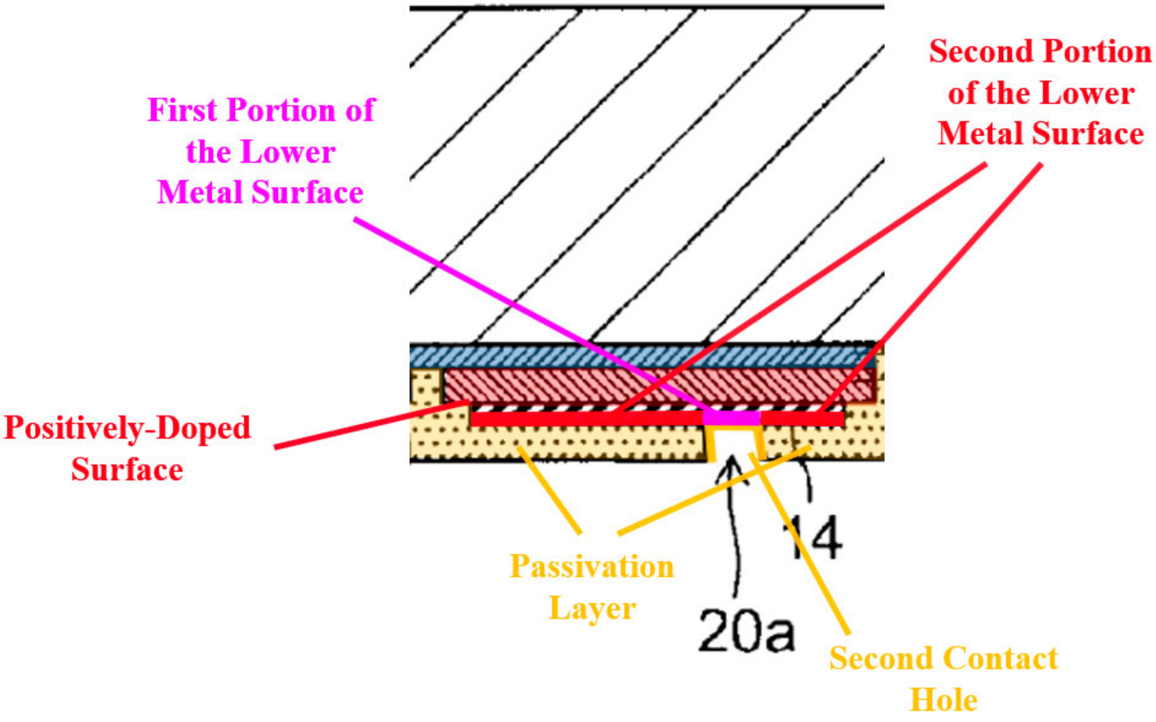
The Sugizaki-Hanaoka-Izumino combination discloses or suggests these features. (Ex. PA-DEC, ¶¶118-122.) As shown in annotated figure 3C below, Sugizaki discloses that a portion of the dielectric film ("passivation layer") is removed to expose the lower portion ("a second portion") of the p-side electrode 14 ("a lower metal surface of said metallization layer"). (Ex. PA-1, ¶[0048].) In addition to defining a second contact hole that exposes a portion of the p-side electrode 14, the remaining dielectric is also in direct contact with the portion of the upper metal surface that is not exposed by the contact hole ("said passivation layer is in direct contact with a second portion of said lower metal surface of said metallization layer disposed on said positively-doped surface"). (Ex. PA-DEC, ¶118.)

FIG. 3C



(Ex. PA-1, FIG. 3C (annotated); Ex. PA-DEC, ¶118.)

The enlarged portion of figure 3C below is annotated to show the “first portion” and the “second portion” of the “lower metal surface of said metallization layer.”



(Ex. PA-1, FIG. 3C (excerpt, annotated); Ex. PA-DEC, ¶119.)

Similarly, as shown in annotated figure 18B and the excerpt of figure 18B below, a portion of the dielectric layer 20 ("passivation layer") has been removed to define a second contact hole as recited in claim 1, where the dielectric layer is also in direct contact with the portion of the lower metal surface that is not exposed by the contact hole. (Ex. PA-1, Abstract, ¶¶[0007]-[0009], [0048], FIG. 18B, claims 1, 9, 10; Ex. PA-DEC, ¶120.)

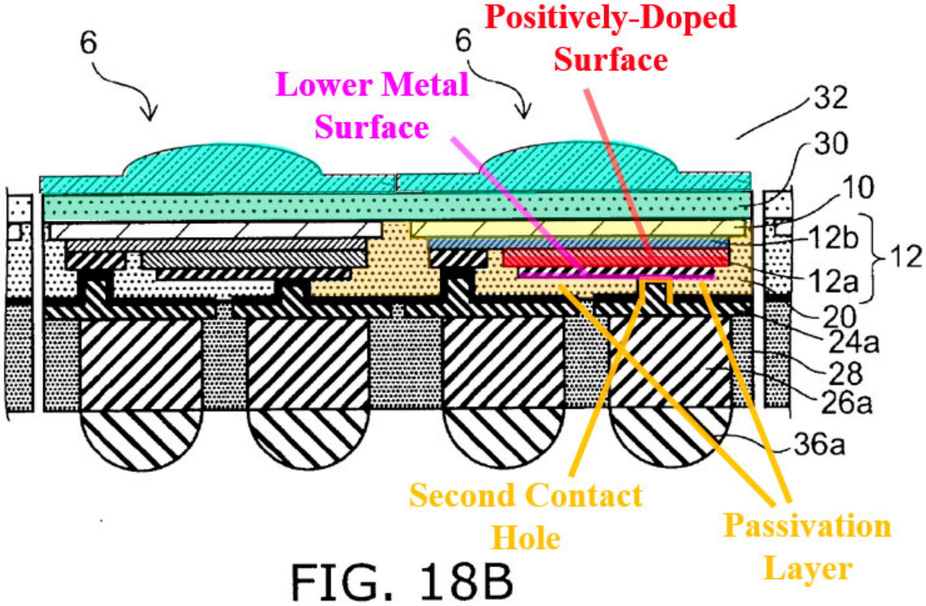
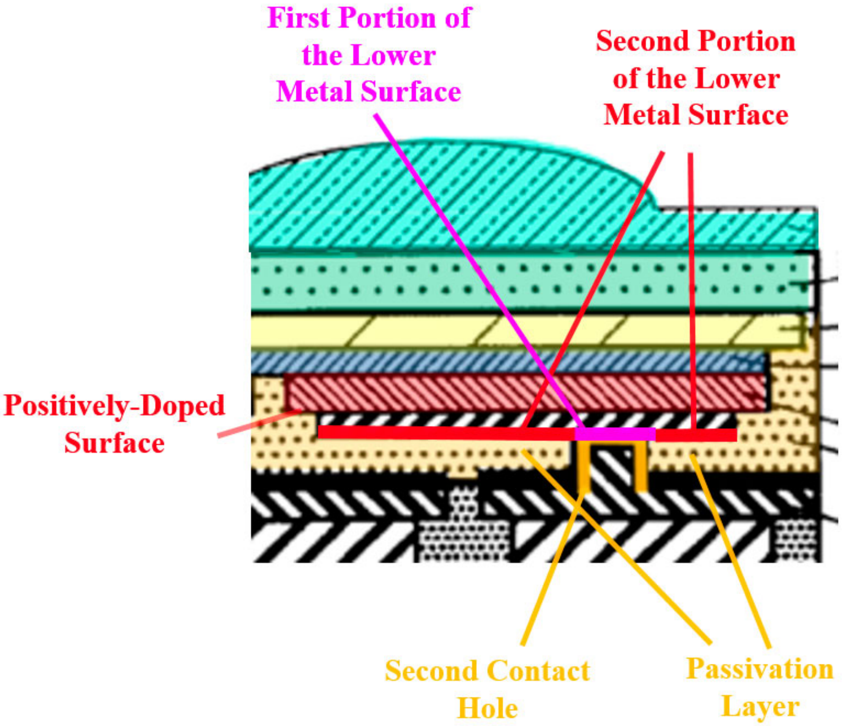


FIG. 18B

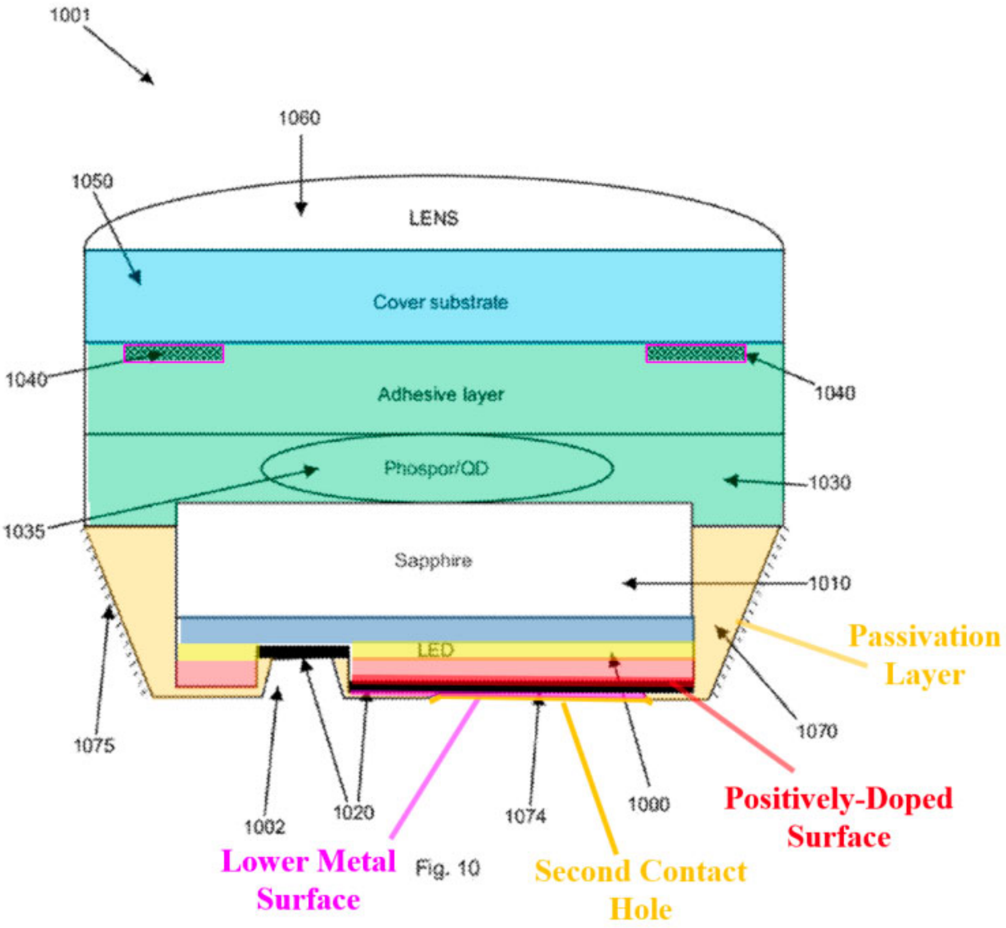
(Ex. PA-1, FIG. 18B (modified, annotated); Ex. PA-DEC, ¶120.)



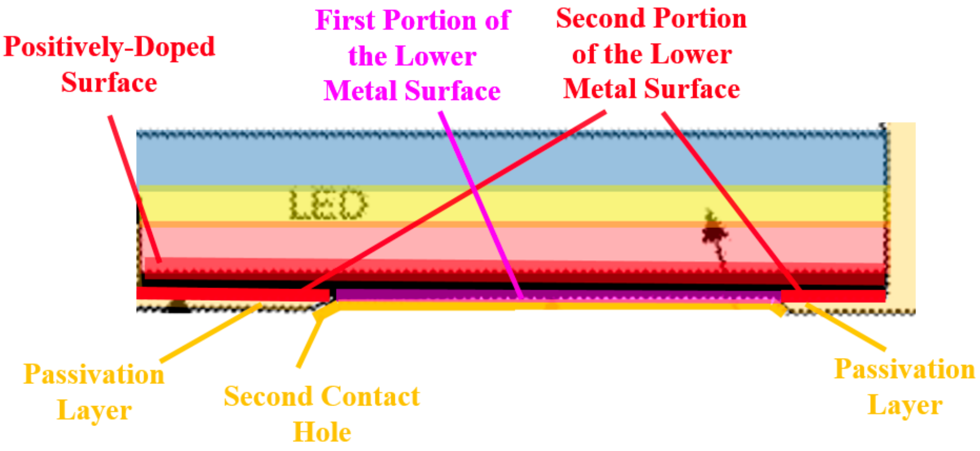
(Ex. PA-1, FIG. 18B (excerpt, modified, annotated); Ex. PA-DEC, ¶120.)

As noted above for claim feature 1(h), the inclusion of the seed metal layer (*see infra* Section VI.A.5) is consistent with the disclosure of the ’405 patent and does not interfere with Sugizaki’s disclosure of claim feature 1(i). (*Supra* Section VI.A.2(h); Ex. PA-DEC, ¶121.)

Sugizaki’s disclosure of this feature is consistent with the disclosure of the ’405 patent. (Ex. PA-DEC, ¶122.) For example, the recited features are shown in annotated figure 10 and the enlarged excerpt of figure 10 of the ’405 patent below. (Ex. PAT-A, 6:45-64, FIG. 10; Ex. PA-DEC, ¶122.)



(Ex. PAT-A, FIG. 10 (annotated); Ex. PA-DEC, ¶122.)



(Ex. PAT-A, FIG. 10 (excerpt, annotated); Ex. PA-DEC, ¶122.)

j. wherein said upper metal surface, said lower metal surface, said negatively-doped surface, said positively-doped surface, and said surface of said optically permissive layer are parallel with one another.

The Sugizaki-Hanaoka-Izumino combination discloses or suggests these features. (Ex. PA-DEC, ¶123.) As shown in annotated figure 18B of Sugizaki below, the upper metal surface, lower metal surface, negatively-doped surface, positively-doped surface, and the surface of the optically permissive layer identified above with respect to claim elements 1[g]-[i] are parallel with one another. (*Id.*) Indeed, the depiction of these layers as being parallel with each other in figure 18B is consistent with how a POSITA would understand the layers to be relatively oriented based on the way they are formed. (*Id.*)

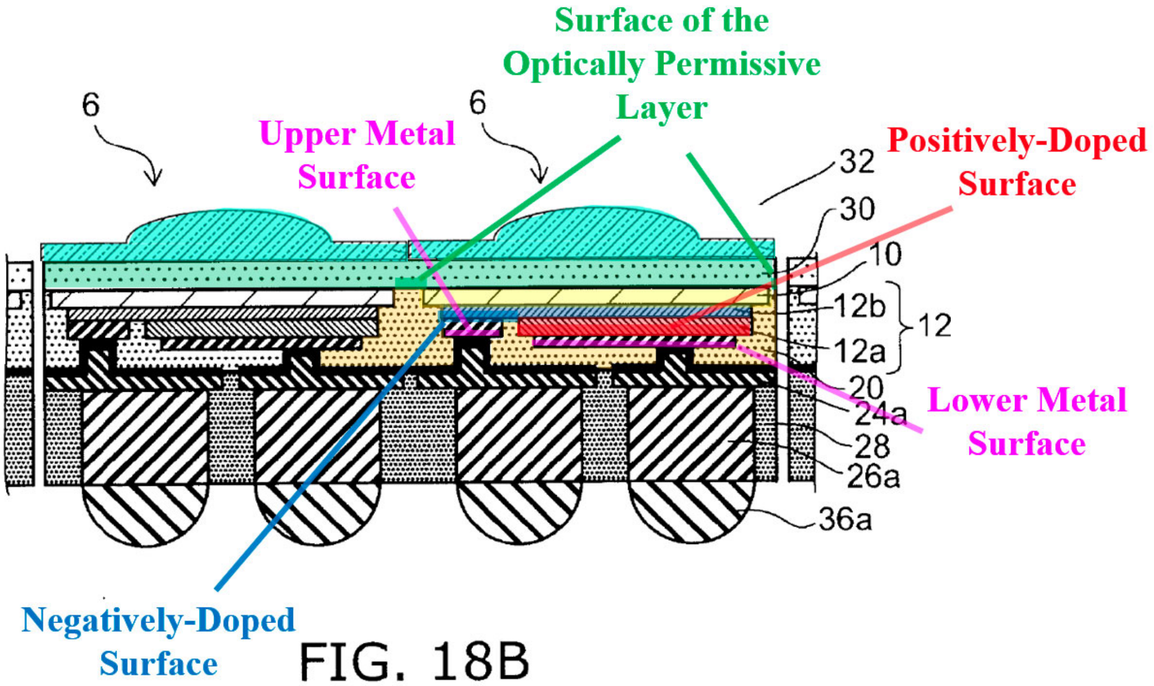


FIG. 18B

(Ex. PA-1, FIG. 18B (modified, annotated); Ex. PA-DEC, ¶123.)

3. Claim 3

a. The light emitting device of claim 1, wherein said passivation layer is substantially electrically non-conductive.

The Sugizaki-Hanaoka-Izumino combination discloses or suggests these features. (Ex. PA-DEC, ¶124.) As discussed above with respect to claim feature 1[g], Sugizaki discloses a dielectric film 20 that corresponds to the "passivation layer." (*See supra* Section VI.A.2[g].)

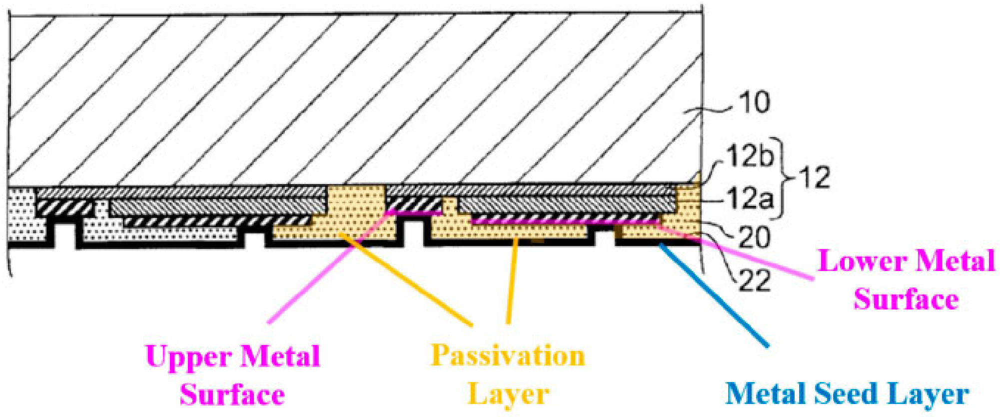
The dielectric film is non-conductive, which is demonstrated by the need to form holes in the dielectric film in order to provide electrical contact the electrodes. (Ex. PA-DEC, ¶124.)

4. Claim 8

a. The light emitting device of claim 1 further comprising a metal seed layer in direct contact with said passivation layer, said upper metal surface of said metallization layer, and said lower metal surface of said metallization layer.

The Sugizaki-Hanaoka-Izumino combination discloses or suggests these features. (Ex. PA-DEC, ¶¶125-126.) For example, Sugizaki discloses depositing a seed metal on the dielectric film ("passivation layer") as well as on the exposed surfaces of the n-side electrode ("upper metal surface of said metallization layer") and p-side electrode ("lower metal surface of said metallization layer"). (Ex. PA-1, Abstract, ¶¶[0007]-[0008], [0033], [0048] ("a seed metal 22 illustratively made of Ti/Cu is formed by sputtering, for example (FIG. 3D)"), FIGs. 2A, 3D, 6A, 18B, claims 1, 9; Ex. PA-DEC, ¶125.) Formation of the of seed metal layer 22 ("metal seed layer") is shown with respect to figure 3D, where, as shown in figures 3D and 18B below, the seed metal 22 is in direct contact with the dielectric film ("passivation layer") and the n- and p-side electrodes 16 and 14, respectively, ("metallization layer"). (Ex. PA-1, ¶[0007], FIGs. 3D, 18B; Ex. PA-DEC, ¶¶125-126.) Therefore, Sugizaki in combination with Hanaoka and Izumino discloses or suggests the features of claim 8. (Ex. PA-DEC, ¶126.)

FIG. 3D



(Ex. PA-1, FIG. 3D (annotated); Ex. PA-DEC, ¶125.)

