UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD.,
Petitioner

v.

LED WAFER SOLUTIONS LLC,
Patent Owner

Patent No. 8,941,137

PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 8,941,137

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Ex. 1002	Declaration of R. Jacob Baker, Ph.D., P.E.
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Ex. 1005	U.S. Patent No. 9,634,191 to Keller et al.
Ex. 1006	U.S. Patent No. 9,287,469 to Chakraborty
Ex. 1007	U.S. Patent No. 8,835,937 to Wirth et al.
Ex. 1008	U.S. Patent Publication No. 2009/0001869 to Tanimoto et al. ("Tanimoto")
Ex. 1009	U.S. Patent Publication No. 2008/0031295 to Tanaka ("Tanaka")
Ex. 1010	U.S. Patent No. 6,023,104 to Koizumi
Ex. 1011	U.S. Patent Publication No. 2010/0284198 to Willwohl
Ex. 1012	RESERVED
Ex. 1013	RESERVED
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Ex. 1021	Complaint (Dkt. #1) in *LED Wafer Solutions LLC v. Samsung Electronics Co., Ltd. et al.,* 6-21-cv-00292 (W.D. Tex. Mar. 25, 2021)
Ex. 1022	Judge Albright's (W.D. Tex.) "Order Governing Proceedings - Patent Cases 062421.pdf" available at https://www.txwd.uscourts.gov/judges-information/standing-orders/
Ex. 1023	Schubert, Light Emitting Diodes, Second Edition, 2006 ("Schubert")

I. INTRODUCTION

Samsung Electronics Co., Ltd. ("Petitioner") requests *inter partes* review ("IPR") of claims 1-4 and 6-11 ("the challenged claims") of U.S. Patent No.8,941,137 ("the '137 patent") (Ex. 1001) assigned to LED Wafer Solutions LLC ("Patent Owner" or "PO"). For the reasons below, the challenged claims should be found unpatentable and canceled.

II. MANDATORY NOTICES

Real Parties-in-Interest: Pursuant to 37 C.F.R. § 42.8(b)(1), Petitioner identifies the following as the real parties-in-interest: Samsung Electronics Co., Ltd., Samsung Electronics America, Inc, and Samsung Semiconductor, Inc.

Related Matters: The '137 patent is asserted in the following civil action *LED Wafer Solutions LLC v. Samsung Electronics Co., Ltd. et al.*, 6-21-cv-00292 (W.D. Tex). The '137 patent is also related to U.S. Patent No. 9,786,822 ("the '822 patent").

Counsel and Service Information: Lead counsel: Naveen Modi (Reg. No. 46,224). Backup counsel: (1) Joseph E. Palys (Reg. No. 46,508), (2) Chetan R. Bansal (Limited Recognition No. L0667), (3) Paul M. Anderson (Reg. No. 39,896), and (4) Jason Heidemann (Reg. No. 77,880).

Service information is Paul Hastings LLP, 2050 M Street NW, Washington, DC 20036, Tel.: 202.551.1700, Fax: 202.551.1705, email: PH-Samsung-LEDWafer-IPR@paulhastings.com. Petitioner consents to electronic service.

III. PAYMENT OF FEES

The PTO is authorized to charge any fees due during this proceeding to Deposit Account No. 50-2613.

IV. GROUNDS FOR STANDING

Petitioner certifies that the '137 patent is available for review, and Petitioner is not barred/estopped from requesting review on the grounds herein.

V. PRECISE RELIEF REQUESTED

A. Claims for Which Review Is Requested

Petitioner requests review and cancellation of claims 1-4 and 6-11 as unpatentable based on the following grounds.

B. Statutory Grounds of Challenge

Ground 1: Claims 1, 7, and 8 are unpatentable under pre-AIA 35 U.S.C. § 103(a) over U.S. Patent No. 9,634,191 to Keller et al. ("Keller") in view of U.S. Patent No. 9,287,469 to Chakraborty ("Chakraborty");

Ground 2: Claims 1-3, 7, and 8 are unpatentable under pre-AIA 35 U.S.C. § 103(a) over Keller in view of U.S. Patent No. 8,835,937 to Wirth et al. ("Wirth");

Ground 3: Claim 4 is unpatentable under pre-AIA 35 U.S.C. § 103(a) over Keller in view of Wirth and U.S. Patent Publication No. 2009/0001869 to Tanimoto et al. ("Tanimoto");

Ground 4: Claim 6 is unpatentable under pre-AIA 35 U.S.C. § 103(a) over Keller in view of Wirth and U.S. Patent Publication No. 2008/0031295 to Tanaka ("Tanaka");

Ground 5: Claims 9 and 10 are unpatentable under pre-AIA 35 U.S.C. § 103(a) over Wirth in view of Applicant Admitted Prior Art ("AAPA") and Keller.

Ground 6: Claim 11 is unpatentable under pre-AIA 35 U.S.C. § 103(a) over Wirth in view of AAPA, Keller, and Tanaka.

The '137 patent issued from an application filed March 6, 2012. The '137 patent further claims priority to two provisional applications, each filed March 6, 2011.

Keller issued from an application filed November 14, 2007. Chakraborty issued from an application filed May 2, 2008. Wirth is an issued patent with a §371(c)(1), (2), (4) date of December 2, 2008. Thus, Keller, Chakraborty, and Wirth qualify as prior art at least under pre-AIA 35 U.S.C. § 102(e). Tanaka published on

Feb. 7, 2008. Tanimoto published January 1, 2009. Thus, Tanimoto and Tanaka qualify as prior art at least under pre-AIA 35 U.S.C. § 102(b).

None of the references were considered during prosecution of the '137 patent (Ex. 1001, Cover ("References Cited"); *see also generally* Ex. 1004).

VI. LEVEL OF ORDINARY SKILL

A person of ordinary skill in the art as of the claimed priority date of the '137 patent ("POSITA") would have had a bachelor's degree in electrical engineering, material science, or the equivalent, and two or more years of experience with light emitting diodes (LEDs). (Ex. 1002 ¶¶18-20.)[1] More education can supplement practical experience and vice versa. (*Id.*)

VII. OVERVIEW OF THE '137 PATENT

A. The '137 patent

The '137 patent relates to "a light emitting diode (LED) device." (Ex. 1001, 1:12-15; *see also id.*, Abstract, 1:66-2:11; Ex. 1002 ¶¶29-33.) The '137 patent admits that light emitting diode (LED) devices were well-known and depicts a prior art LED device in Figure 3 below. (Ex. 1001, 2:51-53, FIG. 3.)

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[1] Petitioner submits the declaration of Dr. R. Jacob Baker, Ph.D., P.E. (Ex. 1002), an expert in the field of the '137 patent. (Ex. 1002 ¶¶3-13; Ex. 1003.)

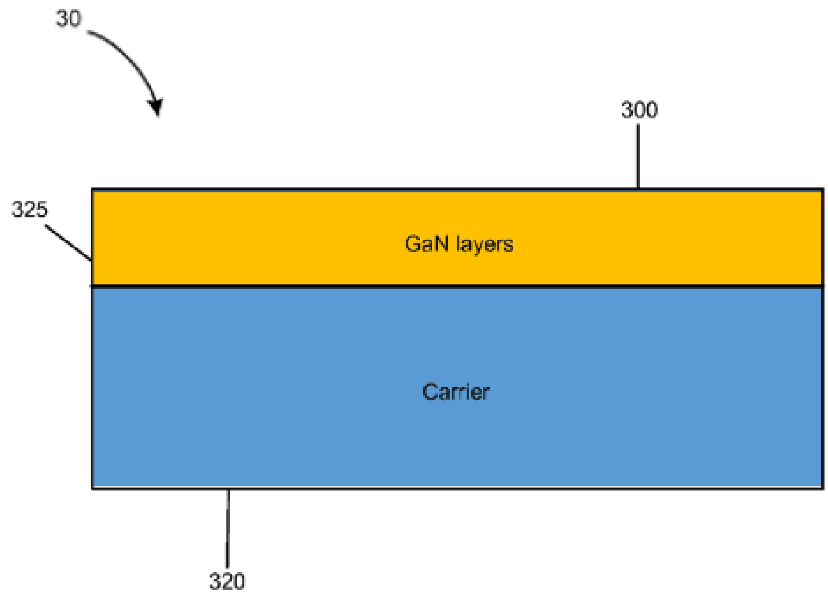

Fig. 3
(Prior Art)

(Ex. 1001, FIG. 3 (annotated and rearranged); Ex. 1002 ¶29.)

The prior art light emitting device 30 of Figure 3 includes a semiconductor LED layer 300 (highlighted in orange), a metallic interface 325, and a carrier layer 320 (highlighted in blue). (Ex. 1001, 4:7-9.) The semiconductor LED layer 300 includes a GaN layer. (*Id.*, FIG. 3.) GaN refers to a gallium nitride "which is a type of bandgap semiconductor suited for use in high power LEDs." (*Id.*, 3:19-23.) The '137 patent states that GaN 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." (*Id.*, 3:23-26.) In other words, the '137 patent admits that prior art GaN LEDs have an intrinsic region disposed between an n-type doped layer and a p-type doped layer. (Ex. 1002 ¶30.)

The disclosed embodiments of the '137 patent build on the prior art device of Figure 3. For instance, the disclosed embodiments describe an LED device comprised of additional layers that "act to promote mechanical, electrical, thermal, or optical characteristics of the device" (Ex. 1001, 2:2-4, 19-23; *see also id.,* Abstract), as seen in Figure 6, reproduced below. (*Id.*, 2:56-57, 4:46-47, FIG. 6.) Like the prior-art LED device in Figure 3 above, the device 60 in Figure 6 includes the GaN LED layer 600 (highlighted in orange) separated from the carrier layer 620 (highlighted in blue) by a metallic interface 625. (*Id.*, 4:48-51; *compare id.*, FIG. 6 *with* FIG.3.) The LED device 60, as shown by Figure 6 below, further includes a metal pad 630 (*id.*, 4:50-51), an optically transparent or transmissive adhesive layer 640 (highlighted in yellow) (*id.*, 4:52-56), a cover substrate 655 (highlighted in green) (*id.*, 5:9-17), and an optical lens 660 (*id.*, 5:18-20.) The transparent or optically permissive adhesive layer 640 may contain "a region containing phosphor and/or quantum dot material (QD) 645." (*Id.*, 5:1-3.) The optical lens 660 "act[s] to spread, diffuse, collimate, or otherwise redirect and form the output of the LED." (*Id.*, 5:20-22.)

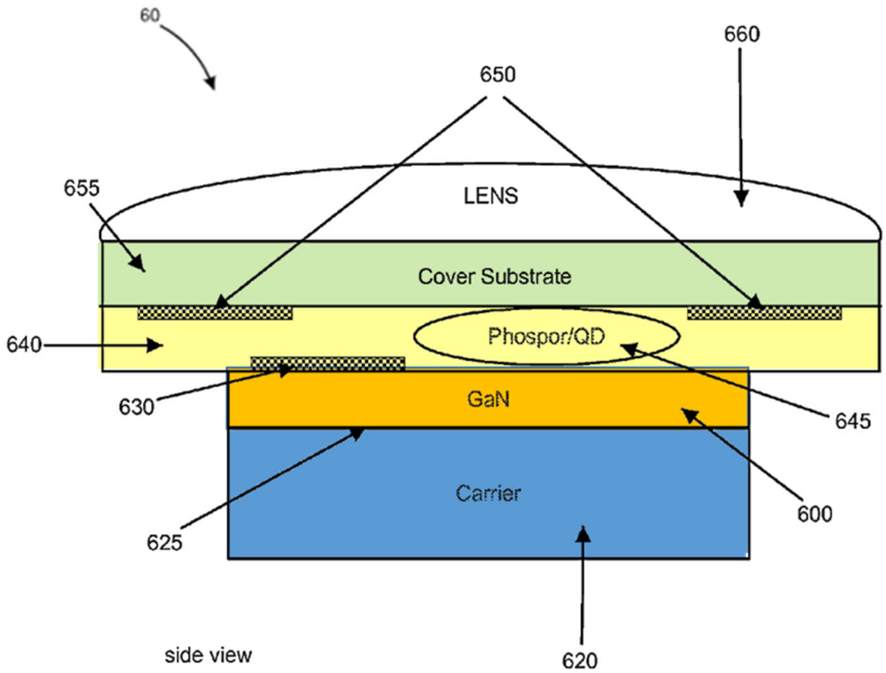

Fig. 6

(Ex. 1001, FIG.6 (annotated and rearranged); Ex. 1002 ¶¶31-32.)

As explained below and in the accompanying declaration of Dr. Baker, all the limitations in the challenged claims were known in the prior art. (*See infra* Section IX; Ex. 1002 ¶33; *see also* Ex. 1002 ¶¶14-17, 21-28 (technology background, citing Exhibit 1023), 35-57 (discussing the prior art at issue in this petition), 58-235 (discussing prior art disclosures in view of each claim's limitations).)

B. Prosecution History of the '137 patent

During prosecution, the claims were amended several times in response to multiple Office Actions. (*See generally* Ex. 1004.) As explained below in Sections IX.A.1.f-g, the Keller-Chakraborty combination discloses or suggests the challenged claims including the features added to gain allowance.

VIII. CLAIM CONSTRUCTION

Under the applicable standard in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc), claim terms are typically given their ordinary and customary meanings as understood by a POSITA at the time of the invention based on the claim language, specification, and the prosecution history of record. *Phillips*, 415 F.3d at 1313; *see also id.* at 1312-16. The Board, however, only construes the claims when necessary to resolve the controversy. *Toyota Motor Corp. v. Cellport Sys., Inc.*, IPR2015-00633, Paper No. 11 at 16 (Aug. 14, 2015) (citation omitted). Petitioner believes no express constructions of any claim terms are necessary to assess whether the prior art reads on the challenged claims. (Ex. 1002 ¶34.)[2]

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[2] Petitioner reserves all rights to raise claim construction and other arguments, including challenges under 35 U.S.C. §§ 101 or 112, in district court as relevant to those proceedings. *See, e.g.*, *Target Corp. v. Proxicom Wireless, LLC*, IPR2020-

IX. DETAILED EXPLANATION OF GROUNDS

A. Ground 1: The Combination of Keller and Chakraborty Render Obvious Claims 1, 7, and 8

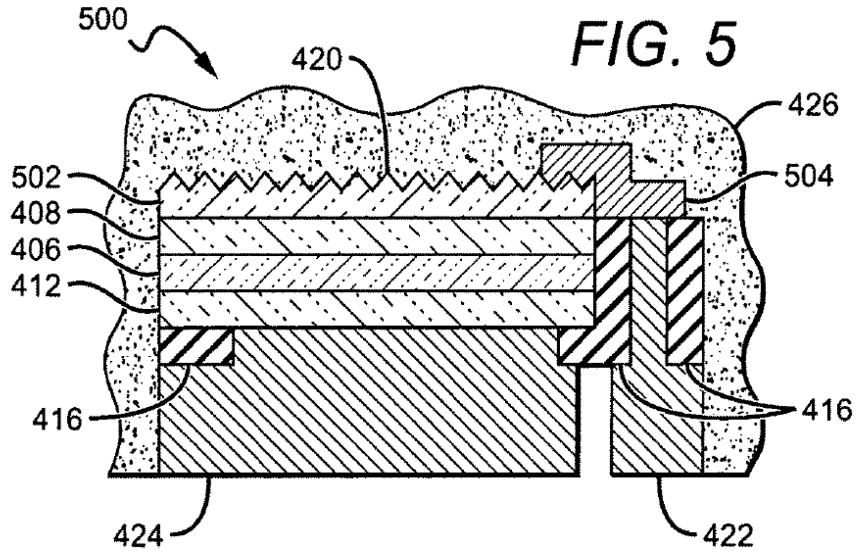
1. Claim 1

a) A light emitting device, comprising:

To the extent that the preamble of claim 1 is limiting, Keller discloses the limitations therein. (Ex. 1002 ¶¶58-60.) Keller discloses a light emitting device. (Ex. 1005, 1:10-12; *see also id.*, Abstract, 4:15-18, 5:29-35, 5:64-66, FIGS.4a-g, 5.) For example, Keller, with reference to Figure 5 below, discloses a semiconductor device that includes an active region 408. (*Id.*, 11:1-4.) Keller explains that this active region 408 emits light.[3] (*Id.*, 8:65-67, 10:44-48; *infra* Section IX.A.1.b.)

00904, Paper 11 at 11-13 (November 10, 2020). A comparison of the claims to any accused products in litigation may raise controversies that are not presented here given the similarities between the references and the patent.

