

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SENSOR ELECTRONIC TECHNOLOGY, INC.,
Petitioner,

v.

LITE-ON TECHNOLOGY CORPORATION,
Patent Owner.

IPR2022-00395
Patent 10,916,685 B2

Before JEAN R. HOMERE, LYNNE E. PETTIGREW, and
ELIZABETH M. ROESEL, *Administrative Patent Judges*.

HOMERE, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
Granting Patent Owner's Motion to Amend
35 U.S.C. § 318(a)

I. INTRODUCTION

Sensor Electronic Technology, Inc. (“Petitioner”) filed a Petition requesting an *inter partes* review (“IPR”) of claims 1–3 and 5 (“the challenged claims”) of U.S. Patent No. 10,916,685 B2 (Ex. 1001, “the ’685 patent”). Paper 1 (“Pet.”), 1. Lite-On Technology Corporation (“Patent Owner”) filed a Preliminary Response (Paper 7, “Prelim. Resp.”). Upon consideration of the parties’ contentions and supporting evidence, the Board instituted an *inter partes* review pursuant to 35 U.S.C. § 314, as to the challenged claims of the ’685 patent with respect to all grounds set forth in the Petition. Paper 8 (“Inst. Dec.”).

After institution, Patent Owner filed a Response (Paper 19, “PO Resp.”) along with a Contingent Motion to Amend (Paper 18, “PO MTA”); Petitioner filed a Reply to Patent Owner’s Response (Paper 25, “Pet. Reply”) along with an Opposition to the Motion to Amend (Paper 26, “Pet. Opp. to MTA”); we provided Preliminary Guidance to Patent Owner’s Motion to Amend (Paper 27, “Prelim. MTA Guidance”); Patent Owner filed a Sur-Reply to Petitioner’s Reply (Paper 32, “PO Sur-Reply”) along with a Reply to Petitioner’s Opposition to the Motion to Amend (Paper 31, “PO Reply to Opp. to MTA”); and Petitioner filed a Sur-Reply to Patent Owner’s Reply (Paper 38, “Pet. Sur-Reply to Opp. to MTA”). At the request of both parties, we held an oral hearing on March 20, 2023. A transcript of the hearing has been entered into the record. Paper 46 (“Tr.”).

We have jurisdiction under 35 U.S.C. § 6. This Final Written Decision is entered pursuant to 35 U.S.C. § 318(a). For the reasons that follow, we determine that Petitioner has demonstrated by a preponderance of

the evidence that challenged claims 1, 2, and 5 of the '685 patent are unpatentable. We further determine that Petitioner has not met its burden of showing, by a preponderance of the evidence, that claim 3 is unpatentable. Additionally, we determine that Petitioner has not met its burden of showing, by a preponderance of the evidence, that proposed substitute claims 20–22 are unpatentable.

II. BACKGROUND

A. Real Parties-In-Interest

Petitioner identifies itself and Seoul Viosys Co. Ltd. as the real parties-in-interest in this proceeding. Pet. 89. Patent Owner names itself as the real party-in-interest. Paper 4, 1.

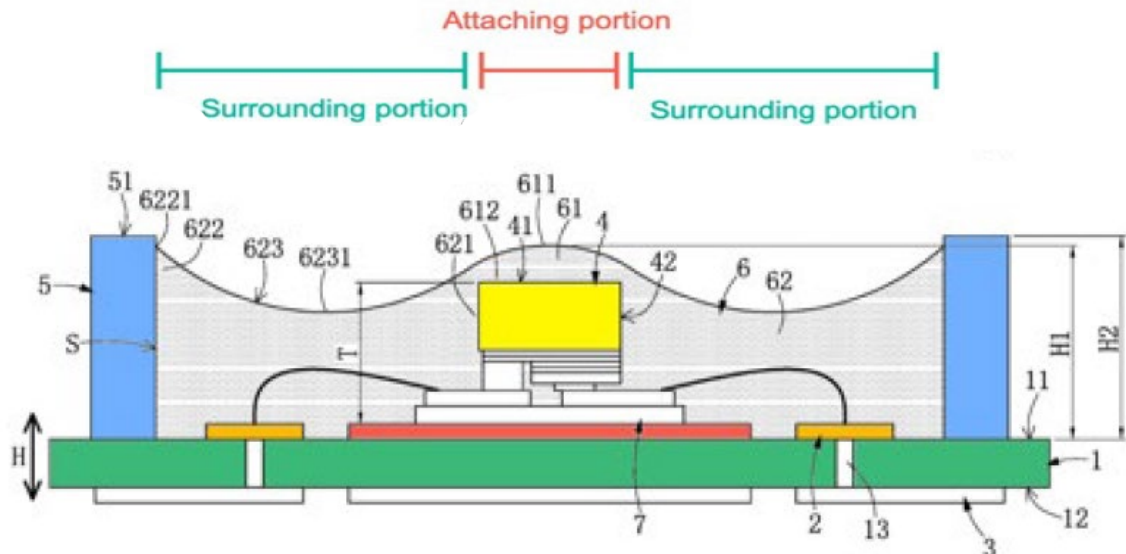
B. Related Matters

The parties indicate that the '685 patent is involved in *Sensor Electronic Technology, Inc. v. Lite-On Technology Corporation*, No. 6:21-cv-00322-ADA (W.D. Tex. 2021). Pet. 89; Prelim. Resp. 2–3.

C. The '685 Patent

The '685 patent is directed to a package structure for a light emitting diode (“LED”) and a manufacturing method thereof for increasing the performance of the LED package structure including a packaging compound configured in a particular manner to improve the light efficiency of the LED. Ex. 1001, 1:21–26.

Petitioner's annotation of Figure 14A of the '685 patent is reproduced below. Pet. 5–6.

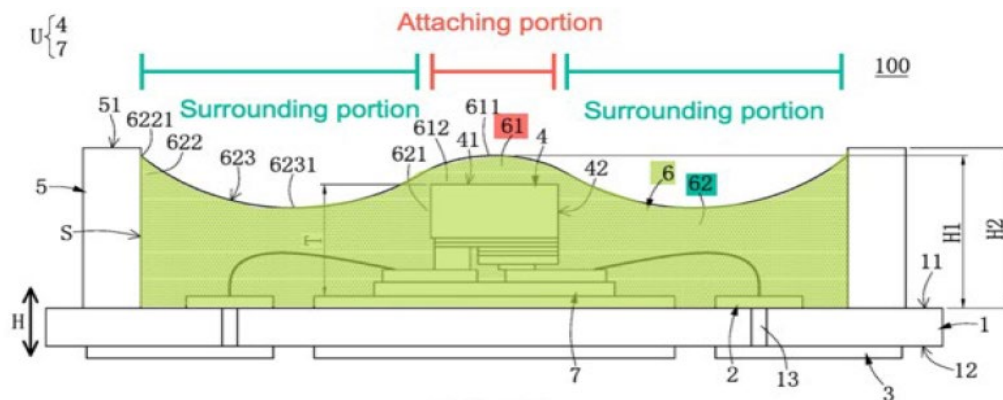


Petitioner's annotated Figure 14A above depicts a LED package structure. Ex. 1001, 2:16–17. The package structure includes substrate 1 (green), electrode layer 2 (orange), a lighting unit, annular wall 5 (blue), and package compound 6 (gray). *Id.* at 5:25–28. The lighting unit includes lighting diode 4 (yellow) and submount 7 (red). *Id.* at 5:62–63. Lighting diode 4 is disposed on submount 7 and is configured to emit a light having a wavelength within a range of 180 nm~410 nm. *Id.* at 5:63–65. Lighting diode 4 is connected to submount 7 fixed on electrode layer 2 in a flip-chip bonding manner, and submount 7 is electrically connected to electrode layer 2 in a wiring manner for establishing electrical connection between lighting diode 4 and electrode layer 2. *Id.* at 3:34–39. Wall 5 is disposed on first surface 11 of substrate 1, and wall 5 and first surface 11 together “jointly define an accommodating space S,” in which lighting diode 4 is arranged. *Id.* at 6:23–26. Package compound 6 includes (1) attaching

portion 61 (labeled in red) adhered to top surface 41 of lighting diode 4, and (2) surrounding portion 62 (labeled in green) arranged around attaching portion 61. *Id.* at 6:40–43.

The '685 patent discusses a “center of curvature” with reference to Figure 14A, which is reproduced below with Petitioner’s annotations.

Pet. 5.



Petitioner’s annotated Figure 14A above shows LED package structure 100. Surrounding portion 62 (labeled in green) of package compound 6 (light green) has inner annular part 621 and outer annular part 622. Ex. 1001, 6:58–59. Surrounding portion 62 also has top surface 623 connecting a top end of inner annular part 621 and a top end of outer annular part 622. *Id.* at 6:59–61. In this embodiment, top surface 623 of surrounding portion 62 of package compound 6 is configured to have a particular curved shape, and is formed with a radius of curvature such that “a center of curvature of the top surface 623 is located outside of the accommodating space S.” *Id.* at 7:23–31. Therefore, light emitted from top surface 623 of surrounding portion 62 can be gathered outside wall 5, thereby preventing light spots from being formed inside wall 5. *Id.* at 7:31–34.

D. Illustrative Claim

Of the challenged claims, claim 1 is independent. Claims 2, 3, and 5 depend from claim 1. Claim 1 is illustrative, and is reproduced below with disputed limitations emphasized:

1. A package structure, comprising:

[1.1] a substrate and a pair of electrodes disposed on the substrate,

[1.2] wherein the substrate has a first surface and a second surface opposite to the first surface, and the substrate defines a height direction perpendicular to the first surface;

[1.3] a lighting unit including a[] lighting diode, wherein the lighting diode has a top surface and a surrounding lateral surface connected to a peripheral edge of the top surface, and the lighting unit is disposed on the first surface of the substrate and is electrically connected to the pair of electrodes;

[1.4] a wall disposed on the first surface of the substrate, wherein the wall and the first surface jointly define an accommodating space, and the lighting diode is arranged in the accommodating space; and

[1.5] a package compound arranged in the accommodating space, wherein the electrodes and the lighting diode are at least partially embedded in the package compound, and the package compound includes:

[1.6] an attaching portion adhering to a top surface of the lighting diode, wherein a height of a top end of the attaching portion with respect to the first surface is less than a height of the wall with respect to the first surface; and

[1.7] a surrounding portion that is arranged around a surrounding lateral surface of the lighting unit and integrally extends from the attaching portion so that light emitted from the surrounding lateral surface is directly guided upward through the surrounding portion, and

[1.8] wherein the surrounding portion has an inner annular part and an outer annular part, wherein the inner annular part is arranged adjacent to the attaching portion, the surrounding portion is connected to an inner surface of the wall,

[1.9] the surrounding portion has an annular slot formed on a top surface thereof, and a bottom end of the annular slot is located at a position aligning with 25-90% of a thickness of the lighting unit along the height direction,

[1.10] wherein the attaching portion and the surrounding portion allow light generated by the lighting unit to pass there-through, and

[1.11] the surrounding portion contacts the surrounding lateral surface of the lighting unit,

[1.12] *wherein the top surface of the surrounding portion is in a curved shape, and a center of a curvature of the top surface of the surrounding portion is arranged outside of the accommodating space,*

[1.13] wherein a height of a top end of the outer annular part of the surrounding portion is higher than a height of the top surface of the lighting diode, and

[1.14] wherein the lighting unit is arranged at a center of the package compound and the surrounding portion is formed symmetrically about the attaching portion.

Ex. 1001, 8:59–9:46 (emphases and bracketed matters added).

E. Asserted Grounds of Unpatentability

We instituted *inter partes* review of the challenged claims based on the following grounds of unpatentability asserted by Petitioner (Pet. 2–3):

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1, 5	103	Nichia-825 ¹
2	103	Nichia-825, Achyut ²
3	103	Nichia-825, Hashimoto ³
1, 5	103	Nichia-824 ⁴
2	103	Nichia-824, Achyut
3	103	Nichia-824, Hashimoto

III. ANALYSIS

A. Claim Construction

In an *inter partes* review, we construe a patent claim “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).” 37 C.F.R. § 42.100(b) (2021).

¹ Japan Application Pub. No. 2009-170825, published on July 30, 2009 (Ex. 1006) (Ex. 1007, English translation).

² U.S. Application Pub. No. 2005/0199897 A1, published on Sept. 15, 2005 (Ex. 1011).

³ U.S. Application Pub. No. 2009/0045423 A1, published on Feb. 19, 2009 (Ex. 1010).

⁴ Japan Application Pub. No. 2009-170824, published on July 30, 2009 (Ex. 1004) (Ex. 1005, English translation).

Under this standard, the words of a claim generally are given their “ordinary and customary meaning,” which is the meaning the term would have to a person of ordinary skill at the time of the invention, in the context of the entire patent including the specification. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc).

Petitioner does not propose an express construction for any claim term. Patent Owner proposes constructions for two claim terms, which are discussed below. No other claim term requires express construction for purposes of resolving the parties’ disputes. *See Realtime Data LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) (“The Board is required to construe ‘only those 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))).

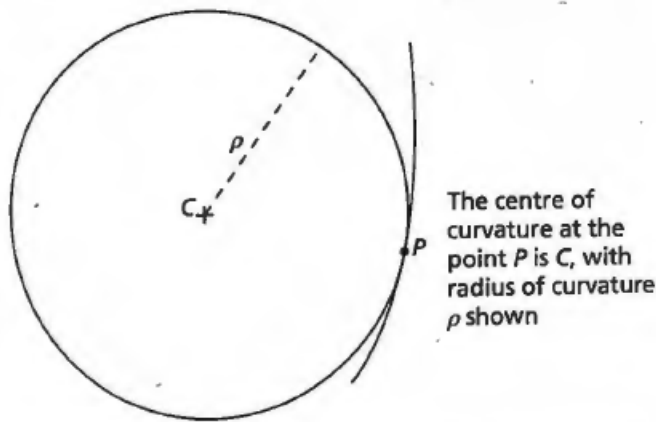
1. “center of a curvature”

Element 1.12 of claim 1 recites “the top surface of the surrounding portion is in *a curved shape*, and *a center of a curvature* of the top surface of the surrounding portion is arranged outside of the accommodating space.” Ex. 1001, 9:37–40 (emphases added).

In the Institution Decision, we construed the term “center of curvature” as “the center of a circle which best fits a curve at a particular point on the curve.” Inst. Dec. 7–9. For the reasons that follow, we adopt the same construction here. Furthermore, we agree with Petitioner that the top surface of the surrounding portion may have more than one center of curvature, and element 1.12 is met if at least one such center of curvature is arranged outside of the accommodating space.

Patent Owner proposes to construe the phrase “center of a curvature” as “the center of the circle which best fits a curve at a particular point on the curve,” citing to the Declaration of Michael Lebby, Ph.D. (Ex. 2001 ¶ 99) and the Concise Oxford Dictionary of Mathematics (Ex. 2002, 3⁵) for support. PO Resp. 19.

Dr. Lebby testifies that a person of ordinary skill in the art would have understood that the phrase “center of curvature” refers to “the center of the circle which best fits a curve at a particular point on the curve.” Ex. 2001 ¶¶ 99–100 (citing Ex. 2002, 3). The Concise Oxford Dictionary of Mathematics defines “[t]he centre of curvature is the centre of that best-fitting circle, known as the circle of curvature” and discloses the following Figure. Ex. 2002, 3.



The Figure above shows the center of curvature at the point P is C with radius of curvature (dotted line). *Id.* ¶ 100.

⁵ Our citations to Exhibit 2002 refer to the page numbers added by Patent Owner on the bottom, right corner.

Petitioner's declarant, Jack Josefowicz, Ph.D., testifies that he agrees with the above dictionary definition of "center of curvature." Ex. 2006, 89:14–19.

Petitioner argues that, because Patent Owner "erroneously imports an extrinsic dictionary definition at the expense of the intrinsic evidence," Patent Owner's proposed construction should not be adopted. Pet. Reply 1. According to Petitioner, although its own expert, Dr. Josefowicz, testified that he agreed with the dictionary definition of the cited phrase, such a statement was not offered as an agreement with Patent Owner's proposed claim construction. *Id.* (citing Ex. 2006, 89:14–19). Petitioner instead argues that the disputed claim limitation should be construed according to intrinsic evidence. *Id.* at 2. That is, because the disputed claim limitation recites "**a** center of a curvature of the top **surface** of the surrounding portion [having a curved shape] is arranged outside the accommodating space," the word "a" provides that there can be more than one center of a curvature for the top surface. *Id.* (citing *Baldwin Graphic, Inc. v. Siebert, Inc.*, 512 F.3d 1338, 1342 (Fed. Cir. 2008)). Therefore, Petitioner argues that Patent Owner's construction of "center of curvature" as "the center of the circle which best fits a curve at a particular point on the curve" is facially consistent with the intrinsic evidence that the top surface has more than one center of curvature. *Id.* (citing Ex. 1025⁶ ¶ 7). In other words, Petitioner argues that the intrinsic evidence supports there is more than one circle that best fits the curve, with each circle based on a particular point among many

⁶ Petitioner inadvertently cited Ex. 1013.

points on the surface, and each circle having one center. *Id.* Petitioner emphasizes that, during prosecution of the '685 patent and during the instant proceedings, Patent Owner identified three different centers of curvature for the top surface in Figure 14A. *Id.* at 2–3 (citing Ex. 1025⁷ ¶¶ 8–11).

