

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.

IPR2021-01504
Patent 9,502,612 B2

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

ABRAHAM, *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”) filed a Petition requesting *inter partes* review of claims 1–4, 6, 7, and 9 of U.S. Patent No. 9,502,612 B2 (Ex. 1001, “the ’612 patent”). Paper 1 (“Pet.”). LED Wafer Solutions, LLC (“Patent Owner”) filed a Preliminary Response. Paper 9 (“Prelim. Resp.”). With our authorization, Petitioner filed a Reply to the Preliminary Response (Paper 10) and Patent Owner filed a Sur-reply (Paper 11).

We have authority to determine whether to institute an *inter partes* review. 35 U.S.C. § 314 (2018); 37 C.F.R. § 42.4(a) (2020). The standard for instituting an *inter partes* review is set forth in 35 U.S.C. § 314(a), which provides that an *inter partes* review may not be instituted “unless the Director determines . . . there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.”

For the reasons set forth below, upon considering the Petition, Preliminary Response, Reply, Sur-Reply, and the evidence of record, we determine the information presented in the Petition fails to establish a reasonable likelihood that Petitioner would prevail with respect to at least one of the challenged claims. Accordingly, we deny the Petition, and do not institute an *inter partes* review.

B. *Related Proceedings*

The parties identify *LED Wafer Solutions LLC v. Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc.*, No. 6:21-cv-292 (W.D. Tex.) (“the District Court litigation”) as a related matter. Pet. 72; Paper 4, 1. Patent Owner further identifies the following related matters in which

additional patents owned by Patent Owner are challenged: IPR20201-01479, IPR2021-01491, IPR2021-01506, IPR2021-01516, IPR2021-01526, and IPR2021-01554. Paper 4, 1–2.

C. The '612 Patent

The '612 patent is titled “Light Emitting Diode Package With Enhanced Heat Conduction.” Ex. 1001, code (54). The '612 patent is directed to light emitting diode (LED) devices that contain certain layers that “act to promote mechanical, electrical, thermal, or optical characteristics of the device.” Ex. 1001, code (57). In particular, the '612 patent discloses LED devices that avoid or ameliorate heat dissipation problems found in conventional LED devices. Ex. 1001, code (57). The '612 patent explains that enhanced heat conduction is achieved using “augmented thermal capacity materials” and novel processing methods. Ex. 1001, 4:44–49.

One embodiment of the '612 patent aimed at improving thermal management of LEDs is shown below in Figure 5.

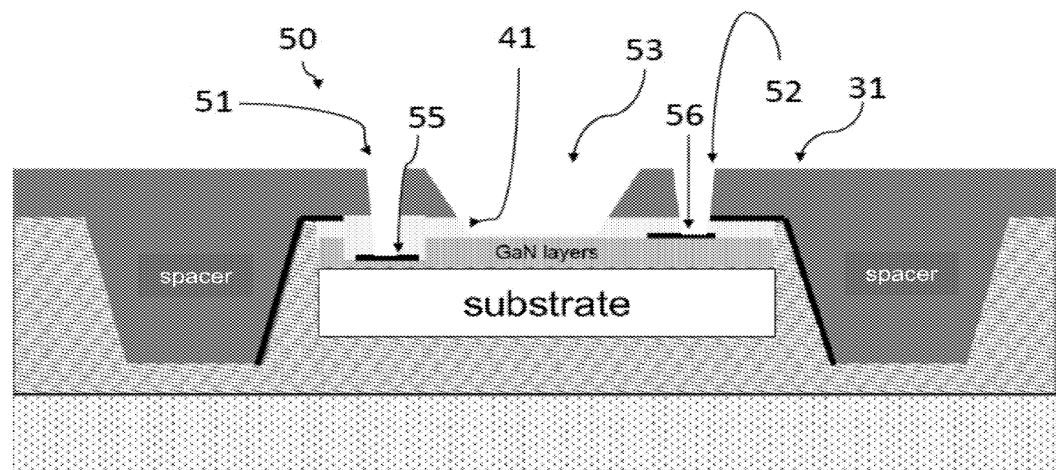


Fig. 5

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Figure 5 shows LED package 50 having cover substrate 54, an LED chip (labelled as GaN layers), silicon wafer 31, and adhesive material 41 disposed between the LED chip and silicon wafer 31. Ex. 1001, 8:60–66. Figure 5 also depicts various geometric reliefs etched in silicon wafer 31 in the form of vias 51 and 52, and thermally conducting hole 53. Ex. 1001, 9:4–18.