[3] Keller's description corresponding to components, e.g., the n- and p-type layers 404, 406, active region 408, n-pad 410, p-pad 412, spacing elements 416, n-electrode 422, p-type electrode 424, and phosphor layer 426, in Figures 4a-g equally apply to the similar components in Figure 5. (Ex. 1002, n.2.) This is so because Keller explains that Figure 5 contains several common elements denoted by the same



(Ex. 1005, FIG. 5; Ex. 1002 ¶60.)

b) a semiconductor LED including doped and intrinsic regions thereof;

Keller discloses this limitation. (Ex. 1002 ¶¶61-70.) Device 500 illustrated in Figure 5 below, includes a p-type layer 406 and an n-type layer 502 with the active region 408 disposed between them. (Ex. 1005, 7:42-48 (discussing similar components p-type layer 406 and active region 408 for Figure 4a)[4].) The

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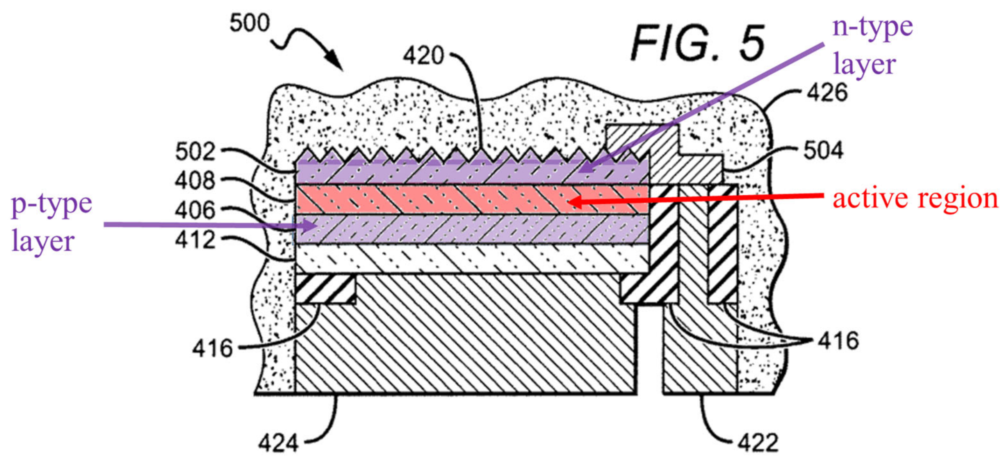
reference numbers to those in Figure 4g (Ex. 1005, 10:64-11:1) and Keller does not repeat the description of the functions of the common components shown in its Figures. (Ex. 1002, n.2; Ex. 1005, 7:42-65, 8:33-9:2, 10:3-8, 10:44-48.)

[4] *See* n.3.

combination of the p-type layer 406, active region 408, and n-type layer 502 is a "semiconductor LED," as claimed.



(Ex. 1005, FIG. 5 (annotated); Ex. 1002 ¶61.)

A POSITA would have understood that the n-type layer 502 and p-type layer 406 are "doped" regions as claimed because Keller discloses that n-type and p-type layers are "oppositely doped" (Ex. 1005, 7:42-48; *see also id.,* 11:1-7 (describing the relationship between the n-type layer 502 in Figure 5 and the n-type layer 404 in Figure 4g); Ex. 1002 ¶62.)

A POSITA would have understood that the active region 408 is an "intrinsic region" for several reasons. (Ex. 1002 ¶¶63-67.) First, the lack of any indication of doping (n-type or p-type) of active region 408 (unlike n-type layer 502 and p-type layer 406) suggests that active region 408 is "intrinsic" (i.e., not doped). (*Id.* ¶63)

Second, as confirmed by the Applicant during prosecution, an intrinsic region, when present, is "typically [provided] between p-n layers." (Ex. 1004, 227.) Here, Keller's active region 408, which is between p and n layers, is consistent with Applicant's assertions regarding the placement of an intrinsic layer. (Ex. 1002 ¶62.)

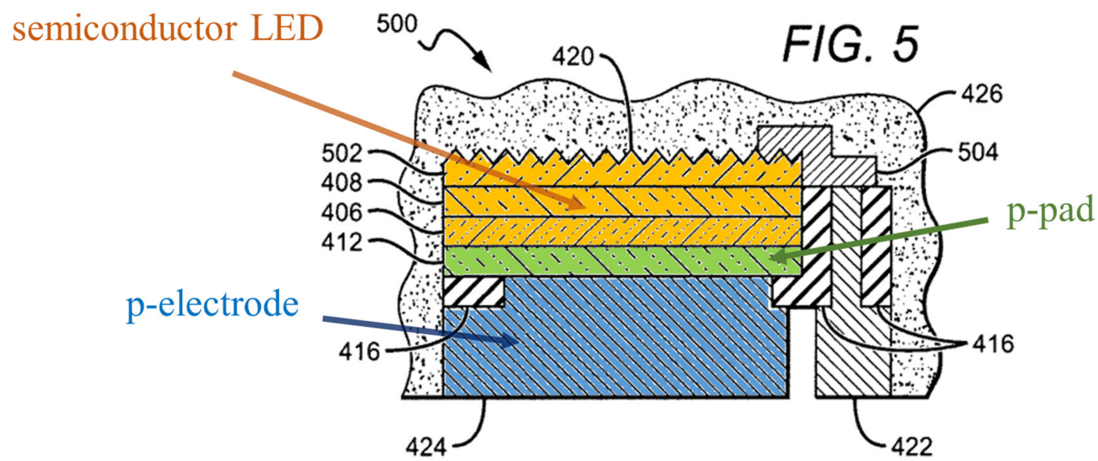
Third, Keller explains that light is emitted from the active region interposed between the n- and p-type region due to the radiative recombination of electrons and holes in the active region. (Ex. 1005, 1:14-21, 2:58-3:7.) This is the same light emission mechanism that is described in the '137 patent with the recombination occurring in the "intrinsic region," which is disposed between the p- and the n-type layers. (Ex. 1001, 4:10-21.) This further confirms that Keller discloses or suggests that the "active region" is an intrinsic region to a POSITA. (Ex. 1002 ¶65.)

Fourth, Keller discloses that in some embodiments, the LED device is a Gallium Nitride (GaN) LED. (Ex. 1005, 7:43-54.) The '137 patent admits that prior art GaN 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. 1001, 3:23-26 (emphasis added); *see also id.,* 4:12-16; Ex. 1002 ¶¶66-67.). Thus, to the extent not explicitly disclosed in Keller, a POSITA would have understood and found it obvious to use an "intrinsic" region for the active region 408 in Keller's GaN LED as that is a well-known conventional structure, as admitted by the '137 patent.

(Ex. 1002 ¶¶68-69.) Indeed, using an "intrinsic" region for the active region 408 in Keller's GaN LED would have been obvious because it would have constituted applying a known feature (an intrinsic region provided between n and p-doped layers in a GaN LED) to a particular device (the Keller GaN LED) to achieve a predictable result (emission of light by radiative recombination of a hole and an electron in the intrinsic region). (*Id.* ¶69); *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 416-18 (2007). For the above reasons, Keller discloses or suggests "a semiconductor LED including doped and intrinsic regions thereof." (Ex. 1002 ¶70.)

c) a conducting support layer disposed proximal to a first surface of said semiconductor LED and separated therefrom by a metallic interface with no additional intervening layers, said conducting support layer is no more than 50 microns in thickness;

Keller discloses this limitation. (Ex. 1002 ¶¶71-77.) As discussed below, Keller also discloses that a p-electrode 424 ("conducting support layer") is disposed proximal to a first surface of the p-type layer 406 ("a first surface of said semiconductor LED") and is separated therefrom by a p-pad 412 ("metallic interface") with no additional intervening layers. For example, as shown in Figure 5 below, the light emitting device 500 includes a semiconductor LED device (elements 406, 408, and 502), p-electrode 424 ("conducting support layer"), and a p-pad 412. (Ex. 1005, FIG. 5.)



(*Id*., FIG. 5 (annotated); Ex. 1002 ¶72.)

The p-electrode 424 provides an electrical path (i.e., it is conductive) to the p-type layer 406 (Ex. 1005, 10:13-15) and "provide[s] mechanical support to the finished device" (*id.*, 9:21-30.) (*See also id.*, 10:9-20.) This p-electrode 424 is formed from a conductive metal layer, such as copper, which has been further processed (e.g., etched), resulting in p-electrode 424 and n-electrode 422. (*Id*., 9:21-34, 10:9-20; *compare id.,* FIG. 4E *with id.,* FIG. 5.) Accordingly, a POSITA would have understood that the p-electrode 424 is a "conducting support layer" and is disposed proximal to a first surface of the p-type layer 406 of the semiconductor LED ("a first surface of said semiconductor LED.") (Ex. 1002 ¶72.)

Furthermore, as shown in Figure 5 above, the p-electrode 424 contacts the p-pad 412 ("metallic interface") (Ex. 1005, 10:13-15), where the "p-pad 412 is formed on the exposed surface of the p-type layer 406" ("a first surface of said semiconductor LED") (*id.*, 8:52-53.) Keller further discloses that the p-pad 412 "may comprise a conductive metal material such as gold, silver or copper." (*Id.*, 8:57-58.) Accordingly, a POSITA would have understood that the p-pad 412 is a "metallic interface" and that p-electrode 424 ("conducting support layer") is separated from the p-type layer 406 of the semiconductor LED by the p-pad 412 with no additional intervening layers. (Ex. 1002 ¶73.)

Keller also discloses "said conducting support layer is no more than 50 microns in thickness," as claimed. (*Id.* ¶74.) For example, Keller explains that the "conductive metal layer 418 should be thick enough to provide mechanical support to the finished device" (Ex. 1005, 9:26-28)—e.g., it "should be at least 20 μm thick, with a preferred thickness in the range of 50-400 μm" (*id.*, 9:28-30.) The disclosed "at least 20" microns thick overlaps with the claimed range. (Ex. 1002 ¶¶74-76); *In re Patel*, 566 F. App'x 1005 (Fed. Cir. 2014) ("It is well-established that a prima facie case of obviousness exists when the claimed and prior art ranges overlap."); *In re Peterson*, 315 F.3d 1325 (Fed. Cir. 2003) ("A prima facie case of obviousness typically exists when the ranges of a claimed composition overlap the ranges disclosed in the prior art.”).[5]

d) an optically permissive layer proximal to a second surface of said semiconductor LED, said first and second surfaces of said semiconductor LED being on opposing faces thereof;

Keller discloses this limitation. (Ex. 1002 ¶¶78-84.) For example, as shown in Figure 5 below, the light emitting device 500 includes a semiconductor LED (elements 406, 408, and 502) and a phosphor layer 426 over that LED. (Ex. 1005, FIG. 5.)

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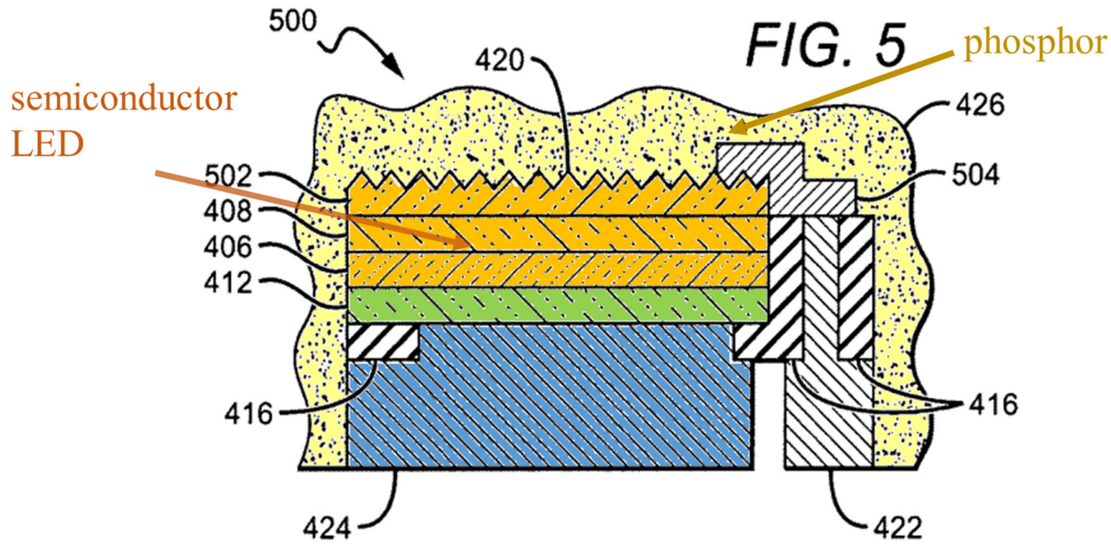
[5] The claimed “50 microns” does not have an associated criticality based on the intrinsic evidence. For example, the patentee initially claimed “no more than 125 microns.” (Ex. 1004, 222.) The patentee, when faced with a section 112 rejection from the Examiner (*id*., 189), changed “125 microns” to “50 microns” (*id*., 166) demonstrating that the values are not critical or achieve an unexpected result.



(*Id*., FIG. 5 (annotated); Ex. 1002 ¶82.)

The phosphor 426 layer down-converts "a portion of the light emitted from the active region 408" resulting in shifting "the device emission spectrum … to yield a color of light that is different from that which is emitted internally from the active region 408." (Ex. 1005, 10:44-48; *see also id*., 10:38-55; Ex. 1002 ¶79.) Accordingly, the phosphor layer 426 is an "optically permissive layer" because this layer receives light emitted from the active region 408 and emits the received light after changing its wavelength. (Ex. 1002 ¶80.) Thus, device 500 includes a phosphor layer 426 ("optically permissive layer") that is proximal to the top surface of the n-type layer 502 ("a second surface of said semiconductor LED.") (*Id.* ¶82.[6]) As illustrated in Figure 5 above, the bottom surface of the p-type layer 406 ("first surface")and the top surface of the n-type layer 502 ("second surface") are on opposing faces of the semiconductor LED (elements 406, 408, and 502). (Ex. 1005, FIG. 5; Ex. 1002 ¶¶83-84.)

e) an optically definable material proximal to or within said optically permissive layer that affects an optical characteristic of emitted light passing therethrough;

Keller discloses this limitation. (Ex. 1002 ¶¶85-88.) The phosphor layer 426 includes "phosphor" ("optically definable material"). (Ex. 1005, 10:43-44.) Alternatively, the phosphor layer 426 itself is the "optically definable material"

[6] Keller discloses this limitation in a further way. The phosphor layer 426 "may be provided in a number of known binders such as, for example, epoxy, silicone, or low-temperature glass." (Ex. 1005, 10:50-53.) Thus, a binder (e.g., silicone) is also an "optically permissive layer" with the phosphor layer 426 as the "optically definable material" (*see infra* Section IX.A.1(e)) provided within such a layer. (Ex. 1002 ¶81; Ex. 1001, 4:57-60 (silicone is provided as an example of optically transparent layer).)

under the interpretation that the binder in which it is provided is the "optically permissive layer." (*See supra* n.6.)

Keller explains that the phosphor layer 426 performs "wavelength conversion" (Ex. 1005, 10:38-55) that "down-convert[s] a portion of the light emitted from the active region 408" causing "a color of light that is different from that which is emitted internally from the active region 408." (*Id.*, 10:44-48.) Thus, the phosphor layer 426 affects an optical characteristic of emitted light from active region 408 by down-converting a portion of the light passing through it. (Ex. 1002 ¶¶86-88.)

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

The combination of Keller and Chakraborty discloses or suggests this limitation. (Ex. 1002 ¶¶89-10.) As discussed above for claim limitations 1.a-e, Keller discloses a light emitting device that includes a semiconductor LED and a phosphor layer 426. (*Supra* Section IX.A.1.a-e.) Keller discloses adding an encapsulant over the light emitting device but does not describe such encapsulants. (Ex. 1005, 6:13-26; Ex. 1002 ¶89.) However, as discussed below, it would have been obvious to use encapsulants like those described by Chakraborty with an LED device like that depicted in figure 5 of Keller, and the resulting modified device discloses or suggests claim limitation 1.f. (Ex. 1002 ¶90.)

(1) Chakraborty

Chakraborty, like Keller, discloses an LED device and methods for manufacturing LED devices. (Ex. 1006, Abstract; *see also id.,* 2:33-40, 2:41-3:2; Ex. 1002 ¶¶91-95, 41-43.) In particular, Chakraborty discloses an "improved light emitting device." (Ex. 1006, Abstract; *see also id.,* 1:8-10, 3:24-26 ("Embodiments of the present invention provide an improved light emitting device"), FIG. 4.) Chakraborty further discloses that encapsulants are added over the LED device to protect the device and affect the emitted light in some intended fashion. (*Id.*, 7:47-55.) Figure 4, reproduced below, illustrates an exemplary LED device in Chakraborty that includes such an encapsulant over the LED device. For example, as illustrated in the extracted portion of Figure 4 below, a flat encapsulant 420 ("optically permissive flat cover substrate") is provided over a conversion layer 414, which is above the semiconductor LED layers 400. (*Id.*, 8:16-38, FIG 4.) The conversion layer 414 in Figure 4 is a phosphor layer, like the phosphor layer 426 in Keller, and is provided over a textured surface of the semiconductor LED layers, just like in Figure 5 of Keller. (Ex. 1002 ¶92.)

