No. 25-

IN THE

Supreme Court of the United States

CAO LIGHTING, INC.,

Petitioner,

v.

WOLFSPEED, INC., CREE LIGHTING USA LLC F/K/A IDEAL INDUSTRIES LIGHTING LLC, LEDVANCE LLC, GENERAL ELECTRIC COMPANY, CONSUMER LIGHTING (U.S.), LLC, DBA GE LIGHTING, CURRENT LIGHTING, SOLUTIONS, LLC, OSRAM SYLVANIA, INC., FEIT ELECTRIC COMPANY, INC.,

Respondents.

ON PETITION FOR A WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT

PETITION FOR A WRIT OF CERTIORARI

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QUESTION PRESENTED

Whether the Federal Circuit's use of its Local Rule 36, which allows summary affirmance without opinion, (a) improperly defers to the Patent Trial and Appeal Board's interpretations of law in *inter partes* review proceedings and so denies judicial review of agency decisions on questions of law as required by *Loper Bright Enterprises v. Raimondo*, (b) improperly insulates the PTAB from the de novo review required by the Administrative Procedure Act, and (c) violates Congress's explicit direction in 35 U.S.C. § 144 requiring an "opinion" of all appeals from the Patent Office.

RULE 29.6 STATEMENT

CAO Lighting, Inc. ("CAO Lighting") is a wholly-owned subsidiary of CAO Group, Inc. No public company owns 10% or more stock in CAO Group, Inc.

RELATED PROCEEDINGS

CAO Lighting, Inc. v. Wolfspeed, Inc., et al., Appeal Nos. 2024-1194, 2024-1221, 2024-1222, 2024-1223, U.S. Court of Appeals for the Federal Circuit, judgment entered September 5, 2025, denial of request for panel review and en banc review November 6, 2025, mandate issued November 13, 2025.

CAO Lighting, Inc. v. Feit Electric Company, Inc., Case Nos. 2023-1906, 2023-1908, U.S. Court of Appeals for the Federal Circuit, judgment entered Oct. 16, 2024;

CAO Lighting, Inc. v. Feit Electric Company, Inc., C.A. No. 2:20-cv-04926-AB-SP, U.S. District Court for the Central District of California, case stayed.

CAO Lighting, Inc. v. General Electric Company et al., C.A. No. 1:20-cv-00681-GBW, U.S. District Court for the District of Delaware, jury verdict entered Feb. 17, 2023, and case stayed.

CAO Lighting, Inc. v. OSRAM Sylvania, Inc. et al., C.A. No. 1:20-cv-00690-GBW, U.S. District Court for the District of Delaware, case stayed.

CAO Lighting, Inc. v. Cree, Inc. et al., C.A. No. 1:21-cv-00634, U.S. District Court for the Middle District of North Carolina, case stayed.

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PETITION FOR WRIT OF CERTIORARI

Petitioner CAO Lighting respectfully petitions this Court for a writ of certiorari to review the judgment of the Court of Appeals for the Federal Circuit.

DECISIONS BELOW

The judgment of the U.S. Court of Appeals in *CAO Lighting, Inc. v. Wolfspeed, Inc. et al.*, Nos. 2024-1194, 2024-1221, 2024-1222, 2024-1223 (Fed. Cir. Sept. 5, 2025) is unreported and is reproduced at Pet.App.1a.[1]

The appeal to the Federal Circuit arose from Final Written Decisions issued by the Patent Trial and Appeal Board: *Wolfspeed, Inc. et al. v. CAO Lighting, Inc.*, IPR2022-00847 (PTAB Sept. 28, 2023), reproduced at Pet.App.5a-92a and *Wolfspeed, Inc. et al. v. CAO Lighting, Inc.*, IPR2022-00848 (PTAB Sept. 28, 2023), reproduced at Pet.App.93a-172a.

JURISDICTION

The Federal Circuit entered its judgment on September 5, 2025, and denied rehearing and rehearing en banc on November 6, 2025. This petition is timely filed pursuant to an extension granted by this Court to March 6, 2026 to file a petition for a writ

[1] This petition cites the materials in the Appendix to the Petition as "Pet.App." All other record citations are to the Joint Appendix filed in the Federal Circuit, Case No. 2024-1194, cited therein "Appx".

of certiorari. This Court has jurisdiction under 28 U.S.C. § 1254(1).

CONSTITUTIONAL, STATUTORY, AND REGULATORY PROVISIONS INVOLVED

Pursuant to Supreme Court Rule 14.1(f), relevant provisions of the U.S. Const. amend V (Pet.App.176a), 5 U.S.C. §§ 554(b)(3) & 554(c) (Pet.App.177a-178a), 5 U.S.C. § 556(d) (Pet.App.181a), 5 U.S.C. § 706 (Pet.App.183a-184a), and 35 U.S.C. § 144 (Pet.App.185a) are reproduced in the Appendix.

INTRODUCTION

In 1946, Congress enacted the Administrative Procedure Act ("APA") "as a check upon administrators whose zeal might otherwise have carried them to excesses not contemplated in legislation creating their offices." *Loper Bright Enterprises v. Raimondo*, 603 U.S. 369, 391 (2024) (quoting *United States v. Morton Salt Co.*, 338 U.S. 632, 644 (1950)). The APA was grounded in a "comprehensive rethinking of the place of administrative agencies in a regime of separate and divided powers." *Id.* (quoting *Bowen v. Michigan Academy of Family Physicians*, 476 U.S. 667, 670-671 (1986)). In addition to prescribing procedures for agency action, the APA delineates the basic contours of *judicial review* of agency action—including, as relevant here, that the reviewing court shall decide "all relevant questions of law" and "hold unlawful" any action, finding, or conclusion not in accordance with the law. 5 U.S.C. § 706. Grounded in due process, the

APA requires agencies to provide reasoned explanations for their decisions, *see id.*, and provides that participants in an agency hearing "shall be timely informed of . . . the matters of fact and law asserted." 5 U.S.C. § 554(b)(3).

The proceedings below transgressed these principles twice over.

First, the Patent Trial and Appeal Board ("PTAB") of the United States Patent Office invalidated CAO Lighting's patent claims based on a claim construction—a question of law—in conflict with an Article III court's construction of the same claim term and a jury's finding of validity on the same prior art combination, and did so in its final written decisions without notice or opportunity to be heard.

Second, the Federal Circuit summarily affirmed, without opinion, those PTAB final written decisions under Federal Circuit Rule 36. The Federal Circuit's failure to provide any reason for its decision violates 35 U.S.C. § 144, which requires the Federal Circuit to issue a "mandate and opinion" after it conducts a "review" of PTAB decisions, including claim-construction decisions. "[A]n exercise of the 'judicial Power' derives its legitimacy from the court's elaboration of reasons," since such reason-giving helps ensure compliance with the rule that "like cases should be treated alike." Michael C. Dorf, *Dicta and Article III*, 142 U. Pa. L. Rev. 1997, 1997, n.4 (1994); *see also* Frederick Schauer, *Giving Reasons*, 47 Stan. L. Rev. 633, 635 (1995) ("The act of giving a reason . . . is an exercise in generalization. The . . . judge who gives a reason steps behind and beyond the case at hand to something more encompassing."). As Judge

encompassing."). As Judge Wilkinson has observed, "[t]he duty of exposition seeks to remind the judge that the power to do something is not the same as the right to do it—that right can be earned, if at all, through reason." J. Harvie Wilkinson III, *The Role of Reason in the Rule of Law*, 56 U. Chi. L. Rev. 779, 798 (1989). In what has become an all-too-common practice, the Federal Circuit's summary affirmance failed to fulfill that duty.

For these reasons, CAO Lighting respectfully requests that the Court grant review of this case and hold that the Federal Circuit must provide the reasons for its decisions that demonstrate independent and de novo review of questions of law decided by the PTAB and challenges to whether the PTAB violated guarantees and requirements under the APA.

STATEMENT OF THE CASE

A. Dr. Cao invents and patents groundbreaking technology to solve an industry-wide problem.

Nearly 26 years ago, Dr. Densen Cao filed the applications that issued as the '961 and the '770 patents. Appx137, 168. These patents provided a solution to a problem that had long vexed the lighting industry: how to replace traditional incandescent and fluorescent general purpose lights with high-powered light emitting diodes (LEDs). Appx154 ('961 patent, 1:6-31); *id.* ('961 patent, 1:46-53); Appx185 ('770 patent, 1:5-31); *id.* ('770 patent, 1:46-53). The shared specification describes how LEDs were not "successfully and economically used to illuminate physical spaces." *E.g.,* Appx154 ('961 patent, 1:20-22).

Not only did LEDs typically lack the necessary high-intensity light to illuminate residential, commercial, and outdoor spaces, but they "took an excessive amount of physical space and created unmanageable amounts of heat." Appx154 ('961 patent, 1:27-28); *see also* Appx14362-14372 (describing problems faced in the lighting industry before 2001 because of inefficiency, intensity, and heat); Appx14925-14939 (describing problems associated with using white light LEDs for general illumination at the time of the invention).

The '961 and '770 patents issued on October 15, 2002 and October 21, 2003, respectively. A few years later, Dr. Cao introduced the Dynasty® family of LED lighting products, which embodied Dr. Cao's patented inventions and were heralded for their efficiency. Appx14865. Dr. Cao's Dynasty LED lighting was selected to illuminate the Louis Vuitton store on the Las Vegas strip in 2009 (Appx14889) and the famous Ghirardelli Square sign in San Francisco in 2010 (Appx14891)—a testament to the success of Dr. Cao's invention. Dr. Cao later formed CAO Lighting, Inc. and assigned the patents to that company.

Years after Dr. Cao's patents issued, several major lighting industry players—General Electric, Osram Sylvania, Feit Electric, and Cree Lighting—introduced their own LED lights that incorporated Dr. Cao's patented technology without authorization. To protect the patent rights he had earned through years of innovation and resources spent developing and marketing his own LED lights, Dr. Cao filed suit against several of these major lighting companies in federal court in the District of Utah in May 2011. *CAO*

Group, Inc. v. GE Lighting, Inc. et al., Case No. 2:11-cv-00426-DB.

B. Dr. Cao's patents withstand rigorous scrutiny in reexamination proceedings with new claims allowed.

Shortly following Dr. Cao's filing of his lawsuit in May 2011, two of the accused infringers, GE Lighting and Osram Sylvania, filed six *inter partes* and *ex parte* reexamination proceedings against Dr. Cao's patents. Appx6542-6615; Appx7911-8054; Appx9657-9879; Appx16117-16181; Appx16437-16694; Appx17281-17462. The Utah case was stayed pending these reexaminations.

The USPTO reexamined the original claims of Dr. Cao's patents primarily in view of International Patent Application Publication No. WO 00/17569 to Begemann ("Begemann"). Appx6103-6117; Appx17199-17214. During reexamination, the original claims of Dr. Cao's patents were cancelled, and new claims were determined to be patentable by the USPTO. Appx160, Appx196. In each patent, the first new claim: (1) incorporates the structure of the light source and semiconductor chip from the original claims; (2) limits the claimed semiconductor chip to a "light emitting diode (LED) chip;" and (3) requires that the LED chip be "configured to output light at greater than 40 milliwatts." Appx162-165, Appx199-202.

These allowed reexamined claims cover the fundamental structure of light sources containing heat sink configurations on which high-powered LED

chips are mounted to emit visible light. Appx14345. Critically, these claims were patentable over Begemann because "it would not have been obvious to have modified Begemann to include one or more LED chips 'configured to *output light at greater than about 40 milliwatts*' because the structure of Begemann is not equipped to handle the increase in heat generation that such a modification would necessarily entail." Appx5916 (emphasis in original).

C. A federal jury finds Dr. Cao's reexamined '961 patent valid and infringed.

In 2020, CAO Lighting renewed its enforcement of Dr. Cao's reexamined patents by filing suit in the United States District Court for the District of Delaware for infringement of, among others, claim 21 of the '961 patent: *CAO Lighting, Inc. v. General Electric Company et al.*, C.A. No. 1:20-cv-00681-GBW and *CAO Lighting, Inc. v. OSRAM Sylvania, Inc. et al.*, C.A. No. 1:20-cv-00690-GBW. CAO Lighting also filed suit against another infringer previously sued in the original Utah action, Feit Electric. *CAO Lighting, Inc. v. Feit Electric Company, Inc.*, C.A. No. 2:20-cv-04926-AB-SP, United States District Court for the Central District of California.

In August 2021, CAO Lighting filed an action against another infringing LED lighting company, Cree Lighting. *CAO Lighting, Inc. v. Cree, Inc. et al.*, C.A. No. 1:21-cv-00634, United States District Court for the Middle District of North Carolina. CAO Lighting had not previously sued Cree Lighting.

The case against GE and Current Lighting, who had acquired a portion of GE's LED lighting business, went to trial in February 2023. The defendants contended that the asserted claims were obvious in view of Begemann and another prior art reference co-authored by Michael Krames, Ph.D. *See* Appx11851-11876; Appx11930-11935. The Krames paper, which discusses experimental testing of LEDs and their potential use in traffic signals and flashlights, was selected for presentation at the proceedings of The International Society for Optical Engineering in 2000 ("Krames 2000"). Appx10706-10724. Dr. Krames, who was engaged as an expert by the Delaware defendants, opined that his Krames 2000 paper discloses an LED chip configured to output light greater than 40 mW because "[a] power output of over 170 mW is obtained at a drive current of 1.5 A dC." Appx11935. Dr. Krames further opined that a person of ordinary skill in the art (POSITA) would be motivated to combine his 170 mW LED chip driven at 1.5 amps with Begemann to achieve the features of the claims. Appx12169-12170.

On February 17, 2023, the jury rejected Dr. Krames' invalidity opinions based on combining Krames 2000 with Begemann and returned a verdict that the asserted claims 21, 32, and 36 of the '961 patent were infringed and not invalid. *See* Appx15722-15724. The jury also awarded damages to CAO Lighting.

D. The PTAB invalidates Dr. Cao's patents based on the same obviousness combination rejected by the Delaware jury.

1. Cree Lighting files IPR petitions asserting Krames 2000 discloses a 170 mW LED at 1.5 amps, on which ground the PTAB institutes.

In April 2022, Cree Lighting filed petitions for *inter partes* review of the '961 and '770 patents based on obviousness grounds that included the same Begemann/Krames 2000 combination rejected by the Delaware jury. Appx9987-10148. Cree's expert, Dr. Michael Lebby, also relied on the same disclosure in Krames 2000 (as Dr. Krames did at the Delaware trial) of an LED chip driven at 1.5 amps to output power of over 170 mW. Appx10071. Dr. Lebby did not, however, explain how the heat sinks in Begemann could dissipate the heat generated by these LEDs having an output of 170 mW at a drive current of 1.5 amps.

On October 19, 2022—even though the Delaware district court case was set for trial just four months later—the PTAB instituted the proceedings from which these present appeals arise.[2] Appx430-476, Appx1291-1325. As to the combination of Begemann and Krames 2000, the PTAB relied on the same disclosure of an LED chip driven at 1.5 amps to

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[2] The Delaware defendants and Feit then filed their own copycat IPR petitions for the '961 patent and requested joinder, which was granted by the PTAB. *See* Appx2144-2154, 2344-2354.

output light of over 170 mW as Dr. Krames did in the Delaware trial and Cree did in its petitions. Appx462; Appx1317.

2. CAO Lighting demonstrates the proposed combination on which the IPRs were instituted would be catastrophically unworkable.

In response, CAO Lighting submitted evidence that a person of skill in the art would not be motivated to combine Begemann with the 170 mW LED chip from Krames 2000, Appx637-642, because, among other reasons, the combination would "lead to the LEDs overheating and burning out . . . [or] would cause the insulating coating on the wiring to melt and likely catch fire . . . ." *See e.g.*, Appx15321, Appx15154-15187; Appx15279-15322. CAO Lighting's evidence included opinions, models, and testing from three different experts in the field that demonstrated the heat generated by the proposed combination of the Krames 2000 chip (170 mW output based on a drive current of 1.5 amps) in the structure of Begemann would cause catastrophic heating and be unacceptably inefficient. *See, e.g.*, Appx14971-14976, Appx15178-15186, Appx15313-15322.

3. Cree abandons its original theory and pivots to a new theory and a new expert.

Rather than contest CAO Lighting's evidence, Cree fled from the only argument presented in its petition. In fact, Cree shifted both theories *and* experts—submitting the declaration of the very same

Dr. Krames whose testimony was rejected by the Delaware jury. Admitting that the combination of Begemann with his LED chip having 170 mW of optical output when driven at 1.5 amps is "quite unreasonable and a [person of skill in the art] would not have even entertained that in actual product development," Appx10781—an admission directly fatal to Cree's original IPR petitions—Dr. Krames (and Cree) pivoted to a new combination of elements from Begemann and Krames 2000. *See* Appx735-740 (alleging a combination of Begemann with another experimental LED from Krames 2000 that output light of 45 mW at a drive current of 250 milliamps).

4. The PTAB invalidates all but one challenged claim by using a new claim construction that contradicts the Delaware district court's construction.

On September 28, 2023, *seven months after the Delaware jury found Dr. Cao's patents valid*, the PTAB issued its Final Written Decisions, invalidating all but one of the claims in the challenged patents. Pet.App.5a-92a, 93a-172a. The PTAB held that the claims were invalid over a combination of Begemann and Krames 2000 because Cree proved "the capability of the Krames chip" to achieve a power output of over 170 mW at a drive current of 1.5 amps. Pet.App.55a. The PTAB thus construed the limitation of "configured to output light at greater than about 40 milliwatts" to require only that the LED chip be "*capable* of the recited output." Pet.App.70a (emphasis in original). The PTAB concluded, therefore, that the claim would be satisfied by any chip theoretically capable of the claimed output, without any

requirement that "a chip [], when placed in the bulb, actually operates at more than about 40 milliwatts," Pet.App.55a.

The PTAB's theoretical "capability" construction ignored and contradicted the Delaware court's construction that the capability of the LED chip emitting light greater than 40 mW must be demonstrated with a reliable drive current. Prior to trial in February 2023, based on a motion by the Delaware defendants, the Delaware court rejected a mere "capability" approach which tested LED chips removed and apart from the accused LED light bulbs. *CAO Lighting, Inc. v. General Electric Co.*, C.A. Nos. 20-681-GBW, 20-690-GBW, 2023 WL 1930354, at *11-12 (D. Del. Jan. 30, 2023). Instead, the court required the LED chip's light output be measured or calculated in a reliable manner with a drive current supplied by the light bulb and where the LED chip's optical output based on that drive current met or exceeded 40 mW. *Id.* at *12 (holding that CAO Lighting's expert "may opine on whether the LEDs in the Accused Products have light output greater than 40 milliwatts only if he confirmed that the drive currents he used were appropriate or otherwise derived the drive currents himself"). In other words, the Delaware court held that it was not sufficient that the LED chip on its own was "capable" of producing 40 mW of optical output in isolation. Rather, the LED chip had to be capable of this output in the circuit in which it was designed for in the accused light bulb. This understanding was applied by the jury, which found Dr. Cao's '961 patent valid over the Begemann/Krames 2000 combination.

In direct contrast to the Delaware court's application of the claim limitation, the PTAB's construction requires no capability for emitting 40 mW in the context of claims as a whole—that is, *in the claimed light source apparatus*. The PTAB's construction ignores the fact that the limitation it construed is part of a more expansive claim directed to the light bulb structure including an enclosure, a base, heat sink panels, and other structural elements.[3] The PTAB's construction not only improperly divorces the limitation from the rest of the claim elements, but it is also scientifically illogical given that an isolated LED chip (i.e., with no drive current) is *incapable* of emitting any light. The PTAB thus altogether eliminated the "configured to" requirement expressly recited in the claims—that the LED chip is "*configured to* output light at greater than about 40 milliwatts" as part of the claimed light source apparatus. Because the PTAB's claim construction disregarded any need to show that the 170 mW LED chip driven at 1.5 amps of Krames 2000 would actually work in the Begemann light bulb structure—including without causing it to catch fire—the PTAB swept away all of CAO Lighting's evidence and concluded the patent claims were obvious in view of combining the Krames 2000 chip emitting 170 mW driven at 1.5 amps with Begemann.

