

U.S. Patent No. 9,240,529  
Patent Owner's Notice of Appeal  
IPR2020-00695

Paper No. \_\_\_\_\_

**UNITED STATES PATENT AND TRADEMARK OFFICE**

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**BEFORE THE PATENT TRIAL AND APPEAL BOARD**

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SATCO PRODUCTS, INC.  
Petitioner

v.

THE REGENTS OF THE UNIVERSITY OF CALIFORNIA  
Patent Owner

Patent No. 9,240,529

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*Inter Partes* Review No. IPR2020-00695

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**PATENT OWNER'S NOTICE OF APPEAL**

Pursuant to at least 35 U.S.C. §§ 141 and 142 and 37 C.F.R. §§ 90.2(a) and 90.3, notice is hereby given that Patent Owner The Regents of the University of California (“The Regents”) appeals to the United States Court of Appeals for the Federal Circuit from the Final Written Decision, dated September 15, 2021 (Paper No. 41) (“Final Decision”) entered in IPR2020-00695 (attached as Exhibit A), and from all underlying findings, orders, decisions, rulings and opinions.

In accordance with 37 C.F.R. § 90.2(a)(3)(ii), The Regents state that the issues on appeal may include, but are not limited to:

- Whether the Board erred when it determined that claims 1, 3, 4, 8, 12, 13, 15, 16, 20 and 24 of U.S. Patent No. 9,240,529 were shown by a preponderance of the evidence to be unpatentable under 35 U.S.C. § 103 by Japan Patent App. Pub. No. 2000/277808A (“Okamoto” Ex. 1008, 1009) and U.S. Patent No. 4,998,925 (“Shimizu” Ex. 1017);
- Whether the Board erred when it determined that claims 9, 10, 21 and 22 of U.S. Patent No. 9,240,529 were shown by a preponderance of the evidence to be unpatentable under 35 U.S.C. § 103 by Okamoto (Ex.

1008, 1009), Shimizu (Ex. 1017), and U.S. Patent No. 6,091,085

(“Lester” Ex. 1019);

- Whether the Board erred when it determined that claims 9, 10, 21 and 22 of U.S. Patent No. 9,240,529 were shown by a preponderance of the evidence to be unpatentable under 35 U.S.C. § 103 by Okamoto (Ex. 1008, 1009), Shimizu (Ex. 1017), and “High Output Power Near-Ultraviolet and Violet Light-Emitting Diodes Fabricated on Patterned Sapphire Substrates Using Metalorganic Vapor Phase Epitaxy” (“Tadatomo”, Ex. 1020);
- Whether the Board erred when it determined that claims 1, 8, 12, 13, 20 and 24 of U.S. Patent No. 9,240,529 were shown by a preponderance of the evidence to be unpatentable under 35 U.S.C. § 103 by Japan Patent App. Pub. No. 2005/035864A (“Miyahara”, Ex. 1011, 1012);
- Whether the Board erred when it determined that claims 3, 4, 15 and 16 of U.S. Patent No. 9,240,529 were shown by a preponderance of the evidence to be unpatentable under 35 U.S.C. § 103 by Miyahara (Ex. 1011, 1012), Okamoto (Ex. 1008, 1009) and Shimizu (Ex. 1017);

- Whether the Board erred when it determined that claims 9, 10, 21 and 22 of U.S. Patent No. 9,240,529 were shown by a preponderance of the evidence to be unpatentable under 35 U.S.C. § 103 by Miyahara (Ex. 1011, 1012) and U.S. Patent No. 6,091,085 (“Lester” Ex. 1019);
- Whether the Board erred when it determined that claims 9, 10, 21 and 22 of U.S. Patent No. 9,240,529 were shown by a preponderance of the evidence to be unpatentable under 35 U.S.C. § 103 by Miyahara (Ex. 1011, 1012) and “High Output Power Near-Ultraviolet and Violet Light-Emitting Diodes Fabricated on Patterned Sapphire Substrates Using Metalorganic Vapor Phase Epitaxy” (“Tadatomo”, Ex. 1020);
- Whether the Board erred in its construction of “lead frame”;
- All other issues decided adversely to The Regents in any orders, decisions, rulings, and opinions.

A copy of this Notice of Appeal is being filed with the Patent Trial and Appeal Board. In addition, this Notice of Appeal and the required docketing fees are being filed with the Clerk's Office for the United States Court of Appeals for the Federal Circuit.

U.S. Patent No. 9,240,529  
Patent Owner's Notice of Appeal  
IPR2020-00695

Respectfully submitted,

Dated: October 29, 2021

By: /s/Jennifer Hayes

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U.S. Patent No. 9,240,529  
Patent Owner's Notice of Appeal  
IPR2020-00695

**CERTIFICATE OF SERVICE**

The undersigned hereby certifies that a copy of the foregoing **Patent Owner's Notice of Appeal** was served on October 29, 2021, by email:

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By:/s/Jennifer Hayes

Counsel for Patent Owner

U.S. Patent No. 9,240,529  
Patent Owner's Notice of Appeal  
IPR2020-00695

**CERTIFICATE OF SERVICE**

I certify that, in addition to being filed electronically through the Patent Trial and Appeal Board's Patent Review Processing System, the original version of PATENT OWNER'S NOTICE OF APPEAL was filed by Priority Mail Express Number EL 857910592 US pursuant to MPEP § 1216.01, 37 CFR § 1.10, and 37 CFR § 104.2 on this 29<sup>th</sup> day of October 2021, with the Director of the United States Patent and Trademark Office at the following address:

Office of the Solicitor  
United States Patent and Trademark Office  
Mail Stop 8, Post Office Box 1450  
Alexandria, Virginia 22313-1450

By:/s/Jennifer Hayes

Counsel for Patent Owner

U.S. Patent No. 9,240,529  
Patent Owner's Notice of Appeal  
IPR2020-00695

**CERTIFICATE OF SERVICE**

I certify that PATENT OWNER'S NOTICE OF APPEAL was filed electronically on this 29<sup>th</sup> day of October 2021, with the Clerk's Office of the United States Court of Appeals for the Federal Circuit, via the CM/ECF filing system:

United States Court of Appeals for the Federal  
Circuit 717 Madison Place, N.W., Suite 401  
Washington, D.C. 20005

By:/s/Jennifer Hayes

Counsel for Patent Owner

# EXHIBIT A

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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SATCO PRODUCTS, INC.,  
Petitioner,

v.

THE REGENTS OF THE UNIVERSITY OF CALIFORNIA,  
Patent Owner.

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IPR2020-00695  
Patent 9,240,529 B2

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Before JENNIFER S. BISK, CHRISTOPHER L. CRUMBLEY, and  
STEVEN M. AMUNDSON, *Administrative Patent Judges*.

BISK, *Administrative Patent Judge*.

JUDGMENT  
Final Written Decision  
Determining All Challenged Claims Unpatentable  
*35 U.S.C. § 318(a)*

## I. INTRODUCTION

Satco Products, Inc. (“Petitioner”), filed a Petition requesting an *inter partes* review of claims 1, 3, 4, 8–10, 12, 13, 15, 16, 20–22, and 24 (“the challenged claims”) of U.S. Patent No. 9,240,529 B2 (Ex. 1001, “the ’529 patent”). Paper 2 (“Pet”). The owner of the ’529 patent, The Regents of the University of California (“Patent Owner”), filed a Preliminary Response. Paper 7 (“Prelim. Resp.”).

We instituted review on September 16, 2020. Paper 8 (“Institution Dec.”). Subsequent to institution, Patent Owner filed a Patent Owner Response (Paper 16 (“PO Resp.”)), Petitioner filed a Reply (Paper 21 (“Reply”)), and Patent Owner filed a Sur-Reply (Paper 28 (“Sur-Reply”)). A transcript of the oral hearing held on June 14, 2021, has been entered into the record as Paper 36 (“Tr.”).

This Final Written Decision is entered pursuant to 35 U.S.C. § 318(a). For the reasons that follow, Petitioner has demonstrated by a preponderance of the evidence that the challenged claims are unpatentable.

## II. BACKGROUND

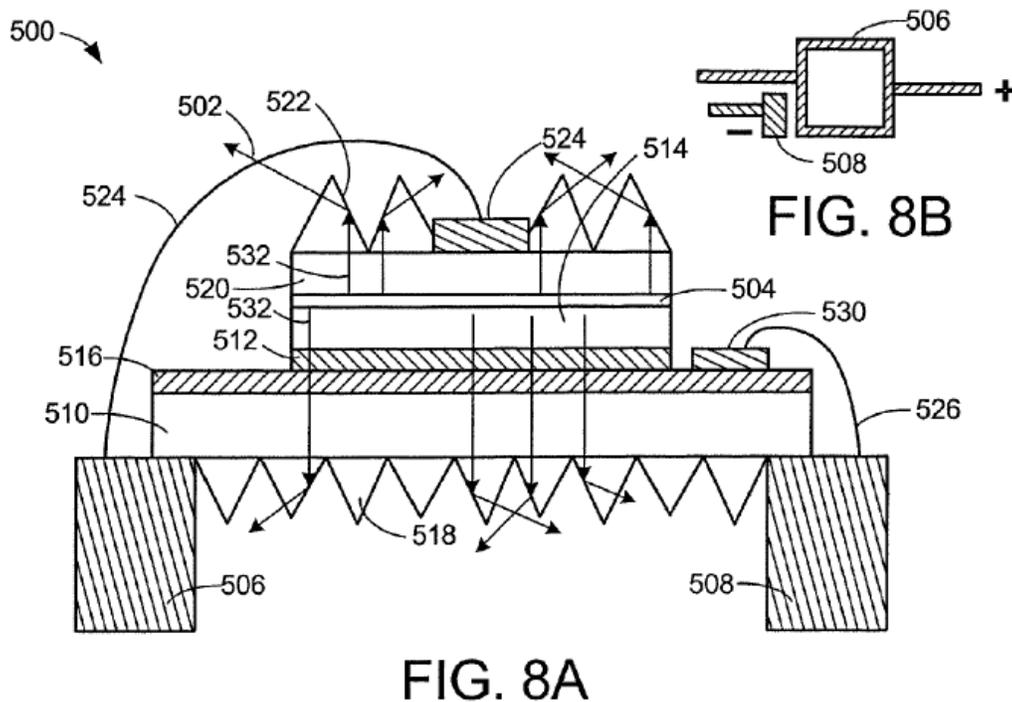
### *A. Related Matters*

The parties identify several related district court cases, including *Satco Products, Inc. v. The Regents of the University of California*, 2:19-cv-06444, in the Eastern District of New York (“the Satco Litigation”). Pet. 1–2; Paper 4, 2–3. In the Satco Litigation, Petitioner filed a complaint seeking a declaratory judgment of non-infringement. Pet. 4. In addition, there are several other pending petitions for IPR challenging patents related to the ’529 patent, including IPR2020-00579, IPR2020-00780, IPR2020-00813, IPR2021-00661, IPR2021-00662, and IPR2021-00794.

*B. The '529 Patent*

The '529 patent relates to “LED Light Extraction and white LED with high luminous efficacy for optoelectronic applications, and, more specifically, relates to a textured phosphor conversion layer LED.” Ex. 1001, 5:4–7. In particular, the '529 patent discloses that “[i]n conventional white LEDs, the phosphor conversion layer is typically placed directly on top of the blue GaN chip.” *Id.* at 5:14–15. Because photons are converted to lower energy photons in that phosphor layer, a large fraction of them are internally reflected and reabsorbed by the chip. *Id.* at 5:17–22. This is inefficient. *Id.* To increase efficiency of the LED, the '529 patent “minimizes the internal reflection of the phosphor layer by preferential patterning the emitting surface to direct more light away from the absorbing chip structure.” *Id.* at 5:42–45.

