

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SIGNIFY NORTH AMERICA CORP.,
Petitioner,

v.

CAO LIGHTING, INC.,
Patent Owner.

IPR2023-00214
Patent 6,465,961 C2

Before GRACE KARAFFA OBERMANN, CHRISTOPHER M. KAISER,
and BRIAN D. RANGE, *Administrative Patent Judges*.

RANGE, *Administrative Patent Judge*.

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

I. INTRODUCTION

Signify North America Corp. (“Petitioner”) filed a Petition requesting *inter partes* review of claims 21, 25–29, 36, 40–43, 47–49, and 52–57 of U.S. Patent No. 6,465,961 C2 (Ex. 1001, “the ’961 patent”). Paper 2 (“Pet.”).¹ CAO Lighting, Inc. (“Patent Owner”) filed a Preliminary Response. Paper 12 (“Prelim. Resp.”).

Under 35 U.S.C. § 314(a), an *inter partes* review may not be instituted unless the information presented in the petition “shows that there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.” The following findings of fact and conclusions of law are not final, but are made for the sole purpose of determining whether Petitioner meets the threshold for initiating review. Any final decision shall be based on the full trial record, including any response timely filed by Patent Owner. Any arguments not raised by Patent Owner in a timely-filed response may be deemed waived.

For the reasons stated below, we determine that Petitioner has established a reasonable likelihood that it would prevail with respect to at least one claim. We hereby institute an *inter partes* review as to claims 21, 25–29, 36, 40–43, 47–49, and 52–57 of the ’961 patent based upon Petitioner’s asserted grounds of unpatentability.

¹ Petitioner calls IPR2023-00214 “the Krames Petition.” See Paper 3 (PETITIONER’S NOTICE RANKING PETITIONS FOR INTER PARTES REVIEW OF U.S. PATENT NO. 6,465,961), 1.

II. BACKGROUND

A. Related Matters

The parties identify nine district court cases that involve the '961 patent: *Cao Lighting, Inc. v. Signify North America Corp.*, No. 2-21-cv-08972 (C.D. Cal.); *CAO Lighting, Inc. v. GE Lighting, Inc. et al.*, No. 1:20-cv-00681 (D. Del.); *CAO Lighting, Inc. v. OSRAM Sylvania Inc. et al.*, No. 1:20-cv-00690 (D. Del.); *CAO Lighting, Inc. v. Feit Electric Company, Inc.*, No. 2:20-cv-04926 (C.D. Cal.); *CAO Lighting, Inc. v. Lights of America, Inc.*, No. 5:20-cv-02367 (C.D. Cal.); *CAO Lighting, Inc. v. Topaz Lighting Corp.*, No. 2:21-cv-08912 (C.D. Cal.); *CAO Lighting, Inc. v. Cree, Inc. et al.*, No. 1-21-cv-00634 (M.D.N.C.); *CAO Group v. GE Lighting et al.*, No. 2-11-cv-00426 (D. Utah); and *CAO Lighting, Inc. v. Light Efficient Design et al.*, No. 4-16-cv-00482 (originally filed D. Idaho), No. 1-17-cv-07359 (transferred to N.D. Ill.). Pet. 4–5; Paper 5, 1–2.

The parties also identify the following proceedings that challenge the '961 patent: *Wolfspeed, Inc. and Ideal Industries Lighting, LLC v. Cao Lighting, Inc.*, IPR2022-00847 (PTAB); *Ledvance LLC, et al. v. Cao Lighting, Inc.*, IPR2023-00123 (PTAB); *Feit Electric Co., Inc. v. Cao Lighting, Inc.*, IPR2023-00129 (PTAB); and *Signify North America Corp. v. Cao Lighting, Inc.*, IPR2023-00213 (PTAB). Pet. 4–5; Paper 5, 1–2.

The parties also indicate that the '961 patent was subject to the following reexamination proceedings: 90/012,957; 95/002,324; and 95/000,680. Pet. 5; Paper 5, 1.

A. The '961 patent

The '961 patent is titled “Semiconductor Light Source Using a Heat Sink with a Plurality of Panels.” Ex. 1001, code (54). The '961 patent

describes semiconductor light sources that include a semiconductor, such as an LED chip, laser chip, LED chip array, laser array, array of chips, or VCSEL chip, mounted on a heat sink, the heat sink having multiple panels for mounting chips in various orientations. *Id.* at code (57). The chips may be mounted directly to a primary heat sink which, in turn, is mounted to a multi-panel secondary heat sink. *Id.*

Fig. 1 of the '961 patent, reproduced below, illustrates a semiconductor light source using a high power chip or array arrangement. *Id.* at 1:65–67.

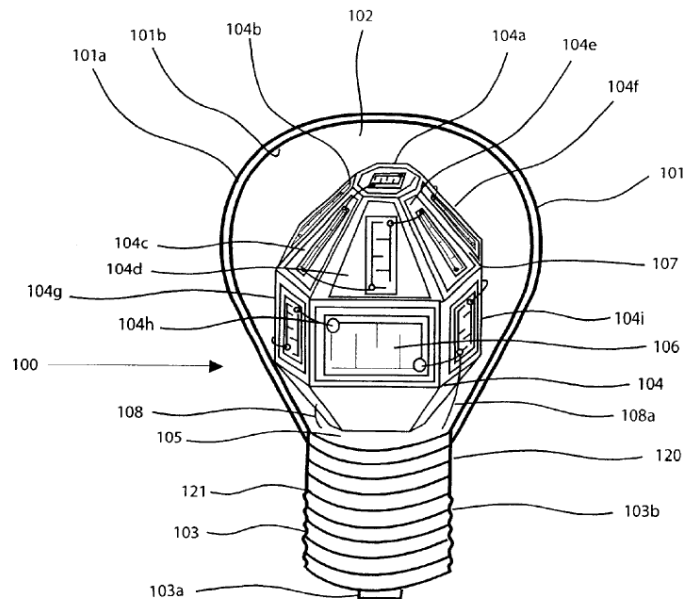


Fig. 1

Fig. 1 illustrates a semiconductor light source using a high power chip or array arrangement. *Id.* at 1:65–67.

Semiconductor light source 100 illustrated in Fig. 1 includes: a bulb-shaped enclosure 101 with an exterior surface 101a and an interior surface 101b; an interior volume 102, which may be a vacuum, or may contain a

gas; a support 105 on which enclosure 101 is mounted; a base 103 configured as a fitting or connector for use in a light socket; at least one heat sink 104 located within interior volume 102; at least one semiconductor device 106 mounted on heat sink 104; electrical connections 107 by which semiconductor devices 106 are electrically connected to each other; and lead wires 108a, 108b that provide semiconductor devices 106 with electrical power. *Id.* at 2:50–3:52. Exterior surface 101a may be smooth and glossy, matte, or another finish or texture. *Id.* at 2:59–3:8. Interior surface 101b may include a coating, such as a phosphor coating to convert blue light into white light, or a coating that converts light, in the wavelength range of about 200 to about 700 nm, to white light. *Id.*

Heat sink 104 may be of any desired shape, depending on the application. *Id.* at 3:22–37. In Fig. 1, heat sink 104 has a generally flat or planar top 104a, and a plurality of generally flat or planar panels or compartment 104b, 104c, 104d, 104e, 104f, 104g, 104h, 104i, each of which may host a single semiconductor device, or an array of semiconductor devices capable of producing light. *Id.* Each semiconductor device may have its own individual heat sink, or two or more semiconductor devices may be located on the same heat sink. *Id.* at 3:65–4:3. Support 105 is designed in order to place the heat sink in the most desirable position within interior volume 102 so that the semiconductors located on the heat sink emit light that will be transmitted in a diffuse or focused pattern through enclosure 101. *Id.* at 3:30–37. Semiconductor device(s) 106 may be, for example, LEDs, LED arrays, VCSELs, VCSEL arrays, or photon recycling devices that cause a monochromatic chip to emit white light. *Id.* at 3:40–46. Heat sink 104 may serve as a positive or negative electrical connection for the

semiconductor devices, and may be made of a material capable of conducting heat away from the semiconductor devices. *Id.* at 3:49–57.

Fig. 2 of the '961 patent, reproduced below, illustrates a semiconductor light source with high power surface mount LED chip modules or lamps. *Id.* at 2:1–3.

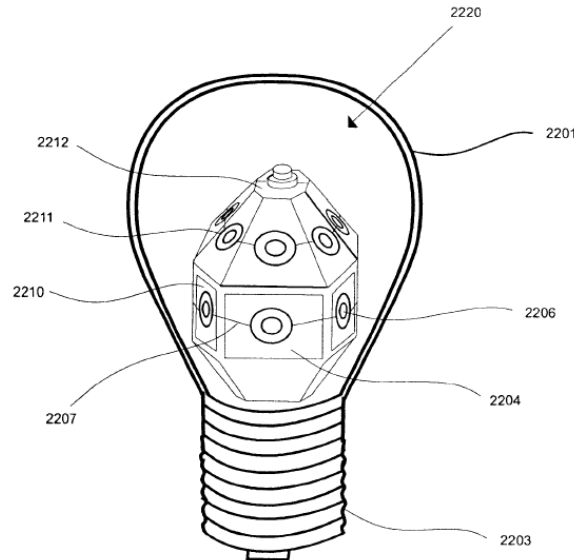


Fig. 2

Fig. 2 illustrates a semiconductor light source with high power surface mount LED chip modules or lamps. *Id.* at 2:1–3.

Fig. 2 illustrates a semiconductor device 2220 in enclosure 2201, the device arranged to accommodate high power surface LEDs—which are LEDs for which the light output from each LED module is greater than 40 milliwatts. *Id.* at 4:4–12. The light source in Fig. 2 employs surface mount LEDs, which are LEDs mounted directly on a heat sink, or other surface, in contrast with traditional LED lamps (which have ordinary electrical leads for wiring and must be separately held in place). *Id.* Element 2206 in Fig. 2 is a high power LED. *Id.* at 4:13–26. LEDs 2206 are electrically connected with

electrical connectors 2207, and are located on heat sink 2204, which has a plurality of heat sink faces 2210, 2211, and 2212—each generally planar and arranged in angular orientation with each other, in order to cause light from the LEDs to be dispersed around a space to be illuminated. *Id.*

Fig. 3f of the '961 patent, reproduced below, illustrates a VCSEL chip on an insulative substrate, used in the semiconductor light source of the '961 patent. *Id.* at 2:12–14.