Further, Petitioner argues that because, during prosecution of the '685 patent, Patent Owner did not rebut the Examiner's finding that the center of curvature also includes the center of an oval, the disputed limitation should be construed under its plain and ordinary meaning to include the center of either a circle or an oval. *Id.* at 5–6.

Patent Owner counters that because “center of curvature” is a well-known phrase of art, a person of ordinary skill in the art (“POSITA”) would have understood that phrase as “the center of the circle which best fits a curve at a particular point on the curve.” PO Sur-Reply 5–6 (citing Ex. 2001 ¶ 99; Ex. 2002 ¶ 3; Ex. 2006 ¶ 89). According to Patent Owner, the best fitting circle is the circle that has the most overlap and has the maximum coincidence with a cross section of the curved top surface. *Id.* at 6–7 (citing Ex. 2001 ¶ 100; Ex. 2007 ¶ 27; Ex. 1015 ¶¶ 146–148, 196). More particularly, Patent Owner asserts the following:

For example, in the context of the '685 Patent, the “particular point on the curve” refers to the cross-sectional view of the curved top surface, which is shown above as a curved line in Figure 14A [below] (annotated as the red curved line). Accordingly, claim limitation 1.12 requires that the center of the best-fitting circle for the curved top surface be located outside of the accommodating space. Thus, a POSITA would have understood that, in the context of the '685

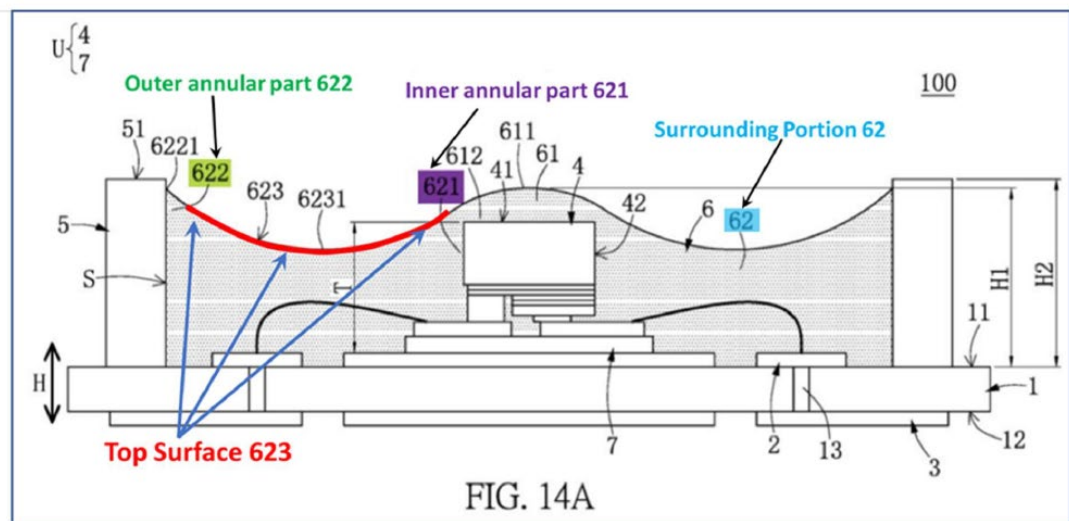
⁷ *Id.*

Patent, the “center of a curvature” for the curved top surface of the surrounding portion is determined by placing a best-fitting circle that has the maximum overlap or maximum coincidence with the cross-section of a curved top surface, which is shown as a curved line.

Id. at 6 (emphasis omitted).

Figure 14A, is reproduced below with Patent Owner’s annotations.

PO Sur Reply 5.



Patent Owner’s annotated Figure 14 A above depicts a cross sectional schematic view of the LED package structure. *Id.*

Patent Owner further responds that the applicant traversed the Examiner’s rejections based on the oval-shaped drawing during prosecution of the ’685 patent, and because the depictions of different circles and an oval, each having a different center, were not drawn to scale in the Reply, they cannot be relied upon as evidence to support Petitioner’s position that the center of curvature may involve more than one circle or even an oval, each having a different center. *Id.* at 7–10. Accordingly, Patent Owner submits that the “center of curvature” should be construed consistent with

the common understanding of a POSITA as meaning one center of one circle which best fits the curvature of the curved top surface at a particular point thereon. *Id.*

Based on the Specification and evidence on the record before us, we agree with Patent Owner's proposed claim construction for the claim phrase "center of a curvature" as "the center of the circle which best fits a curve at a particular point on the curve." In assessing claim language, the indefinite article "a" in patent parlance generally carries the meaning of one or more unless the patentee has evidenced a clear intent to limit the indefinite article to one. *See Baldwin Graphic*, 512 F.3d at 1342. Therefore, we agree with Petitioner that "a center of curvature" means there can be more than one center of a curvature for the top surface.

The parties also dispute whether the term "center of curvature" encompasses the focal point of an ellipse. Pet. 9–10; PO Resp. 27–28. We agree with Patent Owner that it does not. We acknowledge that Patent Owner, during prosecution of the '685 patent, opted to further amend the claim as opposed to directly challenge the Examiner's reading of the claimed "a center of curvature" on an imaginary ellipse manually drawn by Examiner. Nevertheless, we do not agree with Petitioner that such a strategy by Patent Owner is tantamount to a tacit admission that the "center of curvature" could be construed to include the focal point of an ellipse. *See* Pet. 9–10 (citing Ex. 1002, 294, Final Rejection of 4/23/30), PO Sur-Reply 7–9. First, As persuasively argued by Patent Owner, "a POSITA would understand that an ellipse has two focal points and that the center of curvature of an ellipse is not located at the ellipse's center point." PO Resp.

27–28 (citing Ex. 2007 ¶ 29). Accordingly, the POSITA would have appreciated that Patent Owner made the strategic decision to advance its prosecution of the underlying patent application by focusing on the center of the circle instead of one of the centers of an imaginary ellipse.

Because, on the record before us, Petitioner fails to provide an express claim construction for “center of curvature,” and Petitioner likewise fails to provide sufficient evidence to support the arguments that “center of curvature” implicates an oval structure (e.g. an imaginary ellipse), the weight of the evidence favors Patent Owner’s proffered dictionary definition for “center of curvature” as “the center of the circle which best fits a curve at a particular point on the curve.” *See* Ex. 2002 ¶ 3. Accordingly, we agree with Patent Owner that claim limitation 1.12 thus requires the center of the best fitting **circle** for a particular point on the curved top surface is arranged outside the accommodating space. PO Sur-Reply 6.

We nonetheless note our disagreement with Patent Owner’s contention that the best fitting circle is the one with the “most overlap” or “maximum coincidence” with the curved top surface, which is a curved line. *Id.* at 6–7. As argued by Petitioner, Patent Owner has not presented any evidence to substantiate that the center of curvature pertains to the circle that has the “most overlap” or the “maximum coincidence” with the top surface of the surrounding portion. Pet. Reply 9. Such phrases do not appear in the ’685 patent, nor does Patent Owner’s expert declarant, Dr. Lebby, provide any evidence besides a mere conclusion that such overlap or coincidence must take place between the circle and the curved top surface in order to qualify as the best fitting circle. We agree with Petitioner that the Board’s

claim construction, as adopted in the Institution Decision and reiterated here, requires the circle that best fits the curve **at a particular point** on the curve, and there need not be a maximum overlap between the best-fitting circle and the entire curved top surface. *Id.* (citing Ex. 1015, 164:10–22). We agree with Petitioner that the top surface of the surrounding portion is a curved line that includes a plurality of points, and each point along the curve has a circle that best fits the curve at that point. Pet. Reply 2–3. Under our claim construction, the curvature along the top surface may vary such that there are multiple different best-fitting circles. Element 1.12 is met if the center of a best-fitting circle at a particular point along the curve is arranged outside of the accommodating space.

2. “annular slot”

Although we preliminarily construed the term “annular slot” in our Institution Decision, Petitioner argues there is no need for us to construe the term for purposes of this Final Written Decision because Patent Owner has failed to raise any arguments based on its proposed construction of “annular slot” during trial. Pet. Reply 6–7 (citing Inst. Dec. 20–22; PO Resp. 20–33). We agree with Petitioner that there is no remaining dispute impacted by the construction of “annular slot,” and accordingly we do not construe the term for purposes of this Decision. *See Realtime Data*, 912 F.3d at 1375.

B. Principles of Law

“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.

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”)); *see also* 37 C.F.R. § 42.104(b) (requiring a petition for *inter partes* review to identify how the challenged claim is to be construed and where each element of the claim is found in the prior art patents or printed publications relied upon).

A patent claim is unpatentable under 35 U.S.C. § 103 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 based on 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 nonobviousness, i.e., secondary considerations. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).⁸

Additionally, the obviousness inquiry typically requires an analysis of “whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue.” *KSR*, 550 U.S. at 418 (*citing In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006) (requiring “articulated reasoning with some rational underpinning to support the legal conclusion of

⁸ Neither party presents evidence of secondary considerations of non-obviousness.

obviousness”)). Furthermore, Petitioner does not satisfy its burden of proving obviousness by employing “mere conclusory statements,” but “must instead articulate specific reasoning, based on evidence of record, to support the legal conclusion of obviousness.” *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016).

C. Level of Ordinary Skill in the Art

In determining the level of ordinary skill in the art, various factors may be considered, including the “type of problems encountered in the art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field.” *In re GPAC, Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (quotation marks omitted).

Petitioner asserts that a person of ordinary skill in the art of the ’685 patent would have had “a bachelor’s degree in electrical engineering, materials science, physics, or a similar discipline.” Pet. 12–13. Petitioner further asserts that such an artisan also would have had “one to two years of experience in the field of LEDs, with knowledge of device design, the semiconductor and contact metal materials involved with the fabrication of an LED device, as well as LED packaging design.” *Id.* (citing Ex. 1003 ¶¶ 31–32).

Patent Owner asserts that a person of ordinary skill in the art of the ’685 patent would have had “at least the level of skill articulated in the Petition (at 12–13), and adopted by the Board in its institution decision in Paper 8 at 11–13.” PO Resp. 3 (citing Ex. 2007 ¶ 8). We note that although

Patent Owner agrees with Petitioner’s assessment of the level of the ordinary skill in the art, the open-ended language “at least” in Patent Owner’s assessment may cause certain ambiguity. *Id.*

We adopt Petitioner’s proffered level of ordinary skill in the art as its essence is agreed upon and is consistent with the prior art of record. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (“[T]he level of skill in the art is a prism or lens through which a judge, jury, or the Board views the prior art and the claimed invention.”); *Ryko Mfg. Co. v. Nu-Star, Inc.*, 950 F.2d 714, 718 (Fed. Cir. 1991) (“The importance of resolving the level of ordinary skill in the art lies in the necessity of maintaining objectivity in the obviousness inquiry.”). To that end, we note that the prior art itself often reflects an appropriate skill level. *See Okajima*, 261 F.3d at 1355.

D. Obviousness over Nichia-825 alone or in view of other references

Petitioner asserts that claims 1 and 5 are unpatentable under § 103(a) as obvious over Nichia-825. Pet. 14–48. Petitioner also asserts that claim 2 is unpatentable under § 103(a) as obvious over Nichia-825 in view of Achyut, and that claim 3 is unpatentable under § 103(a) as obvious over Nichia-825 in view of Hashimoto. *Id.* at 48–54. Patent Owner opposes. PO Resp. 23–38. Upon consideration of Petitioner’s explanations and supporting evidence in this current record, we are persuaded that Petitioner has demonstrated by a preponderance of the evidence that claims 1 and 5 are unpatentable over Nichia-825 alone and that claim 2 is unpatentable over Nichia-825 in combination with Achyut. However, we are not persuaded

that Petitioner has demonstrated by a preponderance of the evidence that claim 3 is unpatentable over Nichia-825 alone or in combination with Hashimoto. Our analysis below focuses on the disputed claim elements.

1. Nichia-825 (Exhibit 1006) (Exhibit 1007, English Translation)

Nichia-825 discloses a light-emitting device. Ex. 1007 ¶ 1.

Figure 4 of Nichia-825 is reproduced below.

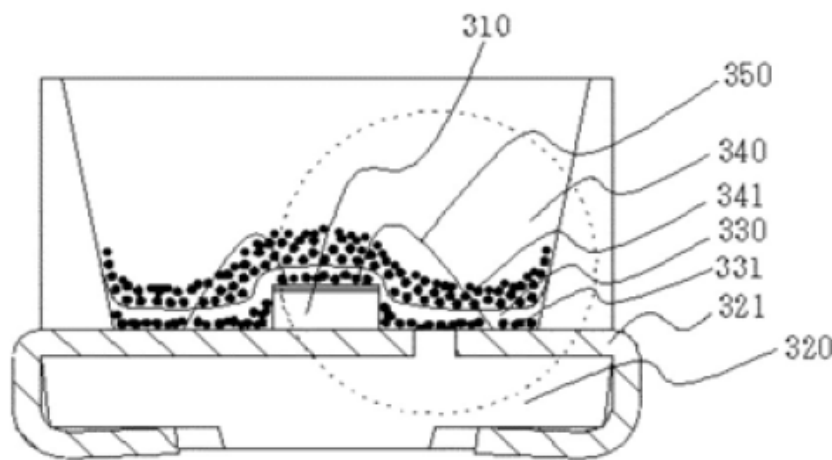


Figure 4 above depicts a sectional view of a light-emitting device. *Id.* ¶ 82. The package structure of the light-emitting device includes lead 321, which is a pair of electrodes disposed on base member 320. *Id.* ¶¶ 71, 78. Base member 320 has “a cup shape having a bottom surface and a sidewall.” *Id.* ¶ 47. The sidewall along with the bottom defines an accommodating space. Light-emitting element 310 is a light-emitting diode and is placed on lead 321 “on the cup-shaped inner bottom surface.” *Id.* ¶¶ 53–54, 71, 78. Light-emitting element 310 is electrically connected to the lead 321 via wire 350. *Id.* ¶ 78. Covering member 330 composed of a silicone resin includes first fluorescent material 331 and is “dropped onto the light-emitting element 310” inside the accommodating space and then cured. *Id.* ¶¶ 72, 78. Light-

emitting element 310 and the leads are at least partially embedded in covering member 330 covered with sealing member 340, which contains second fluorescent material 341 and fills cup-shape base member 320. *Id.* ¶ 41.

Figure 5 of Nichia-825 is reproduced below with highlighting added by Petitioner. Pet. 30.

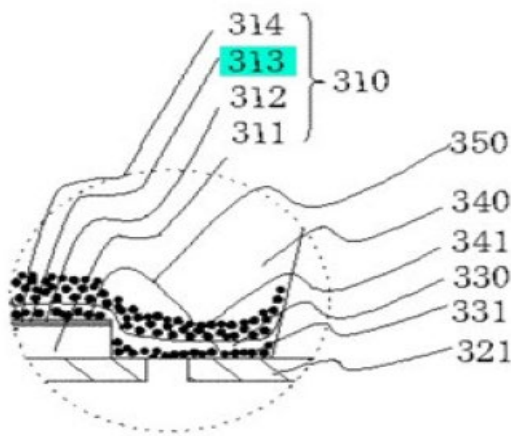
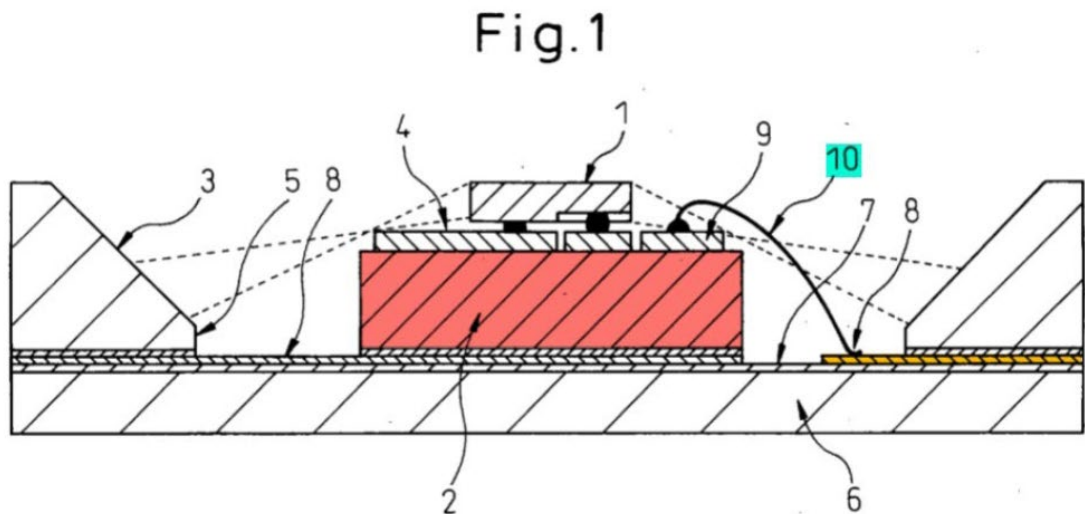


Figure 5 above shows an enlarged portion of the light-emitting device shown in Figure 4. Ex. 1007 ¶ 82. Light-emitting element 310 is formed by laminating n-type semiconductor layer 312, light-emitting layer 313 (green), and p-type semiconductor layer 314 on sapphire substrate 311. *Id.* ¶ 42. First fluorescent material 331 in covering member 330 is deposited such that it does not cover light-emitting layer 313. *Id.* Therefore, light from light-emitting layer 313 can be efficiently taken out to covering member 330. *Id.* Because sealing member 340 has a lower refractive index than that of covering member 330, light emitted from light-emitting element 310 is efficiently output to sealing member 340. *Id.* In addition, the return of light from sealing member 340 to covering member 330 is reduced by utilizing the difference in refractive index. *Id.* Accordingly, the amount of light

emitted from light-emitting element 310 reaching the cup-shaped sidewall of base member 320 can be reduced, so that deterioration of the package can be prevented. *Id.*

2. Hashimoto (Exhibit 1010)

Hashimoto discloses a high efficiency semiconductor light-emitting device (LED). Ex. 1010, code (57). Figure 1 of Hashimoto is reproduced below with highlighting added by Petitioner. Pet. 53.