Figures 8A and 8B of the '529 patent are reproduced below.



Figures 8A and 8B of the '529 patent “illustrate the dual-sided roughened phosphor layer of the present invention.” *Id.* at 7:21–23. LED chip 500 contains glass plate 510, which is coated with Indium Tin Oxide (ITO) layer 516, which, in turn, is attached to deposited ITO layer 512 using epoxy as a glue. *Id.* at 10:14–18. “LED chip 500 is put on a lead frame 506” and wire bonding 524 and 526 connect bonding pads of LED chip 528 and 530 and lead frame 506 and electrode 508 “to allow an electric current to flow through the lead frame 506.” *Id.* at 10:25–30. Lead frame 506 “acts as a support around the edges of LED chip 500.” *Id.* at 10:32–36.

### *C. The Challenged Claims*

Petitioner challenges claims 1, 3, 4, 8–10, 12, 13, 15, 16, 20–22, and 24 of the '529 patent. Claims 1 and 13 are independent. Claim 1 is reproduced below:

1. A light emitting device, comprising:
  - an LED chip emitting light at a first wavelength, wherein the emitted light is extracted from both front and back sides of the LED chip;
  - a lead frame to which the LED chip is attached, wherein the LED chip resides on or above a transparent plate in the lead frame that allows the emitted light to be extracted out of the LED chip through the transparent plate in the lead frame; and
  - a phosphor for converting the light emitted by the LED chip at the first wavelength to a second wavelength.

Ex. 1001, 21:62–22:5.

Claim 13 is substantively similar to claim 1, but recites a method. To the extent our analysis herein focuses on claim 1, it should be understood to apply equally to claim 13. Claims 3, 4, 8–10, and 12 depend from claim 1, and claims 15, 16, 20–22, and 24 depend from claim 13.

*D. Asserted Grounds of Unpatentability*

Petitioner asserts the following grounds of unpatentability:

<b>Claim(s) Challenged</b>	<b>35 U.S.C. §<sup>1</sup></b>	<b>Reference(s)/Basis</b>
1, 3, 4, 8, 12, 13, 15, 16, 20, 24	103(a)	Okamoto, <sup>2</sup> Shimizu <sup>3</sup>
9, 10, 21, 22	103(a)	Okamoto, Shimizu, Lester-085 <sup>4,5</sup>
9, 10, 21, 22	103(a)	Okamoto, Shimizu, Tadatomo <sup>6</sup>

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<sup>1</sup> The Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) (“AIA”), included revisions to 35 U.S.C. § 102 and § 103 that became effective on March 16, 2013. Because the ’529 patent issued from an application that was a continuation of an application filed before March 16, 2013, we apply the pre-AIA version of the statutory basis for unpatentability.

<sup>2</sup>Japan Patent App. Pub. No. 2000/277808A, published Oct. 6, 2000 (Ex. 1008) (certified English translation). The original Japanese-language document is in the record as Exhibit 1009. Citations herein are to the English translation, the accuracy of which has not been challenged at this stage of the proceedings.

<sup>3</sup> U.S. Patent No. 5,998,925 (issued Dec. 7, 1999). Ex. 1017.

<sup>4</sup> U.S. Patent No. 6,091,085 (issued July 18, 2000). Ex. 1019.

<sup>5</sup> Petitioner refers to this ground as Okamoto, Shimizu, Lester-085, “and/or Tadatomo.” Pet. 5, 56. However, the analysis provided by Petitioner only addresses the combinations of Okamoto, Shimizu, and Lester-085 or Okamoto, Shimizu, and Tadatomo and does not address a combination of Okamoto, Shimizu, Lester-085 and Tadatomo. Pet. 56–60.

<sup>6</sup> Tadatomo, K. et al. “High Output Power Near-Ultraviolet and Violet Light-Emitting Diodes Fabricated on Patterned Sapphire Substrates Using Metalorganic Vapor Phase Epitaxy,” Proceedings of SPIE – the International Society for Optical Engineering, vol. 5187, Third International Conference on Solid State Lighting, (26 January 2004): 243-249. Bellingham, WA: SPIE, c2004. Ex. 1020.

Claim(s) Challenged	35 U.S.C. § <sup>1</sup>	Reference(s)/Basis
1, 12, 13, 24	102	Miyahara <sup>7</sup>
1, 8, 12, 13, 20, 24	103(a)	Miyahara
3, 4, 15, 16	103(a)	Miyahara, Okamoto, Shimizu
9, 10, 21, 22	103(a)	Miyahara, Lester-085 <sup>8</sup>
9, 10, 21, 22	103(a)	Miyahara, Tadatomo

Pet. 4–5, 29–80. Petitioner submits the Declaration of Russell D. Dupuis, Ph.D. (Ex. 1003) in support of its arguments. Patent Owner submits the declarations of E. Fred Schubert, Ph.D., M.S. (Ex. 2001 and Ex. 2006) in support of its arguments.

Petitioner alleges that each of the asserted references is prior art to the '529 patent under 35 U.S.C. § 102(b). Pet. 16–21. Petitioner also refers to several references not asserted as part of any ground and alleges that they are also prior art under § 102(b). *Id.* at 15–16 (referring to Ex. 1007 (“Schubert”)), 20 (referring to Ex. 1005 (“Krames-924”) and Ex. 1016 (“Ishizaka-361”)); Ex. 1003 ¶¶ 65, 226 (also referring to Ex. 1028 (“Fujii”) and Ex. 1029 (“Narukawa”)). Patent Owner does not challenge the prior-art status of any reference. *See generally* PO Resp.; Sur-Reply. We find that the references are prior art to the '529 patent.

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<sup>7</sup> Japan Patent App. Pub. No. 2005/035864A (published Feb. 10, 2005). Ex. 1011 (certified English translation).

<sup>8</sup> Petitioner refers to this ground as Miyahara, Lester-085, “and/or Tadatomo.” Pet. 5, 78. However, the analysis provided by Petitioner only addresses the combinations of Miyahara and Lester-085 or Miyahara and Tadatomo and does not address a combination of Miyahara, Lester-085, and Tadatomo. Pet. 78–80.

### III. ANALYSIS

#### *A. Level of Skill in the Art*

The level of skill in the art is a factual determination that provides a primary guarantee of objectivity in an obviousness analysis. *See Al-Site Corp. v. VSI Int'l, Inc.*, 174 F.3d 1308, 1323 (Fed. Cir. 1999) (citing *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966)). The level of skill in the art also informs the claim-construction analysis. *See Teva Pharm. USA, Inc. v. Sandoz, Inc.*, 574 U.S. 318, 332 (2015) (explaining that claim construction seeks the meaning “a skilled artisan would ascribe” to the claim term “in the context of the specific patent claim” (emphasis omitted)).

Petitioner asserts that a person of ordinary skill in the art “would have been knowledgeable regarding conventional designs and fabrication techniques pertaining to LEDs, including LED package designs, and would have had at least 2 years of experience in LED design and fabrication as well as at least a master’s degree in a relevant field (e.g., chemical engineering, materials engineering, or electrical engineering), or alternatively would have an equivalent combination of advanced education and practical experience.” Pet. 13 (citing Ex. 1003 ¶¶ 26–27). Patent Owner contends that the person of ordinary skill “would have had at least a B.S. degree in mechanical or electrical engineering or a related field, and three years of experience in designing semiconductor LED packages.” Prelim. Resp. 2; Ex. 2006 ¶ 25. Patent Owner adds that “a higher level of education or skill might make up for less experience (for example, an M.S. in any of the above fields and two years of practical experience would qualify one as a [person of ordinary skill in the art] (POSITA).” *Id.* (citing Ex. 2001 ¶ 67); Ex. 2006 ¶ 25.

Both parties appear to be in general agreement regarding the level of skill, and neither party contends that any differences between their proposals would have any effect on our analysis of Petitioner's challenges. Although we encouraged the parties to explain any material differences between the two proposals in post-institution briefing (*see* Institution Dec. 8), neither party addressed the issue. *See generally* PO Resp.; Reply; Sur-Reply. We, therefore, adopt a level of ordinary skill that encompasses a person with a degree in mechanical or electrical engineering or a related field and the equivalent of several years of experience in designing semiconductor LED packages.

#### *B. Claim Construction*

For petitions filed on or after November 13, 2018, such as the one in this case, we interpret claims in the same manner used in a civil action under 35 U.S.C. § 282(b), “including construing the claim in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.” 37 C.F.R. § 42.100(b) (2021). Only terms that are in controversy need to be construed, and then only to the extent necessary to resolve the controversy. *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017).

Based on post-institution briefing, we determine that only the construction of “lead frame” is necessary to resolve the issues in controversy. *See* PO Resp. 2 (“[T]he only claim term necessary to resolve the issues in controversy, is the term ‘lead frame.’”); Reply 1–13 (addressing only the construction of “lead frame”).

In the Institution Decision, we noted two issues to be resolved regarding the construction of “lead frame”: (1) whether the transparent plate may be considered a part of the lead frame; and (2) whether specific components (e.g. leads) of the lead frame must provide support to the LED chip. Institution Dec. 8–12. For purposes of institution, we determined that “the transparent plate may be part of the lead frame” (*id.* at 10) and “the lead frame structure, as a whole, provides support to the LED” (*id.* at 11). We then adopted a construction proposed by ITC Staff in a related Investigation—“a support structure for providing an interface to a semiconductor die.” *Id.* at 11. The ITC later adopted this construction. *See* Ex. 3002, 11–14.<sup>9</sup>

Subsequent to institution, both parties agree that the transparent plate may be considered a part of the lead frame. PO Resp. 3–4; Reply 3; Sur-Reply 2. The parties also agree that the lead frame provides support to the LED chip. *Id.*

The parties, however, continue to disagree whether the leads themselves must provide support to the LED chip.<sup>10</sup> PO Resp. 4; Reply 2. According to Patent Owner, “the leads in a lead frame provide structural or mechanical support to the LED chip” by either “directly support[ing] the LED chip (in the absence of a transparent plate) or indirectly support[ing] the LED chip through the transparent plate (in the presence of a transparent

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<sup>9</sup> The parties forwarded a copy of the ITC’s Markman Order in 337-TA-1220, dated June 15, 2021, to notify us of the decision. We have entered the order as Board Exhibit 3002.

<sup>10</sup> Although Patent Owner contends that “the parties agree that the conductive leads must provide structural support to the LED” (PO Resp. 4), Petitioner disagrees (Reply 4).

plate).” PO Resp. 7. Although Petitioner understood Patent Owner’s argument to be “that a lead frame has at least two leads and all leads must provide structural support” (Reply 6), in the Sur-Reply, Patent Owner clarifies that its position is that “some or all of the leads” provide structural support. Sur-Reply 3.

As detailed below, we disagree with Patent Owner that the term “lead frame,” as recited in the challenged claims, requires that any component lead provide support to the LED chip. Instead, we maintain our construction from the Institution Decision that “lead frame” in this context means a support structure for providing an interface to a semiconductor die, where the lead frame structure, as a whole, provides the support to the semiconductor die.