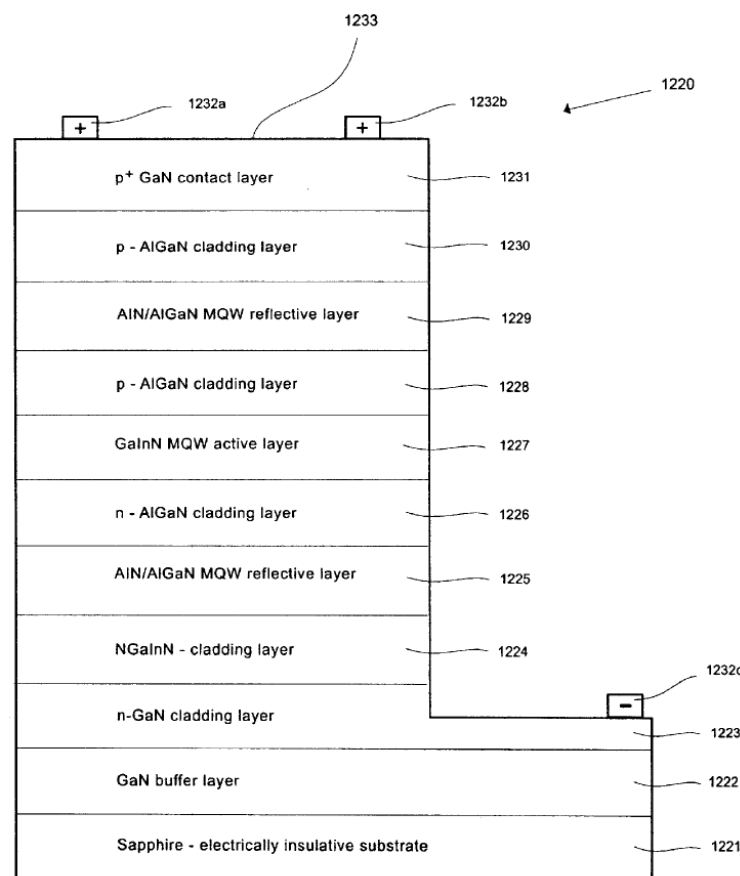


Fig. 3f

Fig. 3f illustrates a VCSEL chip on an insulative substrate, used in the semiconductor light source of the '961 patent. *Id.* at 2:12–14.

The VCSEL chip illustrated in Fig. 3f has an epitaxial layer configuration, on an electrically insulative substrate 1220. *Id.* at 5:30–53.

Chip 1220 includes a substrate 1221 that has electrically insulative properties, such as sapphire. *Id.* On top of substrate 1221 there is a buffer layer 1222, such as GaN, followed by a cladding layer and contact layer 1223 (such as n-GaN). *Id.* Cladding layer 1223 includes a negative electrode 1232c. *Id.* Next is another cladding layer NGaInN 1224, and a reflective layer AlN/AlGaIn MQW (multiple quantum wells) 1225. *Id.* A cladding layer 1226 (n-AlGaIn) is interposed between reflective layer 1225 and an active layer 1227 (GaInN MQW). *Id.* Active layer 1227 is below another cladding layer (p-AlGaIn 1228), which is followed by a second reflective layer 1229 (AlN/AlGaIn MQW). *Id.* Light emitted from the active layer reflects between the two reflective layers until it reaches an appropriate energy level, and then lases, emitting a laser beam of light. *Id.* Second reflective layer 1229 is followed by a cladding layer p-AlGaIn 1230, and a contact layer p⁺ GaN 1231. *Id.* The contact layer may be ring-shaped with a window opening 1233, and has one or more positive electrodes 1232a and 1232b, which are contact areas. *Id.* A negative electrode is created on the n-GaN layer. *Id.*

B. Illustrative Claims

Claim 21 (which incorporates the limitations of cancelled claims 1, 7, and 8) is an illustrative claim. The other challenged claims (claims 25–29, 36, 40–43, 47–49, and 52–57) depend from claim 21. *See* Ex. 1001, 9:52–10:10, 10:28–49, EX PARTE REEXAMINATION CERTIFICATE issued Sept. 2, 2014, and INTER PARTES REEXAMINATION CERTIFICATE issued May 11, 2017.

Claim 21 (with Petitioner's identifiers of claim elements, *see* Pet. 49–51) is reproduced below. Claims 1 (with Petitioner's identifiers of claim elements, *see* Pet. viii), 7, and 8 are also reproduced below.

21. [a] The semiconductor light source as recited in claim 8 wherein:

said at least one semiconductor chip is a light emitting diode (LED) chip configured to output light at greater than about 40 milliwatts, and

[b] said LED chip is configured to emit monochromatic visible light.

8. A device as recited in claim 7 further comprising a first and a second reflective layers, each of said first and second reflective layers being located on opposite sides of said active layer, said reflective layers serving to reflect light emitted by said active layer.

7. A device as recited in claim 1 wherein said chip includes a substrate on which epitaxial layers are grown,

a buffer layer located on said substrate, said buffer layer serving to mitigate differences in material properties between said substrate and other epitaxial layers,

a first cladding layer serving to confine electron movement within the chip, said first cladding layer being adjacent said buffer layer,

an active layer, said active layer emitting light when electrons jump to a valance [sic] state,

a second cladding layer, said second cladding layer positioned so that said active layer lies between cladding layers, and

a contact layer on which an electron [sic] may be mounted for powering said chip.

1. [pre] A semiconductor light source for emitting light to illuminate a space used by humans, the semiconductor light source comprising:

[1A] an enclosure, said enclosure being fabricated from a material substantially transparent to white light,

[1B] an interior volume within said enclosure,

[1C] a heat sink located in said interior volume,

said heat sink being capable of drawing heat from one or more semiconductor devices,

[1D] said heat sink having a plurality of panels on it suitable for mounting semiconductor devices thereon,

[1E] said panels on said heat sink being oriented to facilitate emission of light from the semiconductor light source in desired directions around the semiconductor light source,

[1F] at least one semiconductor chip capable of emitting light mounted on one of said panels,

[1G] said semiconductor chip being capable of emitting monochromatic light,

[1H] said semiconductor chip being selected from the group consisting of light emitting diodes, light emitting diode arrays, laser chips, LED modules, laser modules, and VCSEL chips, and

[1I] a coating for converting monochromatic light emitted by said chip to white light.

Ex. 1001, 9:52–10:10, 10:28–49, EX PARTE REEXAMINATION
CERTIFICATE issued Sept. 2, 2014, and INTER PARTES
REEXAMINATION CERTIFICATE issued May 11, 2017.

C. Asserted Grounds of Unpatentability

Petitioner, supported by the declaration of Nan M. Jokerst, Ph.D. (Ex. 1002), asserts the following grounds of unpatentability (Pet. 6–7):²

Claims Challenged	35 U.S.C. §	References/Basis
21, 25–29, 36, 40, 42, 43, 47–49, 52–57	103(a)	Begemann ³ in view of Sugiura, ⁴ Bogner, ⁵ and Krames ⁶
41	103(a)	Begemann, in view of Sugiura, Bogner, Krames, and Zabransky ⁷
21, 25–29, 36, 40, 42, 43, 47–49, 52–57	103(a)	Begemann in view of Nakamura, ⁸ Matsubara, ⁹ and Krames

² The relevant sections of the Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112–29, took effect on March 16, 2013. The ’961 patent was filed before this date. *See* Ex. 1001, code (22). For the purposes of this Decision, pre-AIA statutes apply.

³ WO 00/17569 A1, published March 30, 2000, Ex. 1005 (“Begemann”).

⁴ US 6,015,979, issued January 18, 2000, Ex. 1008 (“Sugiura”).

⁵ G. Bogner et al., *White LED*, Invited Paper to the SPIE Conference on Light-Emitting Diodes Research, Manufacturing and Applications III, January 1999, Ex. 1007 (“Bogner”). Patent Owner challenges the date of Bogner and the availability of Bogner as prior art to the ’961 patent. Prelim. Resp. 10–19.

⁶ M. R. Krames et al., *High-Brightness AlGaInN Light Emitting Diodes*, Invited Paper, Light-Emitting Diodes: Research, Manufacturing, and Applications IV 2000, Ex. 1011 (“Krames”). Patent Owner challenges the date of Krames and the availability of Krames as prior art to the ’961 patent. Prelim. Resp. 10–19.

⁷ US D271,906, issued December 20, 1983, Ex. 1026 (“Zabransky”).

⁸ US 5,777,350, issued July 7, 1998, Ex. 1006 (“Nakamura”).

⁹ EP 0 977 278 A2, published February 2, 2000, Ex. 1009 (“Matsubara”).

Claims Challenged	35 U.S.C. §	References/Basis
41	103(a)	Begemann in view of Nakamura, Matsubara, Krames, and Zabransky
21, 25–29, 36, 40, 42, 43, 47–49, 52–57	103(a)	Begemann in view of Sugiura, Allen, ¹⁰ and Krames
41	103(a)	Begemann in view of Sugiura, Allen, Krames, and Zabransky
21, 25–29, 36, 40, 42, 43, 47–49, 52–57	103(a)	Begemann in view of Nakamura, Allen, and Krames
41	103(a)	Begemann in view of Nakamura, Allen, Krames, and Zabransky

Patent Owner challenges the availability of Bogner and Krames as prior art to the '961 patent. Prelim. Resp. 10–19.

III. ANALYSIS

A. Legal Standard

A patent 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.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) when in evidence, objective

¹⁰ WO 99/57945 A1, published November 11, 1999, Ex. 1031 (“Allen”).

evidence of nonobviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

B. Level of Ordinary Skill in the Art

In order to determine whether an invention would have been obvious at the time the application was filed, we consider the level of ordinary skill in the pertinent art at the critical time. *Graham*, 383 U.S. at 17. The resolution of this question is important because it allows us to “maintain[] objectivity in the obviousness inquiry.” *Ryko Mfg. Co. v. Nu-Star, Inc.*, 950 F.2d 714, 718 (Fed. Cir. 1991). In assessing 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 omitted). Generally, it is easier to establish obviousness under a higher level of ordinary skill in the art. *Innovation Toys, LLC v. MGA Entm’t, Inc.*, 637 F.3d 1314, 1323 (Fed. Cir. 2011) (“A less sophisticated level of skill generally favors a determination of nonobviousness . . . while a higher level of skill favors the reverse.”).

Petitioner asserts that a person of ordinary skill in the art (POSITA) would have had (a) a bachelor’s degree in engineering (or a comparable field of study) with coursework in semiconductors and/or optoelectronics, and (b) at least three years of experience working in the field of semiconductor light sources. Ex. 1002, ¶¶25-27. Additional relevant industry experience may compensate for a lack of certain education/coursework or vice versa. *Id.*

Pet. 21–22. Patent Owner does not dispute the level of ordinary skill in the art.

For purposes of this Decision, we adopt Petitioner’s proposal as reasonable and consistent with the prior art. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (the prior art may reflect an appropriate level of skill in the art).

C. Claim Construction

In an *inter partes* review proceeding based on a petition filed on or after November 13, 2018, a patent claim shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b). 37 C.F.R. § 42.100(b) (as amended Oct. 11, 2018). This rule adopts the same claim construction standard used by Article III federal courts, which follow *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc), and its progeny. Under this standard, the words of a claim are generally 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. *See Phillips*, 415 F.3d at 1312–13.

Petitioner notes that, “[i]n the corresponding litigation, [Cao] takes the position that the ‘reflective layers’ of original claim 8 (incorporated into claim 21 through dependency) do not necessarily need to be separate layers, but instead can be e.g., **surfaces** of other claimed layers.” Pet. 22 (emphasis original). Petitioner further states that it “reserves the right to dispute that claim construction in the litigation,” while “[h]ere . . . a claim construction on the issue is not necessary inasmuch as the prior art describes reflective layers regardless of whether [Cao’s interpretation is used].” *Id.*

Petitioner does not otherwise propose that the Board explicitly construe any claim terms.

At this stage of the proceeding, Patent Owner also does not propose that the Board explicitly construe any claim terms.