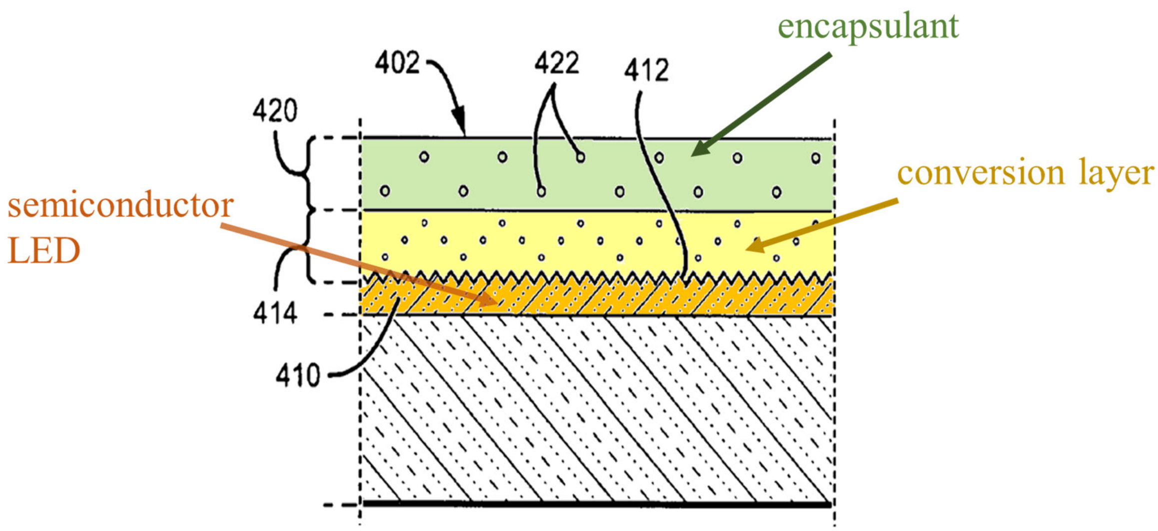


FIG. 4

(Ex. 1006, FIG.4 (extracted and annotated); Ex. 1002 ¶92.)

Chakraborty thus discloses the feature of "an optically permissive flat cover substrate covering at least a portion of the above components," as claimed, because it discloses an encapsulant that is "flat," "optically permissive" (flat encapsulant 220 is made of silicone, which is optically permissive), and covers the underlying LED components (i.e., the phosphor and LED layers). (Ex. 1002 ¶¶93-95.) And as discussed below, it would have been obvious to use such an optically permissive flat cover substrate in Keller's device. (*See infra* Section IX.A.1.f.(2).)

(2) Reasons to Combine

A POSITA would have been motivated in light of Chakraborty to use a flat encapsulant 420 ("optically permissive flat cover substrate") in Keller's semiconductor device (as discussed above for claim limitations 1.a-f) so that the flat cover substrate protects the LED components (phosphor and semiconductor layers) in Figure 5 of Keller and provides the desired ability to "shape an optical beam or otherwise alter the properties of the emitted light" (Ex. 1005, 6:16-19) expressed by Keller. (Ex. 1002 ¶96.) Such an implementation would have been a straightforward combination of well-known technologies using known methods and would have had predictable results. *See KSR*, 550 U.S. at 416-18.

A POSITA would have recognized that Chakraborty and Keller disclose features in a similar technological field. (Ex. 1002 ¶97.) For example, as discussed above, both Keller and Chakraborty relate to techniques for fabricating semiconductor devices. (*Compare* Ex. 1005, Abstract, 5:29-66 *with* Ex. 1006, Abstract, 2:33-36, 41-30, 51-58, 59-3:2; Ex. 1002 ¶¶35-43, 97.) Accordingly, a POSITA would have had reason to consider the teachings of Chakraborty when fabricating an LED device as described in Keller given Chakraborty discloses the benefits associated with using flat encapsulant 420 with an LED device like that disclosed in Keller.

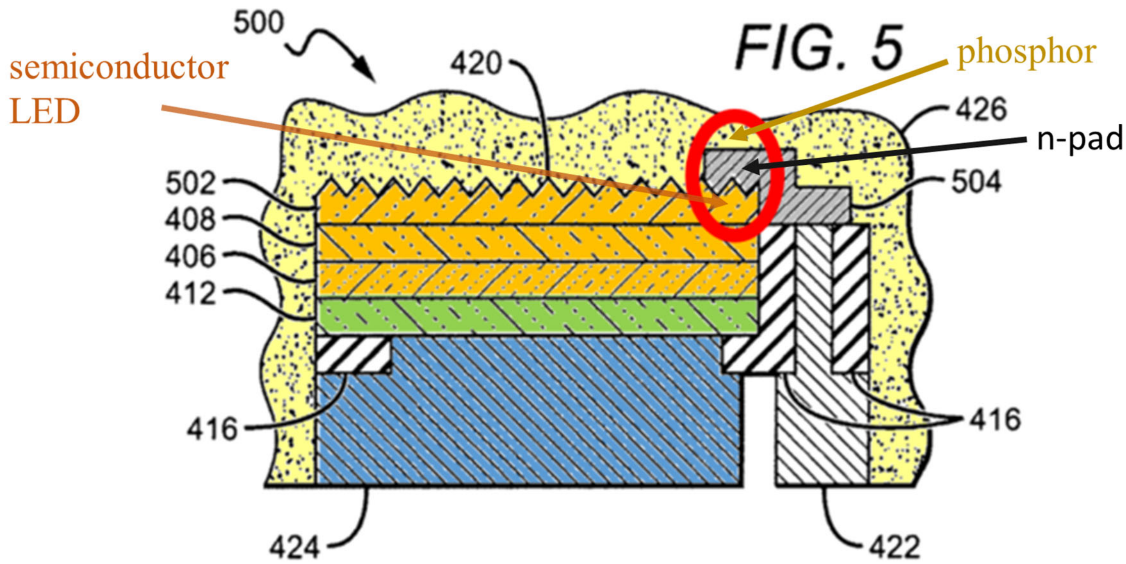
A POSITA would have further recognized that implementing Chakraborty's teachings regarding the flat encapsulant 420 in Keller would have provided protection to Keller's Figure 5 LED device, allowed shaping of the outgoing light beam, and improved the color temperature distribution uniformity of the output profile. (Ex. 1006, 7:47-55, 8:36-46.) A POSITA facing the wide range of needs created by developments in the technical field of Keller and Chakraborty would have appreciated the benefits of using flat encapsulant 420 as described in Chakraborty with Keller's LED device. (Ex. 1002 ¶98; *see also* Section IX.A.1.f.(1).) Indeed, Keller discloses that an LED device may include additional layers such as encapsulants "to shape an optical beam or otherwise alter the properties of the emitted light" (Ex. 1005, 6:16-23), which is accomplished by the flat encapsulant 420.

A POSITA would have been skilled and knowledgeable about configuring Keller's LED device to include a flat encapsulant covering at least the top face of the phosphor layer 426, while considering any known design, and other related concepts, limitations, benefits, and the like to ensure the resulting combination operated properly and as intended. (*Id*. ¶99.) Thus, a POSITA would have had a reasonable expectation of success in the above modification. (*Id*. ¶¶100-101); *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).

Accordingly, the combination of Keller with Chakraborty discloses or suggests claim limitation 1.f. (Ex. 1002 ¶102.)

g) a metal pad between said semiconductor LED and said optically permissive layer,

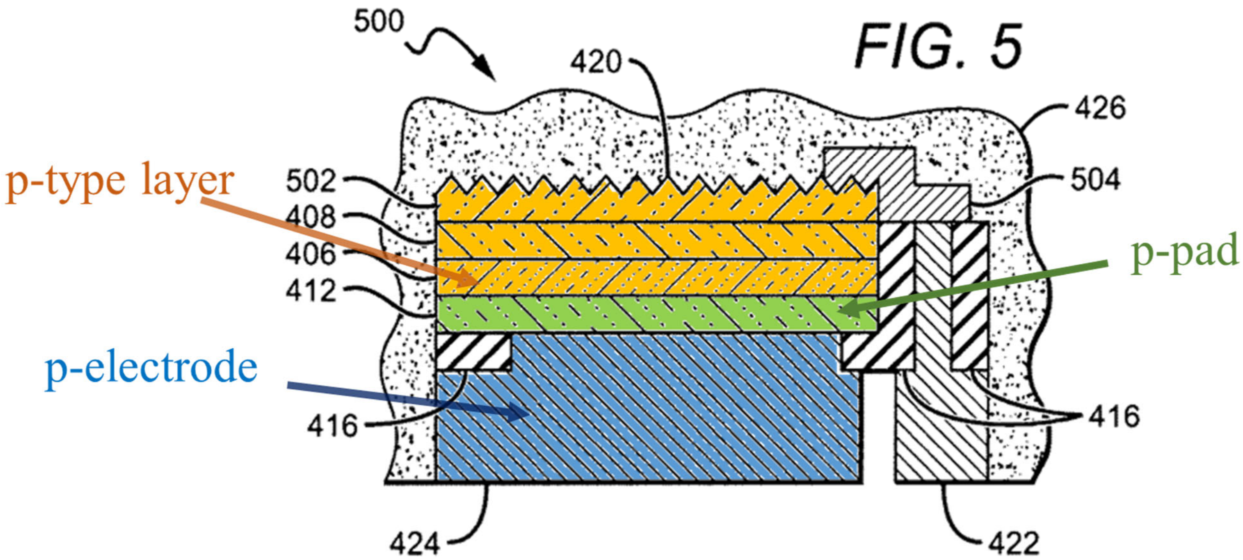
The combination of Keller and Chakraborty discloses or suggests this limitation. (Ex. 1002 ¶¶103-106.) For example, as discussed above, the combined Keller-Chakraborty light emitting device includes the LED device of Figure 5 of Keller. This configuration includes an n-pad 504 between the n-type layer 502 of the semiconductor LED and the phosphor layer 426 ("optically permissive layer"). (Ex. 1005, 10:64-11:11, FIG. 5.) The n-pad "may comprise a conductive metal material such as gold, silver or copper, for example." (*Id.*, 8:57-58.) Accordingly, a POSITA would have understood that the n-pad 504 is a "metal pad," which is situated between the semiconductor LED and the phosphor layer 426. (Ex. 1002 ¶104.)



(Ex. 1005, FIG. 5 (annotated); Ex. 1002 ¶104.)

h) wherein, said first surface of said semiconductor LED, said metallic interface and said conducting support layer are all electrically coupled to one another.

The combination of Keller and Chakraborty discloses or suggests this limitation. (Ex. 1002 ¶¶107-109.) As discussed above, the combined Keller-Chakraborty light emitting device includes a semiconductor LED (i.e., elements 406, 408, and 502), a p-electrode 424 ("conducting support layer"), and a p-pad 412 ("metallic interface"). (*Supra* Sections IX.A.1.b-c.) Because they are both conductive, the p-electrode 424 and p-pad 412 are electrically coupled to the bottom surface of the p-type layer 406 ("first surface of said semiconductor LED"). (Ex. 1005, 10:9-15, FIG. 5.)



(*Id.*, FIG. 5 (annotated); Ex. 1002 ¶107.)

2. Claim 7

a) The light emitting device of claim 1, wherein the metallic interface is adjacent to both the conducting support layer and the semiconductor LED.

The Keller-Chakraborty combination discloses or suggests claim 7. (Ex. 1002 ¶110.) For example, as apparent from Figure 5 of Keller, the p-pad 412 ("metallic interface") is adjacent to the exposed surface of the p-type layer 406 of the semiconductor LED (Ex. 1005, 8:52-53) and the p-electrode 424 (*id.*, 10:13-15).

3. Claim 8

a) The light emitting device of claim 1, said conducting support layer comprises copper.

The Keller-Chakraborty combination discloses or suggests claim 8 for the reasons below and those discussed above for claim limitation 1.c. (*See supra* Section IX.A.1.c; Ex. 1002 ¶¶111-112.) For example, as discussed above, the p-electrode 424 ("conducting support layer") is formed from a conductive metal layer, such as copper. (*See supra* Section IX.A.1.c; Ex. 1005, 9:21-34 (indicating that copper is a "preferred material" for the conductive metal layer 418 used to form the p-electrode 424).)

B. Ground 2: The Combination of Keller and Wirth Render Obvious Claims 1, 2, 3, 7, and 8

1. Claim 1

a) - e)[7]

Keller discloses or suggests these limitations. (*See supra* Section IX.A.1.a-e; Ex. 1002 ¶¶113-118.)

[7] The claim language for limitations 1.a through 1.e is not repeated.

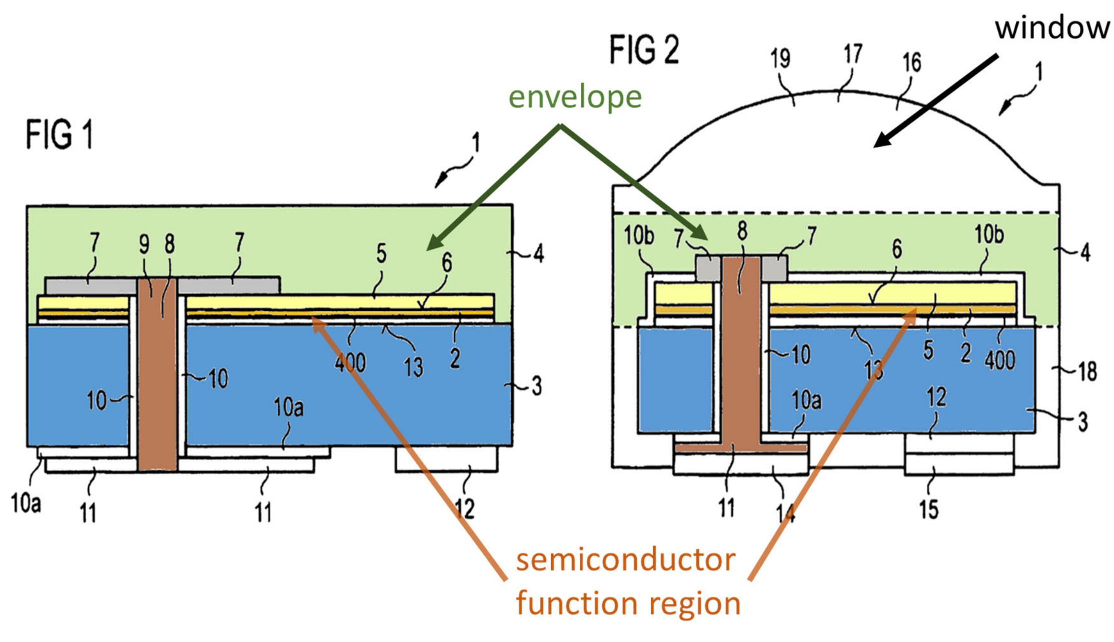
f) an optically permissive flat cover substrate covering at least a portion of the above components; and

The combination of Keller and Wirth discloses or suggests this limitation. (Ex. 1002 ¶¶119-131.) As discussed above for claim limitation 1.f in Ground 1, Keller discloses a light emitting device with a semiconductor LED and a phosphor layer 426. (*Supra* Section IX.A.1.f.) Keller further discloses that "an encapsulant, and other elements or features … are typically added" to the light emitting device (Ex. 1005, 10:60-63; *see also id.*, 6:19-26), but Keller does not disclose such features in detail. (Ex. 1002 ¶119.) As discussed below, it would have been obvious to include an encapsulant over Keller's light emitting device of Figure 5 based on the teachings and suggestions of Wirth and the knowledge of a POSITA. (*Id.* ¶120.) The combined Keller and Wirth device discloses or suggests claim limitation 1.f, as discussed below.

(1) Wirth

Wirth, like Keller, discloses a light-emitting device and methods for manufacturing such devices. (Ex. 1007, Abstract; *see also id.,* 1:20-24, 6:59-7:2; Ex. 1002 ¶¶121, 44-52.) In particular, Wirth discloses a "device comprising a plurality of optoelectronic components that can be produced in a simplified and low-cost manner." (Ex. 1007, 1:59-61; *see also id.*, 4:47-62 ("The optoelectronic component …. can for example be configured in the manner of an LED chip") (excerpted), 18:17-38 (describing that the optoelectronic component in Figure 1 comprises a GaN LED), FIGS. 1, 2.)

With reference to Figures 1 and 2, Wirth discloses an LED structure that includes a "semiconductor function region 2" that is based on GaN, and, like Keller, includes a plurality of semiconductor layers. (*Id.*, 18:15-38, FIG. 1.) Also like Keller, Wirth discloses a phosphor layer positioned over the semiconductor function region 2. (*Id.*, 21:44-49.) Wirth further discloses an encapsulating element (such as an envelope 4 and a window 17) over the phosphor layer and the semiconductor function region 2 to *protect those layers from harmful external influences*. (*Id.*, 5:43-6:32, 20:36-39, 21:44-49, FIG. 1-2.)



(*Id.*, FIGS. 1, 2 (annotated); Ex. 1002 ¶122.)

Envelope 4 ("optically permissive flat cover substrate") covers the semiconductor function region 2 and the phosphor layer that overlies the semiconductor function region 2 such that envelope 4 "cover[s] at least a portion of the above components," as claimed. (Ex. 1007, 18:55-59, 21:44-49, FIGS. 1, 2; Ex. 1002 ¶123.) Envelope 4 is optically permissive because it "is preferably implemented as radiation-transparent" (Ex. 1007, 18:55-59) and it "contains … a silicone, a BCB, a glass, a spin-on oxide, such as Al_2O_3, or a resist" (*id.*). Additionally, as seen in both Figures 1 and 2, the envelope 4's top surface is flat. (*Id.*, FIG. 1 (element 4), FIG. 2 (same).[8]) Thus, a POSITA would have understood that envelope 4 is a radiation-transparent ("optically permissive") flat cover substrate, as claimed. (Ex. 1002 ¶¶123-124.)