Patent Owner provides several arguments in support of its proposed construction requiring at least one lead to provide structural support to the LED chip. First, Patent Owner contends that the plain meaning of the term “lead frame” requires that the leads must form “the structural frame supporting the LED chip.” Sur-Reply 5. According to Patent Owner, “[o]n its face, the meaning is clear” that “‘lead frame’ is a frame formed by leads.” *Id.* at 4. We do not find this conclusory statement helpful in determining whether the leads in a lead frame are required to provide structural support to the LED chip. Patent Owner does not provide any evidence, intrinsic or extrinsic, that the plain meaning of the term “lead frame” requires that any leads provide direct or indirect support to the LED chip. In fact, Patent Owner refers to several dictionary definitions of the term “lead frame,” none of which makes any reference to support. PO Resp. 5 (citing Ex. 1023, 4 (“Lead Frame. The metallic portion of a component package that is used to

interconnect with semiconductor die by wire bonding and to provide output terminal leads.”); Ex. 1024, 4 (“lead frame— . . . 2. The metal part of a solid-state device package that achieves electrical connection between the die and other parts of the system of which the IC is a component. . . .”); Ex. 1026, 3 (“lead frame the metallic portion of the device package that makes electrical connections from the die to other circuitry”).

Second, Patent Owner argues that a person of ordinary skill in the art would have understood the term “lead” to have a different meaning than the term “lead frame,” and “the role of the conductive material in providing structural support is part of what distinguishes a ‘lead frame’ from ‘leads.’” PO Resp. 5; Sur-Reply 3 (“The very fact that lead and lead frame are separate terms indicates that the leads in a lead frame have some distinct or separate function.”). Patent Owner, however, does not point to any evidence, intrinsic or extrinsic, that it is the leads’ role in providing structural support that distinguishes the two terms. *See id.* Moreover, because we construe the term “lead frame” to potentially include other components, in addition to leads, the two terms already have different meanings. Thus, we are not persuaded that the absence of a role in supporting the LED chip renders the term “lead frame” indistinguishable from the term “leads.”

Third, Patent Owner argues that because under some circumstances not relevant to the claims at issue,<sup>11</sup> it is possible that the lead frame includes only the leads, the leads necessarily provide support even in the presence of

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<sup>11</sup> Each of the challenged claims requires a “transparent plate in the lead frame.” Ex. 1001, 14:66–16:59.

other, optional, components. Sur-Reply 3 (“[T]he fact that a transparent plate is allowed, but not required, indicates that the leads provide support whether or not a transparent plate is present.”). Again, Patent Owner does not provide any evidence to support this conclusion. *See id.* We also do not follow the logic of the argument. Patent Owner itself allows that the support given by leads may change in the presence of a transparent plate. *See* PO Resp. 7 (“The leads either directly support the LED chip (in the absence of a transparent plate) or indirectly support the LED chip through the transparent plate (in the presence of a transparent plate).”).

Fourth, Patent Owner argues that if the leads provide no structural support, then the term “lead frame” is essentially meaningless. PO Resp. 5–8; Sur-Reply 3–4. According to Patent Owner, all LED chips require both structural support and leads, but not all LED packages include lead frames. *Id.* (citing Ex. 2009 (“Basin”) showing what Patent Owner refers to as a “chip on board package” that does not include a lead frame). Patent Owner, thus, concludes that the term “lead frame” must require something more than simply the combination of structural support and leads. PO Resp. 5–7.

Even accepting the premise that all LED chips require both structural support and leads, but not all LED packages include lead frames, it is unclear why the differentiating factor for lead frames must be that the leads themselves provide support. Instead, it seems equally viable that the difference between an LED package with a lead frame and one without resides in the manner in which the leads are connected to each other and to any other potential components of the package. For example, Basin, which Patent Owner points to as a “chip on board package” that purportedly does not have a lead frame, shows a circuit board supporting both the LED chip

and the leads themselves. PO Resp. 8 (citing Ex. 2009 ¶ 36). It is possible that the relevant difference between Basin and the '529 patent—why one has a lead frame and the other does not—is that the leads in Basin are not providing support to the LED chip, as asserted by Patent Owner. However, there are other differences between the device in Basin and the device in the '529 patent, which also could be the basis for such difference. In other words, we see no evidence supporting a presumption that the reason Basin lacks a lead frame is that the leads do not provide support to the LED chip. And, as Petitioner points out, Basin itself does not use the term “lead frame” or provide any other clarification of what the term means. *See* Reply 12–13.

Dr. Schubert’s testimony on the issue does not support such a presumption. First, Dr. Schubert states that “structural support *from the lead frame, itself*—and not from a substrate (as discussed below)—is what fundamentally distinguishes the lead frame packaging design from other packaging designs as in surface mounted packaging/ chip-on-board packaging designs.” Ex. 2006 ¶ 63. Nothing in this statement requires any particular portion of the lead frame, including the leads, to provide the structural support. Later, Dr. Schubert states that in a lead frame package “the leads provide support to the LED chip.” *Id.* ¶ 68. However, the only evidence that Dr. Schubert relies upon for this conclusion is the contrast between Basin’s device and that of the '529 patent.<sup>12</sup> Because, as above, we

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<sup>12</sup> Dr. Schubert also refers to the devices of Shimizu and Ishizaka, which are similar to the device in Basin in that they allegedly use chip-on-board packaging instead of a lead frame. *Id.* at 69 (citing Ex. 1017, 8:51–54; Ex. 1016 ¶ 33). However, as with Basin, Dr. Schubert does not address the other differences between the devices of Shimizu and Ishizaka or explain why

see no evidence that the only difference between those two devices is whether or not the leads provide support to the LED chip, we do not find Dr. Schubert's conclusion persuasive. We, therefore, agree with Petitioner that Basin does not support Patent Owner's proposed construction.

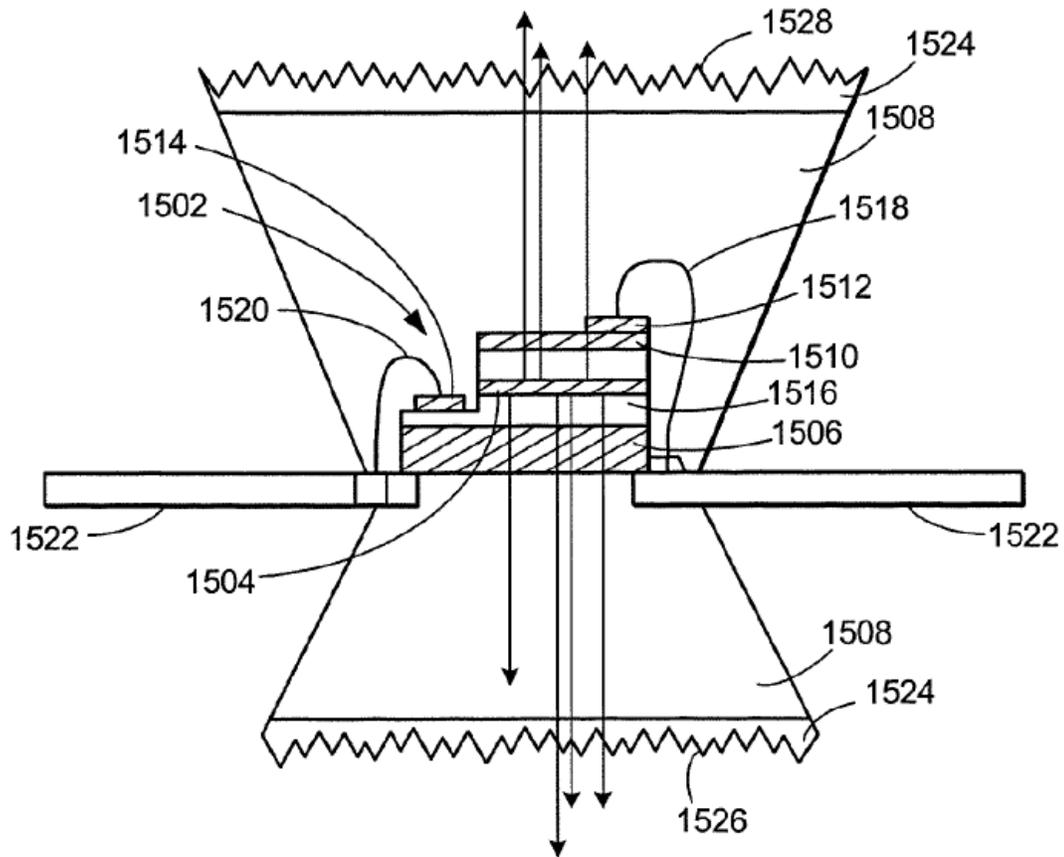
Patent Owner also relies on testimony from Dr. Schubert (PO Resp. 6–9 (citing Ex. 2006 ¶¶ 63–69, 75–86)) stating that “[t]he leads either directly support the LED chip (in the absence of a transparent plate) or indirectly support the LED chip through the transparent plate (in the presence of a transparent plate).” Ex. 2006 ¶ 86. However, Dr. Schubert does not cite to any evidence, intrinsic or extrinsic, supporting this statement. *Id.* In fact, earlier in the same section of his testimony, Dr. Schubert states that (1) “[a] lead frame in the context of LEDs is understood by those of skill in the art as a support structure for an LED chip that comprises at least two conductive leads, an anode lead and cathode lead that are structurally stable and do not require support from another component” (Ex. 2006 ¶ 63); (2) “[t]he term ‘lead frame’ is a very commonly used term in the field of LEDs” that “refers to a frame (support structure) for LEDs that includes leads (electrodes) for making electrical connections between an LED and other structures (e.g., an LED driver or power supply)” (*id.* ¶ 76); and (3) “[i]n the context of the claims at issue and in light of the specification, the 529 Patent (and related patents) teach that the transparent plate, with the leads is involved in the support of the LED chip” (*id.* ¶ 84).

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support provided by leads is the relevant factor distinguishing a lead frame package from a chip-on-board package. *Id.*

However, all of these statements support a finding that the *lead* supports the LED chip, but they do not require that any *leads* support the LED chip. Dr. Schubert does not explain the logical step between the requirement of the lead frame providing support and the leads of the lead frame providing support except to state that “[i]n the context of the claims at issue and in light of the specification, the ’529 (and related patents) teach that the transparent plate, with the leads, is involved in the support of the LED chip” and “[t]herefore, in my opinion a POSITA reading the ’529 Patent would understand that the lead frame recited in the claims include[s] a transparent plate, where both the transparent plate and conductive leads provide [structural] support to the LED.” *Id.* ¶¶ 84–85. Because this conclusion is not supported by intrinsic or extrinsic evidence, we are not persuaded that Dr. Schubert’s testimony provides significant support to Patent Owner’s proposed construction.

Figure 15 of the ’529 patent is reproduced below.



**FIG. 15**

Figure 15 shows an LED including LED structure 1502 with an emitting layer 1504 and sapphire substrate 1506 with a roughened backside to increase the light extraction. Ex. 1001, 11:43–48. “Wire bonds 1518 and 1520 are added to connect the LED structure 1502 to the lead frame 1522.” *Id.* at 11:58–60.

Both parties appear to agree that Figure 15 of the '529 patent shows an anode lead providing at least some structural support to the LED chip. PO Resp. 8 (stating that in Figure 15 “lead frame 1522 both (i) supports the LED chip and (ii) provides the electrical connection through bonding wires 1518 and 1520”); Reply 7 (showing an annotated version of Figure 15 with a portion of element 1522 labelled as “anode lead: structural support”).