As we explain below, Petitioner establishes a reasonable likelihood that it would prevail with respect to at least one claim based on the ordinary and customary meaning of the claim terms. Thus, we determine that no claim terms require express construction for purposes of this Decision. *See, e.g., Nidec Motor Corp. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (“[W]e need only construe terms ‘that are in controversy, and only to the extent necessary to resolve the controversy.’” (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

D. Whether Bogner and Krames Should Be Considered as Prior Art

Patent Owner argues that Petitioner has not established that Bogner and Krames qualify as a “printed publication” that is prior art to the ’961 patent. Prelim. Resp. 10–11. We address each reference below.

1. Bogner

Patent Owner argues that: (i) the Petition “merely *concludes* that Bogner is prior art” but “provides no explanation of how or when Bogner was allegedly made available to the relevant public”; (ii) the Bogner paper itself does not include any information regarding dissemination or distribution, and the only date found in the Bogner paper is January 1999, which appears to be a conference date, however, Petitioner provides no testimony or other evidence attempting to explain the significance of the “January 1999” date; (iii) the one-page printout of a webpage that is dated

October 12, 2022 (included in Ex. 1007) provides “no explanation of who compiled the information on this page, when they did so, or how they did so,” and “[e]ven assuming that the ‘date published’ is intended to refer to the Bogner paper, there is nothing more than a bare conclusion. . . . [with] no discussion of how Bogner was publicly disseminated, or otherwise publicly accessible, or to what audience”; (iv) Petitioner’s “sole declarant, Dr. Nan Marie Jokerst, simply assumes—like the Petition does—that Bogner was published before the filing of the ’961 Patent and is prior art. . . . [but t]his conclusory declaration cannot help Signify meet its burden.” *Id.* at 12–17.

The Board’s precedential decision in *Hulu, LLC v. Sound View Innovations, LLC*, IPR2018-01039, Paper 29 (PTAB Dec. 20, 2019) addresses “[w]hat is required for a petitioner to establish that an asserted reference qualifies as ‘printed publication’ at the institution stage.” *Id.* at 2. The decision explains that, to prevail in a final written decision in an *inter partes* review, the petitioner must establish that a document is a printed publication by a preponderance of the evidence. *Id.* at 11. At the institution stage, however, the 35 U.S.C. § 314(a) “reasonable likelihood” standard for institution applies to the issue of whether a reference has been shown to be a printed publication. *Hulu, LLC* at 12. The “reasonable likelihood” standard for institution is a higher standard than mere notice pleading but is lower than the “preponderance” standard required to prevail in a final written decision. *Id.* at 13.

The *Hulu LLC* decision also explains that “whether a reference qualifies as a ‘printed publication’ is a legal conclusion based on underlying factual findings.” *Id.* at 8–9 (citing *Nobel Biocare Servs. AG v. Intradent USA, Inc.*, 903 F.3d 1365, 1375 (Fed. Cir. 2018)). The decision also declines

to address whether any particular indicia on a document might be “per se sufficient at the institution stage.” *Id.* at 17. Instead, “the indicia on the face of a reference, such as printed dates and stamps, are considered as part of the totality of the evidence.” *Id.* at 17–18 (citation omitted).

On the facts presented in *Hulu, LLC*, the Board determined that the totality of the evidence “established a reasonable likelihood that Dougherty is a printed publication” because the face of Dougherty bore “a copyright date of 1990, a printing date of November 1992, and an ISBN date of 8/94.” *Id.* at 19. Also, Dougherty was a textbook from an established publisher and part of a well-known book series. *Id.* The *Hulu LLC* decision discusses an affidavit, but the affidavit was not necessary for the Board to reach the decision. *Id.* at 20 (“we do not find the affidavit necessary to our decision that Petitioner has presented sufficient evidence for purposes of institution”).

The facts here are analogous to those of *Hulu, LLC*. The Bogner reference provides the indicia at bottom left corner of its first page. Ex. 1007, 143. The indicia states: “Part of the SPIE Conference on Light-Emitting Diodes Research, Manufacturing and Applications III • San Jose, California • January 1999 SPIE Vol 3621 • 0277-786X/99/\$10.00.” *Id.* The January 1999 date being printed adjacent to the name of a particular conference and San Jose, California suggests that the paper was presented at the 1999 conference. The “99” within 0277-786X/99/\$10,00 indicates a 1999 publication, and the “\$10.00” suggests public availability at the price of ten dollars in 1999.

As further evidence, Petitioner includes in the record a page from the SPIE website that appears to be from October 12, 2022. Ex. 1007, 1. The page indicates Bogner was published “14 April 1999” in “SPIE Proceedings

Vol. 3621.” *Id.*¹¹ This information is consistent with the indicia on the first page of the paper itself. The evidence, in total, supports Petitioner’s contention that the paper was presented at a conference in January 1999 and then published within SPIE Proceedings Volume 3621 in April 1999—absent contrary evidence, which Patent Owner does not advance at this stage of the proceeding.

As in *Hulu, LLC*, the Bogner reference’s indicia provide some evidence of printed publication status. The page from the SPIE website provides further evidence. Thus, given the record as a whole, which contains some evidence that Bogner was a printed publication as of 1999 and no evidence to the contrary, and in view of the *Hulu LLC* precedent, we determine that Petitioner has established at this stage of the proceeding a reasonable likelihood that the Bogner reference is a printed publication that was publicly accessible before the critical date¹² of the challenged patent.

2. Krames

Patent Owner argues that Petitioner addresses “the content of the Krames paper without any assertion, let alone any evidence, that Krames was published prior to the critical date of the ’961 Patent.” Prelim. Resp. 12–13. Patent Owner further argues that the indicia of Krames’s date fails to establish any publication. *Id.*

As a threshold matter, we disagree with Patent Owner that Petitioner

¹¹ The page suggests the paper, as of 2022, was publicly available to members for \$17.00 or non-members for \$21.00. Ex. 1007, 1. This price is consistent with a \$10.00 price in 1999 accounting for inflation.

¹² The ’961 Patent was filed August 24, 2001, and does not appear to claim earlier priority. Ex. 1001, (22).

does not allege that Krames is prior art. Petitioner states, for example, Krames’s teachings “were already known” prior to the ’961 patent. Pet. 2. Petitioner also explains what a person of ordinary skill in the art “would have been motivated” to do, based on Krames’ teaching, at the time of the invention. *Id.* at 31–32. Indeed, Petitioner’s inclusion of Krames as a reference relied upon in its obviousness grounds (*id.* at 6–7) conveys that Petitioner asserts that Krames is prior art.

On the merits, Petitioner presents evidence that Krames is a printed publication prior to the critical date of the ’961 patent akin to the Bogner evidence. The indicia at the bottom right of the Krames paper states: “In *Light-Emitting Diodes: Research, Manufacturing, and Applications IV*, H. Walter Yao, Ian T. Ferguson, E. Fred Shubert, Editors, Proceedings of SPIE Vol. 3938 (2000) • 0277-786X/00/\$15.00.” Ex. 1011, 2. The 2000 date suggests publication in a proceedings volume 3938 in 2000. The “00” within 0277-786X/00/\$15.00 indicates a 2000 publication, and the “\$15.00” suggests public availability at the price of fifteen dollars. The indicia also suggest that the paper was published by an established publisher—SPIE (the international society for optics and photonics).

As further evidence, Petitioner includes in the record a page from the SPIE website that appears to be from October 27, 2022. Ex. 1011, 1. The page indicates Krames was published “17 April 2000” in “SPIE Proceedings Vol. 3938.” *Id.*¹³ This information is consistent with the indicia on the first page of the reference. The evidence, in total, supports Petitioner’s contention

¹³ The page suggests the paper, as of 2022, was publicly available to members for \$17.00 or non-members for \$21.00. Ex. 1011, 1. This price is consistent with a \$15.00 price in 2000 accounting for inflation.

that the paper was published within SPIE Proceedings Volume 3938 in April 2000—absent contrary evidence, which Patent Owner does not advance at this stage of the proceeding.

Again, as in *Hulu, LLC*, the Krames reference’s indicia provide some evidence of printed publication status and the page from the SPIE website provides further evidence. Thus, given the record as a whole, which contains some evidence that Krames was a printed publication as of 2000 and no evidence to the contrary, and in view of the *Hulu LLC* precedent, we determine that Petitioner has established at this stage of the proceeding a reasonable likelihood that the Krames reference is a printed publication that was publicly accessible before the critical date of the challenged patent.

E. Discretionary Denial Based on Concurrent Inter Partes Review Proceedings

Patent Owner argues that we should exercise our discretion under 35 U.S.C. § 314(a) and 35 U.S.C. § 325(d) and not institute trial because “substantially the same prior art [and] arguments previously were presented to the Office” in three *inter partes* reviews of the ’961 patent (all currently pending), including: IPR2022-00847 (“the Cree IPR”) and two copycat petitions, IPR2023-00123 and IPR2023-00129, now joined with the Cree IPR. Prelim. Resp. 19–26. Petitioner contends that discretionary denial under *General Plastic* “is not warranted.” Pet. 19 (capitalization altered, emphasis omitted).

In *General Plastic Industrial Co., Ltd. v. Canon Kabushiki Kaisha*, Case IPR2016-01357, slip op. at 15–16 (PTAB Sept. 6, 2017) (Paper 19) (precedential), the Board articulated a non-exhaustive list of factors to be considered in determining whether to exercise discretion under § 314(a) to

deny a petition that challenges the same patent as a previous petition. We address Petitioner's and Patent Owner's arguments as we analyze the *General Plastic* factors below.

1. whether the same petitioner previously filed a petition directed to the same claims of the same patent

Petitioner has not previously filed a Petition directed to the '961 patent. Although *Valve Corp. v. Electronic Scripting Prods., Inc.*, IPR2019-00062, Paper 11 at 2 (PTAB April 2, 2019) (precedential), holds that “application of the *General Plastic* factors is not limited solely to instances when multiple petitions are filed by the same petitioner” that decision also emphasizes that we should “consider any relationship between those petitioners when weighting the *General Plastic* factors.”

The present record establishes no relationship between Petitioner and prior petitioners. Patent Owner argues that Petitioner's alleged copying of prior art and arguments from the Cree IPR creates a relationship. Prelim. Resp. 23. Patent Owner further argues that the present Petition copies from the Cree IPR petition verbatim. Prelim. Resp. 22. Nonetheless, it is not clear that, in this instance, such copying amounts to a “relationship” in the sense of *Valve* explains such a relationship.

This factor, therefore, weighs heavily against discretionary denial.

2. whether at the time of filing of the first petition the petitioner knew of the prior art asserted in the second petition or should have known of it;

Patent Owner does not present direct evidence that Petitioner knew of the presently cited art at the time a different petitioner filed the Cree IPR. Prelim. Resp. 27. We note, however, that this factor also “includes considering whether the prior art relied on in the later petition ‘could have

been found with reasonable diligence.”” *General Plastic*, slip op. at 16. Although the cited references easily could have been found by reviewing the ’961 patent’s file history, it is less clear that the key alleged error in Patent Owner’s representations concerning the teachings of those references would have been readily apparent.

As such, this factor is neutral.