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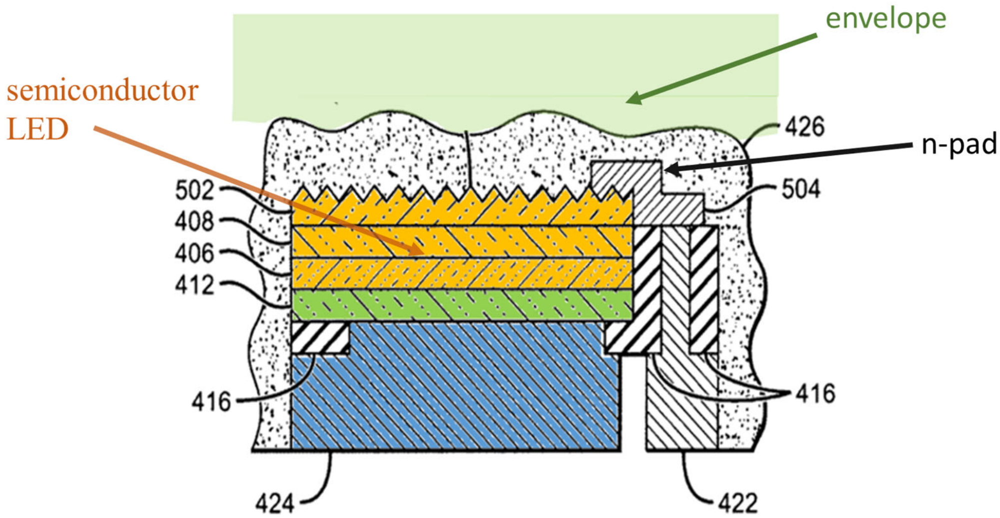
[8] Figure 2 includes a broken line that denotes the boundary area between window 17 and envelope 4. (Ex. 1007, 23:1-4; *see also id.*, 22:47-49, 23:39-46 (discussing gluing window 17 to envelope 4).) Given that the broken line denotes the boundary area between window 17 and envelope 4 and that this broken line is arranged parallel to the surface of the semiconductor function region 2, a POSITA would have understood that envelope 4 has a flat upper surface in Figure 2 as well. (Ex. 1002, n.4.)

(2) Reasons to Combine

A POSITA would have been motivated in light of Wirth to incorporate an encapsulation element (e.g., envelope 4 and window 17) like in Wirth, in Keller's LED device (as discussed above for claim limitations 1.a-f) so that the encapsulation may protect at least the phosphor layer 426 and LED components below it. (Ex. 1002 ¶125; Ex. 1007, 5:43-6:32.) Such an implementation would have been a straightforward combination of well-known technologies using known methods and would have had predictable results. *See KSR*, 550 U.S. at 416-18. Figure 5 of Keller is annotated below to show a non-limiting example of the inclusion of such a protective envelope, like that disclosed by Wirth, where the light green portion above phosphor layer 426 includes an envelope 4 and window 17, like in Wirth.



(Ex. 1005, FIG. 5 (annotated); Ex. 1002 ¶125.)

A POSITA would have recognized that Wirth and Keller disclose features in a similar technological field. (Ex. 1002 ¶¶126, 35-40, 44-52.) For example, as discussed above, both Keller and Wirth relate to techniques for fabricating semiconductor LED devices. (*Compare* Ex. 1005, Abstract, 5:29-66 *with* Ex. 1007, Abstract, 1:20-24, 6:59-7:2.) For these reasons, a POSITA would have had reason to consider the teachings of Wirth when fabricating an LED device as described in Keller, given Wirth discloses the benefits of using an envelope and/or window with an LED device like that disclosed in Keller. (Ex. 1002 ¶126-127; Ex. 1007, 5:43-6:32, FIGS. 1-2.) Indeed, Keller discloses that an LED device may include additional layers such as encapsulants. (Ex. 1005, 6:16-26).

Furthermore, using Wirth's encapsulation to cover the phosphor layer 426 of the Keller LED device in the above combination would have been a straightforward application of basic engineering principles for designing a semiconductor LED device. (Ex. 1002 ¶¶128-129.) Such knowledge, coupled with the disclosures/suggestions of Wirth, would have motivated a POSITA to use an encapsulant, like in Wirth, in Keller's LED device to protect the LED device and provide Keller's desired light-shaping or altering functionality. (*Id.* ¶¶128-129.) Furthermore, Wirth's encapsulation includes window 17, which can comprise "a glass, a portion of a glass plate or substantially the same material as the envelope"

(Ex. 1007, 22:62-64) with an "optical element 19" (*id.*, 23:5-6). "[T]he optical element is configured as convex in the manner of *a lens* and *advantageously increases the efficiency of the optoelectronic component*." (*Id.*, 23:15-18 (emphases added).) Thus, adding the encapsulation (which includes window 17) would not only have added protection to Keller's LED device but also increased the efficiency thereof. (Ex. 1002 ¶129.) Indeed, Wirth's disclosure of a lens as part of the encapsulation is consistent with Keller's disclosure that an "encapsulation . . . added over the device . . . may function as a lens." (Ex. 1005, 6:13-23.)

The combination of Keller with Wirth would have involved the use of known technologies (e.g., semiconductor devices), design concepts, and processes to obtain the foreseeable result of an LED device with an encapsulant over the phosphor and semiconductor layers to protect those layers. (Ex. 1002 ¶130.) A POSITA would have been skilled and knowledgeable in making the above modifications to Keller's device while considering any known design and related concepts, limitations, benefits, and the like to ensure the resulting combination operated properly and as intended. (*Id.*) Thus, a POSITA would have had a reasonable expectation of success in the above modification. *See Pfizer*, 480 F.3d at 1364.

The combination of Keller with Wirth discloses or suggests claim limitation 1.f. (Ex. 1002 ¶131.)

g) a metal pad between said semiconductor LED and said optically permissive layer,

The combination of Keller and Wirth discloses or suggests this limitation. (Ex. 1002 ¶¶132-134.) As explained above for claim limitation 1.g in Ground 1, Keller discloses a metal pad 504 between the surface of n-type layer 502 of the semiconductor LED and the phosphor layer 426 ("optically permissive layer"). (*Supra* Section IX.A.1.g; Ex. 1005, 8:57-58, 10:64-11:11, FIG. 5.)

h) wherein, said first surface of said semiconductor LED, said metallic interface and said conducting support layer are all electrically coupled to one another.

The combination of Keller and Wirth discloses or suggests this limitation. (Ex. 1002 ¶¶135-137.) As explained above for claim limitation 1.h in Ground 1, Keller discloses that the bottom surface of the p-type layer 406 ("a first surface of said semiconductor LED"), the p-electrode 424, and the p-pad 412 are all electrically coupled to one another. (*Supra* Section IX.A.1.h; *see also* Sections IX.A.1.b-c; Ex. 1005 FIG. 5.)

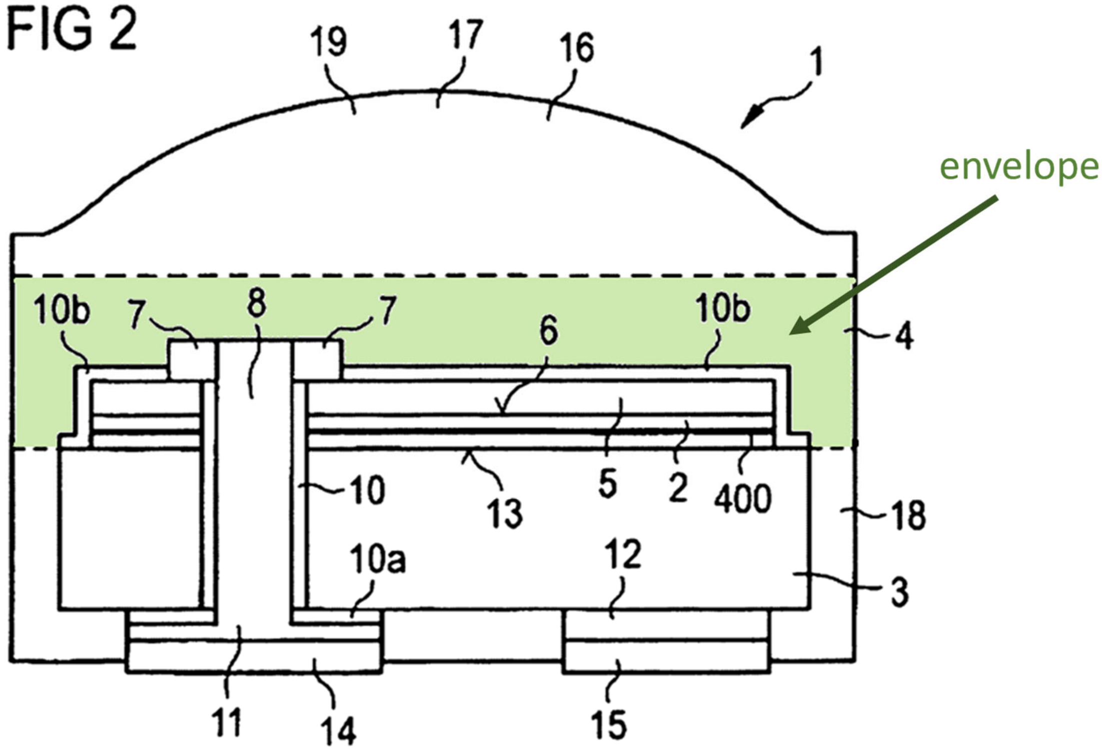
2. Claim 2

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

The Keller-Wirth combination discloses or suggests claim 2 for the reasons below and those discussed above for claim limitations 1.f. (*Supra* Section IX.B.1.f;

Ex. 1002 ¶¶138-141.) For example, the combined Keller-Wirth device includes "a window 17," which "is disposed after envelope 4." (Ex. 1007, 22:31-36; *supra* Section IX.B.1.f.)

FIG 2



(Ex. 1007, FIG. 2 (annotated); Ex. 1002 ¶138.)

Wirth explains that window 17 can comprise "a glass, a portion of a glass plate or substantially the same material as the envelope" (Ex. 1007, 22:62-64) with an "optical element 19" (*id.*, 23:5-6.) "[T]he optical element is configured as convex in the manner of *a lens*." (*Id.*, 23:15-18 (emphasis added).) For these reasons, a POSITA would have understood that Wirth discloses the feature of "a lens covering at least a portion of said optically permissive flat cover substrate," as claimed. (Ex. 1002 ¶139.) Thus, as combined in Section IX.B.1.f, the Keller-Wirth combination discloses or suggests "[t]he light emitting device of claim 1, further comprising a lens covering at least a portion of said optically permissive flat cover substrate." (Ex. 1002 ¶¶140-141.)

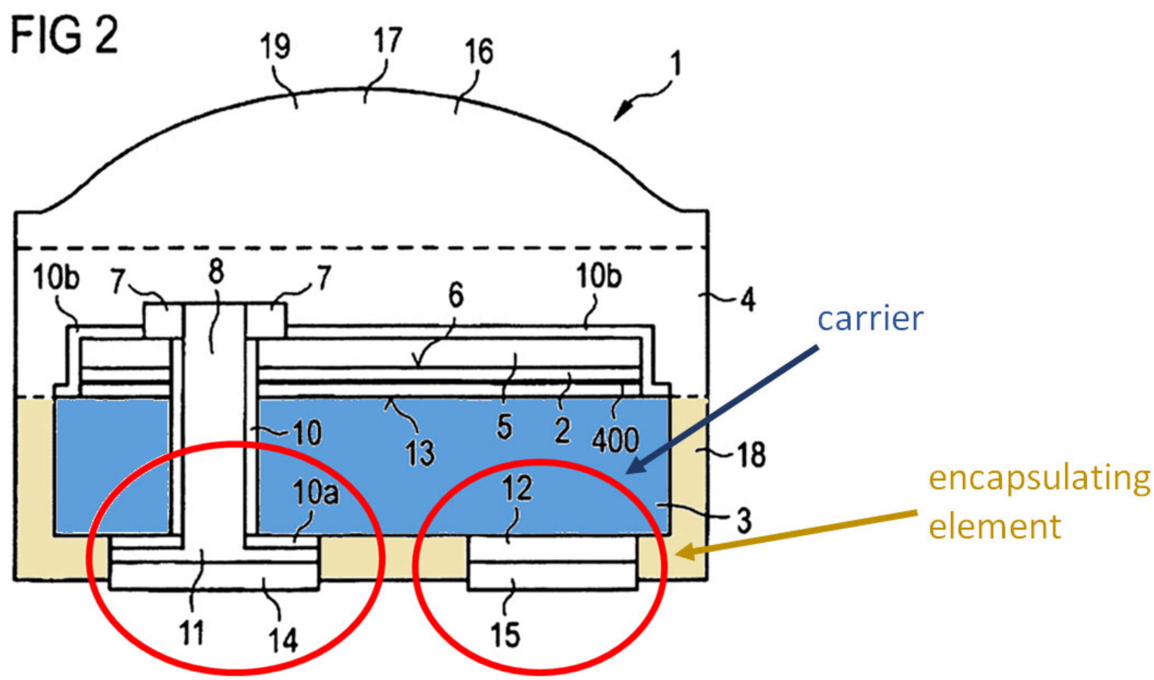
3. Claim 3

a) The light emitting device of claim 1, further comprising a passivation layer disposed on said conducting support layer, said passivation layer being substantially non-conductive yet provided with at least a pair of apertures for connection of conducting electrodes thereto.

The combination of Keller and Wirth discloses or suggests claim 3. (Ex. 1002 ¶¶142-156.) As discussed above for claim limitation 1.c, Keller discloses a light emitting device that includes a p-electrode 424 ("conducting support layer"). (*Supra* Section IX.B.1.c.) Keller also discloses that "an encapsulant, and other elements or features … are typically added" to the light emitting device (Ex. 1005, 10:60-63; *see also id.*, 6:19-26), but Keller does not disclose "a passivation layer disposed on said conducting support layer, said passivation layer being substantially non-conductive yet provided with at least a pair of apertures for connection of conducting electrodes thereto." (Ex. 1002 ¶142.) As discussed below, it would have been obvious to include an encapsulating element ("a passivation layer") that is disposed on the p-electrode 424 in Keller's light emitting device to embrace the p-electrode 424 based on the teachings and suggestions of Wirth and the knowledge of a POSITA. (*Id.* ¶143.)

(1) Wirth

As discussed above for limitation 1.f, Wirth, like Keller, discloses a light-emitting device and methods for manufacturing such devices. (*See supra* Section IX.B.1.f; Ex. 1002 ¶144.) Wirth also discloses that one or more encapsulating elements can be added to the device to protect the device—such as an encapsulating element 18. (Ex. 1007, 6:65-67 ("encapsulation, which can comprise the envelope and optionally one or more additional encapsulating elements … [to] advantageously increases the protection of the semiconductor function region or the active zone against harmful external influences."), 9:37-44 (explaining that an encapsulating element provides "mechanical[] stabiliz[ation]" to the device, thereby allowing very thin optoelectronic devices), 22:35-46, FIG. 2.) For example, encapsulating element 18, in Figure 2 below, is disposed in the direction of the carrier 3. (*Id.*, 22:35-37.) In particular, the encapsulating element 18 "embraces carrier 3, for example in a pincer-like manner, from the side thereof facing away from semiconductor function region 2." (*Id.*, 22:39-42; *see also id.*, 9:37-44.) The encapsulation layer 18, furthermore, is configured with two aperture-like structures (encircled) for the connection of conducting interconnects 11 and 12. (*Id.*, FIG. 2, 21:5-11, 22:16-28; *see also id.*, 6:9-14.) For instance, the encapsulating element 18 ("passivation layer") is "preferably configured such that the contacts of the optoelectronic component are electrically connectable preferably through the encapsulation." (*Id.*, 6:5-9.)



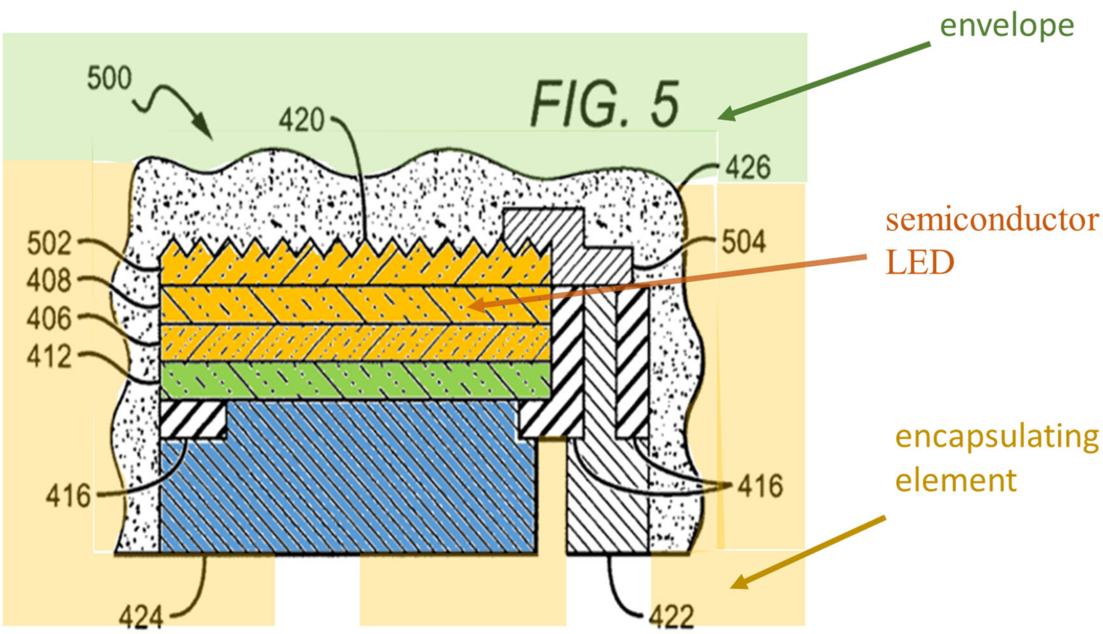
(*Id.*, FIG. 2 (annotated); Ex. 1002 ¶¶145-146.)