The '612 patent explains that adhesive material 41 can be thermally conductive, and can also have optical diffusion, transmission, and/or reflection properties. Ex. 1001, 4:4–14. Additionally, “[r]educing the thickness of the silicon enhances the thermal conductance of the LED package 50 and reduces the temperature of the LED during operation.” Ex. 1001, 8:63–66. According to the '612 patent, vias 51 and 52 and conducting hole 53 provide stress relief induced by grinding silicon wafer 31 down to a desired thickness to provide enhanced thermal conductance. Ex. 1001, 8:66–9:18. These features combine to provide improved LED packaging that allows for the efficient removal of excess heat during active LED operation. Ex. 1001, 4:44–52.

D. Challenged Claims

Petitioner challenges claims 1–4, 6, 7, and 9 of the '612 patent. Pet. 10–11. Claim 1 is the only independent claim challenged, and is reproduced below.

1. A light emitting device, comprising:
 - a substrate having opposing first and second substrate surfaces;
 - a semiconductor LED including doped and intrinsic regions thereof, said semiconductor LED having opposing first and second LED surfaces, said first LED surface disposed on the first substrate surface;

a thermally conductive layer disposed on the second LED surface of the semiconductor LED;

a carrier wafer disposed on the thermally conductive layer;

at least one optically reflective surface disposed between said carrier wafer and said semiconductor LED; and

a substantially optically transmissive layer disposed proximal to the second substrate surface,

wherein the carrier wafer and the thermally conductive layer define a relief to expose at least a portion of the second LED surface.

Ex. 1001, 12:14–31.

E. The Asserted Grounds

Petitioner asserts that claims 1–4, 6, 7, and 9 of the '612 patent would have been unpatentable based on the following challenges:

Claims Challenged	35 U.S.C. §	Reference(s)/Basis
1, 2, 4, 6, 7, 9	103(a) ¹	Hashimoto, ² Schubert, ³ Nakamura ⁴
3	103(a)	Hashimoto, Schubert, Nakamura, Bhat, ⁵ Donofrio ⁶

¹ The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112-29, 125 Stat. 284, 285–88 (2011), revised 35 U.S.C. § 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 § 103. Our opinions on the present record would not change if the AIA version of § 103 were to apply.

² US 2004/0012958 A1, published Jan. 22, 2004 (Ex. 1003).

³ E. Fred Schubert, *Light-Emitting Diodes*, 2d ed., CAMBRIDGE UNIVERSITY PRESS, 2006 (Ex. 1004).

⁴ US 5,777,350, issued July 7, 1998 (Ex. 1005).

⁵ US 2003/0025212 A1, published Feb. 6, 2003 (Ex. 1006).

⁶ US 2010/0140636 A1, published Jun. 10, 2010 (Ex. 1007).

Claims Challenged	35 U.S.C. §	Reference(s)/Basis
1–3, 7, 9	103(a)	Citizen, ⁷ Suehiro, ⁸ Schubert, Nakamura
4, 6	103(a)	Citizen, Suehiro, Schubert, Nakamura, Rothschild ⁹

Pet. 10–11. Petitioner supports its showing of unpatentability of the challenged claims of the '612 patent with the Declaration of William Alan Doolittle, Ph.D. (Ex. 1018).

II. ANALYSIS

A. Claim Construction

Petitioner asks us to construe the claim terms “intrinsic,” “relief,” and “carrier wafer. Pet. 3–9. Patent Owner argues that the claim terms should be given their plain and ordinary meaning. Prelim. Resp. 7–12.

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

⁷ JP 2005-175387A, published Jun. 30, 2005 (Ex. 1008).

⁸ US 2009/0050926 A1, published Feb. 26, 2009 (Ex. 1009).

⁹ US 2006/0104855 A1, May 18, 2006 (Ex. 1017).

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 ’612 patent should be construed as “undoped or not-doped.” Pet. 5 (“[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 ’612 patent (Ex. 1001, 3:61–64), two technical dictionaries (Exs. 1010 and 1011), and the Doolittle Declaration (Ex. 1018 ¶ 31). Pet. 4–5.