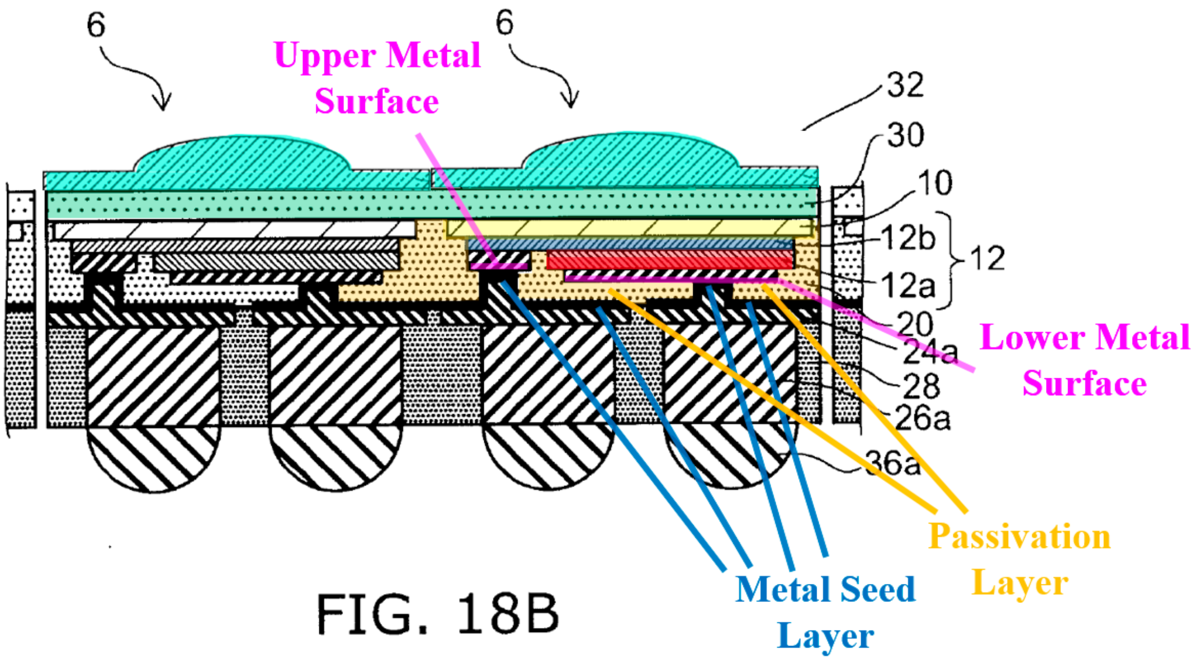


FIG. 18B

(Ex. PA-1, FIG. 18B (modified, annotated); Ex. PA-DEC, ¶126.)

5. Claim 9

a. The light emitting device of claim 8 wherein said metal seed layer is patterned.

The Sugizaki-Hanaoka-Izumino combination discloses or suggests these features. (Ex. PA-DEC, ¶¶127-128.) For example, Sugizaki discloses that, after forming the seed metal, etching is performed to separate the seed metal into a p-side seed metal portion 22a and an n-side seed metal portion 22b, where each portion of the seed metal provides an electrical connection to the respective n- or p- contact. (Ex. PA-1, Abstract, ¶[0054]; Ex. PA-DEC, ¶127.) Annotated figures 5B and 5C below show the patterning of the seed metal layer 22.

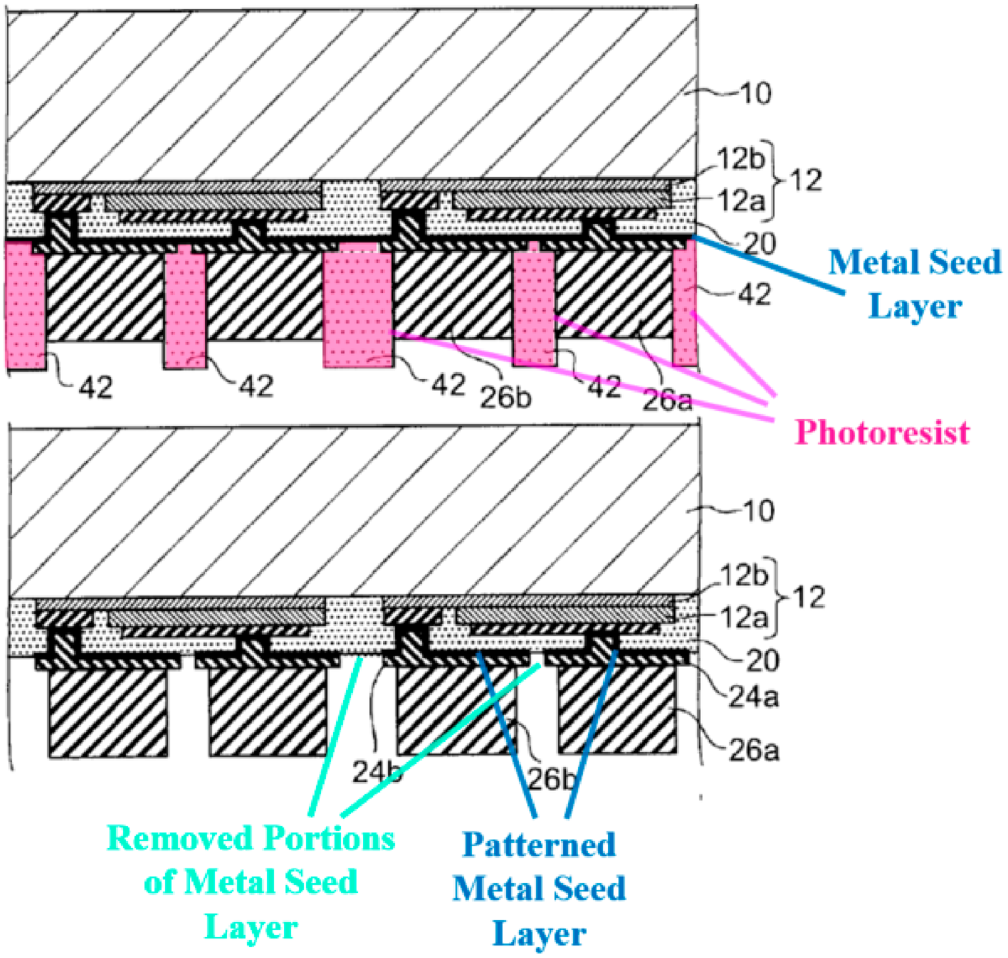


FIG. 5B

FIG. 5C

(Ex. PA-1, FIGs. 5B, 5C (annotated); Ex. PA-DEC, ¶127.)

The patterned seed metal layer shown in figure 5C is also shown in annotated figure 18B below, where the removed seed metal material results in separated p- and n-electrodes for the LED device on the right. (Ex. PA-1, FIG. 18B; Ex. PA-DEC, ¶128.) Therefore, the Sugizaki-Hanaoka-Izumino combination discloses or suggests the features of claim 9. (Ex. PA-DEC, ¶128.)

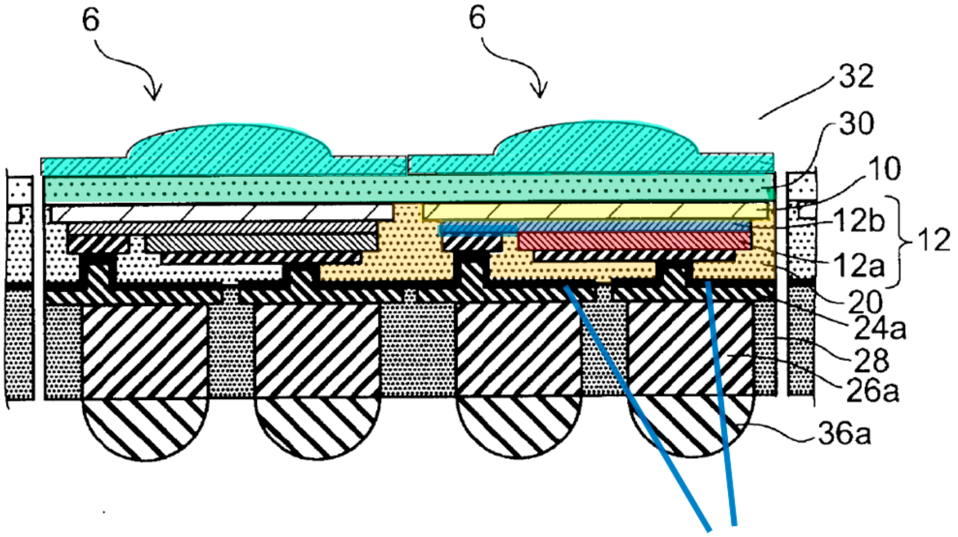


FIG. 18B

(Ex. PA-1, FIG. 18B (modified, annotated); Ex. PA-DEC, ¶128.)

6. Claim 10

a. The light emitting device of claim 8 further comprising a metal layer on said seed metal layer, said metal layer having a thickness of between about 10 microns and about 40 microns.

The Sugizaki-Hanaoka-Izumino combination discloses or suggests these features. (Ex. PA-DEC, ¶¶129-132.) For example, Sugizaki discloses that, after forming and patterning the seed metal as discussed above with respect to claims 8 and 9, copper interconnect layers 24a and 24b and copper pillars 26a and 26b are formed by plating. (Ex. PA-1, ¶¶[0051], [0053]; Ex. PA-DEC, ¶129.)

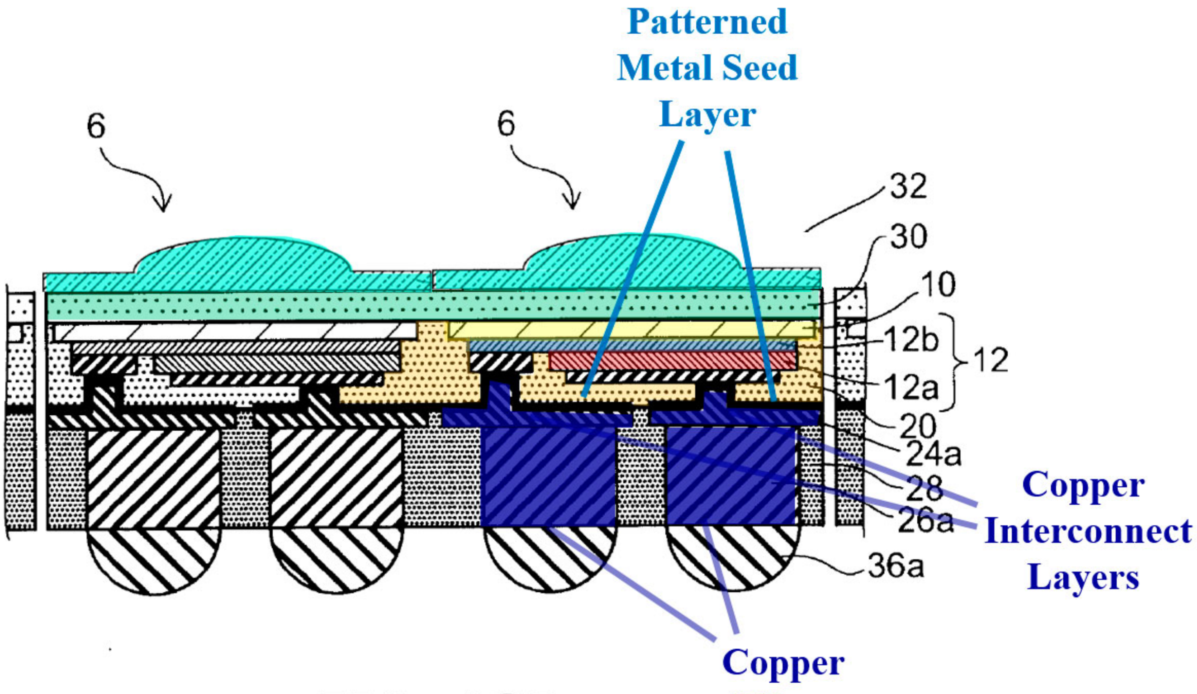


FIG. 18B

(Ex. PA-1, FIG. 18B (modified, annotated); Ex. PA-DEC, ¶129.)

Sugizaki further discloses embodiments where the thickness of the deposited copper pillars 26 is in a range of “10 to several hundred μm.” (Ex. PA-1, ¶[0053].) As such, the copper pillars disclosed by Sugizaki constitute a “metal layer on said seed metal layer, said metal layer having a thickness of between about 10 microns and about 40 microns” as recited in claim 10. (Ex. PA-DEC, ¶130.)

To the extent Patent Owner argues that the copper pillars 26 are not “on” the seed metal layer because they are not “directly on” and in contact with the seed metal layer, it would have been obvious to replace the copper interconnect layers 24a, 24b and copper pillars 26a, 26b shown above in figure 18B with thick copper interconnect layer 24c, 24d as disclosed by Sugizaki with respect to figures 2a and 2b. (Ex. PA-DEC, ¶¶131-132.) For example, Sugizaki discloses that the electrical interconnect that includes metal interconnect layers 24a and 24b as well as metal pillars 26a and 26b (as shown in annotated figure 2A below) can be replaced with thick copper interconnect layers 24c and 24d (as shown in annotated figure 2B below), where “[t]his can simplify the structure and manufacturing process.” (Ex. PA-1, ¶¶ [0034]-[0035], [0045], FIGs. 2A, 2B; see also id., ¶[0086] (“simplify . . . the manufacturing process”); Ex. PA-DEC, ¶131.)

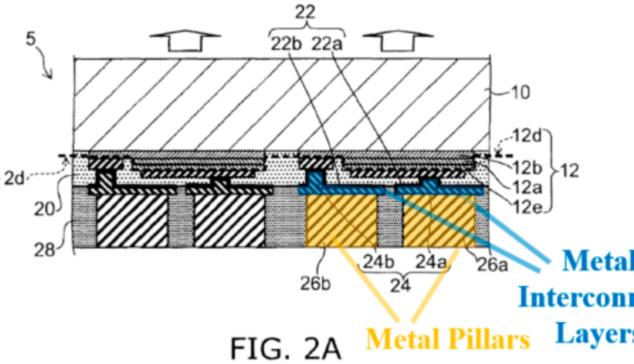


FIG. 2A

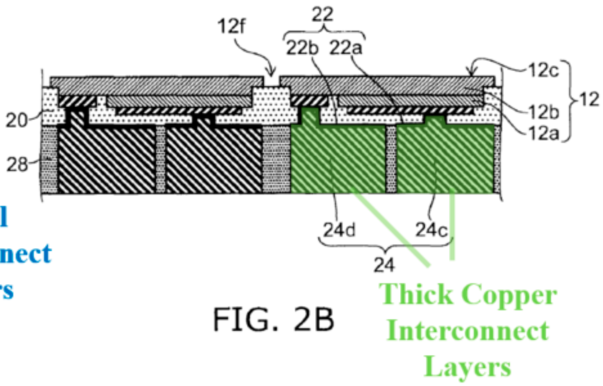


FIG. 2B

(Ex. PA-1, FIGs. 2A, 2B (annotated); Ex. PA-DEC, ¶131.)

While Sugizaki does not expressly state the thickness of the thick copper interconnect layers, based on the relative dimensions provided for the metal pillars 26a, 26b, a POSITA would have found it obvious to form the thick copper interconnect layers such that they have a thickness comparable to that disclosed for the metal pillars 26a, 26b. (Ex. PA-DEC, ¶132.) As noted above, Sugizaki discloses the thickness of the pillars is in a range of "10 to several hundred µm." (Ex. PA-1, ¶[0053].) As such, a POSITA would have understood that the thick copper interconnect layers, which are directly on and in contact with the metal seed layer, would have a similar thickness, where that thickness is included in the claimed range of between about 10 microns and about 40 microns" recited in claim 10. (Ex. PA-DEC, ¶132.)

7. Claim 11

a. The light emitting device of claim 1 further comprising a metal seed layer in direct contact with said passivation layer, said upper metal surface of said metallization layer, and said lower metal surface of said metallization layer.

The Sugizaki-Hanaoka-Izumino combination discloses or suggests these features. (Ex. PA-DEC, ¶133.) For example, Sugizaki discloses that the seed metal layer 22 ("metal seed layer") can be formed of titanium and copper (Ti/Cu), which are "light reflecting material(s)." (Ex. PA-1, ¶[0048]; Ex. PA-DEC, ¶133.)

8. Claim 12

a. A method for making a light emitting device, the method comprising:

To the extent the preamble of claim 12 is limiting, Sugizaki discloses the limitations therein. (Ex. PA-DEC, ¶¶134-135.) For instance, Sugizaki is entitled "Light Emitting Device and Method for Manufacturing Same" and discloses a "method for manufacturing a light emitting device" like that shown in figure 18B. (*Id*.; Ex. PA-1, Title, ¶¶[0007], [0031], [0027], [0092], FIG. 18B; *see supra* Section VI.A.2(a).)

b. forming a light emitting device (LED) comprised of a positively-doped layer, an intrinsic layer, and a negatively-doped layer, wherein said intrinsic layer is between said positively-doped layer and a first surface of said LED is in direct contact with a sapphire layer;

The Sugizaki-Hanaoka-Izumino combination discloses or suggests these limitations. (Ex. PA-DEC, ¶¶136-139.)[8] As discussed above with respect to claim feature 1[b], Sugizaki in combination with Hanaoka discloses or suggests forming an LED with a multilayer body where an intrinsic layer is sandwiched between a positively-doped layer and a negatively doped layer. (*See supra* Section VI.A.2(b).)

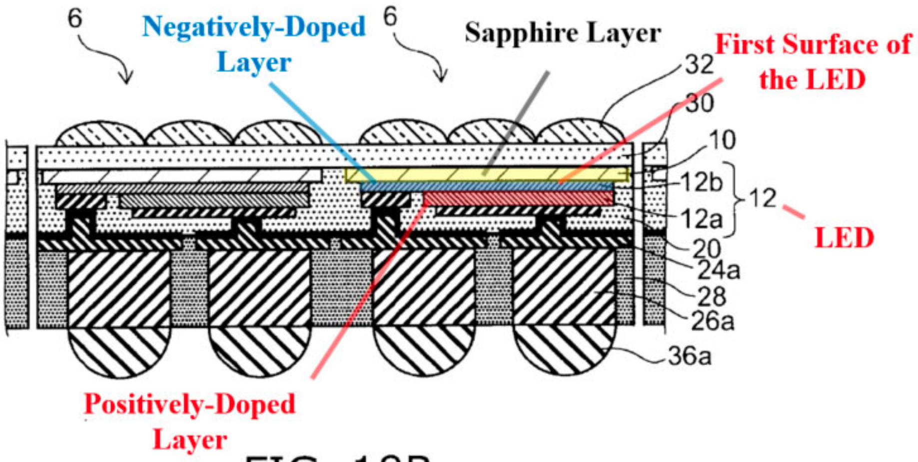


FIG. 18B

(Ex. PA-1, FIG. 18B (annotated); Ex. PA-DEC, ¶139.)

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[8] For this proceeding, Requester assumes that limitation 12(b) should be read as "said intrinsic layer is between said positively-doped layer and a first surface of said LED *that* is in direct contact with a sapphire layer." Requester, however, does not concede that claim 12 is not indefinite.

As shown in figure 18B above, the sapphire layer 10 is in "direct contact" with a first surface of the LED, and the positively-doped layer is on the opposite side of the LED from the sapphire layer as recited in claim element 12(b). (Ex. PA-1, ¶[0047], FIGs. 3A, 18B; Ex. PA-DEC, ¶¶138-139.) Therefore, the intrinsic layer, which is between the doped layers, is formed "between said positively-doped layer and a first surface of said LED [that] is in direct contact with a sapphire layer." (Ex. PA-DEC, ¶¶138-139.)

c. forming a recess in said positively-doped layer and said intrinsic layer of said LED so as to expose a negatively-doped surface of said negatively-doped layer;

The Sugizaki in combination Hanaoka discloses or suggests these limitations for the same reasons discussed above with respect to the recess recited in claim feature 1(b). (*See supra* Section VI.A.2(b); Ex. PA-1, ¶[0047]; Ex. PA-DEC, ¶¶140-141.)

