

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SEOUL SEMICONDUCTOR, CO. LTD.,
Petitioner,

v.

LED WAFER SOLUTIONS, LLC,
Patent Owner.

IPR2021-01479
Patent 8,952,405 B2

Before LYNNE E. PETTIGREW, JEFFREY W. ABRAHAM, and
TERRENCE W. McMILLIN, *Administrative Patent Judges*.

McMILLIN, *Administrative Patent Judge*.

DECISION
Denying Institution of *Inter Partes* Review
35 U.S.C. § 314

I. INTRODUCTION

A. Background and Summary

Seoul Semiconductor, Co. Ltd. (“Petitioner”)¹ filed a Petition to institute an *inter partes* review of claims 1–4, 6, 8–14, and 16 of U.S. Patent No. 8,952,405 B2 (Ex. 1001, “the ’405 patent”) pursuant to 35 U.S.C. § 311 *et seq.* Paper 1 (“Petition” or “Pet.”). LED Wafer Solutions, LLC (“Patent Owner”)² filed a Preliminary Response. Paper 7 (“Preliminary Response” or “Prelim. Resp.”). With our authorization, Petitioner filed a Reply to the Preliminary Response (Paper 9 (“Reply”))³ and Patent Owner filed a Sur-reply (Paper 10 (“Sur-reply”)).

We have authority under 35 U.S.C. § 314, which provides that an *inter partes* review may not be instituted unless the information presented in the Petition and the Preliminary Response shows that “there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.” 35 U.S.C. § 314(a) (2018). After considering the Petition, the Preliminary Response, the Reply, the Sur-Reply and the evidence of record, we do not institute an *inter partes* review as to the challenged claims of the ’405 patent on the grounds of unpatentability presented.

¹ Petitioner indicates that its earlier identification of Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc. as real-parties-in interest in the Petition (*see* Pet. 81) was an error. Paper 4. Consequently, Petitioner identifies Seoul Semiconductor, Co., Ltd. as the correct real party-in-interest to this proceeding. *Id.*

² Patent Owner identifies LED Wafer Solutions, LLC as the real party-in-interest to this proceeding. Paper 5, 1.

³ Petitioner filed a Reply (Paper 8) and, later that same day, filed a Corrected Reply (Paper 9). We refer to the Corrected Reply (Paper 9) and treat it as Petitioner’s Reply to the Preliminary Response.

B. Related Proceedings

The parties identify *LED Wafer Solutions LLC v. Samsung Electronics Co., and Samsung Electronics America, Inc.*, No. 6:21-cv-292 (W.D. Tex.) as a related matter. Pet. 81; Paper 5, 1. The parties further identify IPR2021-01491 as a related matter. Pet. 81, Paper 5, 2. In IPR2021-01491, all the claims of the '405 patent are challenged as unpatentable. IPR2021-01491, Paper 1, 2. Patent Owner further identifies the following related matters in which additional patents owned by Patent Owner are challenged: IPR2021-01504, IPR2021-01506, IPR2021-01516, IPR2021-01526, and IPR2021-01554. Paper 5, 1–2.

C. The '405 Patent

The '405 patent is titled “Light Emitting Diode Package and Method of Manufacture.” Ex. 1001, code (54). The '405 patent explains that “output energy or light is determined by the materials and operating conditions of the LED, including the energy band gap of the LED material and the electrical biasing of the LED” but that “conventional LED devices can be relatively costly to manufacture by some metrics when compared to other light sources” due to their exacting package requirements. *Id.* at 1:28–31, 45–54. The '405 patent provides a light emitting diode (LED) device and packaging for the same in which “the LED is manufactured by epitaxial growth or other chemical or physical deposition techniques of a plurality of layers” and has certain layers which “act to promote mechanical, electrical, thermal, or optical characteristics of the device.” *Id.* at 1:66–2:8. According to the '405 patent, its device “avoids design problems, including manufacturing complexities, costs and heat dissipation problems found in conventional LED devices.” *Id.* at 2:8–10.

Figure 3 of the '405 patent, reproduced below, shows an exemplary LED device with metallization. *Id.* at 2:55–56.