3. whether at the time of filing of the second petition the petitioner already received the patent owner’s preliminary response to the first petition or received the Board’s decision on whether to institute review in the first petition;

Patent Owner argues that Petitioner used the Board’s decision instituting trial in the Cree IPR as a roadmap for its petitions. Prelim. Resp. 24. Patent Owner, however, presents no factual evidence to support this point, for example, instances in the Petition that facially support a finding that the arguments presented track the Board’s prior institution decision. Moreover, we agree with Petitioner that the road-mapping concern is either not relevant or is less relevant when the earlier IPR was instituted. Reply 1–2; *see also General Plastic*, slip op. at 17–18 (explaining that factor 3 is directed to road-mapping concerns). This is not a multiple-bites-of-an-apple situation where the second bite is modified after the first bite fails. This factor weighs against discretionary denial or, at best for Patent Owner, is neutral.

4. the length of time that elapsed between the time the petitioner learned of the prior art asserted in the second petition and the filing of the second petition;

5. whether the petitioner provides adequate explanation for the time elapsed between the filings of multiple petitions directed to the same claims of the same patent;

Both of these factors relate to timing of the second petition as compared to the first petition. Here, Petitioner had no control over the Cree IPR or its timing. And, as explained above, the record establishes no relationship between Petitioner and prior petitioners. These factors are neutral.

6. the finite resources of the Board;

7. the requirement under 35 U.S.C. § 316(a)(11) to issue a final determination not later than 1 year after the date on which the Director notices institution of review.

The Board has adequate resources to address this IPR within the statutory deadline. Given the Board's growing familiarity with the '961 patent and art asserted against it, use of the Board's resources is minimized. Although the *Valve* decision states that "[i]n general, multiple petitions challenging the same patent, especially not filed at or around the same time as in this case, is inefficient and tends to waste resources," the decision does not further explicate when such inefficiency would or would not impinge on the finite resources of the board or the requirement for a final determination within one year. *Valve Corp.*, IPR2019-00062 at 15. Here, we do not discern that any particular inefficiency favors a discretionary denial.

We recognize that the decision in *Unified Patents, Inc. v. PersonalWeb Techs., LLC*, IPR2014-00702, Paper 13 (July 24, 2014)

(informative), declined to institute review where earlier IPRs filed by different petitioners raised similar challenges. That decision relied, in part, on “efficient administration of the [Patent] Office under 35 U.S.C. § 316(b)” as reason to deny institution. *Id.* at 8. That decision is distinguishable, however, because the Petition there relied on prior art identical to that asserted in the prior challenges, and one of the prior challenges was already on appeal to the Court of Appeals to the Federal Circuit. *Id.* at 6. Because Petitioner’s arguments here raise some different issues than the related IPRs and because the related IPRs have not yet reached oral argument or a final written decision and are, thus, not at such an advanced stage, the concerns regarding efficient Patent Office administration are not as great.

For the reasons above, factors six and seven are neutral or, at best, weakly favor discretionary denial.

Conclusion

Factor one weighs strongly against exercising our discretion to deny institution, factor three weighs against exercising our discretion to deny institution or is neutral, factors six and seven are neutral or weakly favor discretionary denial, and the remaining factors are neutral. The balance of the *General Plastic* factors thus weighs against exercising our discretion under § 314(a) to deny institution. Accordingly, we decline to exercise our discretion to deny institution based on the *General Plastic* factors.

F. Discretionary Denial Based on the Conversion Petition

Patent Owner argues that we should exercise our discretion to deny institution under 35 U.S.C. § 314(a) because Petitioner fails to explain why two parallel petitions are needed to address the same claims. Prelim. Resp. 26–28. Patent Owner cites the Consolidated Trial Practice Guide

(“CTPG”) statement that “one petition should be sufficient to challenge the claims of a patent in most instances.” *Id.* at 26 (citing CTPG at 58–59).

Patent Owner further argues that the instant Petition relies on primarily the same art as the Conversion Petition (IPR2023-00214) and adds only Krames and Allen, which, in Patent Owner’s view, are cumulative. *Id.* at 27.

Petitioner explains that the Conversion Petition addresses how allowance of the ’961 patent’s claims were predicated on “an incorrect mathematical conversion of lumens to watts” and explains a proper conversion. Petitioner’s Notice Ranking Petitions for *Inter Partes* Review of U.S. Patent No. 6,465,961, Paper 3, 1 (“Ranking”). Thus, the Conversion Petition focuses on “the proper manner for converting one unit of measurement to another.” *Id.* The instant Krames Petition, in contrast, relies on the Krames reference to show that, aside from the conversion error, the feature relied upon for allowance of the claims (“configured to output light at greater than about 40 milliwatts”) was known in the art. *Id.* at 2. Because the two petitions rely on different invalidity theories (with the Conversion Petition requiring Petitioner’s contentions regarding conversion to prevail whereas the Krames petition requires Petitioner’s contentions regarding Krames’s teachings as a prior art reference to prevail), they are not redundant.

Here, we decline to exercise discretion to deny this Petition based upon multiple Petitions for three reasons. First, as we explain in Section III(H) of this decision, the Petition is strong on the merits, and Patent Owner has, at this stage, offered little argument refuting the merits.

Second, Patent Owner’s burden to respond to both petitions is lessened by Patent Owner’s familiarity with much of the prior art at issue.

As Patent Owner emphasizes, all or nearly all of the art in the Petitions was previously raised either during prior examination or in other *inter partes* reviews. Indeed, it seems likely that, if the Cree IPR (or related follow on IPRs) proceeds to a decision on the merits, there may be little left unresolved for the instant Petition. Institution here, however, provides Petitioner an opportunity to challenge the '961 patent based on Krames in the event that the IPR based on Cree does not reach a decision on the merits.

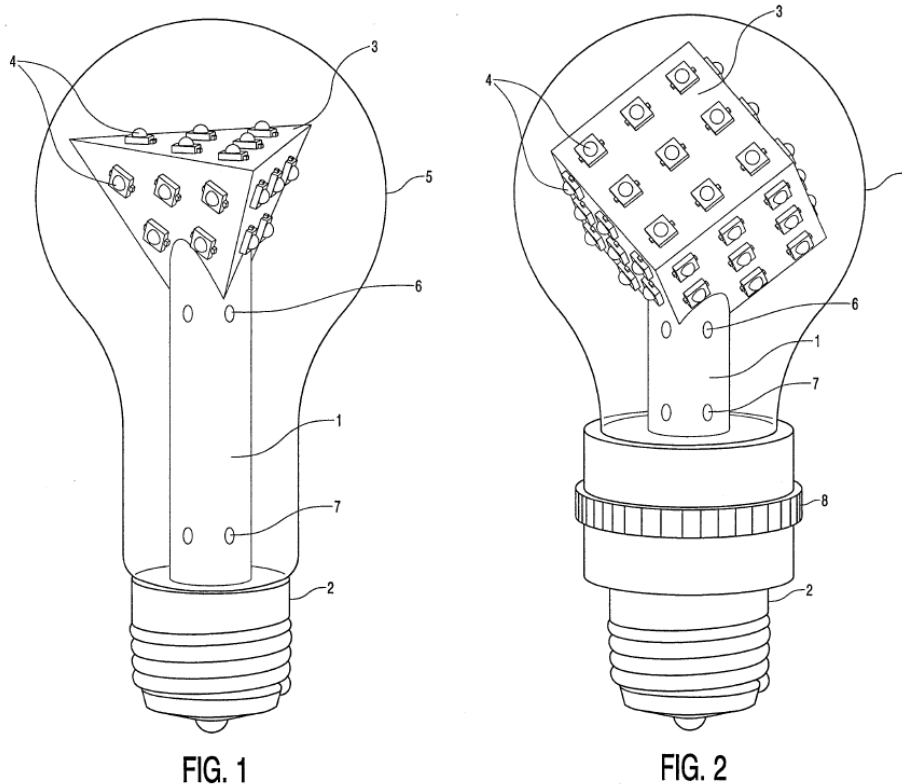
Third, while the two petitions present different invalidity grounds (addressing the same claims) and, as explained above, are not wholly redundant, the two parallel petitions have a great deal of overlap. Prelim. Resp. 26 (arguing that the two petitions are “redundant”). Because portions of the petitions are similar, this also reduces Patent Owner’s burden to respond. Thus, based on the totality of specific circumstances unique to these two petitions, we decline to exercise discretion to deny institution based on parallel petitions.

G. Overview of the Asserted Art

1. Begemann (Exhibit 1005)

Begemann is titled “LED Lamp” and “relates to a LED lamp comprising a gear column, a lamp cap which is connected to an end of the gear column and a substrate which is connected to the other end of the gear column and which is provided with a number of LEDs.” Ex. 1005, code (54), 1:1–3.

Figs. 1 and 2 of Begemann, reproduced below, illustrate first and second embodiments of the LED lamp. *Id.* at 4:10–12.



Figs. 1 and 2 illustrate LED lamps. *Id.* at 4:10–12.

The LED lamp illustrated in Fig. 1 includes a tubular, hollow gear column 1 connected with one end to a lamp cap 2. *Id.* at 4:17–25. The other end of gear column 1 is connected to a substrate 3, which is provided with LEDs 4. *Id.* The space within hollow gear column 1 accommodates the electronics necessary for controlling LEDs 4. *Id.* During operation of the lamp, the LEDs generate a luminous flux of 5 lm or more. *Id.* The lamp further includes an envelope 5 of a synthetic resin, which envelops gear column 1 and substrate 3. *Id.* In Fig. 1, substrate 3 has the shape of a regular pyramid with four flat faces, and is connected to gear column 1 via a vertex of the pyramid. *Id.* at 4:26–34. The outer surface of substrate 3 is made of a metal or a metal alloy, thereby enabling a good heat conduction from LEDs 4 to column 1. *Id.* Each of the faces of the pyramid is provided with five or

six LEDs 4, which are secured to the faces by a heat-conducting adhesive. *Id.* The outer surface of gear column 1 of the LED lamp is made of a metal or a metal alloy, which enables a good heat conduction from substrate 3 to the metal lamp cap 2. *Id.* at 5:1–12. The use of this heat-dissipating arrangement enables LEDs with relatively high luminous flux to be used, without heat problems in the LED lamp. *Id.* The LED lamp also includes means (not shown) for generating an air flow in the lamp. *Id.* These means may be a fan incorporated in gear column 1. *Id.* The air flow leaves gear column 1 via holes 6 provided in the gear column, and re-enters the gear column via holes 7 provided in the gear column. *Id.* By suitably shaping and positioning holes 6, the air flow is led past a substantial number of the LEDs present on substrate 3, such that an improved heat dissipation from the substrate and the LEDs is obtained. *Id.*

Similar to Fig. 1, the LED lamp illustrated in Fig. 2 includes a gear column 1, a metal lamp cap 2, a metal substrate 3 with LEDs 4, an optional envelope 5, outlet holes 6, and inlet holes 7. *Id.* at 5:13–26. In contrast to Fig. 1, substrate 3 in Fig. 2 is cube-shaped with six flat faces, and is connected to gear column 1 via a vertex of the cube. *Id.* Substrate 3 is made of a metal or a metal alloy, thereby enabling a good heat conduction from LEDs 4 to gear column 1. *Id.* Each one of the faces of the pyramid is provided with eight or nine LEDs 4, which are secured to the faces by a heat-conducting adhesive. *Id.* Multiple-chip LEDs may be used, each having three light points (green, red, and blue) per LED, or four light points (green, red, yellow, and blue) per LED. *Id.* These colors are mixed so as to obtain white light in the secondary optical system of each of the LEDs. *Id.* Thus, in operation, the LED lamp provides white light. *Id.*

The LED lamp of Fig. 2 also includes an adjusting ring 8 for simultaneously changing the luminous flux of the LEDs. *Id.* at 5:27–6:2. The adjusting ring enables the lamp to be dimmed. *Id.* The lamp may also include a second adjusting ring (not shown), by which the luminous flux of the LEDs provided on different faces of the substrate can be changed with respect to each other. *Id.* The lamp may include a further adjusting ring (not shown), by which the luminous flux of the three light points of each LED can be changed with respect to each other, which enables the color of the light emitted by the lamp to be changed. *Id.*

2. *Bogner (Exhibit 1007)*

Bogner is a paper titled “White LED.” Ex. 1007, 143. Bogner describes “light emitting diodes [that] are in use to generate white light” using “[p]ixels with green, red and blue LED’s . . . arranged to get any coordinate in the CIE-diagram with matched current for each diode.” *Id.* at 143. Bogner also explains that

[a] far better and simpler solution for production of only white light represents luminescence conversion. The emitted light of a blue diode is used as primary source for exciting [an] organic or inorganic fluorescent which is embedded in the epoxy resin. This technique allows to generate bright white light with only one blue chip.