Petitioner's annotated figure 1 above of Hashimoto depicts LED flip-chip 1 electrically connected to sub-mount 2 (red) via gold bumps. Ex. 1010, ¶¶ 42, 44. Hashimoto also discloses that "gold wires (10) . . . were bonded from the electrodes (9) on the sub-mount to the electrodes (8) on the package substrate." *Id.* ¶ 44.

3. Achyut (Exhibit 1011)

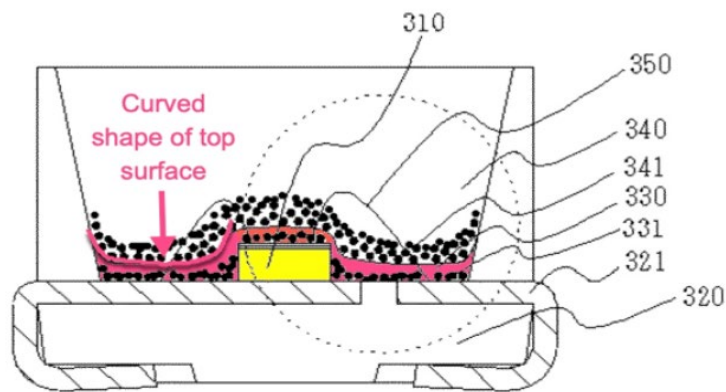
Achyut discloses a light-emitting device including a UV or blue semiconductor light source. Ex. 1011 ¶ 11. According to Achyut, “[o]ne known yellow-whitish light emitting device comprises a blue light-emitting LED having a peak emission wavelength in the near UV-to-blue range (from about 315 nm to about 480 nm) combined with a yellow light-emitting phosphor, such as cerium doped yttrium aluminum garnet $\text{Y}_3\text{Al}_{4.9}\text{O}_{12-\delta}:\text{Ce}^{3+}$ (‘YAG’).” *Id.* at code (57), ¶ 9.

4. Claim 1

a. *“a center of curvature located outside of the accommodating space”*

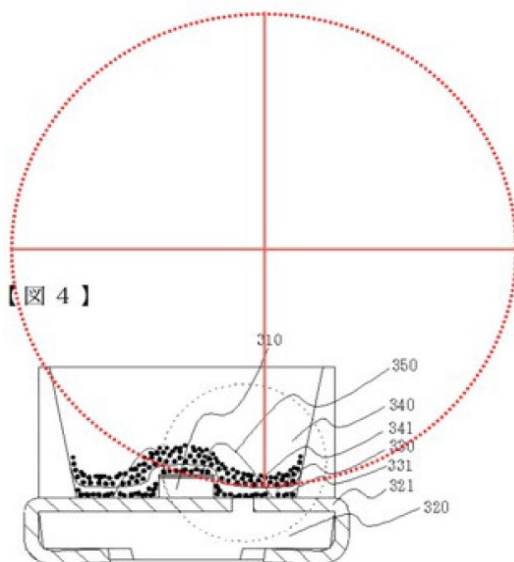
Element 1.12 of claim 1 recites “the top surface of the surrounding portion is in a curved shape, and a center of a curvature of the top surface of the surrounding portion is arranged outside of the accommodating space.” Ex. 1001, 9:37–40.

Petitioner asserts that the top surface of the surrounding portion of covering member 330, as shown below in Figure 4 of Nichia-825, is in a curved shape. Pet. 37–38 (citing Ex. 1007, Fig. 4; Ex. 1003 ¶ 98). According to Petitioner, the center of curvature of the top surface is arranged outside of the accommodating space. *Id.* at 39–40 (citing Ex. 1003 ¶ 98). Figure 4 of Nichia-825 is reproduced below with annotations added by Petitioner. Pet. 38.



Petitioner's annotated Figure 4 above is a sectional view of a light-emitting device. *Id.* at 37; Ex. 1007 ¶ 82. Referring to the annotated figure, Petitioner contends that a surrounding portion of covering member 330 (pink) is arranged around the lateral surface of light-emitting element 310 (yellow), and an attaching portion (orange) is arranged on top of light-emitting element 310. Pet. 36.

Figure 4 of Nichia-825 is reproduced below with further annotations added by Petitioner. Pet. 40.



Petitioner's Annotated Figure 4 above is a sectional view of a light-emitting device. Petitioner has drawn a circle with its center outside the accommodating space and its edge along the top surface of the surrounding portion of covering member 330. Pet. 40.

Dr. Josefowicz testifies that Figure 4 of Nichia-825 shows that the top surface of the surrounding portion is in a curved shape. Ex. 1003 ¶ 98. Dr. Josefowicz also testifies that a person of ordinary skill in the art would have understood that “the resin climbs the inner sidewall of the cup wall, as well as the sidewalls of the light-emitting element because of surface tension on the surface of the liquid resin.” *Id.* Dr. Josefowicz further testifies that such an artisan would have known that “just as the curved upper surface of a liquid in a tube results in a concave shape of the curve, the surface of the resin surrounding portion would have a concave shape and that the radius of curvature would be large compared to the height of the light-emitting element,” and “[t]his would place the center of curvature to be well outside the accommodating space.” *Id.* Further, as noted by Petitioner, Dr. Josefowicz demonstrates in Figure 4 of Nichia-825 that, because the “heights of the top ends of the outer annular part and the attaching portion in Nichia-825 Figure 4 are so close to being at the same height, a POSA would understand that under any reasonable metric, those top ends are “substantially arranged at a same height.” Pet. Reply 12 (citing Ex. 1013 ¶¶ 25–27).

Patent Owner counters that because Petitioner's expert declarant, Dr. Josefowicz, failed to draw a best fitting circle that coincides with the top surface of Nichia-825's covering member 330, let alone a circle that has the

most overlap (or maximum coincidence) with the top surface of the covering member, Petitioner has failed to show that Nichia's disclosure teaches a center of curvature of the top surface of the surrounding portion being outside of the accommodating space. PO Resp. 23–27 (citing Ex. 1003 ¶¶ 98, 99; Ex. 2007 ¶ 27). Patent Owner also argues that because Dr. Josefowicz's drawing of an ellipse has two focal points, a POSITA would understand that it cannot comport with a "center of curvature" as construed above. *Id.* at 28–29 (citing Ex. 2007 ¶ 29). More particularly, Patent Owner asserts:

A POSITA would also understand that there is one best-fitting circle for a given curved surface and that the center of curvature of the top surface of the covering member 330 in Nichia-825 could not be located at two different points. *Id.* Rather, a POSITA would apply a circle that best fits the curved top surface of the covering member 330 package compound to determine the location of its center of curvature.

Id. at 28.

Additionally, Patent Owner argues that, according to the Specification of the '865 patent, in order for the center of curvature of the top surface 623 of the surrounding portion 62 to be arranged outside of the accommodating space, "the top end 611 of the attaching portion 61 and a top end 6221 of the outer annular part 622 of the surrounding portion 62 *are substantially arranged at the same height* with respect to the substrate 1." *Id.* at 29 (citing Ex. 1001, 7:23-27) (emphasis in original). Patent Owner argues that, in contrast, Nichia-825 shows that top ends of covering member 330 are at different heights. *Id.* at 30 (citing Ex. 1007, Fig. 4).

After considering the parties' evidence and arguments, we find Petitioner has shown by a preponderance of the evidence that Nichia-825 discloses the claimed subject matter in Element 1.12.

As discussed above in Section III.A.1, we construe the term “center of curvature” as “the center of a circle which best fits a curve at a particular point on the curve.” Under our claim construction, the top surface of the surrounding portion may have more than one center of curvature, and element 1.12 is met if at least one such center of curvature is arranged outside of the accommodating space.

We find that Petitioner's annotations of Figure 4 of Nichia-825 show that the reference teaches element 1.12 under our claim construction. Pet. 38, 40. As depicted in Petitioner's first annotation of Figure 4 of Nichia-825 above, and corroborated by Dr. Josefowicz's declaration, the top surface of the surrounding portion is in a curved shape. Pet. 38; Ex. 1003 ¶ 98. Petitioner's second annotation Figure 4 of Nichia-825 above identifies the “center of curvature” consistent with our claim construction. Pet. 40. More particularly, Petitioner has drawn a circle that best fits the curved top surface of Nichia-825's covering member 330 at a particular point. *Id.* It is undisputed that the center of the circle drawn by Petitioner is outside the accommodating space. PO Resp. 23–28, PO Sur-Reply 11–13. That is sufficient to satisfy element 1.12 under our claim construction.

Patent Owner's arguments are not consistent with our construction for “center of curvature.” PO Resp. 25–27. Our construction does not require maximum overlap or coincidence between a best-fitting circle and the top surface of the surrounding portion. A best-fitting circle need only provide

the best fit **at a particular point**. Our claim construction also does not require that the top end of the attaching portion have the same height as the top end of the annular surrounding portion. It also does not prohibit a best-fitting circle from intersecting the corner of the lighting unit.

Based on the evidence on the record before us, we find that Petitioner has demonstrated persuasively that Nichia-825 discloses the subject matter of Element 1.12.

b. Remaining limitations

Regarding the remaining limitations of claim 1, Petitioner maps elements 1.1 through 1.11, 11.3, and 11.4 to corresponding teachings in Nichia-825. *See* Pet. 14–37, and 41–46. Patent Owner does not present specific arguments regarding these claim elements. For the reasons set forth in the Petition, we agree with Petitioner that Nichia-825 teaches these claim elements.

In light of the foregoing, we determine that Petitioner has demonstrated by a preponderance of the evidence that claim 1 is unpatentable under § 103(a) as obvious over Nichia-825.

5. Claims 2 and 5

Petitioner contends that Nichia-825 alone teaches the limitations of claim 5. Pet. 46–48. Petitioner further contends that Nichia-825 alone or in combination with Achyut teaches the limitations of claims 2 and 5. Pet. 48–50. Petitioner also articulates reasons to combine the prior art teachings. *Id.* Patent Owner does not present arguments for claims 2 and 5 separate from its arguments for claim 1. *See* PO Resp. 23–33. For the reasons set

forth in the Petition, we agree with Petitioner that Nichia-825 teaches the limitations of claims 2 and 5, that Nichia-825 combined with Achyut teaches the limitations of claim 2, and that a person of ordinary skill in the art would have combined the references as asserted. Accordingly, we determine that Petitioner has demonstrated by a preponderance of the evidence that claims 2 and 5 are unpatentable under § 103(a) as obvious over Nichia-825 alone. We further determine that Petitioner has demonstrated that claim 2 is unpatentable as obvious over Nichia-825 in combination with Achyut.

6. Claim 3

Claim 3 recites the following:

The package structure as claimed in claim 1, wherein the lighting unit includes a submount, the lighting diode is electrically connected to two electrodes of the submount, and an electrical connection between the lighting diode and the pair of electrodes is established by wiring the two electrodes of the submount to the pair of electrodes.

Ex. 1001, 9:50–55.

The claim requires electrically connecting a diode to a submount by connecting the two electrodes of the submount to a pair of electrodes connected to the diode. Petitioner contends that Nichia-825 alone or in combination with Hashimoto teaches the limitations of claim 3. Pet. 51–54. In particular, Petitioner contends that although Nichia-825 discloses “a flip-chip mounted light-emitting element,” it does not teach a lighting diode electrically connected to electrodes on a submount, with an electrical connection established by wiring the electrodes of the submount to the electrodes of the package structure. *Id.* at 51–52 (citing Ex. 1003 ¶¶ 125–32; Ex. 1007 ¶¶ 44, 45). However, Petitioner asserts that it would have been

obvious to a POSITA to modify Nichia-825 to add the claimed submount because “[s]uch a submount for flip-chip LED designs was well-known at the time of the filing of the ‘685 patent and would have been preferred to the solder balls used to connect light-emitting element 410 in Figure 6.” *Id.* at 52 (citing Ex. 1003 ¶ 131). For example, Petitioner asserts that Hashimoto provides such a design as an LED flip-chip electrically connected to a submount such that gold wires are bonded from electrodes on the submount to electrodes on the package substrate. *Id.* at 52 (citing Ex. 1010 ¶ 44).

According to Petitioner,

It would have been obvious to a POSA to modify Nichia-825 to include a submount for use with a flip-chip LED. [Ex. 1003] ¶¶ 130–31. The use of such a submount was well-known before the filing of the ‘685 patent, and a POSA would understand that directly mounting the flip-chip LED onto the electrodes and the substrate, as depicted in Figure 6 of Nichia-825, using solder balls would not be preferable, due to the potential contact failures due to thermal expansion and contraction, as well as physical vibrations. *Id.* Thus, a POSA would be motivated to use a submount to mount the flip-chip LED, like the one disclosed in Hashimoto, and then to electrically connect the submount to the electrodes on the claimed substrate with a reasonable expectation of success. *Id.* ¶ 131. It would be obvious to a POSA to use wire bonds and wires for connecting the submount electrodes to the substrate electrodes instead of the solder balls because wire bonds and wires were considered a more reliable electrical connection.

Id. at 53–54.

Patent Owner counters that Nichia-825 alone or in combination with Hashimoto does not render claim 3 unpatentable because Hashimoto does not cure Petitioner’s admitted deficiencies of Nichia-825 of establishing an electrical connection between the lighting diode and the pair of electrodes by

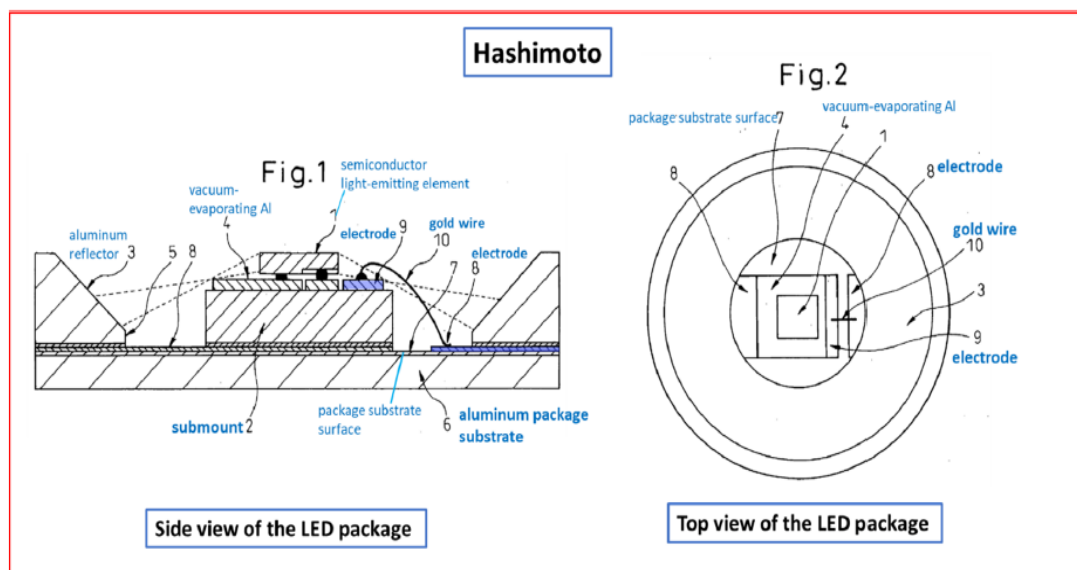
wiring the two electrodes of the submount to the pair of electrodes. PO Resp. 33 (citing Ex. 2007 ¶ 32). According to Patent Owner, Hashimoto only discloses a configuration having a single electrode for a submount that is electrically connected to a single electrode of the package structure via a single wired connection. *Id.* (citing Ex. 1010, Fig. 1). Further, Patent Owner argues that a POSITA would not have been motivated to combine Nichia-825 with Hashimoto because Nichia-825's flip-chip package structure makes a direct solder bump electrical connection to the printed circuit board, whereas the package structure in Hashimoto uses a conductive submount to make the electrical connection to the circuit board. *Id.* at 36 (citing Ex. 1007, Fig. 6; Ex. 1010, Fig. 1). Patent Owner argues that the POSITA would not have a need for the package structure of Hashimoto to include a second wired electrode to the submount because the second connection in Hashimoto is already made to the electrode on the printed circuit board below the conductive submount. *Id.* at 36–37 (citing Ex. 1007 ¶ 36). Patent Owner asserts that the POSITA would also understand that Hashimoto's use of a conductive submount teaches away from insulating the submount of the '685 patent. *Id.* at 37. Additionally, Patent Owner argues that modifying Nichia-825's flip-chip package by adding thereto Hashimoto's conductive submount would increase the height of the LED to a thickness that far exceeds the preferred thickness range of 50 μm to 100 μm for the covering member package compound as prescribed in Nichia-825. *Id.* at 36–37 (citing Ex. 1007 ¶ 56); PO Sur-Reply 17.