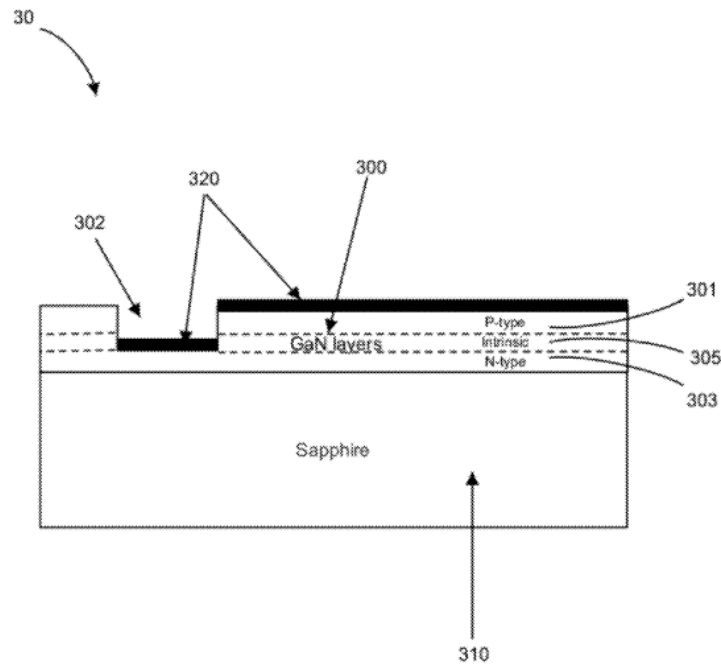


Fig. 3

Figure 3 depicts a LED device with metallization on its surface. *Id.* at 3:64–65. LED device 30 has GaN layer 300 that is disposed on sapphire layer 310. *Id.* at 3:67–4:1. GaN layer 300 comprises intrinsic semiconductor layer 305 positioned between P-type doped layer 301 and N-type doped layer 303 so that electrical biasing of P-type doped layer 301 against N-type doped layer 303 causes photon emission from intrinsic semiconductor layer 305. *Id.* at 4:1–10. Recess 302 is etched into “a portion of the surface of GaN layer 300.” *Id.* at 4:11–4:12. Suitable metallic layer 320 is applied “to portions of LED device 30.” *Id.* at 3:66–67, 4:15–16.

Figure 5 of the '405 patent, reproduced below, shows a cross sectional view of another exemplary LED device. *Id.* at 2:58–59.

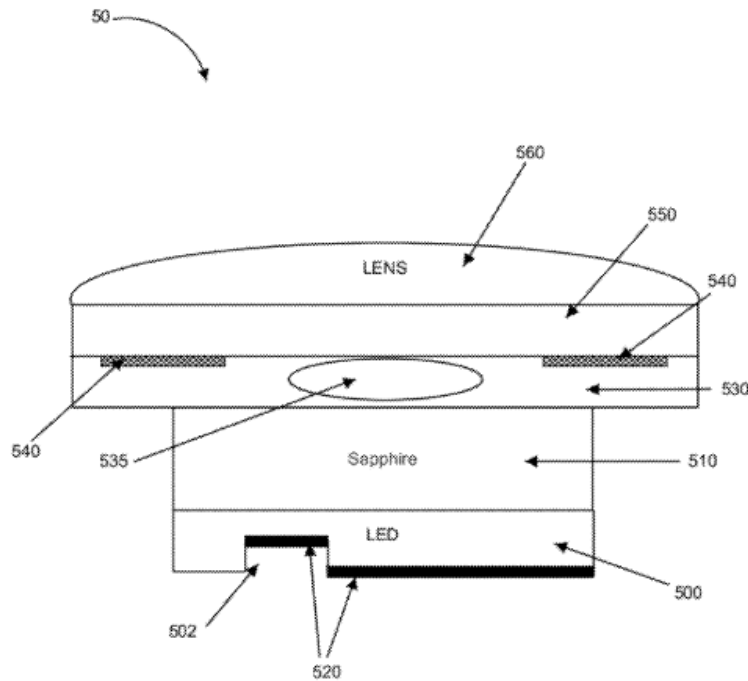


Fig. 5

Figure 5 depicts LED device 50 that “includes the stated LED semiconducting layer or layers 500 as discussed above, along with etched recess 502 and metallization areas 520”⁴ in which LED layer 500 “is disposed on” sapphire layer 510 “as before.” *Id.* at 4:65–5:2. Optically transparent or transmissive adhesive layer 530 “is placed against the opposing side” of sapphire layer 510 “than the LED material 500 (meaning, one face of the sapphire layer 510 is proximal to the LED material layer 500 and the other opposing face of sapphire layer 510 is proximal to the transparent adhesive layer 530[.]” *Id.* at 5:3–8. Within transparent

⁴ LED semiconducting layer or layers 500 were not “discussed above” in the ’405 patent and it appears that this is in reference to the layers discussed for Figure 3.

adhesive layer 530 “is a region containing phosphor and/or quantum dot material (QD) 535 such that photons emitted from LED layer 500 travel through sapphire layer 510 and pass through optically transparent layer 530 and the region containing the phosphor and/or quantum dots 535 so that color (wavelength) and emission of selective desired light out of the LED device can be controlled.” *Id.* at 5:16–23. Cover substrate 550 is aligned over transparent adhesive layer 530 to provide “structural presence and mechanical coupling for elements of the LED device 50.” *Id.* at 5:24–29.

Figure 10 of the '405 patent, reproduced below, shows another exemplary LED device. *Id.* at 3:1.