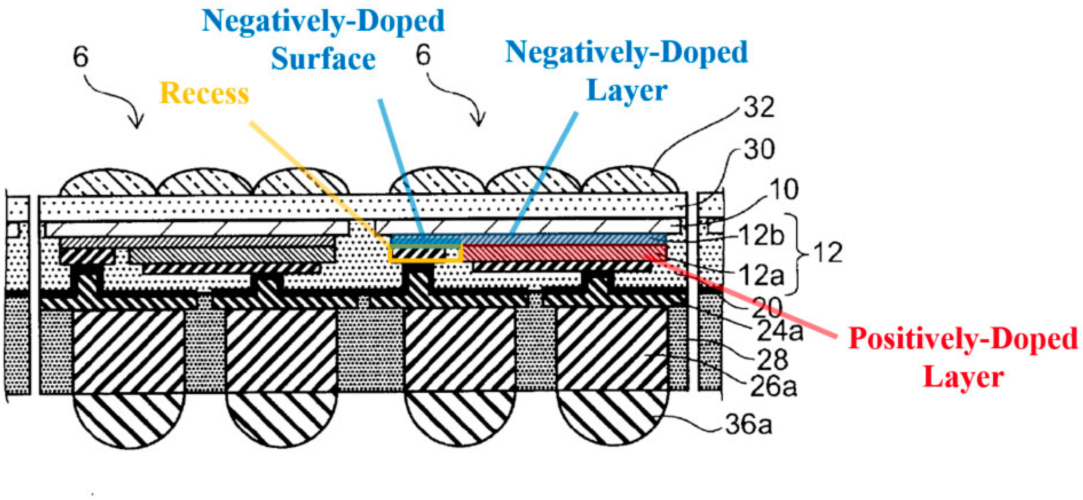


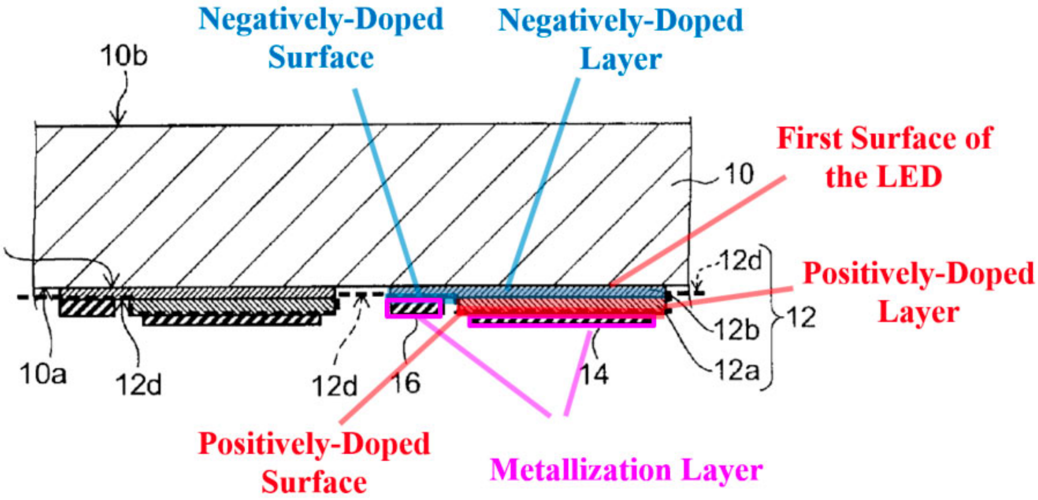
FIG. 18B

(Ex. PA-1, FIG. 18B (annotated); Ex. PA-DEC, ¶141.)

d. depositing a metallization layer on a positively-doped surface of said positively-doped layer and said negatively-doped surface of said negatively-doped layer to provide electrical contact with said positively-doped layer and said negatively-doped layer of said LED, said positively-doped layer surface and said first surface on opposing faces of said LED;

The Sugizaki-Hanaoka-Izumino combination discloses or suggests these limitations. (Ex. PA-DEC, ¶¶142-146.) For instance, as shown in annotated figure 3A below and discussed above with respect to claim element 1[c], Sugizaki in combination with Izumino discloses forming a "metallization layer" on a positively-doped surface of the positively-doped layer and the negatively-doped surface of the negatively-doped layer, where the metallization layer corresponds to the simultaneously-formed contacts 14 and 16. (Ex. PA-DEC, ¶142; *supra* Section VI.A.2(c).) Izumino discloses that the materials for the electrodes are deposited by sputtering. (Ex. PA-3, ¶[0115]).

FIG. 3A



(Ex. PA-1, FIG. 3A (annotated); Ex. PA-DEC, ¶142.)

The p-side electrode 14 portion of the metallization layer is "on a positively-doped surface of said positively-doped layer" and the n-side electrode portion is "on . . . said negatively-doped surface." (Ex. PA-1, ¶[0048]; *see also id.*, ¶[0033]; Ex. PA-DEC, ¶143.) The metallization layer formation disclosed for figure 3A is applicable to figure 18B. (Ex. PA-DEC, ¶144.)

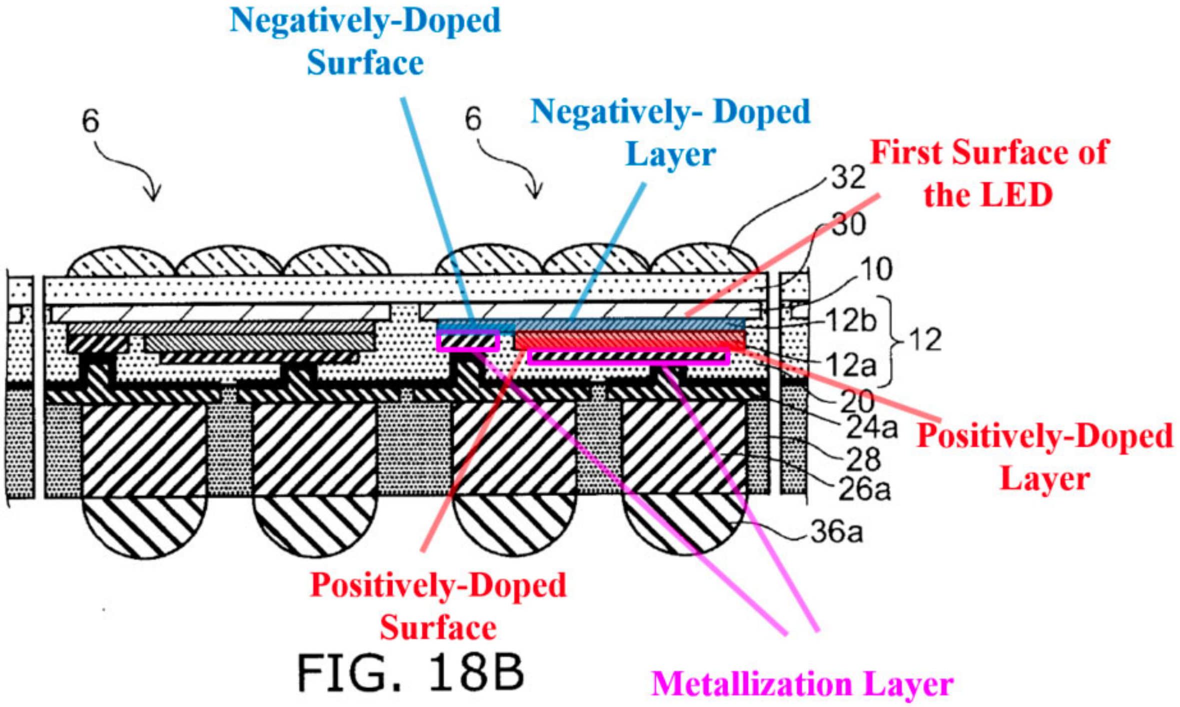


FIG. 18B

(Ex. PA-1, FIG. 18B (annotated); Ex. PA-DEC, ¶144.)

The metallization layer, which includes the p- and n-side electrodes, is connected to additional interconnect in order to allow electrical contact from outside the LED to the positively- and negatively-doped layers ("provide electrical contact with said positively-doped layer and said negatively doped layer of said LED"). (Ex. PA-1, ¶¶[0033]-[0037]; Ex. PA-DEC, ¶145.)

As shown in figure 18B above and consistent with the understanding of a POSITA, the "positively-doped surface," which corresponds to the lower surface of the positively doped layer, and the first surface, which is the top side of the negatively doped layer where it meets the sapphire layer, are "on opposing faces of said LED." (Ex. PA-1, FIG. 18B; Ex. PA-DEC, ¶146.)

e. depositing an optically permissive layer on said sapphire layer, said optically permissive layer comprising an optically definable material containing quantum dots and/or phosphor, said optically definable material adapted to change the frequency of at least some of the emitted light passing therethrough;

The Sugizaki-Hanaoka-Izumino combination discloses or suggests these limitations. (Ex. PA-DEC, ¶¶147-148.) As discussed above with respect to claim element 1[e], Sugizaki discloses depositing a phosphor layer 30 ("optically permissive layer") on the surface of the sapphire layer 10. (*See supra* Section VI.A.2(e); Ex. PA-1, ¶¶[0061], [0068], [0081], FIGs. 6A, 12A-12E, 18B; Ex. PA-DEC, ¶147.) Sugizaki discloses that the phosphor layer 30 can be formed "by a sputtering method, an ink-jet method, a method of applying a silicone resin mixed with phosphor particles, and a method of applying silicone resin mixed with phosphor particles." (Ex. PA-1, ¶[0061].) Sputtering and ink-jet deposition techniques were well-known techniques for forming layers in LED devices. (Ex. PA-DEC, ¶147.)

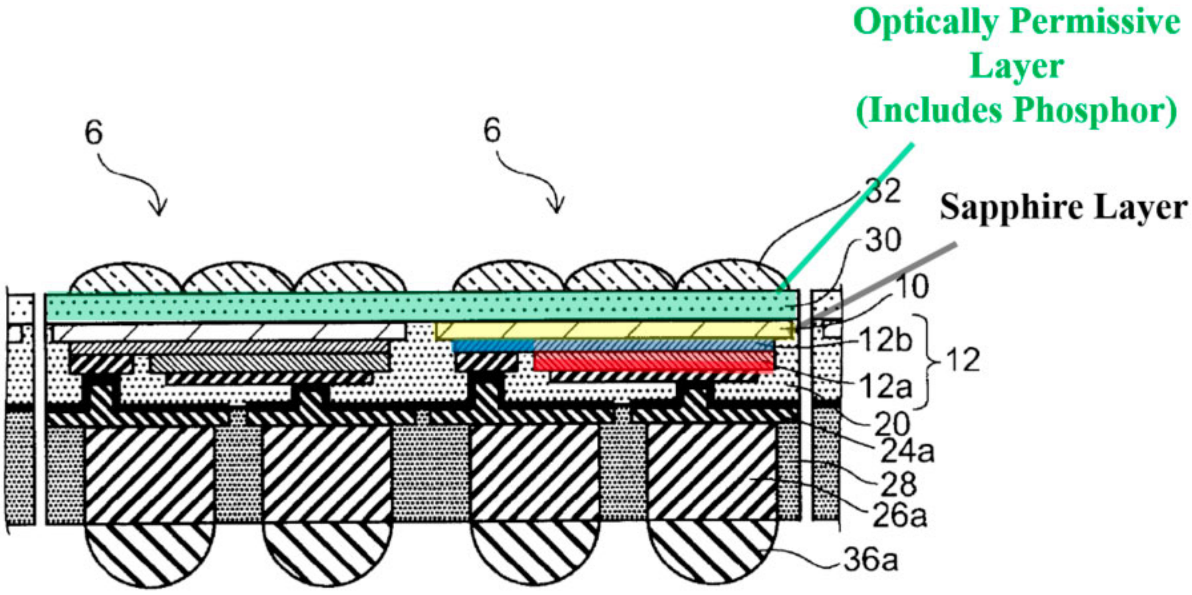


FIG. 18B

(Ex. PA-1, FIG. 18B (annotated); Ex. PA-DEC, ¶147.)

The phosphor layer 30 includes "an optically definable material containing quantum dots and/or phosphor," where the included phosphor is "adapted to change the frequency of at least some of the emitted light passing therethrough." (*See supra* Section VI.A.2(e); Ex. PA-DEC, ¶148.)

Notably, under the Broadest Reasonable Interpretation, "depositing" would include various formation techniques where the optically permissive layer is added to the LED structure. Such an understanding is consistent with the use of "depositing" in the context of the '405 patent. For example, claim 16 of the '405 patent recites "depositing an optically permissive cover substrate covering said optically permissive layer, said sapphire layer, and said LED."

(Ex. PAT-A, claim 16.) As disclosed by the ’405 patent, the cover substrate is attached to the LED body using an adhesive layer, thereby demonstrating the broad interpretation of “depositing.” (*Id*., 5:24-29.)

f. **depositing** a passivation layer in direct contact with said metallization layer, said sapphire layer, a surface of said optically permissive layer, and said LED,

The Sugizaki-Hanaoka-Izumino combination discloses or suggests these limitations. (Ex. PA-DEC, ¶¶149-150.) As discussed above with respect to claim element 1[g], Sugizaki discloses depositing a dielectric film (“passivation layer”) in direct contact with the metallization layer, the sapphire layer 10, the bottom surface of the phosphor layer (“optically permissive layer”), and the LED 12. (*See supra* Section VI.A.2(g); Ex. PA-DEC, ¶¶149-150.) Notably, under the Broadest Reasonable Interpretation, “depositing” would include various formation techniques where the optically permissive layer is added to the LED structure. Such an understanding is consistent with the use of “depositing” in the context of the ’405 patent. For example, claim 16 of the ’405 patent recites “depositing an optically permissive cover substrate covering said optically permissive layer, said sapphire layer, and said LED.” (Ex. PAT-A, claim 16.) As disclosed by the ’405 patent, the cover substrate is attached to the LED body using an adhesive layer, thereby demonstrating the broad interpretation of “depositing.” (*Id*., 5:24-29.)

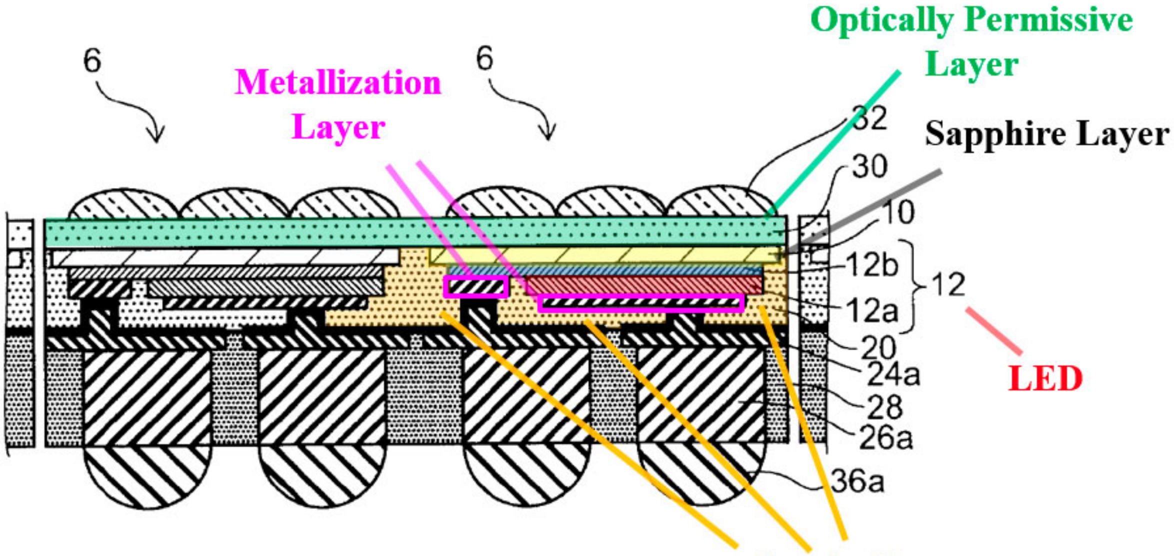


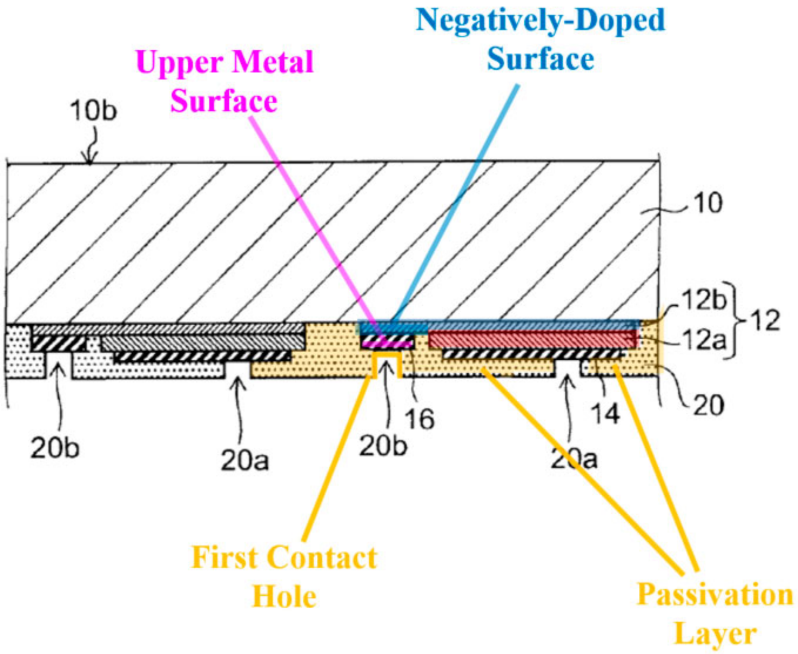
FIG. 18B

(Ex. PA-1, FIG. 18B (annotated); Ex. PA-DEC, ¶149.)

g. defining a first contact hole in said passivation layer to expose a first portion of an upper metal surface of said metallization layer disposed on said negatively-doped surface wherein said passivation layer is in direct contact with a second portion of said upper metal surface of said metallization layer disposed on said negatively-doped surface,

The Sugizaki-Hanaoka-Izumino combination discloses or suggests these limitations. (Ex. PA-DEC, ¶¶151-152.) As discussed above with respect to claim element 1[h], a portion of the dielectric layer 20 ("passivation layer") is removed to define a first contact hole that exposes the lower portion ("a first portion") of the n-side electrode 16 ("an upper metal surface of said metallization layer"). (*See supra* Section VI.A.2(h); Ex. PA-1, Abstract, ¶¶[0007]-[0009], [0048], FIGs. 3C, 18B, claims 1, 9, 10; Ex. PA-DEC, ¶151.)

FIG. 3C



(Ex. PA-1, FIG. 3C (annotated); Ex. PA-DEC, ¶151.)

The dielectric layer is also in direct contact with the portion of the upper metal surface that is not exposed by the contact hole ("said passivation layer is in direct contact with a second portion of said upper metal surface of said metallization layer disposed on said negatively-doped surface"). (*See supra* Section VI.A.2(h); Ex. PA-1, FIG. 18B; Ex. PA-DEC, ¶152.)

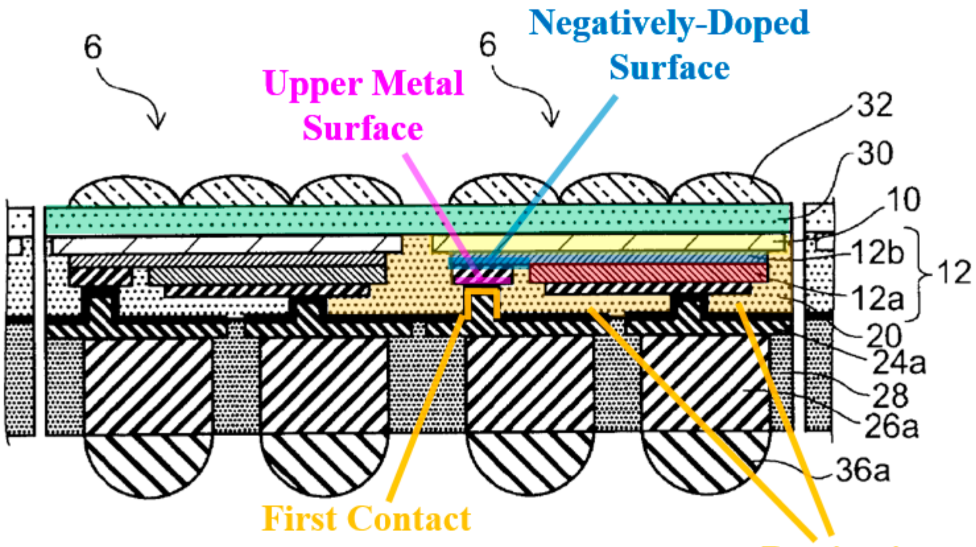


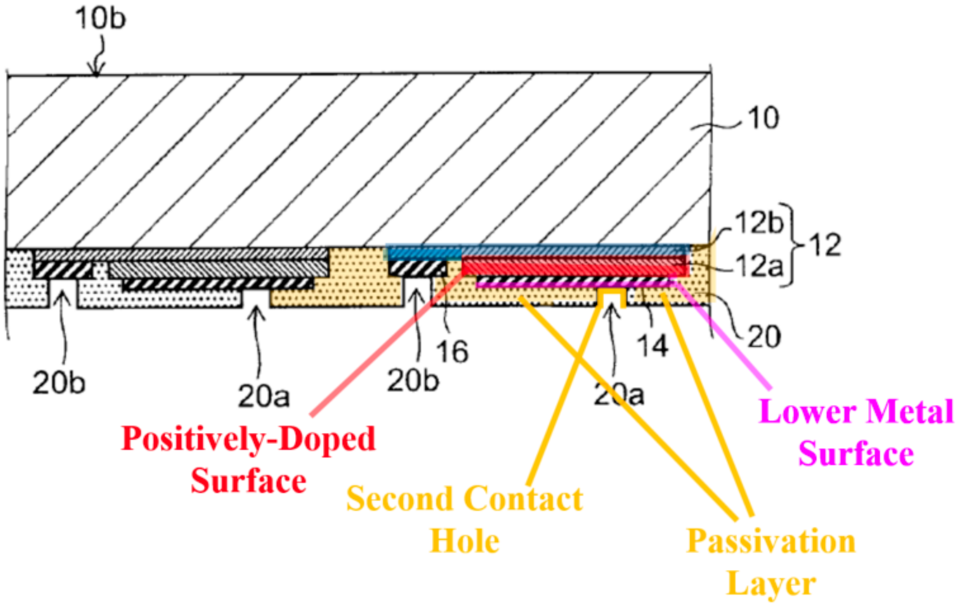
FIG. 18B

(Ex. PA-1, FIG. 18B (annotated); Ex. PA-DEC, ¶152.)

h. **defining a second contact hole in said passivation layer to expose a first portion of a lower metal surface of said metallization layer disposed on said positively-doped surface wherein said passivation layer is in direct contact with a second portion of said lower metal surface of said metallization layer disposed on said positively-doped surface, and**

The Sugizaki-Hanaoka-Izumino combination discloses or suggests these limitations. (Ex. PA-DEC, ¶¶153-154.) For instance, as discussed above with respect to claim element 1[i], a portion of the dielectric layer 20 ("passivation layer") is removed to define a second contact hole that exposes the lower portion ("a first portion") of the p-side electrode 14 ("a lower metal surface of said metallization layer disposed on said positively-doped surface"). (*See supra* Section VI.A.2(i); Ex. PA-1, Abstract, ¶¶[0007]-[0009], [0048], FIGs. 3C, 18B, claims 1, 9, 10; Ex. PA-DEC, ¶153.)