Patent Owner argues that we should reject Petitioner’s proposed construction because it isolates the word “intrinsic” from the claim term “intrinsic region” and fails to give meaning to the claim term as a whole as used in the claim and Specification. Prelim. Resp. 8. Patent Owner further argues that Petitioner improperly relies on extrinsic evidence as the basis for its proposed construction. Prelim. Resp. 8. According to Patent Owner, the technical dictionary definitions of “intrinsic material” and “intrinsic properties” that Petitioner relies upon present “entirely different

understandings from the claimed ‘intrinsic region’; these entirely different terms have their own unique definitions in electronics.” Prelim. Resp. 8.

Patent Owner further contends that to the extent “intrinsic” needs to be construed, the plain and ordinary meaning of the term should be “light emitting,” because “[t]he term ‘intrinsic’ is used in the ‘612 Patent in the context of a region of LEDs between two doped layers that emits ‘visible electro-magnetic radiation (light).’” Prelim. Resp. 9 (citing Ex. 1001, 5:4–17).

We begin our analysis by looking at the language of the claims. *Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1582 (Fed. Cir. 1996) (“First, we look to the words of the claims themselves . . . to define the scope of the patented invention.”). Claim 1 recites “a semiconductor LED including doped and intrinsic regions thereof.” As Petitioner points out, claim 1 contrasts “intrinsic” regions with “doped” regions. Pet. 4.

We turn next to the Specification of the ’612 patent. *Vitronics*, 90 F.3d at 1582 (“[T]he specification ‘is always highly relevant to the claim construction analysis. Usually, it is dispositive; it is the single best guide to the meaning of a disputed term.’”). Both Petitioner and Patent Owner direct us to portions of the Specification that, like claim 1 itself, contrast “intrinsic” regions with “doped” regions. Ex. 1001, 3:61–64 (“[T]he present apparatus provides a light emitting device comprising . . . a semiconductor LED including doped and intrinsic regions thereof.”); Ex. 1001, 5:4–17 (“These LEDs comprise a P-I-N junction device having an intrinsic (I) layer disposed between a N-type doped layer 10 and a P-type doped layer. The 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.”); Pet. 4 n.7; Prelim. Resp. 9. Thus, both the language of claim 1 itself as well as the

Specification of the '612 patent support Petitioner's proposed construction of "intrinsic region."

Petitioner also presents evidence that its proposed construction is consistent with the ordinary and customary meaning of the claim term as understood by one of ordinary skill in the art. *See Phillips*, 415 F.3d at 1322–23 (stating that it is permissible to "rely on dictionary definitions when construing claim terms, so long as the dictionary definition does not contradict any definition found in or ascertained by a reading of the patent documents") (quoting *Vitronics*, 90 F. 3d at 1584 n.6). In particular, Petitioner directs us to a technical dictionary that defines "intrinsic material" as "[a] semiconductor material in which there are equal numbers of holes and electrons, i.e. no impurities," noting that in this context, impurities refers to dopants. Pet. 4–5 (quoting Ex. 1010, 392; citing Ex. 1018 ¶ 31). In view of this, we disagree with Patent Owner that Petitioner's definitions present "entirely different understandings" from the claimed "intrinsic region." Prelim. Resp. 8. Additionally, although we agree with Patent Owner that the '612 patent describes an intrinsic region that is a light emitting region, the evidence Petitioner presents demonstrates that the plain and ordinary meaning of "intrinsic" includes more than just "light emitting."

For all of the foregoing reasons, based on this record and for the purposes of this Decision, we adopt Petitioner's construction of "intrinsic" as meaning "undoped or not-doped." Pet. 5.

We determine that it is not necessary to discuss or construe any additional claim terms 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.¹⁰ *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 Inc. v. Avid Tech. Inc.*, 815 F.3d 1356, 1363 (Fed.

¹⁰ The parties have not asserted or otherwise directed our attention to any objective evidence of nonobviousness.

Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (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 ’612 Patent would have had a Bachelor’s Degree in electrical engineering, or a similar discipline, with one to two years of experience in the field of LED packaging design.” Pet. 2–3. Patent Owner states that for purposes of its Preliminary Response, it will apply Petitioner’s characterization of a person of ordinary skill in the art. Prelim. Resp. 7.