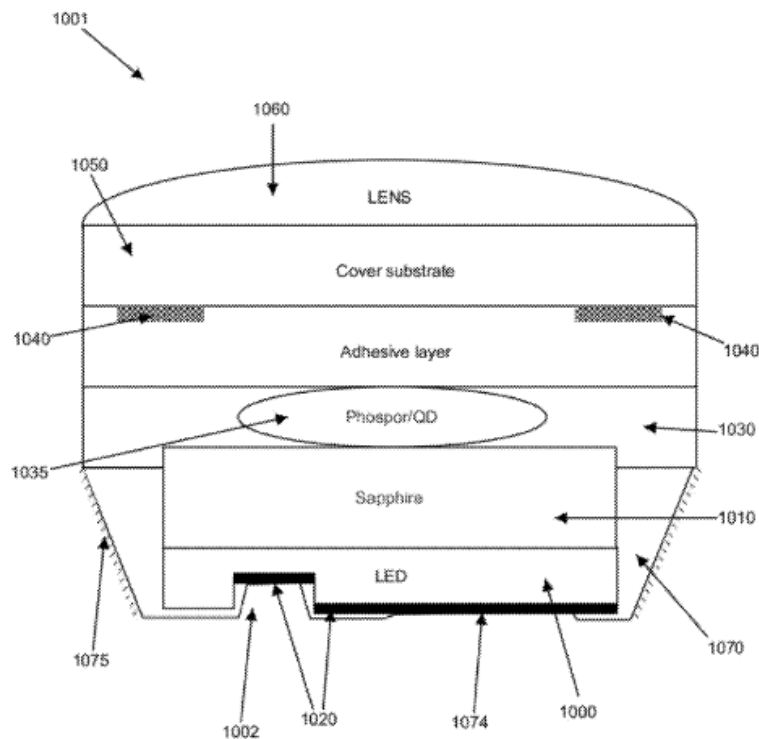


Fig. 10

Figure 10 depicts LED device 1001 in which “[s]imilarly numbered elements discussed earlier are common to or similar to those in this exemplary embodiment.”⁵ *Id.* at 6:45–47. According to the ’405 patent, this embodiment shows “contact holes are drilled” using a laser, “through the passivation layer until reaching the metal pad and silicon substrate.” *Id.* at 6:47–50. Passivation layer 1075 “is cut or etched away as stated above so as to provide conducting access at least to the N-type semiconductor proximal to laser drilled recess 1002 and the P-type semiconductor proximal to portion 1074 of metallization layer 1020.” *Id.* at 6:60–64.⁶ According to the ’405 patent, the passivation layer is “removed to enhance the heat conduction of the LED.” *Id.* at 6:64–65.

D. Challenged Claims

Petitioner challenges claims 1–4, 6, 8–14, and 16 of the ’405 patent.⁷ Pet. 12. Of the challenged claims, claim 1 is an independent apparatus claim and claim 12 is an independent method claim. Ex. 1001, 8:6–56, 9:24–10:25. Claim 1 recites:

1. A light emitting device, comprising:
a semiconductor LED including a positively-doped region,
an intrinsic region, and a negatively-doped region,
wherein said ***intrinsic region is between said positively-doped region and said negatively-doped region***, said semiconductor LED defining a first recess to expose a

⁵ Certain reference numbers, such as reference numbers 1040 and 1050, in Figure 10 are not discussed in the description of the ’405 patent.

⁶ Reference number 1070 is not discussed in the description although reference number 1170 is identified as a passivation layer for Figure 11. *See* Ex. 1001, 7:26.

⁷ The ’405 patent has 17 claims. Ex. 1001, 8:6–10:41. Petitioner challenges all the claims of the ’405 patent except claims 5, 7, 15, and 17. *See, e.g.*, Pet. 12.

- negatively-doped surface of said negatively-doped region;
- an electrically conducting metallization layer in direct contact with at least a portion of each of a positively-doped surface and said negatively-doped surface of said semiconductor LED, wherein said positively-doped surface is on an exposed portion of said positively-doped region of said semiconductor LED and said negatively-doped surface and said positively-doped surface are parallel with each other;
- a sapphire layer in direct contact with a first surface of said semiconductor LED, said positively-doped surface and said first surface of said semiconductor LED being parallel with one another and on opposing faces of said semiconductor LED;
- an optically permissive layer in direct contact with said sapphire layer, said optically permissive layer comprising an optically definable material containing quantum dots and/or phosphor, said optically definable material adapted to change the frequency of at least some of emitted light passing therethrough;
- an optically permissive cover substrate covering at least a portion of the above components; and
- a passivation layer in direct contact with said metallization layer, said sapphire layer, a surface of said optically permissive layer, and said semiconductor LED, wherein said passivation layer defines a first contact hole to expose a first portion of an upper metal surface of said metallization layer disposed on said negatively-doped surface and said passivation layer is in direct contact with a second portion of said upper metal surface of said metallization layer disposed on said negatively-doped surface,
- wherein said passivation layer defines a second contact hole to expose a first portion of a lower metal surface of said metallization layer disposed on said positively-doped surface and said passivation layer is in direct contact with a second portion of said lower metal surface of said

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

Id. at 8:6–56 (emphasis added). Claim 12 recites limitations similar to those of claim 1. Our decision not to institute trial is based on our analysis related to independent claims 1 and 12.

E. The Asserted Grounds

Petitioner challenges claims 1–4, 6, 8–14, and 16 of the '405 patent based on the grounds set forth in the table below.

Claims Challenged	35 U.S.C. §	Reference(s)/Basis
1–3, 8–14, 16	103(a) ⁸	Sugizaki, ⁹ (Schubert ¹⁰ or Nakamura ¹¹)
4	103(a)	Sugizaki, (Schubert or Nakamura), Hashimoto ¹²
6	103(a)	Sugizaki, (Schubert or Nakamura), Lee ¹³
1–3, 8–14, 16	103(a)	Sugizaki, (Schubert or Nakamura), Lee

⁸ The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112-29, 125 Stat. 284, 285–88 (2011), revised 35 U.S.C. §§ 102, 103 effective March 16, 2013. Because the challenged patent claims priority to applications filed before March 16, 2013, we refer to the pre-AIA version of §§ 102, 103. Our opinions on the present record would not change if the AIA versions of §§ 102, 103 were to apply.