FIG. 3C



(Ex. PA-1, FIG. 3C (annotated); Ex. PA-DEC, ¶153.)

The dielectric layer is also in direct contact with the portion of the lower metal surface that is not exposed by the contact hole ("said passivation layer is in direct contact with a second portion of said lower metal surface of said metallization layer disposed on said positively-doped surface"). (*See supra* Section VI.A.2(i); Ex. PA-1, FIG. 18B; Ex. PA-DEC, ¶154.)

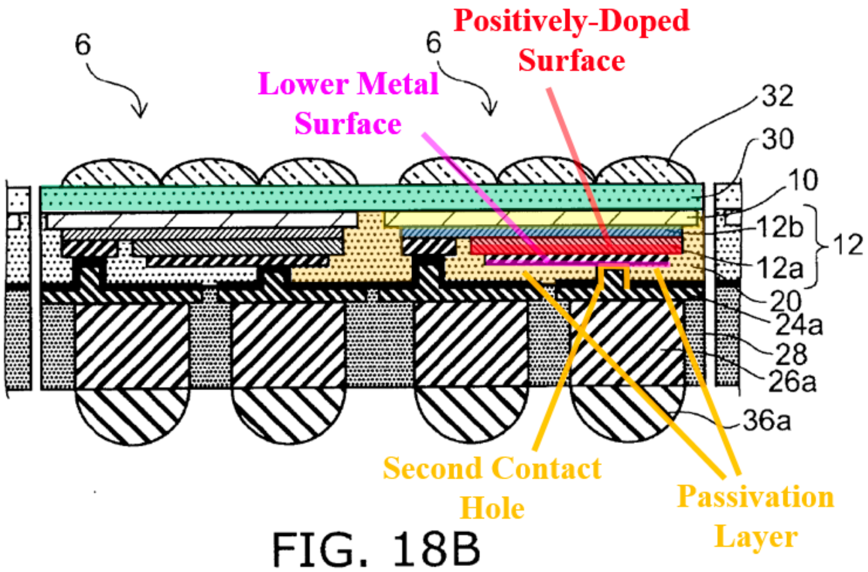


FIG. 18B

(Ex. PA-1, FIG. 18B (annotated); Ex. PA-DEC, ¶154.)

i. wherein said upper metal surface, said lower metal surface, said negatively-doped surface, said positively-doped surface, and said surface of said optically permissive layer are parallel with one another.

The Sugizaki-Hanaoka-Izumino combination discloses or suggests these limitations for the same reasons discussed above with respect to claim feature 1[j]. (*See supra* Section VI.A.2(j); Ex. PA-DEC, ¶155.)

9. Claim 13

a. The method of claim 12, further comprising depositing a metal seed layer on said passivation layer, said upper metal surface of said metallization layer, and lower second metal surface of said metallization layer.

The Sugizaki-Hanaoka-Izumino combination discloses or suggests these features for the same reasons discussed with respect to claim 8 above. (*See supra* Section VI.A.4; Ex. PA-DEC, ¶156.)[9] For example, Sugizaki discloses depositing a seed metal on the dielectric film ("passivation layer") as well as on the exposed surfaces of the n-side electrode ("upper metal surface of said metallization layer") and p-side electrode ("lower metal surface of said metallization layer"). (Ex. PA-1, Abstract, ¶¶[0007]-[0008], [0033], [0048], FIGs. 2A, 3D, 6A, 18B, claims 1, 9.) Figure 3D of Sugizaki shows the deposition of seed metal layer 22 ("metal seed layer") in direct contact with the dielectric film ("passivation layer") and the n- and p-side electrodes 16 and 14, respectively, ("metallization layer"). The seed metal layer 22 is deposited by, for example, sputtering. (*Id.*, ¶[0048]; Ex. PA-DEC, ¶156.)

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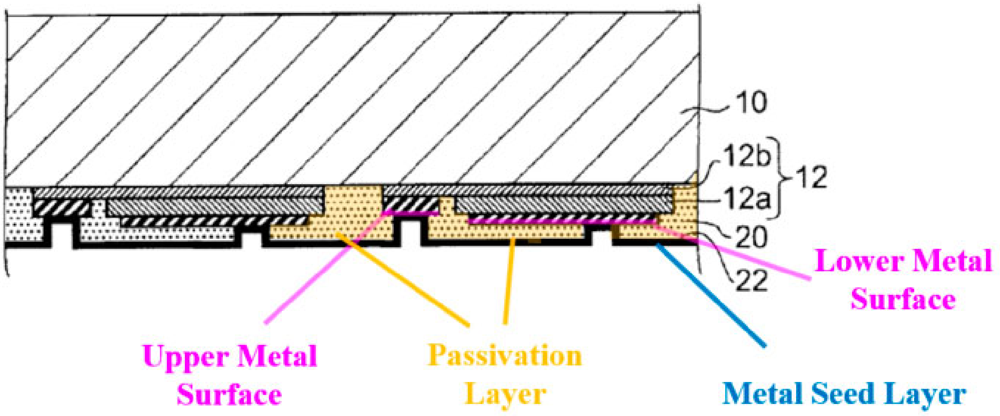
[9] For this proceeding, Requester assumes that the "lower second metal surface of said metallization layer" corresponds to the "lower metal surface" recited in claim 12. Requester, however, does not concede that claim 13 is not indefinite.

FIG. 3D



(Ex. PA-1, FIG. 3D (annotated); Ex. PA-DEC, ¶156.)

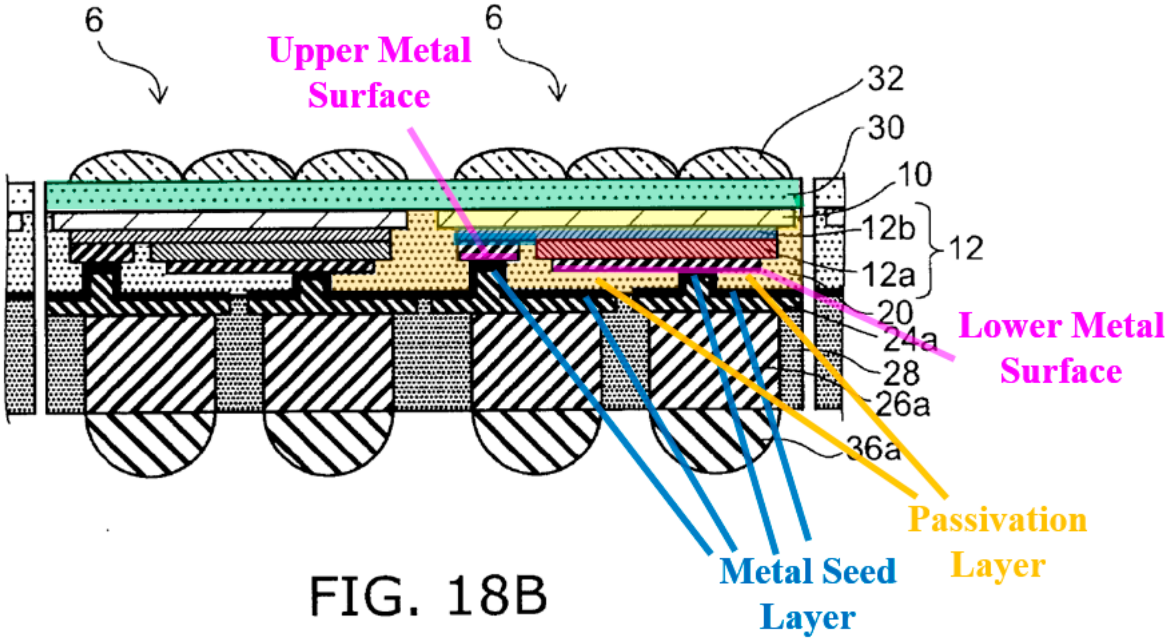


FIG. 18B

(Ex. PA-1, FIG. 18B (annotated); Ex. PA-DEC, ¶156.)

10. Claim 14

a. The method of claim 13 where said metal seed layer is comprised of a light reflecting material.

The Sugizaki-Hanaoka-Izumino combination discloses or suggests these features for the same reasons discussed above with respect to claim 11. (*See supra* Section VI.A.7; Ex. PA-DEC, ¶157.)

11. Claim 15

a. The method of claim 13, further comprising depositing a metal layer on said seed metal layer, said metal layer having a thickness of between about 10 microns and about 40 microns.

The Sugizaki-Hanaoka-Izumino combination discloses or suggests these features for the same reasons discussed above with respect to claim 10, where the metal layer is deposited by plating. (*See supra* Section VI.A.6; Ex. PA-DEC, ¶158.)

12. Claim 16

a. The method of claim 12, further comprising depositing an optically permissive cover substrate covering said optically permissive layer, said sapphire layer, and said LED.

The Sugizaki-Hanaoka-Izumino combination discloses or suggests these features. (Ex. PA-DEC, ¶159.) For example, as discussed above with respect to claim feature 1(f), Sugizaki discloses depositing a layer of "optically permissive" material and then imprinting the lens pattern on that layer of material. (*See* supra Section VI.A.2(f); Ex. PA-1, ¶¶[0075]-[0076], FIGs. 10A-10C; Ex. PA-DEC, ¶159.) As shown in the demonstrative below, the optically permissive cover substrate covers the optically permissive layer, the sapphire layer, and the LED. (Ex. PA-DEC, ¶159.)

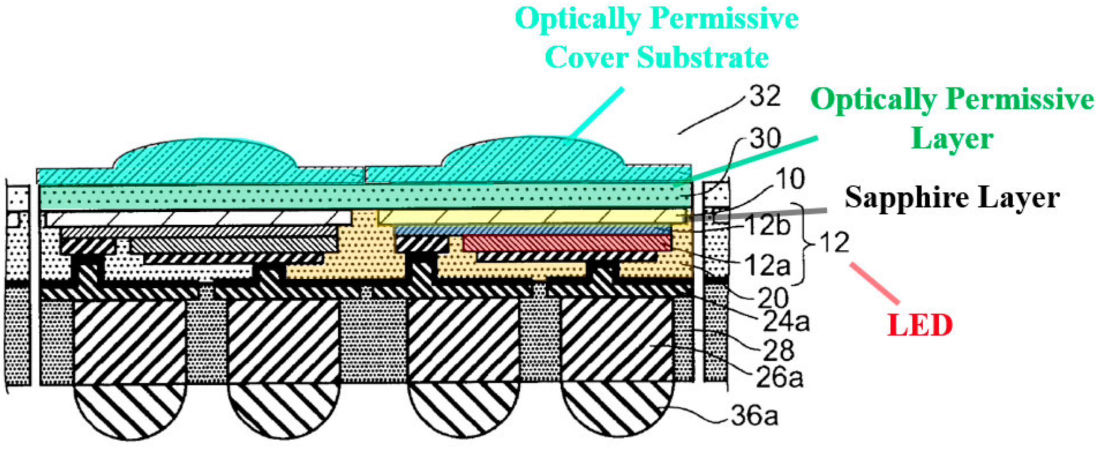


FIG. 18B

(Ex. PA-1, FIG. 18B (modified, annotated); Ex. PA-DEC, ¶159.)

As discussed above, under the Broadest Reasonable Interpretation, “depositing” would include various formation techniques where the optically permissive cover substrate is added to the LED structure. Such an understanding is consistent with the use of “depositing” in the context of the ’405 patent. For example, claim 16 of the ’405 patent recites “depositing an optically permissive cover substrate covering said optically permissive layer, said sapphire layer, and said LED.” (Ex. PAT-A, claim 16.) As disclosed by the ’405 patent, the cover substrate is attached to the LED body using an adhesive layer, thereby demonstrating the broad interpretation of “depositing.” (*Id.*, 5:24-29.)

B. SNQ2: Sugizaki in View of Hanaoka, Izumino, and Camras Discloses or Suggests Claims 2, 5, and 6

As explained below and in the attached declaration of Dr. Baker (Ex. PA-DEC), Sugizaki in view of Hanaoka, Izumino and Camras discloses or suggest the limitations of claims 2, 5, and 6 of the ’405 patent. (Ex. PA-DEC, ¶¶160-180.)

1. Claim 2

a. The light emitting device of claim 1, further comprising a lens covering at least a portion of said optically permissive cover substrate.

Sugizaki in view of Hanaoka, Izumino, and Camras discloses or suggests these features. (Ex. PA-DEC, ¶¶161-168.) As discussed above with respect to claim feature 1[f], Sugizaki discloses covering the LED structure with translucent material that includes a lens that constitutes an “optically permissive cover substrate.” (*See supra* Section VI.A.2(f).)

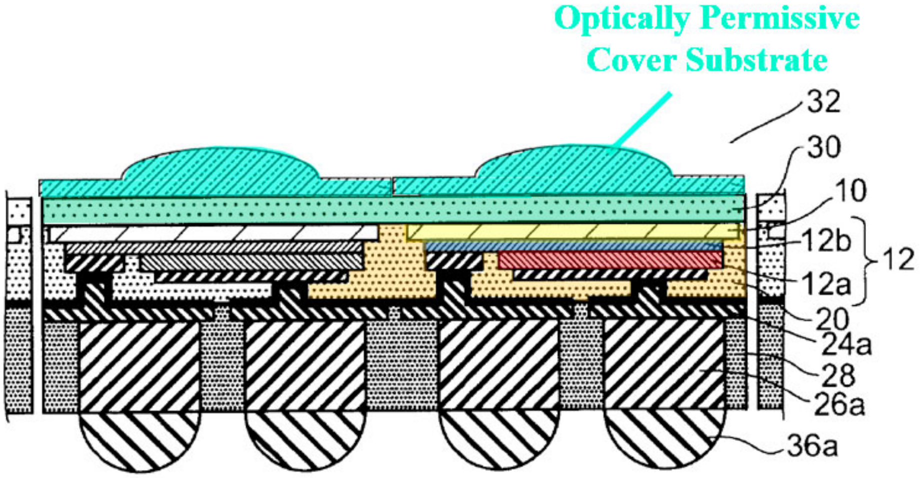
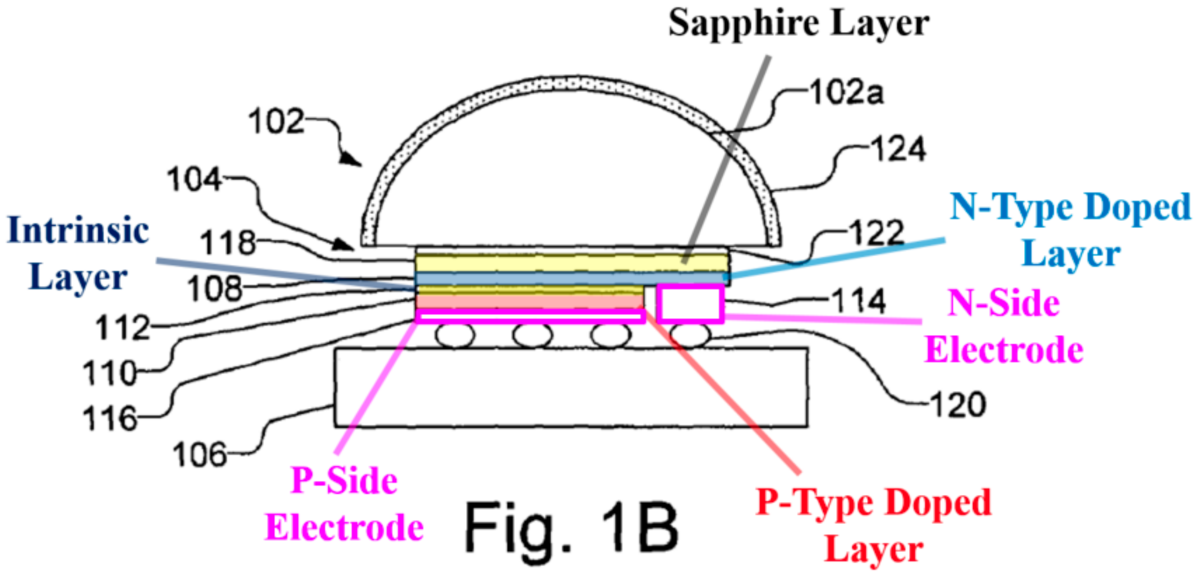


FIG. 18B

(Ex. PA-1, FIG. 18B (modified, annotated); Ex. PA-DEC, ¶161.)

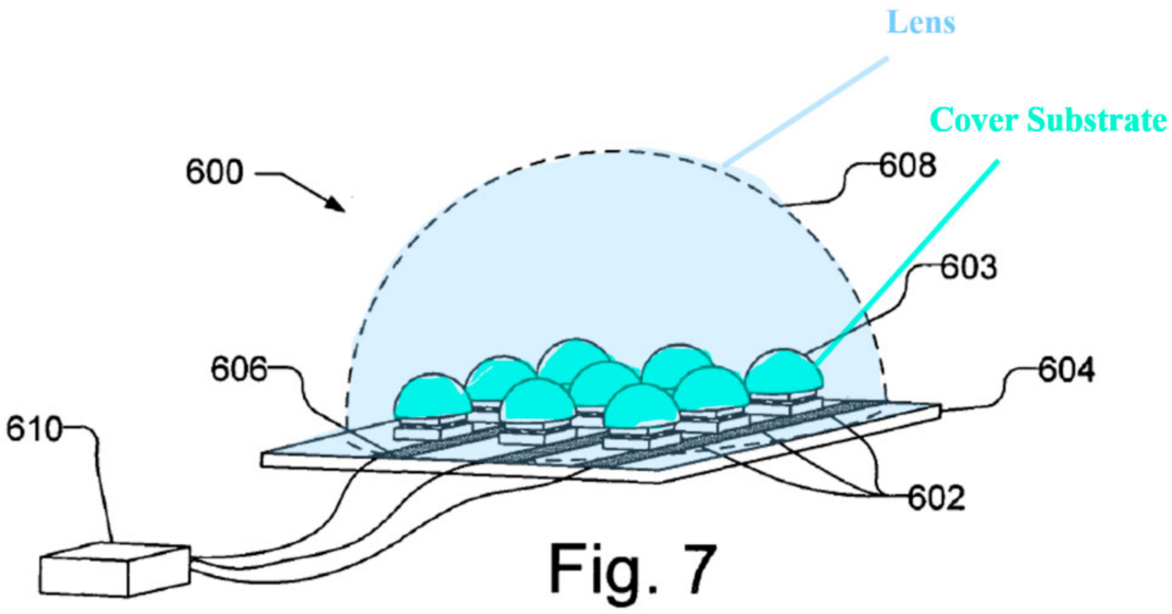
Sugizaki does not disclose a lens that covers at least a portion of the cover substrate illustrated in modified figure 18B above. Camras, however, discloses an embodiment where an array of LEDs, each of which includes a lens like that shown in modified figure 18B of Sugizaki above, are mounted on a board where an additional lens is formed over the group of LEDs. (Ex. PA-4, 9:11-51, FIG. 7; Ex. PA-DEC, ¶162.)

Camras, like Sugizaki, is directed to LED structures formed on a sapphire substrate that include an n-type layer, a p-type layer, and a light emitting active region. (Ex. PA-4, 2:27-32, 2:44-61.) Like Hanaoka and Izumino, Camras discloses that the light emitting active region of the LED is between p-type layer 110 and n-type layer 108 and includes intrinsic (undoped) material. (*Id.*, 2:44-54 ("active region 112 includes one or more semiconductor layers that are doped n-type or p-type or are undoped"); Ex. PA-DEC, ¶163.) Camras further discloses that "[a]ctive region 112 emits light upon application of a suitable voltage across contacts 114 and 116." (Ex. PA-4, 2:62-63.) Figure 1B of Camras, shown in annotated form below, illustrates an LED according to Camras, which is similar to the LED of the Sugizaki-Hanaoka-Izumino combination as it includes an intrinsic layer 112 between p-type layer 110 and n-type layer 108.



(Ex. PA-4, FIG. 1B (annotated); Ex. PA-DEC, ¶163.)

As shown in annotated figure 7 below, Camras discloses an array of LED devices mounted on a board. (Ex. PA-4, 2:9-10, 9:11-12.)