However, neither party directs us to, nor do we see any, disclosure in the '529 patent that explicitly states that element 1522 is providing mechanical support to the LED chip. *See* PO Resp. 8 (citing Ex. 1001, 11:54–60 (“Wire bonds 1518 and 1520 are added to connect the LED structure 1502 to the lead frame 1522.”)). Both parties, therefore, appear to base their understanding on the positioning of element 1522 in the Figure—below the LED chip. Although this disclosure is evidence that the leads of a lead frame *can* provide support to the LED chip, Patent Owner has not persuaded us that any of the leads in the lead frame are *required* to provide such support.

We note that, regardless of the role of the leads in the construction, neither party quantifies the amount of support required to be provided to the LED chip. *See* Tr. 12:24–25 (Petitioner’s counsel stating “[i]t is unclear, from the patent, what the actual amount of support is required.”); 46:7–10 (Patent Owner’s counsel stating “[a]nd I know Your Honor asked earlier how much support leads provide, and I don’t think that that’s necessarily an issue that needs to be resolved because, as we’ll see in the prior art, the leads in those particular references are not providing any physical support.”); *see also* Tr. 49:10–11 (Patent Owner’s counsel stating “I don’t know that there’s evidence that goes directly to the question of what support means in the abstract.”). Our construction, therefore, does not require any particular amount of support to be provided to the LED chip by the lead frame. It is enough that the lead frame provides *any* amount of support to the LED chip.

Accordingly, we maintain our construction from the Institution Decision that the term “lead frame,” as recited by the challenged claims,

means a support structure for providing an interface to a semiconductor die, where the lead frame structure, as a whole, supports the LED.

*C. Grounds Based on Okamoto and Shimizu*

Petitioner contends that: (1) claims 1, 3, 4, 8, 12, 13, 15, 16, 20, and 24 of the '529 patent are unpatentable, because their subject matter would have been obvious over the combined disclosures of Okamoto and Shimizu; (2) claims 9, 10, 21, and 22 would have been obvious over the combined disclosures of Okamoto, Shimizu, and Lester-085; and (3) claims 9, 10, 21, and 22 would have been obvious over the combined disclosures of Okamoto, Shimizu, and Tadatomo. Pet. 4–5, 29–60. For the reasons given below, Petitioner has shown obviousness by a preponderance of the evidence.

A claim is unpatentable under 35 U.S.C. § 103(a) 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.” We resolve the question of obviousness on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) objective evidence of nonobviousness, i.e., secondary considerations.<sup>13</sup> *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

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<sup>13</sup> The record does not include allegations or evidence of objective indicia of nonobviousness.

*1. Overview of Okamoto*

Okamoto is a Japanese Patent Application published October 6, 2000, titled “Light Source Device and Manufacturing Method of the Same.” Ex. 1008, codes (43), (54). Okamoto describes providing a light source device with “LED elements 3 and 4 having light distribution characteristics for emitting in all directions” on a “light-transmissive substrate 2.” *Id.* at code (57). Figure 1 of Okamoto is reproduced below.

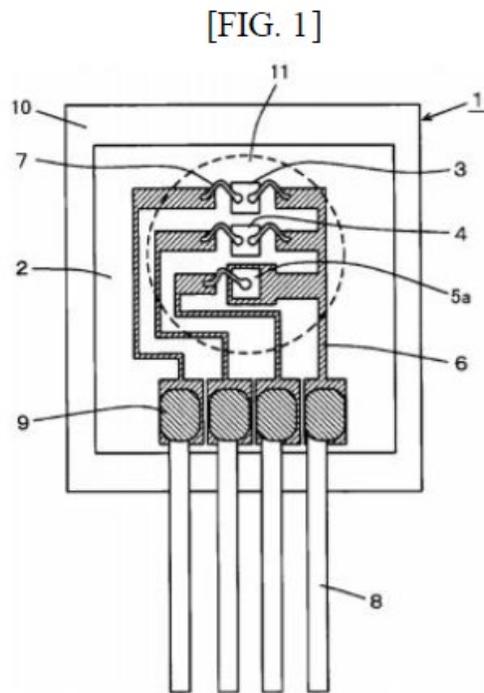
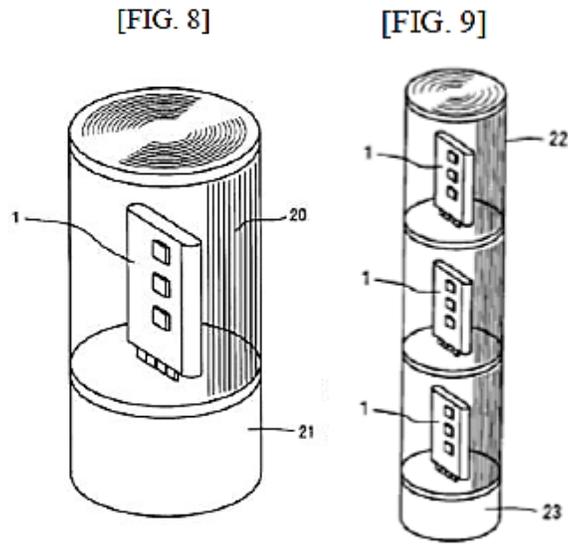


Figure 1 of Okamoto shows “a frontal view illustrating a configuration of a light source device.”<sup>14</sup> *Id.* ¶ 26. The device includes GaN blue LED element 3, GaN green LED element 4, and GaAs red LED element 5a, all three of which are “disposed in a row on a front face of a light-transmissive

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<sup>14</sup> Petitioner refers to Okamoto’s Figure 1 as showing a “lead-type” package. Pet. 46.





Figures 8 and 9 of Okamoto show “perspective views of signal lights having the light source 1 of FIG. 1 incorporated therein.” *Id.* ¶ 41.

## 2. Overview of Shimizu

Shimizu is a U.S. Patent, issued December 7, 1999, titled “Light Emitting Device Having a Nitride Compound Semiconductor and a Phosphor Containing a Garnet Fluorescent Material.” Ex. 1017, codes (45), (54). It describes a “white light emitting diode” that uses “a semiconductor as a light emitting layer and a phosphor which absorbs a part of light emitted by the light emitting component and emits light of wavelength different from that of absorbed light.” *Id.* at code (57). “[T]he phosphor contains a garnet fluorescent material activated with cerium which contains at least one element selected from the group consisting of Y, Lu, Sc, La, Gd and Sm, and at least one element selected from the group consisting of Al, Ga and In.” *Id.* Shimizu describes embodiments with a “lead type light emitting diode” and a “tip type light emitting diode.” *Id.* at 6:48–53. Figure 1 of Shimizu is reproduced below.

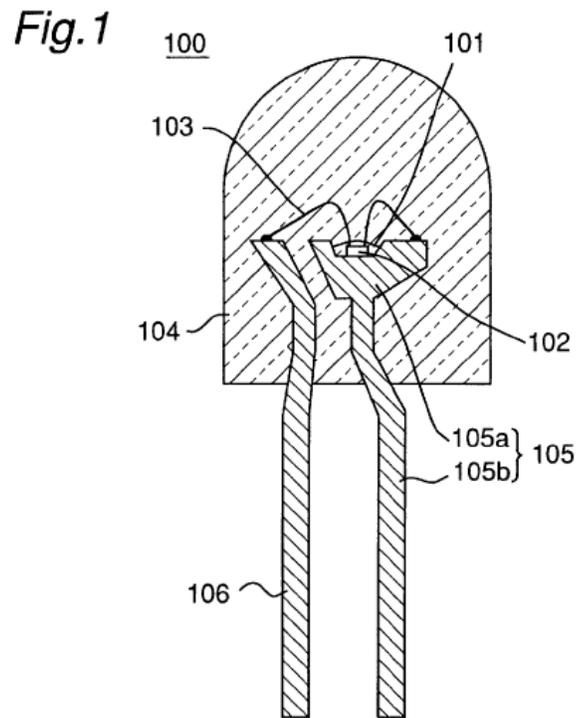


Figure 1 of Shimizu “is a schematic sectional view of a lead type light emitting diode.”<sup>15</sup> *Id.* at 6:48–53. LED 100 has “a mount lead 105 and an inner lead 106,” and “a light emitting component 102.” *Id.* at 8:31–39.

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<sup>15</sup> Petitioner refers to Shimizu’s Figure 1 as showing a “lead-type” package. Pet. 19.

Figure 2 of Shimizu is reproduced below.

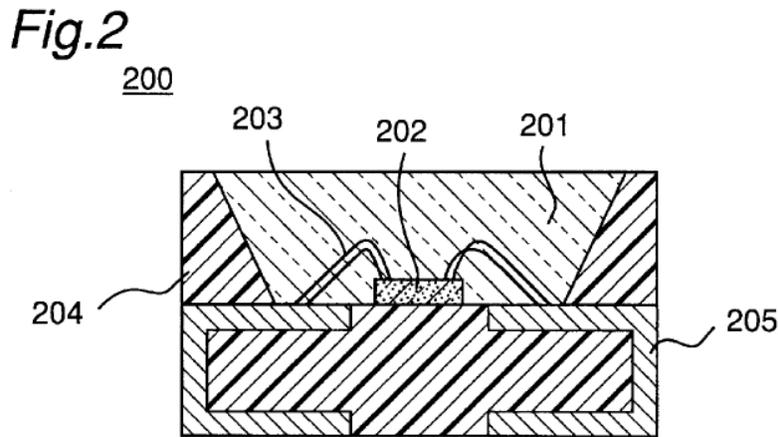


Figure 2 of Shimizu “is a schematic sectional view of a tip type light emitting diode.”<sup>16</sup> *Id.* at 6:52–54. LED 202 is installed in a recess of casing 204, which “is filled with a coating material which contains a specified phosphor to form a coating 201.” *Id.* at 8:51–54. Electrodes of LED 202 are “connected to metal terminals 205 installed on the casing 204 by means of conductive wires 203.” *Id.* at 8:54–59. “[B]ecause the phosphor is used by blending with a resin[,] which makes the . . . coating material 201 (detailed later), color tone of the light emitting diode can be adjusted including white and incandescent lamp color by controlling the mixing proportion with the resin or the quantity used in filling . . . the recess of the casing 204 in accordance to the wavelength of light emitted by the gallium nitride light emitting component [202].” *Id.* at 10:36–44.

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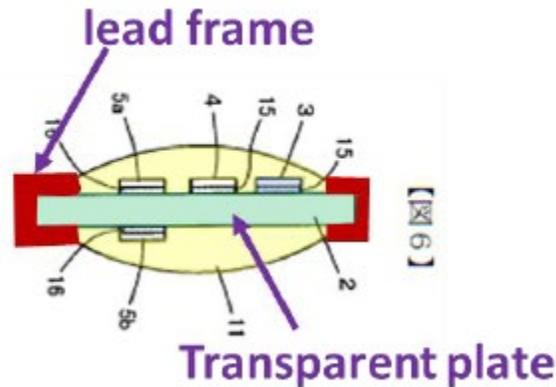
<sup>16</sup> Petitioner refers to Shimizu’s Figure 2 as showing a “chip-type” package. Pet. 19.