Id. at 143–144. High brightness blue light emitting diodes based on gallium nitride (GaN) or indium gallium nitride (InGaN) may be used, as they work as an efficient pump exciting the luminescent/fluorescent material to higher energy levels. *Id.* at 144. As the lifetime of these levels is only a few nanoseconds, the luminescent molecules come back to their ground state by radiation of surplus energy as green, yellow, or red light. *Id.* at 144. The

fluorescent or luminescent material may be a yellow light-emitting phosphor, which “is ideally suited, since blue and yellow light are complementary colors, adding to white light after proper additive mixing.” *Id.* at 143, 146. Fig. 6 of Bogner, reproduced below, illustrates the emission spectrum of L175 (a yellow light-emitting phosphor produced by OSRAM), and Fig. 7 of Bogner, reproduced below, illustrates a representative spectrum of a single chip white LED employing the phosphor. *Id.* at 144, 146, 148. The spectrum is a mixture of the blue radiation of a GaN chip, and the yellow radiation of the phosphor. *Id.* at 148.

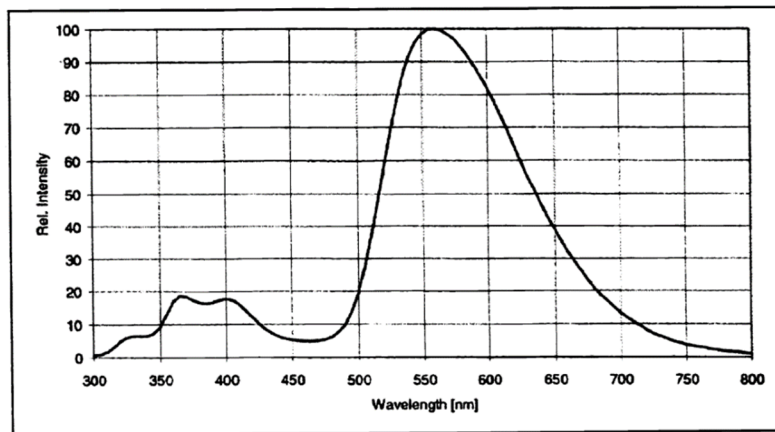


Fig.6: Emission spectrum of L175 (Chromaticity $x = 0.462$, $y = 0.517$)

Fig. 6 illustrates the emission spectrum of L175 (a yellow light emitting phosphor produced by OSRAM). *Id.* at 144, 146, 148.

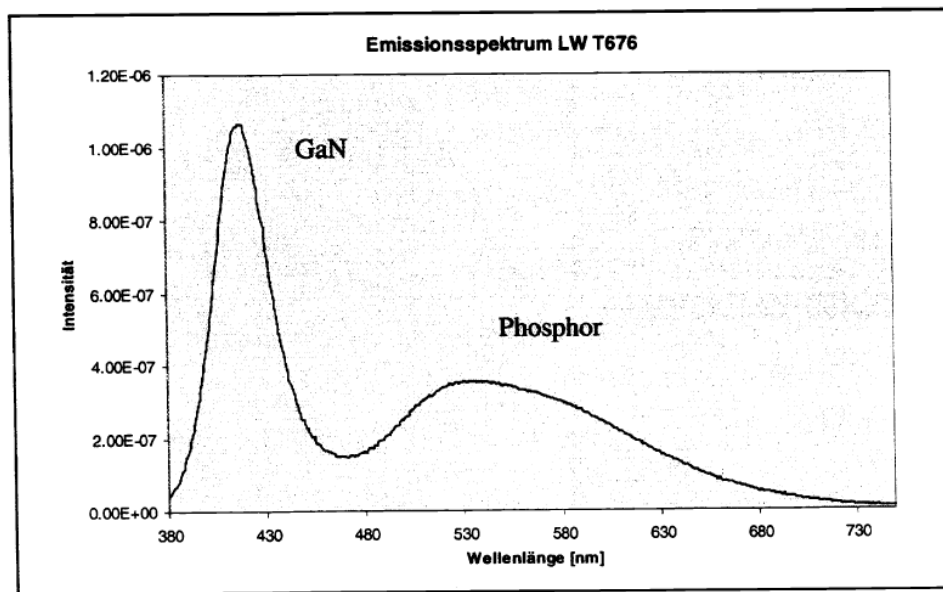


Fig.7: Representative spectrum of a single chip white LED

Fig. 7 illustrates a representative spectrum of a single chip white LED using a yellow light-emitting phosphor. *Id.* at 144, 146, 148.

3. *Sugiura (Ex. 1008)*

Sugiura is titled “Nitride-Based Semiconductor Element and Method for Manufacturing the Same,” and describes a nitride-based semiconductor element comprising a first layer, a mask formed on the first layer, a nitride-based compound semiconductor layer formed on the mask, and a desired element structure formed on the semiconductor layer. Ex. 1008, codes (54), (57). The mask has a plurality of opening portions, and the nitride-based compound semiconductor layer includes (i) a first region having threading dislocations produced in such a manner that, in approximately a middle portion between two adjacent opening portions in the mask, a plurality of dislocations extend in a vertical direction to a surface of the mask, and (ii) a second region which comprises portions other than the middle portions and free from the dislocations. *Id.* at code (57). Fig. 7 of Sugiura, reproduced below, illustrates a sectional view of the structure of a nitride-based

semiconductor laser using a semiconductor element disclosed by Sugiura.
Id. at 9:1–3.

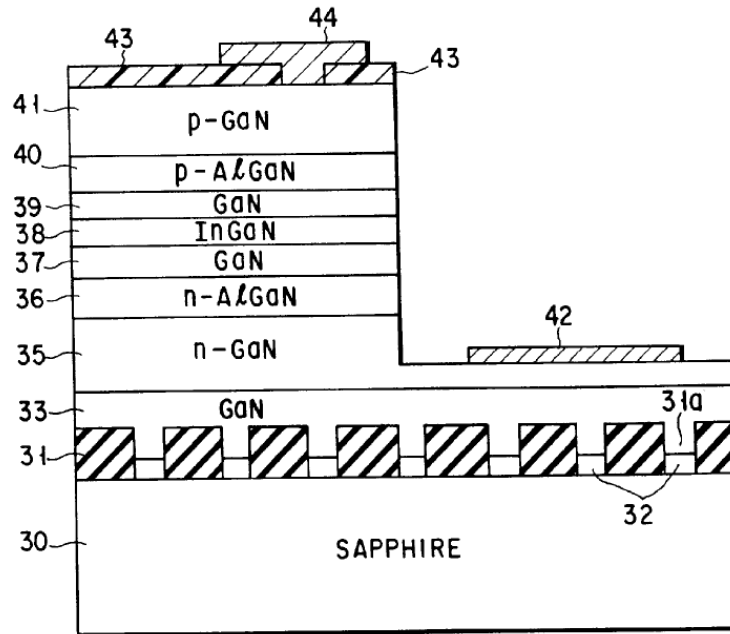


FIG. 7

Fig. 7 illustrates a sectional view of the structure of a nitride-based semiconductor laser using an semiconductor element disclosed by Sugiura.
Id. at 9:1–3.

The nitride-based semiconductor laser illustrated in Fig. 7 includes: a sapphire substrate 30; a mask 31 composed of SiO₂ and having grooves 31a; in grooves 31a of the mask 31, a low-temperature GaN buffer layer 32 formed by MOCVD; an undoped underlying GaN layer 33 formed on mask 31 and buffer layer 32, by lateral growth; and, on GaN layer 33, an n-type GaN contact layer 35, an n-type AlGaIn current injection layer 36, an n-type GaN optical guide layer 37, an InGaIn active layer 38 having a multi-quantum well (MQW) structure, a p-side GaN optical guide layer 39, a p-type AlGaIn current injection layer 40, and a p-type GaN contact layer 41.
Id. at 12:21–36. A portion of this multi-layer structure is removed by dry

etching until the n-type GaN contact layer 35 is reached, and, on the thus exposed contact layer 35, an n-side electrode 42 is formed. *Id.* at 12:37–45. Further, on p-type GaN contact layer 41 of that portion of the multi-layer structure which has not been removed, an SiO₂ film 43 is selectively formed in order to narrow the current, and, on this SiO₂ film 43 and p-type GaN contact layer 41, a p-side electrode 44 is formed. *Id.*

Fig. 9 of Sugiura, reproduced below, illustrates a sectional view of another nitride-based surface-emitting laser element of Sugiura. *Id.* at 9:7–10.

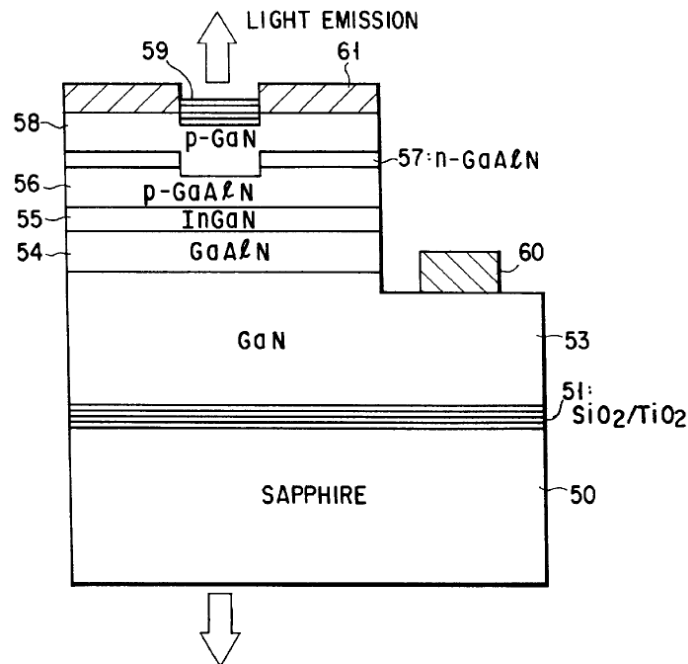


FIG. 9

Fig. 9 illustrates a sectional view of another nitride-based surface-emitting laser element of Sugiura. *Id.* at 9:7–10.