(Ex. PA-4, FIG. 7 (annotated); Ex. PA-DEC, ¶164.)

As disclosed by Camras, the LEDs in the array of LEDs shown in figure 7 include phosphor, where different LEDs in the array each produce white light with different correlated color temperatures (CCTs). (Ex. PA-4, 9:15-18.) Camras further discloses that "[b]y mixing the white light with different CCTs in array 600, a light with a desired CCT may be produced." (*Id.*) The mixing of the white light is accomplished by including a transparent element 608 ("lens" highlighted in annotated figure 7 above) made of, for example, glass, plastic, epoxy or silicone, where the "transparent element 608 may be filled, e.g., with epoxy or silicone, which assists the extracting and mixing of the light and to protect the LEDs 602." (*Id.*, 9:18-23; Ex. PA-DEC, ¶165.)

A POSITA would have looked to Camras for guidance regarding implementing LED devices as disclosed by Sugizaki, particularly because Camras and Sugizaki are references in the same field that disclose LED devices with many common features. (Ex. PA-DEC, ¶166.) Having looked to Camras, such a POSITA would have recognized that, just as is disclosed in figure 7 of Camras, the LED devices of the Sugizaki-Hanaoka-Izumino combination could be used in an array to generate white light. (*Id.*) Such a skilled person would have found it obvious to use, and been motivated to use, Sugizaki-Hanaoka-Izumino LED devices in such a device as it would have enhanced the utility of those LED devices and provided an additional application in which the Sugizaki-Hanaoka-Izumino LEDs could be used. (*Id.*) In such an embodiment, where the Sugizaki-Hanaoka-Izumino LEDs are used in an array like that disclosed in figure 7 of Camras, the inclusion of the additional lens covering the array of LEDs would promote the mixing of white light and further protection of the LEDs. (*Id.*) Such benefits, which are disclosed by Camras, would have been appreciated by a POSITA. (*Id.*)

Moreover, a POSITA would have had a reasonable expectation of success. (*Id.*, ¶167.) The LEDs of Camras, Hanaoka, Izumino, and Sugizaki are similar in many ways, and using LEDs of the Sugizaki-Hanaoka-Izumino combination in an array like in figure 7 of Camras would have been the simple substitution of one device (LEDs of the Sugizaki-Hanaoka-Izumino combination) for another similar device (Camras' LEDs shown in the array of figure 7) in a predictable manner to produce the expected result of an LED array with better white light production and improved protection for the LEDs. (*Id.*)

The lens over the array of Sugizaki-Hanaoka-Izumino LEDs, which covers the entirety of each of those LEDs, constitutes a "lens" that covers "at least a portion of said optically permissive substrate" for each LED as recited in claim 2. (*Id.*, ¶168.) Therefore, an LED device according to the Sugizaki-Hanaoka-Izumino-Camras combination, which includes an additional lens overlying an array of LEDs, discloses or suggests the features of claim 2. (*Id.*)

2. Claim 5

a. The light emitting device of claim 1, further comprising an optically permissive adhesive layer coupling said optically permissive layer and said sapphire layer.

The Sugizaki-Hanaoka-Izumino combination in further view of Camras discloses or suggests these features. (Ex. PA-DEC, ¶¶169-174.) Sugizaki does not explicitly disclose an optically permissive adhesive layer coupling the phosphor layer 30 ("optically permissive layer") to the sapphire layer 10, but Camras discloses using such an adhesive layer to bond a phosphor-containing layer to a sapphire substrate, and a POSITA would have found it obvious to include such an adhesive layer in an LED device according to the Sugizaki-Hanaoka-Izumino combination. (Ex. PA-DEC, ¶169.)

As shown in annotated figure 5 below, Camras discloses a layer of wavelength converting material 510 (e.g., a phosphor coating) ("optically permissive layer") bonded to the sapphire layer using a bonding layer 508. (Ex. PA-4, 7:64-65, 8:27-61; Ex. PA-DEC, ¶¶170-171.)

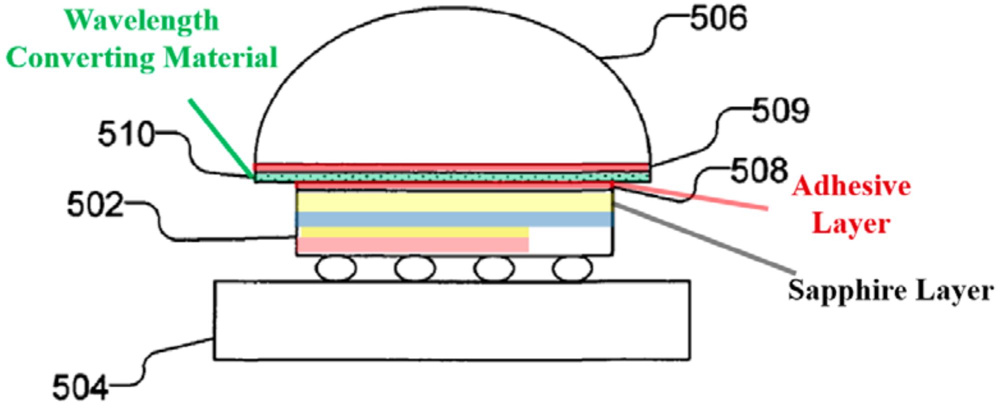


Fig. 5

(Ex. PA-4, FIG. 5 (annotated); Ex. PA-DEC, ¶171.)

For example, Camras discloses:

> In another implementation, the coating of wavelength converting material may be placed between the LED die and the optical element, e.g., within, over, or under the bonding layer 322. FIG. 5, by way of example, illustrates

> an LED die 502 mounted to a submount 504 and bonded to an optical element 506 via **bonding layer 508**, where a layer of wavelength converting material 510 is disposed between the bonding layer 508 and the optical element 506.

(Ex. PA-4, 8:31-38 (emphasis added).)

The bonding layer 508 is an "adhesive layer," as the bonding layer adheres the phosphor-containing wavelength converting layer 510 to the sapphire layer of the LED. (Ex. PA-DEC, ¶171.)

As discussed above for claim 2, a POSITA implementing an LED according to the Sugizaki-Hanaoka-Izumino combination would have had reason to consider the teachings of Camras as all of the references are concerned with implementing similar LED structures. (*Id.*, ¶172.) Having looked to Camras, a POSITA would have found it obvious to include an adhesive layer like the bonding layer 508 in the Sugizaki-Hanaoka-Izumino combination in order to enable independently formed materials to be used as the phosphor layer 30 shown in figure 18B of Sugizaki, where the phosphor layer is used to convert the wavelength of the light generated by the LED. (Ex. PA-1, ¶[0061]; Ex. PA-DEC, ¶172.) For example, Camras discloses wavelength converting material such as "phosphor impregnated glass or wavelength converted ceramic that is **formed independently** and then bonded to the LED die 502 and optical element 506." (Ex. PA-4, 8:42-45 (emphasis added).)

Using independently-formed wavelength converting materials, such as ceramics or glass that include phosphor, would have been desirable in some applications and would provide additional flexibility in terms of formation of the LED device of the Sugizaki-Hanaoka-Izumino combination. (Ex. PA-DEC, ¶173.) Indeed, a person of ordinary skill in the art would have recognized that using independently formed wavelength converting materials provides the additional benefit in that those materials can be tested prior to being attached to the LED so that defective wavelength conversion structures can be discarded, which can improve yields and reduce costs. (Ex. PA-9, ¶¶[0067]-[0068], [0073]; Ex. PA-DEC, ¶173.) Such a skilled person would have understood that an adhesive material, like the bonding layer 508 disclosed by Camras, would be used to bond such independently-formed wavelength converting materials to, for example, the sapphire layer in the Sugizaki-Hanaoka-Izumino combination, where such bonding and layer ordering is consistent with the disclosure of both Sugizaki and Camras. (Ex. PA-DEC, ¶173.) Indeed, using such a bonding layer to adhere an independently-fabricated layer including phosphor to the sapphire substrate would have been nothing more than the application of a known technique to a known device to achieve a predictable result. *KSR*, 550 U.S. at 416-18.

The adhesive layer used to bond the optically permissive layer to the sapphire layer would be "optically permissive" to allow the light generated by the LED to be emitted from the LED device. (Ex. PA-DEC, ¶174.) Moreover, Camras discloses bonding layers that are "optically permissive adhesive layers" as that term is used in the '405 patent, as Camras discloses bonding layers of epoxies and silicones. (Ex. PA-4, 4:27-53; Ex. PA-10, ¶[0044][10]; Ex. PAT-A, 5:8-10 ("The transparent adhesive layer 530 may be composed of silicone or some other suitable adhesive…."); Ex. PA-DEC, ¶174.) Therefore, the Sugizaki-Hanaoka-Izumino-Camras combination discloses or suggests the features of claim 5. (Ex. PA-DEC, ¶174.)

3. Claim 6

a. The light emitting device of claim 1, further comprising a mechanical offsetting member providing a dimensional spacing between said optically permissive layer and said optically permissive cover substrate.

The Sugizaki-Hanaoka-Izumino combination in further view of Camras discloses or suggests these limitations. (Ex. PA-DEC, ¶¶175-180.) Sugizaki does not explicitly disclose a mechanical offsetting member between the phosphor layer and the optically permissive substrate, but Camras discloses an adhesive layer, which constitutes a "mechanical offsetting member," between similar layers, and a POSITA would have found it obvious to include such a layer in the LED device of the Sugizaki-Hanaoka-Izumino combination. (Ex. PA-DEC, ¶175.)

As discussed above with respect to claim 5, Camras discloses embodiments where a wavelength converting material 510 is independently formed and then bonded to the sapphire layer using a bonding layer 508. (*See supra* Section VI.B.2; Ex. PA-4, 8:27-61.) Camras further discloses another bonding layer 509 that is used to bond the wavelength converting material 510 to the optical element 506. (Ex. PA-4, 8:38-42, 8:48-54; Ex. PA-DEC, ¶176.)

The bonding layer 509 ("mechanical offsetting member") between the wavelength converting layer 510 and the optical element 506 is shown in annotated figure 5 of Camras below. The bonding layer 509 constitutes a "mechanical offsetting member" as recited in claim

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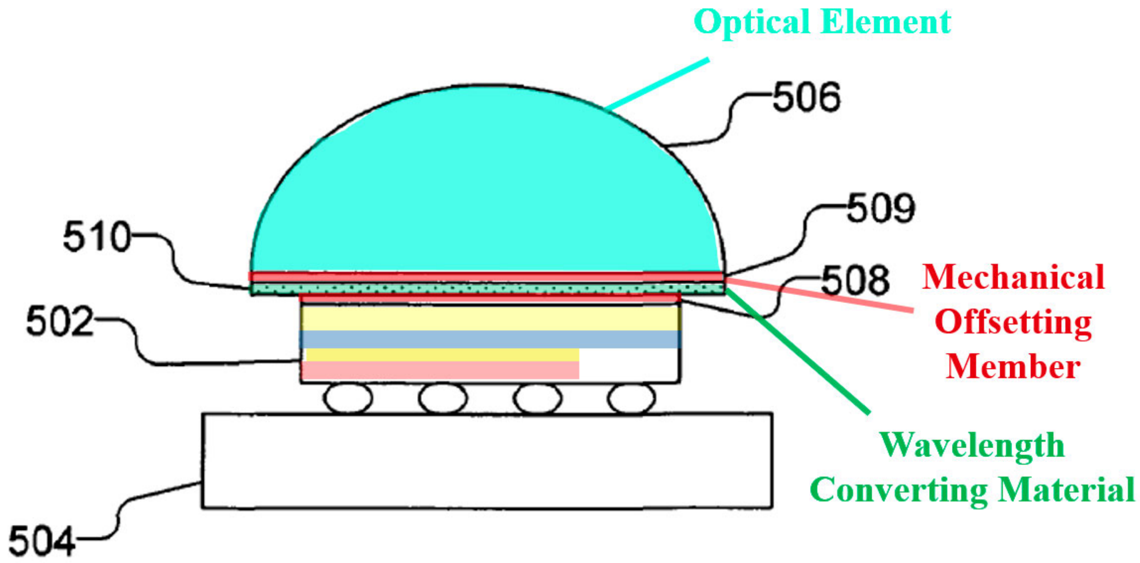
[10] Camras-194 is incorporated by reference by Camras. (Ex. PA-4, 4:61-65.)

6 as it lies between the cover substrate and the optically permissive layer, thereby providing a mechanical offset therebetween. (Ex. PA-DEC, ¶177.)



(Ex. PA-4, FIG. 5 (annotated); Ex. PA-DEC, ¶177.)

A POSITA would have found it obvious to include such a mechanical offsetting member in an LED device according to the Sugizaki-Hanaoka-Izumino combination in order to enable independently formed materials to be used as the phosphor layer 30 or the array lens 32 shown in figure 18B of Sugizaki, where the phosphor layer is used to convert the wavelength of the light generated by the LED and the array lens 32 is similar to the optical element 506 disclosed by Camras. (Ex. PA-1, ¶[0061]; Ex. PA-DEC, ¶178.)

For example, Camras discloses wavelength converting material such as "phosphor impregnated glass or wavelength converted ceramic that is **formed independently** and then bonded to the LED die 502 and optical element 506." (Ex. PA-4, 8:42-45.) Using independently formed wavelength converting materials, such as ceramics or glass that include phosphor, would have been desirable in some applications. (Ex. PA-DEC, ¶179.) Similarly, using an independently formed array lens would have been desirable in some applications. (*Id.*) Such a skilled person would have understood that a bonding material that provides a mechanical offset would be used to bond wavelength converting materials (the "optically permissive layer" in claim element 1[e]) to, for example, the cover substrate ("optically permissive cover substrate") in claim element 1[f]) in the Sugizaki-Hanaoka-Izumino-Camras combination, where such placement is consistent with the disclosure of both Sugizaki and Camras. (*Id.*) Indeed, using such a bonding layer to adhere one or more independently-fabricated layers would have been nothing more than the application of a known technique to a known device to achieve a predictable result. *KSR*, 550 U.S. at 416-18.

The mechanical offsetting layer used to bond the optically permissive layer to the cover substrate would also provide a dimensional spacing between the optically permissive layer and the optically permissive cover substrate. (Ex. PA-DEC, ¶180.) Camras discloses example bonding materials formed from glass or semiconductors that would provide separation ("dimensional spacing") between the layers as well as additional mechanical support. (Ex. PA-4, 4:27-53.) Indeed, during prosecution the Examiner recognized that a "mechanical offsetting member" can have any shape and is "not specific or limiting with respect to the shape, size, or material." (Ex. PAT-B, 118.)

Therefore, the Sugizaki-Hanaoka-Izumino-Camras combination discloses or suggests the features of claim 6. (Ex. PA-DEC, ¶180.)

C. SNQ3: Sugizaki in View of Hanaoka, Izumino, and Tanimoto Discloses or Suggests Claim 4

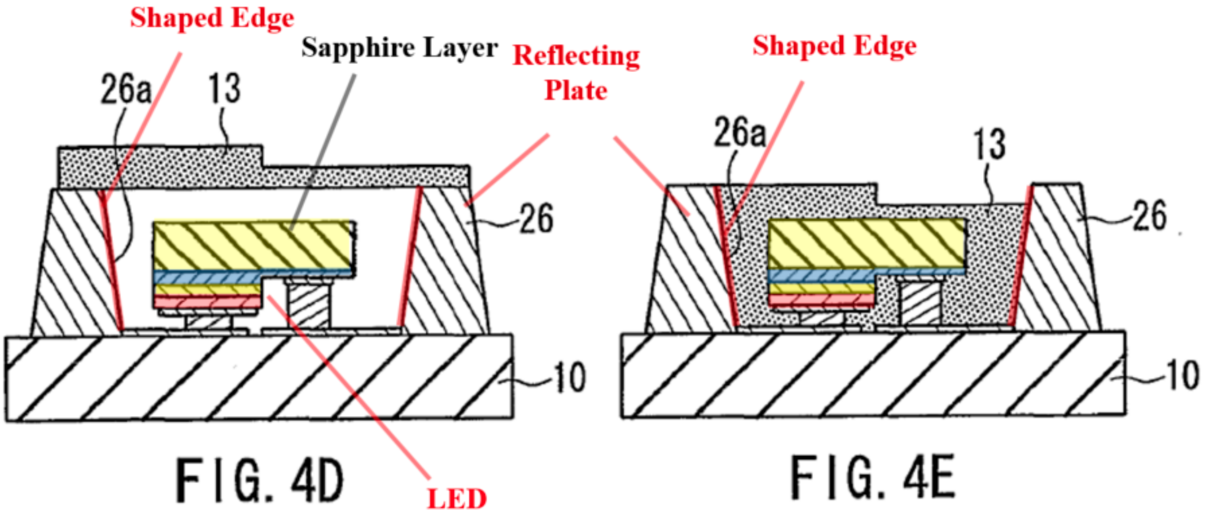
As explained below and in the attached declaration of Dr. Baker (Ex. PA-DEC), Sugizaki in view of Hanaoka, Izumino, and Tanimoto discloses or suggests the limitations of claim 4 of the '405 patent. (Ex. PA-DEC, ¶¶181-190.)

1. Claim 4

a. The light emitting device of claim 1, said passivation layer further comprising a shaped edge on a lateral portion of said passivation layer at least between said positively-doped surface and said first surface, said shaped edge configured to reflect light generated by said light emitting device outwardly therefrom.

Sugizaki in combination with the Hanaoka, Izumino, and Tanimoto discloses or suggests these features. (Ex. PA-DEC, ¶¶182-190.) As discussed above with respect to claim elements 1[g]-[i], the Sugizaki-Hanaoka-Izumino combination discloses or suggests a passivation layer as recited in claim 1. (*See supra* Sections VI.A.2(g)-(i).) However, none of Sugizaki, Hanaoka, and Izumino explicitly discloses a shaped edge on a lateral portion of the passivation layer to reflect light as recited in claim 4. But Tanimoto discloses such a feature, and a POSITA would have found it obvious to include such a shaped edge on the passivation layer of the Sugizaki-Hanaoka-Izumino combination. (Ex. PA-DEC, ¶182.)

Tanimoto, like Sugizaki, Hanaoka, and Izumino, is directed to LED devices formed using a plurality of semiconductor layers on a sapphire substrate, where a layer that includes phosphor is used to adjust the wavelength of the light emitted by the LED. (Ex. PA-5, ¶¶[0026], [0028], [0030]-[0031], [0048]; Ex. PA-DEC, ¶183.) For example, figures 4D and 4E of Tanimoto, reproduced in annotated form below, show such an LED device, where a reflecting plate with a shaped edge is provided. (Ex. PA-5, ¶¶[0059]-[0060].) Such a reflecting plate helps direct light generated by the LED outward from the LED (in a direction opposite the underlying substrate 10). (Ex. PA-DEC, ¶183.)



(Ex. PA-5, FIGs. 4D, 4E (annotated); Ex. PA-DEC, ¶183.)

Tanimoto further discloses that the area between the shaped edges of the reflecting plate can be hollow or filed with a phosphor layer. (Ex. PA-5, ¶¶[0059]-[0060].) In view of Tanimoto, a POSITA would have found it obvious to include a similarly configured reflecting plate in the LED of the Sugizaki-Hanaoka-Izumino combination in order to direct the light from the LED in the intended direction. (Ex. PA-DEC, ¶184.)

A POSITA would have looked to Tanimoto for guidance regarding implementing LED devices as disclosed or suggested by the Sugizaki-Hanaoka-Izumino combination, particularly because Sugizaki, Hanaoka, Izumino, and Tanimoto are all references in the same field that disclose LED devices with many common features. (Ex. PA-DEC, ¶185.) Having looked to

Tanimoto, such a person would have been motivated to include a reflecting plate in the LED of the Sugizaki-Hanaoka-Izumino combination. (*Id.*)

As discussed above with respect to the Sugizaki-Hanaoka-Izumino combination, a passivation layer surrounds various aspects of the LED structure. (*See supra* Sections VI.A.2(g)-(i).) Tanimoto discloses LED structures that include a reflecting plate on both sides of the LED structure, where the reflecting plate directs the light generated by the LED. (Ex. PA-5, ¶¶[0059]-[0060], FIGs. 4D, 4E.) A POSITA would have been motivated to use the reflecting plates as disclosed by Tanimoto in an LED device according to the Sugizaki-Hanaoka-Izumino combination because such reflecting plates facilitate the upward reflection of light to be emitted. (Ex. PA-DEC, ¶¶186-187.) Indeed, Sugizaki discloses that that portions of the p- and n-side electrodes can be formed of reflecting material in order to aid in directing the generated light upward, thereby confirming the desirability of such upward reflection. (Ex. PA-1, ¶[0049]; Ex. PA-DEC, ¶187.) Similarly, Izumino discloses reflective surfaces intended to direct light generated by the LED in the desired direction. (Ex. PA-3, ¶[0101], ¶[0101] ("In this aspect, the material of the p-side pedestal electrode and/or the electrode formed on the entire p-type semiconductor layer side should be a material that reflects the light emitted from the light emitting element toward the translucent substrate of the light emitting element."), ¶[0114] ("[S]ince the light emitted from the LED chip 103 is reflected by the diffusion electrode 211 of the entire surface and emitted from the direction of the sapphire substrate, the efficiency of light extraction from the flip chip mounted LED chip 103 can be improved.").)