After considering the parties' evidence and arguments, we find Petitioner has not shown by a preponderance of the evidence that Nichia-825

alone or in combination with Hashimoto discloses the subject matter in claim 3. As noted above, Petitioner's proposed combination is to modify Nichia-825's LED directly mounted on the substrate (Nichia-825 Fig. 6) by inserting Hashimoto's conductive submount between Nichia-825's LED and the substrate, and by further using Hashimoto's electrodes to provide electrical connection between the LED and the submount. However, the evidence on the record before us does not support the proposed modification. In his opening declaration, Dr. Josefowicz opines that, because Hashimoto discloses the "same configuration as shown in Figure 14A of the '685 [patent]," "Hashimoto discloses the limitation of claim 3." Ex. 1003 ¶¶ 128, 129 (citing Ex. 1010 ¶ 44). In his reply declaration, Dr. Josefowicz changes his testimony, opining: "although [Hashimoto] Figures 1 and 2 only show one wire (10), one electrode (9), and one electrode (8), a POSA would have understood that the package *can be* connected using two gold wires (10) to connect electrodes 9 to electrodes (8)." Ex. 1025 ¶ 25 (emphasis added). Dr. Josefowicz's opinions in his opening declaration and reply declaration are facially inconsistent and do not account for the electrically-conductive adhesive that Hashimoto indicates is used to attach the submount to the package substrate. Ex. 1010 ¶ 44, PO Resp. 34–35. We agree with Patent Owner that a POSITA would have appreciated that Hashimoto's electrically-conductive adhesive electrically connects the submount to the package structure. *Id.* at 35 (citing Ex. 2007 ¶ 34). In particular, Hashimoto explains: "[t]he sub-mount is often made of an electrically conducting material of a low resistance and in a shape in order to feed the electric power through the back surface of the sub-mount." Ex.

1010 ¶ 33. Dr. Lebby explains that “[i]n Figure 1 of Hashimoto, the electrode 9 is used for making an electrical connection, via wire 10, to electrode 8 of the n-type region of the LED device, whereas the electrical connection for the p-type region of the LED device goes through the conductive submount 2 to the package electrode 8 beneath the submount 2.” Ex. 2007 ¶ 34. We find that Dr. Lebby’s testimony is supported by Hashimoto and provides persuasive rebuttal to Dr. Josefowicz’s opinion about how a POSITA would have understood Hashimoto.

We also find insufficient evidence on this record to support Petitioner’s view that Hashimoto’s use of the plural, “gold wires (10),” means that there is more than a single wire (10) for each light emitting element. Pet. Reply 21 (citing Ex. 1010 ¶ 44). As illustrated by Patent Owner’s annotated Figures 1 and 2 (reproduced below), Hashimoto shows only one gold wire 10 is used to connect the electrode 9 to the electrode 8 on package substrate 6. PO Resp. 34.



Patent Owner's annotated Figures 1 and 2 above depict a cross section of a semiconductor light emitting device (LED). Ex 1010 ¶¶ 18, 19. Although Hashimoto Figures 1 and 2 show a single gold wire 10 connecting single electrode 9 of the LED to single electrode 8 of the substrate in Figures 1 and 2 above, Petitioner nevertheless contends that Hashimoto discloses two wired connections for each LED. Pet. 52 (citing Ex. 1010 ¶ 44). Petitioner relies on Hashimoto paragraph 44, which uses of the plural form for "wire" and "electrode" in its description of Figures 1 and 2: "gold wires (10) of a diameter of 25 μ m were bonded from the electrodes (9) on the sub-mount to the electrodes (8) on the package substrate." *Id.* We find insufficient support for Petitioner's interpretation of Hashimoto. Paragraph 44 (and the preceding paragraphs) of Hashimoto discuss light-emitting *elements* in the plural. Each light emitting element is 1 mm square, each submount is 2 mm square, and the package substrate is 50 mm x 150 mm. Ex. 1010 ¶ 44. A POSITA would readily appreciate that this particular discussion of Hashimoto pertains to mounting multiple LEDs/sub-mounts onto the package substrate, and each LED/sub-mount has a single gold wire (10) connecting electrode (9) of the sub-mount to electrode (8) on the package substrate. As noted above, Dr. Josefowicz agrees that both Figures 1 and 2 of Hashimoto show only one gold wire (10). We see no disclosure in Hashimoto of a single LED/sub-mount having two wires (10). When describing the face-up embodiment of Figure 9, Hashimoto explicitly shows and describes "two wires" connecting the LED electrodes to the package substrate leads. Ex. 1010 ¶ 34. Hashimoto also discloses that the LED electrodes can be connected by "two wires" to electrode patterns on the

substrate. *Id.* ¶ 38. But when describing the connections between the sub-mount electrodes and the package substrate, Hashimoto does not show or describe the use of “two wires.”

Based on the evidence on the record before us, we find that Petitioner has not shown sufficiently that Nichia-825 alone or in combination with Hashimoto teaches or suggests the subject matter of claim 3. In light of the foregoing, we determine that Petitioner has not demonstrated by a preponderance of the evidence that claim 3 is unpatentable under § 103(a) as obvious over Nichia-825 alone or in combination with Hashimoto.

E. Obviousness over Nichia-824 alone or in view of other references

Petitioner asserts that claims 1 and 5 are unpatentable under § 103(a) as obvious over Nichia-824. Pet. 54–83. Petitioner also asserts that claim 2 is unpatentable under § 103(a) as obvious over Nichia-824 in view of Achyut. *Id.* at 83–86. Additionally, Petitioner asserts that claim 3 is unpatentable as obvious over Nichia-824 in view of Hashimoto. *Id.* at 86–88. Patent Owner opposes. PO Resp. 38–52. Upon consideration of Petitioner’s explanations and supporting evidence in this current record, we are persuaded that Petitioner has demonstrated by a preponderance of the evidence that claims 1 and 5 claims are unpatentable over Nichia-824 alone, and that claim 2 is unpatentable over Nichia-824 in combination with Achyut. However, we are not persuaded that Petitioner has demonstrated by a preponderance of the evidence that claim 3 is unpatentable over Nichia-824 in combination with Hashimoto. Our analysis below focuses on the disputed claim elements.

1. Nichia-824 (Exhibit 1004) (Exhibit 1005, English Translation)

Nichia-824 discloses a light-emitting device in which a light-emitting element is sealed with a sealing resin. Ex. 1005 ¶ 1. Figure 1 of Nichia-824 is reproduced below.

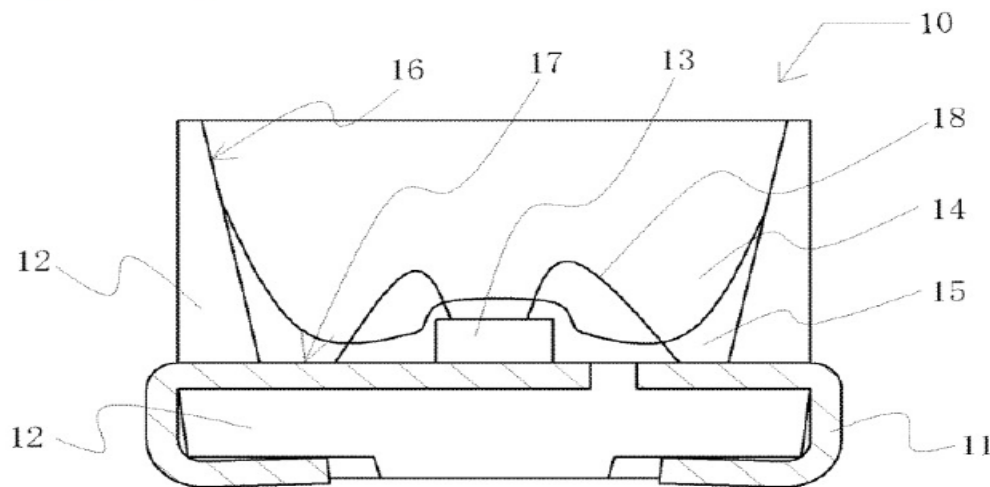


Figure 1 above is a sectional view of light-emitting device 10. *Id.* ¶ 56. Light-emitting device 10 includes light-emitting element 13 that is electrically connected to metal member 11 by conductive wire 18. *Id.* ¶ 16. Package 12 is configured to form a recessed portion which has metal member 11, bottom surface 17 formed to expose a part of metal member 11, and side surface 16. *Id.* The inside of the recessed portion is sequentially covered with resin layer 15 and sealing resin 14. *Id.*

2. Claim 1

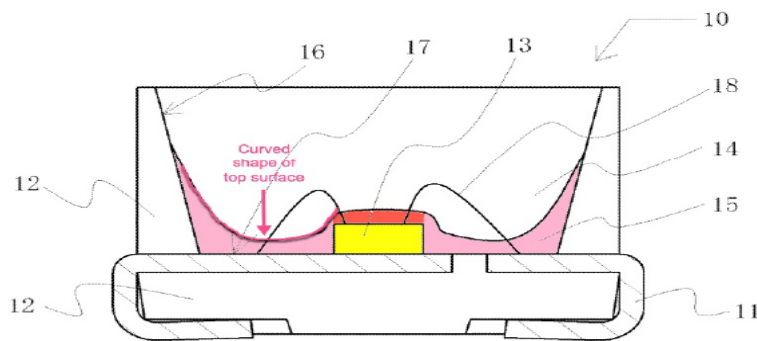
a. *“a center of curvature located outside of the accommodating space”*

Element 1.12 of claim 1 recites “the top surface of the surrounding portion is in a *curved shape*, and a *center of a curvature* of the top surface of the surrounding portion is arranged outside of the accommodating space.”

Ex. 1001, 9:37–40 (emphases added).

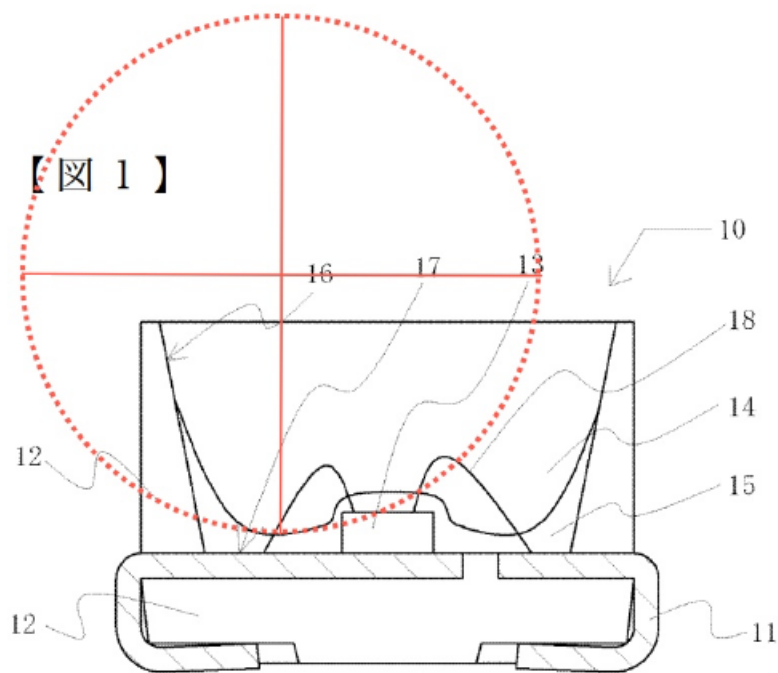
Petitioner asserts that the top surface of the surrounding portion of resin layer 15, as shown below in Figure 1 of Nichia-824, is in a curved shape. Pet. 75 (citing Ex. 1005, Fig. 1; Ex. 1003 ¶ 192). According to Petitioner, the center of the curvature of the top surface of resin layer 15 is arranged outside of the accommodating space. *Id.* at 75–76 (citing Ex. 1003 ¶ 193).

Figure 1 of Nichia-824 is reproduced below with annotations added by Petitioner. Pet. 75.



Annotated Figure 1 above is a sectional view of light-emitting device 10. Ex. 1005 ¶ 56. Referring to the annotated figure, Petitioner contends that a surrounding portion of resin layer 15 (pink) is arranged around the lateral surface of light-emitting element 13 (yellow), and an attaching portion (orange) is arranged on top of light-emitting element 13. Dr. Josefowicz testifies that “Figure 1 of Nichia-824 shows that the top surface of the surrounding portion is in a curved shape.” Ex. 1003 ¶ 192.

Figure 1 of Nichia-824 is reproduced below with annotations added by Petitioner. Pet. 76.



Petitioner's Annotated Figure 1 above is a sectional view of light-emitting device 10. Ex. 1005 ¶ 56. Petitioner has drawn a circle with its center outside the accommodating space and its edge along the top surface of the surrounding portion of resin layer 15. Pet. 76.

Dr. Josefowicz testifies that a person of ordinary skill in the art would have understood that “the resin climbs the inner sidewall of the cup wall, as well as the sidewalls of the light-emitting element because of surface tension on the surface of the liquid resin.” Ex. 1003 ¶ 192. Dr. Josefowicz also testifies that such an artisan would have known that “just as the curved upper surface of a liquid in a tube results in a concave shape of the curve, the surface of the resin surrounding portion would have a concave shape and that the radius of curvature would be large compared to the height of the light-emitting element,” and “[t]his would place the center of curvature to be well outside the accommodating space.” *Id.*

Patent Owner counters that because Petitioner's expert declarant, Dr. Josefowicz failed to draw a best fitting circle that coincides with the top surface of resin layer 15, let alone a circle that has the most overlap (or maximum coincidence) with the top surface of resin layer 15, Petitioner has failed to show that Nichia's disclosure teaches a center of curvature of the top surface of the surrounding portion being outside of the accommodating space. PO Resp. 40–41 (citing Ex. 1003 ¶¶ 193; Ex. 2007 ¶¶ 42, 43). According to Patent Owner, Dr. Josefowicz instead has drawn a best fitting circle to coincide the most with the top surface of resin layer 15 having a center of curvature arranged within the accommodating space of the package. *Id.* at 41–42 (citing Ex. 2007 ¶ 43). Patent Owner also argues that because Dr. Josefowicz's drawing of an ellipse has two focal points, a POSITA would understand that it cannot comport with a "center of curvature" as construed above. *Id.* at 42–43 (citing Ex. 2003 ¶ 193, Ex. 2007 ¶ 44). More particularly, Patent Owner asserts:

A POSITA would also understand that there is one best-fitting circle for a given curved surface and that the center of curvature of the top surface of the resin layer 15 in Nichia-824 could not be located at two different points. *Id.* Rather, a POSITA would apply a circle that best fits the curved top surface of the resin layer 15 package compound to determine the location of its center of curvature.

Id. at 43.

Additionally, Patent Owner argues that, according to the Specification of the '865 patent, in order for the center of curvature of the top surface 623 of the surrounding portion 62 to be arranged outside of the accommodating

space, “the top end 611 of the attaching portion 61 and a top end 6221 of the outer annular part 622 of the surrounding portion 62 *are substantially arranged at the same height* with respect to the substrate 1.” *Id.* at 44 (citing Ex.1001, 7:23-27) (emphasis in original). Patent Owner argues that, in contrast, Nichia-824 shows that top ends of the resin layer 15 are at different heights. *Id.* at 45. (Ex. 1005, Fig. 1).

After considering the parties’ evidence and arguments, we find Petitioner has shown by a preponderance of the evidence that Nichia-824 discloses the claimed subject matter in Element 1.12.

As discussed above in Section III.A.1, we construe the term “center of curvature” as “the center of a circle which best fits a curve at a particular point on the curve.” Under our claim construction, the top surface of the surrounding portion may have more than one center of curvature, and element 1.12 is met if at least one such center of curvature is arranged outside of the accommodating space.

We find that Petitioner’s annotations of Figure 1 of Nichia-824 show that the reference teaches element 1.12 under our claim construction. Pet. 75, 76. As depicted in Petitioner’s first annotation of Figure 1 of Nichia-824 above, and corroborated by Dr. Josefowicz’s declaration, the top surface of the surrounding portion is in a curved shape. Pet. 75; Ex. 1003 ¶ 192. Petitioner’s second annotation Figure 1 of Nichia-824 above identifies the “center of curvature” consistent with our claim construction. Pet. 76. More particularly, Petitioner has drawn a circle that best fits the curved top surface of Nichia-824’s resin layer 15 at a particular point. *Id.* It is undisputed that the center of the circle drawn by Petitioner is outside the accommodating

space. PO Resp. 38–42, PO Sur-Reply 13–15. That is sufficient to satisfy element 1.12 under our claim construction.

Patent Owner’s arguments are not consistent with our construction for “center of curvature.” PO Resp. 41. Our construction does not require maximum overlap or coincidence between a best-fitting circle and the top surface of the surrounding portion. A best-fitting circle need only provide the best fit **at a particular point**. Our claim construction also does not require that the top end of the attaching portion have the same height as the top end of the annular surrounding portion. It also does not prohibit a best-fitting circle from intersecting the corner of the lighting unit.

Based on the evidence on the record before us, we find that Petitioner has demonstrated persuasively that Nichia-824 discloses the subject matter of Element 1.12.

b. Remaining limitations

Regarding the remaining limitations of claim 1, Petitioner maps elements 1.1 through 1.11, 11.3, and 11.4 to corresponding teachings in Nichia-825. *See* Pet. 55–74, and 77–81. Patent Owner does not present specific arguments regarding these claim elements. For the reasons set forth in the Petition, we agree with Petitioner Nichia-825 teaches these claim elements.

In light of the foregoing, we determine that Petitioner has demonstrated by a preponderance of the evidence that claim 1 is unpatentable under § 103(a) as obvious over Nichia-824.