Although the PTAB contends it merely accepted the parties' construction, it in fact dramatically broadened the claim scope by looking at

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[3] The entirety of the challenged claim 21 of the '961 patent, which includes claims 1, 7, and 8, is reproduced at Pet.App.15a-17a. The entirety of the challenged claim 18 of the '770 patent, which includes claims 1 and 9, is reproduced at Pet.App.99a-101a.

the claim term in isolation from the rest of the claim elements. The PTAB's construction was directly contrary to how the Delaware court construed and interpreted the claim term and how Cree and its experts interpreted and applied the claim term throughout the IPRs. The PTAB's application of its construction to reach its obviousness finding then was directly contrary to the Delaware jury's verdict finding the same claims valid over the same combination of Begemann and Krames 2000.

The PTAB's construction was pronounced for the first time in the final written decisions. The PTAB gave no notice to CAO Lighting of this legal interpretation, provided no opportunity for CAO Lighting to respond, and thus deprived CAO Lighting of its rights under the Administrative Procedure Act.

E. The Federal Circuit summarily affirms without addressing the APA violations or the conflict with the Delaware court's construction.

On appeal, among other errors, CAO Lighting identified the PTAB's construction of the 40 mW limitation that ignored the district court's contrary construction and application of that claim term, on which the jury instructed and on which the jury reached the opposite conclusion from the PTAB on the same prior art combination presented by the same expert. Case No. 24-1194, Doc. 49, Appellant's Opening Brief at 37-54. CAO Lighting also raised the APA violations resulting from the PTAB's claim construction pronounced for the first time in its final written decisions. *Id.* at 53-54. *See also* Case No. 24-1194, Appellant's Reply Brief at 19-29.

On September 5, 2025, just three days after oral argument on CAO Lighting's appeal—an appeal that squarely presented the PTAB's legal determination of claim construction in disregard of the district court's claim construction and the related APA violations—the Federal Circuit summarily affirmed the PTAB final written decisions under Rule 36 without issuing any opinion. Pet.App.1a-4a. On November 6, 2025, the Federal Circuit denied CAO Lighting's petition for panel rehearing and rehearing en banc. Pet.App.173a.

REASONS FOR GRANTING THE PETITION

I. The Federal Circuit's Rule 36 summary affirmance improperly defers to the PTAB's decisions on questions of law in violation of this Court's *Loper Bright* decision.

In *Loper Bright*, this Court reaffirmed the principle that courts, not agencies, bear the ultimate responsibility for deciding questions of law consistent with the Administrative Procedure Act. The Court made clear that "courts, not agencies, will decide '*all* relevant questions of law'" arising on appeal from agency actions. *Loper Bright*, 603 U.S. at 391-92 (citing 5 U.S.C. § 706) (Court's emphasis). *Loper Bright* thus confirmed the foundational principle "embrac[ing] the Framers' understanding of the judicial function" that "[i]t is emphatically the province and duty of the judicial department to say what the law is." *Id.* at 385 (quoting *Marbury v. Madison*, 1 Cranch 137, 177 (1803)).

Under *Loper Bright*, therefore, courts must "decide legal questions by applying their own

judgment." 603 U.S. at 392. There is "no deferential standard for courts to employ in answering those legal questions." *Id.* And the APA requires courts to "hold unlawful" and set aside any action, findings, or conclusions by the agency not in accordance with the law. *Id.* at 391 (citing 5 U.S.C. § 706(2)(A)).

The IPR procedures conducted by the PTAB are not excluded from the APA's requirements. This Court in *Cuozzo Speed Technologies, LLC v. Lee* emphasized that the American Invents Act ("AIA") establishing the IPR process does not "enable the agency to act outside its statutory limits." 579 U.S. 261, 275 (2016). In *SAS Institute Inc. v. Iancu*, the Court reaffirmed application of the APA to PTAB decisions:

> If a party believes the Patent Office has engaged in " 'shenanigans' " by exceeding its statutory bounds, judicial review remains available consistent with the [APA], which directs courts to set aside agency action "not in accordance with law" or "in excess of statutory jurisdiction, authority, or limitations."

584 U.S. 357, 371 (2018) (citations omitted).

In IPRs, the PTAB frequently construes patent claim terms to determine their scope. This claim construction is ultimately a question of law "exclusively within the province of the court." *Markman v. Westview Instruments, Inc.*, 517 U.S. 370, 372 (1996). In *Markman*, the Court reasoned that claim construction is a question of law because it requires the court to determine the meaning of terms in a patent document—a task closely analogous to the

interpretation of written instruments, which has historically been a judicial function. *Id.* at 384–91. Thus, when the PTAB interprets a patent claim, it is deciding a question of law. If claim construction is "exclusively" a judicial function, then no agency—including the PTAB—can be the sole or final arbiter of what a claim term means without running afoul of *Loper Bright*.

The principle reaffirmed by *Loper Bright* that courts, not agencies, decide questions of law, carries particular force when applied to the Federal Circuit's now-routine practice of using Federal Circuit Rule 36 to summarily affirm the PTAB's final written decisions that frequently include construction of patent claim terms. The Federal Circuit's Rule 36 summary affirmance procedure is, however, irreconcilable with *Loper Bright's* requirement the court must decide legal questions, such as claim construction, *by applying its own judgment*. The Federal Circuit has acknowledged that Rule 36 "simply confirms" the result below and "does not endorse or reject any specific part" of the lower tribunal's reasoning. *See Phil-Insul Corp. v. Airlite Plastics Co.*, 854 F.3d 1344, 1355 (Fed. Cir. 2017). Rule 36 summary affirmances that neither endorse nor reject legal interpretations by the PTAB fall short of the judicial review and independent judgment required by *Loper Bright*.

Rule 36 affirmances are especially untenable for two additional reasons that occurred here: (1) the PTAB's claim construction was adopted without adequate notice or opportunity to be heard, and (2) the PTAB's construction conflicts with an Article III court's construction of the same claim term. Indeed,

the existence of conflicting claim constructions by an Article III court and the PTAB is striking evidence that the legal question is neither straightforward nor free from error. It begs for the court's independent judgment and review—as required by the APA and the separation of power principles reaffirmed by *Loper Bright*. Without an opinion explaining why the PTAB's claim construction is correct and why the district court's is not, it is difficult for a party to frame a certiorari petition and difficult for this Court to evaluate whether review is warranted.

In a post-*Loper Bright* world, where the Court has reaffirmed the judiciary's independent role in legal interpretation, the Federal Circuit's use of Rule 36 to silently defer to and endorse PTAB decisions on legal issues—including claim construction, and especially over an Article III court's conflicting construction—is an abdication of the judicial review required by *Loper Bright*.

II. Rule 36 summary affirmances cannot provide the required de novo judicial review of violations of the APA.

A. The APA requires notice and an opportunity to be heard on all matters of fact and law.

The APA unquestionably applies to IPR proceedings. Among other requirements under the APA, a patent owner in an IPR adjudicated by the PTAB " 'is undoubtedly entitled to notice of and a fair opportunity to meet the grounds of rejection' based on due process and [APA] guarantees." *Qualcomm Inc. v. Intel Corp.*, 6 F.4th 1256, 1262 (Fed. Cir. 2021)

(quoting *Belden Inc. v. Berk-Tek LLC*, 805 F.3d 1064, 1080 (Fed. Cir. 2015)). The APA requires that the PTAB timely inform the patent owner of the matters of fact and law asserted, 5 U.S.C. § 554(b)(3); provide all interested parties the opportunity for submission and consideration of the facts and arguments, a hearing, and decision, *id.* § 554(c); and allow a party to submit rebuttal evidence as may be required for a full and true disclosure of the facts, *id.* § 556(d). As noted above and emphasized in *Loper Bright*, § 706 mandates that the "reviewing court shall decide all relevant questions of law" and "hold unlawful and set aside agency action" that is contrary to law or adopted "without observance of procedure required by law." 603 U.S. at 391 (quoting 5 U.S.C. § 706). Moreover, the Federal Circuit must review the PTAB's compliance with the APA's procedural requirements de novo. *Axonics, Inc. v. Medtronic, Inc.*, 75 F.4th 1374, 1380 (Fed. Cir. 2023).

When initiating an IPR, petitioners must identify the specific grounds on which the challenge to each claim is based and supporting evidence for the challenge to each claim, *see* 35 U.S.C. §§ 312(a)(3), and "[h]ow the challenged claim is to be construed," *see* 37 C.F.R. § 42.104(b)(3). When the PTAB departs from the grounds or identifies clam constructions in its final written decision without giving the parties notice and an opportunity to address the new construction, it undermines the procedural framework expressly authorized by Congress and violates the APA's due process guarantees. The PTAB effectively moves the goalposts after the game has been played, depriving the patent owner of a meaningful opportunity to present evidence and argument under the

construction that will actually determine the outcome. When the PTAB adopts a claim construction that was not identified in the institution decision, not briefed by the parties, and not subject to adversarial testing, it acts "without observance of procedure required by law." *See Qualcomm*, 6 F.4th at 1262 (citation modified). When the PTAB applies a construction for a claim term for the first time in its final written decision, the patent owner has had no opportunity to present rebuttal evidence or expert testimony tailored to that construction. This is a textbook violation of the APA: the agency has adjudicated a property right on a ground the affected party never had a chance to address.

Rule 36 affirmance of such a decision compounds the separation-of-powers problem that the APA was enacted to cure. Not only does the PTAB resolve the existence of a private right, but the Federal Circuit's summary affirmance denies any meaningful judicial review of the procedural deficiency (or, as explained above, the substance of the PTAB's decision). This is precisely the kind of deficit that *Loper Bright* sought to remedy by insisting that courts exercise independent judgment rather than defaulting to agency conclusions.

B. The PTAB's *sua sponte* claim construction in conflict with an Article III court's construction independently demands a reasoned judicial review.

From the petitions through the final written decisions, no party in these IPRs disputed the claim term at issue. Nothing in the IPRs suggested the

PTAB would adopt a different construction than the Delaware district court's interpretation and application. CAO Lighting had every reason to rely on the Delaware court's construction; it governed the presentation of both infringement evidence and invalidity evidence at trial. The oral hearing before the PTAB provided no notice that a different construction was under consideration by the PTAB. Even if it had, the hearing in an IPR does not provide an adequate opportunity to respond. *See* Office Patent Trial Practice Guide, 77 Fed. Reg. 48,756, 48,768 (Aug. 14, 2012) ("No new evidence or arguments may be presented at the oral argument."). Even if CAO Lighting had somehow anticipated the PTAB's claim construction, it had no opportunity to present expert or documentary evidence to rebut the obviousness analysis that flowed from that construction. *See Qualcomm*, 6 F.4th at 1265.

In other cases, the Federal Circuit has vacated PTAB decisions for inadequate explanations and lack of fair notice, including where crucial grounds emerged too late for a meaningful response. *See, e.g.*, *Axonics,* 75 F.4th at 1381-1384; *Qualcomm*, 6 F.4th at 1262-1265. The APA and due process violation by the PTAB here is strikingly similar to the violations addressed in *Qualcomm*. There, the Federal Circuit held unlawful and set aside six IPR decisions because the PTAB adopted a dispositive claim construction without providing notice or an adequate opportunity to respond. *Qualcomm*, 6 F.4th at 1262. The court of appeals reiterated that the APA requires setting aside agency action that is "without observance of procedure required by law." *Id.* at 1262-63. Nor does a patent owner's opportunity to seek rehearing after receiving

notice through the final written decision provide an adequate opportunity to respond. *Id.* at 1265.

The consequences of the Federal Circuit's Rule 36 silence on APA and due process violations are serious. An Article III court applied its construction of the claim term one way, and a jury found Dr. Cao's patents valid and infringed. Seven months later, the PTAB applied its construction of the same term differently and found the same claims invalid based on essentially the same combination. The Federal Circuit's silent summary affirmance offered no guidance whatsoever, even though "inconsistent findings" should not occur "on the same technical issue between the same parties on the same record." *Vicor Corp. v. SynQor, Inc.*, 869 F.3d 1309, 1322 (Fed. Cir. 2017). The inconsistency in claim construction between the PTAB and the district court is even more pronounced since both the PTAB and the district court are now required to apply the same standard in construing the disputed claim term as set out in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005). *See* Changes to the Claim Construction Standard for Interpreting Claims in Trial Proceedings Before the Patent Trial and Appeal Board, 83 Fed. Reg. 51,340, 51,341 (Oct. 11, 2018) (codified at 37 C.F.R. § 42.100(b) (2020)).

Loper Bright confirms that courts—not agencies—must ultimately decide legal questions without deference. The IPR process is not excluded from this requirement. Separation of powers concerns are acutely implicated when vested patent rights are extinguished by an agency without judicial reasoning and in conflict with an Article III court. Indeed, "separation of powers—and its guarantee that cases

involving the revocation of vested property rights must be decided by Article III courts—is *itself* part of the process that is due under our Constitution." *United States v. Arthrex, Inc.*, 594 U.S. 1, 36 (2021) (Gorsuch, J., concurring in part and dissenting in part) (emphasis in original).

For the Federal Circuit to silently adopt the PTAB's construction over the district court's construction creates an unjustified hierarchy in which an agency's legal conclusion takes precedence over that of an Article III court's, merely by virtue of which appeal reaches the Federal Circuit first. At a minimum, the Federal Circuit must demand an explanation from the agency when that agency's findings contradict an Article III court's legal conclusion, and then the Federal Circuit must provide its own reasoned analysis of that contradiction and which interpretation of a legal question (by the agency or by the district court) is correct. Rule 36 should never be used to insulate due process and APA violations by the PTAB; and it cannot be used to avoid judicial review of an agency's interpretation of legal questions.

III. Rule 36 summary affirmances of PTAB decisions cannot be reconciled with 35 U.S.C. § 144's requirement for an "opinion."

Congress has *explicitly* mandated that in appeals from the Patent Office, the Federal Circuit "shall issue . . . *its mandate and opinion*," which must be "entered of record in the Patent and Trademark Office" and "govern the further proceedings in the case." 35 U.S.C. § 144 (emphasis added). Section 144

is not discretionary; it is a specific, unambiguous mechanism through which Congress directed the Federal Circuit to fulfill its obligation to exercise independent judicial review of legal conclusions of an agency.

Rule 36 summary affirmances do not, however, provide an "opinion" within the meaning of § 144 or meaningful judicial review required by the APA and *Loper Bright*. As stated by the Federal Circuit, its Rule 36 procedure neither endorses nor rejects any part of the PTAB's ruling. *See Phil-Insul.*, 854 F.3d at 1355. The Federal Circuit has rationalized its use of Rule 36 as within its "wide latitude" to decide "whether or how to write opinions." *Id.* But whether or not Rule 36 is justified in some appeals, its use here to summarily affirm the PTAB's decisions on legal questions—and the improper process by which it decided that legal question in violation of the APA—is improper. Indeed, APA and due process violations cannot have been addressed by the PTAB; rather, they were *caused by* the PTAB.

Challenges to Rule 36 affirmances of PTAB decisions of legal questions have been raised to this Court before. To date, the Court has declined review. In some of these certiorari petitions, the Solicitor General has provided the agency's position. For example, the Solicitor General rationalized that "when a Rule 36 summary affirmance is used to reject a legal challenge that is reviewed de novo, the affirmance communicates the court's judgment that the agency committed no legal error." Brief for the Federal Respondent in Opposition to Petition for a Writ of Certiorari at 11, *Specialty Fertilizer Products, LLC v. Shell Oil Company*, 585 U.S. 1017 (2018) (No.

17-1243); *see also* Brief for the Federal Respondent in Opposition to Petition for a Writ of Certiorari, *Ultratec, Inc. v. CaptionCall, LLC*, 142 S. Ct. 460 (2021) (No. 20-1700) (same); Brief for Respondent in Opposition to Petition for a Writ of Certiorari, *Celgard, LLC v. Iancu,* 584 U.S. 959 (2018) (No. 16-1526) (same). But those statements came before *Loper Bright*. In the only post-*Loper Bright* brief on the propriety of Rule 36 summary affirmances, the Solicitor General did not assert this same rationalization—that summarily affirming legal challenges reviewed de novo merely communicates the court's judgment that the agency committed no legal error. *See* Brief for the United States in Opposition to Petition for a Writ of Certiorari, *Audio Evolution Diagnostics, Inc. v. United States*, 145 S. Ct. 2777 (2025) (No. 24-806). The Solicitor General instead simply asserted that the use of summary affirmance there was permissible because "binding Federal Circuit precedent . . . controlled the outcome." *Id.* at 15. That rationale plainly has no application here.

After *Loper Bright*, the prior rationalizations for Rule 36 affirmances of PTAB interpretations of law or statute are highly suspect. A one-word statement "AFFIRMED" provides no assurance—to the parties, the public, or other courts—that the Federal Circuit conducted its own independent review of the legal question of claim construction, the conflict between the PTAB's construction and an Article III court's construction, or the fact that the PTAB's conflicting construction arose without notice or opportunity to be heard. "[A] decision without principled justification

would be no judicial act at all." *Planned Parenthood of Se. Pa. v. Casey*, 505 U.S. 833, 865 (1992).

In sum, *Loper Bright* forbids judicial deference to agency legal determinations. *Markman* reserves claim construction for the courts. The APA requires notice and a meaningful opportunity to be heard before an agency adjudicates property rights. And the existence of conflicting results with an Article III court and jury verdict demands a reasoned judicial opinion—not a one-line order. Taken together, these principles compel the conclusion that the Federal Circuit must, at a minimum, issue a reasoned opinion when reviewing a PTAB claim construction that was adopted under procedurally deficient circumstances and that conflicts with an Article III court's interpretation of the same term. Rule 36 affirmance in such cases is not merely inadvisable; it is unlawful.

IV. This case is an ideal vehicle for the Court to address the proper limits on summary affirmance in PTAB appeals.

As Justice Gorsuch recognized in his opinion concurring in part and dissenting in part in *Arthrex*, each new case this Court entertains on the IPR process established by the America Invents Act "highlights more and more problems with the statute"—including the due process challenges, the lack of independence of APJs who hear and decide which patents are invalidated while maintaining relationships with potential future employers, the Director's "plenary authority" to personally select APJs to hear specific IPR proceedings, the PTAB's power to overrule final judicial judgments affirming patent rights, and more. *Arthrex*, 594 U.S. at 35-37

(2021) (Gorsuch, J., concurring in part and dissenting in part). As Justice Gorsuch observed, "this menu of constitutional problems is surely just illustrative, not exhaustive." *Id*. at 37.

This case presents due process deprivations in the IPR process that were left open by the Court's majority opinion in *Oil States Energy Services, LLC v. Greene's Energy Group, LLC*, 584 U.S. 325 (2018). That holding was explicitly narrow, "address[ing] the constitutionality of inter partes review only." *Id*. at 344 ("We emphasize the narrowness of our holding."). Here, however, not only have Dr. Cao's patent rights been stripped away but so too has a jury verdict awarding him monetary damages for infringement of those patents—all without notice and opportunity to be heard in violation of the APA and with improper judicial deference to the PTAB's legal claim construction in contradiction to an Article III court's construction.

This case also presents the scenario that Justice Gorsuch, joined by Chief Justice Roberts, laid out in the opening paragraph of his *Oil States* dissent:

> After much hard work and no little investment you devise something you think truly novel. Then you endure the further cost and effort of applying for a patent, devoting maybe $30,000 and two years to that process alone. At the end of it all, the Patent Office agrees your invention is novel and issues a patent. The patent affords you exclusive rights to the fruits of your labor for two decades. But what happens if someone later

> emerges from the woodwork, arguing that it was all a mistake and your patent should be canceled? Can a political appointee and his administrative agents, instead of an independent judge, resolve the dispute?

584 U.S. at 346 (Gorsuch, J., dissenting).

Dr. Cao endured years of infringement of his patents and then years of reexamination of those patents resulting in claims found patentable by the Patent Office. A district court construed these claims, and a jury found the patents valid, infringed, and awarded damages. But the PTAB adopted in its final written decisions a construction divorced from the claim as a whole to arrive at a conclusion of obviousness. This finding was at odds with the entire history of Dr. Cao's patents through issuance, reexamination, and trial. The PTAB never explained the stark contradiction of its decision with the jury verdict finding the opposite. The PTAB stripped away Dr. Cao's patent rights in violation of the APA.