Wirth thus discloses an encapsulating element 18 ("passivation layer") that is "disposed on said conducting support layer, … [and] provided with at least a pair of apertures for connection of conducting electrodes thereto," as claimed.

(Ex. 1002 ¶147.) Furthermore, a POSITA would have understood that encapsulating element 18 is non-conductive because otherwise the two interconnects 11 and 12 would be short-circuited. (*Id.*) Encapsulating element 18 is a "passivation" layer because it provides protection to the LED device from harmful external influences. (Ex. 1007, 21:54-66; Ex. 1002 ¶¶148-149.)

(2) Reasons to Combine

A POSITA would have been motivated in light of Wirth to use an encapsulating element 18, as seen in Wirth's figure 2 in the combined Keller-Wirth device (as discussed above for claim limitations 1.a-h) to provide mechanical stabilization to the light emitting device and protect the device from harmful external influences. (Ex. 1002 ¶150; Ex. 1007, 9:37-44.) Indeed, such a non-conductive passivation layer would help to ensure electrical separation between the electrodes 422 and 424 in Keller, as well as electrical separation between the electrical connections that are made to those electrodes. Such an implementation would have been a straightforward combination of well-known technologies using known methods and would have had predictable results. *See KSR*, 550 U.S. at 416-18. Figure 5 of Keller has been annotated to provide a non-limiting example of the inclusion of a passivation layer, similar to that shown in Figure 2 of Wirth above, in the Keller-Wirth device.



(Ex. 1005, FIG. 5 (annotated); Ex. 1002 ¶150.)

A POSITA would have recognized that Wirth and Keller disclose features in a similar technological field. (Ex. 1002 ¶151.) For example, as discussed above, both Keller and Wirth relate to techniques for fabricating semiconductor LED devices. (*See supra* Section IX.B.1.f.) So a POSITA would have had reason to consider the teachings of Wirth when fabricating the combined Keller-Wirth LED device, given Wirth discloses the benefits of using an encapsulating element 18 with an LED device. (Ex. 1002 ¶151; Ex. 1007, 9:37-44, 22:39-58, 24:26-39, FIG. 2.)

A POSITA would have recognized that incorporating a passivation layer, like the encapsulating element 18 in the combined Keller-Wirth light emitting device, would have provided structural support to the device (Ex. 1007, 9:37-44, 22:39-42) and the encapsulating element 18 combined with the envelope 4 would provide a "substantially hermetically tight" encapsulation to protect the device from "external influences" (*id.*, 22:49-52). (Ex. 1002 ¶152.) In such a device, the apertures in encapsulating element 18 would allow electrical connection to the electrodes 422 and 424 in Keller. (*Id.*; *see also* Ex. 1005, 10:9-20.)

Furthermore, depositing the encapsulating element 18 onto the conducting support layer in the above combination would have been a straightforward application of basic engineering principles for designing a semiconductor LED device. (Ex. 1002 ¶153.) Such knowledge, coupled with the disclosures/suggestions of Wirth, would have motivated a POSITA to use an encapsulating element 18 in the combined Keller-Wirth LED device to protect the device. (*Id.* ¶154.)

The combination of Keller with Wirth would have involved the use of known technologies (e.g., semiconductor devices), design concepts, and processes to obtain the foreseeable result of an LED device using an encapsulating element 18 to protect the device. (*Id.* ¶155.) A POSITA would have been skilled and knowledgeable about configuring the combined Keller-Wirth LED device to have deposited an encapsulating element 18 on the conducting layer of the LED device, where encapsulating element 18 includes a pair of apertures for connection of conducting electrodes, while considering any known design and related concepts, limitations, benefits, and the like to ensure the resulting combination operated properly and as intended. (*Id.*) Thus, a POSITA would have had a reasonable expectation of success in the above modification. *See Pfizer*, 480 F.3d at 1364.

Accordingly, the combination of Keller with Wirth discloses or suggests claim 3. (Ex. 1002 ¶156.)

4. Claim 7

a) The light emitting device of claim 1, wherein the metallic interface is adjacent to both the conducting support layer and the semiconductor LED.

The Keller-Wirth combination discloses or suggests claim 7. (Ex. 1002 ¶157.) For example, as discussed above for claim 7 in Ground 1, Keller discloses such a configuration. (*See supra* Section IX.A.2.) Accordingly, a POSITA would have understood that the combined Keller-Wirth light emitting device included such a configuration. (Ex. 1002 ¶157.)

5. Claim 8

a) The light emitting device of claim 1, said conducting support layer comprises copper.

The Keller-Wirth combination discloses or suggests claim 8. (Ex. 1002 ¶158.) For example, as discussed above for claim 8 in Ground 1, Keller discloses that p-electrode 424 (“conducting support layer”) is formed from copper.

(*See supra* Section IX.A.3.) Accordingly, a POSITA would have understood that the combined Keller-Wirth light emitting device included such a configuration. (Ex. 1002 ¶158.)

C. Ground 3: The Combination of Keller, Wirth, and Tanimoto Render Obvious Claim 4

1. Claim 4

a) The light emitting device of claim 3, said passivation layer further comprising a shaped edge configured to reflect light generated by said light emitting device outwardly therefrom.

Keller in combination with Wirth and Tanimoto discloses or suggests claim 4. (Ex. 1002 ¶¶159-170.) As discussed above for claim 3, the Keller-Wirth combination discloses or suggests a passivation layer as recited in claim 3. (*See supra* Section IX.B.3.) However, neither Wirth nor Keller explicitly discloses a shaped edge 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 Keller-Wirth combination. (Ex. 1002 ¶¶160-161.)

(1) Tanimoto

Tanimoto, like Keller and Wirth, is directed to LED devices that include phosphor to adjust the wavelength of the light emitted by the LED. (Ex. 1008 ¶¶[0026], [0028], [0030]-[0031], [0048]; Ex. 1002 ¶¶162, 53-54.) For example, figures 4D and 4E of Tanimoto, reproduced in the annotated form below, show such an LED device, where a reflecting plate with a shaped edge is provided, and a POSITA would have understood that such a reflecting plate would help direct light generated by the LED outward from the LED in a direction opposite the position of underlying substrate 10. (Ex. 1008 ¶¶[0059]-[0060]; Ex. 1002 ¶162.)

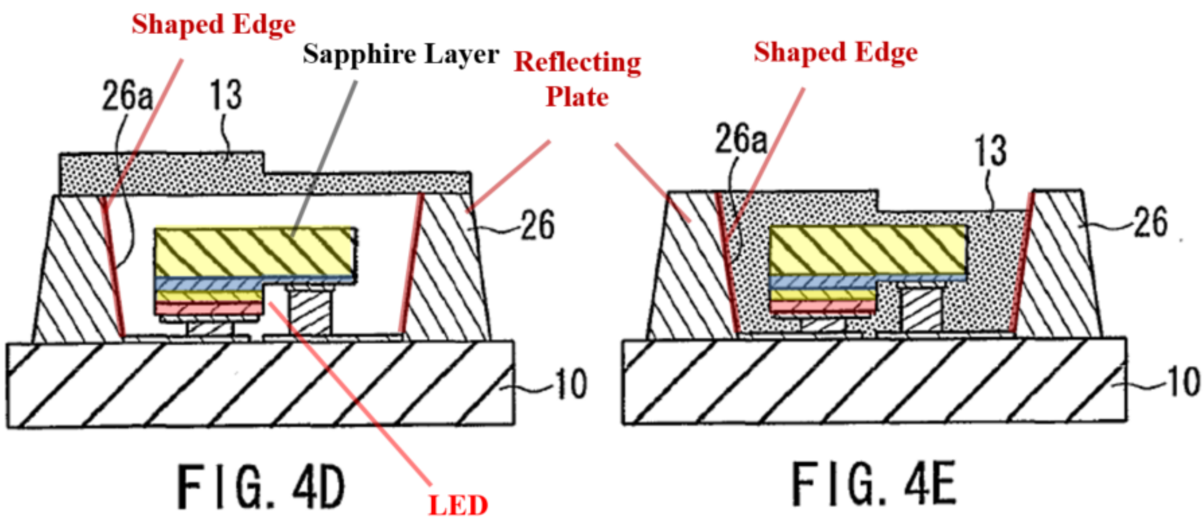


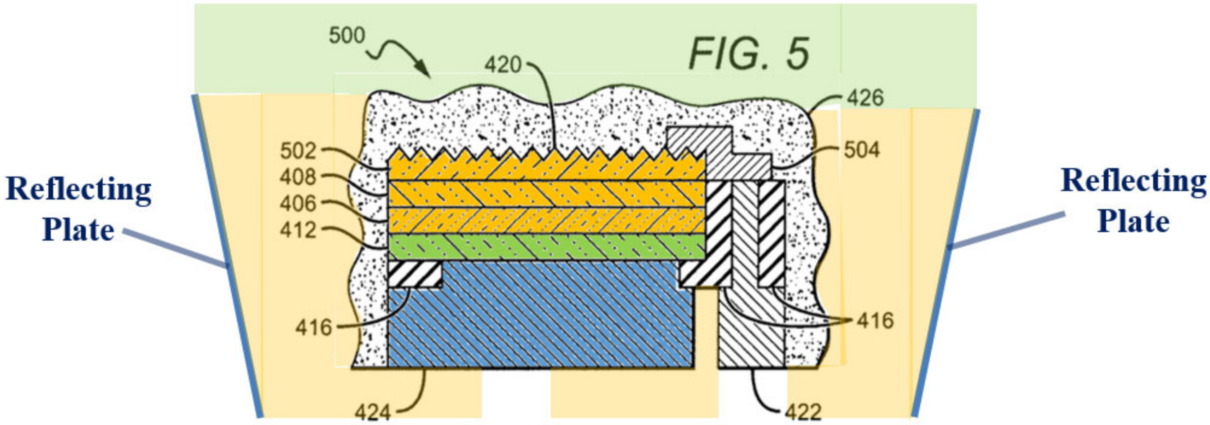
FIG. 4D FIG. 4E

(Ex. 1008, FIGS. 4D, 4E (annotated); Ex. 1002 ¶162.)

Tanimoto also discloses that the area between the shaped edges of the reflecting plate can be hollow or filled with a phosphor layer. (Ex. 1008 ¶¶[0059]-[0060].) In view of Tanimoto, a POSITA would have found it obvious to include similarly configured reflecting plates in the LED of the Keller-Wirth combination to direct the light from the LED in the intended direction through the cover substrate. (Ex. 1002 ¶¶163-164.)

(2) Reasons to Combine

A POSITA would have looked to Tanimoto for guidance regarding implementing LED devices as disclosed or suggested by the Keller-Wirth combination, particularly because Keller, Wirth, and Tanimoto are all references in the same field that disclose LED devices with many common features. (Ex. 1002 ¶¶165, 35-40, 44-54.) As discussed above with respect to claim 3, a POSITA would have found it obvious to include a passivation layer, like that disclosed by Wirth, in the Keller-Wirth combination in order to provide further encapsulation that protects the LED device from harmful external influences. (*See supra* Section IX.B.3.) Having looked to Tanimoto, such a person would have been motivated to include reflecting plates on the passivation layer in the LED of the Keller-Wirth combination to promote better use of the light produced by the LED. (Ex. 1002 ¶165.) A non-limiting example of the Keller-Wirth-Tanimoto combination is illustrated below, where the reflecting plates are positioned on the outer edges of the passivation material that encapsulates the LED device.



(Ex. 1005, FIG. 5 (annotated); Ex. 1002 ¶165.)

A POSITA would have found it straightforward to use reflecting plates as disclosed by Tanimoto in an LED device according to the Keller-Wirth combination based on the person's knowledge and Tanimoto's disclosure on how to implement such a feature in a similar device. (Ex. 1002 ¶166.) Moreover, such a skilled person would have had a reasonable expectation of success in using reflecting plates in an LED device according to the Keller-Wirth combination because, as shown by Tanimoto, such reflecting plates and similarly shaped features used to direct light outward from LEDs were commonplace in the prior art. (*Id.*)

Indeed, including such reflecting plates on the passivation layer in the LED of the Keller-Wirth combination would have been just 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 Keller-Wirth combination) to achieve a predictable result (improved directionality of the light generated by the LED). (*Id*. ¶167); *KSR*, 550 at 416. As discussed above, both Keller-Wirth, and Tanimoto all describe LED devices for generating light, but Tanimoto describes reflecting plates not found in Keller and Wirth for providing upward light reflection. As a result, a POSITA would have recognized that Tanimoto's teachings relating to reflecting plates could have been applied to the Keller-Wirth LED in a similar way. *Id.* at 417.

A POSITA would have also been motivated to include such reflecting plates in the Keller-Wirth-Tanimoto combination so that the area inside the reflecting plates is filled by the passivation layer discussed above for claim 3 having a tapered shape on both sides of the LED. (Ex. 1002 ¶168.) 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 Figure 5 of Keller above. As a result, the passivation layer would have included "a shaped edge configured to reflect light generated by said light emitting device outwardly therefrom" as recited in claim 4. (*Id*.)

Moreover, the shaped edges, which correspond to the reflecting plates of 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. (*Id*. ¶169.) Indeed, the use of reflecting plates along with the passivation layer tracks the disclosure of the '137 patent. (Ex. 1001, 6:61-7:3 ("the passivation layer 1270 has been cut and dimensioned to expose a shoulder 1202 in the device, which can be shaped in a beveled or contoured or angled way as shown in FIG. 13 *to provide a mirrored surface 1302 for reflecting light out of the light emitting device* 1301.") (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. 1008 ¶[0072] (emphasis added); Ex. 1002 ¶¶169-170.) As a result, the Keller-Wirth-Tanimoto combination discloses or suggests the features of claim 4.

D. Ground 4: The Combination of Keller, Wirth, and Tanaka Render Obvious Claim 6

1. Claim 6

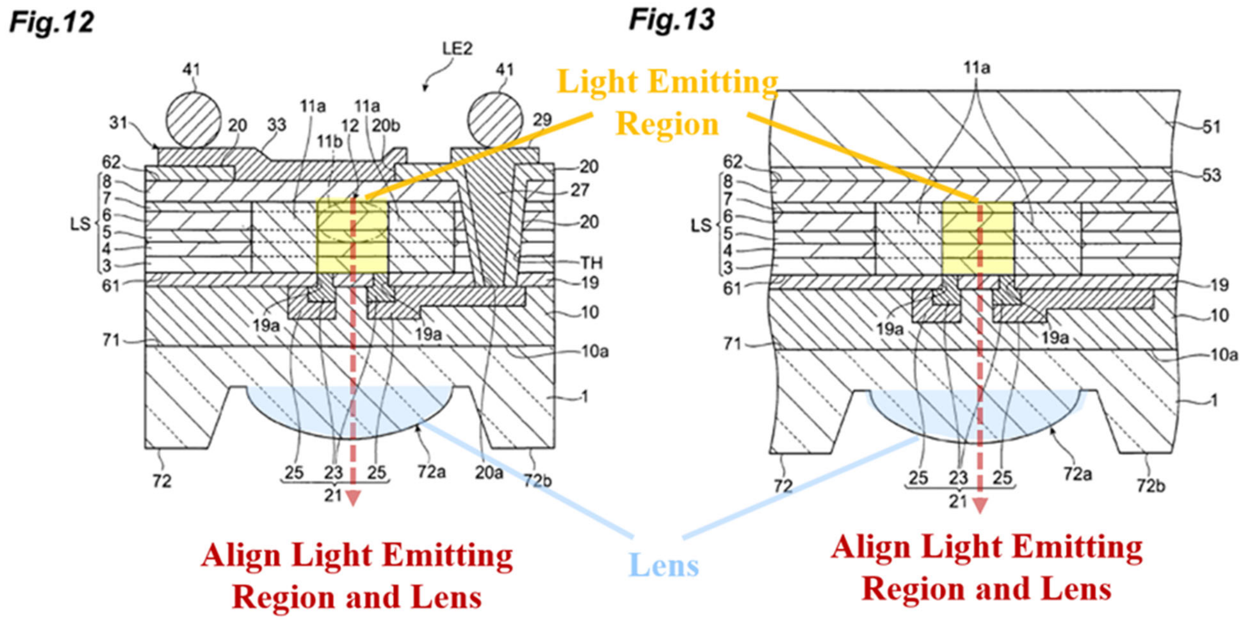
a) The light emitting device of claim 1, further comprising at least one alignment mark indicative of a required position of said device with respect to said optically permissive flat cover substrate.