3. Claims 2 and 5

Petitioner contends that Nichia-824 alone teaches the limitations of claim 5. Pet. 83–86. Petitioner further contends that Nichia-824 alone or in combination with Achyut teaches the limitations of claims 2 and 5. *Id.* Petitioner also articulates reasons to combine the prior art teachings. *Id.* Patent Owner does not present arguments for claims 2 and 5 separate from its arguments for claim 1. *See* PO Resp. 38–48. For the reasons set forth in the Petition, we agree with Petitioner that Nichia-824 teaches the limitations of claims 2 and 5, that Nichia-825 combined with Achyut teaches the limitations of claim 2, and that a person of ordinary skill in the art would have combined the references as asserted. Accordingly, we determine that Petitioner has demonstrated by a preponderance of the evidence that claims 2 and 5 are unpatentable under § 103(a) as obvious over Nichia-824 in combination with Achyut. We further determine that Petitioner has likewise demonstrated that claim 5 is unpatentable as obvious over Nichia-824 alone.

4. Claim 3

The parties reiterate the same arguments discussed above regarding whether Hashimoto teaches the limitations of claim 3. Pet. 86–88; PO Resp. 48–52. Based on the evidence on the record before us, we find that Petitioner has not shown sufficiently that Nichia-824 alone or in combination with Hashimoto teaches or suggests the subject matter of claim 3 for the same reasons discussed above with respect to the combination of Nichia-825 and Hashimoto. In light of the foregoing, we determine that Petitioner has not demonstrated by a preponderance of the evidence that claim 3 is

unpatentable under § 103(a) as obvious over Nichia-824 alone or in combination with Hashimoto.

IV. PATENT OWNER'S CONTINGENT MOTION TO AMEND

Pursuant to 35 U.S.C. § 316(d)(1) and 37 C.F.R. § 42.121(a), Patent Owner filed a contingent Motion to Amend the '685 Patent and proposed substitute claims 20–22, which should replace claims 1, 2, and 5, if the Board determines that any of those claims is unpatentable. PO MTA 2–4. Patent Owner also requested preliminary guidance in accordance with the Pilot Program. *Id.* at 2.

After Petitioner filed its Opposition to the Motion to Amend, we issued our non-binding Preliminary Guidance, advising the parties that, on the record at that time, Patent Owner demonstrated a reasonable likelihood that it had satisfied the procedural requirements imposed by 35 U.S.C. § 316(d) and 37 C.F.R. § 42.121(a) for its Motion to Amend. Prelim. MTA Guidance 2–3. We further advised the parties that, on the record at that time, Petitioner did not demonstrate a reasonable likelihood that proposed substitute claims 20–22 were unpatentable for new matter, indefiniteness or obviousness. *Id.* at 5–14.

As discussed above, we determine that Petitioner has established by a preponderance of the evidence that claims 1, 2, and 5 are unpatentable as obvious over Nichia-824 or Nichia-825 alone or with other references. Therefore, we proceed to address Patent Owner's contingent motion to amend and proposed substitute claims 20–22, which correspond to original claims 1, 2, and 5, respectively. For the reasons discussed below, we

determine that Petitioner has not proven that the proposed substitute claims are unpatentable, and for that reason, we grant Patent Owner's contingent Motion to Amend.

A. Applicable Law

In an *inter partes* review, amended claims are not added to a patent as of right, but rather must be proposed as a part of a motion to amend. 35 U.S.C. § 316(d) (2018). The Board must assess the patentability of proposed substitute claims “without placing the burden of persuasion on the patent owner.” *Aqua Prods., Inc. v. Matal*, 872 F.3d 1290, 1328 (Fed. Cir. 2017) (en banc); see *Lectrosonics, Inc. v. Zaxcom, Inc.*, IPR2018-01129, Paper 15 at 3–4 (PTAB Feb. 25, 2019) (precedential) (“*Lectrosonics*”). Subsequent to the issuance of *Aqua Products*, the Federal Circuit issued a decision in *Bosch Automotive Service Solutions, LLC v. Matal*, 878 F.3d 1027 (Fed. Cir. 2017) (“*Bosch*”), as well as a follow-up Order amending that decision on rehearing. See *Bosch Auto. Serv. Sols., LLC v. Iancu*, No. 2015-1928 (Fed. Cir. Mar. 15, 2018) (Order on Petition for Panel Rehearing).

In accordance with *Aqua Products*, *Bosch*, and *Lectrosonics*, a patent owner does not bear the burden of persuasion to demonstrate the patentability of the substitute claims presented in the motion to amend. Rather, ordinarily, “the petitioner bears the burden of proving that the proposed amended claims are unpatentable by a preponderance of the evidence.” *Bosch*, 878 F.3d at 1040 (as amended on rehearing); see *Lectrosonics*, Paper 15 at 3–4; 37 C.F.R. § 42.121(d)(2). In determining whether a petitioner has proven unpatentability of the substitute claims, the Board focuses on “arguments and theories raised by the petitioner in its

petition or opposition to the motion to amend.” *Nike, Inc. v. Adidas AG*, 955 F.3d 45, 51 (Fed. Cir. 2020).

B. Proposed Substitute Claims

The Motion to Amend includes proposed substitute claims 20–22, reproduced below with the added limitations underlined (as compared to claims 1, 2, and 5):

20. A package structure, comprising:

[20.1] a substrate and a pair of electrodes disposed on the substrate,

[20.2] wherein the substrate has a first surface and a second surface opposite to the first surface, and the substrate defines a height direction perpendicular to the first surface;

[20.3] a lighting unit including an lighting diode, wherein the lighting diode has a top surface and a surrounding lateral surface connected to a peripheral edge of the top surface, and the lighting unit is disposed on the first surface of the substrate and is electrically connected to the pair of electrodes;

[20.4] a wall disposed on the first surface of the substrate, wherein the wall and the first surface jointly define an accommodating space, and the lighting diode is arranged in the accommodating space; and

[20.5] a package compound arranged in the accommodating space and that partially fills the accommodating space, wherein the electrodes and the lighting diode are at least partially embedded in the package compound, and the package compound includes:

[20.6] an attaching portion adhering to a top surface of the lighting diode, wherein a height of a top end of the attaching portion with respect to the first surface is less than a height of the wall with respect to the first surface; and

[20.7] a surrounding portion that is arranged around a surrounding lateral surface of the lighting unit and integrally extends from the attaching portion so that light emitted from the surrounding lateral surface is directly guided upward through the surrounding portion, and

[20.8] wherein the surrounding portion has an inner annular part and an outer annular part, wherein the inner annular part is arranged adjacent to the attaching portion, the surrounding portion is connected to an inner surface of the wall,

[20.9] the surrounding portion has an annular slot formed on a top surface thereof, and a bottom end of the annular slot is located at a position aligning with 25~90% of a thickness of the lighting unit along the height direction,

[20.10] wherein the attaching portion and the surrounding portion allow light generated by the lighting unit to pass there-through, and

[20.11] the surrounding portion contacts the surrounding lateral surface of the lighting unit,

[20.12] wherein the top surface of the surrounding portion is in a curved shape and a center of a curvature of the top surface of the surrounding portion is arranged outside of the accommodating space, and wherein the top surface provides an interface to the air above the package compound,

[20.13] wherein a height of a top end of the outer annular part of the surrounding portion is higher than a height of the top surface of the lighting diode, and

[20.14] wherein the lighting unit is arranged at a center of the package compound and the surrounding portion is formed symmetrically about the attaching portion.

[21.] The package structure as claimed in claim 20, wherein the lighting diode is configured to emit a light having a wavelength within a

range of 180nm-410nm, and wherein a top end of the attaching portion and a top end of the outer annular part of the surrounding portion are substantially arranged at a same height with respect to the substrate.

[22.] The package structure as claimed in claim 20, wherein a top end of the package compound has a cross section that is in a substantial W shape, and wherein only a single layer of package compound forms the attaching portion 61 and the surrounding portion 62.

PO MTA, App. A, 26–28.⁹

C. Procedural Requirements

“Before considering the patentability of any substitute claims, . . . the Board first must determine whether the motion to amend meets the statutory and regulatory requirements set forth in 35 U.S.C. § 316(d) and 37 C.F.R. § 42.121.” *See Lectrosonics*, Paper 15 at 4.

First, we consider whether the motion to amend proposes a reasonable number of substitute claims. 35 U.S.C. § 316(d)(1)(B). “There is a rebuttable presumption that a reasonable number of substitute claims per challenged claim is one (1) substitute claim.” *Lectrosonics*, Paper 15 at 4–5 (citing 37 C.F.R. § 42.121(a)(3)).

Patent Owner proposes substitute claims 20–22 as replacements for original claims 1, 2, and 5. PO MTA 2–4, App. A.

⁹ Appendix A to Patent Owner’s Motion to Amend begins at page 26.

Because Patent Owner's Motion proposes no more than one substitute claim for each challenged claim, we determine that Patent Owner has proposed a reasonable number of substitute claims. *See* Prelim. MTA Guidance 4 (taking same approach in preliminary guidance in finding that Patent Owner proposes a reasonable number of substitute claims).

Second, we consider whether the proposed substitute claims respond to a ground of unpatentability involved in this trial. *Lectrosonics*, Paper 15 at 5–6. Patent Owner argues that the proposed substitute claims respond to each of the trial grounds set forth in the Institution Decision. PO MTA 3–4. Patent Owner's Motion to Amend also includes arguments and evidence addressing the grounds of unpatentability. *Id.* at 18–22. Petitioner does not argue that Patent Owner's Motion to Amend fails to respond to a ground of unpatentability. We agree with Patent Owner that the proposed substitute claims respond to a ground of unpatentability involved in this trial.

Third, we consider the breadth of the proposed substitute claims. “A motion to amend may not present substitute claims that enlarge the scope of the claims of the challenged patent or introduce new subject matter.” *Lectrosonics*, Paper 15 at 6–8 (citing 35 U.S.C. § 316(d)(3); 37 C.F.R. § 41.121(a)(2)(ii)). As to the requirement that the amendments may not enlarge the scope of the original claims, Patent Owner argues that its proposed substitute claims 20–22 add limitations and do not delete any limitations. PO MTA 3. Petitioner does not argue that Patent Owner's amendment enlarges the scope of the claims. We determine that proposed substitute claims 20–22 are narrower in scope than claims 1, 2, and 5 and that Patent Owner's amendment does not enlarge the scope of the claims.

D. Challenge to Patentability Based on New Matter

As to the requirement that the amendments not introduce “new matter,” Patent Owner provides citations to the application from which the ’685 Patent issued to demonstrate written description support for each limitation in the proposed substitute claims. PO MTA 6–17. Petitioner argues that Patent Owner’s Motion fails to meet the “no new matter” requirement. Pet. Opp. to MTA 18–21.

Proposed substitute independent claim 20 differs from claim 1 only in two limitations, which introduce new language. PO MTA 4. Limitation [20.5] recites (with new language underlined) “a package compound arranged in the accommodating space and that partially fills the accommodating space, wherein the electrodes and the lighting diode are at least partially embedded in the package compound.” *Id.* at 8, 26. Patent Owner contends support for this limitation is at paragraphs 2, 3, 48, and 49, and Figure 14A of the originally-filed application, in Exhibit 2004. *Id.* at 8–9. Limitation [20.12] recites (with new language underlined) “wherein the top surface of the surrounding portion is in a curved shape and a center of a curvature of the top surface of the surrounding portion is arranged outside of the accommodating space, and wherein the top surface provides an interface to the air above the package compound.” *Id.* at 13–14, 27. Patent Owner contends support for this limitation is at paragraphs 53 and 58, and Figures 14A and 16. *Id.* at 13–15 (citing Lebby Decl. ¶ 10).

Petitioner does not specifically address limitations [20.5] or [20.12], instead contending, first, that Patent Owner “has not adequately explained” the support, because, according to Petitioner, most of the support provided at

pages 6–17 of the Motion “are mere string cites.” Pet. Opp. to MTA 18. We do not find this argument persuasive because, for the new language introduced, Patent Owner has not relied on string cites, but has provided adequate explanation for each cite. PO MTA 8–9, 13–15. Petitioner also contends that Patent Owner has not adequately provided written description support for limitation [20.7] in the Motion. Pet. Opp. to MTA 18–21. In particular, Petitioner argues that paragraph 53 of the ’005¹⁰ application only refers to light being emitted from top surface 623, but does not refer to light emission from lateral surfaces 42 of lighting diode 4.

As support for this limitation, Patent Owner identifies Figure 14A and paragraph 53 of the ’005 application, which was cited as support when the limitation was added during prosecution. PO MTA. 10–11 (citing Ex. 1002, 264).¹¹ Patent Owner also offers Dr. Lebby’s testimony about a person of ordinary skill in the art’s (POSITA’s) understanding of Figure 14A and paragraph 53. PO MTA 10–12 (citing Lebby Decl. ¶ 7). Further, Patent Owner states the following:

[A] POSITA would have understood that [0053] teaches configuring the top surface 623 of the surrounding portion 62 of the package compound

¹⁰ The ’005 application refers to US Patent Application No. 16/009,005, which matures into the ’685 Patent. PO MTA 6.

¹¹ The relevant portion of this page in the prosecution history states, “Applicant has amended independent claim 1 and claim 11 to recite ‘the top surface of the surrounding portion is in a curved shape, and a center of a curvature of the top surface of the surrounding portion is arranged outside of the accommodating space.’ Support for the amendments can be found in the disclosure, for example, the paragraph [0053], lines 9–13 and claim 6, as originally filed.” Ex. 1002, 264.

6 in a curved shape with a radius of curvature that is large enough so that the top surface 623 functions to guide a substantial portion of the light rays emitted from the lateral surfaces 42 of the lighting diode 4 in an upward direction through the surrounding portion 62—and in so doing—the formation of light spots on the inside of the walls 5 of the package structure is avoided and the light emitted from the surrounding lateral surface is directly guided upward through the surrounding portion. EX2010, ¶8.

PO Reply to Opp. to MTA 12.

Petitioner argues that Patent Owner and Dr. Lebby “mischaracterize the prosecution history” because the cited page 264 “is for an entirely different claim limitation.” Pet. Opp. to MTA 19 (citing MTA 11; Lebby Decl. ¶ 7; Ex. 1002, 264).

After considering the parties’ arguments and evidence, it is our view that Patent Owner has met its burden to show written description support for limitation 20.7. *See* 37 C.F.R. §§ 42.121(b)(1), (d)(1). Even if Patent Owner has cited the incorrect portion of the prosecution history, as Petitioner alleges, Patent Owner now relies on paragraph 53 of the ’005 application, together with Figure 14A and Dr. Lebby’s testimony. Although Petitioner criticizes Dr. Lebby’s testimony about paragraph 53 as conclusory (Pet. Opp. to MTA 20), Petitioner does not specifically address Dr. Lebby’s testimony about what a POSITA would have understood from Figure 14A. PO MTA 10–11; Ex. 2005 ¶ 7. We recognize that paragraph 53 does not particularly discuss light being emitted from the lateral surfaces of the diode. However, the “description need not recite the claimed invention *in haec verba* but must do more than merely disclose that which would render the

claimed invention obvious.” *ICU Med., Inc. v. Alaris Med. Sys., Inc.*, 558 F.3d 1368, 1377 (Fed. Cir. 2009). We agree with Patent Owner that, at the time of the invention, when read in conjunction with Figure 14A, paragraph 53 would inform the POSITA that a substantial portion of the light rays are emitted from lateral surfaces 42 and top surface 623 of lighting diode 4 in an upward direction through surrounding portion 62 of package compound 6 being in a curved shape with a large enough radius of curvature. Accordingly, we agree with Patent Owner that the original disclosure supports the proposed amendment and that the proposed substitute claims do not introduce new matter.

Finally, the Contingent Motion includes a claim listing, as required by 37 C.F.R. § 42.121(b). PO MTA, App. A; *see Lectrosonics*, Paper 15 at 8.

In view of the above, we determine that Patent Owner’s contingent Motion to Amend meets the statutory and regulatory requirements of 35 U.S.C. § 316(d) and 37 C.F.R. § 42.121 respectively.

E. Challenge to Patentability Based on Indefiniteness

Petitioner contends that proposed substitute claim 21 is indefinite because the newly-recited language “wherein a top end of the attaching portion and a top end of the outer annular part of the surrounding portion are substantially arranged at a same height with respect to the substrate” introduces a subjective term of degree into the claim. Pet. Opp. to MTA 21–

22.¹² In particular, Petitioner contends that the Specification provides no “guidance on how to determine whether two things are ‘substantially arranged at a same height.’” *Id.* at 22 (citing Ex. 2004 ¶ 53, Ex. 1014 ¶ 62). According to Petitioner, although the Specification refers to top end 611 of attaching portion 61 having a height H1, it does not indicate that top end of outer annular part of the surrounding portion as having the same height H1 nor does it provide any particular dimensions therefor. *Id.* Nonetheless, Petitioner acknowledges that the Specification and Figure 14A appear to show that height H1 of top end 611 of the attaching portion is the same height as that of the top end of the annular portion. *Id.* at 23.

In response, Patent Owner states the following:

As explained by Dr. Lebby, “[the ’685 Patent] has figures that support the specification and the specification indicates to me when something is substantially the same, it doesn't have to be perfectly the same.” EX1015, 273:18-274:1. Thus, the specification clearly informs a POSITA, with reasonable certainty, about the scope of the limitation in amended claim 21. EX2010, ¶¶9-12; *see also Tinnus Enterprises, LLC v. Telebrands Corp.*, 733 F. App’x 1011, 1018 (Fed. Cir. 2018) (finding that the claim term “substantially filled” is not indefinite).