The Federal Circuit's Rule 36 summary affirmance exposes the illusory nature of judicial review under that procedural rule—which neither endorses nor rejects, and thus effectively defers to the judgment of the agency they are supposed to review. If the Patent Office engages in "shenanigans" by exceeding its statutory bounds, judicial review must be available consistent with the APA, as this Court emphasized in *SAS*, 584 U.S. at 371, and *Cuozzo,* 579 U.S. at 275. And the APA directs courts to set aside agency action as *unlawful* that is "contrary to constitutional right," "in excess of statutory

jurisdiction, authority, or limitations," or "arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law." 5 U.S.C. § 706(A)-(C).

Here, the PTAB veered off on its own, divorced from what the petition presented, and in disregard of what a district court and jury decided, in violation of the APA. These are the "shenanigans" that are supposed to be prevented by meaningful judicial review under *Loper Bright*, the APA, and § 144's "opinion" mandate. This is the kind of due process violation left open in *Oil States* for the right case. Surely, the Patent Office should be held to account for its arbitrary, improper claim construction and lack of compliance with the law at the end of the day, as envisioned by Justice Thomas in his concurrence in *Cuozzo*. 579 U.S. at 286-87. But with yet another Rule 36 summary affirmance by the only court authorized to review the Patent Office's actions, the statutory obligation of a meaningful review and opinion was ignored and improper deference given to an agency's interpretation of a question of law in violation of *Loper Bright*.

This, in fact, is the case that Justice Gorsuch predicted would need come before this Court—the case that provides the opportunity to address the "revolving door" of IPR issues and the ongoing due process problems created by the IPR process. *Arthrex*, 594 U.S. at 38 (Gorsuch, J., concurring in part and dissenting in part). This is the case that will allow the Court to hold that "the process due someone with a vested property right in a patent is a proceeding before a neutral and independent judge." *Id.*

This case thus presents an ideal vehicle to address the harms caused by the Federal Circuit's repeated use of Rule 36 in PTAB appeals when it involves the PTAB's decisions on questions of law or due process and APA violations—questions that demand a meaningful de novo review by the Federal Circuit. The fact that the PTAB's due process and APA violation arises from claim construction—a question of law—makes this case an especially appropriate vehicle. The PTAB's authority to construe patent claims in the first instance cannot remove judicial review of that construction without violating *Loper Bright*. The fact that the PTAB's construction and findings here diverged dramatically from an Article III court and jury trial highlights why this case is the right vehicle to address these issues.

V. Without this Court's intervention, the Federal Circuit's continuing use of Rule 36 in deference to PTAB decisions will harm the patent system and quell legitimate innovation.

This case is of exceptional importance to the uniformity, certainty, and integrity of the patent system. The underlying rationale for making claim construction a question of law—and for establishing a single court of appeals to hear all patent cases—is uniformity. *Markman*, 517 U.S. at 390 (emphasizing "the importance of uniformity in the treatment of a given patent as an independent reason to allocate all issues of construction to the court"). Otherwise, a "zone of uncertainty which enterprise and experimentation may enter only at the risk of infringement claims would discourage invention only a little less than unequivocal foreclosure of the field."

Id. (quoting *United Carbon Co. v. Binney & Smith Co.*, 317 U.S. 228, 236 (1942)). Furthermore, "[i]t was just for the sake of such desirable uniformity that Congress created the Court of Appeals for the Federal Circuit as an exclusive appellate court for patent cases . . . observing that increased uniformity would 'strengthen the United States patent system in such a way as to foster technological growth and industrial innovation.'" *Markman*, 517 U.S. at 390 (quoting H.R.Rep. No. 97-312, pp. 20-23 (1981)). But the Federal Circuit's Rule 36 deference, without explanation, to the PTAB's legal interpretation—contrary to an Article III court's interpretation of the same claim term—violates *Loper Bright* and undermines the legitimacy of the Federal Circuit's role in the patent system.

The lack of uniformity is particularly egregious here, where the same body effectively rules against itself. The Patent Office is tasked with issuing patents for legitimate inventions, creating a presumption of validity that inventors, patent owners, competitors, and the public rely upon. Yet the same agency invalidates the very patents it issued at historically alarming rates.[4] This is not an agency carefully "weed[ing] out bad patent claims," *Thryv, Inc v. Click-To-Call Techs., LP*, 590 U.S. 45, 54 (2020); it is an agency running roughshod over patent rights—and, with the Federal Circuit's equally alarming rate of

[4] At the time the PTAB invalidated Dr. Cao's patent claims in 2023, the rate of invalidity was reportedly an extraordinary 84%. Paul Morinville et al., *The PREVAIL Act Won't Work Unless PTAB Incentives are Balanced*, IPWatchdog (Aug. 6, 2023), https://ipwatchdog.com/2023/08/06/the-prevail-act-wont-work-unless-ptab-incentives-are-balanced/.

summary affirmances, an agency that is unchecked and undeterred.[5]

This Court's review also is necessary to the certainty and trust in the patent system that "form the backbone of our competitive American economy," and "[o]ur patent system has helped catalyze inventions that fuel industries and improve the quality of life . . . ." John A. Squires, Under Secretary of Commerce for Intellectual Property and Director of the United States Patent and Trademark Office, Ceremonial Swearing-in Remarks of John A. Squires (Sept. 22, 2025), https://www.uspto.gov/about-

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[5] In PTAB appeals in 2023, the Federal Circuit affirmed the PTAB on all issues 74% of the time. Daniel F. Klodowski et al., *Special Report: Trends in Federal Circuit PTAB Appeals Through 2023,* Finnegan's At the PTAB Blog (Apr. 19, 2024), https://www.finnegan.com/en/insights/blogs/at-the-ptab-blog/special-report-trends-in-federal-circuit-ptab-appeals-through-2023.html. In 2024, affirmance on all issues increased to 84% of the time. Erik R. Puknys et al., *Trending at the PTAB: Insights from 2024 Fed. Circ. Statistics*, Finnegan (Feb. 21, 2025), https://www.finnegan.com/en/insights/articles/trending-at-the-ptab-insights-from-2024-fed-circ-statistics.html. In these affirmances of the PTAB (almost all IPRs), the Federal Circuit used Rule 36 about 43% of the time to summarily affirm the PTAB's decisions in 2023. Daniel F. Klodowski et al., *Special Report: Trends in Federal Circuit PTAB Appeals Through 2023,* Finnegan's At the PTAB Blog (Apr. 19, 2024), https://www.finnegan.com/en/insights/blogs/at-the-ptab-blog/special-report-trends-in-federal-circuit-ptab-appeals-through-2023.html. In 2024, that percentage increased as well with the Federal Circuit using Rule 36 to summarily affirm the PTAB's decisions (again, almost all IPRs) to nearly 53%. Erik R. Puknys et al., *Trending at the PTAB: Insights from 2024 Fed. Circ. Statistics*, Finnegan (Feb. 21, 2025), https://www.finnegan.com/en/insights/articles/trending-at-the-ptab-insights-from-2024-fed-circ-statistics.html

us/news-updates/ceremonial-swearing-remarks-john-squires.

Indeed, recent actions by the USPTO underscore that restoring transparency and principled, uniform adjudication is an urgent policy imperative for the U.S. patent system. In September 2025, the Acting Director issued a memorandum instructing the PTAB that when it reaches a result different from prior Office, district court, or ITC adjudications on the same or substantially similar claims, the PTAB "shall explain" why a different outcome is warranted, with a "more detailed explanation" required where the same or substantially the same evidence or arguments are at issue. Memorandum from Coke Morgan Stewart, Acting Under Secretary of Commerce for Intellectual Property and Acting Director of the United States Patent and Trademark Office Coke Morgan Stewart, to Members of the Patent Trial and Appeal Board (Sept. 16, 2025).

This directive recognizes that reason-giving is essential to uniformity and public confidence. But while laudable, it does not—and cannot—suffice for meaningful judicial review of agency action required by *Loper Bright*. And it cannot excuse silent deference by the Federal Circuit's Rule 36 procedure to an agency's decisions on legal questions.

CONCLUSION

For the foregoing reasons, the petition for a writ of certiorari should be granted.

Respectfully submitted,

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APPENDIX

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APPENDIX A – RULE 36 JUDGMENT OF THE UNITED STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT DATED SEPTEMBER 5, 2025

UNITED STATES COURT OF APPEALS
FOR THE FEDERAL CIRCUIT

CAO LIGHTING, INC.,
Appellant

v.

WOLFSPEED, INC., CREE LIGHTING USA LLC F/K/A IDEAL INDUSTRIES LIGHTING LLC, LEDVANCE LLC, GENERAL ELECTRIC COMPANY, CONSUMER LIGHTING (U.S.), LLC, DBA GE LIGHTING, CURRENT LIGHTING SOLUTIONS, LLC, OSRAM SYLVANIA, INC., FEIT ELECTRIC COMPANY, INC.,
Cross-Appellants

2024-1194, 2024-1221

Appeals from the United States Patent and Trademark Office, Patent Trial and Appeal Board in Nos. IPR2022-00847, IPR2023-00123, IPR2023-00129

CAO LIGHTING, INC.,
Appellant

Appendix A

v.

WOLFSPEED, INC., CREE LIGHTING USA LLC
F/K/A IDEAL INDUSTRIES LIGHTING LLC,
Cross-Appellants

2024-1222, 2024-1223

Appeals from the United States Patent and Trademark Office, Patent Trial and Appeal Board in No. IPR2022-00848.

JUDGMENT

RONALD E. CAHILL, Barnes & Thornburg LLP, Boston, MA, argued for appellant. Also represented by HEATHER B. REPICKY; PAUL B. HUNT, JOSHUA PAUL LARSEN, TODD VARE, Indianapolis, IN.

JOHN C. ALEMANNI, Kilpatrick Townsend & Stockton LLP, Raleigh, NC, argued for all cross-appellants. Cross-appellants Cree Lighting USA LLC, Wolfspeed, Inc. also represented by MATIAS FERRARIO, Winston-Salem, NC; ANDREW N. SAUL, Atlanta, GA.

KEVIN P. MARTIN, Goodwin Procter LLP, Boston, MA, for cross-appellants Consumer Lighting (U.S.), LLC, Current Lighting Solutions, LLC, General Electric Company, LEDVANCE LLC, Osram Sylvania, Inc. Also represented by BRIAN DRUMMOND,

SRIKANTH K. REDDY; SANJEET DUTTA, Redwood City, CA. Cross-appellants Consumer Lighting (U.S.), LLC, General Electric Company also represented by CATHERINE GARZA, Norton Rose Fulbright US LLP, Austin, TX; ARTHUR P. LICYGIEWICZ, Dallas, TX. Cross-appellant Current Lighting Solutions, LLC also represented by FRANK A. ANGILERI, THOMAS W. CUNNINGHAM, JOHN P. RONDINI, Brooks Kushman PC, Royal Oak, MI. Cross-appellant Osram Sylvania, Inc. also represented by MARK A. HANNEMANN, Troutman Pepper Locke LLP, New York, NY.

RYAN DYKAL, Boies Schiller Flexner LLP, Washington, DC, for cross-appellant Feit Electric Company, Inc. Also represented by MARK SCHAFER; MAXWELL C. MCGRAW, Shook, Hardy & Bacon, LLP, Kansas City, MO; AMELIA ELIZABETH MURRAY, Chicago, IL.

THIS CAUSE having been heard and considered, it is

ORDERED and ADJUDGED:

PER CURIAM (LOURIE, TARANTO, and CUNNINGHAM, *Circuit Judges*).

AFFIRMED. *See* Fed. Cir. R. 36.

Appendix A

ENTERED BY ORDER OF THE COURT

/s/ Jarrett B. Perlow
Jarrett B. Perlow
Clerk of Court

September 5, 2025
Date

APPENDIX B – FINAL WRITTEN DECISION FROM THE UNITED STATES PATENT AND TRADEMARK OFFICE BEFORE THE PATENT AND TRIAL AND APPEAL BOARD IN IPR2022-00847 DATED SEPTEMBER 28, 2023

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

WOLFSPEED, INC., IDEAL INDUSTRIES LIGHTING, LLC D/B/A CREE LIGHTING, LEDVANCE LLC, GENERAL ELECTRIC COMPANY, CONSUMER LIGHTING (U.S.), LLC D/B/A GE LIGHTING, CURRENT LIGHTING SOLUTIONS, LLC, OSRAM SYLVANIA, INC., AND FEIT ELECTRIC COMPANY, INC.,

Petitioner,

v.

CAO LIGHTING, INC.,

Patent Owner.

IPR2022-00847
Patent 6,465,961 C2

Appendix B

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

JUDGMENT

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

I. INTRODUCTION

Wolfspeed, Inc. and IDEAL Industries Lighting, LLC d/b/a Cree Lighting ("Cree") (collectively, the "Original Petitioners") filed a Petition requesting *inter partes* review of claims 21, 22, 25, 26, 28–30, 32–36, 40–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 71–73, 77, 78, 81, 82, 85, 86, and 88–91 (the "Challenged Claims") of U.S. Patent No. 6,465,961 C2 (Ex.1001, "the '961 patent"). Paper 1 ("Pet."). We instituted *inter partes* review of the challenged claims on all asserted grounds. Paper 10 ("Dec."). After institution, Patent Owner filed a Patent Owner Response (Paper 32, "Resp."), Petitioner filed a Reply (Paper 44, "Reply"), and Patent Owner filed a Sur-Reply (Paper 50, "Sur-Reply"). An oral hearing was held on July 18, 2023, and a transcript of the hearing is included in the record (Paper 65, "Tr.").

LEDVANCE LLC ("LEDVANCE"), OSRAM Sylvania, INC. ("OSRAM"), General Electric

Company, Consumer Lighting (U.S.), LLC d/b/a GE Lighting ("GE"), and Current Lighting Solutions, LLC ("Current") (collectively, the "IPR2023-00123 Petitioners") also filed a Petition (IPR2023-00123, Paper 3) seeking *inter partes* review of the Challenged Claims of the '961 patent. The IPR2023-00123 Petitioners also filed a motion for joinder to be joined as a petitioner to the present matter. IPR2023-00123, Paper 2. After full briefing, we instituted *inter partes* review for IPR2023-00123 and joined that matter with the present matter. IPR2023-00123, Paper 19. The IPR2023-00123 Petitioners rely on the same grounds and same arguments as the Original Petitioners. *Id.* at 6–7, 9–10.

Feit Electric Company, Inc. ("Feit") also filed a Petition (IPR2023-00129, Paper 1) seeking *inter partes* review of the Challenged Claims of the '961 patent. Feit also filed a motion for joinder to be joined as a petitioner to the present matter. IPR2023-00129, Paper 3. After full briefing, we instituted *inter partes* review for IPR2023-00129 and joined that matter with the present matter. IPR2023-00129, Paper 14. The IPR2023-00123 Petitioners rely on the same grounds and same arguments as the Original Petitioners. *Id.* at 6–7, 9–10.

In this decision, we collectively refer to the Original Petitioners, the IPR2023-00123 Petitioners, and Feit as "Petitioner." We refer to documents from the present matter. The petitions and relevant

documents from IPR2023-00123 and IPR2023-00129 are the same in substance.

We have jurisdiction under 35 U.S.C. § 6. This decision is issued pursuant to 35 U.S.C. § 318(a). For the reasons that follow, we determine that Petitioner has shown, by a preponderance of the evidence, that claims 21, 22, 25, 26, 28–30, 32–36, 40, 42–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 71–73, 77, 78, 81, 82, 85, 86, and 88–91 of the '961 patent are unpatentable. We determine that Petitioner has not shown, by a preponderance of the evidence, that claim 41 is unpatentable.

II. BACKGROUND

A. Related Matters

The parties indicate that the '961 patent is the subject of the following district court proceedings: *CAO Lighting, Inc. v. Cree, Inc. et al.*[1] No. 1:21-cv-00634 (M.D.N.C.) ("the parallel district court litigation"), *CAO Lighting, Inc. v. GE Lighting, Inc., 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.

[1] Petitioner states that "Cree, Inc., a named defendant in the Underlying Litigation, is now Wolfspeed, Inc." Pet. 133 n.3. Petitioner identifies this case as "the district court case" or "Underlying Litigation" that involves the parties. Pet. 19.

Cal.), *CAO Lighting, Inc. v. Topaz Lighting Corp.,* No. 2-21-cv-08912 (C.D. Cal.), and *CAO Lighting, Inc. v. Signify NV f/k/a Philips Lighting NV et al.,* No. 2-21-cv-08972 (C.D. Cal.). Pet. 133–134; Paper 4, 1–2.

Patent Owner also identifies the following proceedings as related matters: *CAO Group v. GE Lighting et al.*, 2-11-cv-00426 (District of Utah), *CAO Lighting, Inc. v. Light Efficient Design et al.*, 4-16-cv-00482 (originally filed in District of Idaho), 1-17-cv-07359 (transferred to Northern District of Illinois), *inter partes* Reexamination Control No. 95/000,680, and *inter partes* Reexamination Control No. 95/002,324. Paper 4, 1.

We also note IPR2023-00123 and IPR2023-00129 which, as we explain above, have been joined with this matter. We also note that in IPR2023-00213 and IPR2023-00214, Signify North America Corp. challenges the '961 patent.

B. The '961 Patent

The '961 patent originally issued with claims 1–20. Ex. 1001, 9:52–12:63. After a first reexamination, claims 8 and 9 were cancelled and new claims 21–103 were added. *Id.* at p. 26, Ex Parte Reexamination Certificate ("EPRC") 1:26–8:62. Claims 1–7 and 10–20 were cancelled by an additional reexamination. *Id.* at p. 31, Inter Partes Reexamination Certificate ("IPRC") 1:10–12.

The '961 patent is titled "Semiconductor Light Source Using a Heat Sink with a Plurality of Panels." *Id.* at code (54). According to the '961 patent, "[p]rior

art semiconductor light sources have not been successfully and economically used to illuminate physical spaces." *Id.* at 1:20–22. The '961 patent states that "[t]ypical prior art LED modules lack high light intensity due to the size of the LED chips used." *Id.* at 1:23–25. In view of this, the '961 patent states there is a need "in the prior art for a semiconductor light source for use in illuminating a space with single color light in the visible range and which can efficiently dissipate the heat that they produce." *Id.* at 1:46–49.

We reproduce Figure 1 of the '961 patent below.

Appendix B

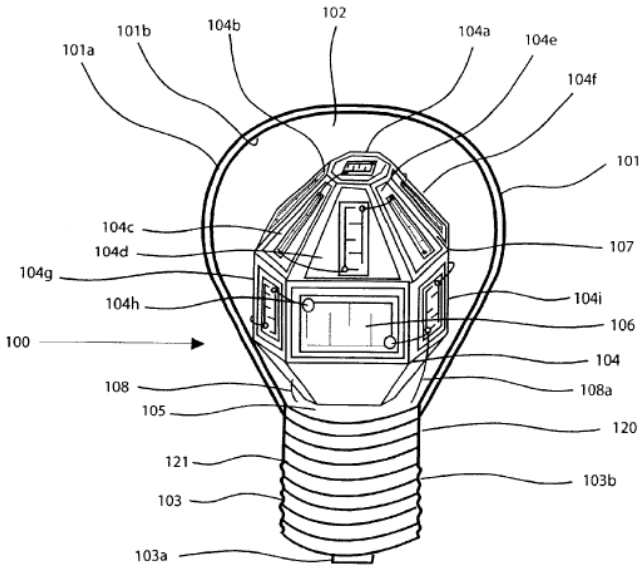

Fig. 1

Figure 1 shows a semiconductor light source that uses a high power chip or array arrangement. *Id.* at 1:65–67. Semiconductor light source 100 includes enclosure 101 having interior volume 102. *Id.* at 2:48–52, 3:9. Enclosure 101 may be mounted to support 105. *Id.* at 3:15. Semiconductor light source 100 further includes base 103, which "may be configured as a fitting or connector for use in a desired light socket." *Id.* at 3:17–18. Heat sink 104 is further located within interior volume 102. *Id.* at 3:22–23. The '961 patent describes heat sink 104 as having "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, etc. each of which may host a

single or an array of semiconductor devices capable of producing light." *Id.* at 3:24–29. In addition, at least one semiconductor device 106 is mounted on heat sink 104. *Id.* at 3:37–38. The '961 patent describes the use of "high power" LEDs by stating that "'[h]igh power' LED's means that the light output from each LED module is greater than 40 milliwatts." *Id.* at 4:6–8.