Keller in combination with Wirth and Tanaka discloses or suggests claim 6. (Ex. 1002 ¶¶171-181.) As discussed above for claim 1, the combined Keller-Wirth device includes an envelope ("optically permissive flat cover substrate") and a window provided over the Figure 5 LED device of Keller. (*Supra* Section IX.B.1.f.) Neither Keller nor Wirth explicitly discloses the use of an alignment mark to position

Keller's LED device with respect to the envelope and window. But Tanaka discloses such a feature, and a POSITA would have found it obvious to include such a step of using an alignment mark for aligning the envelope and window to a required position on the LED device in the combined Keller-Wirth device. (Ex. 1002 ¶¶172-173.)

(1) Tanaka

Tanaka, like Keller and Wirth, is directed to fabricating LED devices. (Ex. 1009 ¶¶[0001], [0004]-[0006]; Ex. 1002 ¶¶174, 55-57.) For example, Tanaka discloses LED devices formed using a plurality of semiconductor layers, where a lens is affixed to the LED device. (Ex. 1009 ¶¶[0052], [0109]; *see also id.*, Abstract.) 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." (*Id.* ¶¶[0111]-[0112].)



(*Id*., FIGS. 12, 13 (annotated); Ex. 1002 ¶174.)

Tanaka discloses that the lens (which is the glass substrate 1 with lens part 72a) is aligned with the light emitting region of the LED using a marker. (Ex. 1009 ¶[0115].) For example, Tanaka discloses:

> With reference to **a marker provided on the rear face 72 side of the glass substrate** 1, the light-emitting region 11b on the semiconductor substrate 51 and the lens part 72a on the glass substrate 1 can be easily aligned with each other by using a double-sided aligner.

(*Id*. ¶[0116] (emphasis added); Ex. 1002 ¶¶175-176.)

(2) Reasons to Combine

As discussed above in Section IX.B.1.f, a POSITA would have been motivated to add an envelope and window (which includes a lens), like in Wirth, to

Keller's Figure 5 device. (*See* Ex. 1007, 23:5-24 (window 17 in Wirth functions as a lens).) A POSITA would have thus looked to Tanaka because it includes guidance regarding implementing LED devices as disclosed or suggested by the Keller-Wirth combination. (Ex. 1002 ¶177.) Having looked to Tanaka, a POSITA would have been motivated to include at least one reference mark for arranging and aligning Wirth's envelope and window with Keller's LED in order to allow the envelope and window combination to be properly positioned on Keller's LED (and thereby improve the optical performance of the resulting LED device.) (*Id.*)

The envelope and window combination in Wirth is analogous to the lens in Tanaka. (*Id.* ¶178.) Accordingly, a POSITA would have been motivated based on Tanaka's disclosure of alignment markers to use a similar alignment marker in the Keller-Wirth device to ensure proper positioning of the lens with respect to the rest of the LED device. (*Id.*; Ex. 1009 ¶¶[0115]-[0116].)

Moreover, such a skilled person would have had a reasonable expectation of success in using at least one reference mark in the combined Keller-Wirth LED device because, as shown by Tanaka, such alignment techniques were commonplace in the prior art. (Ex. 1002 ¶179; *see also* Ex. 1010, 1:33-35 (explaining that the use of alignment marks are necessary on the LED chips for alignment), Ex. 1011 ¶¶[0005]-[0007] (explaining that the use of alignment marks for aligning parts, such as a cover and optical element (e.g., lens), on an LED devices reduces manufacturing tolerances and improves the accuracy of a correct arrangement, thereby improving optical performance of the LED device).)[9]

Indeed, including at least one reference mark in the combined Keller-Wirth LED device, which indicates a required position of the LED device to the lens, would have been just applying a known feature (aligning an encapsulant that is a cover or lens based on a reference mark on the LED as disclosed by Tanaka) to a particular device (the combined Keller-Wirth LED device) to achieve a predictable result (proper alignment of the encapsulant on the LED device). (Ex. 1002 ¶180; *KSR*, 550 at 416.

Therefore, the combined Keller-Wirth-Tanaka LED device discloses or suggests "at least one alignment mark indicative of a required position of said device with respect to said optically permissive flat cover substrate" as recited in claim 6. (*Id*. ¶181.)

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[9] Petitioner is citing Koizumi (Ex. 1010) and Willwohl (Ex. 1011) only to demonstrate knowledge of a POSITA.

E. Ground 5: Wirth in View of AAPA and Keller Render Obvious Claims 9 and 10

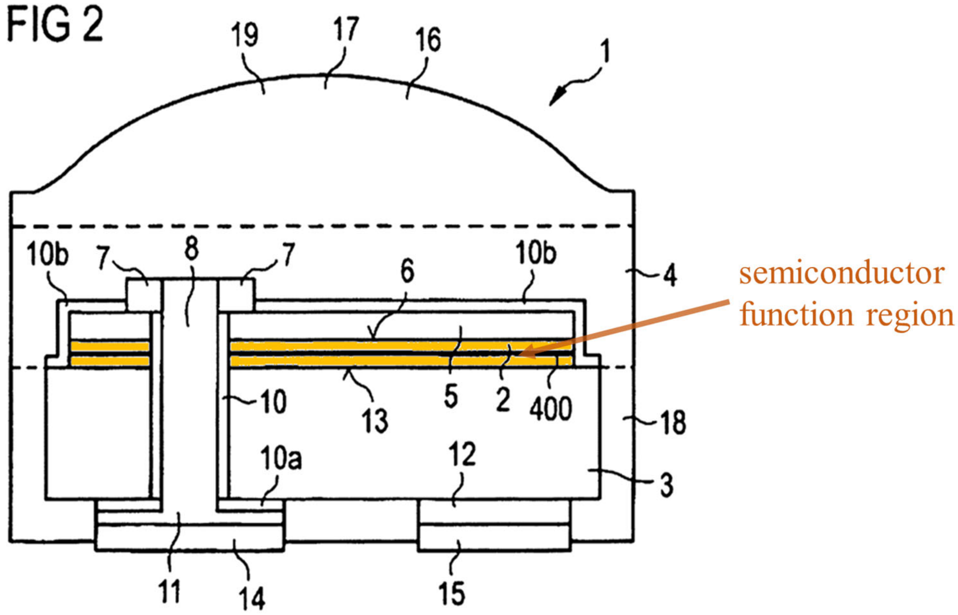
1. Claim 9

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

Wirth discloses the preamble of claim 9. (Ex. 1002 ¶¶182-184.) Wirth discloses an optoelectronic component 1 ("light emitting device") that includes a semiconductor function region 2 as illustrated in Figure 2 below. (Ex. 1007, 18:17-21.)[10] Wirth explains that the semiconductor function region 2 includes an active zone 400 that emits light. (*Id.*, 18:25-33.)

[10] Wirth's description corresponding to components in Figure 1 equally applies to the similar components in Figure 2. (Ex. 1002, n.6.) This is so because Wirth explains that "[t]he component shown here [in FIG. 2] is substantially the same as that depicted in FIG. 1" (Ex. 1007, 21:52-53) and Figure 2 contains several common elements denoted by the same reference numbers to those in Figure 1 (*compare id.*, Fig. 1 *with* Fig. 2). Nor does Wirth repeat the description of the functions of the common components shown in its Figures. (Ex. 1002, n.6; Ex. 1007, 21:50-24:53.)

FIG 2



(*Id*., FIG. 2 (annotated); Ex. 1002 ¶183.)

As explained below, Wirth also discloses the method of making the LED device of Figure 2. (Ex. 1002 ¶184; *see also infra* Section IX.E.1.b-i.)

b) growing a plurality of doped layers in a light emitting device (LED) on a substrate[11];

Wirth discloses this feature. (Ex. 1002 ¶¶185-188.) For example, Wirth discloses that the "semiconductor function region 2 . . . comprises a plurality of semiconductor layers and/or is based for example on GaN or GaP." (Ex. 1007, 18:25-38.) Wirth explains that the semiconductor function region 2 includes an

[11] Petitioner notes that "light emitting device" is not the same as the "light emitting device" of the preamble.

active zone 400 that emits light. (*Id.*, 18:25-33.) Therefore, Wirth's semiconductor function region 2 is a "light emitting device."

The "semiconductor function region 2" having the active zone 400 is further described with reference to Figure 4, which describes the process to prepare "a component similar to that depicted in Figure 2 . . . ." (*Id.*, 27:22-26.) In particular, the semiconductor function region includes a "semiconductor layer sequence 200," which includes "active zone 400." (*Id.*, 27:27-32.) The semiconductor layer sequence 200 (and therefore, the semiconductor function region 2) is epitaxially grown on a growth substrate. (*Id.*, 18:39-47, 20:43-46, 23:60-24:13, 27:27-43.) Wirth further discloses that the "semiconductor layer sequence 200" can include doped layers that sandwich the active zone 400. (*Id.*, 40:36-43.) Thus, Wirth discloses "growing a plurality of doped layers in a light emitting device (LED) on a substrate." (Ex. 1002 ¶186.)

Petitioner notes that while the discussion of Figure 2 shows carrier layer 3 as the "growth substrate" (Ex. 1007, 18:39-47), Wirth also discloses a variation of Figure 2 in which the carrier layer 3 is **<u>not</u>** the "growth substrate" but is instead added to the semiconductor function region in a later step. (*Id.*, 23:60-24:25; *see also id.,* 8:20-35.) In this variation, the semiconductor function region 2 is epitaxially grown on a "growth substrate" (which is different from the carrier layer

3). (*Id.*, 23:60-24:25.) Petitioner relies on this variation of Figure 2 for purposes of claim 9. The "growth substrate" (that is different from carrier 3) is the claimed "substrate." (Ex. 1002 ¶¶187-188.)

c) depositing a metallic interface onto said LED opposite to said substrate;

Wirth discloses this feature. (Ex. 1002 ¶¶189-190.) In the variation of Figure 2 discussed above in Section IX.E.1.b, a "metallic, mirror layer" is applied on one side of the semiconductor function region 2 after growing the region epitaxially on the growth substrate. (Ex. 1007, 23:60-24:13 ("Once the mirror layer has been applied to the side of the semiconductor function region or semiconductor layer sequence facing away from the growth substrate, the growth substrate is removed.").) Wirth discloses that the metallic mirror layer ("metallic interface") can be applied to the "the side of the semiconductor function region … facing away from the growth substrate" by "vapor deposition or sputtering" (*Id.*, 9:6-12), and therefore discloses "depositing a metallic interface onto said LED opposite to said substrate" as recited in claim 9. (Ex. 1002 ¶190.)

d) electroplating a conductive support layer onto said metallic interface;

Wirth in combination with AAPA and Keller discloses or suggests this feature. (Ex. 1002 ¶¶191-197.) As discussed above for limitation 9.c, in the variation of Figure 2 where the carrier layer 3 is different from the growth substrate, Wirth discloses depositing a mirror layer on the side of the semiconductor function region 2 that is opposite the side facing the growth substrate. Wirth further discloses that a "carrier layer 3" is disposed onto the mirror layer ("metallic interface"). (Ex. 1007, 24:7-13.[12]) Carrier layer 3 is a "support layer" because it "supports and stabilizes the semiconductor function region mechanically." (*Id.*, 8:20-35.) Furthermore, Wirth discloses that carrier layer 3 is "preferably implemented as electrically conductive." (*Id.*, 20:22-25.) Therefore, carrier layer 3 is a "conductive support layer."

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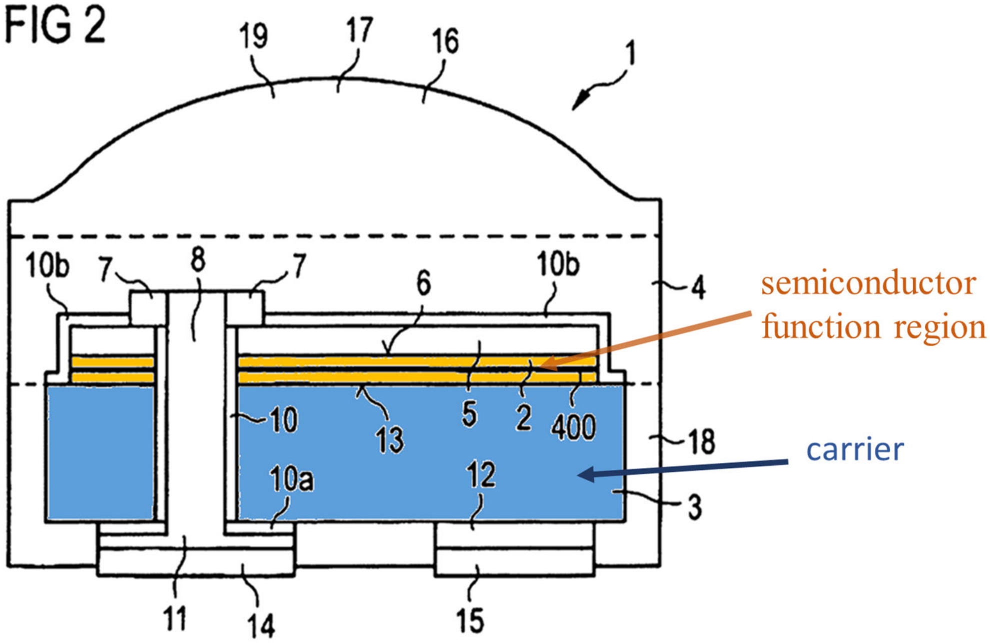
[12] This configuration can be seen in Figure 7 of Wirth, where the mirror layer 22 is between the semiconductor function region 2 and the carrier layer 3. (*Id.*, 24:14-25.)

FIG 2



(*Id.*, FIG. 2 (annotated); Ex. 1002 ¶¶192-193.[13])

Wirth does not, however, disclose that the carrier layer is formed by "electroplating." (Ex. 1002 ¶193.) The AAPA, however, discloses a metallic carrier layer, where, just like Wirth, a metallic interface separates the carrier layer from the semiconductor LED layers. (*Id.* ¶194.) Figure 2 of the AAPA, reproduced below, shows a conventional light emitting device 20 where a GaN semiconductor layer 200 (highlighted in orange) has been deposited/grown on a substrate 210 (e.g., sapphire) (highlighted in purple). (Ex. 1001, 3:54-65.) "A metallic interface 225 separates

[13] Figure 2 does not show the mirror layer because the mirror layer is part of the variation of Figure 2, which Petitioner relies upon. (Ex. 1007, 23:60-24:25.)

but provides an interface for GaN layer 200 and [a] carrier layer 220," which may be "Copper." (*Id.*, 3:56-60.)

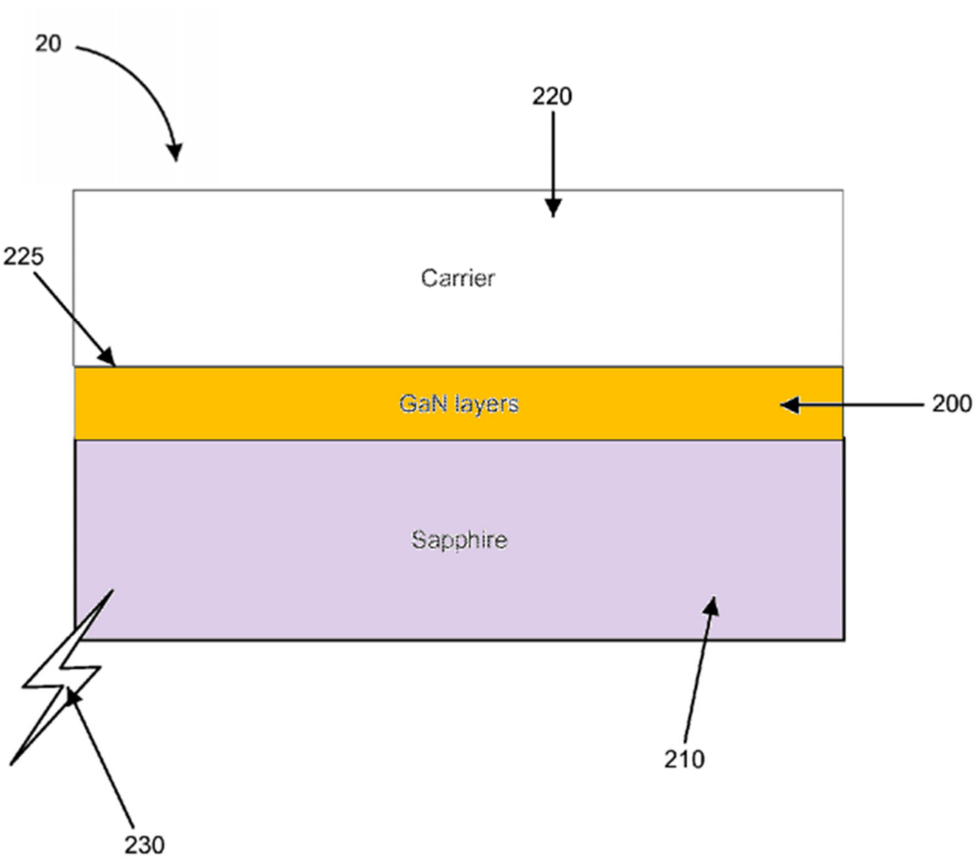


Fig. 2
(Prior Art)

(Ex. 1001, FIG. 2 (annotated and rearranged); Ex. 1002 ¶194.)