PO Reply to Opp. to MTA 11.

Petitioner’s arguments are not persuasive. “[A] patent is invalid for indefiniteness if its claims, read in light of the specification delineating the

¹² *See Nautilus, Inc. v. Biosig Instruments, Inc.*, 134 S. Ct. 2120, 2129 (2014). There must be “objective boundaries for those of skill in the art” in the specification and prosecution history. *Interval Licensing LLC v. AOL, Inc.*, 766 F.3d 1364, 1370-71 (Fed. Cir. 2014).

patent, and the prosecution history, fail to inform, with reasonable certainty, those skilled in the art about the scope of the invention.”); *see Nautilus, Inc. v. Biosig Instruments, Inc.*, at 901. Figure 14A of the ’685 patent is reproduced below:

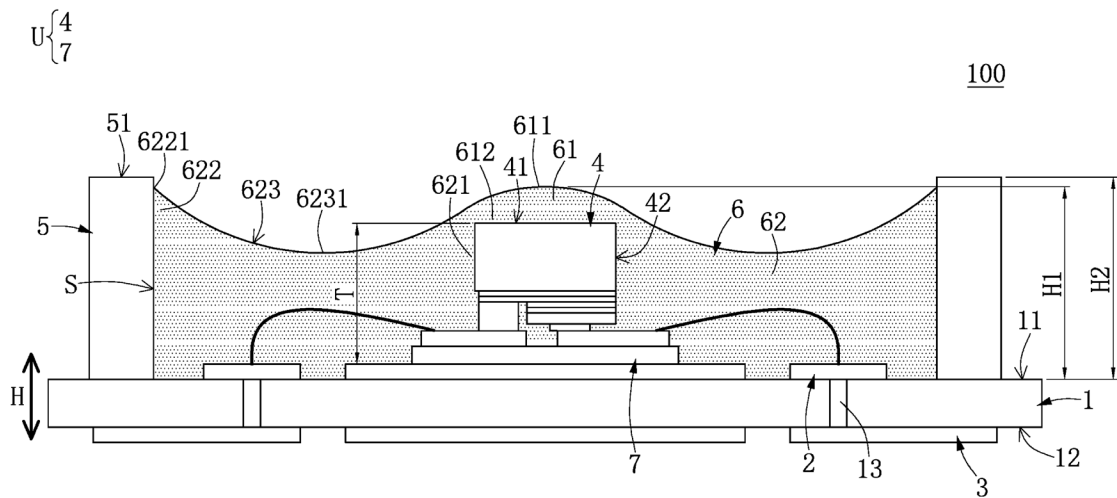


FIG. 14A

Figure 14A above, as acknowledged by Petitioner, depicts dimension “H1,” which shows graphically that top end 611 of attaching portion 61 and top end 6221 of outer annular part 622 of surrounding portion 62 have the same height H1 with respect to the substrate 1. Ex. 1001, 7:23–29. A POSITA would readily ascertain from such depiction in Figure 14A and the cited supporting description that top end 611 of attaching portion 61 and top end 6221 of outer annular part 622 of surrounding portion 62 have *substantially* the same height when both are measured from substrate 1.¹³

¹³ *See Tinnus Enterprises, LLC v. Telebrands Corp.*, 733 F. App’x 1011, 1018 (Fed. Cir. 2018) (“the claim term ‘substantially filled’ satisfies the *Nautilus* standard because, as explained next, the claim language, in view of the specification and prosecution history, inform a person of ordinary skill about the scope of the invention”).

Accordingly, such a depiction and discussion would inform the ordinarily-skilled artisan about the scope of proposed substitute claim 21. On this record, Petitioner has not persuaded us that proposed substitute claim 21 is indefinite because the POSITA would not require more guidance to understand this claim language.

F. Challenges to Patentability Based on Obviousness

Petitioner asserts the following grounds of unpatentability against proposed substitute claims 20–22:

Proposed Substitute Claims Challenged	35 U.S.C. §	References
20–22	103(a)	Nichia-825, Omata ¹⁴
20–22	103(a)	Nichia-825, Lin ¹⁵
20–22	103(a)	Nichia-824, Omata
20–22	103(a)	Nichia-824, Lin

1. Petitioner’s Challenge Based on Nichia-825 and Omata

Petitioner asserts that proposed substitute claims 20–22 are unpatentable under § 103(a) as obvious over Nichia-825 alone or in combination with Omata. Pet. Opp. to MTA 1–8. Patent Owner opposes. PO Reply to Opp. to MTA. 1–5. Upon consideration of Petitioner’s

¹⁴ Ex. 1021, US 2004/0201987, published October 14, 2004 (“Omata”).

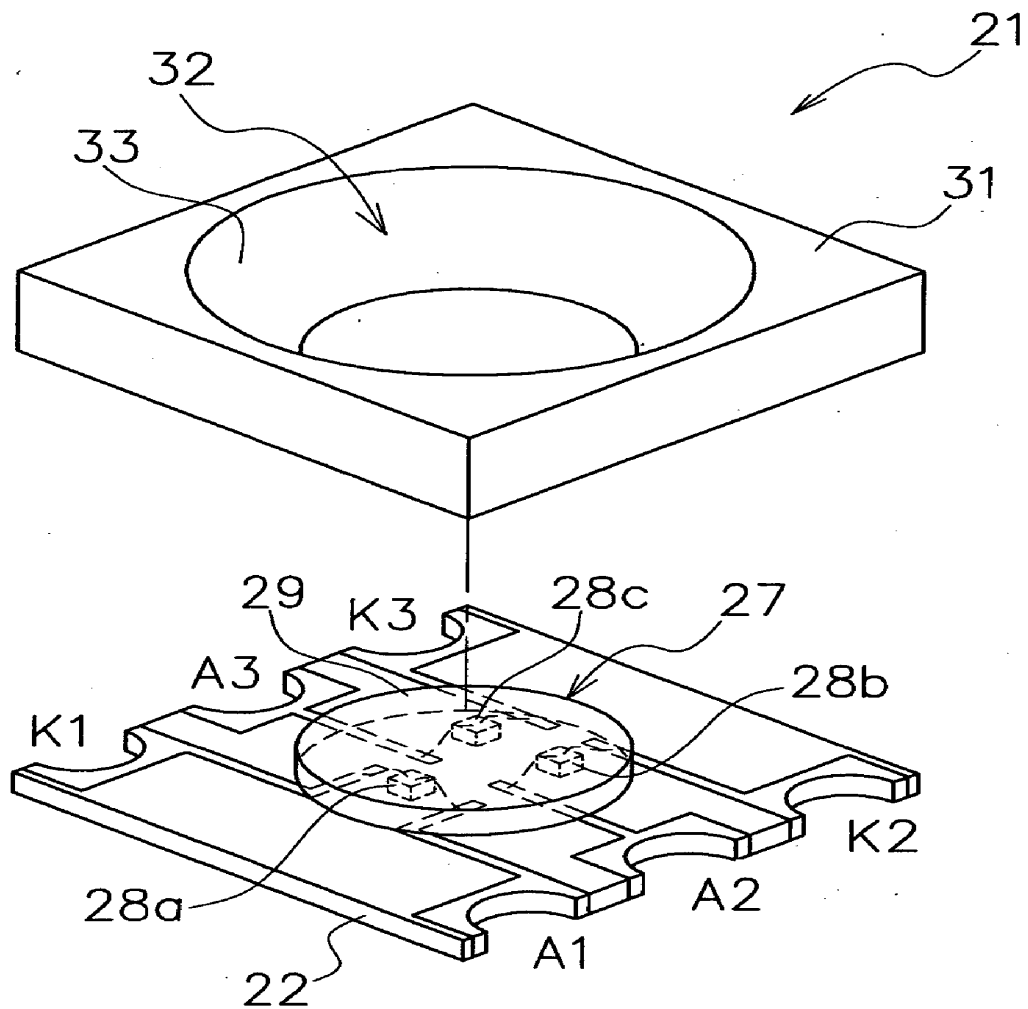
¹⁵ Ex. 1022, US Patent N0. 10,490,712, published November 26, 2019 (“Lin”).

explanations and supporting evidence in this current record, we are not persuaded that Petitioner has demonstrated by a preponderance of the evidence that proposed substitute claims 20–22 are unpatentable over Nichia-825 alone or in combination with Omata. Our analysis below focuses on the disputed claim elements.

a. Overview of Omata

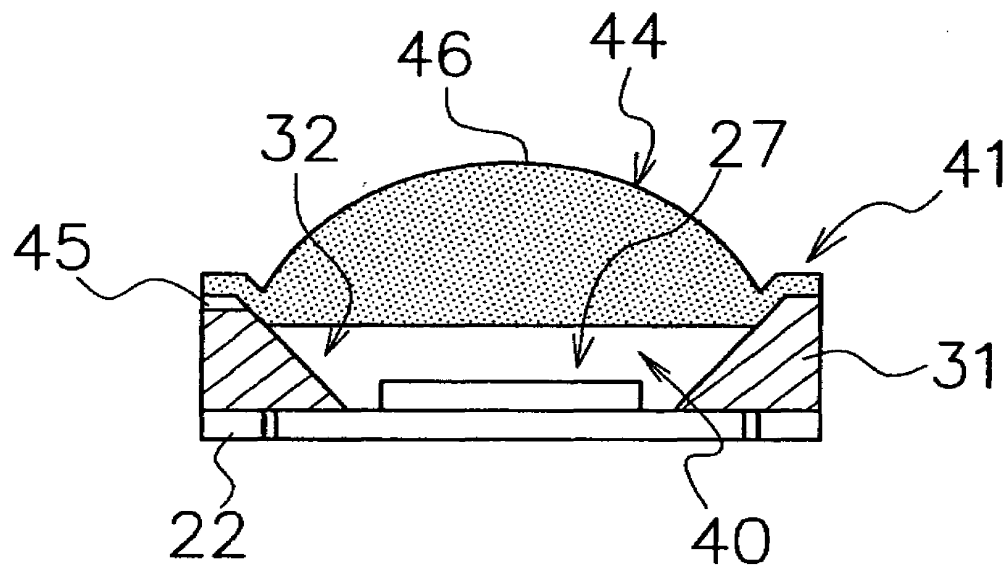
Omata discloses an LED lamp mountable as a flash light source of a camera in a mobile phone to provide directivity light in a predetermined direction and increased brightness. Ex. 1021 ¶¶ 2, 8.

Figure 4 of Omata is reproduced below:



As depicted in Figure 4 above, Omata discloses LED package 21 with light emitting unit 27 including LEDs 28a, 28b, and 28c sealed by transparent resin material 29, which may be mixed with a YAG fluorescent material and to use a “blue light emitting type” as the LEDs. *Id.* Ex. 1021 ¶¶ 32, 54.

Figure 6 of Omata is reproduced below.



Omata's Figure 6 above further depicts LED lamp 41 including air layer 40 in concave portion 32 positioned above light emitting unit 27, and a lens body 44 provided on reflecting frame 31 so that air layer 40 is disposed between lens body 44 and light emitting unit 27. *Id.* ¶ 39. LED lamp 41 also includes air hole 45 for communicating air layer 40 with an outside area to provide low barometric pressure within the air layer to safely carry out a reflow processing and to prevent the deterioration of the LED lamp quality. *Id.* Omata also discloses that lens body 44 is "formed of a transparent or translucent resin" and that "the concave portion 32" of the LED package "is closed by providing lens body 44 on the reflecting frame 31 in the LED lamp 41." *Id.* Omata further discloses that "by providing the lens body 44" on the LED package, "it is possible to intend a more increased amount of emitted light . . . because light radiated upwardly by the light emitting unit 27 and the reflecting surface 33 is collected by the convex surface 46 of the lens body." *Id.* Omata additionally discloses that because the light

emitting from the light emitting unit 27 “passes through the air layer 40 and the lens body . . . , the refracting index of the light becomes large, and therefore a more large light collecting effect can be obtained.” *Id.* ¶ 49.

b. Proposed substitute independent claim 20

Limitation [20.12] in proposed substitute claim 20 recites in relevant part “wherein the top surface provides an interface to the air above the package compound.” PO MTA, App. A, 27. Petitioner contends that, although Nichia-825’s Figure 4 embodiment includes sealing member 340 disposed above covering member 330’s top surface, it would have been obvious “to use covering member 330 without sealing member 340” in Nichia-825 (Ex. 1007) by replacing sealing member 340 with a lens such that covering member 330 provides an interface to the air above. Pet. Opp. to MTA 2–3 (citing Ex. 1014 ¶ 13). Petitioner contends this configuration was “common in the art,” citing Omata (Ex. 1021). *Id.* Further, Petitioner contends that, because Nichia-825 discloses a second embodiment where sealing member 140 can have a “convex lens shape,” a POSITA would have been motivated by Omata’s disclosure to place a lens above Nichia-825’s LED package capable of controlling the directivity of the light. *Id.* (citing Ex. 1007 ¶ 37, Ex. 1014 ¶ 14). In particular, Petitioner contends “Omata discloses an LED package with a layer of resin on top of the LED chips, an air gap above the resin layer, and a lens on top of the LED package.” *Id.* at 4 (citing Ex. 1014 ¶¶ 16–18, 21). Accordingly, Petitioner asserts that “because of the air gap between the resin layer of the light emitting unit 27 and the lens, more light is collected from the LED package than if the lens was formed directly over the light emitting unit without an air gap, as it is in

Nichia-825's Figure 2 embodiment.” *Id.* at 4–5 (citing Ex. 1014 ¶ 21; Ex. 1021 ¶ 49). Petitioner thus proposes to remove sealing member 340 from Nichia-825 and replace it with an air gap and lens “to increase the light extraction.” *Id.* at 5.

In our Preliminary Guidance, we made a preliminary finding that Petitioner's proposed combination would lead to the air hole exposing the LED lamp to external contamination, and the lack of an air hole could cause pressure problems. Prelim. MTA Guidance 10–11. Thus, we concluded that Petitioner had not established a sufficient motivation to remove the sealing member 340, in its Nichia-825/Omata combination, because it appears that the contamination problem, or the pressure problem, would remain unresolved in Petitioner's proposed combination. *Id.*

In its Reply to the Preliminary Guidance, Petitioner asserts that because Omata discloses a concave portion capable of being closed by providing the lens body on the reflecting frame, the proposed removal of Nichia-825's sealing layers and replacing them with a lens and an air gap would result in the inner LED portion being closed from the external environment thereby maintaining the protection function of the sealing layers. Pet. Sur-Reply to Opp. to MTA 2. Further, Petitioner contends that because Nichia-825 discloses resin layer 15 for completely covering the LED chip, “even if the thicknesses of the covering layers are thin, a POSA would understand that the covering layers are configured to prevent the penetration of silicone resin, gas, and other external contaminants.” *Id.* at 3 (citing Ex. 1007 ¶¶ 11, 49, 56)(footnote omitted). Furthermore, Petitioner argues that the sealing layers prevent degradation of the LED package

merely by increasing the light extraction due to their low refractive index. *Id.* at 5. Accordingly, Petitioner submits that a POSITA would be apprised that “the amount of light emitted from the light-emitting element 310 reaching the cup-shaped sidewall of the package...can be reduced, so that deterioration of the package can be prevented.” *Id.* (citing Ex. 1007 ¶ 42; Ex. 1026, 14:13–20). Thus, Petitioner argues, removing the silicone sealing layer and replacing it with an air gap would increase the light extraction from the package, thus performing the same function of the sealing layer disclosed in Nichia-825. *Id.* (citing Ex. 1014 ¶¶ 35, 36). Additionally, Petitioner argues that Omata’s air hole is designed to allow air to flow out of the LED package to help balance the pressure inside the package with the external air pressure during the reflow process. *Id.* at 6–7 (Ex. 1021 ¶ 39; Ex. 1026, 22:10–19, 32:2–4). Thus, Petitioner submits that Omata discloses no concern with introducing external contaminants through the air hole, which allows air to flow in the opposite direction once pressure has been equalized. *Id.* at 7.

Patent Owner responds that Nichia-825 alone or in combination with Omata does not teach the limitation [20.12], and would not thereby have rendered proposed substitute claim 20 obvious. PO Reply to Opp. to MTA 1. In particular, Patent Owner argues that it would not have been obvious to modify Nichia-825 to use covering member 330 without the protection of sealing member 340 because the LED package would have lost its protection to corrosion, which would seep into covering member 330. *Id.* In particular, Patent Owner states the following:

The proposed combination seeks to remove Nichia-825's protective sealing member 340, replace it with Omata's lens, and leave an air gap between covering member 330 and the lens. However, Omata already has a protecting seal that covers LED 27 (resin material 29) and an air hole to prevent problems with the air gap. If Nichia-825's Figure 4 embodiment were modified according to Omata's teaching, a similar air hole would exist in the LED package of Nichia-825 and moisture and corrosive gas would be allowed to enter the package and deteriorate the LED element.

Id. at 4.

Thus, a POSITA would not have abandoned Nichia-825's teachings of a sealing member 340 that directly covers covering member 330 and return to the very prior art configuration (of a single sealing layer covering the light-emitting device).

Id. at 2.

A POSITA also would not have been motivated to remove sealing member 340 from the Figure 4 embodiment of Nichia-825 and replace it with Omata's air gap and lens above the LED package. EX2010, ¶19. A POSITA would have known and understood that Omata's air gap and lens configuration would not provide the same or similar function as Nichia-825's sealing member, but rather would be detrimental to Nichia-825's LED by exposing it to the external contamination, which is precisely what Nichia-825's sealing member prevents. EX1007, ¶¶ 57, 28; EX2010, ¶¶ 15, 22, and 23.