We reproduce Figure 3d of the '961 patent below.

Appendix B

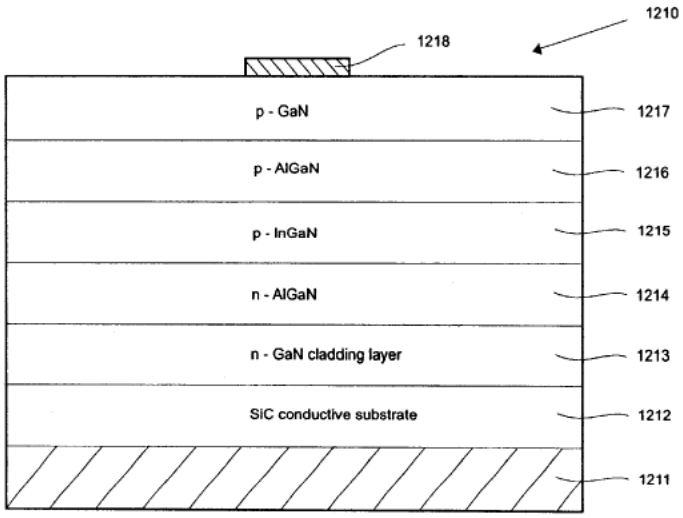

Fig. 3d

Figure 3d illustrates an LED structure on a substrate. *Id.* at 2:9–10. The structure includes electrically conductive substrate 1212, buffer layer 1213, cladding layer 1214, active layer 1215 where energy is converted to light, cladding layer 1216, and contact layer 1217. *Id.* at 5:11–20.

We reproduce Figure 3d of the '961 patent below.

Appendix B

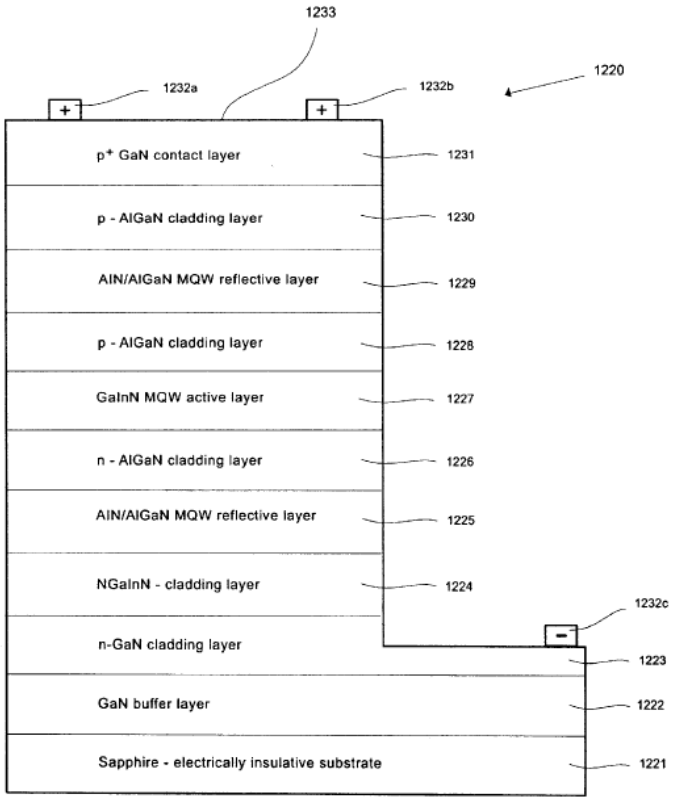

Fig. 3f

Figure 3f depicts a VCSEL chip on an insulative substrate. *Id.* at 2:12–13. VCSEL chip 1220 includes substrate 1221, buffer layer 1222, cladding layer 1223, another cladding layer 1224, reflective layer 1225, cladding layer 1226, active layer 1227, another cladding layer 1228, second reflective layer 1229, cladding layer 1230, and contact layer 1231. *Id.* at 5:31–49. The '961 patent explains that "[l]ight 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.* at 5:45–48.

C. Illustrative Claims

Petitioner challenges claims 21, 22, 25, 26, 28–30, 32–36, 40–44, 47– 49, 52, 53, 56–59, 62, 63, 65–68, 71–73, 77, 78, 81, 82, 85, 86, and 88–91. Pet. 11. Claim 21 depends from claim 8, which was cancelled via reexamination. Ex. 1001, EPRC 1:32–39. Claim 8 depended from claim 7, and claim 7 depended from claim 1. *Id.* at 10:27–44. Claims 7 and 1 were also cancelled via reexamination. *Id.* at IPRC 1:10–13. The remaining challenged claims depend from claim 21. *Id.* at EPRC 1:40–8:62. Therefore, we treat claim 21 as the sole independent claim. To reflect claim 21's full scope, we reproduce claims 1, 7, 8, and 21 below.

> 1. A semiconductor light source for emitting light to illuminate a space used by humans, the semiconductor light source comprising:
>
> an enclosure, said enclosure being fabricated from a material substantially transparent to white light,
>
> an interior volume within said enclosure,
>
> a heat sink located in said interior volume,
>
> said heat sink being capable of drawing heat from one or more semiconductors devices,

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

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, at least one semiconductor chip capable of emitting light mounted on one of said panels,

said semiconductor chip being capable of emitting monochromatic light,

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

a coating for converting monochromatic light emitted by said chip to white light.

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 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.

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.

21. 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

said LED chip is configured to emit monochromatic visible light.

Ex. 1001, 9:52–10:10, 10:28–43, 10:44–48, EPRC 1:32–48.

Appendix B

D. Asserted Grounds of Unpatentability

Petitioner, supported by the declaration of Michael S. Lebby, Ph.D. (Ex. 1006), asserts the following three grounds of unpatentability (Pet. 13):[2]

Claim(s) Challenged	**35 U.S.C. §**	**Reference(s)/ Basis**
21, 22, 25, 26, 28–30, 32–36, 40–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 71–73, 77, 78, 81, 82, 85, 86, 88–91	103(a)	Begemann,[3] Krames,[4] Allen[5]

[2] The relevant sections of the Leahy-Smith America Invents Act ("AIA"), Pub. L. No. 112–29, took effect on March 16, 2013. The application that issued as 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, published March 30, 2000, Ex. 1007 ("Begemann").

[4] Krames et al., *High-brightness AlGaInN light-emitting diodes*, Proc. SPIE 3938, LIGHT-EMITTING DIODES: RESEARCH, MANUFACTURING, AND APPLICATIONS IV (2000), Ex. 1008 ("Krames"). The publication status of the Krames reference is disputed, and we address that dispute in Section III.E, *infra*.

[5] WO 99/57945, published November 11, 1999, Ex. 1011 ("Allen").

Appendix B

Claim(s) Challenged	**35 U.S.C. §**	**Reference(s)/ Basis**
21, 22, 25, 26, 28–30, 32–36, 40–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 71–73, 77, 78, 81, 82, 85, 86, 88–91	103(a)	Begemann, Nakamura,[6] Allen, Krames
21, 22, 25, 26, 28–30, 32–36, 40–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 71–73, 77, 78, 81, 82, 85, 86, 88–91	103(a)	Begemann, Sugiura,[7] Allen, Krames

III. ANALYSIS

A. Patent Owner's Motion to Exclude Exhibit 1028

Patent Owner moves to exclude the Declaration of Michael R. Krames, Exhibit 1028 ("the Krames declaration"). Paper 57, *passim* ("PO Mot."); *see also* Paper 63 (Patent Owner Reply in Support of Motion to Exclude) ("PO Reply"). Petitioner opposes the motion. Paper 58 ("Pet. Opp."). Patent Owner argues that the Petition is based on the contention that the Krames reference teaches that its LED chip achieves "[a] power output of over 170 mW … at a drive current

[6] US 5,777,350, issued July 7, 1998, Ex. 1009 ("Nakamura").

[7] US 6,015,979, issued January 18, 2000, Ex. 1010 ("Sugiura").

of 1.5 A dc." PO Mot. 3–4 (quoting Pet. 53–54) (alternation in original). Patent Owner responded to the Petition, in part, by showing, via expert declarations, that use of the Krames chip at 170 mW with a drive current of 1.5 A dc "would cause the LEDs and the Begemann device to burn up." *Id.* at 5 (citing Resp. 34–36).

Petitioner filed the Krames declaration in support of its Reply. *Id.* at 5; *see also* Ex. 1028. The Krames declaration states that a person of ordinary skill in the art would not have "entertained" a drive current of 1.5 amps in product development and would instead use lower amperage. PO Mot. 6 (citing Ex. 1028 ¶ 22).

Patent Owner argues that the Krames declaration does not properly address the Patent Owner Response in accordance with 37 C.F.R. § 42.23(b). PO Mot. 9. Patent Owner argues that the declaration instead changes "the starting point from Cree's own Petition." *Id.* Patent Owner further argues that the Krames declaration is irrelevant because it does not relate to whether or not a person of ordinary skill in the art "would have been motivated to combine the 1.5/170 milliwatt LED chip from the Krames article with the LED light of Begemann" with "a reasonable expectation of success." *Id.* at 10–11. Patent Owner also seeks to exclude the declaration pursuant to Federal Rule of Evidence 403 because unfair prejudice outweighs probative value and under Federal Rule of Evidence 702(d) because Dr. Krames

does not apply his principles and methods to the facts of the case. *Id.* at 11–12.

Patent Owner's argument is unpersuasive because the Krames declaration addresses the Patent Owner Response and is relevant to the issues at hand. We start with an important observation: claim 21 (the only independent claim at issue) is an apparatus claim; the claim is directed to a "semiconductor light source." Ex. 1001, 9:52. One requirement of this apparatus is that it comprise "at least one semiconductor chip" (*id.* at 10:1) where the "at least one semiconductor chip is a light emitting diode (LED) chip configured to output light at greater than about 40 milliwatts." *Id.* at EPRC, 1:34–36. As we explain when addressing claim construction, *infra*, we adopt Patent Owner's proposed construction of "a light emitting diode (LED) chip configured to output light at greater than about 40 milliwatts" as meaning "at least one LED chip is *capable of* emitting light greater than about 40 milliwatts." *See* Section III.D, *infra* (emphasis added).

Because of these recitations, Petitioner bears the burden of establishing that the prior art teaches or suggests a semiconductor chip "capable of emitting light greater than about 40 milliwatts." As explained herein, we determine that in the Petition, Petitioner met this burden by establishing by a preponderance of the evidence that the Krames reference teaches an LED chip that has this capability. Pet. 54 (quoting Ex. 1008, 10). Notably, claim 21 does *not* require actual

operation of anything at greater than 40 milliwatts because claim 21 is not a method claim. Petitioner never had a burden of establishing a method of running the Krames reference's LED at this power output within a semiconductor light source.

Petitioner's unpatentability grounds are not based upon Krames alone. Pet. 13. Claim 21 is directed to a greater lightbulb structure and also a structure related to the semiconductor chip for the semiconductor light source. Ex. 1001, 9:52–10:10, 10:44–58, EPRC 1:32–39. Petitioner relies on Begemann as teaching semiconductor light source aspects aside from structure of the chip. *See, e.g.*, Pet. 32–39. Petitioner relies on Krames as teaching semiconductor chip structure. *See, e.g.*, Pet. 41–54.

Because Petitioner's unpatentability ground relies on both Krames and Begemann, Petitioner also bears the burden of establishing by a preponderance of the evidence that a person of ordinary skill in the art would have used Krames's semiconductor chip as the chip in Begemann's lightbulb structure. To meet this burden, Petitioner establishes that Begemann teaches use of an LED chip but does not teach a specific chip. Pet. 29 (citing, e.g., Ex. 1007, 2:3–5; 4:30–32). Petitioner also establishes that Krames teaches an appropriate chip that has the same goal as Begemann. *Id.* (citing, e.g., Ex. 1008, 6; Ex. 1007, 2:3–5). We determine that Petitioner's evidence, absent rebuttal evidence, is sufficient to establish that a person of ordinary skill in the art would have had a

"high expectation of success" in mounting Krames's chips as LEDs 4 of Figure 3 of Begemann. *Id.* at 30 (citing Ex. 1006 ¶ 93).

Against this backdrop, Patent Owner argues that a person of ordinary skill in the art would *not* have combined Krames's LEDs with Begemann's device. Resp. 33–38. Of particular relevance here, Patent Owner argues that a person of ordinary skill in the art "would not have expected Begemann's heat dissipating structure to be able to handle the heat generated by Krames' higher-powered LEDs." *Id.* 34.

In the Reply, Petitioner uses the Krames declaration (Ex. 1028) to argue, for example, that a person of ordinary skill in the art would have used a lower amperage than the 1.5 A dc that Patent Owner's Response focuses on. Reply 8 (citing Ex. 1028 ¶ 22). This use of the Krames declaration is timely because it responds to an argument Patent Owner makes in the Patent Owner Response. 37 C.F.R. § 42.23(b) ("A reply may only respond to arguments raised in . . . patent owner response.").

As to relevancy and whether the Krames declaration is applicable to the facts of this case, the issues at hand are (1) whether or not a person having ordinary skill would have had reason to use the Krames LED with Begemann with a reasonable expectation of success and (2) whether or not the Krames LED is capable of outputting light at greater than about 40 milliwatts. Again, we emphasize that claim 21 does not recite a method where the LED

within the recited semiconductor light source actually outputs greater than about 40 milliwatts.

The Krames declaration is relevant to the facts of this case because the declaration has bearing on whether or not a person of ordinary skill in the art would have combined the Krames reference's LED with Begemann's lightbulb design. *See, e.g.*, Ex. 1028 ¶ 22. Patent Owner argues that evidence must be relevant to motivation to combine "an LED chip from the Krames article (operating at 1.5 amps to produce 170 milliwatts of output)" but claim 21 has no "operating at 1.5 amps to produce 170 milliwatts of output" requirement. What is relevant is that Krames discloses a single chip that has the capability of outputting more or less light depending on operating conditions. Pet. Opp. 3; *see also* Ex. 1008, 8 (providing that Figure 12 of the Krames reference is described as illustrating "[l]ight output vs. current characteristic of a blue … 1x1 mm2 AlGaInN LED in a power package, compared to a conventional AlGaInN LED in a 5 mm lamp a package"). Because claim 21 does not require actually running the recited LED at any particular wattage or amperage, it is appropriate for the Krames declaration to rebut Patent Owner's argument that a person of ordinary skill would not have considered using the Krames LED with Begemann at high amperage by explaining that a person of ordinary skill in the art would have considered using the exact same Krames LED with Begemann at a low amperage instead and that at this lower amperage the Krames

LED would generate an amount of heat that would be easily dissipated by Begemann's lamp while still providing an optical output of "greater than about 40 milliwatts" as recited by claim 21. Ex. 1028 ¶¶ 23–24 (citing Ex. 1008, 8). The fact that the Krames LED is configured to run at the high amperage if desired for a different application does not negate the rationale for combining the Krames LED to run at a lower amperage.

With respect to prejudice outweighing probative value, the probative value is high because the Krames declaration directly bears on a key issue: reason to combine with reasonable expectation of success. Also, the prejudice is minimal because Patent Owner could have, in the Patent Owner Response, addressed the general issue of whether a person having ordinary skill in the art would have had reason to combine Begemann's teachings with the Krames reference LED under *any* operating conditions.

In the Reply Brief, Patent Owner argues that the statement of material facts in Patent Owner's motion should be considered admitted because Petitioner did not specifically deny them. PO Reply 2. As explained above, Petitioner refutes Patent Owner's framing of the motion to exclude in relevant respects. Also, 37 C.F.R. § 42.23(a) states, with our emphasis added, that "[a]ny material fact not specifically denied *may* be considered admitted." In the interest of justice, we decline to consider the statement of material facts

admitted.[8]; *see also* 37. C.F.R. § 42.5(b) ("The Board may waive or suspend a requirement of parts 1, 41, and 42.").

Thus, for the reasons explained above, we deny Patent Owner's motion to exclude Exhibit 1028.

B. Petitioner's Motion to Exclude Exhibits 2017 and 2030

Petitioner seeks to exclude Exhibit 2017 as hearsay. Paper 59, 1 ("Pet. Mot."); see also Paper 62 (Petitioner's Reply in support of Motion to Exclude). Exhibit 2017 is entitled "SOLID STATE LIGHTING CATALOG," and Patent Owner states that the catalog is from 2015. Resp. 62. Patent Owner argues that the catalog shows "expansion and breadth of its patented Dynasty LED lamp business." Id. Patent Owner argues that Exhibit 2017 is an admissible business record. Paper 59, 2–6 ("PO Opp.").

Petitioner seeks to exclude Exhibit 2030 because the exhibit is an attorney-generated trial demonstrative and because it is hearsay. Pet. Mot. 3. Patent Owner argues that Exhibit 2030 is admissible because it was not properly objected to during deposition, because it is used to demonstrate Petitioner's positions, and to address an opposing party's statement. PO Opp. 4–7.

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[8] The parties also dispute whether or not Patent Owner's motion to exclude is procedurally proper. Pet. Opp. 9; PO Reply 4–5. We need not address this issue because we deny the motion to exclude for the reasons we explain here.

As explained herein, we ultimately determine that Petitioner meets its burden of establishing by a preponderance of the evidence that claims 21, 22, 25, 26, 28–30, 32–36, 40, 42–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 71–73, 77, 78, 81, 82, 85, 86, and 88–91 of the '961 patent are unpatentable even if we fully consider Exhibits 2017 and 2030. Moreover, we determine that Petitioner does not meet its burden of establishing that claim 41 of the '961 is unpatentable, and our determination would be the same even if we did not consider Exhibits 2017 and 2030. As such, we dismiss Petitioner's Motion to Exclude as moot.

C. 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. *Innovention*

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 proposes a level of ordinary skill in the art as follows:

> As of the '961 Patent's claimed priority date (August 24, 2001), a POSITA would have had at least a bachelor's degree in an engineering discipline with coursework in semiconductors and/or optoelectronics, and three or more years of experience working in the semiconductor and/or optoelectronics fields. Less work experience may be compensated by a higher level of education with the foregoing coursework.

Pet. 20 (citing Ex. 1006 ¶ 34). Patent Owner provides a different description of the level of ordinary skill in the art:

> The POSITA for the '961 Patent would have at least a bachelor of science degree in electrical engineering, physics, materials science, or a similar area of study, so as to understand the basic principles of light and LED design and operation. Ex. 2018 at ¶ 19. The POSITA would also have experience related to LED lighting products, LED chip technology and applications, and/or LED packaging techniques for a period of at least one year. *Id.* In addition, the POSITA would

> understand, generally, how to implement LED chips and packages in the design and/or application of general-purpose lighting products for use in residential and commercial (or industrial) buildings and structures as well as outdoor spaces used by humans (such as roads, streets, parking lots, pathways, etc.). *Id.*

Resp. 18–19.

We agree with Patent Owner that the challenged claims relate to light fixtures, LED packaging, and LED chip layer structure and that the '961 patent claims reflect "a hybrid of the light bulb art and semiconductor art." Resp. 19. The prior art of record, for example, Begemann, likewise reflects "a hybrid of the light bulb art and semiconductor art." *Id.* (quoting Pet. 28). Petitioner's expert, Dr. Lebby, agreed that a person having ordinary skill in the art would need to be "familiar with thermal issues." Ex. 2015, 26:15–28:16.

While Petitioner's proposed description of a person having ordinary skill in the art could, in some instances, be sufficient to qualify a person as having ordinary skill, Patent Owner's proposal is a more complete and accurate description of the level of skill commensurate with the scope of the challenged '961 patent claims. Patent Owner's description appears consistent with the prior art and patent specification before us and is supported by witness testimony. *See Okajima v. Bourdeau*, 261

F.3d 1350, 1355 (Fed. Cir. 2001) (prior art itself may reflect an appropriate level of skill). For the purpose of this Decision, we adopt Patent Owner's description. We further note that the outcome of our decision would be the same under either party's asserted skill level.