The nitride-based surface-emitting laser element illustrated in Fig. 9 includes: a sapphire substrate 50; a mask 51 in which opening portions each having a diameter of 0.5 μm are provided at intervals of 50 μm ; an n-type

GaN contact layer 53 with a thickness of 2 μm , into which silicon has been doped; an n-type $\text{Ga}_{0.8}\text{Al}_{0.2}\text{N}$ current injection layer 54 into the upper portion of which silicon has been doped, and which has a thickness of 0.25 μm ; an $\text{In}_{0.1}\text{Ga}_{0.9}\text{N}$ active layer 55 with a thickness of 0.1 μm ; a p-type $\text{Ga}_{0.8}\text{Al}_{0.2}\text{N}$ current injection layer 56 into the upper portion of which Mg has been doped; an n-type $\text{Ga}_{0.8}\text{Al}_{0.2}\text{N}$ current narrowing layer 57; a p-type GaN contact layer 58 into which Mg has been doped; a first reflector 59; an n-type electrode 60; and a p-type electrode 61. *Id.* at 15:50–16:40. Moreover, the multi-layer film (mask) 51, including SiO_2 and TiO_2 and formed on sapphire substrate 50, is rendered into a second reflector. *Id.*

4. *Krames (Exhibit 1011)*

Krames is a paper titled “High-Brightness AlGaInN Light-Emitting Diodes.” Ex. 1011, 2. Krames describes “LEDs based on AlGaInN [that] emit light efficiently from the ultraviolet-blue to the green portion of the visible wavelength spectrum.” *Id.* at 12. The AlGaInN LEDs are grown by organometallic vapor phase epitaxy (OMVPE). *Id.* Fig. 3 of Krames, reproduced below, illustrates an AlGaInN LED structure. *Id.* at 4.

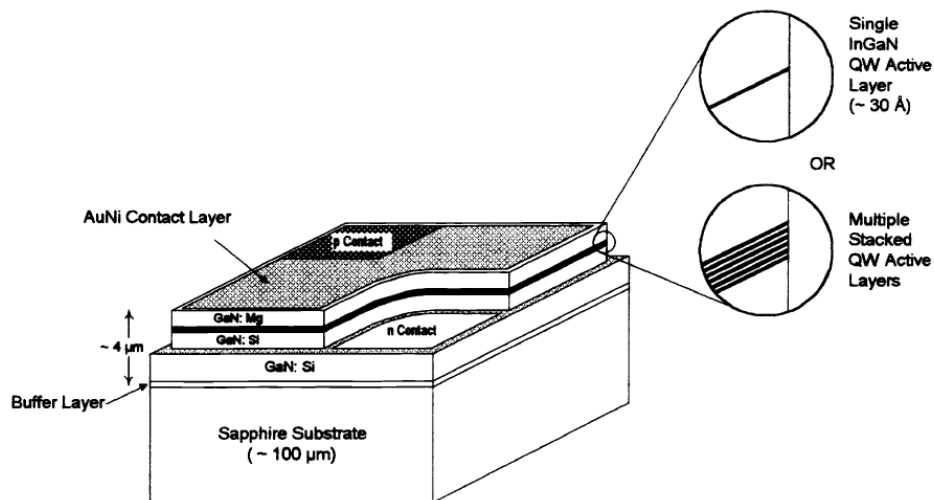


Fig. 3. Typical AlGaInN LED structure.

Fig. 3 illustrates an AlGaInN LED structure. *Id.* at 4.

The AlGaInN LED structure includes a buffer layer, and GaN:Si and GaN:Mg layers with an active layer therebetween. *Id.* at 4. The LED structure is grown on a sapphire substrate, but a SiC substrate may also be used. *Id.* Because sapphire is insulating, both the p and n Ohmic contacts are formed on the top surface of the LED chip, with the Ohmic n-contact metallization applied to the n-type GaN layer, and the p-type Ohmic contact spreading current from the p-bond pad across the junction area through a semi-transparent Ni/Au Ohmic contact metallization deposited across the GaN:Mg surface. *Id.* Current from the n-type contact spreads through the GaN:Si layers beneath the active region. *Id.*

Krames explains that the brightest AlGaInN LEDs are achieved using quantum-well active regions wherein the mole fraction of InN in the wells determines the peak emission wavelength. *Id.* at 3. The heterostructure designs of AlGaInN LEDs are typically comprised of InGaIn quantum wells with GaN or InGaIn barriers, surrounded by GaN confining layers. *Id.* at 5. An AlGaIn “electron stopper” layer is usually provided on the top of the active region to improve electron confinement. *Id.* A metal back-reflector may be inserted on the sapphire substrate to increase light output. *Id.* at 6. External quantum efficiencies for AlGaInN LEDs, of ~21% in the blue ($\lambda_p \sim 470\text{nm}$) and ~15% in the green ($\lambda_p \sim 530\text{nm}$) spectral regions have been observed. *Id.* at 3.

5. *Matsubara (Ex. 1009)*

Matsubara is titled “Substrate-Fluorescent LED” and “relates to a new LED which emits complex light with a spectrum having two peaks,” and more particularly, an “LED having a substrate and an active layer which

produces neutral colors, e.g., pink, red, purple, orange, yellow or white color by synthesizing the band gap emission from the active layer and the fluorescence from the substrate.” Ex. 1009, code (54), ¶ 1. Fig. 20 of Matsubara, reproduced below, illustrates components of a white color LED having a C or O doped or N-vacant GaN substrate, and a GaInN active layer. *Id.* ¶ 76.

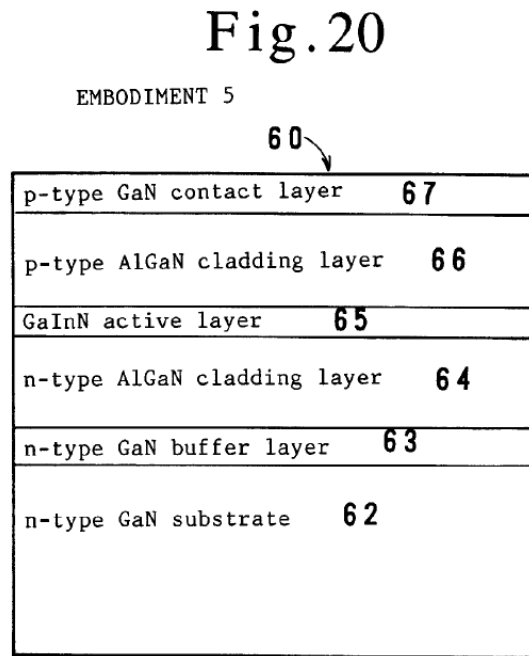


Fig. 20 illustrates components of a white color LED having a C or O doped or N-vacant GaN substrate and a GaInN active layer. *Id.* ¶ 76.

The white color LED illustrated in Fig. 20 includes a substrate 62 made from a GaN wafer by a vapor phase growing method, and an epitaxial emission structure on the n-type GaN substrate 62. *Id.* ¶¶ 120–121. The GaN wafer forming substrate 62 is doped with oxygen (O), carbon (C), or nitrogen vacancy (Va(N)). *Id.* ¶ 120. O atoms, C atoms, or N-vacancies act as fluorescence centers in the GaN substrate. *Id.* The epitaxial emission structure contains a GaInN active layer emitting 430 nm blue-purple light.

Id. ¶ 121. The layers of the epitaxial GaN wafer are, from bottom to top: (1) n-GaN substrate (C•O•Va(N) dope; fluorescence 550 nm) 62; (2) a n-GaN buffer layer 63; (3) an n-Al_{0.20}Ga_{0.80}N cladding layer 64; (4) an Ga_{0.88}In_{0.12}N active layer (with active emission at 430 nm) 65; (5) a p-Al_{0.20}Ga_{0.80}N cladding layer 66; and (6) a p-GaN contact layer 67. *Id.* ¶¶ 121–122. The p-dopant is Mg in layers (5) and (6), and the n-dopant is Si in layers (1), (2) and (3). *Id.* ¶ 123. The spectrum of the LED illustrated in Fig. 20 has a sharp peak at 430 nm from the epitaxial structure and a broad peak at 550 nm from the GaN substrate, and the color of the LED is bluish white. *Id.* ¶ 125.

6. *Nakamura (Ex. 1006)*

Nakamura is titled “Nitride Semiconductor Light-Emitting Device,” and describes a nitride semiconductor light-emitting device having an active layer of a single-quantum well structure or multi-quantum well made of a nitride semiconductor containing indium and gallium. Ex. 1006, codes (54), (57). Fig. 11 of Nakamura, reproduced below, illustrates a cross-sectional view of such a light-emitting device. *Id.* at 5:58–60.

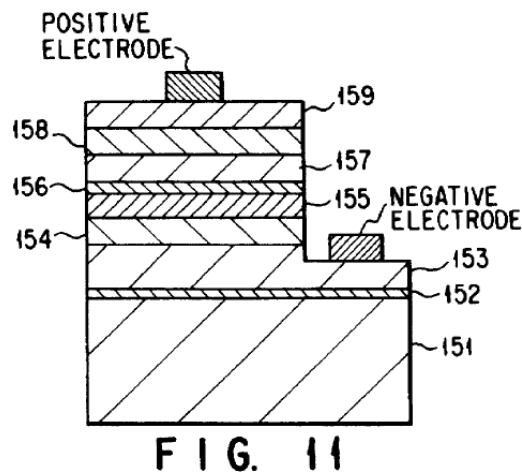


Fig. 11 illustrates a cross-sectional view of a light-emitting device.
Id. at 5:58–60.

The light-emitting device illustrated in Fig. 11 includes: a substrate 151, on which a buffer layer 152 is formed for alleviating a lattice mismatch between substrate 151 and the nitride semiconductor; an n-type contact layer 153 for forming a negative electrode thereon; a second n-type clad layer 154; a first n-type clad layer 155; an active layer 156; a first p-type clad layer 157; a second p-type clad layer 158; and a p-type contact layer 159 for forming a positive electrode thereon. *Id.* at 19:43–54. GaN, and more specifically, an n-type $\text{In}_x\text{Ga}_{1-x}\text{N}$ (with x at least 0 and less than 1), is employed as the first n-type clad layer 155. *Id.* at 19:60–65. Second p-type clad layer 158 is a p-type $\text{Al}_b\text{Ga}_{1-b}\text{N}$ (with b at least 0 and less than 1). *Id.* at 20:15–19.

Fig. 12 of Nakamura, reproduced below, illustrates a cross-sectional view of another light-emitting device. *Id.* at 5:60–63.

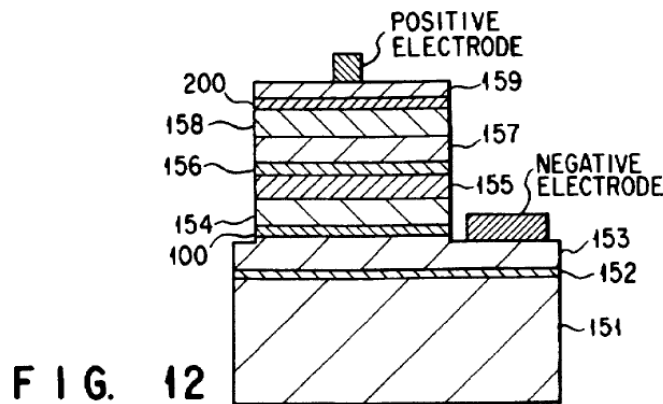


Fig. 12 illustrates a cross-sectional view of a light-emitting device provided with a light-reflecting film. *Id.* at 5:60–63.