### 3. Independent Claims 1 and 13

Petitioner contends that independent claims 1 and 13 would have been obvious over Okamoto and Shimizu. Pet. 34–41, 45. Petitioner points to Okamoto’s lead frame 8 and wiring pattern 6 as making up conductive leads for LED 3 and to Okamoto’s glass substrate 2 as teaching the claimed transparent plate. See Pet. 36–37 (citing Ex. 1008, Figs. 1, 6, ¶¶ 27, 29, 32, 34, 37; Ex. 1003 ¶ 137). Petitioner contends that Okamoto’s lead frame 8 and glass substrate 2 “form a support structure” for LED 3. *Id.* According to Petitioner, Figures 1, 6, and 8 of Okamoto show “the blue LED chip is mounted on the transparent plate, and the portion of the leads that stick out of the plate-containing package are used to mount the package within a larger device.” *Id.* at 37–38 (citing Ex. 1008, Figs. 1, 6, 8, ¶¶ 32, 34, 37). Petitioner also provides testimony from Dr. Dupuis supporting these assertions. Ex. 1003 ¶¶ 137–145.

Petitioner concedes that “Okamoto’s lead frame sits *on* its transparent plate, rather than the transparent plate being *in* the lead frame.” Pet. 45 (citing Ex. 1008 ¶¶ 34, 36). To remedy this deficiency, Petitioner points to Shimizu’s chip-type package disclosed in Figure 2. *Id.* at 50–52. To

demonstrate the results of combining Okamoto and Shimizu, Petitioner creates a modified version of Okamoto's Figure 6, as reproduced below.



Pet. 49. Petitioner explains that the modified version of Okamoto's figure shows that "it would have been straight forward for a POSITA to replace Okamoto's 'lead-type' lead frame with a 'chip-type' lead frame, such as Shimizu's, such that the two halves of the lead frame (highlighted Red) surround either side of Okamoto's glass plate (highlighted Green)." *Id.* at 48. Petitioner adds that "[t]he same LEDs may be used with a chip-type package and phosphors may still be employed" regardless of whether the lead-type frame of Okamoto is replaced with the chip-type frame of Shimizu. *Id.* at 49.

To explain that a person of ordinary skill in the art would have been motivated to combine Shimizu's chip-type package with Okamoto, Petitioner points to Okamoto's vertically oriented embodiment. *Id.* at 46 (citing Ex. 1008, Figs. 8–9). Because this embodiment includes "four legs of the lead frame extending from the base of the light," Petitioner asserts that "this type of lead frame is cumbersome to implement in some applications." *Id.* at 46–47 (citing Ex. 1003 ¶¶ 190–191). According to Petitioner, a person

of ordinary skill would find Shimizu’s “chip-type” package “useful in combination with the LED arrangement shown by Okamoto to facilitate less cumbersome interconnections and alternative packages and device orientations, such as where a lower-profile package is needed.” *Id.* at 47 (citing Ex. 1003 ¶¶ 190–191; Ex. 1017, Fig. 2).

Patent Owner argues that a person of ordinary skill in the art would not have been motivated to combine Okamoto and Shimizu because they would have understood that “Okamoto was capable of generating white light using the dispersant of Okamoto’s embodiment, without the need for a phosphor, if white light was the desired output.” PO Resp. 11 (citing Ex. 2006 ¶¶ 87–112). According to Patent Owner, “[t]his is particularly true given that Shimizu recognizes even its improved phosphors were subject to degradation.” *Id.* at 12 (citing Ex. 1017, 3:51–58); Sur-Reply 8. Patent Owner contends that a person of ordinary skill in the art “starting with Okamoto who desired white light would be motivated to adjust the parameters of Okamoto’s embodiment to obtain it, rather than first modifying the multicolored LEDs of Okamoto, then adding a phosphor and having to address the concern of phosphor degradation,” which modification would cause Okamoto to lose “the capability of emitting a single-color light (R, G, or B).” PO Resp. 12 (citing Ex. 2006 ¶¶ 87–112); Sur-Reply 8.

Even if, as Patent Owner contends, a person of ordinary skill in the art would have understood that “white light can be created by combining the three primary colors of light” (PO Resp. 11), we disagree that a person of ordinary skill in the art would not have been motivated to use one of the three disclosed LEDs (the blue LED) with phosphor to create white light as disclosed by Shimizu. Ex. 1017, 4:50–67. We find, based on Petitioner’s

evidence, that “it was common well before the priority date of the ’529 patent to use appropriate phosphors in combination with blue LEDs to create white light.” Pet. 31 (citing Ex. 1007, 246, 248; Ex. 1003 ¶¶ 113–114, 117; Ex. 1006); Ex. 1044, 100:23–103:10 (Dr. Schubert acknowledging that using Shimizu’s phosphor technique was well known and commonly used to create white light at the relevant time).

In response, Patent Owner provides testimony from Dr. Schubert that Shimizu “both acknowledges and disparages the technology disclosed in Okamoto where colors of light, such as white light, are generated by blending red, blue, and green light.” Ex. 2006 ¶ 98 (citing Ex. 1017, 1:31–56). Despite Shimizu’s disparagement of “the light blending technique of Okamoto in favor of using phosphors,” Dr. Schubert concludes that a person of ordinary skill in the art would not be motivated to combine Shimizu’s technique because “Shimizu discloses that its own improved phosphors deteriorate over time . . . causing color shifts and decreased luminance.” *Id.* ¶ 101 (citing Shimizu 3:22–62).

Nothing in Shimizu or Dr. Schubert’s testimony, however, overcomes the guidance from *KSR* that “if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill.” *KSR Int’l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1740 (2007). We find that the record evidence shows a person of ordinary skill in the art would naturally look to Shimizu’s well-known and commonly used technique of using phosphor to create white light instead of combining the lights of Okamoto. *See In re ICON Health & Fitness, Inc.* 496 F.3d 1374, 1380 (Fed. Cir. 2007) (“One

skilled in the art would naturally look to prior art addressing the same problem as the invention at hand.”). Moreover, even though Shimizu itself acknowledges there are some potential problems with using its phosphor technique, these issues would not discourage one of ordinary skill in the art from using that technique, which Shimizu itself prefers. Ex. 1017 1:31–3:21; *see Optimus Tech. v. Ion Beam Applications*, 469 F.3d 978, 989–90 (Fed. Cir. 2006) (finding that one of ordinary skill in the art would still be motivated to combine two references even though a direct combination would result in a “death ray” instead of a cancer treatment device).

Patent Owner also argues that “Petitioner ignores Dr. Schubert’s explanation that Shimizu was directed towards general illumination, while Okamoto is directed towards a signaling light source” so a person of ordinary skill in the art would not combine the two references. Sur-Reply 7 (citing Ex. 1044, 93:15–96:13; PO Resp. 10–20). Because we do not see this argument in Patent Owner’s Response, nor do we see anything in Dr. Schubert’s declaration to support such an argument, *see* PO Resp. 10–20; Ex. 2006 ¶¶ 87–112, we do not agree that Petitioner ignored an argument. *See*. Moreover, we find that both Shimizu and Okamoto disclose methods of creating white light using an LED and, therefore, the evidence supports a finding that both references are relevant to a consideration of obviousness. *See In re Oetiker*, 977 F.2d 1443, 1447 (Fed. Cir. 1992) (“In order to rely on a reference as a basis for rejection of the applicant’s invention, the reference must either be in the field of the applicant’s endeavor or, if not, then be reasonably pertinent to the particular problem with which the inventor was concerned.”).

Patent Owner also argues that the combination of Okamoto and Shimizu does not properly show the recited “lead frame.” PO Resp. 13–20. Patent Owner argues that Okamoto does not show its lead frame structurally supporting the LED (*id.* at 13–15) and the combination of Shimizu and Okamoto does not remedy that deficiency (*id.* at 15–20). Patent Owner’s argument depends upon its proposed construction of the term “lead frame” that requires at least one of the leads included in the lead frame provide support to the LED chip. As discussed above, we do not agree that this is the correct construction of the term.

Patent Owner contends that modifying Okamoto using Shimizu’s Figure 2 embodiment would not result in the modified Figure 6 depicted by Petitioner because extending wiring patterns 6 to wrap around the edge of substrate 2 would result in wiring patterns only on the left side of Petitioner’s modified figure. PO Resp. 17 (citing Ex. 2006 ¶¶ 87–112). According to Patent Owner, because the modified LED has electrical terminals on two sides of the device, it cannot be plugged into a receptacle as indicated in Okamoto’s Figure 8. *Id.* at 18 (citing Ex. 2006 ¶¶ 87–112).

Petitioner contends that this argument does not address the actual obviousness contention made in the Petition. Reply 17. Instead, Petitioner states that “Ppetitioner did not argue that a POSITA would extend Okamoto’s wiring ‘around one edge of substrate 2,’” but “argued that a POSITA would use a different, but commonly-known lead frame arrangement, disclosed in Shimizu, with Okamoto’s LED and transparent glass plate.” *Id.* (citing Pet. 49). We agree that the Petition does not contend that Okamoto’s modified device would be plugged into a receptacle as in Figure 8. *See* Pet. 46–47 (noting that the arrangement of Okamoto’s device in Figure 8 “is

cumbersome to implement in some applications” and a person of ordinary skill in the art “would know that alternative LED packages existed”); Ex 1003 ¶¶ 190–191. Moreover, Petitioner’s modification is not limited to physically extending wires such that they only wrap around the left side of substrate 2. *See* Pet. 51; *MCM Portfolio LLC v. Hewlett-Packard Co.*, 812 F.3d 1284, 1294 (Fed. Cir. 2015) (“The test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference.” (quoting *In re Keller*, 642 F.2d 413, 425 (CCPA 1981)); *ICON*, 496 F.3d at 1382 (“[W]e do not ignore the modifications that one skilled in the art would make to a device borrowed from the prior art.”); *In re Sneed*, 710 F.2d 1544, 1550 (Fed. Cir. 1983) (“[I]t is not necessary that the inventions of the references be physically combinable to render obvious the invention under review.”).

Patent Owner argues that the modified lead frame does not have leads that provide support for the LED chip because Shimizu’s LED chip 202 and metal terminals 205 are installed on casing 204. PO Resp. 20 (citing Ex. 1017, 8:51–59; Ex. 2006 ¶¶ 87–112). As discussed above, however, we do not construe the term lead frame to require that any particular element, including any lead, provide independent support for the LED, but that the lead frame, as a whole, supports the LED. As shown in Petitioner’s modified Figure 6, the LED sits on the transparent plate, which in turn sits in between the leads. *See* Pet. 51. Thus, we find that the lead frame of this modified device, consisting of the leads and the transparent plate, provides the required support to the LED.

Patent Owner also asserts that “Petitioner fails to explain how its proposed modification of wrapping the wring pattern 6 around the ends of

the substrate results in a lower-profile.” PO Resp. 18. According to Patent Owner, “Okamoto already provides the alleged lower-profile benefits of Shimizu, as seen by comparing figure 2 of each reference.” *Id.* at 19. But Dr. Dupuis supports Petitioner’s contention by stating that a person of ordinary skill in the art would know to use a “chip-type” package instead of a “lead-type” package in applications where a lower profile is needed. Ex. 1003 ¶¶ 191–192 (citing Ex. 1017, 8:31–67; Ex. 1016 Fig. 1, 33–35; Ex. 1022 Figs. 1–3, 6–8, 13, ¶¶ 2–14).