D. 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 contends that "[t]he terms in the Challenged Claims should receive their ordinary and customary meaning as understood by a POSITA in the context of the patent specification and prosecution history." Pet. 19 (citing Ex. 1006 ¶ 71). Petitioner states that "Patent Owner has taken a position as to the scope of certain claim terms through infringement

contentions in the district court case." *Id.* Specifically, Petitioner avers that Patent Owner proposes claim constructions for the term "reflective layers" and contends that grounds 1 and 3 demonstrate unpatentability even under Patent Owner's interpretation of "reflective layers." *Id.* at 20 (citing Ex. 1017, 22–23; Ex. 1006 ¶ 72). In the Petition, however, Petitioner does not propose any particular construction for "reflective layers" beyond ordinary and customer meaning. *Id.* at 19–20.[9]

Patent Owner identifies claim construction for two terms as "particularly relevant." Resp. 14–15. First, Patent Owner argues that "a light emitting diode (LED) chip configured to output light at greater than about 40 milliwatts" means "at least one LED chip is capable of emitting light greater than about 40 milliwatts." Resp. 14–15. Patent Owner notes that a district court already adopted this construction and notes that the "LED chip" includes LEDs, LED modules, and LED arrays but excludes laser chips, laser modules, and VCSEL chips. *Id.* (citing Ex. 2003, 15–18). Petitioner argues that the phrase "needs no

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[9] Petitioner states that "Patent Owner thus contends the recited 'reflective layers' can include transparent or semi-transparent layers that exhibit some reflectivity (e.g., SiO2) or an interface between two layers (e.g., the buffer and substrate layers) that exhibit differing indices of refraction." Pet. 20. Patent Owner frames this as being Petitioner's "novel construction" (Resp. 16), but Petitioner does not expressly endorse this Patent Owner contention.

construction" and that Petitioner's grounds meet this construction. Reply 1–2. We adopt Patent Owner's proposed construction because it is well supported by the record including the District Court's reasoning. Ex. 2003, 15–18.

Second, Patent Owner argues that we should adopt the claim construction for "a first and a second reflective layers . . . serving to reflect light emitted by said active layer" that was reached by California and Delaware district courts: "first and second reflective layers are distinct from each other and [] reflect more than negligible light." Resp. 15, 18.[10] Petitioner responds by again stating the phrase "needs no construction" and by also arguing that the grounds meet the construction. Reply 1–4.

Patent Owner's claim construction is well-supported by the record including the reasoning provided by the California and Delaware district courts. Ex. 2002, 19–21 (California district court explaining why the "reflective layers" must be distinct layers based on how claim 8 is structured and also explaining why the amount of reflection must be non-negligible); Ex. 2003, 2, 13 (Delaware district court explaining why reflection has to be more than negligible but need not reflect more light than the light absorbed or transmitted). We, thus, agree that "first and a second reflective layers . . . serving to

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[10] Patent Owner's proposed claim construction combines various statements made by the district courts into one statement. Resp. 15 (citing Ex. 2002, 19–21; Ex. 2003, 2, 13).

reflect light emitted by said active layer" means that the "first and second reflective layers are distinct from each other and reflect more than negligible light." We further note that the preponderance of the evidence supports that as little as one percent light reflectance is "non-negligible" in this context. Reply 4; *also* Ex. 1032, 188:7–14 (Patent Owner's witness, Dr. Shealy, testifying that reflection "on the order of one percent" would be more than negligible); *see also* Tr. 53 (counsel for Patent Owner agreeing that Dr. Shealy opined that "three percent reflection is enough to be non-negligible").

It is unnecessary to construe any other claim terms in this Decision because none of the parties' disputes turn on the meaning of other claim terms. *See, e.g.*, *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017).

E. Prior Art Status of the Krames Reference

Patent Owner argues that Petitioner fails to demonstrate that the Krames reference is prior art. Resp. 23–29. A reference may qualify as prior art if, for example, it is a printed publication. 35 U.S.C. § 102(a)(1); *see also* 35 U.S.C. § 103 (referring back to Section 102 when referencing prior art). Whether a reference qualifies as a "printed publication" is a legal conclusion based on underlying factual determinations. *Suffolk Techs., LLC v. AOL Inc.*, 752 F.3d 1358, 1364 (Fed. Cir. 2014). The determination of whether a document is a "printed publication" under 35 U.S.C. § 102(b) "involves a case-by-case

inquiry into the facts and circumstances surrounding the reference's disclosure to members of the public." *In re Klopfenstein*, 380 F.3d 1345, 1350 (Fed. Cir. 2004). "Because there are many ways in which a reference may be disseminated to the interested public, 'public accessibility' has been called the touchstone in determining whether a reference constitutes a 'printed publication' bar under 35 U.S.C. § 102(b)." *Blue Calypso, LLC v. Groupon, Inc.*, 815 F.3d 1331, 1348 (*quoting In re Hall*, 781 F.2d 897, 898–99 (Fed. Cir. 1986)). "A reference will be considered publicly accessible if it was 'disseminated or otherwise made available to the extent that persons interested and ordinarily skilled in the subject matter or art exercising reasonable diligence, can locate it.'" *Id.* (*quoting Kyocera Wireless Corp. v. Int'l Trade Comm'n*, 545 F.3d 1340, 1350 (Fed. Cir. 2008)).

The '961 patent was filed on August 24, 2001, and does not claim any earlier priority date. Ex. 1001, code (22). We find that the record supports the following facts, and we determine that these facts, cumulatively, support that the Krames reference is prior art because it was a printed publication at least as of June 29, 2000:

1. The Krames reference, on its face, indicates that it is an "Invited Paper." Ex. 1008, 2.

2. The face of the Krames reference bears these indicia: "In *Light-Emiting Diodes: Research, Manufacturing, and Applications IV*, H. Walter Yao, Ian T. Ferguson, E. Fred Schubert, Editors,

Proceedings of SPIE[11] Vol. 3938 (2000)·0277-786X/00/$15.00." *Id.* These indicia suggest that the Krames reference was published in the SPIE Proceedings volume ("the Proceedings") and the Proceedings were available to the public for fifteen dollars.

3. Rachel J. Watters is a librarian and "Head of Resource Sharing for the University of Wisconsin-Madison's General Library System" located in Madison, Wisconsin. Ex. 1020, 1. Ms. Watters worked as a librarian with the University of Wisconsin library system since 1998. *Id.* Ms. Watters has a master's degree in Library and Information Studies. *Id.*

4. When the University of Wisconsin-Madison Libraries received a volume, it was checked in, added to library holdings records, and made available to readers as soon as possible and, at most, within two to three weeks. *Id.* at 2.

5. The University of Wisconsin-Madison Libraries catalogued the Proceedings as of June 29, 2000. *Id.*; *see also id.* at Ex. B, 27[12] (library record indicating June 29, 2000 "Receiving date" for the Proceedings).

6. The Kurt Wendt Library at the University of Wisconsin-Madison owns the Proceedings of SPIE,

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[11] SPIE refers to "The International Society for Optical Engineering" or "The Society of Photo-Optical Instrumentation Engineers." Ex. 1020, Ex. A (pgs. 6, 8).

[12] Reference is made to the page number of Exhibit 1020: page 27 of 28.

3938 that the Krames reference appears in. *Id.* at 2; *see also id.* at Ex. A (copy of excerpt of the Kurt Wendt Library's copy of the Proceedings).

7. The Proceedings, on their face, indicate that papers from the Proceedings were presented at "26-27 January 2000 San Jose, California." *Id.* at Ex. A, 6.

8. Dr. Lebby attended this January 2000 conference. Ex. 1006 ¶ 78. Dr. Lebby also confirms that "proceedings from this conference were distributed to all members of SPIE as well as to libraries which had a subscription to the *Proceedings of SPIE*, so it was widely available to and accessible by those with skill in the art." *Id.*[13]

9. The Proceedings indicate that papers included in the Proceedings volume "were selected by the conference program committee to be presented in oral or poster format." Ex. 1020, Ex. A, 7.

10. The Proceedings indicate a 2000 copyright date and further indicate that the volume was publicly available from the Copyright Clearance Center for fifteen dollars per article. *Id.*

11. The excerpt of the library's Proceedings volume has a sticker in the upper left corner: "TK 7871.89 L53 2000." *Id.* at 6. The sticker suggests the volume was catalogued by the library in 2000. The table of contents page also bears hand writing that repeats similar indicia including "2000." *Id.* at 8.

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[13] We note that Dr. Lebby does not directly state *when* the Proceedings were widely available. *See* Sur-Reply 14.

12. The library catalog record of the University of Wisconsin-Madison indicates that the Proceedings volume "was properly catalogued and could be found by or requested by a person of skill in the art of the subject matter of the foregoing article exercising reasonable diligence." Ex. 1020, 3.

13. Members of the interested public could locate the Proceedings volume on June 29, 2000, the date it was catalogued, "by searching the public library catalog or requesting a search through [Wisconsin TechSearch] WTS." *Id.*

The facts above are evidence of the Krames reference's publication as of June 29, 2000, because the facts tend to make the Krames reference's publication as of June 29, 2000, more probable than it would be without the facts. *See* Fed. R. Evid. 401(a) (defining evidence as relevant "if it has any tendency to make a fact more or less probable than it would be without the evidence"). The evidence is sufficient to support publication. Meanwhile, no evidence of record suggests that Krames was *not* a printed publication as of June 29, 2000. Thus, a preponderance of the evidence supports Krames's prior art status.

Patent Owner argues that Ms. Watters "never establishes a firm date when Krames was purportedly available to the relevant public." Resp. 25. Patent Owner bases this argument by taking a tortured reading of Ms. Watters's statement that "[m]embers of the interested public could locate a copy of [the Proceedings] on or after June 29, 2000, the date it was

catalogued." *Id.* (quoting Ex. 1020, 3); *see also* Sur-Reply 13–14. The best understanding of Ms. Watters's statement, in view of the context of Ms. Watters explaining the library's cataloguing process, is that a member of the interested public had two options: the person could choose to locate the Proceedings on June 29, 2000, or the person could choose to locate the Proceedings after June 29, 2000. Thus, the statement supports public availability as of June 29, 2000.

Patent Owner also argues that Exhibits A and B to the Watters declaration also do not establish when the Proceedings were available. Resp. 25–26. The Exhibits, however, serve to corroborate Ms. Watters's credible testimony as to when the Proceedings were available.

Patent Owner also argues that a person of ordinary skill in the art would not have been able to find the Krames article and argues that a prior, non-precedential board decision, *Salesforce.com, Inc. v. WSOU Investments, LLC*, IPR2022-00357, Paper 12 (PTAB July 13, 2022), is analogous. Resp. 26–28. But the *Salesforce* decision is distinguishable. The *Salesforce* patent claims related to, for example, interfacing two network environments via a message gateway and content reformatted in a vectorized format. *Salesforce.com, Inc.*, IPR2022-00357, Paper 12 at 3. Given this context, the panel determined that Petitioner did not establish a reasonable likelihood the Fox article was publicly accessible before the critical date because the MARC record was only

"keyed to the title of the entire conference proceedings." *Id.* at 14. Because the conference proceedings were entitled "Proceedings of the 2002 International Conference on International Computing," the panel reasonably determined that a person having ordinary skill in the art would not have, with reasonable diligence, known to look in these proceedings to find information relevant to the claimed subject matter. *Id.* In *Salesforce*, the topic of the proceedings was very broad compared to the subject matter of the claims at issue.

In contrast, a person of ordinary skill in the art could have reasonably located the Krames article based on the title of the Proceedings. As a starting point, there is no dispute that Begemann is prior art. Begemann teaches an LED lamp fixture that makes use of LED chips, but it does not give very many details about the design of those chips. Ex. 1007, 1:1–14, 2:22–23, 5:13–18, Figs. 2, 3A, 3B. A person having ordinary skill in the art at the relevant time (August 24, 2001) would have sought out more information about what different kinds of light emitting diodes could be manufactured for application with Begemann. See Section III.F.4.a, *infra*. As such, a person having ordinary skill in the art would have been very interested in a recent (2000) publication from a known technical society entitled "Light-Emitting Diodes: Research, Manufacturing, and Applications IV." Ex. 1008, 2; *see also* Ex. 1020, Ex. A, 6. The evidence supports that the Proceeding's title

was indexed such that a person of ordinary skill could find it, and this would have been sufficient to lead a person having ordinary skill in the art to the Krames article. Ex. 1020, 2–3; *see also* Reply 5–6.

Patent Owner also notes that the barcode on the back of Proceedings volume (Ex. 1020, Ex. A, 24) has a different number than the barcode number the ExLibris system states (Ex. 1020, Ex. B, 26). Resp. 27. Patent Owner does not provide evidence explaining the import of this distinction. It is possible, for example, that the book has different barcodes for different purposes (for example, one for the manufacturer and another assigned to the library). Given that other indicia do not indicate any conflict or controversy regarding publication date, the evidence supports Ms. Watters's testimony establishing June 29, 2000, library indexing. Ex. 1020, 2–3.

Patent Owner further argues that Exhibit B has some unexplained features related to page number and volume availability. Resp. 27. Again, Patent Owner lacks evidence regarding the import of these observations.

Patent Owner argues that Ms. Watters does not provide evidence that she personally knew about publication of the Krames article. *Id.* at 28; Sur-Reply 12. This does not undermine Ms. Watters's credible testimony regarding her library's systems and when, based on the library's records, Krames was publicly available (indexed by the library in a useful fashion).

To summarize, the record provides sufficient evidence supporting that Krames published by June 29, 2000. The record provides no evidence to the contrary. The weight of the evidence supports Krames's June 29, 2000, publication. As such, Petitioner has established by a preponderance of the evidence that Krames is a printed publication.

F. Obviousness Analysis

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

2. Objective Indicia of Non-Obviousness

Patent Owner argues that commercial success and the combination of long-felt need, failure of others in the industry, and industry skepticism weigh in

favor of patentability. Resp. 61–66. Petitioner argues that Patent Owner fails to show that commercial products embody and are coextensive with the challenged claims. Reply 26–29. For objective indicia of nonobviousness to be accorded substantial weight, its proponent must establish a nexus between the evidence and the merits of the claimed invention. *Lectrosonics, Inc. v. Zacom, Inc.*, IPR2018-01129, Paper 33 at 32 (PTAB Jan. 24, 2020) (precedential); *see also Fox Factory Inc. v. SRAM, LLC*, 944 F.3d 1366, 1373 (Fed. Cir. 2019) (to establish objective indicia of non-obviousness, Patent Owner bears the burden of tying the objective evidence that embodies the claimed features)

Here, as to commercial success and industry praise, Patent Owner argues that Cree's "Embodying Products" meet the limitations of claim 18 of the '961 patent. Resp. 61. Then, Patent Owner argues that "Cree's Lighting Products segment" has been commercially successful. *Id.* at 62. Patent Owner also argues that Cree received praise "for its LED light bulbs." *Id.* Patent Owner does not establish, however, that the "Embodying Products" are the same as "Cree's Lighting Products segment" or "its LED light bulbs."

Just to the contrary, Patent Owner provides, for example, sales figures for lighting products "including the embodying products" (and, presumably, including other products as well). Ex. 2019 ¶ 46 (emphasis omitted). Patent Owner's witness, Ms.

Kindler, admits to assessing only revenues associated "with [Patent Owner's] Embodying Products as part of its Lighting Products segment." *Id.* Although Patent Owner provides evidence that Cree states that its "Lighting Products segment 'primarily consist[ed] of LED lighting systems and lamps,' which would include the Embodying Products," the record is unclear what other products the "Lighting Products segment" includes. *Id.* The evidence fails to persuasively connect patented features to commercial success or praise.

Patent Owner also argues that "there is a nexus between the industry's LED lighting products eventually introduced and the '961 Patent." Resp. 61–62. Patent Owner does not argue, however, that "the industry's LED lighting products" enjoyed commercial success, praise, or indicia supporting non-obviousness.

Patent Owner argues that its 2015 catalog shows "expansion and breadth" of its patented Dynasty LED lamp business. *Id.* at 62 (citing Ex. 2017). The catalog establishes what Patent Owner offered for sale and how Patent Owner advertised Dynasty LED lamps. But the catalog does not persuasively establish commercial success or success relative to any competitors in the market.

Patent Owner further argues that Patent Owner's "Dynasty LED lamps" are covered by the '961 patent and had "notable examples of installation" at two stores. *Id.* (citing Ex. 2019 ¶¶ 30–31, 49). These

examples, at best, provide very limited evidence of some commercial success.

With regard to long-felt but unmet need, Patent Owner argues that others in the industry failed to develop "a monochromatic general illumination light source that uses a semiconductor LED chip while also dissipating heat" and cites problems others in the industry had in developing such a light both before and after filing of the '961 patent. *Id.* at 62–66. The record, however, suggests that the '961 patent did not solve particular industry problems. Rather, Patent Owner's witness testified, for example, that he purchased an off-the-shelf LED as a prototype, that attaching heat sinks was well known, and that phosphor coatings for white light were well known. Reply 28–29 (citing Ex. 1030, 291:20–295:6 (testimony of '961 inventor)).[14]

In sum, the evidence of objective indicia of non-obviousness is weak and, therefore, has little influence on our obviousness conclusions in either direction. All of our obviousness determinations, as we discuss *infra*, are made after considering all evidence

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[14] Petitioner also argues that attaching heat sinks and adding phosphor coatings was well known. Reply 28–29. Petitioner cites the Ex. 1030 trial transcript at 126:25–127:6 and 134:17–21 for testimony supporting this argument, but these pages appear to be omitted from the present record. Nonetheless, the prior art discussed herein (for example, Begemann, Krames, and Allen) establishes that heat sinks and phosphor coatings were known in the art.

in the record, including all evidence relating to objective indicia of non-obviousness.

3. Overview of the Asserted Art

a. *Begemann (Exhibit 1007)*

Begemann describes "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. 1007, 1:1–3.

We reproduce Begemann's Figure 2 below.

Appendix B

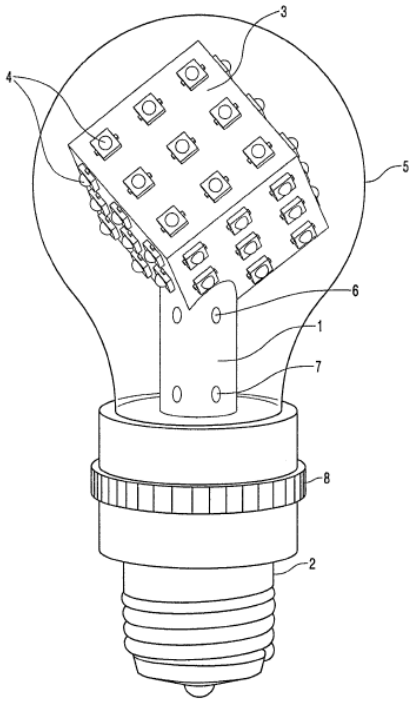

FIG. 2

Figure 2 depicts an embodiment of a LED lamp. *Id.* at 4:11. LED lamp includes gear column 1, metal lamp cap 2, metal substrate 3 having LEDs 4, envelope 5, and outlet holes 6 and inlet holes 7 for air flow. *Id.* at 5:13–16. Begemann describes substrate 6 as cube-shaped and states that each one of the faces has a number of LEDs 4. *Id.* at 5:17–18, 5:21–22. Begemann explains that multiple-chip LEDs are used in this embodiment, "which each have three light points (green, red and blue) per LED or four light points (green, red, yellow, blue) per LED" and "[t]hese colors

are mixed so as to obtain white light in the secondary optical system of each of the LEDs." *Id.* at 5:22–25.

We reproduce Begemann's Figure 3A below.

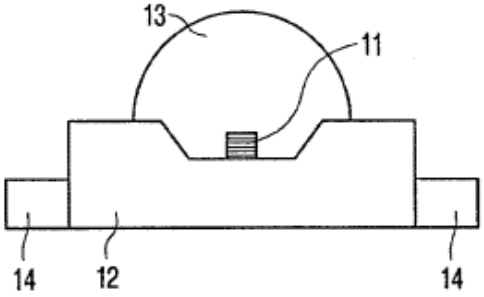

FIG. 3A

Figure 3A shows a LED that includes single-chip LEDs, which each has only one light point 11 per LED. *Id.* at 6:3–5. Begemann explains that "[l]ight point (11) is provided with a primary optical system(13), by means of which the radiation characteristic of the LED can be influenced." *Id.* at 6:6–8.

b. *Krames (Exhibit 1008)*

Krames is a paper titled "High-brightness AlGaInN light-emitting diodes." Ex. 1008, 2. Specifically, Krames describes AlGaInN LEDs grown via organometallic vapor phase epitaxy ("OMVPE"). *Id.* Krames describes a light output versus current characteristic for a blue (wavelength of about 470 nm) 1 x 1 mm2 AlGaInN LED. *Id.* at 10. Krames explains that a power output of over 170 mW is obtained at a drive current of 1.5 A DC. *Id.*

Appendix B

Krames's Figure 3 is reproduced below.