⁹ US 2010/0148198 A1, published June 17, 2010 (Ex. 1003).

¹⁰ E. Fred Schubert, *Light-Emitting Diodes*, 2d ed., CAMBRIDGE UNIVERSITY PRESS, 2006 (Ex. 1004).

¹¹ US 5,777,350, issued July 7, 1998 (Ex. 1006).

¹² US 2004/0012958 A1, published Jan. 22, 2004 (Ex. 1005).

¹³ US 2008/0023721 A1, published Jan. 31, 2008 (Ex. 1009).

Pet. 12. Petitioner supports its showing of unpatentability of the challenged claims of the '405 patent with the Declaration of William Alan Doolittle, Ph.D. (Ex. 1013).

II. ANALYSIS

A. Claim Construction

Petitioner asks us to construe claim terms “intrinsic” and “metallization.” Pet. 8–11. Patent Owner “requests that the Board adopt the ordinary and customary meaning of the claim terms as understood by one of ordinary skill in the art.” Prelim. Resp. 11.

Claim construction in this proceeding is governed by 37 C.F.R. § 42.100(b), which provides:

In an *inter partes* review proceeding, a claim of a patent, or a claim proposed in a motion to amend under §42.121, shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. 282(b), including construing the claim in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.

Under the standard set forth in *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–19 (Fed. Cir. 2005) (en banc), claim terms are given their ordinary and customary meaning, as would have been understood by a person of ordinary skill in the art at the time of the invention, in light of the language of the claims, the specification, and the prosecution history of record. *See Thorner v. Sony Comput. Ent. Am. LLC*, 669 F.3d 1362, 1365–66 (Fed. Cir. 2012). There is a “heavy presumption,” however, that a claim term carries its ordinary and customary meaning. *CCS Fitness, Inc. v. Brunswick Corp.*, 288 F.3d 1359, 1366 (Fed. Cir. 2002) (citation omitted). We only construe

terms to the extent necessary to determine the dispute between the parties. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (“[W]e need only construe terms ‘that are in controversy, and only to the extent necessary to resolve the controversy.’”) (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)).

Petitioner asserts that the term “intrinsic” as used in the claims of the ’405 patent should be construed as “undoped or not-doped.” Pet. 10 (“[T]he term ‘intrinsic’ when used to characterize a semiconductor means ***undoped or not-doped***.”). In support of this construction, Petitioner cites the Specification of the ’405 patent (Ex. 1001, 3:61–64), two technical dictionaries (Exs. 1007 and 1008), and the Doolittle Declaration (Ex. 1013 ¶ 32). *See id.* at 9–10. As noted previously, Patent Owner requests that we adopt the ordinary and customary meaning of the claim terms as understood by a skilled artisan. Prelim. Resp. 11. However, Patent Owner fails to provide any argument or evidence as the ordinary and customary meaning of “intrinsic” in the context of the claims of the ’405 patent or to otherwise provide any explanation regarding the meaning of the term “intrinsic.” *See generally id.* Based on this record, for the limited purpose of determining whether the Petition shows that there is a reasonable likelihood that the Petitioner would prevail with respect to any of the claims challenged in the Petition and whether institution of a trial is appropriate, we adopt Petitioner’s construction of “intrinsic” as meaning “undoped or not-doped.”

We determine that it is not necessary to discuss or construe any additional claim terms (including “metallization”) to make a determination as to whether trial should be instituted.

B. Legal Standards

A patent claim is unpatentable as obvious if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) when presented, objective evidence of non-obviousness.¹⁴ *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

With regard to combining the teachings of multiple references, an articulated reason with some rational underpinning to combine the known elements in the fashion claimed must be provided to support a conclusion of obviousness. *See KSR*, 550 U.S. 418; *see also In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1381 (Fed. Cir. 2016) (It is the petitioner’s “burden to demonstrate both that a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention, and that the skilled artisan would have had a reasonable expectation of success in doing so.”) (citation and internal quotation omitted).

“In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.” *Harmonic*, 815 F.3d at 1363 (citing 35 U.S.C. § 312(a)(3))

¹⁴ The parties have not asserted or otherwise directed our attention to any objective evidence of nonobviousness.

(requiring *inter partes* review petitions to identify “with particularity . . . the evidence that supports the grounds for the challenge to each claim”)).

Petitioners cannot satisfy their burden of proving obviousness by employing “mere conclusory statements.” *Magnum Oil*, 829 F.3d at 1380.

C. Level of Ordinary Skill in the Art

With regard to the level of ordinary skill in the art, Petitioner contends that “[a] person of ordinary skill at the time of the invention of the ’405 Patent would have had a Bachelor’s Degree in electrical engineering, materials science, physics or a similar discipline, with one to two years of experience in the field of LED packaging design.” Pet. 7 (citing Ex. 1013 § V). Patent Owner states that it “takes no position with respect to Petitioner’s proposed level of ordinary skill in the art.” Prelim. Resp. 31.

Petitioner’s undisputed proposal is consistent with the technology described in the Specification of the ’405 patent and the cited prior art. In order to determine whether Petitioner has demonstrated a reasonable likelihood of showing the unpatentability of at least one of the challenged claims, we adopt Petitioner’s proposed level of skill in the art.