Patent Owner also argues that Figure 2 of Okamoto “already provides the alleged lower-profile benefits of Shimizu.” PO Resp. 19. Okamoto, however, states that Figure 2 is “a planar view of the light source device of” Figure 1. Ex. 1008 ¶ 43. And Figure 1 of Okamoto, reproduced above, clearly shows protruding lead frame 8. *Id.* at Fig. 1, ¶ 29. Figure 2 of Okamoto, however, does not show lead frame 8 because glass substrate 2 obscures lead frame 8 in that planar view. *See id.* at Fig. 2. Figure 2 does show solder material 9 that attaches lead frame 8 to wiring pattern 6 at an end of glass substrate 2. *Id.* at Fig. 2, ¶ 29. Thus, we do not agree with Patent Owner that Figure 2 of Okamoto shows a package with a lower profile. Instead, the record supports Petitioner’s position that the modified device created using the disclosures of Okamoto and Shimizu has a lower profile (leads wrapped around substrate 2 as opposed to protruding as shown by Okamoto Figures 1 and 8). *See* Pet 48–49; Ex. 1003 ¶¶ 191–197.

In sum, on the complete record, we find that the combination of Okamoto and Shimizu teaches each limitation of claims 1 and 13, and we find that an ordinarily skilled artisan would have had reasons, with rational underpinning, to combine Okamoto and Shimizu.

*4. Claims 3, 4, 15, and 16*

Claim 3 depends from claim 1 and claim 15 depends from claim 13. Both claims recite “further comprising a molding or shaped optical element, which acts as a lens, formed on or around the LED chip, wherein the molding or shaped optical element is transparent at the first wavelength” (“the lens limitation”). Ex. 1001, 15:11–14, 16:14–17. Claim 4 depends from claim 3 and claim 16 depends from claim 15 and both recite “wherein the phosphor is located on top of the molding or shaped optical element, within the molding or shaped optical element, or near a surface of the molding or shaped optical element.” *Id.* at 15:15–18, 16:18–21. Petitioner explains that “Okamoto’s spherical molding (11, yellow) is a lens that is formed on or around the LED chips” and “is transparent to the emission wavelength of the LEDs.” Pet. 42, 53 (citing Ex. 1008, Fig. 6, ¶¶ 30, 37, 39; Ex. 1003 ¶¶ 150–154, 211–212).

In the Institution Decision, we agreed with Patent Owner’s assertion, in the Preliminary Response, that Okamoto “does not state that [element 11] has a particular shape, nor that it acts as a lens,” but instead describes resin 11 as being deposited by dripping. Institution Dec. 22 (citing Prelim. Resp. 12). Based on this assumption, we noted that “[i]t is unclear that drip deposition of element 11 discloses a ‘molding or shaped optical element’ that acts as a lens.” *Id.* Patent Owner did not address in detail Okamoto’s disclosure of the lens limitation in its Patent Owner Response, but instead stated “the Institution Decision correctly found that Okamoto does not

disclose a molding or shaped optical element, which acts as a lens.”<sup>17</sup> PO Resp. 27.

In its Reply, Petitioner argues that element 11 of Okamoto’s Figure 6 “explicitly shows light-transmissive resin 11 shaped like a lens.” Reply 28 (citing Pet. 42). In addition, Petitioner points out that both the Petition “and its expert also cited Okamoto at paragraphs 0030, 37, and 39.” *Id.* In particular, Petitioner asserts that paragraph 37 “makes clear that light emitted from [Okamoto’s] LEDs on the back-face side of the glass substrate pass through, *inter alia*, light-transmissive epoxy resins 10 and 11 and, as a result ‘it is possible to obtain omnidirectional light emission characteristics.’” *Id.* According to Petitioner, paragraph 39 discloses that “Okamoto discloses a molding that acts as a lens” because it explicitly states that “light transmissive resin 10 is formed into a spherical surface to smooth the distribution of the amount of light.” *Id.* at 29 (quoting Ex. 1008 ¶ 39). Petitioner adds that Okamoto discloses “that resin 11 is part of the molding and, with its shape and dispersant, is acting as a lens” and “resin 10 [also] meets the claim limitation . . . because it forms a molded body around

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<sup>17</sup> Petitioner asserts that by merely agreeing with our discussion in the Institution Decision, and not repeating its argument from the Preliminary Response, Patent Owner “waives the argument.” Reply 28. Petitioner, however, has the burden to show all propositions of unpatentability in an IPR. 35 US.C. § 316(e); *Aqua Prods., Inc. v. Matal*, 872 F.3d 1290, 1296 (Fed. Cir. 2017) (en banc); *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1376 (Fed. Cir. 2016) (“[I]t is inappropriate to shift the burden to the patentee after institution to prove that the patent is patentable.”). Thus, we agree with Patent Owner that it was not necessary for Patent Owner to make any particular arguments on this issue in the Patent Owner Response. *See* Sur-Reply 21.

Okamoto's device and refracts light like a lens." *Id.* at 29–30 (citing Ex. 1003 ¶¶ 150–154; Ex. 1045 ¶¶ 12–13).

Patent Owner does not respond to the substance of Petitioner's arguments, but argues that Petitioner "commits legal error by seeking to change its theory of invalidity." Sur-Reply 22. According to Patent Owner, "Petitioner identified resin 11, and *only* resin 11, as a lens-shaped molding." *Id.*

Upon further review of the record, we agree with Petitioner that the record shows that Okamoto explicitly states that resin is molded. *See* Ex. 1008 ¶ 30 ("The glass substrate 2 and the LED elements 3, 4, 5a, and 5b covered with the light-transmissive resin 11 are integrally molded with a light-transmissive resin 10 to form a light-transmissive molded body."). We also find that Okamoto shows that "integrally molded" resins 10 and 11 are shaped like a lens. *Id.* at Fig. 6 element 11, ¶¶ 30, 37, 39. Petitioner provides testimony supporting this reading of Okamoto. Ex. 1045 ¶¶ 5–12. We credit Dr. Dupuis's uncontroverted testimony that "a POSITA would recognize that molding 11 is shaped like a lens and acts as such for the LEDs contained therein" and "[t]he fact that Okamoto states that resin 11 is deposited via dripping does not mean that the resin is not used to form a molding or shaped optical element, as the claims require." *Id.* ¶¶ 5, 8.

The only evidence to the contrary is Dr. Schubert's testimony, in a declaration proffered in support of Patent Owner's Preliminary Response, that Okamoto's "dripping procedure is generally suitable for producing flat resin surfaces but not suitable for producing a shaped and/or polished lens." Ex. 2001 ¶ 81. However, this statement does not say that Okamoto's dripping procedure cannot create a shaped lens, nor does it indicate what a

person of ordinary skill in the art would understand about the shape of resin 11 from Okamoto's complete disclosure. In particular, neither Patent Owner nor Dr. Schubert, explains why the spherically shaped, light-transmissive resin 11 shown in Okamoto's Figure 6 does not function as a lens. Thus, we agree that Okamoto's resin 11 meets the lens limitation.

Moreover, because we agree that resin 11, as presented in the Petition (Pet. 42, 53–54), meets the lens limitation, we need not determine whether Petitioner's alternate theory that resin 10 meets the claim limitation is improper. Accordingly, on the complete record, we find that the combination of Okamoto and Shimizu teaches each limitation of claims 3, 4, 15, and 16.

#### *5. Claims 8, 12, 20, and 24*

Claim 8 depends from claim 1 and claim 20 depends from claim 13. Both claims recite “wherein the LED chip includes a transparent substrate and the transparent substrate is adjacent the transparent plate.” Ex. 1001, 15:33–35, 16:37–39. The Petition relies for this limitation on Okamoto's disclosure of its LED chip including a “transparent substrate, such as one made from sapphire” that is mounted to the glass plate. Pet. 43–44 (citing Ex. 1008 ¶¶ 31–32; Ex. 1003 ¶¶ 166–171). We credit Dr. Dupuis's uncontroverted testimony and find that Okamoto teaches the additional limitation of claims 8 and 20.

Claim 12 depends from claim 1, and claim 24 depends from claim 13. Both claims recite “wherein the LED chip is made from a material selected from the group comprising a (Al, Ga, In)<sub>N</sub> material system, a (Al, Ga, In)<sub>As</sub> material system, a (Al, Ga, In)<sub>P</sub> material system, and a (Al, Ga, In) AsPNSb material system, a ZnGeN<sub>2</sub> material system, and a ZnSnGeN<sub>2</sub> material

system.” Ex. 1001, 15:48–53, 16:54–59. The Petition relies for this limitation on Okamoto’s disclosure that “its blue LED chips may include any of ‘boron, gallium, aluminum and indium’ and are preferably GaN-based.” Pet. 44 (quoting Ex. 1008 ¶¶ 11, 12, 27; Ex. 1003 ¶¶ 174–178). We credit Dr. Dupuis’s uncontroverted testimony and find that Okamoto teaches the additional limitation of claims 12 and 24.

In sum, on the complete record, we find that the combination of Okamoto and Shimizu teaches each limitation of claims 8, 10, 20, and 24.

#### *6. Overview of Lester-085*

Lester-085 is a U.S. Patent, issued July 18, 2000, titled “GaN LEDs with Improved Output Coupling Efficiency.” Ex. 1019, codes (45), (54). It describes “[a]n LED having a higher light coupling efficiency than prior art devices, particularly those based on GaN.” *Id.* at code (57). Lester-085 discloses improving “the coupling efficiency of a GaN-based LED by disrupting the waveguide . . . by altering the surface of the interface between the sapphire/GaN layer and/or the surface of the GaN layer.” *Id.* at 3:20–24. One method of altering the surface “involves roughening the sapphire/GaN interface,” which “can be accomplished by any of a number of techniques,” including “polishing it with relatively coarse grinding grit.” *Id.* at 3:25–28, 3:65–4:1.

#### *7. Overview of Tadatomo*

Tadatomo is an article titled “High Output Power Near-ultraviolet and Violet Light-emitting Diodes Fabricated on Patterned Sapphire Substrates Using Metalorganic Vapor Phase Epitaxy.” Ex. 1020, 243. It discusses improving the performance and reliability of LEDs by using a patterned substrate. *Id.* at 243–44.

8. *Claims 9, 10, 21, and 22*

Petitioner asserts that claims 9, 10, 21, and 22 would have been obvious over the combined teachings of Okamoto, Shimizu, and Lester-085 or Tadatomo. Pet. 56–60. Claims 9 and 10 depend from dependent claim 8, and claims 21 and 22 depend from dependent claim 20. Ex. 1001, 15:36–43, 16:41–48. Claims 9 and 21 recite “wherein the transparent substrate is roughened, textured, or patterned, to increase the light extraction from the LED chip through the transparent plate in the lead frame.” *Id.* at 15:36–39, 16:41–44. Claims 10 and 22 recite “wherein the transparent substrate is a patterned sapphire substrate (PSS) that increases the light extraction through an interface between the LED chip and the patterned sapphire substrate.” *Id.* at 15:40–43, 16:45–48.

According to Petitioner, a person of ordinary skill in the art “would have been motivated to and would have found it obvious to use conventional sapphire substrate roughening and/or texturing with Okamoto’s GaN LEDs as shown by Lester-085 and Tadatomo” “so as to enhance light extraction.” Pet. 56, 58–59 (citing Ex. 1003 ¶¶ 221–226; Ex. 1007, 122–23). Petitioner also asserts that a person of ordinary skill in the art “would reasonably expect to succeed in implementing these enhancements because these features were well-known and within [their] skillset.” *Id.* at 59 (citing Ex. 1003 ¶ 228; Ex. 1007, 122–23; Ex. 1030, 7:12–13, Fig. 3; Ex. 1019; Ex. 1020; Ex. 1005; Ex. 1028, 857).