Thus, the '137 patent admits that conventional LED devices had conductive carrier layers and such "conductive" carrier layers could be copper. Moreover, as evidenced by Keller, it was well-known to use electroplating to apply a conductive layer (like Copper) onto another metallic interface. (Ex. 1002 ¶195, citing Ex. 1005, 9:21-34 (in an LED, depositing a Cu layer by electroplating onto another metallic interface).

In view of Wirth's disclosure that carrier layer 3 should be "conductive," and the '137 patent's admission that conventional LED devices had carrier layers made of copper, which a POSITA knew (based on Keller) could be electroplated, it would have been obvious to form carrier layer 3 on the mirror layer in Wirth by electroplating copper. (Ex. 1002 ¶196.) The '137 patent attributes no criticality to the use of electroplating. In fact, the detailed description of the '137 patent does not even discuss this feature demonstrating that the claimed feature merely adopted a prior known way of forming conductive carrier layers. (*Id.*)

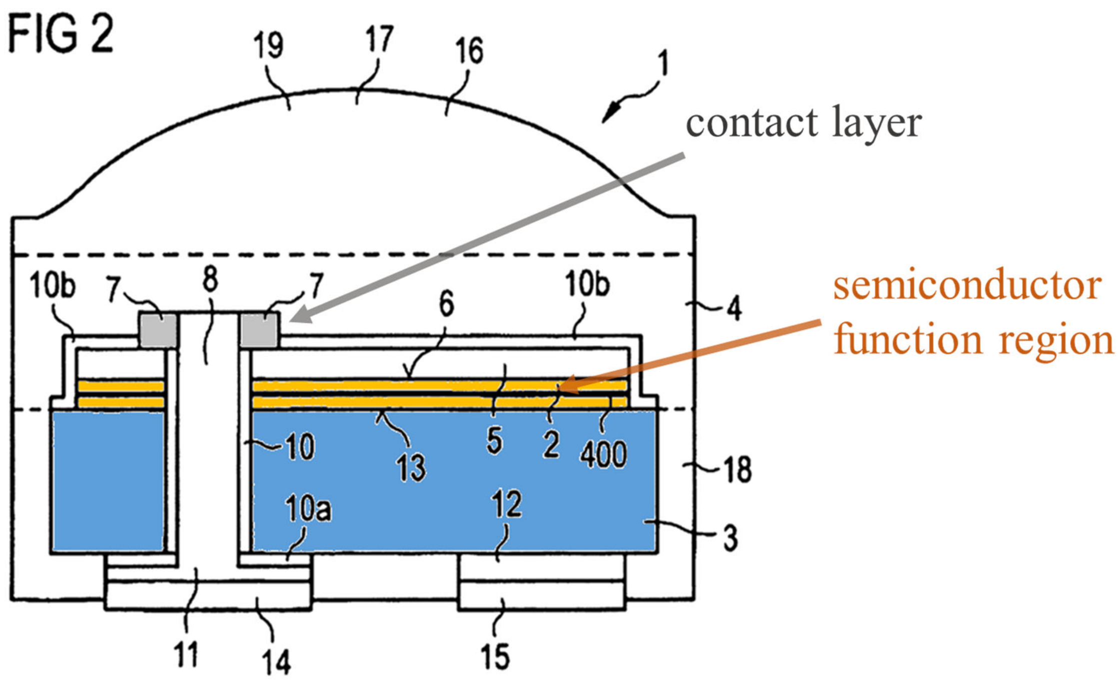
Based on the combined teachings of Wirth, Keller and AAPA, and the knowledge in the art, a POSITA would have had reasons to consider the teachings of Keller and AAPA when contemplating how to form carrier layer 3 on the mirror layer disclosed by Wirth. Indeed, electroplating a copper carrier layer on the mirror layer in Wirth would have been a predictable way to deposit the conductive support layer onto the metallic interface 225. (*Id.* ¶197.) Applying a copper carrier (like in AAPA) by electroplating copper (like in Keller) onto the metallic interface in Wirth would have been the application of a known technique (electroplating copper) to a known device (Wirth's LED device) to achieve a predictable result (carrier layer formed from copper). (*Id.*); *KSR*, 550 U.S. at 416.

e) lifting off said substrate from said LED;

The Wirth-AAPA-Keller combination discloses or suggests this limitation. (Ex. 1002 ¶¶198-202.) For instance, Wirth discloses removing the growth substrate. (Ex. 1007, 24:4-12.) Moreover, as was well-known in the prior art, this removal could be performed using a laser. (Ex. 1002 ¶200.) For example, the AAPA shows the growth substrate removal using "laser liftoff." (Ex. 1001, 3:66-4:2.) Similarly, Keller discloses that the growth substrate can be removed by "known methods" such as "laser ablation," confirming the well-known nature of laser lift off as admitted by the AAPA. (Ex. 1005, 9:35-40.) Based on the combined teachings of Wirth, Keller and AAPA, and the knowledge in the art, a POSITA would have had reasons to consider the teachings of Keller and AAPA when contemplating how to remove the growth substrate in Wirth's process. (Ex. 1002 ¶201.) Applying a laser liftoff, like in AAPA and Keller, to the growth substrate in Wirth would have been the application of a known technique (using laser liftoff) to a known device (Wirth's LED device) to achieve a predictable result (removal of the growth substrate). (*Id.* ¶¶201-202); *KSR*, 550 U.S. at 416.

f) forming a metal pad on the newly exposed LED surface;

The Wirth-AAPA-Keller combination discloses or suggests this limitation. (Ex. 1002 ¶¶203-206.) Wirth discloses a contact layer 7, which is a metal, on top of the semiconductor function region 2. (Ex. 1007, 19:35-41 (emphasis added); *see also id*., 19:42-51 (also disclosing that the metal contact layer is configured as ring-shaped), FIG. 4E.) A POSITA would have understood that contact layer 7 is a "metal pad" that is used to supply current to the top surface of the LED layers (i.e., the semiconductor function region 2.) (Ex. 1002 ¶¶203-204.)



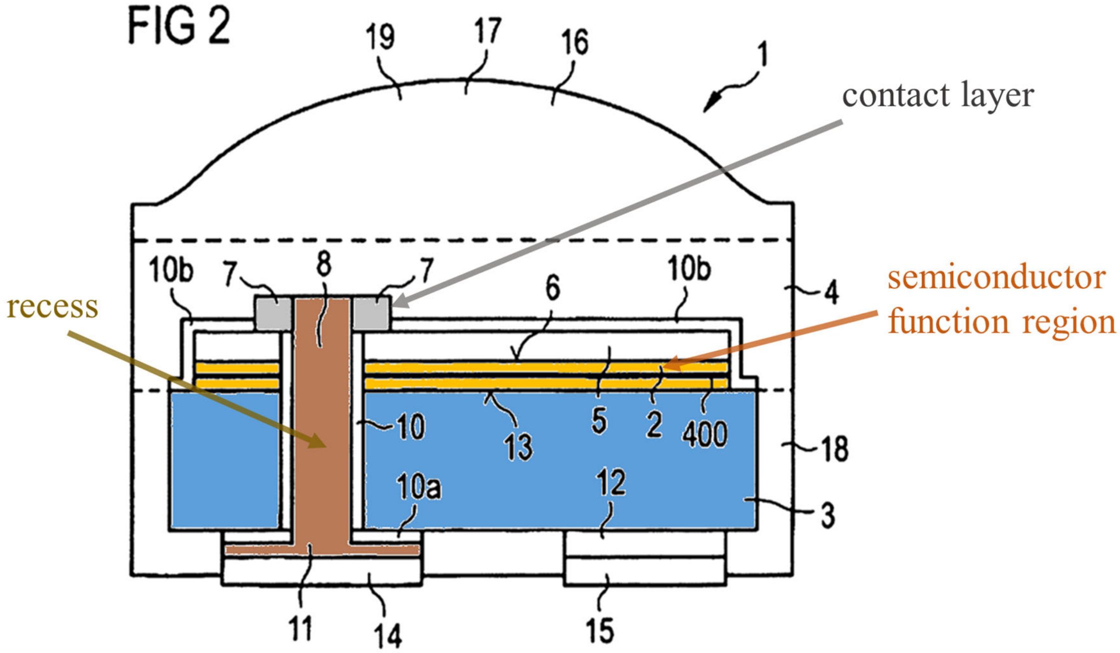
(Ex. 1007, FIG. 2 (annotated); Ex. 1002 ¶203.)

A POSITA would have further understood that the contact layer 7 would have been provided on top of the newly exposed surface of semiconductor function region 2 because that is the surface from which the growth substrate has been removed. (Ex. 1002 ¶205; Ex. 1007, 24:4-13.) Indeed, that is the only surface of the semiconductor function region 2 where a new element can be provided given that the other surface is covered by the metallic mirror followed by the carrier layer 3. (Ex. 1002 ¶205.)

g) etching a recess through said conductive support layer, said metallic interface and said LED so as to allow electrical contact with said metal pad and consequently a first doped layer of said LED;

The Wirth-AAPA-Keller process discloses or suggests this feature. (Ex. 1002 ¶¶207-212.) Wirth discloses forming a recess/gap 9, via etching, through the carrier and the LED (i.e., semiconductor function region 2). (Ex. 1007, 19:52-63, 28:45-48, FIGS. 1, 2; *see also id.*, 3:9-15, 11:6-20, 18:48-54.) Wirth explains that this recess/gap 9 is also filled with conducting conductor material 8 starting from the first contact layer 7 (*id.*, 19:52-63) to the first interconnect 11 (*id.*, 22:16-20.) (*Id.*, FIGS. 1, 2, 18:48-54.) This creates a conductive electrical path from interconnect 11 to the first main face 6 of the semiconductor function region through the conductor material 8 and first contact layer 7. (*Id.*, 21:66-22:4.)

FIG 2



(*Id.*, FIG. 2 (annotated); Ex. 1002 ¶¶208-210.)

Because "the semiconductor layer sequence is preferably implemented as p-conducting on the side comprising first main face 6 and n-conducting on the side comprising second main face 13, located oppositely from first main face 6 relative to active zone 400," (Ex. 1007, 47:22-28[14]), the first main face 6 corresponds to the

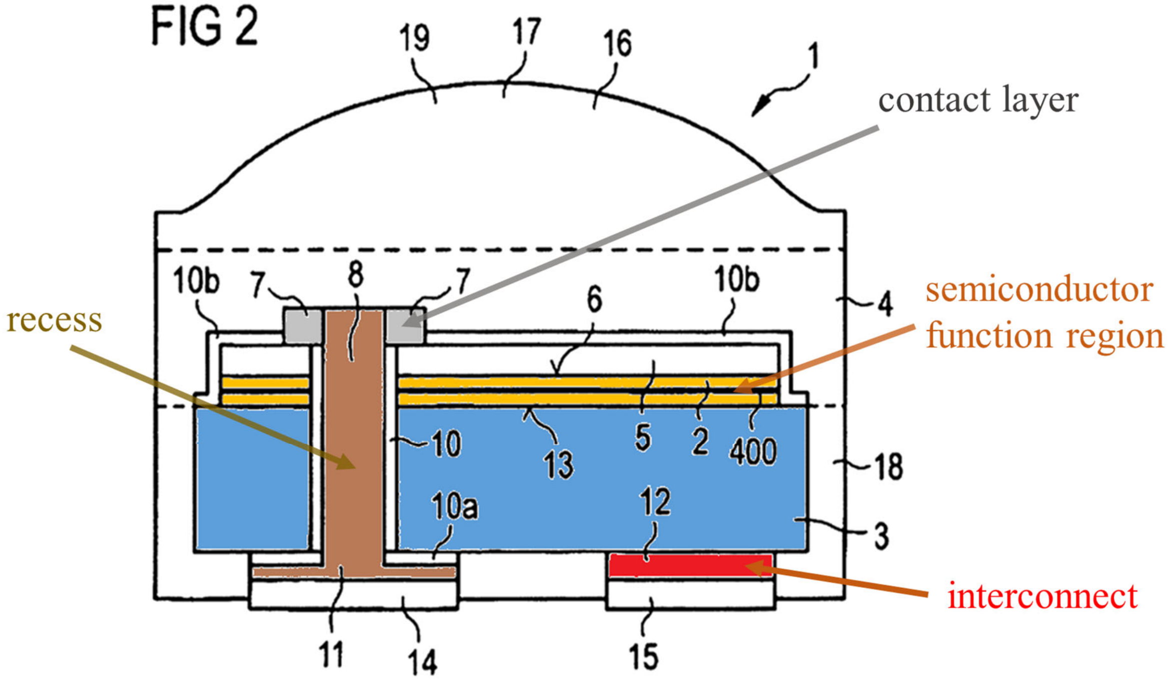
[14] A POSITA would have understood that this disclosure relates to the disclosure corresponding to Figure 2 in Wirth because the disclosure elaborates on the configuration of semiconductor layer sequence of the semiconductor function region 2. (Ex. 1002, n.9.)

p-type doped layer in the semiconductor layer sequence. As such, Wirth discloses or suggests that the metal pad 7 allows an electrical contact to the p-type doped layer ("first doped layer"). (Ex. 1002 ¶¶211-212.)

h) providing electrical contact to said conductive support layer and consequently to a second doped layer of said LED so as to bias the LED using a bias voltage applied between said first and second doped layers of the LED; and

The Wirth-AAPA-Keller combination discloses or suggests this limitation. (Ex. 1002 ¶¶213-219.) As discussed above in Sections IX.E.1(f)-(g), a contact layer 7 is formed with respect to the p-type doped layer ("first doped layer") of the semiconductor function region 2 ("LED") in the combined Wirth-AAPA-Keller device. (*See supra* Section IX.E.1.(f)-(g).) Similarly, as explained below, the combined Wirth-AAPA-Keller process further provides that an electrical contact (interconnect 12) is formed at the surface of the carrier layer 3 ("conductive support layer"), which in turn provides an electrical connection to the n-type layer ("second doped layer") of the semiconductor function region 2 so as to bias the semiconductor function region 2 using a bias voltage applied between the top and bottom doped layers of the semiconductor function region 2. (*E.g.*, Ex. 1007, 20:10-29, 32:15-21, FIG. 1.)

FIG 2



(*Id.*, FIG. 2 (annotated); Ex. 1002 ¶214.)

Wirth explains that "[i]nterconnect 12 is conductively connected ["providing electrical contact"] to the carrier [3]." (Ex. 1007, 20:22-25.) Carrier 3 is also electrically conductive. (*Id.*) As shown in Figure 2 above, carrier 3 contacts the second main face 13 of the bottom-doped layer in the semiconductor function region 2. (*Id.*, FIG. 2; *supra* Section IX.E.1.b.) Wirth further explains that "the second main face 13 of the semiconductor function region *is conductively connected* to second interconnect 12, [] via carrier 3." (*Id.*, 32:15-21 (emphasis added).) Accordingly, a POSITA would have understood that the interconnect 12 is configured to provided electrical contact to carrier 3 ("conductive support layer") and consequently to the second main face 13 ("second doped layer of said LED") because both interconnect 12 and carrier 3 are electrically conductive. (Ex. 1002 ¶215.) Moreover, second main face 13 corresponds to the n-doped layer. (Ex. 1007, 47:22-28.)