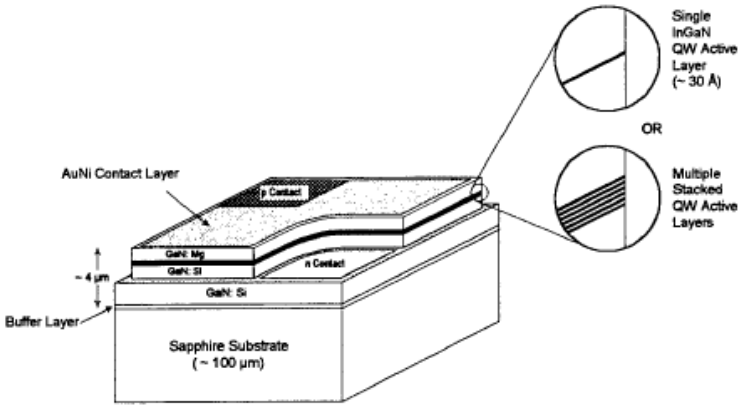

Fig. 3. Typical AlGaInN LED structure.

Figure 3 depicts a typical AlGaInN LED structure. *Id.* at 4. Krames discloses that "[t]he two most common substrates used for OMVPE growth of AlGaInN are sapphire and SiC." *Id.* Krames explains that "[s]apphire is insulating and therefore both p and n Ohmic contacts must be formed on the top surface of the LED chip." *Id.* The n-type contact is formed by mesa etching the AlGaInN LED structure to expose n-type GaN layers beneath the active region and then applying an ohmic n-contact metallization (e.g., Ti/Al) to the n-type GaN. *Id.* Krames states that the p-type contact is formed "by depositing a semi-transparent Ni/Au Ohmic contact metallization across the GaN:Mg surface." *Id.*

c. Allen (Exhibit 1011)

Allen describes a lamp that includes one or more monolithic LED devices that each has an array of LED

dies. Ex. 1011, code (57). Allen states that the "[t]he array of LED dies may comprise a mixture of RGB sub-dies or 'white dies' or a mixture of both types of dies" and that "[w]hite dies may be, for example, blue dies with phosphorescent coating to produce a wideband spectrum." *Id.* at 4:9–12.

We reproduce Allen Figures 6A and 6B below.

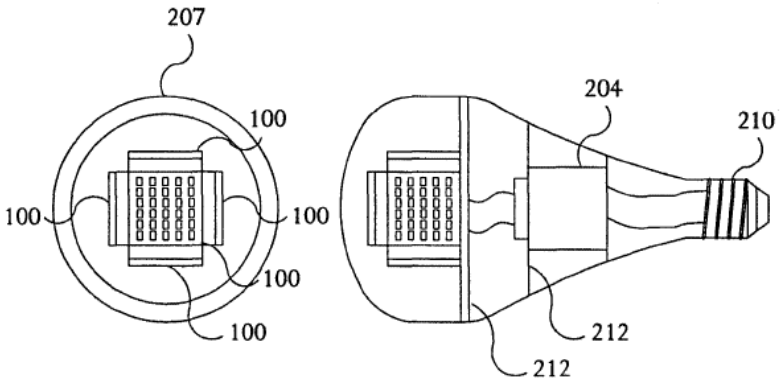

FIG. 6A FIG. 6B

Figure 6A depicts a top view of an "A-type" screw-in hemispherical lamp configuration. *Id.* at 3:17–18. Figure 6B shows a side view of the hemispherical lamp. *Id.* at 3:19–20. The lamp includes monolithic LED device 100, lamp housing 207, mounting brackets 212, voltage converter 204, and base 210. *Id.* at 6:10–12. Allen states that voltage converter 204 "may be a transformer, such as step-down transformer, series resistor, or other type of voltage converter employed in the art to convert from a supply

voltage such as an AC or DC supply followed by a bridge rectifier circuit." *Id.* at 6:16–18.

d. *Nakamura (Ex. 1009)*

Nakamura describes "a semiconductor light-emitting device such as a light-emitting diode (LED) or a laser diode (LD)." Ex. 1009, 1:7–9. We reproduce Nakamura Figure 11.

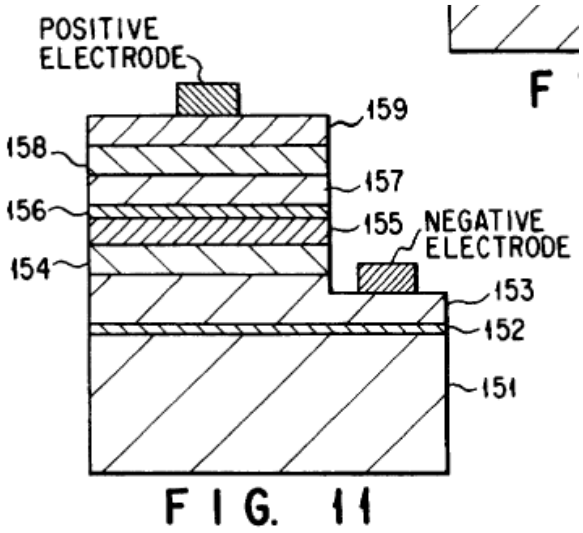

Figure 11 is a cross-sectional view of a light-emitting device. *Id.* at 5:58–60. The light-emitting device includes substrate 151, buffer layer 152, n-type contact layer 153, second n-type clad layer 154, first n-type clad layer 155, active layer 156, second p-type clad layer 158, and p-type contact layer 159. *Id.* at 19:45–54. Nakamura further discloses that it is possible to dispose a light-reflecting film "consisting of at least two kinds of nitride semiconductor layers,

each differing in composition," on an outer side of first n-type clad layer 155 and/or a second multi-layer film "consisting of at least two kinds of nitride semiconductor layers, each differing in composition," on an outer side of second p-type clad layer 158. *Id.* at 21:47–55.

e. Sugiura (Ex. 1010)

Sugiura describes "a nitride-based semiconductor element such as a semiconductor laser, a light-emitting diode, an electronic device, or the like." Ex. 1010, 1:6–8. Sugiura's Figure 7 is reproduced below.

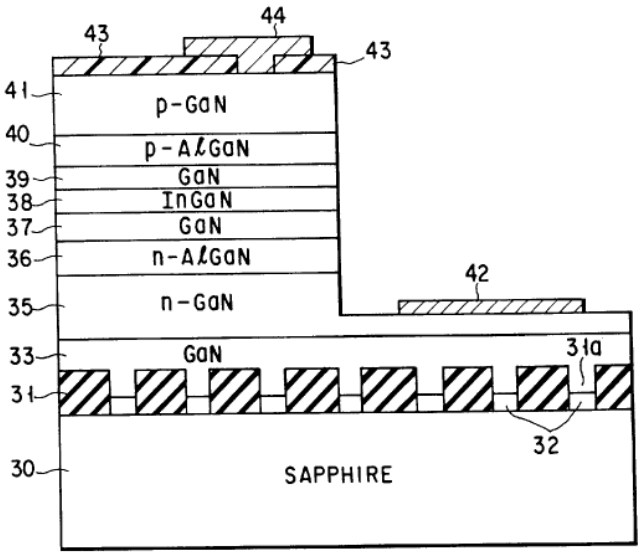

FIG. 7

Figure 7 illustrates a sectional view of a nitride-based semiconductor laser. *Id.* at 9:1–3. The nitride-based

semiconductor laser includes sapphire substrate 30, mask 31 having grooves 31a, low-temperature GaN buffer layer 32, undoped underlying GaN layer 33, n-type GaN contact layer 35, n-type AlGaN current injection layer 36, n-type GaN optical guide layer 37, InGaN active layer 38, p-side GaN optical guide layer 39, p-type AlGaN current injection layer 40, and p-type GaN contact layer 41. *Id.* at 12:24–36. Sugiura states that "[a]lthough this embodiment has been described above with reference to the case it is applied to a laser, . . . the present invention can be applied not only to a nitride-based semiconductor laser but also to a light-emitting diode." *Id.* at 14:58–61.

4. Ground One: Unpatentability over Begemann, Krames, and Allen

Petitioner asserts that claims 21, 22, 25, 26, 28–30, 32–36, 40–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 71–73, 77, 78, 81, 82, 85, 86, and 88–91 are unpatentable under 35 U.S.C. § 103(a) as obvious over Begemann, Krames, and Allen, citing the Declaration of Dr. Michael S. Lebby for support. Pet. 32–104 (citing Ex. 1006). Below, we first address Petitioner's argued reasons to combine the references' teachings. We then address independent claim 21. Next, we address disputed recitations of dependent claims. Finally, we address the remaining dependent claims collectively.

a. *Combining the teachings of Begemann, Krames, and Allen*

Appendix B

We first address the combination of Begemenan and Krames. Pet. 29–30. Begemann teaches that "[c]ustomary incandescent lamps can only be replaced by LED lamps which are provided with LEDs having … a high luminous flux." Ex. 1007, 2:3–5. Begemann discloses LEDs mounted to surfaces within the interior of its bulb and as part of an LED package. Id. at Figs. 2, 3A. Begemann does not, however, disclose what specific LED chip should be used with its device. Pet. 29. A person having ordinary skill in the art would have naturally searched LED chip references to determine what existing chips could be combined with Begemann's disclosure.

Krames teaches an LED chip that a person of ordinary skill in the art would have recognized as useful in Begemann's LED package. Krames notes that "[b]y increasing the chip size and providing low-thermal-resistance power packages capable of dissipating several Watts, LEDs should be able to compete more favorably with conventional lighting technologies in many applications." Ex. 1008, 6. Krames thus has a goal similar to that of Begemann. Ex. 1007, 2:3–5. A person of ordinary skill in the art would have had a reasonable expectation of success in mounting the LED chips Krames teaches into the Figure 3 apparatus of Begemann. Ex. 1006 ¶ 93.

Patent Owner argues that a person of ordinary skill in the art would have recognized that Begemann's heat sink is inadequate to handle the heat of Begemann's suggested RGB LEDs. Resp. 34.

This argument does not squarely respond to the ground of challenge. Petitioner's unpatentability grounds are based upon combining Begemann's teachings with Krames's LED and Allen's phosphor coating. Moreover, Begemann teaching a heat sink along with teaching its LEDs suggests, by a preponderance of the evidence, that Begemann's heat sinks are adequate for Begemann's LEDs. See, e.g., Ex. 1007, Fig. 2, 2:17–19, 5:17–18.

Patent Owner argues that a person having ordinary skill in the art would not have combined the Krames LED with the Begemann device because Begemann's structure would not be able to handle the heat of the Krames "higher-powered LEDs." Resp. 34–36. Patent Owner's argument is unpersuasive because it is premised on the Krames LED chips being driven at 1.5 amperes and producing 390 lumens. Reply 8 (citing Ex. 2021 ¶¶ 48–64 (Patent Owner witness, Mr. McCreary, considering heat based on these conditions)); Ex. 2022 ¶¶ 86–109 (Patent Owner witness, Mr. York, referring to Mr. McCreary's modeling). A preponderance of the evidence supports that a person of ordinary skill in the art would have utilized the Krames LED chip in conjunction with Begemann at a lower drive current and with lower lumens. See, e.g., Ex. 1034, 107:6-25 (Patent Owner's witness, Mr. York, testifying that the practical drive current for the Krames chip was somewhere around 350 milliamps); Ex. 1028 ¶¶ 22, 28 (Petitioner's witness, Dr. Krames, testifying that an output of 136

lumens would be a reasonable output and a drive current near 350 mA would be reasonable).

Patent Owner argues that it focused on a drive current of 1.5 amps because Petitioner relied on this amperage in the Petition. Sur-Reply 16–17. This argument is unpersuasive because it reflects a misunderstanding of the scope of claim 21 and how the Petition addresses claim 21. Claim 21 recites "at least one semiconductor chip is a light emitting diode (LED) chip configured to output light at greater than about 40 milliwatts." Ex. 1001, EPRC 1:34–36. Patent Owner agrees that claim 21's "configured to" language requires that the chip be "capable of" outputting light at greater than about 40 milliwatts. Resp. 14–15. The claim does not require a chip that, when placed in the bulb, actually operates at more than about 40 milliwatts. Thus, to show that the Krames chip meets this claim language, Petitioner explained that "Krames teaches its LED chip achieves '[a] power output of over 170 mW … at a drive current of 1.5 A dc.'" Pet. 54 (quoting Ex. 1008, 10)(alteration in original). In other words, Petitioner proved the capability of the Krames chip.

Petitioner never, however, insisted that a person of skill in the art would run the Krames chip within Begemann at such a high power output. Rather, Petitioner's reason to combine is that Begemann teaches use of LED chips with high luminous flux, and Krames teaches such a chip. Pet. 29–30. When Patent Owner attempted to refute this

reason to combine by arguing that the Krames chip would overheat at 170 mW and 1.5 A dc, Petitioner appropriately responded by establishing that the Krames chip could operate at a variety of power and amperage conditions. Reply 9–10; see also Rembrandt Diagnostics, LP, v. Alere, Inc., 76 F.4th 1376, 1382–84

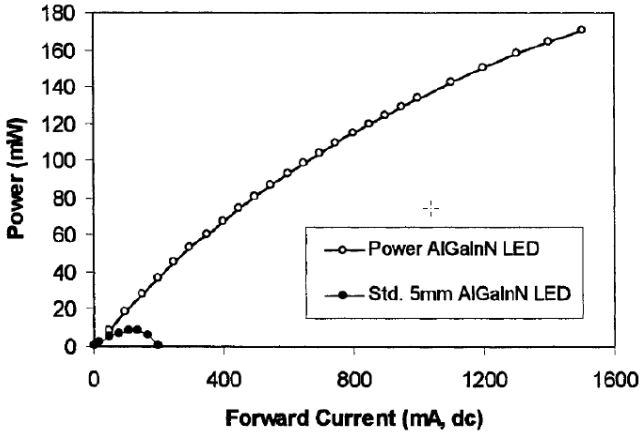

Fig. 12. Light output vs. current characteristic of a blue (λ_p ~470 nm), 1x1 mm^2 AlGaInN LED in a power package, compared to a conventional AlGaInN LED in a 5 mm lamp package.

(Fed. Cir. 2023) (holding that Board did not err by considering Petitioner arguments responsive to Patent Owner assertions regarding motivation to successfully combine). Figure 12 of Krames illustrates possible operating conditions for the Krames chip, and we reproduce that figure below.

Ex. 1008, 9. Krames Figure 12 depicts a graph comparing the light output versus current characteristics of the Krames LED chip versus a conventional LED. *Id.*

Krames Figure 12 illustrates that the Krames chip can operate at amperages much lower than 1.5 A. Indeed, Krames indicates "excellent reliability performance" at 350 mA. Id. at 10; see also Ex. 1028 ¶ 22. The preponderance of the evidence also establishes that, at lower amperage, a person of ordinary skill in the art would have recognized that any heat issues would have been manageable. See Reply 9–10 (citing Ex. 1028 ¶¶ 22–23; Ex. 1008, 9).

Patent Owner also argues that a person having ordinary skill in the art would not have utilized the Krames LED with Begemann because the Krames LED is less energy efficient than an incandescent light bulb and less efficient than the Begemann RGB LEDs. Resp. 36–37. Krames, however, teaches, at 350 mA, "the best performance in terms of power conversion efficiency" and "excellent reliability performance." Reply 8 (quoting Ex. 1008, 7); *see also* Ex. 1008, 9 (teaching excellent reliability performance at 350 mA). Petitioner persuasively argues that the combination of Begemann and Krames could output 136 lumens which exceeds the light output of many commercial bulbs (while dissipating resulting heat). Reply 11–12 (citing Ex. 1028 ¶¶ 27–29). Also, Krames teaches that its LEDs "should be able to compete more favorably with conventional lighting technologies in many applications." Ex. 1008, 6; *see also id.* at 10 (explaining that the Krames chip offers advantages where "high flux density is important" and may offer

unique advantages in "traffic signaling"), 11 (noting "long-life of solid-state emitters").

A person having ordinary skill in the art would have recognized potential advantages of using the Krames LED chip and would have been able to weigh the advantages against any disadvantages. The existence of advantages and disadvantages does not make the combination of Begemann and Krames less obvious in view of Begemann suggesting use of LED chips and Krames providing an appropriate LED chip that provides at least some advantages. *See Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1165 (Fed. Cir. 2006) ("a given course of action often has simultaneous advantages and disadvantages, and this does not necessarily obviate motivation to combine"). In sum, the preponderance of the evidence, as explained above, supports that a person of ordinary skill in the art would have had reason to combine the teachings of Begemann and Krames with a reasonable expectation of success.

With respect to Allen, Begemann teaches a "white LED" for at least one embodiment. Pet. 31–32 (quoting Ex. 1007, 3:6–9). Krames teaches conversion of blue light into white "via phosphors" and Allen teaches that "blue dies with phosphorescent coating" may be used. Ex. 1008, 11; Ex. 1011, 4:11–12; Ex. 1006 ¶¶ 95–96. A preponderance of the evidence supports Petitioner's position that a person of skill in the art would have combined the teachings of Begemann, Allen, and Krames to reach claim 1's recited coating.

Patent Owner argues that Petitioner's proposed obviousness combination is inconsistent because it "argues for the purported obviousness of replacing Begemann's LEDs with Krames' LED chips" but "also argues for the purported obviousness of replacing Begemann's LEDs with Allen's chips." Resp. 30. Patent Owner further argues that neither the Krames chip nor the Allen chip alone teach all recitations of claim 21. *Id.* at 30–31. This argument is unpersuasive because the Petition is reasonably clear that ground one asserts Begemann with the Krames chip and Allen's phosphor coating. *See* Pet. 29–30 (explaining why it would have been obvious to use the Krames chip with Begemann), 31–32 (explaining why it would have been obvious to modify the Krames chip by using a coating of phosphors). When Petitioner maps claim 21 (which depends from cancelled claims 1, 7, and 8) to the asserted art, Petitioner refers to Begemann for the greater lightbulb structure and Krames for the chip. *Id.* at 32–54. For claim 21, Petitioner refers to Allen *only* for the phosphor coating. *Id.* at 41.[15] Petitioner does not rely on only the chip of Krames or only the chip of Allen to meet claim 21, and, as we further address below, Petitioner accounts for each recitation of claim 21.

To summarize, the preponderance of the evidence establishes that a person of ordinary skill in

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[15] When addressing dependent claims, Petitioner also refers to Allen for certain aspects of the bulb structure. *See, e.g.*, Pet. 62, 64, 66–75, 78–83.

the art would have had good reason to implement the Krames chip in the Begemann device while also making use of a phosphor coating as Allen teaches and that a person of ordinary skill in the art would have had a reasonable expectation of success in combining the references' teachings in this manner.

b. *Independent Claim 21*

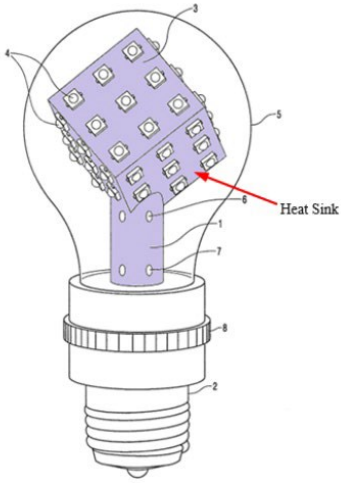
Claim 21 depends from cancelled claims 1, 7, and 8. The preamble of claim 1 recites, "A semiconductor light source for emitting light to illuminate a space used by humans, the semiconductor light source comprising." Petitioner argues that Begemann discloses a semiconductor light source. Pet. 32–33. The preponderance of the evidence supports that Begemann teaches or suggests this recitation. Ex. 1007, 6:23–24, Fig. 2; Ex. 1006 ¶ 98.