Id. at 3.

After considering the parties' arguments and evidence, we determine that Petitioner has not met its burden to show that a POSITA would have been motivated to modify Nichia-825 in the manner proposed by Petitioner.

Nichia-825 discloses an LED package that improves on corrosion problems on silver surfaces in prior art LED packages, which had switched to a silicone resin, from an epoxy resin. Ex. 1007 ¶¶ 5, 9. Nichia-825 explains that in prior art LED packages, the silicone resin also "invades into

a gap between the lead frame 521 and the package 520, and the invaded silicone resin causes the package 520 to be broken due to thermal expansion.” *Id.* ¶¶ 5, 7 (referencing Fig. 12). To overcome these two problems, Nichia-825 proposes covering member 330 made from a special, organic silicone resin composition over the light-emitting element, with “a thickness thinner than a height of the light-emitting element,” where covering member 330 is covered by a sealing member 340 of a “silicone resin different from the covering member.” *Id.* ¶ 10. This prevents the silicone resin from entering the gap and reduces corrosion. *Id.* ¶¶ 11, 30. Covering member 330 is thin, preferably 50 microns, to prevent peeling due to thermal stress. *Id.* ¶¶ 32, 56. Nichia-825 explains that conventional LED packages inject “sealing resin 540 into a cup of the package 520 for protection from external dirt, dust, and the like.” *Id.* ¶ 5. In Nichia-825, the sealing member 340 protects the LED package from external contamination, and covering member 330 protects the LED package from the sealing member 340. These components are shown in Figure 4 of Nichia-825, reproduced below.

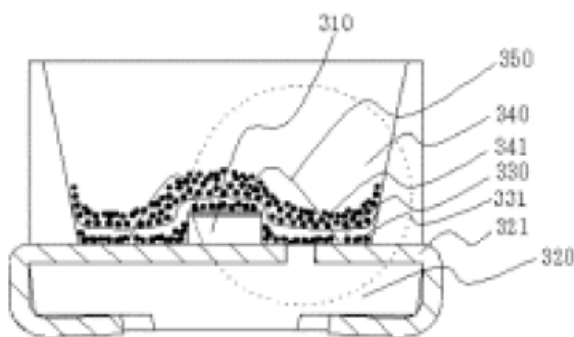


Figure 4 shows base member 320, formed in a cup shape, light-emitting element 310, lead 321, wire 350, covering member 330 (with fluorescent

material 331), and sealing member 340 (with second fluorescent material 341). *Id.* ¶ 41.

Omata discloses an LED package with a lens body above the light emitting unit, to achieve increased brightness. Ex. 1021 ¶ 11. Specifically, Omata discloses “light emitting unit 27,” comprising “three LED elements 28a, 28b and 28c . . . and a transparent or translucent resin material 29 to seal the LED elements,” and “a lens body 44 provided on the reflecting frame 31 so that the air layer 40 is disposed between the lens body 44 and the light emitting unit 27.” *Id.* ¶¶ 32, 39. Omata discloses that “there is a fear that the air layer 40 in the concave portion 32 is inflated when mounting the LED lamp on the circuit substrate by means of a reflow processing.” *Id.* ¶ 39. “In order to improve this problem, an air hole 45 for communicating the air layer 40 with an outside area of the LED lamp is provided to lower a barometric pressure in the air layer 40.” *Id.*

Petitioner thus proposes to remove Nichia-825’s protective sealing member 340, replace it with Omata’s lens, and leave an air gap between covering member 330 and the lens. However, Omata itself has a protecting seal at resin material 29, which covers LED 27, and an air hole to prevent problems with the air gap. We reiterate our preliminary finding that Petitioner’s proposed modification of Nichia-825 would lead to the air hole exposing the LED lamp to external contamination. Prelim. MTA Guidance 10.

We are not persuaded by Petitioner’s reply arguments for the following reasons. Although Nichia-825 discloses a concave portion

capable of being closed by providing the lens body on the reflecting frame, the proposed removal and replacing of Nichia-825's sealing layers with a lens and an air gap would result in the inner LED portion being partially closed from the external environment. Although the air hole would provide the requisite air interface as required by the disputed limitation, we agree with Patent Owner that it would provide a conduit for contaminations to seep into the LED, and thereby undercut the corrosion problem that Nichia-825 sought to remedy at the outset by introducing sealing member 340. Further, we find insufficient evidence on the record before us to substantiate Petitioner's argument that Nichia-825's covering layers along with the proposed replacement of sealing member 340 with Omata's lens and an air gap would provide sufficient protection to the LED against corrosion.

Synthesizing our findings regarding motivation to combine Nichia-825 and Omata, we determine that Petitioner has not shown that a POSITA would have viewed the potential benefit identified by Petitioner as outweighing the detriments identified by Patent Owner, including moisture penetration. Accordingly, we determine that Petitioner has not met its burden to show that a POSITA would have been motivated to combine the teachings of Nichia-825 and Omata in the manner proposed by Petitioner.

c. Proposed substitute claims 21 and 22

Claim 21 depends from proposed substitute claim 20, and recites in relevant part "wherein a top end of the attaching portion and a top end of the outer annular part of the surrounding portion are substantially arranged at a same height with respect to the substrate." PO MTA, App. A, 28. Claim 22

depends from proposed substitute claim 20, and recites in relevant part “wherein only a single layer of package compound forms the attaching portion 61 and the surrounding portion 62.” *Id.*

The shortcomings in Petitioner’s arguments and evidence for independent claim 20 are not remedied by its arguments and evidence for dependent claims 21 and 22. Pet. Opp. to MTA 11–17. For these reasons, we determine that Petitioner has not met its burden to show that proposed substitute claims 21 and 22 are unpatentable as obvious in view of Nichia-825 and Omata.

Accordingly, Petitioner has not met its burden to show that proposed substitute claims 20–22 are unpatentable as obvious over Nichia-825 alone or in combination with Omata.

2. *Petitioner’s Challenge Based on Nichia-825 and Lin*

Petitioner asserts that proposed substitute claims 20–22 are unpatentable under § 103(a) as obvious over Nichia-825 alone or in combination with Lin. Pet. Opp. to MTA 8–11. Patent Owner opposes. PO Reply to Opp. to MTA. 5–7. Upon consideration of Petitioner’s explanations and supporting evidence in this current record, we are not persuaded that Petitioner has demonstrated by a preponderance of the evidence that proposed substitute claims 20–22 are unpatentable over Nichia-825 alone or in combination with Lin. Our analysis below focuses on the disputed claim elements.

a. Overview of Lin

Lin discloses an LED package with a cavity containing an LED chip.
Ex. 1022 5:40–42, 6:18-20. Figure 2 of Lin is reproduced below:

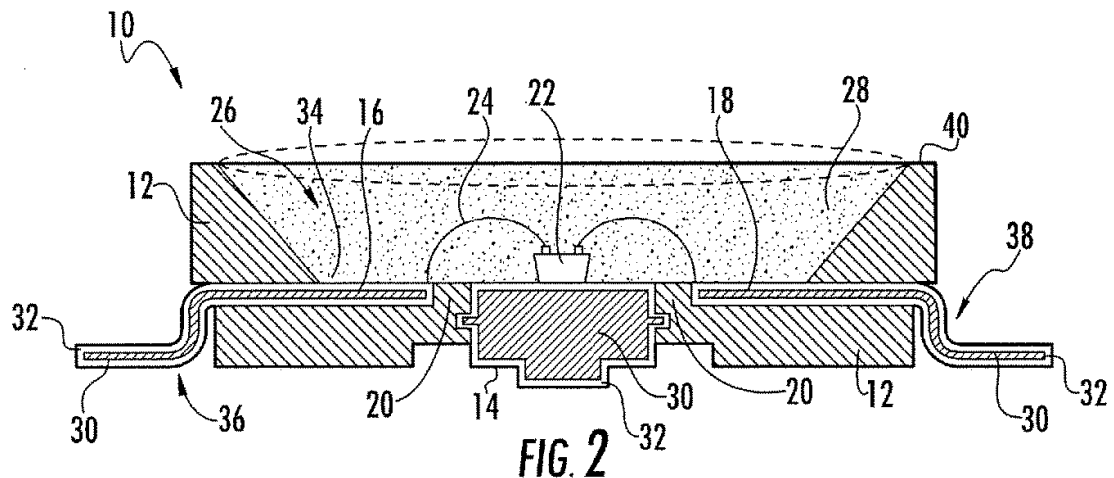


Figure 2 of Lin above depicts LED package 10 including cavity 26 filled partially or completely with encapsulant 28 containing “one or more phosphor materials.” *Id.* at 6:24–27. Encapsulant 28 “can be filled to any level within cavity 26 and may be disposed below . . . a top surface 40 of package 10” and that it can “be filled such that it forms a concave or convex surface with respect to a top face 40 of package 10 as indicated by the broken lines in FIG. 2.” *Id.* at 6:62–7:1.

b. Proposed substitute independent claim 20

Petitioner reiterates the proposed modification of Nichia-825 by removing sealing member 340 from the top surface of covering member 330

thereby exposing covering member so that it provides an interface to the air above the package compound. Pet. Opp. to MTA 9. According to Petitioner, “it would have been obvious to use a single layer of encapsulant over the LED chip [in Nichia’s-825’s Figure 4 embodiment] such that there was [a] gap between that layer and the top of the LED package” because “such packages were well-known in the art at the time of the filing of the ’685 Patent”. *Id.* (citing Ex. 1014 ¶ 31). In particular, Petitioner states the following:

[A] POSA would have been motivated to use covering member 330 as the single layer of encapsulant over the LED chip in Nichia-825’s Figure 4 embodiment. A POSA would have known that the use of single-layer encapsulant LED packages was commonplace at the time of the filing of the ’685 patent and that they were simpler to manufacture, and would have known that, as disclosed in Hayashi, using a curved layer of encapsulant would have resulted in increased light extraction from the package than filling the encapsulant up to the top of the package. Ex. 1014 ¶¶ 32-36. A POSA also would have known that air has a low refractive index, and so even if sealing member 340 had a lower refractive index than covering member 330, it would have been preferable to have air over covering member 330 instead of a layer of silicone resin because air’s refractive index is lower. *Id.* ¶ 36. Thus, a POSA would be motivated to improve the Nichia-825 Figure 4 embodiment to increase the light extraction from the package by having an air gap above covering member 330 and would have had a reasonable expectation of success in doing so. *Id.* ¶ 37. That improved embodiment renders obvious claim limitation 20.12 because by having an air gap above covering member 330, the top surface of covering member 330 provides an interface to the air above the covering member 330. *Id.* ¶ 38.

Id. at 10–11.

Further, Petitioner argues that Nichia-825’s discussion of silver-plating corrosion (similarly to Lin’s discussion) does not teach away from

using a single layer of encapsulant filled below the top package because Lin discloses using a phenyl-containing silicone as an encapsulant (as compared to a methyl-containing silicone) that would not lead to a decrease in brightness after operation of the package. *Id.* at 11 (citing Ex. 1022, 10:7–18, 18:35–54; Ex. 1014 ¶ 39).

In our Preliminary Guidance, we made the following preliminary finding:¹⁶

Petitioner indicates Lin also addresses silver corrosion by “using a phenyl-containing silicone as the encapsulant [, which] did not lead to a decrease in brightness after operation of the package, compared to using a methyl-containing silicone.” Opp. 11. Petitioner does not, however, show the relevance of Lin’s disclosure to Nichia-825’s compounds. Petitioner’s contention is introduced in response to Patent Owner’s argument that Nichia-825 “teaches away from using a single packaging compound,” but Petitioner does not explain whether the combination proposed, eliminating Nichia-825’s sealing member 340, would utilize phenyl-containing silicone to address the corrosion problem. *Id.* Nichia-825’s covering member 330, however, already addresses the corrosion problem, and Petitioner has not established a reason to alter covering member 330, or why a different compound would be used, either in that layer or layer 340 that is removed. Thus, Petitioner’s proposal lacks sufficient motivation. On this record, Petitioner has not shown a reasonable likelihood that proposed substitute claim 20, or proposed substitute claims 21 and 22 depending therefrom, are unpatentable over Nichia-825 and Lin.

Prelim. MTA Guidance 11–12.

¹⁶ We noted that Petitioner bases this contention on two additional references, Lin (Ex. 1022) and Hayashi (Ex. 1023) (though the ground is stated as relying on Lin, not Hayashi). Prelim. MTA Guidance 11.

In its Reply to the Preliminary Guidance, Petitioner provides no further arguments beyond those previously discussed above for the Nichia-825-Omata combination. Pet. Sur-Reply to Opp. to MTA 1–10.

Patent Owner responds that Nichia-825 alone or in combination with Lin does not teach the limitation [20.12], and would not thereby have rendered proposed substitute claim 20 obvious. PO Reply to Opp. to MTA 5. In particular, Patent Owner argues that it would not have been obvious to modify Nichia-825 to use covering member 330 without the protection of sealing member 340 because the LED package would have lost its protection to corrosion, which would seep into covering member 330. *Id.* (citing Ex. 2010 ¶ 24). Accordingly, Patent Owner states the following:

It would not have been preferable to have air interface over covering member 330 instead of the sealing member 340. A POSITA would have understood that if the sealing member 340 were removed, the LED package would lack a protective layer, and the 50-micron-thin covering member alone would not completely cover the LED chip or provide sufficient protection to the LED chip. EX2010, ¶27. On the other hand, if only the sealing member is used in the LED package without the covering member, then the problems of silver corrosion would occur and result in lower performance of the LED. *Id.*; EX1007, ¶¶ 79-80.
Id. at 6.

Further Patent Owner argues that a POSITA would have understood that Lin's phenyl-containing silicone is different than Nichia-825's covering member made from a specifically designed, organic curable silicone resin including a siloxane-based compound. *Id.* at 6 (citing Ex. 2010 ¶¶ 28, 29; Ex. 1022, 11:59–12:15). According to Patent Owner, because Nichia-825's covering member already addresses the corrosion problem, a POSITA would

have understood that “there would have been no reason to alter the covering member, or to use Lin’s phenyl-containing silicone to replace the covering member in Nichia-825.” *Id.* at 6–7 (citing Ex. 2010 ¶ 29).

Petitioner proposes to remove Nichia-825’s protective sealing member 340, thereby exposing covering member 330 so that it provides an interface to the air above the package compound. Petitioner appears to rely upon Nichia-825’s disclosure of applying a single layer of encapsulant (e.g., phenyl-containing silicone as taught by Lin) filled below the top package to protect the LED package from corrosion. Petitioner’s arguments are not persuasive.

We reiterate our preliminary finding that

Petitioner has not explained why an ordinarily skilled artisan would abandon Nichia-825’s teachings of a sealing member 340, over covering member 330, to return to the very prior art configuration (of a single layer covering the light-emitting device), upon which Nichia-825’s invention is designed to improve. Petitioner proposes omitting a protective layer, but does not explain how Nichia’s thin covering member 330 alone, at, e.g., a mere 50 microns, would form a sufficiently protective layer above the LED chip.

Prelim MTA Guidance 11.

Although Petitioner proposes applying a particular type of encapsulant directly over covering member 330, Nichia-825 indicates that the application of encapsulant over covering member 330 is insufficient to protect the LED package from corrosion. Ex. 1007 ¶¶ 7, 10. Consequently, Nichia-825 recommends adding sealing member 340 to effectively combat the LED corrosion problem. *Id.* On this record, we find insufficient evidence to

substantiate Petitioner's argument that Nichia-825's applying an encapsulant layer on covering member 330 along with the proposed replacement of sealing member 340 with an air gap would provide sufficient protection to the LED against corrosion. Therefore, Petitioner has not established on the record before us that merely applying an encapsulant layer upon covering member 330 (without sealing member 340) would effectively protect the LED package from corrosion to the same extent that it did with the sealing member 340.

Synthesizing our findings regarding motivation to combine Nichia-825 and Lin, we determine that Petitioner has not shown that a POSITA would have viewed the potential benefits identified by Petitioner as outweighing the detriments identified by Patent Owner, including corrosion. Accordingly, we determine that Petitioner has not met its burden to show that a POSITA would have been motivated to combine the teachings of Nichia-825 and Lin in the manner proposed by Petitioner.

c. Proposed substitute claims 21 and 22

Claim 21 depends from proposed substitute claim 20, and recites in relevant part "wherein a top end of the attaching portion and a top end of the outer annular part of the surrounding portion are substantially arranged at a same height with respect to the substrate." PO MTA, App. A, 28. Claim 22 depends from proposed substitute claim 20, and recites in relevant part "wherein only a single layer of package compound forms the attaching portion 61 and the surrounding portion 62." *Id.*

The shortcomings in Petitioner’s arguments and evidence for independent claim 20 are not remedied by its arguments and evidence for dependent claims 21 and 22. Pet. Opp. to MTA 8–11. For these reasons, we determine that Petitioner has not met its burden to show that proposed substitute claims 21 and 22 are unpatentable as obvious over the combination of Nichia-825 and Lin.

Accordingly, Petitioner has not met its burden to show that proposed substitute claims 20–22 are unpatentable as obvious over Nichia-825 alone or in combination with Lin.