A POSITA would have also understood that interconnect 12 in Wirth is configured in order "to bias the LED using a bias voltage applied between said first and second doped layers of the LED." (Ex. 1002 ¶216.) For example, Wirth explains that "the semiconductor function region *can be driven electrically via the first interconnect and the second interconnect*." (Ex. 1007, 20:22-25(emphasis added).) As explained above, the second interconnect provides an electrical contact to the bottom-doped layer ("second doped layer") of the semiconductor function region 2. (*Id.*, 32:15-21.) Wirth also explains that the first main face 6 of the top-doped layer of the semiconductor function region 2 "is conductively connected via connecting conductor 8 to first interconnect 11." (*Id.*, 32:9-21.) Accordingly, a POSITA would have understood that there would have been bias voltage applied, using the interconnects, between the two doped layers in order for semiconductor function region to be *driven electrically* in order to emit light. (Ex. 1002 ¶217; Ex. 1007, 18:25-38 (explaining that the semiconductor function region is intended for radiating light), 21:31-43 (similar).) This common knowledge is confirmed by

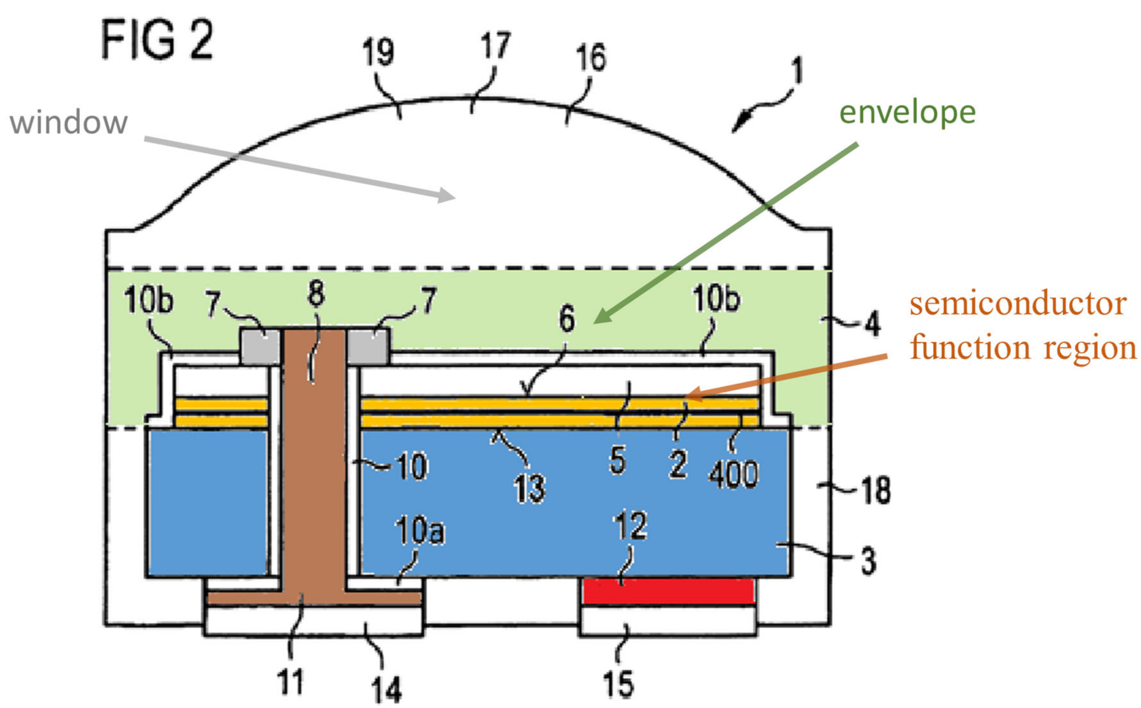
Keller, which discloses that "[w]hen a bias is applied across the doped layers, holes and electrons are injected into the active layer where they recombine to generate light." (Ex. 1005, 1:17-21.)

Wirth's disclosure regarding driving the semiconductor function region tracks the disclosure in the '137 patent. (Ex. 1002 ¶218.) For example, the '137 patent admits that it was known that an LED device "is driven using suitable electrical driving signals by way of electrodes or contacts coupled to the N and the P type portions of the LED" to "cause[] the emission of visible electromagnetic radiation (light) from the intrinsic portion of the device." (Ex. 1001, 3:26-32.)

The Wirth-AAPA-Keller process therefore discloses or suggests claim limitation 9.h. (Ex. 1002 ¶219.)

i) securing the LED to an optically permissive cover substrate using an optically permissive layer including an optically definable material through which light generated by said LED can pass.

The Wirth-AAPA-Keller process discloses or suggests this limitation. (Ex. 1002 ¶¶220-224.) For example, the optoelectronic component 1, as illustrated in Figure 2 below, includes a window 17 ("optically permissive cover substrate"). (Ex. 1007, 22:29-35.) Window 17 is "preferably configured as radiation-transparent ["optically transparent"] with respect to this radiation in order to advantageously increase the efficiency of the component." (*Id.*, 22:58-61.) Wirth also discloses that the window 17 is made of glass. (*Id.*, 22:62-64). Window 17, as illustrated in Figure 2 below, provides cover to envelope 4 of the optoelectronic component 1. (*Id.*, 22:31-35 ("This encapsulation includes a window 17, which, viewed from the first main face of the semiconductor function region, is disposed after envelope 4, which at least partially envelops or is embedded in the semiconductor function region.").) Accordingly, a POSITA would have understood that window 17 is "an optically permissive cover substrate," as claimed. (Ex. 1002 ¶221.)



(Ex. 1007, FIG. 2 (annotated); Ex. 1002 ¶221.)

Wirth's optoelectronic component 1 also includes an envelope 4 ("optically permissive layer"). (Ex. 1007, 18:55-58.) For example, Wirth discloses that envelope 4 "is preferably implemented as *radiation-transparent*" (*id.*, 18:55-58 (emphasis added)). Wirth discloses that "[a] phosphor, particularly for generating mixed color light, is preferably disposed in the envelope 4." (Ex. 1007, 23:51-53; *see also id.*, 23:53-59 ("In particular, the envelope material can serve as a carrier matrix for phosphor particles, which can subsequently be applied to the semiconductor function region along with the material of the envelope.").) Per Wirth, "phosphor particles . . . absorb[] the radiation generated by the semiconductor function region and remit[] it as longer-wavelength radiation." (Ex. 1007, 21:31-34.) Thus, phosphor is an "optically definable material" and envelope 4 is "an optically permissive layer including an optically definable material through which light generated by said LED can pass." (Ex. 1002 ¶¶222-223.)

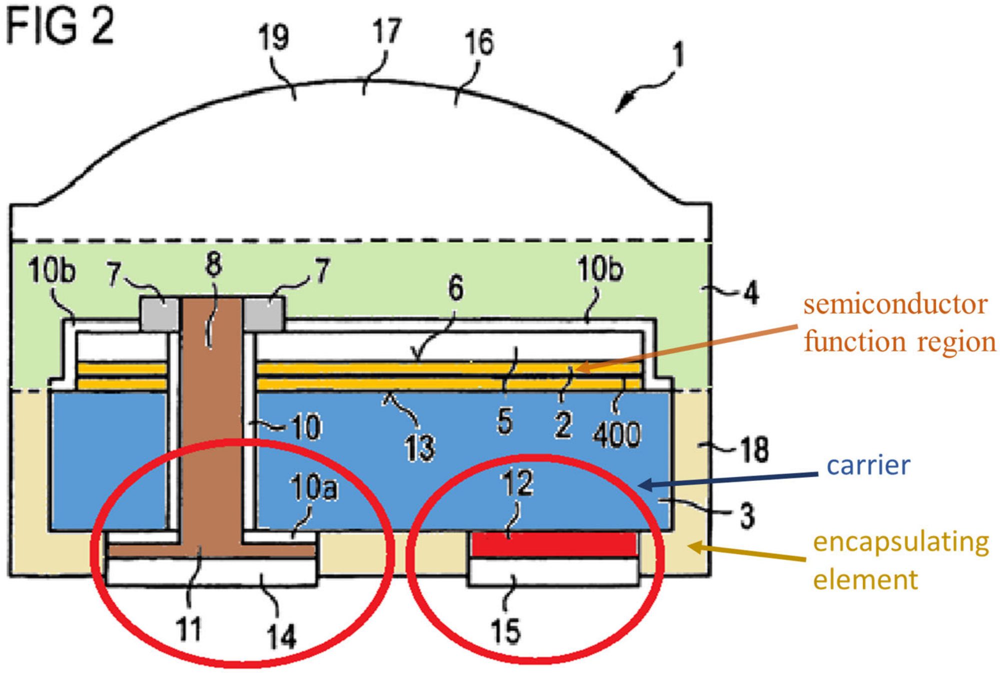
Wirth also discloses that the window 17 is ***secured*** to the LED using the envelope 4. Specifically, Wirth discloses that envelope 4, which may contain silicone, has an "adhesive action" such that window 17 may be glued to envelope 4. (Ex. 1007, 23:39-50.) Wirth's envelope 4 is therefore similar to the transparent adhesive layer 640 of the '137 patent, which "may be composed of silicone." (Ex. 1001, 4:57-60; Ex. 1002 ¶224.)

2. Claim 10

a) The method of claim 9, further comprising applying an electrically isolating passivation layer to said conductive support layer, and further providing at least a pair of apertures in said passivation layer for electrical coupling of a corresponding pair of biasing electrodes with corresponding first and second doped layers of said LED.

The Wirth-AAPA-Keller combination discloses or suggests claim 10. (Ex. 1002 ¶¶225-227.) For example, as discussed above for claim 3 in Ground 2, Wirth discloses that the encapsulation element 18 ("passivation layer"), which is non-conductive (e.g., "electrically isolating"), is disposed ("appl[ied]) on carrier 3 ("conductive support layer") as shown in Figure 2 below. (*See supra* Section IX.B.3; *see also* Ex. 1007, 22:35-42, FIG. 2.) In addition, as discussed above, two aperture-like structures (encircled) ("providing at least a pair of apertures") are situated in the encapsulation element 18 in order to provide electrical connecting of interconnects 11 and 12 (e.g., "corresponding pair of biasing electrodes") to the semiconductor function region. (*See supra* Section IX.B.3; *see also* Ex. 1007, 6:5-14, 22:16-28, FIG. 2.) A POSITA would have understood that interconnects 11 and 12 are electrodes where the bias voltage is applied. (Ex. 1002 ¶225; Ex. 1005, 3:22-30 (explaining that the bias voltage is applied to the LED device through electrodes).)

FIG 2



(Ex. 1007, FIG. 2 (annotated), Ex. 1002 ¶225.)

Furthermore, as illustrated in Figure 2, interconnects 11 and 12 are electrically coupled with a top and bottom-doped layer ("first and second doped layers) of the semiconductor function region 2 ("LED"), respectively. (*See supra* Section IX.B.3; *see also* Ex. 1007, 6:5-14, 21:5-11, 22:16-28, FIG. 2.)

Accordingly, the Wirth-AAPA-Keller combination discloses or suggests claim 10. (Ex. 1002 ¶¶226-227.)

F. Ground 6: The Combination of Wirth, AAPA, Keller and Tanaka Renders Obvious Claim 11

1. Claim 11

a) The method of claim 10, further comprising placing one or more alignment marks on said LED so as to permit proper positioning of said LED with respect to said optically permissive cover substrate.

Wirth in view of AAPA, Keller, and Tanaka discloses or suggests claim 11. (Ex. 1002 ¶¶228-235.) As discussed above for claim 9, the combined Wirth-AAPA-Keller process includes a step of securing the LED to an encapsulation (which includes an envelope and window). (*Supra* Section IX.E.1.i.) Wirth does not explicitly disclose the use of an alignment mark to position the LED with respect to this encapsulation. However, as discussed above in Section IX.D with respect to claim 6, it would have been obvious, in view of Tanaka, to use an alignment mark on the LED device to accurately position the envelope-window combination on the underlying LED device. (*Supra* Section IX.D.) For similar reasons, it would have been obvious to use alignment marks on the LED in the combined Wirth-AAPA-Keller process to position the envelope-window combination with respect to the LED device. (Ex. 1002 ¶¶231-235.)

X. DISCRETIONARY DENIAL IS NOT APPROPRIATE

The Board should decline any arguments for a discretionary denial under 35 U.S.C. §§ 314(a) or 325(d). The '137 patent is not at issue in any other proceeding before the Board. Therefore, the factors concerning discretionary denial under 35 U.S.C. § 314(a) set forth in *General Plastic Industrial Co., Ltd. v. Canon Kabushiki Kaisha*, IPR2016-01357, Paper No. 19 at 3, 8, 15-19 (Sept. 6, 2017), are not applicable here. Nor does Petitioner rely on any art or arguments that are the same or substantially the same as those previously presented to the Office. *See Advanced Bionics, LLC v. Med-El Elektromedizinische Geräte GmbH*, IPR2019-01469, Paper 6 at 8 (Feb. 13, 2020) (precedential).

Similarly, *NHK Spring Co., Ltd. v. Intri-Plex Techs, Inc.*, IPR2018-00752, Paper 8 (P.T.A.B. Sept. 12, 2018) does not apply here. *See Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 at 3 (P.T.A.B. Mar. 20, 2020) (precedential) ("*NHK* applies … where the district court has set a trial date to occur earlier than the Board's deadline to issue a final written decision in an instituted proceeding."). The six-factor test addressed in *Fintiv* favors institution. *See id.*, 5-6.

For the *first factor* (stay), there is no stay, but courts routinely issue stays after institution. *Western Digital Corp. et al v. Kuster*, IPR2020-01391, Paper 10 at 8-9 (Mar. 11, 2021); *Samsung Elec. Am., Inc. v. Snik LLC*, IPR2020-01427, Paper 10 at 10 (Mar. 9, 2021). At a minimum, this factor deserves little weight given that factors two through four and six weigh in favor of institution. *See Fintiv*, 7.

The second (proximity of trial dates) and third (investment in parallel proceedings) factors weigh in favor of institution. The district court has not set a trial date, and, there has not been significant resource investment by the court and the parties, particularly compared to the resource expenditures leading up to a trial. *See Resideo Techs., Inc. v. Innovation Sciences, LLC*, IPR2019-01306, Paper 19 at 11 (Jan. 27, 2020). Furthermore, the court's order governing patent proceedings sets a default Markman hearing date as "23 weeks after [case management conference] (or as soon as practicable)" and a default trial date as "52 weeks after Markman hearing (or as soon as practicable)." (Ex. 1022, 9, 11); *see Precision Planting, LLC. v. Deere & Co.*, IPR2019-01044, Paper 17 at 14-15 (P.T.A.B. Dec. 2, 2019) (weighs against finding that case is at "an advanced stage"); *Abbott Vascular, Inc. v. FlexStent, LLC*, IPR2019-00882, Paper 11 at 30 (P.T.A.B. Oct. 7, 2019) (same). Additionally, WDTX civil trials "may possibly slip" due to "months of backlogged trials." *HP Inc. v. Slingshot Printing LLC*, IPR2020-01085, Paper 12 at 7 (Jan. 14, 2021). Nevertheless, even "an early trial date" is "non-dispositive" and simply means that "the decision whether to institute will likely implicate other factors," which, as explained, favor institution. *Fintiv*, 5, 9.

Furthermore, the Board has held "that it is often reasonable for a petitioner to wait to file its petition until it learns which claims are being asserted against it in the parallel proceeding." *Id.* at 11. Here, Patent Owner has not served its infringement contentions.

The fourth factor (overlap) also weighs in favor of institution. For instance, Petitioner hereby stipulates that, if the IPR is instituted, Petitioner will not pursue the IPR grounds in the district court litigation. Thus, "[i]nstituting trial here serves overall system efficiency and integrity goals by not duplicating efforts and by resolving materially different patentability issues." *Apple, Inc. v. SEVEN Networks, LLC*, IPR2020-00156, Paper 10 at 19 (P.T.A.B. June 15, 2020) (finding the fourth factor "strongly favored" institution even though there was no stipulation and a significant dispute about the extent of overlap); *see also Sand Revolution II, LLC v. Continental Intermodal Group-Trucking LLC*, IPR2019-01393, Paper 24 at 12 (P.T.A.B. June 16, 2020) (finding the fourth factor weighs in favor of institution due, in part, to petitioner's stipulation that it will not pursue the same grounds in district court).

For the fifth factor (parties), the Petitioner and PO are the same parties as in district court.

The sixth factor (other circumstances) weighs in favor of institution given the undeniable similarity between Petitioner's primary reference and the '137 patent and that Petitioner diligently filed this Petition within six months of PO's complaint.

(Ex. 1021.) Institution is consistent with the significant public interest against "leaving bad patents enforceable." *Thryv, Inc. v. Click-To-Call Techs., LP*, 140 S. Ct. 1367, 1374 (2020). This Petition is the ***sole*** challenge to the '137 patent before the Board—a "crucial fact" favoring institution. *Google LLC v. Uniloc 2017 LLC*, IPR2020-00115, Paper 10 at 6 (May 12, 2020).

XI. CONCLUSION

For the reasons given above, Petitioner requests institution of IPR for the challenged claims based on each of the specified grounds.

Respectfully submitted,

Dated: September 7, 2021 By: /Naveen Modi/
Naveen Modi (Reg. No. 46,224)
Counsel for Petitioner

CERTIFICATE OF COMPLIANCE

Pursuant to 37 C.F.R. § 42.24(d), the undersigned certifies that the foregoing Petition for *Inter Partes* Review of U.S. Patent No. 8,941,137 contains, as measured by the word-processing system used to prepare this paper, 13074 words. This word count does not include the items excluded by 37 C.F.R. § 42.24 as not counting towards the word limit.

Respectfully submitted,

Dated: September 7, 2021 By: /Naveen Modi/
Naveen Modi (Reg. No. 46,224)
Counsel for Petitioner

CERTIFICATE OF SERVICE

I hereby certify that on September 7, 2021, I caused a true and correct copy of the foregoing Petition for *Inter Partes* Review of U.S. Patent No. 8,941,137 and supporting exhibits to be served via express mail on the Patent Owner at the following correspondence address of record as listed on PAIR:

Intrinsic Law Corp.
221 Moody Street
Waltham MA 02453

A courtesy copy was also sent via electronic mail to the Patent Owner's litigation counsel at the following addresses:

E. Leon Carter
lcarter@carterarnett.com
Scott W. Breedlove
sbreedlove@carterarnett.com
Joshua J. Bennett
jbennett@carterarnett.com
Bradley D. Liddle
bliddle@carterarnett.com
Nathan Cox
ncox@carterarnett.com
CARTER ARNETT PLLC
8150 N. Central Expy, 5th Floor
Dallas, Texas 75206

By: /Naveen Modi/
Naveen Modi (Reg. No. 46,224)0