The light-emitting device illustrated in Fig. 12 includes a first multi-layered film 100 and a second multi-layered film 200. *Id.* at 21:59–22:27. First multi-layered film 100 and second multi-layered film 200 are each formed of nitride semiconductors differing in composition and in refractive

index which are alternately superimposed under the condition, for example, of $\lambda/4 n$ (where λ is the wavelength, and n is a refractive index) thereby forming a two or more-ply structure so as to reflect the emission wavelength of an active layer 156. *Id.* First multi-layered film 100 is interposed between a second n-type clad layer 154 and an n-type contact layer 153, and second multi-layered film 200 is interposed between a second p-type clad layer 158 and a p-type contact layer 159, so that if a laser oscillation is effected using, for example, a stripe electrode of 10 μm or less as a positive electrode, the light emission from active layer 156 can be confined through these multi-layered films in the active layer to easily allow the generation of a laser oscillation. *Id.*

7. *Allen (Ex. 1031)*

Allen is titled “A Lamp Employing a Monolithic LED Device,” and “relates to a lamp having an array of LED dies, and, in particular, to a lamp employing a monolithic LED device.” Ex. 1031, code (54), 1:5–6. Allen’s lamp includes one or more monolithic LED devices, each having an array of LED dies rather than pre-packaged, the discrete LEDs providing light sources. *Id.* at code (57). Each monolithic LED device may have the LED dies wired in block series-parallel form, in order to optimize the size and cost of a voltage converter. *Id.* The LED dies are coupled as the array on the substrate, and then encapsulated in a light conducting medium forming a lens on the array of LED dies. *Id.* The LED dies may be controlled such that its individual color components, e.g., red, green, and blue, are either variable or fixed. *Id.*

Figs. 6A and 6B of Allen, reproduced below, illustrate a top view of an “A-type” screw-in hemispherical lamp configuration (Fig. 6A), and a side

view of the “A-type” screw-in hemispherical lamp configuration. *Id.* at 3:17–20.

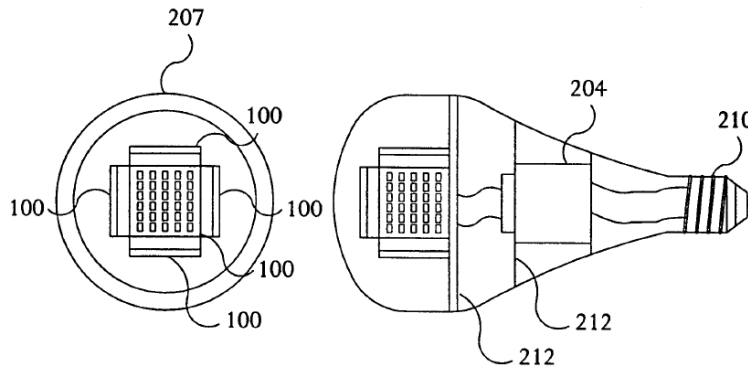


FIG. 6A

FIG. 6B

Figs. 6A and 6B illustrate a top view of an “A-type” screw-in hemispherical lamp configuration (Fig. 6A), and a side view of the “A-type” screw-in hemispherical lamp configuration. *Id.* at 3:17–20.

The lamp illustrated in Figs. 6A and 6B employs one or more monolithic LED devices 100 in a bulb housing 207. *Id.* at 6:10–12. Housing 207 includes mounting brackets 212, a voltage converter 204, and a base 210. *Id.* at 6:10–12, 6:27–34. The parts of the lamp housing are fastened or glued together in a hermetically sealed fashion to prevent moisture damage. *Id.* at 6:32–34. The lamp includes either a set of white dies, or a set of colored RGB dies, for the LED dies that produce light output power of a desired color temperature. *Id.* at 8:35–9:2. These sets of dies are wired together in a block series-parallel configuration. *Id.* at 9:1–7. The lamp illustrated in Figs. 6A and 6B is a standard 110 VAC “A-type” hemispherical lamp configuration based on a set of five planar monolithic LED devices 100. *Id.* at 9:29–10:3. Each monolithic LED device 100 may have an equivalent light output incandescent power requirement of 20 Watts

(200 lumens), forming a replacement for an equivalent 100 Watt incandescent bulb. *Id.* Mounting 212 supporting the five monolithic LED devices 100 may be transparent or translucent, whereas the mounting 212 that supports the voltage converter 204 is preferably opaque. *Id.* Variations of this lamp configuration may be employed with dies providing red, green or yellow colors. *Id.*

8. *Zabransky (Ex. 1026)*

Zabransky is a design patent titled “Lamp,” and describes an ornamental design for a lamp. Ex. 1026, codes (54), (57). Zabransky’s lamp includes a cylindrically-shaped bulb for use in a light socket. *See* Ex. 1026, Figs. 1–2, 5–6.

H. Unpatentability Grounds

1. *Unpatentability over Begemann, Sugiura, Bogner, and Krames (Petitioner’s Ground 1)*

Petitioner asserts that claims 21, 25–29, 36, 40, 42, 43, 47–49, and 52–57 are unpatentable under 35 U.S.C. § 103(a) as obvious over Begemann in view of Sugiura, Bogner, and Krames, citing the Declaration of Dr. Jokerst for support. Pet. 6, 23–70 (citing Ex. 1002). Below, we address the limitations of claim 21 (which includes the limitations of claims 1, 7, and 8) while addressing the dependent claims collectively. We note that Patent Owner generally does not dispute Petitioner’s assertions on the merits at this time.

a. *Claim 21*

[1.pre] A semiconductor light source for emitting light to illuminate a space used by humans, the semiconductor light source comprising:

Petitioner argues that Begemann teaches this claim limitation. Pet. 32–33. Based on the current record, we find Petitioner’s argument to be sufficiently supported by evidence. Begemann teaches, for example, LED lamps with high luminous flux that can replace customary incandescent lamps. Ex. 1005, 2:1–5; *see also id.* at Fig. 4 (illustrating light outside a house).

[1A] an enclosure, said enclosure being fabricated from a material substantially transparent to white light

Petitioner argues that Begemann teaches this claim limitation. Pet. 33–34. Based on the current record, we find Petitioner’s argument to be sufficiently supported by evidence. Begemann teaches, for example, enclosure (5) made of a “(semi-)transparent envelope” that may be fabricated from glass or synthetic resin. Ex. 1005, 2:22–26; *see also id.* at Figs. 1, 2.

[1B] an interior volume within said enclosure

Petitioner argues that Begemann teaches this claim limitation. Pet. 34. Based on the current record, we find Petitioner’s argument to be sufficiently supported by evidence. Begemann teaches, for example, that enclosure (5) defines an interior volume. *See, e.g.*, Ex. 5, Figs. 1, 2.

[1C] a heat sink located in said interior volume, said heat sink being capable of drawing heat from one or more semiconductors devices

Petitioner argues that Begemann teaches or renders obvious this claim limitation. Pet. 35–36. Based on the current record, we find Petitioner’s argument to be sufficiently supported by evidence. Begemann teaches, for

example, “heat-conducting adhesive” that connects MC-PCB 12 to substrate 3. Ex. 1005, 5:17–26. The evidence supports that a person of ordinary skill in the art would have known that PCB 12, the heat-conductive adhesive, substrate 3, and gear column 1 form a heat sink that conducts heat away from the LEDs. Ex. 1005, 2:27–34; Ex. 1002 ¶¶ 113–15.

[1D] said heat sink having a plurality of panels on it suitable for mounting semiconductor devices thereon

Petitioner argues that Begemann teaches this claim limitation. Pet. 36–37. Based on the current record, we find Petitioner’s argument to be sufficiently supported by evidence. Begemann teaches, as part of the structure that acts as a heat sink, faces of polyhedron substrate 3 with LEDs 4 mounted thereon. Ex. 1005, Abstract, 1:24–28, 4:17–34, 5:17–22, 6:3–11, Figs. 1–2; Ex. 1002 ¶ 116.

[1E] said panels on said heat sink being oriented to facilitate emission of light from the semiconductor light source in desired directions around the semiconductor light source

Petitioner argues that Begemann teaches this claim limitation. Pet. 37–38. Based on the current record, we find Petitioner’s argument to be sufficiently supported by evidence. Begemann teaches panels in a tetrahedron orientation to facilitate light emission. *See, e.g.*, Ex. 1005, Figs. 1–2; 2:8–21 (“it has been found that a good uniformity in light distribution can already be obtained using substrates in the form of a tetrahedron”).

[1F] at least one semiconductor chip capable of emitting light mounted on one of said panels,

Petitioner argues that Begemann teaches this claim limitation. Pet. 38–39. Based on the current record, we find Petitioner’s argument to be sufficiently supported by evidence. Begemann’s LEDs 4 on its panels are semiconductor chips. Ex. 1005, Figs. 1–2, 3A; 4:26–34, 6:3–11, Ex. 1002 ¶¶ 118–119.

[1G] said semiconductor chip being capable of emitting monochromatic light

Petitioner contends the combination of Begemann and Bogner teaches this claim limitation. Pet. 39. Based on the current record, we find Petitioner’s argument to be sufficiently supported by evidence. Begemann teaches that its lamp emits monochromatic light. *See, e.g.*, Ex. 1005, 4:26–34 (“the LED lamp shown is monochromatic”). Bogner chips having, for example, a wavelength of 470 nm. Ex. 1007, 149. Petitioner sufficiently explains that a person having ordinary skill in the art would have understood based on the combined teachings of Begemann and Bogner that the white LED called for in Begemann would have been a blue LED with a phosphor coating. Pet. 30–31 (*citing* Ex. 1014, 371–375). Use of Bogner’s blue LED with a phosphor coating as the white LED in Begeman would have been simple substitution to obtain predictable results. *Id.*; *see also* Ex. 1002 ¶¶ 102, 120.

[1H] said semiconductor chip being selected from the group consisting of light emitting diodes, light emitting diode arrays, laser chips, LED modules, laser modules, and VCSEL chips, and

Petitioner argues that Begemann teaches this claim limitation. Pet. 40. Based on the current record, we find Petitioner’s argument to be sufficiently

supported by evidence. Begmann teaches light emitting diodes. *See, e.g.*, Ex. 1005, 1:4–12.

[11] a coating for converting monochromatic light emitted by said chip to white light

Petitioner contends the combination of Begemann and Bogner teaches this claim limitation. Pet. 40–41. Based on the current record, we find Petitioner’s argument is supported sufficiently by evidence. As explained above, the evidence supports that a person of ordinary skill in the art would have understood that Begemann’s reference to a white LED refers to or at least suggests a blue LED with phosphor coating (to produce white light). Ex. 1002 ¶¶ 122–127. Bogner establishes that use of a single blue LED coated in phosphor was a known way to make a white LED. Ex. 1007, 143–146.