Claim 1 next recites "an enclosure, said enclosure being fabricated from a material substantially transparent to white light." Petitioner argues that Begemann teaches this recitation. Pet. 33–34. The preponderance of the evidence supports that Begemann teaches or suggests this recitation. Begemann states, for example, that "during operation of the LED lamp shown, white light is obtained" and that the Begemann device has an "envelope . . . made of glass [or] synthetic resin." Ex. 1007, 2:23–24, 5:26; *see also id.* at Fig. 2; Ex. 1006 ¶ 99.

Claim 1 next recites "an interior volume within said enclosure." As Petitioner asserts, the preponderance of the evidence supports that

Begemann teaches or suggests this recitation. Pet. 34–35, Ex. 1007, Fig. 2; Ex. 1006 ¶ 100.

Claim 1 next recites "a heat sink located in said interior volume." Petitioner identifies such a sink by annotating Figure 2. Pet. 35–37. We reproduce that annotated figure below.



Pet. 35–36 (reproducing Ex. 1006, Fig. 2). Begemann Figure 2 is a view of a second embodiment of Begemann's LED lamp. Ex. 1007, 4:11. Petitioner annotates the Figure to identify heat sink areas. The preponderance of the evidence supports that Begemann teaches or suggests this recitation. Begemann teaches, for example, that substrate 3 is made of a metal or metal alloy, thereby enabling a good heat conduction and that the outer surface of the gear column (1) of the LED lamp is made of a metal or

a metal alloy enabling good heat conduction. *Id.* at 5:1–21; *see also* Ex. 1006 ¶ 101.

Claim 1 next recites "said heat sink being capable of drawing heat from one or more semiconductors devices." As Petitioner explains, the preponderance of the evidence supports that Begemann teaches or suggests this recitation. Pet. 37.

Claim 1 next recites "said heat sink having a plurality of panels on it suitable for mounting semiconductor devices thereon." Petitioner annotates Figure 2 to identify a plurality of panels. Pet. 37–38. The preponderance of the evidence supports that Begemann teaches or suggests this recitation. *See* Ex. 1007, Fig. 2; Ex. 1006 ¶ 103.

Claim 1 next recites "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 again annotates Figure 2 to illustrate how Begemann teaches this recitation. Pet. 38–39. The preponderance of the evidence supports that Begemann teaches or suggests this recitation. *See* Ex. 1007, Fig. 2; Ex. 1006 ¶ 104.

Claim 1 next recites "at least one semiconductor chip capable of emitting light mounted on one of said panels." Petitioner annotates Begemann Figures 2 and 3A to illustrate how Begemann teaches this recitation. Pet. 39–40. The preponderance of the evidence supports that Begemann teaches or suggests this recitation. Ex. 1007, Figs. 2, 3A; Ex. 1006 ¶ 105.

Claim 1 next recites "said semiconductor chip being capable of emitting monochromatic light." Petitioner argues that Begemann teaches this recitation. Pet. 40. The preponderance of the evidence supports that Begemann teaches or suggests this recitation. Begemann teaches that its "single chip LEDs" have "only one light point per LED." Ex. 1007, 4:32–34.[16] Begemann explains, for example, that its green, red, yellow, blue light points may be mixed to obtain white light. *Id.* at 5:17–26. Petitioner's witness, Dr. Lebby, testifies that having only one light point means the light is monochromatic. Ex. 1006 ¶ 106.

Claim 1 next recites "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." The preponderance of the evidence supports that Begemann teaches or suggests this recitation. As Petitioner asserts, Begemann teaches that its chips are LEDs. Pet. 40–41; Ex. 1007, 6:4–5, Fig. 3A; Ex. 1006 ¶ 107.

Claim 1 next recites "a coating for converting monochromatic light emitted by said chip to white light." Petitioner asserts that Allen and Krames teach such a coating. Pet. 41. The preponderance of the evidence supports that Allen and Krames teach or suggest this recitation. *See* Ex. 1011, 4:11–12 (Allen stating that "[w]hite dies may be, for example, blue

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[16] Petitioner mistakenly cites 3:32–34 (Pet. 40), but the quote is easily located on the next page.

dies with phosphorescent coating to produce a wideband spectrum"); Ex. 1008, 11 (Krames explaining "conversion of blue light into white via phosphors"); Ex. 1006 ¶¶ 108–109. Also, as we explain above, the preponderance of the evidence supports Petitioner's arguments regarding combining the teachings of Begemann, Krames, and Allen.

We next address elements of claim 7, which depends from claim 1. Claim 7 first recites "A device as recited in claim 1 wherein said chip includes a substrate on which epitaxial layers are grown." Petitioner asserts that Krames teaches such a substrate. Pet. 41. The preponderance of the evidence supports that Krames teaches or suggests this recitation. Ex. 1008, Fig. 3 (depicting "Sapphire Substrate"), 4 ("the two most common substrates used for OMVPE growth of AlGa1nN are sapphire and SiC"); *see also* Ex. 1006 ¶¶ 110–111.

Claim 7 next recites "a buffer layer located on said substrate." Petitioner asserts that Krames teaches a buffer layer located on its substrate. Pet. 42–43. The preponderance of the evidence supports that Krames teaches or suggests this recitation. Ex. 1008, Fig. 3 (depicting "Buffer Layer"); *see also* Ex. 1006 ¶ 112. Claim 7 next recites "said buffer layer serving to mitigate differences in material properties between said substrate and other epitaxial layers." Petitioner asserts that Krames's buffer layer serves this role. Pet. 43–45. The preponderance of the evidence supports that Krames teaches or suggests this

recitation. Ex. 1008, Fig. 3; Ex. 1006 ¶¶ 113–114; Ex. 1014, 353 (reference Krames cites explaining that mismatch between substrate and film makes film difficult to grow).

Claim 7 next recites "a first cladding layer serving to confine electron movement within the chip." Petitioner asserts that Krames discloses this layer. Pet. 45–46. The preponderance of the evidence supports that Krames teaches or suggests this recitation. Ex. 1008, 5 (referring to GaN confining layers), Fig. 3; Ex. 1006 ¶ 115.

Claim 7 next recites "said first cladding layer being adjacent said buffer layer." Petitioner asserts that Krames discloses this recitation. Pet. 46. The preponderance of the evidence supports that Krames teaches or suggests this recitation as illustrated, for example, by Krames Figure 3. Ex. 1008, Fig. 3; Ex. 1006 ¶ 116.

Claim 7 next recites "an active layer." Petitioner asserts that Krames discloses an active layer. Pet. 46–47. The preponderance of the evidence supports that Krames teaches or suggests this recitation. Ex. 1008, Fig. 3; Ex. 1006 ¶ 117.

Claim 7 next recites "said active layer emitting light when electrons jump to a valance state." Petitioner asserts that Krames's active layers perform this function. Pet. 47. The preponderance of the evidence supports that Krames teaches or suggests this recitation. Ex. 1006 ¶ 118.

Claim 7 next recites "a second cladding layer." Pet. 48. Petitioner asserts that Krames teaches this layer. *Id.* The preponderance of the evidence supports that Krames teaches or suggests this recitation. Ex. 1008, 5, Fig. 3; Ex. 1006 ¶ 119.

Claim 7 next recites "said second cladding layer positioned so that said active layer lies between cladding layers." Petitioner asserts that Krames teaches this layer and annotates Krames Figure 3 to illustrate this point. Pet. 48–49. The preponderance of the evidence supports that Krames teaches or suggests this recitation. Ex. 1008, Fig. 3; Ex. 1006 ¶ 120.

Claim 7 next recites "a contact layer on which an electron may be mounted for powering said chip." Petitioner asserts that Krames teaches this layer. Pet. 49–50. The preponderance of the evidence supports that Krames teaches or suggests this recitation. Ex. 1008, Fig. 3; Ex. 1006 ¶ 122.

We next address elements of claim 8, which depends from claim 7. Claim 8 recites "[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." We address claim construction relating to this term in Section III.D, *supra*.

Petitioner contends that Krames's Gold-Nickel "AuNi Contact Layer" is a first reflective layer and

Krames's "metal back-reflector" is a second reflective layer. Pet. 50–53. The preponderance of the evidence supports that Krames teaches or suggests these recitations. Ex. 1008, Fig. 3, 6; Ex. 1006 ¶¶ 123–126.

As to the first reflective layer, Patent Owner argues that Krames's Gold-Nickel (AuNi) contact layer is not a reflective layer because Petitioner lacks evidence that this layer would reflect more than a negligible amount of light. Resp. 39–40. Patent Owner argues that the surface of the Nickel facing the active layer would be rough and not polished and that the reflection, if any, would be negligible. *Id.* (citing Ex. 2020 ¶ 148). Patent Owner also argues that Dr. Krames did not consider the AuNi contacts to be reflectors. Sur-Reply 24–25 (citing Ex. 2030, DDX10-58; Ex. 2029, 807:22–809:9; Ex. 2033, 38:23–44:16).

Petitioner, however, provides persuasive evidence that the gold-nickel AuNi contact layer would provide non-negligible reflection. In particular, Petitioner shows that such a layer of typical thicknesses would have a reflectivity of 20.6% or, more conservatively with different thickness, 5.9%; either result is more than the 1% or 3% necessary for reflectance to be more than negligible. Reply 13–14 (citing Ex. 1027 ¶¶ 9–12); *see also* Ex. 1032, 188:7–14 (Patent Owner's witness, Dr. Shealy, testifying that reflection "on the order of one percent" would be more than negligible); Tr. 53 (counsel for Patent Owner agreeing that Dr. Shealy opined that "three percent

reflection is enough to be non-negligible").[17] Also, whether or not Dr. Krames subjectively considered the contact to be a "reflective layer" does not persuasively bear on the technical issue of whether the contact would, nonetheless, provide the small amount of reflection necessary for reflection to be non-negligible.

Patent Owner disputes Petitioner's reflectivity evidence by arguing that the AuNi layer would have 60.8% absorbance and only 18.6% transmittance and would "block substantially all of the light from the LED." Sur-Reply 24. Patent Owner, however, does not offer evidence that undermines Petitioner's position that the reflection would be more than the one or three percent necessary to be non-negligible. Because non-negligible reflectance may be as little as one or three percent reflectance, it may be true that the reflectance is non-neglible and also true that the AuNi layer blocks "substantially all" (ninety-seven to ninety-nine percent of light). Patent Owner also argues that Petitioner's calculations (performed by Dr. Lebby) are flawed (Sur-Reply 25–26), but Dr. Lebby's testimony nonetheless provides sufficient evidence that the AuNi layer is non-negligibly reflective, and Patent Owner offers no persuasive evidence to the contrary.

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[17] Patent Owner notes that Petitioner's argument is "advanced for the first time in Cree's Reply." Sur-Reply 23. Patent Owner does not, however, contend that Petitioner's argument is inappropriate for this reason. We determine the argument is appropriate because it is responsive to Patent Owner's Response.

As such, the preponderance of the evidence supports Petitioner.

As to the second reflective layer, Patent Owner argues that the evidence does not support that the "metal back-reflector" can be a second reflector layer because Krames does not teach what the metal back-reflector is or how it is inserted. Resp. 40–41. This argument is unpersuasive. Krames describes "inserting a metal back-reflector on the sapphire substrate" and that, because of the insertion, "the light output was recovered to result in a reliable AlGaInN LED with no penalty to light output." Ex. 1008, 6. Dr. Lebby also provides testimony explaining this reflector. Ex. 1006 ¶¶ 124–125. This is adequate to support, by a preponderance of the evidence, that Krames teaches or suggests the recited second reflective layer especially given that one to three percent reflectance is adequate to meet the requirement of a "reflective layer" in this context. *See* Reply 14–15.

Petitioner contends, as an alternative, that the interface between the substrate and the buffer layer is a "second reflective layer." Pet. 52. Patent Owner argues that "[a]n interface is not a layer." Resp. 40. Because we determine that the "metal back-reflector" is a second reflective layer, we do not need to reach the issue of whether or not this interface might satisfy claim 8's second reflector layer.

We next address elements of claim 21 which depends from claim 8. Claim 21 first recites, "[t]he

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." Petitioner contends that Krames teaches a LED chip with 170 milliwatt power output (i.e., more than 40 milliwatts). Pet. 53–54. The preponderance of the evidence supports that Krames teaches or suggests this recitation. Ex. 1008, 10; Ex. 1006 ¶ 128. Importantly, this claim language requires a semiconductor chip *capable* of the recited output, and Patent Owner does not persuasively dispute that the Krames chip is *capable* of meeting this recitation.

Claim 21 next recites "said LED chip is configured to emit monochromatic visible light." Petitioner contends that Krames teaches this recitation. Pet. 54. The preponderance of the evidence supports that Krames teaches or suggests this recitation. Ex. 1008, 5; Ex. 1006 ¶ 129.

To summarize, Petitioner has shown by a preponderance of the evidence that the combined teachings of Begemann, Krames, and Allen teach or reasonably suggest all of the elements of claim 21 in the manner claim 21 (and the claims that claim 21 depends from) recites. Thus, we are persuaded that Petitioner has established by a preponderance of the evidence that the combination of Begemann, Krames, and Allen renders claim 21 obvious.

c. *Dependent Claim 29*

Claim 29 recites, "[t]he semiconductor light source as recited in claim 28 wherein: said opening defined in said dome-shaped enclosure is large enough for said heat sink to pass through said opening." Ex. 1001, EPRC 2:17–21. The "opening" of claim 29 is defined in claim 28 which refers to "said enclosure [referring back to the enclosure of claim 1] is shaped as a dome that defines an opening." *Id.* at 2:9–16.

Petitioner reproduces Figure 6B of Allen to illustrate that the opening of Allen is large enough for Allen's heat sink to pass through. Pet. 66–67. Petitioner further argues that a person having ordinary skill in the art would incorporate this aspect of Allen "to achieve an LED lamp with improved performance and manufacturability to replace conventional incandescent lamps." Pet. 32 (citing Ex. 1006 ¶ 96).

Patent Owner argues that Petitioner relies only on Begemann as providing a heat sink and that "Cree provides absolutely no explanation why a POSITA would have been motivated to use or combine Allen's enclosure with Begemann." Resp. 41–42. This argument is unpersuasive. Petitioner provides a rationale for combining the teachings of Allen and Begemann, and the rationale is supported by at sufficient evidence, namely the declaration of Dr. Lebby. Pet. 32 (citing Ex. 1006 ¶ 96); *see also* Reply 21–22. Patent Owner provides no evidence that would undermine or weigh against Petitioner's stated reasons to combine.

Patent Owner further argues that a person having ordinary skill in the art would understand that Allen's "dome-shaped enclosure" would not function for its intended purpose with Begemann's lightbulb because it "does not fit the geometry of Begemann's light bulb." Resp. 42 (citing Ex. 1007, Figs. 1–2 and Ex. 1011 Figs. 6A–6B). This argument is unpersuasive because it does not squarely address Petitioner's contentions; Petitioner's combination relies on using Allen's bulb shape having Allen's opening rather than relying on Begemann's lightbulb shape. *See* Reply 22.

Thus, Petitioner has shown by a preponderance of the evidence that the combined teachings of Begemann, Krames, and Allen teach or reasonably suggest all of the elements of claim 29 in the manner claim 29 recites. Ex. 1006 ¶ 96; Ex. 1011, Fig. 6B. Thus, we are persuaded that Petitioner has established by a preponderance of the evidence that the combination of Begemann, Krames, and Allen renders claim 29 obvious.

d. *Dependent Claim 32*

Claim 32 recites, "[T]he semiconductor light source as recited in claim 21 wherein: the semiconductor light source further comprises an AC/DC converter, said AC/DC converter is configured to convert AC power into DC power that is usable by said LED chip, and said AC/DC converter is positioned outside said interior volume." Ex. 1001, EPRC 2:33–40.

Petitioner argues that Allen teaches the recited voltage converter. Pet. 68–69 (citing Ex. 1011, 6:15–18). Petitioner further argues that Allen teaches that voltage converter 204 is located outside of the interior volume. Pet. at 69–70 (citing Ex. 1011, 6:15–18, Fig. 6B). Petitioner also provides evidence, namely testimony from Dr. Lebby, supporting that a person of ordinary skill in the art would have been motivated to put circuitry outside of the interior volume to avoid obscuring emitted light. Pet. 70 (citing Ex. 1006 ¶ 148).

Patent Owner argues that Allen's voltage converter 204 is not "outside said interior volume" as claim 32 recites. Resp. 42–43. Patent Owner argues that Petitioner "incorrectly limits the interior volume within the enclosure to only the space to the left of the leftmost 'support 212.'" *Id.* at 43. This argument is unpersuasive because the preponderance of the evidence supports Petitioner.

As Petitioner argues, claim 1 (which claim 32 ultimately depends from) states that the recited "enclosure" must be "fabricated from a material substantially transparent to white light." Reply 23. Allen's structure to the right of the leftmost "support 212" (where the converter 204 is located) is opaque: "the mounting 212 supporting the five monolithic LED devices 100 is preferably transparent or translucent, whereas *the mounting 212 that supports the voltage converter 204 is preferably opaque*." Ex. 1011, 9:32–34 (emphasis added). Allen continues: "the parts of the

bulb housing 207 forming the globular front face 206 and form the side up to the mounting support for the power supply is likely to be transparent or frosted, whereas the remaining parts of the housing 207 forming the base 210 are preferably opaque." *Id.* at 9:34–10:3.

Patent Owner argues that the entire enclosure need not be opaque. Sur-Reply 30–31. This argument does not squarely address Petitioner's position. The preponderance of the evidence supports that Allen's enclosure for the LEDs is the transparent portion to the left of support 212 while the opaque portion is an opaque base that is not part of that same enclosure. The opaque portion to the right of support 212 is separated from the transparent portion to the right of support 212 and, thus, does not enclose the same components and is not the same enclosure. Ex. 1011, Fig. 6B.

Patent Owner also argues that Petitioner's alleged reason to combine Allen with Begemann "to avoid the emitted light from being obscured by such circuitry or structures" would not be a concern. Resp. 44. Patent Owner argues that Begemann does not identify this problem and places components in its interior volume. *Id.* This argument is unpersuasive because Allen discloses a workable and advantage design; a person having ordinary skill in the art would have understood that Begemann would benefit from having electronic components outside the interior lighting volume for the same reason Allen benefits

from this design. *KSR Int'l, Co.*, 550 U.S. at 417 ("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"); *see also* Ex. 1006 ¶ 148.

Petitioner has shown by a preponderance of the evidence that the combined teachings of Begemann, Krames, and Allen teach or reasonably suggest all of the elements of claim 32 in the manner claim 32 recites. Ex. 1006 ¶ 148; Ex. 1011, 9:32–10:3, Fig. 6B. We are persuaded Petitioner has established by a preponderance of the evidence that the combination of Begemann, Krames, and Allen renders claim 32 obvious.

e. *Dependent Claim 34*

Claim 34 recites:

> The semiconductor light source as recited in claim 33 wherein: the semiconductor light source further comprises a positive lead wire and a negative lead wire configured to provide power from said AC/DC converter to said LED chip, and said positive lead wire and said negative lead wire run from said AC/DC converter, through an interior of said base, into said interior

> volume, and over an exterior surface of said heat sink.

Ex. 1001, EPRC 2:46–55. Petitioner argues that Allen Figure 6B illustrates positive and negative lead wires. Pet. 72 (citing Ex. 1011, Figs. 6A, 6B; Ex. 1006 ¶ 151). Petitioner argues that it would have been obvious to include Allen's AC/DC converter in Begemann's base and to connect those wires as recited in order to power the LEDs. *Id.* at 72–73 (citing Ex. 1006 ¶ 152).

Patent Owner argues that the identified structures do not "run from said AC/DC converter, through an interior of said base." Resp. 45. We disagree. As we explain with regard to claim 32, Allen's structure to the right of leftmost "support 212" is the recited base. Reply 24. Figure 6B shows the wires running through this base.