Patent Owner argues that a person of ordinary skill in the art would not have combined Lester-085 or Tadatomo with Okamoto because of “an important difference between these [two] references.” PO Resp. 21. Specifically, according to Patent Owner, both Lester-085 and Tadatomo

disclose devices in which “light is only extracted from one side of the LED,” but Okamoto has an LED package “where light is intended to be emitted from both sides.” *Id.* at 21. According to Patent Owner, “[w]hether the total amount of light emitted would be increased, stay the same, or decreased, is a complex question based upon the specific device design” and “[i]t is overly simplistic to say what worked for one LED would work for another.” *Id.* at 22 (quoting Ex. 1003 ¶¶ 113–122).

Petitioner disputes that this difference is relevant, stating that “the fact that Okamoto teaches emitting light omnidirectionally means that at least some light will be emitted through the substrate interface,” and because “Lester/Tadamoto teach how to reduce internal reflection at a substrate interface,” they “teach techniques that would reduce internal reflections at [Okamoto’s] interface.” Reply 24 (citing Pet. 56–60). Dr. Dupuis testifies that a person of ordinary skill in the art would have known about surface roughening and would have wanted to increase performance by implementing these techniques with Okamoto’s GaN LED. Ex. 1003 ¶ 226 (citing Ex. 1030, Fig. 3, 7:12–13; Ex. 1020, 247; Ex. 1007, 122; Ex. 1005, Fig. 8, 7:46–59, 2:65–3:20; Ex. 1019, 3:10–4:26; Ex. 1028, 857; Ex. 1029, L1084).

We find that substantial evidence supports Petitioner’s contention that a person of ordinary skill in the art would have reasonably expected the roughening techniques disclosed by Lester-085 and Tadamoto to work with Okamoto’s device and would have been motivated to combine these teachings to increase performance of the LED device.

On the one hand, Dr. Schubert testifies that “[c]ombining Okamoto with Lester and Tadamoto still reflects light . . . into the active/absorbing

layer of the LED chip, falling short of the invention claimed by the '529 patent.” Ex. 2006 ¶ 119 (quoting Ex. 1001, 6:22–41). In addition, Dr. Schubert states that “the '529 Patent teaches that it extracts light *through* the roughened surfaces, not *away from* the roughened surfaces, as taught by Lester.” *Id.* ¶ 120 (quoting Ex. 1019, 10:14–42). However, the claims at issue do not prohibit any light from being reflected into the LED chip. Instead they require that the amount of light extracted from the LED chip is increased. Moreover, Dr. Schubert does not refer to objective evidence to support his conclusion that “without more” a person of ordinary skill in the art “would not understand that feature of contrasting disclosures (Okamoto on one hand, and Lester and Tadatomo on the other hand) could be combined.” *Id.* ¶ 118.

On the other hand, Dr. Dupuis points to objective evidence that supports his conclusions. For example, Dr. Dupuis points (Ex. 1003 ¶ 226) to Krames, a patent issued July 14, 1998, that describes an LED device “wherein the top and back surfaces . . . are textured” to “improve the extraction of first-pass light.” Ex. 1005, Fig. 8, 2:65–3:4, 7:46–48. Similarly, Fujii, titled “Increase in the Extraction Efficiency of GaN-based Light-emitting Diodes via Surface Roughening,” published in 2003, states:

In conclusion, an anisotropic etching method has been applied to a GaN-based LED for the purpose of increasing extraction efficiency. LED output test results have indicated that, presumably due to the decrease in light propagation in the GaN film, there is a relationship between a roughened appearance and extraction efficiency. Although total integrated optical power has not been measured, the extraction efficiency from a top surface was increased twofold to threefold compared to that of an LED before roughening. It is notable that the technique mentioned in this paper is simple and does not require complicated processes,

implying that it will be suitable for manufacturing of GaN-based LEDs with surface roughening.

Ex. 1028, 857; *see also* Ex. 1029 (Narukawa), L1084. This is objective evidence that a person of ordinary skill in the art at the relevant time would have understood that applying Lester 085's or Tadatomo's techniques to an LED device, no matter the configuration of light emission, would improve efficiency of light extraction. In addition, Dr. Dupuis refers (Ex. 1003 ¶ 226) to a 2003 textbook by Dr. Schubert stating generally that "[o]ther efficient ways to increase the light extraction efficiency include the use of *roughened or textured semiconductor surfaces.*" Ex. 1007, 122. And Dr. Schubert confirms this understanding in his deposition. Ex. 1044, 87:21–91:6.

On balance, the record evidence supports Petitioner's position and we find that the combination of Okamoto, Shimizu, and Lester-085 or Tadatomo teaches each limitation of claims 9, 10, 21, and 22, an ordinarily skilled artisan would have had reasons, with rational underpinning, to combine the references, and the ordinarily skilled artisan would have had a reasonable expectation of success.

#### *D. Grounds Based on Miyahara*

Petitioner contends that: (1) claims 1, 12, 13, and 24 of the '529 patent are unpatentable, because their subject matter is anticipated by, or would have been obvious over, Miyahara; (2) claims 3, 4, 15, and 16 would have been obvious over the combined disclosures of Miyahara, Okamoto, and Shimizu; (3) claims 8 and 20 would have been obvious over Miyahara; (4) claims 9, 10, 21, and 22 would have been obvious over Miyahara, and Lester-085; and (5) claims 9, 10, 21, and 22 would have been obvious over

Miyahara and Tadatomo. Pet. 4–5, 61–80. For the reasons that follow, we determine that Petitioner establishes by a preponderance of the evidence that claims 1, 3, 4, 8–10, 12, 13, 15, 16, 20–22, and 24 would have been obvious to one of ordinary skill in the art in view of the proposed combinations based on Miyahara.

### *1. Overview of Miyahara*

Miyahara is a Japanese Patent Application published on February 10, 2005, titled “Substrate for Mounting Light-emitting Element.” Ex. 1011, codes (43), (54). Figure 11 of Miyahara is reproduced below.

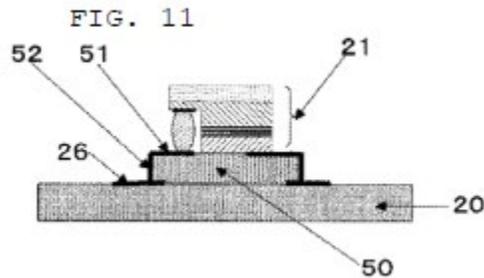


Figure 11 of Miyahara is “a cross-sectional diagram[] showing the substrate for mounting a light-emitting element.” *Id.* ¶ 19. Light-emitting element 21 is mounted on submount 50, which in turn is mounted on the substrate for mounting a light-emitting element 20. *Id.* ¶ 31. Substrate 20 and light-emitting element 21 are electrically connected by the use of electrical circuit 52 to connect electrical circuit 51 with surface electrical circuit 26. *Id.* Submount 50 includes “an optically transparent sintered body.” *Id.* ¶ 34.

### *2. Independent Claims 1 and 13*

Petitioner contends that independent claims 1 and 13 are anticipated by, or would have been obvious over, Miyahara. Pet. 61–71. Petitioner asserts that Miyahara’s submount 50 is a transparent plate “surrounded by

‘thick-film metallization’ on its top, side, and bottom surfaces . . . in order to electrically connect LED (21) to power,” which combine to teach the lead frame limitation. Pet. 64–65 (citing Ex. 1011 Fig. 11, ¶¶ 31, 121; Ex. 1003 ¶¶ 265–266). Petitioner also relies on Miyahara as disclosing “that phosphors may be used with any of its embodiments to convert light into any desired color, including white light.” *Id.* at 68 (citing Ex. 1011 ¶¶ 2, 9, 23). According to Petitioner, a person of ordinary skill in the art “would have understood—particularly because of Miyahara’s teaching that phosphors may be used on any of its embodiments to convert light into white light—that the LED chip of Fig. 11 may be sealed with a resin that included phosphor for the purpose of converting emitted light from blue to white.” *Id.* at 69–70.

Patent Owner argues that Miyahara fails to disclose “that the leads provide support to the LED chip.” PO Resp. 23. In particular, Patent Owner argues that Miyahara’s elements 26, 51, and 52 (1) do not constitute “a single structural element, but instead an electrical circuit formed by several elements,” and (2) may be formed by thick film metallization as discussed by Petitioner, but also may be formed by sintering or thin film metallization, or a combination of these techniques. PO Resp. 24–26. According to Patent Owner, a person of ordinary skill in the art “would not consider a thick film metallization to be providing structural support in Miyahara, [and] they would know that a thin film metallization could not possibly provide structural support.” *Id.* at 25. Patent Owner adds that “even if a thick film metallization could provide support in certain circumstances, a POSITA would understand it is not doing so in Figure 11.” *Id.*

In our Institution Decision, we explained that because “we do not agree with Patent Owner that every element of the lead frame must support the LED, we see no significance in the fact that elements 26, 51, and 52 may be separate or how they are formed.” Institution Dec. 27. We also noted that “Patent Owner appears to agree that submount 50 supports the LED.” *Id.* (citing Prelim. Resp. 26). In the Response, Patent Owner explains that the Institution Decision’s “conclusion was based on the erroneous belief that the leads did not have to provide structural support,” and “[w]ith that requirement in mind, the fact that they may be separate elements formed at separate times illustrates that they are not providing structural support.” PO Resp. 26 (citing Ex. 2006 ¶¶ 122–128).

Because, as discussed above, we do not agree with Patent Owner’s assertion that the leads of the lead frame must support to the LED chip, we continue to agree with Petitioner that the combined elements of 26, 51, and 52 of Miyahara disclose a lead frame as recited by claims 1 and 13. In fact, Dr. Schubert agrees that “[i]n Figure 11, substrate 20 and submount 50 provide the structural support to the LED chip.” Ex. 2006 ¶ 126. Because submount 50 is part of the lead frame and provides support to the LED chip, we need not address Patent Owner’s argument that the thick film metallization of elements 26, 51, and 52 do not also support the chip.

We have reviewed Petitioner’s contentions, the testimonial evidence, and the disclosure of Miyahara, and determine that the record provides substantial evidence supporting Petitioner’s assertions of obviousness of claims 1 and 13 over Miyahara. Because we agree with Petitioner that claims 1 and 13 would have been obvious over Miyahara, we do not address whether the claims are anticipated by Miyahara.

*3. Claims 3, 4, 15, and 16*

Petitioner asserts that claims 3, 4, 15, and 16 would have been obvious over the combined teachings of Miyahara, Okamoto, and Shimizu. Pet. 71–75. Claim 3 depends from claim 1, and claim 15 depends from claim 13. Both claims recite “further comprising [forming] a molding or shaped optical element, which acts as a lens, formed on or around the LED chip, wherein the molding or shaped optical element is transparent at the first wavelength.” Ex. 1001, 15:11–14, 16:13–16. Claim 4 depends from claim 3, and claim 16 depends from claim 15 and both claims recite “wherein the phosphor is located on top of the molding or shaped optical element, within the molding or shaped optical element, or near a surface of the molding or shaped optical element.. *Id.* at 15:15–18, 16:18–21.