A POSITA would have found it straightforward to use reflecting plates as disclosed by Tanimoto in an LED device according to the Sugizaki-Hanaoka-Izumino combination based on the person's knowledge and Tanimoto's disclosure as to how to implement such a feature in a similar device. (Ex. PA-DEC, ¶188.) Moreover, such skilled person would have had a reasonable expectation of success in using reflecting plates in an LED device according to the Sugizaki-Hanaoka-Izumino combination because, as demonstrated by Tanimoto, such reflecting plates and similarly shaped features used to direct light outward from LEDs were commonplace in the prior art. (Ex. PA-DEC, ¶188; Ex. PA-5, ¶¶[0059]-[0060]; *see also* Ex. PA-16, 5:27-38, 5:48-52 (describing an increase in "luminance efficiency" by reflective conductive traces and patterns).)

Indeed, including such reflecting plates in the LED of the Sugizaki-Hanaoka-Izumino combination would have been nothing more than applying a known feature (reflecting plates on both sides of the LED device as disclosed by Tanimoto) to a particular device (the LED of the Sugizaki-Hanaoka-Izumino combination) to achieve a predictable result (improved directionality of the light generated by the LED). (Ex. PA-DEC, ¶188.) *KSR*, 550 at 416. As discussed above, Sugizaki, Hanaoka, Izumino, and Tanimoto all describe LED devices for generating light, but Tanimoto describes reflecting plates not found in Sugizaki, Hanaoka, and Izumino for providing upward light reflection. Therefore, a POSITA would have recognized that Tanimoto's teachings relating to improved light output through the use of reflecting plates could have been applied to the Sugizaki-Hanaoka-Izumino LED in a similar way. *Id.* at 417.

A POSITA would also have been motivated to include such reflecting plates in the Sugizaki-Hanaoka-Izumino-Tanimoto combination such that the area inside the reflecting places is filled by the passivation layer discussed above with respect to claim element 1[g] having a tapered shape on both sides of the LED. (Ex. PA-DEC, ¶189.) The border of the area filled with the passivation layer would correspond to the area defined by the shaped edges of the reflecting plates shown in annotated figures 4D and 4E of Tanimoto above. (*Id.*) As such, the passivation layer would have included a "shaped edge on a lateral portion of said passivation layer at least between said positively-doped surface and said first surface" as recited in claim 4. (*Id.*)

Moreover, the shaped edges, which correspond to the reflecting plates on the sides of the LED device "are configured to reflect light generated by said light emitting device outwardly therefrom" as also recited in claim 4. (Ex. PA-DEC, ¶190.) Indeed, the use of reflecting plates in conjunction with the passivation layer is consistent with the disclosure of the '405 patent. (Ex. PAT-A, 6:33-38 ("FIG. 9 illustrates an exemplary LED device 90 having a shaped [and] **optionally mirrored or metalized passivation layer 970** to enhance the performance of the device. The passivation at the diode side can be patterned in a manner to provide for example optical reflectivity by angling or shaping the edges 975 of passivation layer 970.") (emphasis added).) Tanimoto similarly discloses that the reflecting plates "may be e.g., **metal having a high reflectance such as aluminum** or a ceramic material having a high reflectance such as alumina." (Ex. PA-5, ¶[0072] (emphasis added); Ex. PA-DEC, ¶190.) Therefore, the Sugizaki-Hanaoka-Izumino-Tanimoto combination discloses or suggests the features of claim 4. (*Id.*, ¶190.)

D. SNQ4: Sugizaki in view of Hanaoka, Izumino, and Tanaka Discloses or Suggests Claims 7 and 17

As explained below and in the attached declaration of Dr. Baker (Ex. PA-DEC), Sugizaki in view of Hanaoka, Izumino, and Tanaka discloses or suggests the limitations of claims 7 and 17 of the '405 patent. (Ex. PA-DEC, ¶¶191-200.)

1. Claim 7

a. The light emitting device of claim 1, further comprising at least one alignment mark indicative of a required position of said device with respect to said optically permissive cover substrate.

Sugizaki in combination with the Hanaoka, Izumino, and Tanaka discloses or suggests these features. (Ex. PA-DEC, ¶¶192-199.)[11] None of Sugizaki, Hanaoka, and Izumino explicitly discloses the use of alignment marks to position the LED with respect to the optically permissive cover substrate discussed above with respect to claim element 1[f] above. (*See supra* Section VI.A.2(f).) Tanaka, however, discloses such a feature, and a POSITA would have found it obvious to include such alignment marks in the LED device according to the Sugizaki-Hanaoka-Izumino combination. (Ex. PA-DEC, ¶192.)

Tanaka, like Sugizaki, is directed to LED devices formed using a plurality of semiconductor layers, where a lens is affixed to the LED device. (Ex. PA-6, ¶¶[0001], [0004]-[0006]; Ex. PA-DEC, ¶193.) For example, annotated figures 12 and 13 of Tanaka, reproduced below, show such an LED device, where "the rear face 72 of the glass substrate 1 is formed with lens part 72a for receiving the light emitted from the multilayer structure LS." (Ex. PA-6, ¶¶[0111]-[0112].)

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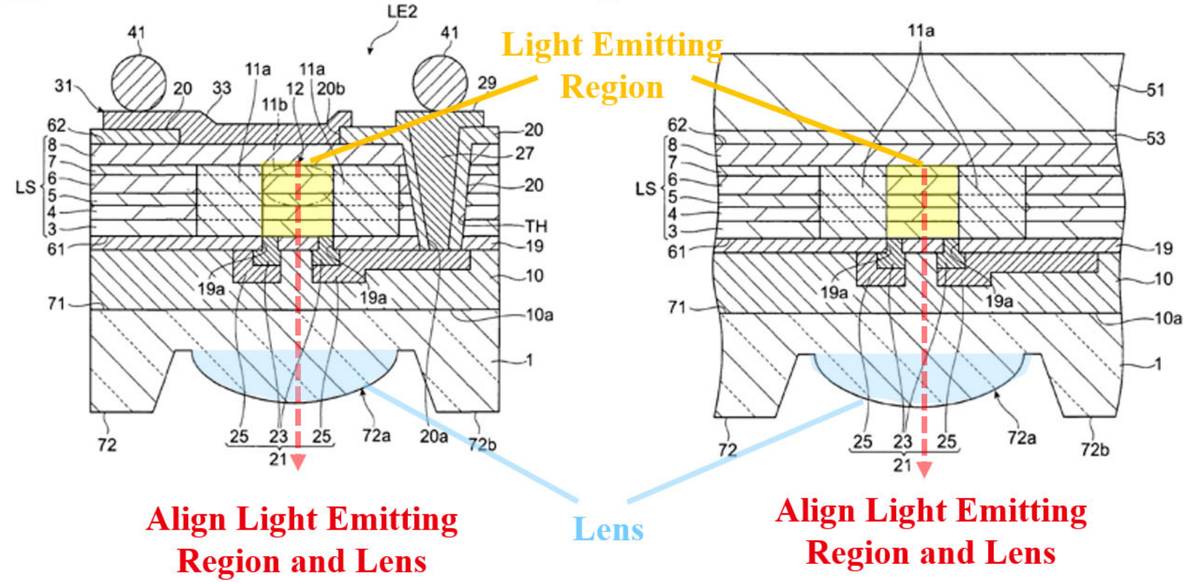
[11] For this proceeding, Requester assumes "said device" in claim 7 refers to the LED as the cover substrate is part of the claimed "device" recited in the preamble of claim 1. Requester does not concede that claim 7 is not indefinite.

Fig.12 **Fig.13**



(*Id*., FIGs. 12, 13 (annotated); Ex. PA-DEC, ¶193.)

Tanaka discloses that the glass substrate 1 is bonded to the semiconductor substrate, where, as described by Tanaka, the lens is aligned with the light emitting region of the LED using a marker. (Ex. PA-6, ¶¶[0115],[0116]; Ex. PA-DEC, ¶194.)

A POSITA would have looked to Tanaka for guidance regarding implementing LED devices as disclosed or suggested by the Sugizaki-Hanaoka-Izumino combination, particularly because Sugizaki, Hanaoka, Izumino, and Tanaka are all references in the same field that disclose LED devices with many common features. (Ex. PA-DEC, ¶195.) Having looked to Tanaka, such a person would have found it obvious to include an alignment mark in the LED device of the Sugizaki-Hanaoka-Izumino combination in order to allow an independently-formed substrate that includes a lens to be properly deposited in a position on the LED device such that the lens properly directs the light generated by the LED. (*Id*.)

As discussed above with respect to the Sugizaki-Hanaoka-Izumino combination, Sugizaki discloses an optically permissive cover substrate that includes a lens, where the cover substrate is positioned on the LED device in order to direct the light generated by the LED. (*See supra* Section VI.A.2(f).) Tanaka discloses LED structures that include multilayer bodies with a light emitting region, where an independently-formed lens is later affixed to the LED structure and a marker is used to ensure proper positioning of the lens with respect to the rest of the LED device. (Ex. PA-6, ¶¶[0115]-[0116]; Ex. PA-DEC, ¶196.) A POSITA would have found it obvious to use such an alignment mark, as disclosed by Tanaka, in conjunction with an LED device according to the Sugizaki-Hanaoka-Izumino combination. (Ex. PA-DEC, ¶196.)

A POSITA would have been motivated to use an alignment mark as disclosed by Tanaka because such an alignment mark would have allowed independently-formed substrates ("optically permissive cover substrates") that include lenses to be used with the LED devices of the Sugizaki-Hanaoka-Izumino combination while still ensuring proper relative placement of the lens with respect to the LED. (*Id.*, ¶197.) Indeed, Tanaka discloses that because the glass substrate 1 including the lens 72a "can be processed before bonding, the processing method is less restricted, which achieves a higher degree of freedom in designing the lenses in terms of lens forms and the like." (Ex. PA-6, ¶[0120]; Ex. PA-DEC, ¶197.)

A POSITA would have found it straightforward to use an alignment mark as disclosed by Tanaka in an LED device according to the Sugizaki-Hanaoka-Izumino combination as such alignment marks were commonplace in semiconductor manufacturing and often used to properly orient different layers and structures in such semiconductor devices. (Ex. PA-DEC, ¶198; *see also* Ex. PA-20, 1:33-35; Ex. PA-21 ¶¶[0005]-[0007].) Moreover, such a skilled person would have had a reasonable expectation of success in using an alignment mark in an LED device according to the Sugizaki-Hanaoka-Izumino combination because, as demonstrated by Tanaka, such alignment marks were known for use in aligning a lens with a light emitting region in LED devices. (Ex. PA-DEC, ¶199.) Indeed, doing so would have been nothing more than applying a known technique (including an alignment mark in the LED device as disclosed by Tanaka) to a particular device (the LED device of the Sugizaki-Hanaoka-Izumino combination) to achieve a predictable result (proper alignment of the LED and the overlying lens). (*Id.*) *KSR*, 550 at 416. Such an alignment mark is "indicative of a required position of said device with respect to said optically permissive cover substrate" as recited in claim 7. (Ex. PA-DEC, ¶199.)

2. Claim 17

a. The method of claim 16, further comprising placing one or more alignment marks on said LED so as to permit proper positioning of said LED with respect to an optically permissive cover substrate.

Sugizaki in combination with the Hanaoka, Izumino, and Tanaka discloses or suggests these features. (Ex. PA-DEC, ¶200.) As discussed above with respect to claim 7, a POSITA would have found it obvious to include an alignment mark in the LED device of the Sugizaki-

Hanaoka-Izumino-Tanaka combination in order to allow a lens to be properly positioned with respect to the light emitting portion of the LED. (*Supra* Section VI.E.1.) A POSITA would have understood that such alignment marks could be placed on any one or more of the cover substrate, lens, and LED, in order to provide proper alignment of the structures. (Ex. PA-DEC, ¶200.) Indeed, Tanaka discloses using a "double-sided aligner" thereby suggesting that marks on both the LED and cover substrate are aligned with each other. (*Id.*; Ex. PA-6, ¶[0116]) Therefore, the Sugizaki-Hanaoka-Izumino-Tanaka combination discloses or suggests the features of claim 17. (Ex. PA-DEC, ¶200.)

E. SNQ5: Sugizaki in View of Hanaoka, Izumino, and Chakraborty Discloses or Suggests Claims 1-3 and 8-16

1. Claims 1, 3, and 8-16

Relevant to SNQ5, the analysis set forth above for claims 1 and 16 explains how the Sugizaki discloses or suggests depositing an "optically permissive cover substrate" that overlies and therefore "covers" the optically permissive layer, the sapphire layer, and the LED. (*See supra* Sections VI.A.2(f), VI.A.12.) Specifically, Sugizaki discloses or suggests a lens, which constitutes "an optically permissive cover substrate." (*Id.*)

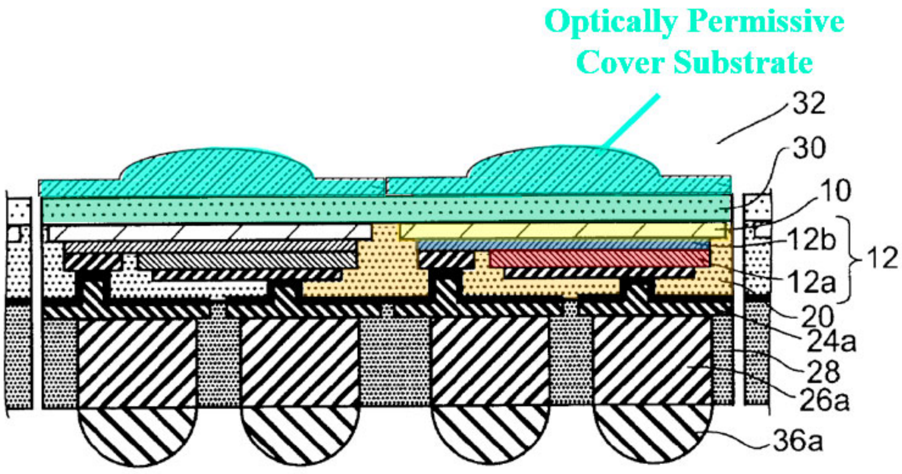


FIG. 18B

(Ex. PA-1, FIG. 18B (modified, annotated); Ex. PA-DEC, ¶201.)

In IPR proceedings, Patent Owner argued that because claim 2 of the '405 patent recites a "lens" separately from the "optically permissive cover substrate," the spin-on glass of Sugizaki that has an upper lens shape and lower planar layer is not an "optically permissive cover substrate."

(IPR2021-01491 (Paper 6), 39-40.) As noted above for claim 1, such an argument conflicts with the broadest reasonable interpretation of this claim element, as evidenced by the Examiner's assertions during prosecution as well as Patent Owner's allegations in litigation. Moreover, even if Patent Owner's argument that the spin on glass that includes a portion formed in a lens shape is not an "optically permissive cover substrate" is given consideration, including an additional layer or layers that are not part of a "lens," and which would constitute an "optically permissive cover substrate" as claimed, would have been obvious in view of the teachings of Chakraborty. (Ex. PA-DEC, ¶¶202-208.)

Chakraborty, like Sugizaki, is related to light emitting devices that include phosphor-containing structures that convert the wavelength of the light generated. (Ex. PA-9, Title ("Light Emitting Devices with High Efficiency Phosp[hor] Structures."), ¶[0001] ("This invention relates to solid state light emitting devices a fabrication methods therefore, and more particularly, to wavelength conversion structures used in solid state light emitting devices.").) As shown in annotated figure 6C of Chakraborty below, an LED device includes an LED chip 200 that is bonded to a wavelength conversion layer 220 that includes phosphor, where a graded index layer 230 and a light scattering layer 235 are positioned between the phosphor layer 220 and a lens 240. (*Id.*, ¶¶[0083]. [0084], FIG. 6C; Ex. PA-DEC, ¶203.)

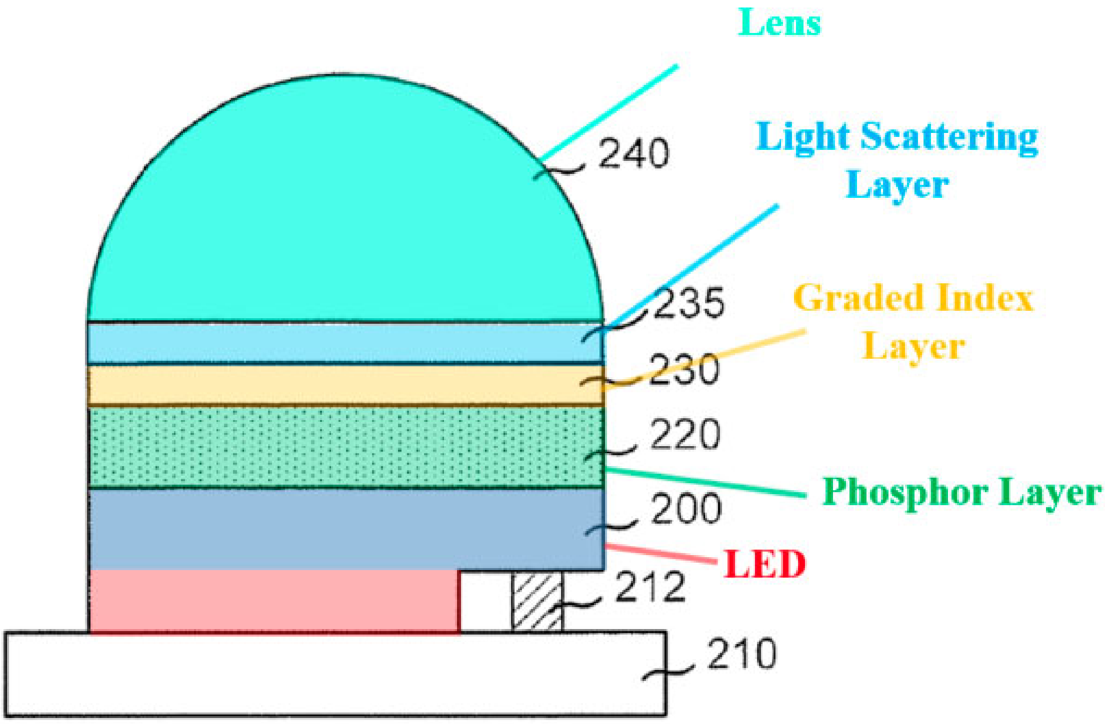


FIGURE 6C

(*Id.*, FIG. 6C (annotated); Ex. PA-DEC, ¶203.)

Chakraborty discloses that optical elements such as the graded index layer 230, light scattering layer 235, and lens 240 can be used in the LED device in addition to the phosphor-containing wavelength conversion structure in order to modify the light emitted by the device. (Ex. PA-DEC, ¶204.) For example, Chakraborty discloses:

> Many other optical elements may be provided in combination with a wavelength conversion structure, according to various embodiments of the present invention. In general, an optical element may be configured to modify at least some of the light that is emitted from the solid state light emitting die by changing its amplitude, frequency and/or direction. These optical elements may include an additional wavelength conversion structure including polycrystalline phosphor particles, an optical refracting element such as a lens, an optical filtering element such as a color filter, an optical scattering element such as optical scattering particles, an optical diffusing element such as a textured surface and/or an optical reflecting element such as a reflective surface, that is included in an/or on the single crystal

> phosphor wavelength conversion structure. Combinations of these and/or other embodiments may be provided.

(Ex. PA-9, ¶[0089].)

It would have been obvious to form an LED as disclosed by Sugizaki in which one or more additional optical elements are included between the phosphor layer and the spin on glass that is formed in the shape of a lens, where the one or more additional optical elements constitutes an "optically permissive cover substrate" as recited in claims 1 and 16. (Ex. PA-DEC, ¶205.) Based on Chakraborty's teachings, a POSITA would have had good reason to implement Sugizaki's LED structure such that one or more such additional optical elements, similar to the optical filtering element, optical scattering element, optical reflective element, optical diffusing element, and lens disclosed by Chakraborty, are included in the LED, because, for example, such a configuration would allowed Sugizaki's LED to efficiently filter, scatter, diffuse, or guide the light output by the device. (*Id.*, ¶205.)