D. Consideration of Alleged Obviousness in View of Sugizaki and Schubert or Nakamura

Our decision is based on consideration of Petitioner’s arguments and evidence regarding the combination of Sugizaki and Schubert or Nakamura. *See* Pet. 12 (every asserted ground in the Petition relies on “Sugizaki in view of Schubert or Nakamura”). We start with a description of the disclosures of Sugizaki, Schubert, and Nakamura and then consider the arguments and evidence.

1. *Sugizaki (Ex. 1003)*

Sugizaki is titled “Light Emitting Device and Method for Manufacturing Same.” Ex. 1003, code (54). Specifically, Sugizaki relates to “a method for manufacturing a light emitting device” including “forming a multilayer body” having “a light emitting layer so that a first surface thereof is adjacent to a first surface side of a translucent substrate.” *Id.* ¶ 7. Sugizaki discloses that prior light emitting devices need an interconnect layer and a columnar electrode for bonding a light emitting element chip onto a transparent substrate with high positional accuracy, and are insufficient to meet the requirements for downsizing and mass productivity. *Id.* ¶ 6.

Figure 1A of Sugizaki, reproduced below, shows an exemplary light emitting device. *Id.* ¶ 10.

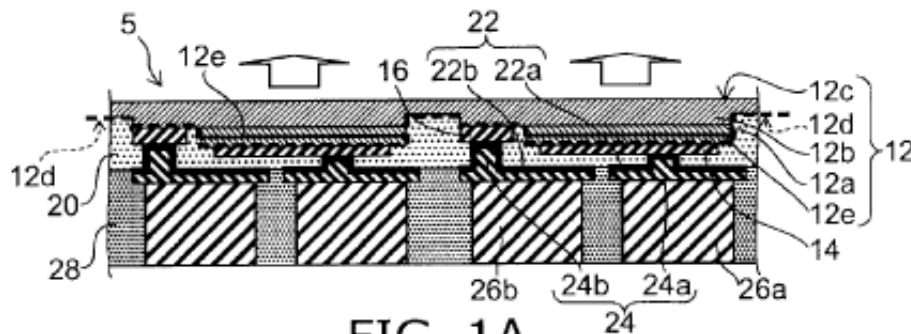


FIG. 1A

Figure 1A depicts a schematic cross-sectional view of a light emitting device. *Id.* ¶ 31. The light emitting device includes multilayer body 12 that has upper layer 12a, light emitting layer 12e, lower layer 12b, first surface 12c which is exposed, and second surface 12d on the opposite side. *Id.* ¶ 32. Upper layer 12a may include a p-type cladding layer, light emitting layer 12e, and an n-type cladding layer. *Id.* Lower layer 12b “may be of n-type and serve[s] as a lateral path of current.” *Id.* P-side electrode 14 is provided

on the surface of upper layer 12a and n-side electrode 16 is connected to n-side metal interconnect layer 24b through n-side seed metal 22b. *Id.* ¶ 33. Sugizaki discloses that “n-side electrode 16 can be a multilayer of Ti/Al/Pt/Au” and “p-side electrode 14 can be a multilayer of Ni/Al (or Ag)/Au.” *Id.* ¶ 49. The light emitting device also has dielectric film 20 that is made of an organic or inorganic material and is filled between seed metal 22a, 22b and second surface 12d. *Id.* ¶ 33.

Figure 18B of Sugizaki, reproduced below, shows a “process cross-sectional view[] of a manufacturing method of a variation of the fourth embodiment.” *Id.* ¶ 27.

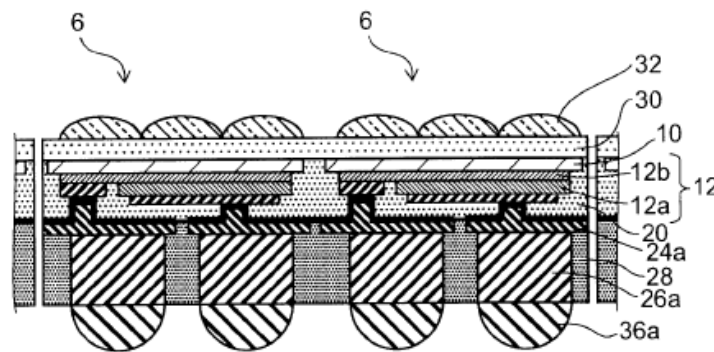


FIG. 18B

Figure 18B shows a schematic cross-sectional view of a light emitting device with an arrangement of convex lens 32, phosphor layer 30, sapphire substrate 10, dielectric film 20, and multilayer body 12 having upper layer 12 and lower layer 12b, as described previously. Sugizaki discloses that “in separation into packages, because the portion free from the rigid translucent substrate is cut (FIG. 18B), high productivity and yield can be achieved.” *Id.* ¶ 93.

2. *Schubert (Ex. 1004)*

Schubert is titled “Light-Emitting Diodes.” Ex. 1004, title. Schubert discloses that “[d]oping of the active region and confinement layers plays a crucial role in the efficiency of double heterostructure (DH) LEDs.” *Id.* at 116. Schubert explains that “[t]he active region of III–V arsenide and phosphide DH LEDs must not be heavily doped” and that “[h]eavy doping with either p-type or n-type dopants would place the p-n junction effectively at the edge of the DH well region, i.e. at the active/confinement interface, thereby promoting carrier spill-over into one of the confinement regions.” *Id.* According to Schubert, “[d]iffusion of carriers into the cladding region decreases the radiative efficiency.” *Id.* Schubert further discloses that “[t]herefore it is required that the active region is *either* doped at a level *lower* than the doping concentration in the confinement regions or left undoped” and that “[f]requently the active layer is left undoped.” *Id.* Schubert also explains that “[t]he displacement of the p-n junction from its intended location into the cladding layer can be a significant problem in DH LED structures” and that “[u]sually, the lower confinement layer is n-type, the upper confinement layer is p-type, and the active region is undoped or lightly doped with n- or p-type dopants.” *Id.* at 118.