3. Petitioner’s Challenge Based on Nichia-824 and Omata

Petitioner asserts that proposed substitute claims 20–22 are unpatentable under § 103(a) as obvious over Nichia-825 alone or in combination with Omata. Pet. Opp. to MTA 11–15. Patent Owner opposes. PO Reply to Opp. to MTA. 7–8. Upon consideration of Petitioner’s explanations and supporting evidence in this current record, we are not persuaded that Petitioner has demonstrated by a preponderance of the evidence that proposed substitute claims 20–22 are unpatentable over Nichia-824 alone or in combination with Omata. Our analysis below focuses on the disputed claim elements.

a. Proposed substitute independent claim 20

Limitation [20.12] in proposed substitute claim 20 recites irrelevant part “wherein the top surface provides an interface to the air above the package compound”. PO MTA, App. A, 27. Petitioner contends although Nichia-824’s Figure 1 embodiment includes sealing resin 14 disposed above

resin layer's top surface, it would have been obvious "to use resin layer 15 with an air gap above it such that its top surface provides an interface to the air above the package compound." Pet. Opp. to MTA 12 (Ex. 1014 ¶ 44). Alternatively, Petitioner contends that it would have been obvious to use a lens above the package depicted in Figure 1 of Nichia-824 to efficiently transmit the light from the LED to the outside of the package. *Id.* at 12–13 (citing Ex. 1005 ¶¶ 39, 41; Ex. 1014 ¶¶ 46, 47). Petitioner contends that this configuration was "common in the art," citing Omata (Ex. 1021). *Id.* Thus, Petitioner submits that a POSITA would be motivated to improve Nichia-824's Figure 1 embodiment to increase light extraction from the package by adding a lens above the LED package and having an air gap above resin layer 15 such that its top surface provides an interface to the air above the resin layer. *Id.* at 13. Further, Petitioner contends that Nichia-824's discussion of filling with silicone resin an older LED package all the way to the top does not teach away from using a single packaging compound or a single covering member over the LED with a layer of air above it because such covering members were well-known in the art at the time of the filing of '685 Patent. *Id.* at 13-14 (citing Ex. 1005 ¶¶ 5–7, 19; Ex. 1014 ¶ 21). In particular, Petitioner contends that Omata discloses having an air gap above the resin layer of LED 27 rather than putting the lens directly abutting the resin layer helps increase light collection from the LED package. *Id.* at 14 (citing Ex. 1014 ¶¶ 21; Ex. 1021 ¶ 49).

In our Preliminary Guidance, we made a preliminary finding that Petitioner had not shown a sufficient motivation to substantiate the proposed substitution of Nichia-824's sealing resin 14 with an air gap and Omata's

lens above the air gap because Petitioner had not addressed the purpose of sealing resin 14 for protecting the light-emitting element, the conductive wire and the like from an external force and dust, and the problems the air hole, or lack of air hole, would introduce in the Nichia-824 and Omata combination. Prelim. MTA Guidance 13.

In its Reply to the Preliminary Guidance, Petitioner provides no further arguments beyond those previously discussed above for the Nichia-825-Omata combination. Pet. Sur-Reply to Opp. to MTA 1–10.

Patent Owner responds that Nichia-824 alone or in combination with Omata does not teach the limitation [20.12], and would not thereby have rendered proposed substitute claim 20 obvious. PO Reply to Opp. to MTA 7. In particular, Patent Owner argues that it would not have been obvious to modify Nichia-824 to use resin layer 15 without sealing resin 14 directly above it because that would have deprived the LED of the necessary protection that it needs to properly function. *Id.* In particular, Patent Owner argues that a POSITA would have readily understood that Nichia-824's application of sealing resin 14 over resin layer 15 enhances the protection provided to the LED because sealing resin 14 protects the LED package from external contamination, and resin layer 14 protects the LED package from corrosive gases that may penetrate the sealing resin. *Id.* (citing Ex. 2010 ¶¶ 33–35). Accordingly, Patent Owner states the following:

A POSITA would not have been motivated to remove sealing resin 14 from the embodiments of Nichia-824 and replace it with Omata's air gap and lens above Nichia-824's LED package. EX2010, ¶39. Nichia-824 is directed to solving problems associated with silver corrosion and peeling of a sealing resin in an LED package by using a

resin layer as an interface between the sealing resin and the bottom and side surfaces of the LED package. EX1005, ¶¶ 9, 24, Solution. Omata is directed to achieving increased brightness for an LED lamp that requires “an air hole 45 for communicating the air layer 40 with an outside area of the LED lamp” and to prevent “the air layer 40 in the concave portion 32 [being] inflated” EX1021, ¶¶ 11, 32, 39.

In the proposed combination, the air hole would expose the LED lamp of Nichia-824 to external contamination, and the lack of an air hole would cause pressure problems. EX2010, ¶41. A POSITA would not have been motivated to make the substitution, especially because: (i) the purpose of sealing resin 14 is to protect the light-emitting element and the conductive wire from external force and dust; and (ii) the problems the air hole, or lack of the air hole, would introduce in the proposed Nichia-824 and Omata combination. EX2010, ¶¶ 40-42.

Id. at 8.

After considering the parties’ arguments and evidence, we determine that Petitioner has not met its burden to show that a POSITA would have been motivated to modify Nichia-824 in the manner proposed by Petitioner. Nichia-824’s Figure 1, is reproduced below:

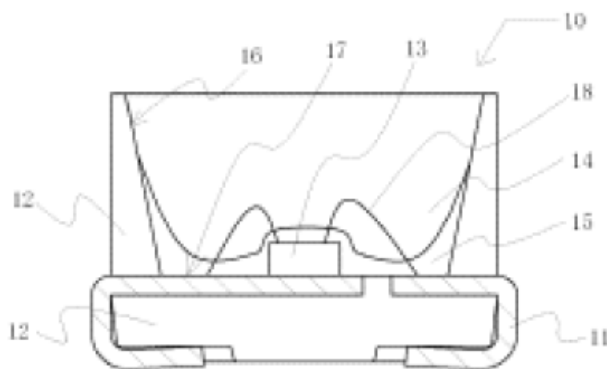


Figure 1 of Nichia-824 above shows LED package 10, conductive element 11, light-emitting element 13, sealing resin 14, resin layer 15, and wire 18. *Id.* ¶ 57. In particular, Nichia-824 discloses an LED package with

light-emitting element 13 mounted in a recessed portion of package 12, and covered with resin layer 15 and sealing resin 14. Ex. 1005 ¶ 16. Resin layer 15 is formed so as to cover bottom surface 17 of package 12 and at least a part of the side surface 16 of the package 12. *Id.* ¶ 17. Because “metal member 11 is covered with the resin layer 15 having low water vapor permeability and then sealed with the sealing resin 14, discoloration of the metal member 11 is suppressed.” *Id.* ¶ 18. Nichia-824 further discloses that sealing resin 14 “efficiently transmits the light from the light-emitting element to the outside, and protects the light-emitting element, the conductive wire and the like from an external force and dust.” *Id.* ¶ 39.

Petitioner thus proposes to eliminate sealing resin 14 and replacing it with an air gap and Omata’s lens above the air gap, “for the same reasons discussed above with respect to Nichia-825 in view of Omata.” Pet. Opp. to MTA 13. However, Omata itself has a protecting seal at resin material 29, which covers LED 27, and an air hole to prevent problems with the air gap. We reiterate our preliminary finding that Petitioner’s proposed modification of Nichia-824 would lead to the air hole exposing the LED lamp to external contamination. Prelim MTA Guidance 10. Although Nichia-824 uses resin layer 15 as a first level of LED protection, it recommends the application of sealing resin 14 atop resin layer 15 to provide additional barrier against the external contamination problem. Accordingly, we find insufficient evidence on the record before us to substantiate Petitioner’s argument that Nichia-824’s resin layer with Omata’s lens and an air gap would provide sufficient protection to the LED against corrosion.

Synthesizing our findings regarding motivation to combine Nichia-824 and Omata, we determine that Petitioner has not shown that a POSITA would have viewed the potential benefits identified by Petitioner as outweighing the detriments identified by Patent Owner, including moisture penetration. Accordingly, we determine that Petitioner has not met its burden to show that a POSITA would have been motivated to combine the teachings of Nichia-824 and Omata in the manner proposed by Petitioner.

b. Proposed substitute claims 21 and 22

Claim 21 depends from proposed substitute claim 20, and recites in relevant part “wherein a top end of the attaching portion and a top end of the outer annular part of the surrounding portion are substantially arranged at a same height with respect to the substrate.” PO MTA, App. A, 28. Claim 22 depends from proposed substitute claim 20, and recites in relevant part “wherein only a single layer of package compound forms the attaching portion 61 and the surrounding portion 62.” *Id.*

The shortcomings in Petitioner’s arguments and evidence for independent claim 20 are not remedied by its arguments and evidence for dependent claims 21 and 22. Pet. Opp. to MTA 14–17.] For these reasons, we determine that Petitioner has not met its burden to show that proposed substitute claims 21 and 22 are unpatentable as obvious in view of Nichia-824 and Omata.

Accordingly, Petitioner has not met its burden to show that proposed substitute claims 20–22 are unpatentable as obvious over Nichia-824 alone or in combination with Omata.

4. *Petitioner's Challenge Based on Nichia-824 and Lin*

Petitioner asserts that proposed substitute claims 20–22 are unpatentable under § 103(a) as obvious over Nichia-824 alone or in combination with Lin. Pet. Opp. to MTA 16–18. Patent Owner opposes. PO Reply to Opp. to MTA. 9–11. Upon consideration of Petitioner's explanations and supporting evidence in this current record, we are not persuaded that Petitioner has demonstrated by a preponderance of the evidence that proposed substitute claims 20–22 are unpatentable over Nichia-824 alone or in combination with Lin. Our analysis below focuses on the disputed claim elements.

a. Proposed substitute independent claim 20

Petitioner reiterates the proposed modification of Nichia-824 by removing sealing resin 14 from resin layer 15 so that resin layer 15 provides an interface to the air above the LED package compound. Pet. Opp. to MTA 16. According to Petitioner, “it would have been obvious to use a single layer of encapsulant over the LED chip [in Nichia's-824's Figure 1 embodiment] such that there was a gap between that layer and the top of the LED package” because “such packages were well-known in the art at the time of the filing of the '685 Patent.” *Id.* at 16–17 (citing Ex. 1014 ¶ 54). In particular, Petitioner states the following:

[A] POSA would be motivated to improve the Nichia-824 Figure 1 embodiment to increase the light extraction from the package by having an air gap above resin layer 15 and would have had a reasonable expectation of success in doing so. That improved embodiment renders obvious claim limitation 20.12 because by having an air gap above resin layer 15, the top surface of resin layer 15 provides an interface to the air above that layer. *Id.* ¶ 55.

Id. at 17.

Further, Petitioner argues that Nichia-824's discussion of silicone sealing resin peeling off of the package (similarly to Lin's discussion) does not teach away from using a single layer of encapsulant filled below the top of the package because Lin discloses using a phenyl-containing silicone as an encapsulant (as compared to methyl-containing silicone) that would not lead to a decrease in brightness after operation of the package. *Id.* at 17–18 (citing Ex. 1022, 1:33–44, 18:35–54; Ex. 1014 ¶ 57).

In our Preliminary Guidance, we made the following preliminary finding:¹⁷

Petitioner contends it would have been obvious to remove Nichia-824's resin layer 14, and rely only on resin layer 15, as taught by Lin, because it would be "simpler to manufacture." *Id.* at 16... Petitioner has not provided a sufficient motivation to alter Nichia-824, because it has not replaced the function of layer 14, to protect, with another component. *See* Ex. 1005 ¶ 39.

Prelim. MTA Guidance 13–14.

In its Reply to the Preliminary Guidance, Petitioner provides no further arguments beyond those previously discussed above for the Nichia-825-Omata combination. Pet. Sur-Reply to Opp. to MTA 1–10.

Patent Owner responds that Nichia-824 alone or in combination with Lin does not teach the limitation [20.12], and would not thereby have

¹⁷ We noted that Petitioner bases this contention on two additional references, Lin (Ex. 1022) and Hayashi (Ex. 1023) (though the ground is stated as relying on Lin, not Hayashi). Prelim. MTA Guidance 11.

rendered proposed substitute claim 20 obvious. PO Reply to Opp. to MTA 9. In particular, Patent Owner argues that it would not have been obvious to modify Nichia-824 to use resin layer 15 without the protective function of sealing resin 14 because the LED package would have lost its protection to corrosion, which would seep into the LED package. *Id.* (citing Ex. 2010 ¶ 44). Accordingly, Patent Owner states the following:

A POSITA would have understood that Nichia-824's resin layer is harder, more rigid and brittle than the sealing resin, and would cause LEDs to fail upon thermal shocking tests and large temperature changes, if used by itself. EX2010, ¶45. A POSITA would have understood that such hard and brittle materials are not generally used as an encapsulant for high power LEDs and that their use requires an additional overlying, lower elastic modulus sealing resin to improve the reliability of the LED package.
Id.

Further, Patent Owner argues that a POSITA would have understood that Lin's phenyl-containing silicone is different than Nichia-824's modified silicone resin having an elastic modulus of 1000 MPa or more. *Id.* at 10 (citing Ex. 21020 ¶ 46). According to Patent Owner, because Nichia-824's resin layer already addresses the corrosion problem, a POSITA would have understood that "there would have been no reason to alter this resin layer, or to replace it with Lin's phenyl-containing silicone." *Id.* at 10.

Petitioner thus proposes to remove Nichia-824's protective sealing resin 14, thereby exposing resin layer 15 so that it provides an interface to the air above the package compound. Petitioner appears to rely upon Nichia-824's disclosure of applying a single layer of encapsulant (e.g., phenyl-containing silicone as taught by Lin) filled below the top package to protect the LED package from corrosion. We reiterate our preliminary

finding that Petitioner has not accounted for how the LED package would effectively combat moisture and external contaminant penetration without the protection of the sealing resin 14. Prelim MTA Guidance 11.

Although Petitioner proposes applying resin layer 15 directly on the LED, Nichia-824 indicates that the application of resin layer 15 is insufficient to protect the LED package from corrosion. Consequently, Nichia-824 recommends further applying sealing resin 14 over resin layer 15 to effectively combat the LED corrosion problem. On this record, we find insufficient evidence to substantiate Petitioner's argument that Nichia-824's applying resin layer 15 over the LED along with the proposed replacement of sealing resin with an air gap would provide sufficient protection to the LED against corrosion. Therefore, Petitioner has not established on the record before us that merely applying resin layer 15 on the LED (without sealing resin 14) would effectively protect the LED package from corrosion to the same extent that it would with sealing resin 14.

Synthesizing our findings regarding motivation to combine Nichia-824 and Lin, we determine that Petitioner has not shown that a POSITA would have viewed the potential benefits identified by Petitioner as outweighing the detriments identified by Patent Owner, including corrosion. Accordingly, we determine that Petitioner has not met its burden to show that a POSITA would have been motivated to combine the teachings of Nichia-824 and Lin in the manner proposed by Petitioner.

b. Proposed substitute claims 21 and 22

Claim 21 depends from proposed substitute claim 20, and recites in relevant part “wherein a top end of the attaching portion and a top end of the outer annular part of the surrounding portion are substantially arranged at a same height with respect to the substrate.” PO MTA, App. A, 28. Claim 22 depends from proposed substitute claim 20, and recites in relevant part “wherein only a single layer of package compound forms the attaching portion 61 and the surrounding portion 62.” *Id.*

The shortcomings in Petitioner’s arguments and evidence for independent claim 20 are not remedied by its arguments and evidence for dependent claims 21 and 22. Pet. Opp. to MTA 14–17. For these reasons, we determine that Petitioner has not met its burden to show that proposed substitute claims 21 and 22 are unpatentable as obvious in view of Nichia-824 and Lin.

Accordingly, Petitioner has not met its burden to show that proposed substitute claims 20–22 are unpatentable as obvious over Nichia-824 alone or in combination with Lin.

5. Conclusion

Weighing the *Graham* factors, we conclude that Petitioner has not shown by a preponderance of the evidence that proposed substitute claims 20–22 would have been obvious over the combination of Nichia-824/825 alone. Rather, we determine that Petitioner’s proposed combined teachings of the references presents a deficient case of obviousness unsupported by objective indicia of nonobviousness.

Based on the foregoing, we grant Patent Owner's Contingent Motion to Amend.

V. CONCLUSION

In summary:

Claim(s)	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1, 5	103(a)	Nichia-825	1, 5	
2	103(a)	Nichia-825, Achyut	2	
3	103(a)	Nichia-825, Hashimoto		3
1, 5	103(a)	Nichia-824	1, 5	
2	103(a)	Nichia-824, Achyut	2	
3	103(a)	Nichia-824, Hashimoto		3
Overall Outcome			1, 2, 5	3

Motion to Amend Outcome	Claim(s)
Original Claims Cancelled by Amendment	
Substitute Claims Proposed in the Amendment	20–22
Substitute Claims: Motion to Amend Granted	20–22
Substitute Claims: Motion to Amend Denied	
Substitute Claims: Not Reached	

VI. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that Petitioner has shown by a preponderance of the evidence that claims 1, 2, and 5 of the '685 Patent are unpatentable;

FURTHER ORDERED that Petitioner has not shown by a preponderance of the evidence that claim 3 of the '685 Patent is unpatentable;

FURTHER ORDERED that Patent Owner's Contingent Motion to Amend is *granted* as to proposed substitute claims 20–22; and

FURTHER ORDERED that because this Decision is final, a party to the proceeding seeking judicial review of the Decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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Patent 10,916,685 B2

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