Petitioner’s undisputed proposal is consistent with the technology described in the Specification of the ’612 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 Based on Hashimoto or Citizen/Suehiro in view of Schubert or Nakamura

Our institution decision is based on consideration of Petitioner’s arguments and evidence regarding the combination of Hashimoto with Schubert or Nakamura and Citizen/Suehiro with Schubert or Nakamura. *See* Pet. 10–11 (every asserted ground in the Petition relies on Hashimoto or Citizen/Suehiro in view of Schubert or Nakamura). We start with a description of the disclosures of Hashimoto, Citizen, Suehiro, Schubert, and Nakamura, and then consider the arguments and evidence.

1. Hashimoto (Ex. 1003)

Hashimoto is titled “Light Emitting Device Comprising LED Chip,” and issued on January 22, 2004. Ex. 1003, codes (43), (54). Hashimoto discloses a light emitting device using an LED chip that has n-type and p-type semiconductor layers formed on the crystals of a light-transmissive substrate, and is intended to “improve[] the uniformity of intensity of light emission in the light emitting surface while enhanced in the efficiency of light extraction from the LED chip (external quantum efficiency).” Ex. 1003 ¶¶ 1, 10.

2. Citizen (Ex. 1008)

Citizen is titled “Optical semiconductor package,” and was published on June 30, 2005. Ex. 1008, codes (43), (54). Citizen aims to “provide an optical semiconductor package that prevents light emitted by an optical semiconductor chip, such as an LED or the like, from being absorbed into a base substrate, to suppress a loss of the emitted light, and thus may increase the overall luminance.” Ex. 1008, 1.

3. Suehiro (Ex. 1009)

Suehiro is titled “Light Emitting Device,” and was published on February 26, 2009. Ex. 1009, codes (43), (54). Suehiro describes a light emitting device having a light emitting element that is glass-sealed on a mounting board. Ex. 1009 ¶ 3. According to Suehiro, its light emitting device can “suppress absorption loss by reflection of light emitted from a light emitting element to enhance the light extraction efficiency.” Ex. 1009 ¶ 8.

4. 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.”

Ex. 1004, 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.” Ex. 1004, 116. According to Schubert, “[d]iffusion of carriers into the cladding region decreases the radiative efficiency.” Ex. 1004, 116. 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.” Ex. 1004, 116. 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.” Ex. 1004, 118.

5. *Nakamura (Ex. 1005)*

Nakamura is titled “Nitride Semiconductor Light-Emitting Device.” Ex. 1005, code (54). Nakamura “relates to a semiconductor light-emitting device such as a light-emitting diode (LED) or a laser diode (LD).” Ex. 1005, 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.” Ex. 1005, 15:33–36.

6. *Motivation to Combine Hashimoto and Schubert or Nakamura*

Independent claim 1 of the '612 patent is directed to an LED including doped and intrinsic regions. Ex. 1001, 12:17–18. For this limitation, Petitioner relies on a combination of the teachings of Hashimoto in view of Schubert or Nakamura. Pet. 17–23.

Petitioner contends that Hashimoto discloses a semiconductor LED including doped and light emitting regions. Pet. 17–18. Petitioner does not contend that Hashimoto expressly discloses an LED that includes an intrinsic region, as claim 1 requires. *See* Pet. 17–20. Instead, Petitioner addresses the differences between independent claim 1 and the cited art in a section of the Petition that provides as follows:

2. Differences Between Claim 1 and the Cited Art

Petitioner asserts that there are no specific differences between Hashimoto and claim 1 of the '612 patent. Indeed, the fact that the layers both above and below the light emitting layer are expressly described as p-type and n-type (*i.e.*, doped), the silence regarding doping of the light emitting layer is consistent with the light emitting layer of Hashimoto being undoped and alone suggests that characteristic.

Pet. 21 (citing Ex. 1018 ¶ 45). Dr. Doolittle states that “the use of . . . undoped light emitting layers [w]as entirely conventional at the relevant time.” Ex. 1018 ¶ 45. Dr. Doolittle also states that “[e]ven if Hashimoto were alone found insufficient to render the use of an undoped light emitting layer obvious . . . , the Schubert book (Ex. 1005) and Nakamura patent (Ex. 1006) both confirm that a person having ordinary skill in the art would have found it obvious to utilize an intrinsic light emitting layer.” Ex. 1018 ¶ 46.