3. *Nakamura (Ex. 1006)*

Nakamura is titled “Nitride Semiconductor Light-Emitting Device.” Ex. 1006, code (54). Nakamura “relates to a semiconductor light-emitting device such as a light-emitting diode (LED) or a laser diode (LD).” *Id.* at 1:7–9. Nakamura explains that “when the active layer of the quantum well structure is a non-doped layer, a band-to-band emission of narrow half band

width, [sic] an exciton emission or a inter-quantum well level emission may be obtained.” *Id.* at 15:33–36.

4. *Motivation to Combine Sugizaki and Schubert or Nakamura*

Independent claims 1 and 12 of the ’405 patent are directed to a LED including a positively-doped region or layer, a negatively-doped region or layer, and an intrinsic region or layer between the positively-doped region or layer and negatively-doped region or layer. Ex. 1001, 8:7–8 (claim 1), 9:26–28 (claim 12). For the independent claims of the ’405 patent, Petitioner relies on a combination of the teachings of Sugizaki in view of Schubert or Nakamura. *See* Pet. 14–20 (discussion of claim 1), 51–52 (discussion of claim 12 (relying on discussion of claim 1)). Patent Owner argues that “Petitioner fails to meet its burden to provide adequate explanation on the motivation to combine [for] any of the [asserted] grounds, including reasonable expectation of success.” Prelim. Resp. 3; *see also id.* at 37–41.

Petitioner acknowledges that Sugizaki does not disclose an intrinsic region or layer as recited in the claims of the ’405 patent. The Petition states:

As will be explained in detail below, the one characteristic not expressly described in Sugizaki is an intrinsic (i.e., undoped) region between positively and negatively doped regions. The corresponding region in Sugizaki is a light emitting region, for which Sugizaki is silent regarding the absence (or presence) of dopant. **The selection of an intrinsic light-emitting layer was conventional** and would have been obvious to a person having ordinary skill in the art for the reasons discussed below.

Pet. 5 (emphasis added). Later in the Petition is a section that specifically addresses the differences between independent claim 1 and the cited art which provides:

2. Differences Between Claim 1 and the Cited Art

Petitioner asserts that there are no specific differences between Sugizaki and claim 1 of the '405 patent. Instead, the sole issue is the level of detail provided by Sugizaki regarding the doping in the disclosed layers. Indeed, the fact that the layers both above and below the light emitting layer are expressly described as doped, the silence regarding doping of the light emitting layer is consistent with the light emitting layer of Sugizaki being undoped and alone suggests that characteristic.

Pet. 18–19. Although Petitioner contends that an intrinsic, light-emitting layer was conventional, the evidence in the Petition consisting of two references describing that the use of such a layer was known is inadequate to establish that such use was conventional. And, although Petitioner asserts that there are no specific differences between Sugizaki and the invention recited in claim 1 (or claim 12), the Petition does not include any allegation that any claim of the '405 patent is anticipated by Sugizaki or present a single reference obviousness ground based on Sugizaki. *See generally id.* To the extent Petitioner contends that the failure in Sugizaki to state whether the light emitting layer is undoped or doped in light of the disclosure that the adjoining layers are doped “is consistent with” or “suggests” the light emitting layer is undoped, we find inadequate support for such a determination in Sugizaki or elsewhere in the record.

Rather, considering the Petition as a whole, and especially in light of the presentation in the Petition regarding the “intrinsic region” element of claim 1 (*see id.* at 14–17), we understand that Petitioner does not contend that Sugizaki discloses the “intrinsic region” or “intrinsic layer” element as recited in the claims of the '405 patent. In discussing the “*Disclosure in Sugizaki*” in the context of the obviousness of claim 1, the Petition states,

“Sugizaki discloses a semiconductor LED including a positively-doped region, a light emitting region, and a negatively-doped region, wherein the light emitting region is between the positively-doped region and the negatively-doped region.” Pet. 15 (citing Ex. 1003, Fig. 18B). Petitioner points to “semiconductor LED [12] comprising layers [12a] and [12b]” in Figure 18B, but acknowledges that “Figure 18B and the corresponding written description in the specification, however, do not identify or describe those layers.” *Id.* However, citing 37 C.F.R. § 1.84(p)(4),¹⁵ Petitioner relies on the description of layer 12a in connection with another embodiment in the ’405 patent as illustrated in Figure 1A. The Petition states, “figure 1A and the corresponding text indicate that semiconductor layer [12a] of figure 18B would have included a sandwich of positively doped layer, a light emitting layer [12e], and a negatively doped layer.” *Id.* at 17 (citing Ex. 1003 ¶ 32 (“The upper layer 12a may include a p-type cladding layer, a light emitting layer 12e, and an n-type cladding layer.”)). Thus, with regard to the “intrinsic region” element of claim 1 (and the “intrinsic layer” element of claim 12), Petitioner relies on the disclosure of “light emitting layer [12e]” in Sugizaki. Petitioner identifies no further description of the composition of this “light emitting layer [12e]” in Sugizaki. *See generally id.* Specifically, Petitioner identifies, and we discern, no teaching or suggestion in Sugizaki that this “light emitting layer [12e]” is an intrinsic region or layer or is undoped or not doped. We determine that in Sugizaki an intrinsic region or layer is neither shown nor described.