Indeed, the applicability of Chakraborty's teachings to other LED devices was recognized during prosecution of the '405 patent:

> Chakraborty teaches additional details related to packaging an LED (see Figs. 6A-6C and 8A-9), with an optically permissive cover substrate. An optically permissive cover substrate may be met by any one of layers 230, 235, 240, 420, 424, 425, 430, 520, or even combinations thereof, e.g. 230+235 or 235+240, or 420+425, etc. since these layers are optically permissive and cover at least a portion of the above recited LED components.
>
> It would have been obvious to one of ordinary skill in the art at the time of the invention to apply the teachings of Chakraborty to the teachings of Yoo to package the LED using additional elements for light extraction efficiency. . . . it would be obvious for a skilled artisan to look to related art to provide details for packaging an LED, especially for improved light extraction and efficiency as taught by Chakraborty. The additional optically permissive cover substrates are advantageously employed in these configurations to efficiently convert, scatter and guide the light out of the device. A skilled artisan would look to related LED art to determine how the LED may be packaged in different configurations to facilitate light extraction while providing protection for the device and Chakraborty teaches several embodiments to illustrate package configurations, numerous configurations including layers that meet the limitation of an optically permissive cover substrate and Chakraborty further discloses the embodiments may be used in combination and subcombinations as well

> (paragraph [0103]). Chakraborty teaches the versatility of these packaging structures showing that additional elements (e.g. WL conversion material, a lens, graded layer, etc) can be formed directly on an LED, e.g. Fig. 6, or as a part of the package, e.g. Fig. 8. Based on the disclosure of Chakraborty, these package configurations show how the elements may be effectively combined and these configurations would be known to a skilled artisan.

(Ex. PAT-B, 99-100.) Notably, Applicant did not contest the Examiner's findings with respect to the disclosure of Chakraborty or how Chakraborty's teachings were applicable to Yoo.

As a POSITA would have appreciated, the inclusion of such additional optical elements would have represented the application of a known element (Chakraborty's additional optical elements) to similar structure (Sugizaki's LED) to obtain a predictable result (an LED with additional light processing capabilities). (Ex. PA-DEC, ¶206.) Indeed, "when a patent simply arranges old elements with each performing the same function it had been known to perform and yields no more than one would expect from such an arrangement, the combination is obvious." *KSR*, 550 at 417.

A POSITA would have had a reasonable expectation of success in modifying Sugizaki based on the teachings of Chakraborty, at least because Chakraborty discloses how to include such additional optical elements in an LED device similar to that of Sugizaki. (Ex. PA-DEC, ¶206.) Modifying Sugizaki as discussed above would have involved no more than an application of known technologies (e.g., including additional optical elements as described in Chakraborty) according to known methods (e.g., conventional LED manufacturing techniques, like those described in Sugizaki and Chakraborty) to yield the predictable result of an LED that includes one or more additional optical elements and has expanded light processing capabilities. (*Id.*) *See KSR*, 550 U.S. at 416. Annotated figure 18B of Sugizaki below has been modified to include such an additional optical element ("cover substrate") positioned between the phosphor layer 30 and the spin on glass that includes a lens shape.

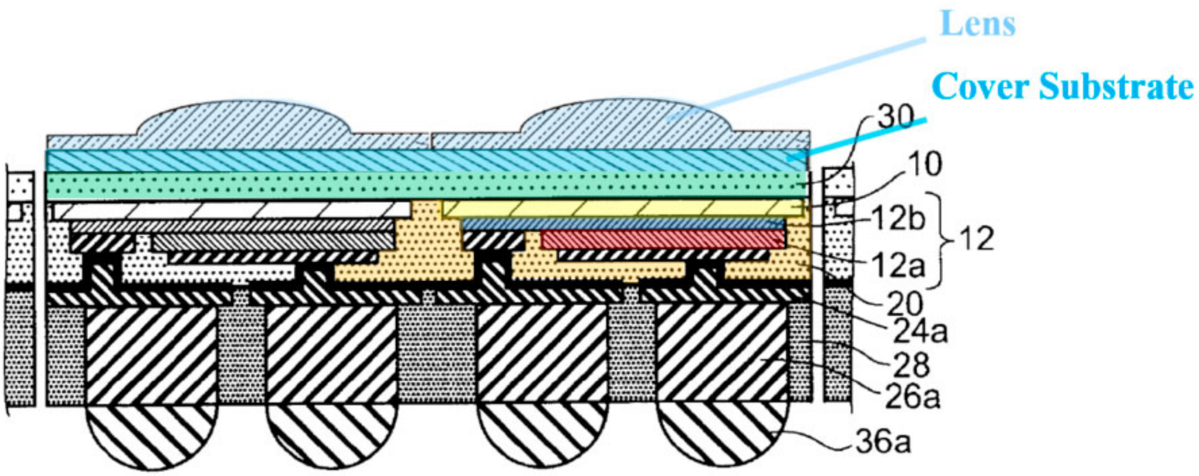


FIG. 18B

(Ex. PA-1, FIG. 18B (modified, annotated); Ex. PA-DEC, ¶207.)

The Sugizaki-Han-Izumino-Chakraborty combination discloses or suggests the remaining features of claims 1, 3, and 8-16 as set forth in Section VI.A. (Ex. PA-DEC, ¶208; *see supra* Section VI.A.)

2. Claim 2

a. The light emitting device of claim 1, further comprising a lens covering at least a portion of said optically permissive cover substrate.

Sugizaki-Han-Izumino-Chakraborty combination discloses or suggests these features. (Ex. PA-DEC, ¶209.) As discussed above for claims 1, 3, and 8-16, the Sugizaki-Han-Izumino-Chakraborty combination discloses or suggests including an additional optical element ("optically permissive cover substrate") positioned between the phosphor layer 30 and the spin on glass that includes a lens shape. (*Supra* Section VI.E.1.) As shown in annotated figure 18 of Sugizaki that is modified according to the Sugizaki-Han-Izumino-Chakraborty combination discussed above, the spin on glass that includes a lens shape ("lens") covers at least a portion of the optically permissive cover substrate. (Ex. PA-DEC, ¶209.)

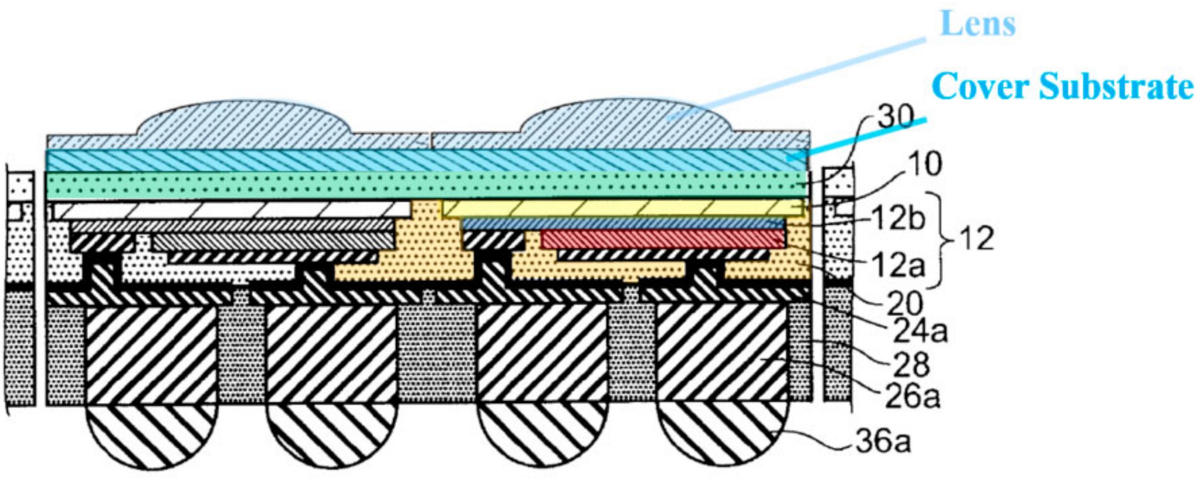


FIG. 18B

(Ex. PA-1, FIG. 18B (modified, annotated); Ex. PA-DEC, ¶209.)

F. SNQ6: Sugizaki in View of Hanaoka, Izumino, Chakraborty, and Camras Discloses or Suggests Claims 2, 5, and 6

Sugizaki in view of Hanaoka, Izumino, Chakraborty, and Camras discloses or suggests the limitations of claims 2, 5, and 6 of the ’405 patent for substantially the same reasons discussed above in Section VI.B, where, in the combination for SNQ6, the “optically permissive cover substrate” is an additional optical element included in the LED structure as disclosed by Chakraborty and discussed above in Section VI.E.1. (*See supra* Sections VI.B, VI.E.1; Ex. PA-DEC, ¶210.) Including an additional optical element as disclosed by Chakraborty does not detract from the relied upon disclosures in Section VI.B.

G. SNQ7: Sugizaki in View of Hanaoka, Izumino, Chakraborty, and Tanimoto Discloses or Suggests Claim 4

Sugizaki in view of Hanaoka, Izumino, Chakraborty, and Tanimoto discloses or suggests the limitations of claim 4 of the ’405 patent for substantially the same reasons discussed above in Section VI.C, where, in the combination for SNQ7, the “optically permissive cover substrate” is an additional optical element included in the LED structure as disclosed by Chakraborty and discussed above in Section VI.E.1. (*See supra* Sections VI.C, VI.E.1; Ex. PA-DEC, ¶211.) Including an additional optical element as disclosed by Chakraborty does not detract from the relied upon disclosures in Section VI.C.

H. SNQ8: Sugizaki in View of Hanaoka, Izumino, Chakraborty, and Tanaka Discloses or Suggests Claims 7 and 17

Sugizaki in view of Hanaoka, Izumino, Chakraborty, and Tanaka discloses or suggests the limitations of claims 7 and 17 of the '405 patent for substantially the same reasons discussed above in Section VI.D, where, in the combination for SNQ8, the "optically permissive cover substrate" is an additional optical element included in the LED structure as disclosed by Chakraborty and discussed above in Section VI.E.1. (*See supra* Sections VI.D, VI.E.1; Ex. PA-DEC, ¶212.) Including an additional optical element as disclosed by Chakraborty does not detract from the relied upon disclosures in Section VI.D. A POSITA would have recognized that alignment marks, such as those disclosed by Tanaka, would be useful for ensuring proper placement of the additional optical element ("optically permissive cover substrate") in the Sugizaki-Hanaoka-Izumino-Chakraborty-Tanaka combination in the same manner as for the lens structure discussed as the "optically permissive cover substrate" in the Sugizaki-Hanaoka-Izumino-Tanaka combination in Section VI.D above.

I. SNQ9: Sugizaki in View of Han and Izumino Discloses or Suggests Claims 1-3 and 8-16

Relevant to SNQ9, the analysis set forth above for claims 1 and 12 explains how the combination of Hanaoka with Sugizaki discloses or suggests forming an LED as disclosed by Sugizaki in which an undoped layer ("intrinsic region/layer") is included between the positively-doped (p-type) and negatively-doped (n-type) regions/layers. (*See supra* Section VI.A.2(b), VI.A.8(b).) Specifically, Hanaoka discloses using such an intrinsic region/layer in an LED device and explains that the inclusion of such a region/layer as the active layer can extend the life of the LED device (Ex. PA-2, ¶[0034]; Ex. PAT-E, Order Granting Request for Ex Parte Reexamination for Control No. 90/015,092, 9), and a POSITA would have found it obvious to include such an intrinsic region/layer as between the positively- and negatively-doped layers in Sugizaki's LED device. To the extent it is argued that the combination of Hanaoka and Sugizaki does not disclose or suggest "an intrinsic region/layer" as claimed, the inclusion of such an intrinsic region/layer in the LED of Sugizaki would have been obvious in view of Han. (Ex. PA-DEC, ¶¶213-220.)

As discussed above, conventional LEDs of the time comprised an undoped active layer. (Ex. PA-DEC, ¶214.) For example, gallium nitride (GaN) LEDs were well understood and "predominantly expected to replace existing light sources such as incandescent lamps, fluorescent lamps and mercury lamps." (Ex. PA-17, ¶[0002].) The typical GaN LED included an "undoped

InGaN (an active layer . . .)" that was sandwiched between an n-type and a p-type layer. (*Id.*, ¶[0002], FIGs. 1-2.)

Han discloses one such conventional LED comprising an undoped active layer ("intrinsic region"). (Ex. PA-DEC, ¶215.) For instance, Han discloses a "conventional . . . nitride semiconductor LED." (Ex. PA-7, ¶[0007].) The conventional LED "includes . . . an n-type GaN layer-based clad layer 14, an active layer 16, and a p-type GaN layer-based clad layer" that are sequentially deposited on a substrate. (*Id.*, ¶[0007], FIG. 1.)

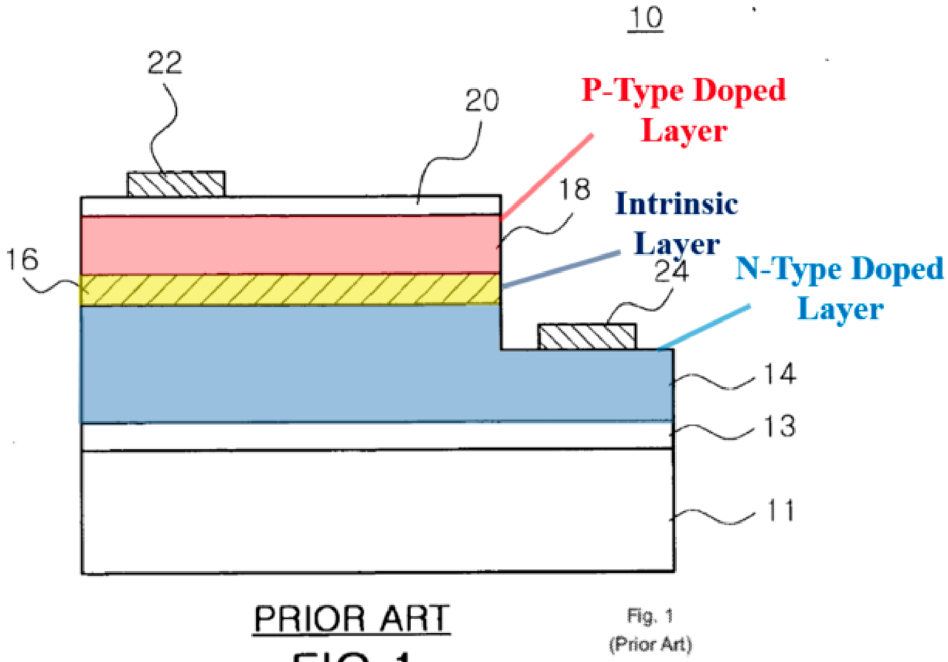


FIG.1

(*Id.*, FIG. 1 (annotated); Ex. PA-DEC, ¶215.)

To enhance light emitting efficiency, Han discloses that the active layer may be "formed of a multiple quantum well structure including an undoped GaN layer barrier layer and an undoped InGaN layer well layer." (*Id.*, ¶[0007].) Such an undoped active layer, often referred to as an "intrinsic" region (Ex. PA-DEC, ¶216; *see, e.g.*, PA-11, ¶[0004]), was well understood in the art. (Ex. PA-DEC, ¶216; *see*, e.g., Ex. PA-12, ¶[0004], ¶[0007] ("an undoped active layer . . . . The active layer 5 may have a multiple quantum well structure in which a plurality of GaN quantum barrier layers and a plurality of InGaN quantum well layers are alternately laminated"); Ex. PA-13, 1:14-45; Ex. PA-22, Abstract, ¶[0054]; Ex. PA-14, ¶[0028]; Ex. PA-2, ¶[0033] ("As illustrated in FIG. 9, the active layer 105 has a multiple quantum well structure in which an undoped

$\mathrm{In}_{0.1}5\mathrm{Ga}_{0.8}5\mathrm{N}$ well layer (thickness: 4 nm) and an undoped $\mathrm{In}_{0.2}\mathrm{Ga}_{0.9}8\mathrm{N}$ barrier layer (thickness: 8 nm) are formed in the order of a barrier layer, a well layer, a barrier layer, a well layer, a barrier layer, a well layer, and a barrier layer on then-type GaN light guide layer 104.”).) Therefore, Han discloses an LED with an intrinsic region/layer between the positively- and negatively-doped regions/layers. (Ex. PA-DEC, ¶216.)

It would have been obvious to form an LED as disclosed by Sugizaki such that an undoped layer (“intrinsic region”) is included between positively-doped (p-type) and negatively-doped (n-type) regions, like taught by Han and understood in the art. (*Id.*, ¶217.) Based on Han’s teachings, a POSITA would have had good reason to implement Sugizaki’s LED structure such that the light emitting layer is an undoped active region positioned between the p-type and n-type layers, similar to as taught by Han, because, for example, such a configuration would have improved the efficiency of Sugizaki’s LED. (Ex. PA-7, ¶[0007] (describing efficiency benefits associated with an LED that comprises an undoped, multiple quantum well structure); Ex. PA-13, 1:14-33 (same); Ex. PA-DEC, ¶__.) Additionally, “if [an] active layer is doped with impurities, [a] light emitting element is likely to be deteriorated” more quickly over time as compared to a light emitting element with an undoped active layer. (Ex. PA-2, ¶[0034]; Ex. PA-DEC, ¶217.) Including Han’s active layer comprising undoped barrier and well layers in the Sugizaki LED structure would have also “extend[ed] the life” and improved the reliability of the structure. (Ex. PA-2, ¶¶[0034], [0007], Abstract; Ex. PA-DEC, ¶217.)

As a POSITA would have appreciated, such a substitution of different types of active (light emitting) layers would have represented a simple substitution of one known element for another to obtain a predictable result, especially here, where Sugizaki explicitly contemplates that the use of different multilayer structures being used in the LED. (Ex. PA-1, ¶[0104]; Ex. PA-DEC, ¶218.) Indeed, “when a patent simply arranges old elements with each performing the same function it had been known to perform and yields no more than one would expect from such an arrangement, the combination is obvious.” *KSR*, 550 at 417. Furthermore, the modification would have been obvious to try. (Ex. PA-DEC, ¶218.) A POSITA would have appreciated that the light-emitting active layer could have been doped or undoped. (*Id.*) Implementing the Sugizaki light emitting layer as an undoped, intrinsic layer, as taught by Han and others, would have been an obvious choice. (*Id.*)

A POSITA would have had a reasonable expectation of success in modifying Sugizaki based on the teachings of Han, at least because the LED configuration was well understood in the art. (*See, e.g.*, Ex. PA-12, ¶[0004], ¶[0007]; Ex. PA-13, 1:14-33 (same); Ex. PA-7, ¶[0007]; Ex. PA-14, Abstract, ¶[0054]; Ex. PA-15, ¶[0028]; Ex. PA-DEC, ¶219.) Modifying Sugizaki as discussed above would have involved no more than an application of known technologies (e.g., the LED structure described in Sugizaki and the active region described in Han) according to known methods (e.g., conventional LED manufacturing techniques, like those described in Sugizaki and Han) to yield the predictable result of an LED that includes an undoped active layer and has greater efficiency. (Ex. PA-DEC, ¶219.) *See KSR*, 550 U.S. at 416.

The Sugizaki-Han-Izumino combination discloses or suggests the remaining features of claims 1, 3, and 8-16 as set forth in the preceding sections. (*See supra* Section VI.A.) Using Han, instead of Hanaoka, in combination with Sugizaki and Izumino does not detract from the relied upon disclosures in Section VI.A. (Ex. PA-DEC, ¶220.)

J. SNQ10: Sugizaki in View of Han, Izumino, and Camras Discloses or Suggests Claims 2, 5, and 6

Sugizaki in view of Han, Izumino, and Camras discloses or suggests the limitations of claims 2, 5, and 6 of the ’405 patent for substantially the same reasons discussed above in Section VI.B. Using Han, instead of Hanaoka, in combination with Sugizaki, Izumino, and Camras does not detract from the relied upon disclosures in Section VI.B. (*See supra* Section VI.B; Ex. PA-DEC, ¶221.)

K. SNQ11: Sugizaki in View of Han, Izumino, and Tanimoto Discloses or Suggests Claim 4

Sugizaki in view of Han, Izumino, and Tanimoto discloses or suggests the limitations of claim 4 of the ’405 patent for substantially the same reasons discussed above in Section VI.C. Using Han, instead of Hanaoka, in combination with Sugizaki, Izumino, and Tanimoto does not detract from the relied upon disclosures in Section VI.C. (*See supra* Section VI.C; Ex. PA-DEC, ¶222.)

L. SNQ12: Sugizaki in View of Han, Izumino, and Tanaka Discloses or Suggests Claims 7 and 17

Sugizaki in view of Han, Izumino, and Tanaka discloses or suggests the limitations of claims 7 and 17 of the ’405 patent for substantially the same reasons discussed above in Section VI.D. Using Han, instead of Hanaoka, in combination with Sugizaki, Izumino, and Tanaka does not detract from the relied upon disclosures in Section VI.D. (*See supra* Section VI.D; Ex. PA-DEC, ¶223.)

M. SNQ13: Sugizaki in View of Han, Izumino, and Chakraborty Discloses or Suggests Claims 1-3 and 8-16

Sugizaki in view of Han, Izumino, and Chakraborty discloses or suggests the limitations of claims 1-3 and 8-16 of the ’405 patent for substantially the same reasons discussed above in Section VI.E. Using Han, instead of Hanaoka, in combination with Sugizaki, Izumino, and Chakraborty does not detract from the relied upon disclosures in Section VI.E. (*See supra* Section VI.E; Ex. PA-DEC, ¶224.)