Although Dr. Doolittle 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. *See* Pet. 20–21 (discussing the disclosures of Schubert and Nakamura). And, although Petitioner asserts that there are no specific differences between Hashimoto and the invention recited in claim 1, the Petition does not include any allegation that Hashimoto anticipates any claim of the '612 patent or present a single reference obviousness ground based on Hashimoto. *See generally* Pet. To the extent Petitioner contends that the failure in Hashimoto to state whether the light emitting layer is undoped or doped in light of the disclosure that the adjoining layers are doped “suggests” the light emitting layer is undoped, we find inadequate support for such a determination in Hashimoto or elsewhere in the record.

Specifically, Petitioner identifies, and we discern, no teaching or suggestion in Hashimoto that its light emitting layer is an intrinsic region or layer or is undoped or not doped. We determine that in Hashimoto an intrinsic region or layer is neither shown nor described.

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 there the active (i.e., the light emitting) region of a light emitting diode must either have low doping or be ‘left undoped.’ The reference further explains that ‘[f]requently the active layer is left undoped.’” Pet. 20 (citing Ex. 1004, 116). Schubert, however, is not uniform in recommending that LEDs include undoped layers. The cited pages of Schubert also state the following: “[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.” Ex. 1004, 116–117. 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. Ex. 1004, 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 an 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 InGa_N 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 InGa_N 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. 20–21 (citing Ex. 1005, 15:57–16:1).¹¹ 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 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. 1005, 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,

¹¹ 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. 1005, code (45).

indicates that doping is more common. Ex. 1005, 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 Hashimoto and either Schubert or Nakamura, the entire presentation in the Petition states as follows:

3. Person Having Ordinary Skill in the Art

The person having ordinary skill in the art is discussed in Section III above. The ’612 patent and Hashimoto 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 have encompassed the deposition of layers having a desired level of doping, include no doping (*i.e.*, intrinsic layers). 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 Hashimoto 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

Hashimoto based at least on the teachings of Schubert and/or Nakamura. That feature, therefore, should be deemed obvious.

Pet. 21–23 (citing Ex. 1018 ¶¶ 46–48).

We determine this presentation is vague and conclusory as to why or how a skilled artisan would have combined the teachings of Hashimoto and either Schubert or Nakamura to arrive at the invention recited in any claim of the '612 patent and fails to consider and account for all the teachings of the asserted combination of references.¹² 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, includ[ing] no doping,” we note that “obviousness concerns not only whether a skilled artisan *could have made* but *would have been motivated to make* the 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

¹² In making this determination, we have considered the declaration testimony of Dr. Doolittle in cited (but unexplained) paragraphs 46–48 of Exhibit 1018. 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.

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 (*i.e.*, intrinsic) region in an LED as claim 1 of the '612 patent requires.

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 Hashimoto 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 in light of the teachings in both Schubert and Nakamura relating to the use of doped, light emitting layers.

7. *Motivation to Combine Citizen/Suehiro with Schubert or Nakamura*

For two of its patentability challenges, Petitioner relies on the combination of Citizen and Suehiro with Schubert or Nakamura as disclosing the "intrinsic region" limitation of claim 1. Pet. 47–55. For its unpatentability challenges based on Citizen and Suehiro, Petitioner relies on

arguments that are nearly identical to those based on Hashimoto. *See* Pet. 52 (referring to the earlier section of the Petition addressing the same material); *compare* Pet. 17–23 (arguments for challenges based on Hashimoto) *with* Pet. 51–55 (arguments for challenges based on Citizen and Suehiro). For example, Petitioner contends that Suehiro discloses a semiconductor LED having a pair of doped layers and a light emitting layer, and discloses or suggests an intrinsic region in view of Schubert and Nakamura for the same reasons discussed above, including relying on similar statements from Dr. Doolittle. Pet. 51–55 (citing Ex. 1018 ¶¶ 79–83). Petitioner does not direct us to anything in Citizen, Suehiro, or the declaration of Dr. Doolittle that cures the deficiencies discussed above in its challenges based on Hashimoto. As a result, we determine Petitioner has not shown adequately in the Petition a motivation to combine with a reasonable expectation of success for the same reasons discussed above.

8. *Summary*

We deny institution because we determine that Petitioner has failed to show a reasonable likelihood of establishing, based upon the teachings in Hashimoto, Citizen, Suehiro, 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 Hashimoto or the combined teachings of Citizen and Suehiro would include an intrinsic region as recited in independent claim 1 of the '612 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 '612 patent is instituted.

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