¹⁵ 37 C.F.R. § 1.84(p)(4) provides, “the same reference character must never be used to designate different parts.”

With regard to the “*Disclosure in S[c]hubert*,” the Petition states: “Schubert’s oft-cited book *Light Emitting Diodes* (2d ed. 2006) explains that the active (i.e., the light emitting) region of a light emitting diode should have either low doping or be ‘left undoped.’ The reference further explains that ‘[f]requently the active layer is left undoped.’” Pet. 17 (citing Ex. 1004, 116–117). Schubert, however, is not uniform in recommending that LEDs include undoped layers. The cited pages of Schubert also state: “p-type doping of the active region is more common than n-type doping of the active region;” “p-type doping of the active region ensures a more uniform carrier distribution throughout the active region;” “light p-type doping of the active region is preferable over light n-type doping. Therefore, most active layers of LEDs and lasers are lightly doped with acceptors;” “[i]ntentional doping of the active region can have advantages as well as disadvantages;” and “[a]n example of a material whose luminescence efficiency increases with doping concentration is Be-doped GaAs. It is well known that the radiative efficiency of Be-doped GaAs increases with the Be doping level in the moderate doping concentration range.” Ex. 1004, 116–117. Far from uniformly teaching the use of an intrinsic (undoped) active or light emitting layer, Schubert teaches that doping the active or light emitting layers of LEDs is “more common,” “preferable,” and “can have advantages.” *Id.* And, to the extent Schubert provides an indication as to the level of doping that is most commonly used, Schubert teaches light p-type doping is most common. *Id.* at 117 (“Therefore, most active layers of LEDs and lasers are lightly doped with acceptors.”). Put differently, considering the teachings of Schubert as a whole, Petitioner has not shown that a skilled artisan would

have understood this reference to recommend the use of an intrinsic (undoped) active or light emitting layer in a LED.

With regard to Nakamura, Petitioner cites the following passage in the Petition as “emphasiz[ing] the benefits of an undoped active layer:”

[S]ince the active layer should ideally emit a strong light through a band-to-band emission according to the present invention, the employment of a non-doped InGaN as material for the active layer is most desirable. Speaking in other way, if an active layer is doped with an impurity, the crystallinity of the resultant layer is more likely to be deteriorated as compared with a non-doped active layer. Moreover, a light-emitting device where a non-doped InGaN is employed as an active layer is advantageous in lowering V_f (forward voltage) value as compared with a light-emitting device doped with an impurity.

Pet. 18 (citing ex. 1006, 15:57–16:1).¹⁶ However, this passage in Nakamura is immediately preceded by the following passage that discusses doping the active layer to intensify light emission:

Alternatively, the active layers 126 and 136 may be doped with a donor impurity and/or an acceptor impurity. If the crystallinity of an active layer doped with an impurity can be controlled to the same quality as that of non-doped active layer, it is possible, through the doping with a donor impurity, to further increase the band-to-band light-emitting intensity as compared with the non-doped active layer. It is possible, through the doping with an acceptor impurity, to shift a peak wavelength toward the lower energy side by a magnitude of about 0.5 eV from the peak wavelength of the band-to-band emission, but the half band width will be enlarged in such a case. If doping with both

¹⁶ Schubert states in the passage cited in the Petition that “[d]uring the growth of InGaN, for example, **a marked improvement of crystal quality has been found upon doping with silicon (Nakamura *et al.*, 1996, 1998)**” in discussing processes for making LEDs. *See* Ex. 1004, 117 (emphasis added). The Nakamura *et al.* reference relied on by Petitioner in this proceeding issued in 1998. Ex. 1006, code (45).

acceptor impurity and donor impurity is performed on an active layer, the light-emitting intensity of the active layer will be further intensified as compared with an active layer doped only with an acceptor impurity. If an active layer doped with an acceptor impurity is to be formed, the conductivity type of the active layer should preferably be turned into n-type by doping it with a donor impurity such as Si together with the doping of the acceptor impurity.

Ex. 1006: 15:38–57. Here again, the cited reference is far from uniform in recommending the use of intrinsic (undoped) regions or layers in LEDs. And, while establishing intrinsic (undoped) regions or layers were known, Nakamura does not show that the light emitting layers of LEDs were conventionally or commonly undoped. Indeed, Nakamura, like Schubert, indicates that doping is more common. *See id.* at 1:29–30 (Under “Description of the Related Art” stating, “[t]he active layer is doped with a donor impurity such as Si or Ge and/or an acceptor impurity such as Mn or Mg.”).