N. SNQ14: Sugizaki in View of Han, Izumino, Chakraborty, and Camras Discloses or Suggests Claims 2, 5, and 6

Sugizaki in view of Han, Izumino, Chakraborty, and Camras discloses or suggests the limitations of claims 2, 5, and 6 of the ’405 patent for substantially the same reasons discussed above in Section VI.F. Using Han, instead of Hanaoka, in combination with Sugizaki, Izumino, Chakraborty, and Camras does not detract from the relied upon disclosures in Section VI.F. (*See supra* Section VI.F; Ex. PA-DEC, ¶225.)

O. SNQ15: Sugizaki in View of Han, Izumino, Chakraborty, and Tanimoto Discloses or Suggests Claim 4

Sugizaki in view of Han, Izumino, Chakraborty, and Tanimoto discloses or suggests the limitations of claim 4 of the ’405 patent for substantially the same reasons discussed above in Section VI.G. Using Han, instead of Hanaoka, in combination with Sugizaki, Izumino, Chakraborty, and Tanimoto does not detract from the relied upon disclosures in Section VI.G. (*See supra* Section VI.G; Ex. PA-DEC, ¶226.)

P. SNQ16: Sugizaki in View of Han, Izumino, Chakraborty, and Tanaka Discloses or Suggests Claims 7 and 17

Sugizaki in view of Han, Izumino, Chakraborty, and Tanaka discloses or suggests the limitations of claims 7 and 17 of the ’405 patent for substantially the same reasons discussed above in Section VI.H. Using Han, instead of Hanaoka, in combination with Sugizaki, Izumino, Chakraborty, and Tanaka does not detract from the relied upon disclosures in Section VI.H. (*See supra* Section VI.H; Ex. PA-DEC, ¶227.)

Q. SNQ17: Sugizaki in View of Nagahama and Izumino Discloses or Suggests Claims 1-3 and 8-16

Relevant to SNQ17, the analysis set forth above for claims 1 and 12 explains how the combination of Hanaoka with Sugizaki discloses or suggests forming an LED as disclosed by Sugizaki in which an undoped layer ("intrinsic region/layer") is included between the positively-doped (p-type) and negatively-doped (n-type) regions/layers. (*See supra* Section VI.A.2(b), VI.A.8(b).) Specifically, Hanaoka discloses using such an intrinsic region/layer in an LED device and explains that the inclusion of such a region/layer as the active layer can extend the life of the LED device (Ex. PA-2, ¶[0034]; Ex. PAT-E, Order Granting Request for Ex Parte Reexamination for Control No. 90/015,092, 9), and a POSITA would have found it obvious to include such an intrinsic region/layer as the active layer in Sugizaki's LED device. To the extent it is argued that the combination of Hanaoka and Sugizaki does not disclose or suggest "an intrinsic region/layer," as claimed, the inclusion of such an intrinsic region/layer in the LED of Sugizaki would have been obvious in view of Nagahama. (Ex. PA-DEC, ¶¶228-234.)

As discussed above, conventional LEDs of the time comprised an undoped active layer. (Ex. PA-DEC, ¶229.) For example, gallium nitride (GaN) LEDs were well understood and "predominantly expected to replace existing light sources such as incandescent lamps, fluorescent lamps and mercury lamps." (Ex. PA-17, ¶[0002].) The typical GaN LED included an "undoped InGaN (an active layer . . .)" that was sandwiched between an n-type and a p-type layer. (*Id.*, ¶[0002], FIGs. 1-2.)

Nagahama discloses one such conventional LED comprising an undoped active layer ("intrinsic region"). (Ex. PA-DEC, ¶230.) For instance, Nagahama discloses "fabrication method of a nitride semiconductor device comprising a nitride semiconductor . . . , such as a light emitting diode (LED)." (Ex. PA-8, 1:7-13.) The active layer of the LED includes an "un-doped" well layer that "increase[s] the light emitting efficiency of the light emitting device." (*Id.*, 20:3-24, FIG. 1; *see also id.*, 20:35-43 ("in order to improve the crystallinity to the maximum extent, an un-doped well layer has to be grown"), 20:60-65 ("In the case of a high output device such as a high output LD and a high power LED, to be operated with a high quantity of electric current, if the well layer is undoped and practically contains no n-type impurity, the re-coupling of carriers in the well layer can be promoted and light emitting re-coupling can be carried out at a high efficiency.").)

It would have been obvious to form an LED as disclosed by Sugizaki such that an undoped layer ("intrinsic region") is included between positively-doped (p-type) and negatively-doped (n-type) regions, like taught by Nagahama and understood in the art. (Ex. PA-DEC, ¶231.) Based on Nagahama's teachings, a POSITA would have had good reason to implement Sugizaki's LED structure such that the light emitting layer is an undoped active region positioned between the p-type and n-type layers, similar to as taught by Nagahama, because, for example, such a configuration would have improved the efficiency of Sugizaki's LED and supported high output applications. (Ex. PA-8, 20:4-21:9; Ex. PA-DEC, ¶231.)

As a POSITA would have appreciated, such a substitution of different types of active light-emitting layers would have represented a simple substitution of one known element for another to obtain a predictable result, especially here, where Sugizaki explicitly contemplates that the use of different multilayer structures being used in the LED. (Ex. PA-1, ¶[0104]; Ex. PA-DEC, ¶232.) Indeed, "when a patent simply arranges old elements with each performing the same function it had been known to perform and yields no more than one would expect from such an arrangement, the combination is obvious." *KSR*, 550 at 417. Furthermore, the modification would have been obvious to try. (Ex. PA-DEC, ¶232.) A POSITA would have appreciated that the light-emitting active layer could have been doped or undoped. (*Id.*) Implementing the Sugizaki light emitting layer as an undoped, intrinsic layer, as taught by Nagahama and others, would have been an obvious choice. (*Id.*)

A POSITA would have had a reasonable expectation of success in modifying Sugizaki based on the teachings of Nagahama, at least because the LED configuration was well understood in the art. (*See, e.g.*, Ex. PA-12, ¶[0004], ¶[0007]; Ex. PA-13, 1:14-33 (same); Ex. PA-7, ¶[0007]; Ex. PA-14, Abstract, ¶[0054]; Ex. PA-15, ¶[0028]; Ex. PA-DEC, ¶233.) Modifying Sugizaki as discussed above would have involved no more than an application of known technologies (e.g., the LED structure described in Sugizaki and the active region described in Nagahama) according to known methods (e.g., conventional LED manufacturing techniques, like those described in Sugizaki and Nagahama) to yield the predictable result of an LED that includes an undoped active layer and has greater efficiency. (Ex. PA-DEC, ¶233.) *See KSR*, 550 U.S. at 416.

The Sugizaki-Nagahama-Izumino combination discloses or suggests the remaining features of claims 1, 3, and 8-16 as set forth in the preceding sections. (*See supra* Section VI.A.)

Using Nagahama, instead of Hanaoka, in combination with Sugizaki and Izumino does not detract from the relied upon disclosures in Section VI.A. (Ex. PA-DEC, ¶234.)

R. SNQ18: Sugizaki in View of Nagahama, Izumino, and Camras Discloses or Suggests Claims 2, 5, and 6

Sugizaki in view of Nagahama, Izumino, and Camras discloses or suggests the limitations of claims 2, 5, and 6 of the '405 patent for substantially the same reasons discussed above in Section VI.B. Using Nagahama, instead of Hanaoka, in combination with Sugizaki, Izumino, and Camras does not detract from the relied upon disclosures in Section VI.B. (*See supra* Section VI.B; Ex. PA-DEC, ¶235.)

S. SNQ19: Sugizaki in View of Nagahama, Izumino, and Tanimoto Discloses or Suggests Claim 4

Sugizaki in view of Nagahama, Izumino, and Tanimoto discloses or suggests the limitations of claim 4 of the '405 patent for substantially the same reasons discussed above in Section VI.C. Using Nagahama, instead of Hanaoka, in combination with Sugizaki, Izumino, and Tanimoto does not detract from the relied upon disclosures in Section VI.C. (*See supra* Section VI.C; Ex. PA-DEC, ¶236.)

T. SNQ20: Sugizaki in View of Nagahama, Izumino, and Tanaka Discloses or Suggests Claims 7 and 17

Sugizaki in view of Nagahama, Izumino, and Tanaka discloses or suggests the limitations of claims 7 and 17 of the '405 patent for substantially the same reasons discussed above in Section VI.D. Using Nagahama, instead of Hanaoka, in combination with Sugizaki, Izumino, and Tanaka does not detract from the relied upon disclosures in Section VI.D. (*See supra* Section VI.D; Ex. PA-DEC, ¶237.)

U. SNQ21: Sugizaki in View of Nagahama, Izumino, and Chakraborty Discloses or Suggests Claims 1-3 and 8-16

Sugizaki in view of Nagahama, Izumino, and Chakraborty discloses or suggests the limitations of claims 1-3 and 8-16 of the '405 patent for substantially the same reasons discussed above in Section VI.E. Using Nagahama, instead of Hanaoka, in combination with Sugizaki, Izumino, and Chakraborty does not detract from the relied upon disclosures in Section VI.E. (*See supra* Section VI.E; Ex. PA-DEC, ¶238.)

V. SNQ22: Sugizaki in View of Nagahama, Izumino, Chakraborty, and Camras Discloses or Suggests Claims 2, 5, and 6

Sugizaki in view of Nagahama, Izumino, Chakraborty, and Camras discloses or suggests the limitations of claims 2, 5, and 6 of the '405 patent for substantially the same reasons discussed above in Section VI.F. Using Nagahama, instead of Hanaoka, in combination with Sugizaki, Izumino, Chakraborty, and Camras does not detract from the relied upon disclosures in Section VI.F. (*See supra* Section VI.F; Ex. PA-DEC, ¶239.)

W. SNQ23: Sugizaki in View of Nagahama, Izumino, Chakraborty, and Tanimoto Discloses or Suggests Claim 4

Sugizaki in view of Nagahama, Izumino, Chakraborty, and Tanimoto discloses or suggests the limitations of claim 4 of the '405 patent for substantially the same reasons discussed above in Section VI.G. Using Nagahama, instead of Hanaoka, in combination with Sugizaki, Izumino, Chakraborty, and Tanimoto does not detract from the relied upon disclosures in Section VI.G. (*See supra* Section VI.G; Ex. PA-DEC, ¶240.)

X. SNQ24: Sugizaki in View of Nagahama, Izumino, Chakraborty, and Tanaka Discloses or Suggests Claims 7 and 17

Sugizaki in view of Nagahama, Izumino, Chakraborty, and Tanaka discloses or suggests the limitations of claims 7 and 17 of the '405 patent for substantially the same reasons discussed above in Section VI.H. Using Nagahama, instead of Hanaoka, in combination with Sugizaki, Izumino, Chakraborty, and Tanaka does not detract from the relied upon disclosures in Section VI.H. (*See supra* Section VI.H; Ex. PA-DEC, ¶241.)

VII. Detailed Explanation of the Pertinence and Manner of Applying the Prior Art to the Claims

A. Bases for Proposed Rejections of the Claims

The following is a quotation of pre-AIA 35 U.S.C. § 102 that forms the basis for all of the identified prior art:

> A person shall be entitled to a patent unless . . .
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent, or
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States . . . .

The following is a quotation of pre-AIA 35 U.S.C. § 103(a) that forms the basis of all of the following obviousness rejections:

> A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negative by the manner in which the invention was made.

The question under 35 U.S.C. § 103 is whether the claimed invention would have been obvious to one of ordinary skill in the art at the time of the invention. In *KSR International Co. v. Teleflex Inc*., 550 U.S. 398 (2007), the Court mandated that an obviousness analysis allow for "common sense" and "ordinary creativity," while at the same time not requiring "precise teachings directed to the specific subject matter of the challenged claim[s]." *KSR*, 550 U.S. at 418, 420-421. According to the Court, "[t]he combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results." *Id.* at 416. In particular, the Court emphasized "the need for caution in granting a patent based on the combination of elements found in the prior art." *Id.* at 401. The Court also stated that "when a patent simply arranges old elements with each performing the same function it had been known to perform and yields no more than one would expect from such an arrangement, the combination is obvious." *Id.* at 417.

The Office has provided further guidance regarding the application of *KSR* to obviousness questions before the Office.

> If a person of ordinary skill can implement a predictable variation, § 103 likely bars its patentability. For the same reason, if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill.

MPEP § 2141(I) (quoting *KSR* at 417.)

The MPEP identifies many exemplary rationales from *KSR* that may support a conclusion of obviousness. Some examples that may apply to this reexamination include:

- Combining prior art elements according to known methods to yield predictable results;

> - Simple substitution of one known element for another to obtain predictable results;
> - Use of a known technique to improve similar devices in the same way;
> - Applying a known technique to improve devices in the same way;
> - Choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success ("obvious to try")

MPEP § 2141(III).

In addition, the Office has published *Post-KSR* Examination Guideline Updates. *See* Fed. Reg. Vol. 75, 53464 (the "Guideline Updates"). The Guideline Updates discuss developments after *KSR* and provide teaching points from recent Federal Circuit decisions on obviousness. Some examples are listed below:

> A claimed invention is likely to be obvious if it is a combination of known prior art elements that would reasonably have been expected to maintain their respective properties or functions after they have been combined.

Id. at 53646.

> A combination of known elements would have been prima facie obvious if an ordinary skilled artisan would have recognized an apparent reason to combine those elements and would have known how to do so.

Id. at 53648.

> Common sense may be used to support a legal conclusion of obviousness so long as it is explained with sufficient reasoning.

Id.

B. Proposed Rejections

Pursuant to 37 C.F.R. § 1.510(b)(2), Requester identifies claims 1-17 as the claims for which reexamination is requested. The proposed rejections below, in conjunction with the analysis in Sections IV-VI above and the attached declaration of Dr. Baker (Ex. PA-DEC), provide a detailed explanation of the pertinence and manner of applying the prior art to each of claims 1-17.

1. Proposed Rejection #1

Claims 1, 3, and 8-16 are obvious over Sugizaki, Hanaoka, and Izumino under 35 U.S.C. § 103(a), as noted above in Section VI.A and the declaration of Dr. Baker provided in Exhibit PA-DEC.

2. Proposed Rejection #2

Claims 2, 5, and 6 are obvious over Sugizaki, Hanaoka, Izumino, and Camras under 35 U.S.C. § 103(a), as noted above in Section VI.B and the declaration of Dr. Baker provided in Exhibit PA-DEC.

3. Proposed Rejection #3

Claim 4 is obvious over Sugizaki, Hanaoka, Izumino, and Tanimoto under 35 U.S.C. § 103(a), as noted above in Section VI.C and the declaration of Dr. Baker provided in Exhibit PA-DEC.

4. Proposed Rejection #4

Claims 7 and 17 are obvious over Sugizaki, Hanaoka, Izumino, and Tanaka under 35 U.S.C. § 103(a), as noted above in Section VI.D and the declaration of Dr. Baker provided in Exhibit PA-DEC.

5. Proposed Rejection #5

Claims 1-3 and 8-16 are obvious over Sugizaki, Hanaoka, Izumino, and Chakraborty under 35 U.S.C. § 103(a), as noted above in Section VI.E and the declaration of Dr. Baker provided in Exhibit PA-DEC.

6. Proposed Rejection #6

Claims 2, 5, and 6 are obvious over Sugizaki, Hanaoka, Izumino, Chakraborty, and Camras under 35 U.S.C. § 103(a), as noted above in Section VI.F and the declaration of Dr. Baker provided in Exhibit PA-DEC.

7. Proposed Rejection #7

Claim 4 is obvious over Sugizaki, Hanaoka, Izumino, Chakraborty, and Tanimoto under 35 U.S.C. § 103(a), as noted above in Section VI.G and the declaration of Dr. Baker provided in Exhibit PA-DEC.

8. Proposed Rejection #8

Claims 7 and 17 are obvious over Sugizaki, Hanaoka, Izumino, Chakraborty, and Tanaka under 35 U.S.C. § 103(a), as noted above in Section VI.H and the declaration of Dr. Baker provided in Exhibit PA-DEC.

9. Proposed Rejection #9

Claims 1, 3, and 8-16 are obvious over Sugizaki, Han, and Izumino under 35 U.S.C. § 103(a), as noted above in Section VI.I and the declaration of Dr. Baker provided in Exhibit PA-DEC.

10. Proposed Rejection #10

Claims 2, 5, and 6 are obvious over Sugizaki, Han, Izumino, and Camras under 35 U.S.C. § 103(a), as noted above in Section VI.J and the declaration of Dr. Baker provided in Exhibit PA-DEC.

11. Proposed Rejection #11

Claim 4 is obvious over Sugizaki, Han, Izumino, and Tanimoto under 35 U.S.C. § 103(a), as noted above in Section VI.K and the declaration of Dr. Baker provided in Exhibit PA-DEC.

12. Proposed Rejection #12

Claims 7 and 17 are obvious over Sugizaki, Han, Izumino, and Tanaka under 35 U.S.C. § 103(a), as noted above in Section VI.L and the declaration of Dr. Baker provided in Exhibit PA-DEC.

13. Proposed Rejection #13

Claims 1-3 and 8-16 are obvious over Sugizaki, Han, Izumino, and Chakraborty under 35 U.S.C. § 103(a), as noted above in Section VI.M and the declaration of Dr. Baker provided in Exhibit PA-DEC.

14. Proposed Rejection #14

Claims 2, 5, and 6 are obvious over Sugizaki, Han, Izumino, Chakraborty, and Camras under 35 U.S.C. § 103(a), as noted above in Section VI.N and the declaration of Dr. Baker provided in Exhibit PA-DEC.

15. Proposed Rejection #15

Claim 4 is obvious over Sugizaki, Han, Izumino, Chakraborty, and Tanimoto under 35 U.S.C. § 103(a), as noted above in Section VI.O and the declaration of Dr. Baker provided in Exhibit PA-DEC.

16. Proposed Rejection #16

Claims 7 and 17 are obvious over Sugizaki, Han, Izumino, Chakraborty, and Tanaka under 35 U.S.C. § 103(a), as noted above in Section VI.P and the declaration of Dr. Baker provided in Exhibit PA-DEC.

17. Proposed Rejection #17

Claim 1, 3, and 8-16 are obvious over Sugizaki, Nagahama, and Izumino under 35 U.S.C. § 103(a), as noted above in Section VI.Q and the declaration of Dr. Baker provided in Exhibit PA-DEC.

18. Proposed Rejection #18

Claims 2, 5, and 6 are obvious over Sugizaki, Nagahama, Izumino, and Camras under 35 U.S.C. § 103(a), as noted above in Section VI.R and the declaration of Dr. Baker provided in Exhibit PA-DEC.

19. Proposed Rejection #19

Claim 4 is obvious over Sugizaki, Nagahama, Izumino, and Tanimoto under 35 U.S.C. § 103(a), as noted above in Section VI.S and the declaration of Dr. Baker provided in Exhibit PA-DEC.

20. Proposed Rejection #20

Claims 7 and 17 are obvious over Sugizaki, Nagahama, Izumino, and Tanaka under 35 U.S.C. § 103(a), as noted above in Section VI.T and the declaration of Dr. Baker provided in Exhibit PA-DEC.

21. Proposed Rejection #21

Claim 1-3 and 8-16 are obvious over Sugizaki, Nagahama, Izumino, and Chakraborty under 35 U.S.C. § 103(a), as noted above in Section VI.U and the declaration of Dr. Baker provided in Exhibit PA-DEC.

22. Proposed Rejection #22

Claims 2, 5, and 6 are obvious over Sugizaki, Nagahama, Izumino, Chakraborty, and Camras under 35 U.S.C. § 103(a), as noted above in Section VI.V and the declaration of Dr. Baker provided in Exhibit PA-DEC.

23. Proposed Rejection #23

Claim 4 is obvious over Sugizaki, Nagahama, Izumino, Chakraborty, and Tanimoto under 35 U.S.C. § 103(a), as noted above in Section VI.W and the declaration of Dr. Baker provided in Exhibit PA-DEC.

24. Proposed Rejection #24

Claims 7 and 17 are obvious over Sugizaki, Nagahama, Izumino, Chakraborty, and Tanaka under 35 U.S.C. § 103(a), as noted above in Section VI.X and the declaration of Dr. Baker provided in Exhibit PA-DEC.

VIII. Conclusion

For the reasons set forth above, the Requester has established at least one substantial new question of patentability with respect to claims 1-17 of the '405 patent. The analysis provided in this Request and in the declaration of Dr. Baker (Ex. PA-DEC) demonstrates the invalidity of claims 1-17 in view of prior art that was not substantively considered by the Patent Office. Therefore, it is requested that this request for reexamination be granted and claims 1-17 be cancelled.

As identified in the attached Certificate of Service and in accordance with 37 C.F.R. §§ 1.33(c) and 1.510(b)(5), a copy of this Request has been served, in its entirety, to the address of the attorney of record.

Respectfully submitted,

PAUL HASTINGS LLP

Dated: November 7, 2022

By: /Naveen Modi/
Naveen Modi
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