[7] wherein said chip includes a substrate on which epitaxial layers are grown, a buffer layer located on said substrate, said buffer layer serving to mitigate differences in material properties between said substrate and other epitaxial layers, a first cladding layer serving to confine electron movement within the chip, said first cladding layer being adjacent said buffer layer, an active layer, said active layer emitting light when electrons jump to a valance[sic] state, a second cladding layer, said second cladding layer positioned so that said active layer lies between cladding layers, and a contact layer on which an electron may be mounted for powering said chip.

Petitioner contends the combination of Begemann, Bogner, and Sugiura teaches this claim limitation. Pet. 42–47. Based on the current record, we find Petitioner’s argument is sufficiently supported by evidence.

Begemann and Bogner do not teach the details of semiconductor layers, but Sugiura teaches these details. *Id.* (providing citations to Sugiura). Petitioner shows sufficiently explains that it would have been obvious to a person having ordinary skill in the art to use Sugiura's chip design to predictably perform the LED function of Begemann and Bogner because all three references seek to perform the same function. *Id.*

[8] further comprising a first and a second reflective layers, each of said first and second reflective layers being located on opposite sides of said active layer, said reflective layers serving to reflect light emitted by said active layer.

Petitioner contends the combination of Begemann, Bogner, and Sugiura teaches this claim limitation. Pet. 47–49. Based on the current record, we find Petitioner's argument to be sufficiently supported by evidence. In particular, Petitioner sufficiently shows that it would have been obvious to use Sugiura's laser diode design as an LED or that optical guide layers 514, 516 in Sugiura Figure 15 would reflect light. Pet. 48 (citing Ex. 1002 ¶¶ 139–140; Ex. 1008, 1:5–8, 9:53–58, 15:9–45, 23:59–24:44).

Petitioner also argues that Krames teaches these features. Pet. 49–50. Based on the current record, we find Petitioner's argument to be sufficiently supported by evidence. Petitioner annotates Krames Figure 3 to demonstrate how Krames teaches the recited reflective layers. *Id.*; Ex. 1011, Fig. 3; Ex. 1002 ¶ 142. Petitioner also provides evidence supporting that a person of ordinary skill in the art would have had reason to combine Krames' chip with Begemann's package to “compete more favorably with conventional lighting technologies in many applications.” Pet. 31–32 (quoting Ex. 1011, 6). Petitioner further provides evidence that a person of ordinary skill in the

art would have had a reasonable expectation of success in making this combination. *Id.*; Ex. 1002 ¶ 108.

[21a] wherein: said at least one semiconductor chip is a light emitting diode (LED) chip configured to output light at greater than about 40 milliwatts, and

Petitioner contends that Krames teaches that its LED chip achieves “a power output of over 170 mW.” Pet. 50. Based on the current record, we find Petitioner’s argument to be sufficiently supported by evidence. *See* Ex. 1011, 10; Ex. 1002 ¶ 144.

[21b] said LED chip is configured to emit monochromatic visible light.

Petitioner contends the combination of Begemann and Bogner teaches this claim limitation. Pet. 50. Based on the current record, we find Petitioner’s argument to be sufficiently supported by evidence. Both Begemann and Bogner teach or suggest semiconductor chips emitting monochromatic light. Ex. 1005, 4:30–34; Ex. 1007, 143, 149; Ex. 1002 ¶ 145. Petitioner further contends, with sufficient supporting evidence, that Krames discloses this limitation. Pet. 50; Ex. 1011, 5.

Conclusion as to claim 21

Based on the evidence in the present record, we determine that Petitioner has shown sufficiently for purposes of this Decision that the combination of Begemann, Bogner, Sugiura, and Krames teaches or suggests all elements of claim 21 and that Petitioner sufficiently shows that a person of ordinary skill in the art would have had reason to combine the references’ teachings with rational underpinning and reasonable expectation of success. Thus, we determine Petitioner has established a reasonable

likelihood of prevailing in showing that claim 21 is unpatentable over the combination of Begemann, Bogner, Sugiura, and Krames.

b. *Dependent Claims 25–29, 36, 40, 42, 43, 47–49, and 52–57*

Petitioner accounts for the limitations recited in claims 25–29, 36, 40, 42, 43, 47–49, and 52–57 (which depend from claim 21). Pet. 6, 51–70. Petitioner shows sufficiently for purposes of this Decision that each element of claims 25–29, 36, 40, 42, 43, 47–49, and 52–57 is taught or suggested by the combined teachings of Begemann, Bogner, Sugiura, and Krames and shows reason to combine the references’ teachings with rational underpinning and reasonable expectation of success. Thus, we determine that Petitioner has sufficiently established a reasonable likelihood of establishing claims 25–29, 36, 40, 42, 43, 47–49, and 52–57 are obvious in view of Begemann, Bogner, Sugiura, and Krames.

2. *Unpatentability over Begemann, Sugiura, Bogner, Krames, Krames, and Zabransky (Petitioner’s Ground 2)*

Petitioner asserts claim 41 (which depends from claim 21 via claim 40) is unpatentable under 35 U.S.C. § 103(a) as obvious over Begemann in view of Sugiura, Bogner, Krames, and Zabransky. Pet. 6, 70–74 (citing Ex. 1002).

Petitioner accounts for the limitations recited in claim 41. *Id.* Petitioner shows sufficiently for purposes of this Decision that each element of claim 41 is taught or suggested by the combined teachings of Begemann, Bogner, Sugiura, Krames, and Zabransky and shows reason to combine the references’ teachings with rational underpinning and reasonable expectation of success. Thus, we determine that Petitioner has sufficiently established a

reasonable likelihood of establishing claim 41 is obvious in view of Begemann, Bogner, Sugiura, and Zabransky.

3. *Unpatentability over Begemann, Nakamura, Matsubara, and Krames (Petitioner's Ground 3)*

Petitioner asserts that claims 21, 25–29, 36, 40, 42, 43, 47–49, and 52–57 are unpatentable under 35 U.S.C. § 103(a) as obvious over Begemann in view of Nakamura, Matsubara, and Krames, citing the Declaration of Dr. Jokerst for support. Pet. 75–89 (citing Ex. 1002) (Petitioner's Ground 3). Below, we address the limitations of claim 21 (which includes the limitations of claims 1, 7, and 8) while addressing the dependent claims collectively. We again note that, Patent Owner does not dispute Petitioner's assertions on the merits at this time.

a. *Claim 21*

Begemann's teachings apply to claim 1 for the reasons we explain with regard to claim 1. For this ground, Petitioner uses Matsubara rather than Bogner as providing a teaching of a phosphor coating to convert monochromatic blue LED light to white light. Pet. 80.

Based on the current record, we find Petitioner's argument regarding Matsubara's teachings to be sufficiently supported by evidence. Pet. 80–82 (*citing, e.g.,* Ex. 1009 ¶¶ 11–16, 38, 44, 49–50, 55, 76, 95–97). Petitioner also adequately establishes, with supporting evidence, that a person of ordinary skill in the art would have had reason to combine the references' teachings with rational underpinning and reasonable expectation of success. *Id.* (*citing, e.g.,* Ex. 1002 ¶¶ 202–205).

This ground also refers to Nakamura's teachings regarding layer structure rather than Sugiura. *Id.* at 82–83. Petitioner presents evidence that

Nakamura teaches the claimed layer structure. *Id.* (citing Ex. 1002 ¶ 1999; Ex. 1006, 1:19–40, 2:30–565, 6:12–30, 22:46–61). Petitioner also presents evidence that Nakamura describes the reflective layers of claim 8. *Id.* at 85–86 (citing Nakamura). Petitioner also adequately establishes, with supporting evidence, that a person of ordinary skill in the art would have had reason to combine the references’ teachings with a reasonable expectation of success. *Id.* at 84–85 (citing, e.g., Ex. 1002 ¶ 209–216).

Conclusion as to claim 21

Based on the evidence in the present record, we determine that Petitioner has shown sufficiently for purposes of this Decision that the combination of Begemann, Nakamura, Matsubara, and Krames teaches or suggests all elements of claim 21 and that Petitioner sufficiently shows reason to combine the references’ teachings with rational underpinning and reasonable expectation of success. Thus, we determine Petitioner has established a reasonable likelihood of prevailing in showing that claim 21 is unpatentable over the combination of Begemann, Nakamura, Matsubara, and Krames.

b. *Dependent Claims 25–29, 36, 40, 42, 43, 47–49,
and 52–57*

Petitioner accounts for the limitations recited in claims 25–29, 36, 40, 42, 43, 47–49, and 52–57 (which depend from claim 21). Pet. 87. Petitioner shows sufficiently for purposes of this Decision that each element of claims 25–29, 36, 40, 42, 43, 47–49, and 52–57 is taught or suggested by the combined teachings of Begemann, Nakamura, Matsubara, and Krames and shows reason to combine the references’ teachings with rational underpinning and reasonable expectation of success. Thus, we determine

that Petitioner has sufficiently established a reasonable likelihood of establishing claims 25–29, 36, 40, 42, 43, 47–49, and 52–57 are obvious in view of Begemann, Nakamura, Matsubara, and Krames.

4. *Unpatentability over Begemann, Nakamura, Matsubara, Krames, and Zabransky (Ground 4)*

Petitioner asserts claim 41 (which depends from claim 21 via claim 40) is unpatentable under 35 U.S.C. § 103(a) as obvious over Begemann in view of Matsubara, Nakamura, and Zabransky. Pet. 89–90 (citing Ex. 1002).

Petitioner accounts for the limitations recited in claim 41. *Id.* Petitioner shows sufficiently for purposes of this Decision that each element of claim 41 is taught or suggested by the combined teachings of Begemann, Nakamura, Matsubara, Krames, and Zabransky and shows reason to combine the references' teachings with rational underpinning and reasonable expectation of success. Thus, we determine that Petitioner has sufficiently established a reasonable likelihood of establishing claim 41 is obvious in view of Begemann, Nakamura, Matsubara, Krames, and Zabransky.

5. *Unpatentability over combinations including Allen (Grounds 5 through 8)*

Grounds five through eight are the same as grounds one through four except that Petitioner additionally relies on Allen teaching a blue LED with a phosphor coating. Pet. 90–94. Petitioner presents sufficient evidence regarding Allen's teachings and shows reason to combine the references' teachings with rational underpinning and reasonable expectation of success. *Id.* (citing, e.g., Ex. 1014, 371–375; Ex. 1005, 3:6–9, 6:3–21, claim 5, Fig. 3A; Ex. 1031, 4:9–12, Figs. 6a–6b; Ex. 1002 ¶¶ 229–239). We determine that Petitioner has sufficiently established a reasonable likelihood of

establishing unpatentability based on these grounds for substantially the same reasons as we explain for grounds one through four.

IV. CONCLUSION

For the reasons above, we determine that the information presented in the Petition establishes that there is a reasonable likelihood that Petitioner would prevail with respect to challenged claims 21, 25–29, 36, 40–43, 47–49, and 52–57 of the '961 patent. At this juncture in the proceeding, we have not made a final determination with respect to the patentability of the challenged claims, or with respect to claim construction.

V. ORDER

For the foregoing reasons, it is

ORDERED that pursuant to 35 U.S.C. § 314(a), an *inter partes* review of claims 21, 25–29, 36, 40–43, 47–49, and 52–57 of the '961 patent is hereby instituted with respect to all grounds of unpatentability set forth in the Petition; and

FURTHER ORDERED that pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4, notice is hereby given of the institution of a trial; the trial will commence on the entry date of this Decision.

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Patent 6,465,961 C2

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