With regard to combining the relevant teachings of Sugizaki and either Schubert or Nakamura, the entire presentation in the Petition states:

3. Person Having Ordinary Skill in the Art

The person having ordinary skill in the art is discussed in Section III above. The '405 patent and Sugizaki both assume that the creation of semiconductor layers for use in a light emitting diode was within the level of ordinary skill in the art. That assumption would encompass the deposition of layers having a desired level of doping, i.e., to include no doping. Moreover, the prior art is a proper consideration in determining the level of ordinary skill. *See In re GPAC*, 57 F.3d 1573, 1579 (Fed. Cir. 1995). The assumption regarding the capabilities of the skilled artisan to form the layers of a light emitting diode, therefore, directly inform the level of ordinary skill.

4. Reasons Supporting Obviousness

With respect to leaving the light emitting region of Sugizaki undoped (i.e., intrinsic), Schubert explains that dopants within the active region can result in “spill-over into one of the confinement regions.” That undesirable result “decreases the radiative efficiency.” Based on that explanation, Schubert concludes that “[f]requently the active layer is left undoped.”

Similarly, Nakamura explains that the excluding dopants from the active layer can improve band-to-band emission, can improve crystallinity, and can advantageously lower the forward voltage.

A person having ordinary skill in the art would have had reason to implement an intrinsic light emitting layer in Sugizaki based at least on the teachings of Schubert and/or Nakamura. That feature, therefore, should be deemed obvious.

Pet. 19–20 (citing Ex. 1013 (Doolittle Decl.) ¶¶ 39–41). We determine this presentation is vague and conclusory as to why or how a skilled artisan would have combined the teachings of Sugizaki and either Schubert or Nakamura to arrive at the invention recited in any claim of the ’405 patent and fails to consider and account for all the teachings of the asserted combination of references.¹⁷ With regard to the “assumption” that “creation of semiconductor layers for use in a light emitting diode was within the level of ordinary skill in the art” and “[t]hat assumption would encompass the deposition of layers having a desired level of doping, i.e., to include no doping,” we note that “obviousness concerns not only whether a skilled artisan *could have made* but *would have been motivated to make* the

¹⁷ In making this determination, we have considered the declaration testimony of Dr. Doolittle in cited (but unexplained) paragraphs 39 and 40 of Exhibit 1013. We find that, like the presentation in the Petition, this testimony fails to discuss or account for the teachings in both Schubert and Nakamura relating to doping the active or light emitting layer.

combinations or modifications of prior art to arrive at the claimed invention.” *Belden Inc. v. Berk-Tek LLC*, 805 F.3d 1064, 1073 (Fed. Cir. 2015). And, the view of the cited art set forth in the Petition is too narrowly focused and does not reconcile or take into account in any way the complete teachings of the cited references as to doping the light emitting layer. In particular, although the references establish that the use of an undoped, light emitting layer was known, the references provide reasons why a skilled artisan might choose to use a doped, light emitting layer. Petitioner, however, fails to identify any specific reason for combining the relevant teachings of the cited references to arrive at the claimed invention. And, the disclosures in the cited references as to the level of doping of the active or light emitting layer of LEDs do not establish that intrinsic (undoped) layers were conventional or most commonly used.

It is Petitioner’s burden to provide an articulated reason with some rational underpinning to combine the known elements from the cited art in the fashion claimed in order to support a conclusion of obviousness. *See KSR*, 550 U.S. 418. The Petition provides no adequate explanation as to why a skilled artisan would have chosen to use an undoped layer as the light emitting layer of an LED based on the collective teachings of the cited references. We determine that the Petition does not sufficiently support a determination that a skilled artisan would have been motivated to use an undoped layer in a LED as recited in claims 1 and 12 of the ’405 patent.

Based on this record, we determine that Schubert and Nakamura establish that it was known in the prior art to use an intrinsic (undoped) region or layer in an LED. However, we further determine that Petitioner has not adequately shown in the Petition a motivation to combine with a

reasonable expectation of success the teachings of Sugizaki as to a light emitting layer with the teachings of either Schubert or Nakamura as to the use of an intrinsic (undoped) region or layer in an LED, especially in the context of the relied-upon embodiment of Figure 18B of Sugizaki and in light of the teachings in both Schubert and Nakamura relating to the use of doped, light emitting layers.

5. *Summary*

We deny institution because we determine that Petitioner has failed to show a reasonable likelihood of establishing, based upon the relied-upon teachings in Sugizaki and either Schubert or Nakamura, that a skilled artisan would have been motivated to combine the cited prior art references with a reasonable expectation of success such that the LED device disclosed in Sugizaki would include an intrinsic region or layer as recited in independent claims 1 and 12 of the '405 patent.

III. CONCLUSION

We determine that Petitioner has not demonstrated a reasonable likelihood of showing at least one of the claims challenged in the Petition would have been unpatentable. Accordingly, for the reasons stated herein, we deny the Petition.

IV. ORDER

In consideration of the foregoing, it is:

ORDERED that the Petition is *denied* and no *inter partes* review as to any claim of the '405 patent is instituted.

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FOR PETITIONER:

Michael Eisenberg
STEPTOE & JOHNSON LLP
meisenberg@steptoe.com

Charles Sanders
Jonathan Strang
LATHAM & WATKINS LLP
charles.sanders@lw.com
jonathan.strang@lw.com

FOR PATENT OWNER:

Bradley Liddle
Seth Lindner
Scott Breedlove
Michale Pomeroy
CARTER ARNETT PLLC
bliddle@carterarnett.com
slindner@carterarnett.com
sbreedlove@carterarnett.com
mpomeroy@smu.edu