Petitioner points to Okamoto and Shimizu as each disclosing a lens-shaped molding/shaped optical element. Pet. 72–74 (citing Ex. 1008 Fig. 1, 6, ¶¶ 30, 37, 39; Ex. 1017 Fig. 1, 17:9–14, 16–19). According to Petitioner, a person of ordinary skill in the art “would be motivated to and would find it obvious to implement Miyahara’s encapsulating transparent resin as a lens shape” and “would reasonably expect to succeed in implementing this enhancement because producing Miyahara’s transparent resin in a lens shape only requires the use of ordinary skill, where an appropriate mold is used to create the lens shape, as shown by Okamoto and Shimizu.” *Id.* (citing Ex. 1003 ¶¶ 287–298).

Patent Owner argues that Okamoto does not disclose the lens limitation. PO Resp. 27. However, as discussed above with respect to the Okamoto-based obviousness ground, we agree that Okamoto’s resin 11, as presented in the Petition (Pet. 42, 53–54), discloses the lens limitation.

Patent Owner argues that “[a]lthough Shimizu (Ex. 1017) does disclose a lens shaped molding, it is from an embodiment that is inapplicable to Miyahara.” Prelim. Resp. 27–28. According to Patent Owner, the molding Petitioner relies upon is shown in the lead type embodiment of Shimizu’s Figure 1, while Miyahara is more similar to the chip type embodiment of Shimizu’s Figure 2. *Id.* at 28. Patent Owner asserts that the embodiment of Figure 2 shows a recess filled with coating material and a person of ordinary skill in the art “would understand filling a recess is an entirely different process from forming a molding, and would not allow the creation of a lens.” *Id.* (citing Ex. 1017, 8:51–54; Ex. 2006 ¶¶ 129–132).

Petitioner responds that “Patentee’s argument is based on the false premise that Miyahara could only be combined with Shimizu’s chip-type embodiment and would necessarily have the same LED ‘recess,’” but “Petitioner showed that Miyahara expresses a preference for using transparent sealing resins in embodiments (like Miyahara’s FIG. 11) that *do not have* a recess.” Reply 27 (citing Pet. 72).

Although we agree with Petitioner that Okamoto discloses the lens limitation, and, thus, need not rely on Shimizu for this teaching, we also find that substantial evidence supports the conclusion that a person of ordinary skill in the art would have been motivated to seal Miyahara’s LED chip with transparent resin as a lens shape as disclosed by Shimizu. Dr. Dupuis testifies that because Miyahara describes both a “molding or shaped optical element including a glass or resin cap” and “the use of transparent sealing material,” a person of ordinary skill in the art “would have understood that Miyahara shows the LED chip in FIG. 11 is preferably sealed with a transparent resin” and “would have found it obvious to use a molding or

shaped optical element to better protect the LED chip and to increase the uniformity of the light extraction from the LED device.” Ex. 1003 ¶¶ 287–290. Dr. Dupuis supports this conclusion with evidence including pointing to a textbook in which Dr. Schubert states that “light extraction efficiency can be enhanced by using dome-shaped encapsulants with a large refractive index.” Ex. 1007, 96; *see also* Ex. 1007, 139 (“Virtually all LEDs, with the exception of communication LEDs used for fiber optic applications, are encapsulated with an optically transparent epoxy.”). We credit Dr. Dupuis’s testimony and are not convinced that it is relevant that Miyahara discloses an alternative embodiment that employs a different process.

Accordingly, having reviewed Petitioner’s contentions, the testimonial evidence, and the disclosures of Miyahara, Okamoto, and Shimizu, we determine that the record provides substantial evidence supporting Petitioner’s assertions of obviousness of claims 3, 4, 15, and 16 over Miyahara, Okamoto, and Shimizu.

#### *4. Claims 8 and 20*

Petitioner asserts that claims 8 and 20 would have been obvious over Miyahara. Pet. 75–78. Claim 8 depends from claim 1, and claim 20 depends from claim 13. Both claims recite “wherein the LED chip includes a transparent substrate and the transparent substrate is adjacent the transparent plate.” Ex. 1001, 15:33–35, 16:37–39.

In the Petition, based on its construction of the term lead frame—where the transparent plate was not a part of the lead frame—Petitioner asserted that Figure 11 of Miyahara discloses a transparent substrate above the LED and “adjacent (but not immediately adjacent)” transparent submount 50. Pet. 76. Petitioner thus asserted that a person of ordinary skill

in the art would have known that the arrangement of the LED chip in Figure 11 could be used in a different orientation such as shown in Figure 7 of Miyahara where the LED substrate is located below instead of on top of the device (a “flip-chip” orientation) resulting in the transparent substrate being immediately adjacent to transparent submount 50. *Id.* at 76–77.

Subsequently, based on the claim construction we adopted in the Institution Decision, and continue to maintain here, Petitioner explains that this modification of orientation is no longer necessary. Reply 31–32. Instead, Figures 7 and 11 of Miyahara expressly disclose lead frames that include the transparent plate (submount 50), and submount 50 is immediately adjacent transparent plate 20. *Id.* (citing Ex. 1011, Fig. 7, 11). We agree that Figures 7 and 11 of Miyahara show transparent substrate 50 adjacent transparent plate 20 as recited in claims 8 and 20.

Patent Owner argues that Petitioner has not properly shown that Miyahara discloses a lead frame. Sur-Reply 20–21. Because we do not adopt Patent Owner’s proposed construction of lead frame, as discussed above, we find that Miyahara discloses a lead frame which includes transparent substrate 50.

Accordingly, having reviewed Petitioner’s contentions, the testimonial evidence, and the disclosure of Miyahara, we determine that the record provides substantial evidence supporting Petitioner’s assertions of obviousness of claims 8 and 20 over Miyahara.

#### *5. Claims 12 and 24*

Claim 12 depends from claim 1 and claim 24 depends from claim 13. Both claims recite “wherein the LED chip is made from a material selected from the group comprising a (Al, Ga, In)<sub>N</sub> material system, a (Al, Ga, In)As

material system, (Al, Ga, In)P material system, a (Al, Ga, In)AsPNSb material system, a ZnGeN<sub>2</sub> material system, and a ZnSnGeN<sub>2</sub> material system.” Ex. 1001, 15:48–53, 16:54–59. The Petition relies for this limitation on Miyahara’s disclosure that “its nitride-based LED chips can include ‘gallium nitride, indium nitride or aluminum nitride.’” Pet. 70 (quoting Ex. 1011 Fig. 1, ¶¶ 12, 35; Ex. 1003 ¶¶ 279–280). We credit Dr. Dupuis’s uncontroverted testimony and find that Miyahara teaches the additional limitation of claims 12 and 24.

In sum, on the complete record, we find that substantial evidence supports a finding that claims 12 and 24 would have been obvious over Miyahara. Because we agree with Petitioner that claims 12 and 24 would have been obvious over Miyahara, we do not address whether the claims are anticipated by Miyahara.

#### *6. Claims 9, 10, 21, and 22*

Petitioner asserts that claims 9, 10, 21, and 22 would have been obvious over the combined disclosures of Miyahara and Lester-085 or Miyahara and Tadatomo. Pet. 78–80. Claims 9 and 10 depend from dependent claim 8, and claims 21 and 22 depend from dependent claim 20. Ex. 1001, 15:36–43, 16:41–48. Claims 9 and 21 recite “wherein the transparent substrate is roughened, textured, or patterned, to increase the light extraction from the LED chip through the transparent plate in the lead frame.” *Id.* at 15:36–39, 16:41–44. Claims 10 and 22 recite “wherein the transparent substrate is a patterned sapphire substrate (PSS) that increases the light extraction through an interface between the LED chip and the patterned sapphire substrate.” *Id.* at 15:40–43, 16:45–48.

Petitioner relies on the same portions of Lester-085 and Tadatomo as in the challenge to these claims based on Okamoto, Shimizu, and Lester-085 or Tadatomo. Pet. 78–79. According to Petitioner, a person of ordinary skill in the art “would have been motivated to and would have found it obvious to use roughened/patterned substrates in Miyahara’s LEDs to increase light extraction, as expressly taught by Lester-085 and/or Tadatomo.” *Id.* at 79 (citing Ex. 1003 ¶¶ 337–354; Ex. 1030, Fig. 3; Ex. 1019; Ex. 1020; Ex. 1005; Ex. 1028, 857).

Patent Owner argues that a person of ordinary skill in the art would not have combined Lester-085 or Tadatomo with Miyahara for similar reasons that they would not combine Lester-085 or Tadamoto with Okamoto, namely, because of the differences in the devices in the references. PO Resp. 29–30. For the same reasons as discussed above in connection with the combination of Okamoto, Shimizu, and Lester-085 or Tadatomo, we find that substantial evidence supports Petitioner’s contention that a person of ordinary skill in the art would have reasonably expected the roughening techniques disclosed by Lester-085 and Tadatomo to work with Miyahara’s device and would have been motivated to combine these teachings to increase performance of the LED device. Ex. 1003 ¶¶ 339–354.

In sum, on the complete record, we find that substantial evidence supports a finding that claims 9, 10, 21, and 22 would have been obvious over Miyahara and Lester-085 or Miyahara and Tadatomo.

#### IV. CONCLUSION<sup>18</sup>

Based on the full record, we determine that Petitioner shows by a preponderance of the evidence that claims 1, 3, 4, 8–10, 12, 13, 15, 16, 20–22, and 24 of the '529 patent are unpatentable.

<b>Claims</b>	<b>35 U.S.C. §</b>	<b>Reference(s)/ Basis</b>	<b>Claims Shown Unpatentable</b>	<b>Claims Not Shown Unpatentable</b>
1, 3, 4, 8, 12, 13, 15, 16, 20, 24	103(a)	Okamoto, Shimizu	1, 3, 4, 8, 12, 13, 15, 16, 20, 24	
9, 10, 21, 22	103(a)	Okamoto, Shimizu, Lester-085	9, 10, 21, 22	
9, 10, 21, 22	103(a)	Okamoto, Shimizu, Tadatomo	9, 10, 21, 22	
1, 12, 13, 24	102 <sup>19</sup>	Miyahara		
1, 8, 12, 13, 20, 24	103(a)	Miyahara	1, 8, 12, 13, 20, 24	
3, 4, 15, 16	103(a)	Miyahara, Okamoto, Shimizu	3, 4, 15, 16	

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<sup>18</sup> Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. See 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. See 37 C.F.R. § 42.8(a)(3), (b)(2).

<sup>19</sup> As explained above, because we agree with Petitioner that claims 1, 12, 13, and 24 would have been obvious over Miyahara, we do not address whether the claims are anticipated by Miyahara.

<b>Claims</b>	<b>35 U.S.C. §</b>	<b>Reference(s)/ Basis</b>	<b>Claims Shown Unpatentable</b>	<b>Claims Not Shown Unpatentable</b>
9, 10, 21, 22	103(a)	Miyahara, Lester-085	9, 10, 21, 22	
9, 10, 21, 22	103(a)	Miyahara, Tadatomo	9, 10, 21, 22	
<b>Overall Outcome</b>			1, 3, 4, 8–10, 12, 13, 15, 16, 20–22, 24	

#### V. ORDER

For the reasons given, it is:

ORDERED that, pursuant to 35 U.S.C. § 314(a), Petitioner has shown by a preponderance of the evidence that claims 1, 3, 4, 8–10, 12, 13, 15, 16, 20–22, and 24 of the '529 patent are unpatentable; and

FURTHER ORDERED that parties to the proceeding seeking judicial review of this Final Written Decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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Patent 9,240,529 B2

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