Patent Owner also argues that Petitioner does not provide a reason why a person having ordinary skill in the art would combine Allen's voltage converter 204 and lead wires with Begemann's device or place Allen's voltage converter 204 within Begemann's base. Resp. 45. Petitioner, when addressing claim 33, provides a persuasive reason why a person of ordinary skill in the art would use Allen's voltage converter and position it in the base. Pet. 71 ("A POSITA would have been motivated and found it obvious to put circuitry or other electronic structures in Begemann's base to avoid the emitted light from being obscured by such circuitry or structures"). Patent Owner does not present evidence

persuasively undermining this reasoning or evidence. A preponderance of the evidence supports Petitioner's position. Ex. 1011, Fig. 6B, 6:15–18; Ex. 1006 ¶ 150. We are persuaded Petitioner has established by a preponderance of the evidence that the combination of Begemann, Krames, and Allen renders claim 34 obvious.

f. *Dependent Claim 36*

Claim 36 recites: "[t]he semiconductor light source as recited in claim 21 wherein: said coating is directly applied to a face of said LED chip." Ex. 1001, EPRC 2:61-63. Petitioner argues that Allen teaches "[w]hite dies may be, for example, blue dies with phosphorescent coating to produce a wideband spectrum." Pet. 74 (citing Ex. 1011, 4:11–12). Petitioner further provides evidence that a "die" is a way of referring to an LED chip. *Id.* (citing Ex. 1006 ¶ 155).

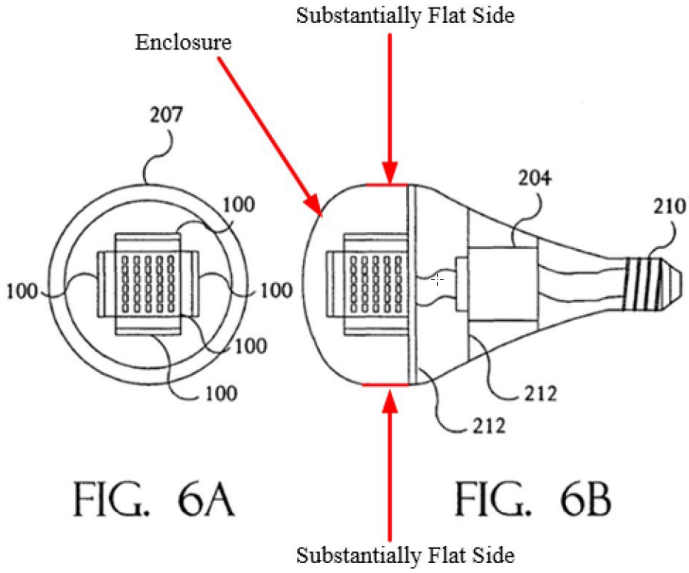
Patent Owner argues that this passage does not teach applying the coating directly to the face of an LED chip because the coating could instead encapsulate the LED chip as taught by U.S. Patent No. 5,959,316. Resp. 46 (citing Ex. 2024, Fig. 3, 3:6–11).

The preponderance of the evidence supports Petitioner's position. Allen suggests that it is its die that has a coating rather than suggesting that there is a spacer adjacent to the die that is coated. Reply 24–25 (citing Ex. 1011, 4:11–12). The die is the LED chip. Ex. 1006 ¶ 155. We are persuaded Petitioner has

established by a preponderance of the evidence that the combination of Begemann, Krames, and Allen renders claim 36 obvious.

g. *Dependent Claim 41*

Dependent claim 41 recites, "[T]he semiconductor light source as recited in claim 40 wherein: said enclosure includes a substantially flat side." Ex. 1001, EPRC 3:18–20. Petitioner annotates Figure 6B of Allen to argue that Allen's enclosure has a substantially flat side. Below, we reproduce Figure 6A alongside Figure 6B as Petitioner annotates that figure.



Pet. 76 (reproducing Ex. 1011, Figs. 6A, 6B). Allen Figure 6A shows a top view of an exemplary embodiment of Allen "employed in an 'A-type' screw-in hemispherical lamp configuration," and Figure 6B

shows a side view of the same embodiment. Ex. 1011, 3:17–20. Petitioner annotates Figure 6B by pointing to the enclosure and top and bottom portions labeled as "[s]ubstantially [f]lat [s]ide." Pet. 76.

Patent Owner argues that Petitioner does not establish that Allen's Figure 6B enclosure has a "substantially flat side" because "the two purportedly 'flat sides' are actually part of a cylindrical—not flat—portion of Allen's enclosure." Resp. 47. The preponderance of the evidence supports Patent Owner's position.

The '961 patent addresses use of a "flat" enclosure in the context of Figure 10. We reproduce Figure 10 below for reference.

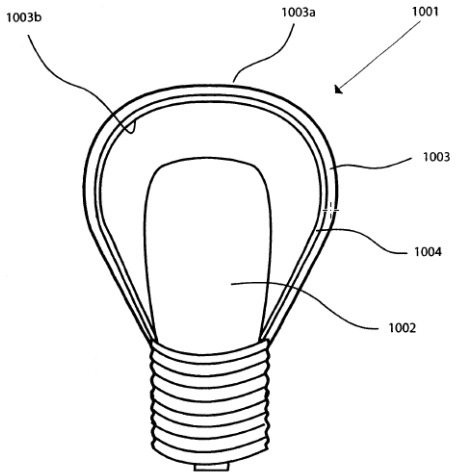


Fig. 10

Ex. 1001, Fig. 10. Figure 10 "depicts an LED or laser light source located in a light enclosure having a phosphor coating." *Id.* at 2:42–43. The '961 patent distinguishes Figure 10 from a flat shape by stating that "[t]he depicted shape is that of a bulb, but flat, arcuate, rounded or other shapes may be used depending on the application." Id. at 8:41–43.

Petitioner argues that Figure 6B depicts a disclosure with a "substantially flat side" because, even though the disclosure is cylindrical, it still "comprises a flat side which encircles the lamp." Reply 25. We disagree. The surface of the Figure 6B bulb is cylindrical. Given the context of the '961 patent, as explained above, "flat" describes a three-dimensional object being flat—in other words being flat in three dimensions. The '961 patent does not indicate that "flat" or "substantially flat" can be understood so broadly that it includes a curved three-dimensional surface that only appears flat based on viewing the surface from a particular direction.

We further emphasize that Petitioner's position is based upon combining Allen's teachings with Begemann (as opposed to, for example, modifying the art's teachings based on what is generally known in the art). Pet. 76 ("[a] POSITA would have found it obvious to use Allen's enclosure with two substantially flat sides as the enclosure of Begemann"); Reply 26 ("a POSITA would have found it obvious to use Allen's enclosure with two substantially flat sides as the enclosure of

Begemann"). Because Allen does not teach a substantially flat surface, combining the teachings will also not result in a substantially flat surface.

Thus, for the reasons explained above, Petitioner has not adequately established by a preponderance of the evidence that claim 41 would have been obvious in view of the cited art.

h. *Dependent Claims 22, 25, 26, 28, 30, 33, 35, 40, 42–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 71–73, 77, 78, 81, 82, 85, 86, and 88–91*

Petitioner accounts for the limitations recited in claims 22, 25, 26, 28, 30, 33, 35, 40, 42–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 71–73, 77, 78, 81, 82, 85, 86, and 88–91. Pet. 54–104. Petitioner provides detailed explanations as to how the combined teachings of Begemann, Krames, and Allen disclose, teach, or suggest the limitations of these claims and why it would have been obvious to combine those teachings with a reasonable expectation of success, citing Dr. Lebby's testimony for support. *Id.* (citing Ex. 1006).

We are persuaded that Petitioner has demonstrated that all of the limitations recited in claims 22, 25, 26, 28, 30, 33, 35, 40, 42–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 71–73, 77, 78, 81, 82, 85, 86, and 88–91 would have been obvious over Begemann, Krames, and Allen. Patent Owner provides no arguments regarding these claims outside of the arguments discussed above. *See generally* Resp.

Having reviewed Petitioner's arguments and supporting evidence, we are persuaded that Petitioner has established by a preponderance of the evidence that claims 22, 25, 26, 28, 30, 33, 35, 40, 42–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 71–73, 77, 78, 81, 82, 85, 86, and 88–91 are unpatentable under § 103(a) over Begemann, Krames, and Allen.

5. Ground Two: Unpatentability over Begemann, Nakamura, Allen, and Krames

Petitioner asserts that claims 21, 22, 25, 26, 28–30, 32–36, 40–44, 47– 49, 52, 53, 56–59, 62, 63, 65–68, 71–73, 77, 78, 81, 82, 85, 86, and 88–91 are unpatentable under 35 U.S.C. § 103(a) as obvious over Begemann, Nakamura, Allen, and Krames, citing the Declaration of Dr. Michael S. Lebby for support. Pet. 104–116 (citing Ex. 1006). To the extent Petitioner's assertions and Patent Owner's counter arguments do not relate to Nakamura, we address those issues above when addressing Ground One and, for brevity, we do not repeat that analysis here.

Petitioner argues that Nakamura teaches an LED chip appropriate for combination with Begemann and that Nakamura's LED chip teaches claim 21's recited reflective layers. Pet. 30, 104–115. But, as we explain below, Patent Owner persuasively argues that the Nakamura chip embodiment having the required reflective layers is a chip for a laser rather than an LED. Resp. 51–53. Because the embodiment with reflective layers is a laser chip, Petitioner does not adequately establish that a person

of ordinary skill in the art would have combined that chip with Begemann which seeks to use LED chips. Ex. 1007, 2:3–5, Figs. 2, 3A; *see also* Resp. 52–53.

Petitioner relies on the structure of Nakamura's Figure 11 to argue claim 21's recited chip layers would have been obvious. Pet. 104–115. Nakamura's Figure 11, most generally, depicts a "light emitting device according to the seventh embodiment of the present invention." Ex. 1009, 5:58–60, 19:43–45. Nakamura states that its invention "relates to a semiconductor light-emitting device such as a light-emitting diode (LED) or a laser diode (LD)." *Id.* at 1:7–11. Thus, the Figure 11 device, in general, could be either an LED or a laser diode.

Petitioner, however, also relies on Nakamura's text at 21:47–55 as disclosing a "light-reflecting film." Pet. 112–114. Here, the text indicates that it is "also possible" for the seventh embodiment "to dispose as a light-reflecting film a first multi-layered film 100." Ex. 1009, 21:47–50. Notably, Figure 11 does not illustrate the reflective first multi-layered film 100.

Rather, Nakamura is best understood as teaching that the light-reflecting film is an option that could be added to the seventh (Figure 11) embodiment. Why would someone want to add the light-reflecting film option? Nakamura immediately answers the question. *Id.* at 21:56–22:27. In particular, Nakamura Figures 12 and 13 illustrate a "light-emitting device provided with such a light-reflecting film" and "these Figures illustrate a

structure of a *laser device*." *Id.* at 21:56–62 (emphasis added). Nakamura explains that the purpose of the light-reflecting multilayer film is to confine light "to easily allow the generation of laser oscillation." *Id.* at 22:1–11. In other words, while Figure 11 could be an LED chip of a laser diode chip, Nakamura strongly indicates that there would be no reason to add the light-reflecting multilayer film of Figures 12 and 13 unless you wished to generate laser oscillation. Resp. 51–53.

Petitioner argues that Nakamura teaches incorporating reflective layers into a "light-emitting device" and argues, based on testimony of Dr. Lebby, that reflective layers in a light-emitting device would be useful to create a "super-luminous LED." Reply 17–18 (emphasis omitted). Petitioner's argument is unpersuasive. Nakamura, for the reasons explained above, is best understood as teaching that its light-reflecting multilayer film is useful to generate laser oscillation for a laser. Nakamura does not mention super-luminous LEDs or suggest use of its light-reflecting multilayer film in an LED. Thus, even if super-luminous LEDs existed in the art, Petitioner's position fails to establish that a person having ordinary skill in the art would have understood that Nakamura suggests that its light-reflecting multilayer film would have been useful in an LED. Sur-Reply 26–27. Moreover, Patent Owner provides credible evidence that adding the light-reflecting

multilayer film into an LED would be inefficient. *Id.* at 26 (citing Ex. 2020 ¶¶ 158, 161; Ex. 2015, 34:7–23).

Thus, Petitioner has not met the burden of establishing by a preponderance of the evidence that a person having ordinary skill in the art would have had reason to incorporate Nakamura's light-reflecting multilayer film into an LED chip for Begemann. As such, Petitioner does not establish that Petitioner's stated theory of obviousness based on the combined teachings of Begemann, Nakamura, Allen, and Krames establishes the obviousness of claim 21 or any dependent claim.[18]

6. Ground Three: Unpatentability over Begemann, Sugiura, Allen, and Krames

Petitioner asserts that claims 21, 22, 25, 26, 28–30, 32–36, 40–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 71–73, 77, 78, 81, 82, 85, 86, and 88–91 are unpatentable under 35 U.S.C. § 103(a) as obvious over Begemann, Sugiura, Allen, and Krames, citing the

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[18] We note that, above, we determine that Petitioner adequately established the obviousness of certain claims based on Begemann, Allen, and Krames (ground one). As a practical matter, a person having ordinary skill in the art would have also found the same claims obvious over Begemann, Nakamura, Allen, and Krames; the person having ordinary skill in the art could ignore Nakamura's laser teachings. The Petition's second ground nonetheless fails because the ground relies on Nakamura rather than Krames for its LED chip, and, as we explain, Petitioner has not adequately established that a person of ordinary skill in the art would have had reason to use the Nakamura chip with Begemann.

Declaration of Dr. Michael S. Lebby for support. Pet. 116–130 (citing Ex. 1006). To the extent Petitioner's assertions and Patent Owner's counter arguments do not relate to Sugiura, we address those issues above when addressing Ground One and, for brevity, we do not repeat that analysis here.

Petitioner argues that Sugiura teaches an LED chip appropriate for combination with Begemann and that Sugiura's LED chip teaches claim 21's recited reflective layers. Pet. 30, 116–130. But Petitioner's argument is unpersuasive for reasons similar to why the argument regarding Nakamura failed. As we explain below, Patent Owner persuasively argues that the Sugiura chip embodiment having the required reflective layers is a chip for a laser rather than an LED. Resp. 58–59. Because the embodiment with reflective layers is a laser chip, Petitioner does not adequately establish that a person of ordinary skill in the art would have combined that chip with Begemann which seeks to use LED chips. Ex. 1007, 2:3–5, Figs. 2, 3A; *see also* Resp. 58–59.

Petitioner relies on the structure of Sugiura Figure 7 to argue claim 21's recited chip layers would have been obvious. Pet. 116–130. Petitioner alleges that SiO2 film 43 is a first reflective layer and either a metal back reflector (as taught by Krames) or the interface between the substrate (layer 30) and the buffer layer (combination of layers 32 and 33) is a second reflective layer. Pet. 126–128.

Figure 7 of Sugiura, however, shows "the structure of the nitride-based semiconductor *laser* according to a second embodiment of the present invention." Ex. 1010, 12:21–23 (emphasis added). Sugiura teaches that "SiO2 film 43 is selectively formed in order to narrow the current." *Id.* at 12:40–45. Dr. Shealy persuasively explains that "narrowing the current" is contrary to LED design which seeks to spread the current. Ex. 2020 ¶ 187. Dr. Shealy states "[c]urrent narrowing can be an effective strategy in an edge-emitting laser, but it is destructive to efficiency in an LED." *Id.* Petitioner argues that Sugiura expressly teaches that Figure 7 may be a laser or an LED device. Reply 19. Petitioner is correct in this regard. Ex. 1010, 14:58–67 ("Although this embodiment [Figure 7] has been described above with reference to the case it is applied to a laser, . . . the present invention can be applied not only to a nitride-based semiconductor laser but also to a light-emitting diode [LED]".). This teaching, however, does not mean that a person having ordinary skill in the art would have chosen to include SiO2 film 43 when implementing Figure 7 as an LED. Rather, Sugiura suggests that SiO2 film 43 is "selectively formed" only when it is desirable to narrow the current (Ex. 1010, 12:21–23), and the preponderance of the evidence supports that a person having ordinary skill in the art would have had no need to narrow the current of an LED (Ex. 2020 ¶ 187). As such, the preponderance of the evidence suggests that if a person having ordinary

skill in the art were to implement Sugiura Figure 7 as an LED, SiO2 film 43 would have been omitted.

Petitioner also argues that laser design is "intimately related to LEDs." Reply 20 (emphasis omitted). The evidence supports such a relationship. The argument, however, does not persuasively explain why structure for narrowing current such as Sugiura's SiO2 film 43 would be appropriate for an LED.

Thus, Petitioner has not met the burden of establishing by a preponderance of the evidence that a person having ordinary skill in the art would have had reason to incorporate Sugiura's SiO2 film 43 into an LED chip for Begemann. As such, Petitioner does not establish that Petitioner's stated theory of obviousness based on the combined teachings of Begemann, Sugiura, Allen, and Krames establishes the obviousness of claim 21 or any dependent claim.[19]

IV. CONCLUSION

Based on the evidence presented with the Petition, the evidence introduced during the trial, and the parties' respective arguments, Petitioner has

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[19] We note that, although claims would have been obvious based on Begemann, Allen, and Krames (ground one), the Petition's third ground fails because the ground relies on Sugiura rather than Krames for its LED chip, and, as we explain, there would not have been good reason to use a Sugiura chip having SiO2 film 43 with Begemann.

shown by a preponderance of the evidence that claims 21, 22, 25, 26, 28–30, 32–36, 40, 42–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 71–73, 77, 78, 81, 82, 85, 86, and 88–91 of U.S. Patent No. 6,465,961 C2 are unpatentable.[20] Petitioner has not shown by a preponderance of the evidence that claim 41 of U.S. Patent No. 6,465,961 C2 is unpatentable.

In summary:

[20] 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).

Appendix B

Claim(s)	35 U.S.C. §	Reference(s)/ Basis	Claims Shown Unpatenteable	Claims Not Shown Unpatentabile
21, 22, 25, 26, 28–30, 32–36, 40–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 71–73, 77, 78, 181, 82, 85, 86, 88–91	103 (a)	Begemann, Krames, Allen	21, 22, 25, 26, 28–30, 32–36, 40, 42–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 71–73, 77, 78, 181, 82, 85, 86, 88–91	41
21, 22, 25, 26, 28–30, 32–36, 40–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 71–73, 77, 78, 81, 82, 85, 86, 88–91	103 (a)	Begemann, Nakamura, Allen, Krames		21, 22, 25, 26, 28–30, 32–36, 40–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 71–73, 77, 78, 81, 82, 85, 86, 88–91

21, 22, 25, 26, 28–30, 32–36, 40–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 71–73, 77, 78, 81, 82, 85, 86, 88–91	103 (a)	Bege-mann, Sugiura, Allen, Krames		21, 22, 25, 26, 28–30, 32–36, 40–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 71–73, 77, 78, 81, 82, 85, 86, 88–91
Overall Outcome			21, 22, 25, 26, 28–30, 32–36, 40, 42–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 71–73, 77, 78, 181, 82, 85, 86, 88–91	41

V. ORDER

For the foregoing reasons, it is

ORDERED that Petitioner establishes by a preponderance of the evidence that claims 21, 22, 25,

26, 28–30, 32–36, 40, 42–44, 47–49, 52, 53,56–59, 62, 63, 65–68, 71–73, 77, 78, 81, 82, 85, 86, and 88–91 of U.S. Patent No. 6,465,961 C2 are unpatentable;

FURTHER ORDERED that Petitioner does not establish by a preponderance of the evidence that claim 41 of U.S. Patent No. 6,465,961 C2 is unpatentable;

FURTHER ORDERED that Patent Owner's Motion to Exclude Exhibit 1028 is *denied*;

FURTHER ORDERED that Petitioner's Motion to Exclude Exhibits 2017 and 2030 is *dismissed as moot*; and

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

APPENDIX C – FINAL WRITTEN DECISION FROM THE UNITED STATES PATENT AND TRADEMARK OFFICE BEFORE THE PATENT AND TRIAL AND APPEAL BOARD IN IPR2022-00848 DATED SEPTEMBER 28, 2023

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

WOLFSPEED, INC. and IDEAL INDUSTRIES LIGHTING, LLC D/B/A CREE LIGHTING,

Petitioner,

v.

CAO LIGHTING, INC.,

Patent Owner.

IPR2022-00848
Patent 6,634,770 C3

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

Appendix C

RANGE, *Administrative Patent Judge*.

JUDGMENT

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

I. INTRODUCTION

Wolfspeed, Inc. and IDEAL Industries Lighting, LLC d/b/a Cree Lighting ("Cree") (collectedly, "Petitioners") filed a Petition requesting *inter partes* review of claims 18, 22, 25, 26, 28–30, 32–36, 40–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 70–73, 77, 78, 81, 82, 85, 86, and 88–91 (the "Challenged Claims") of U.S. Patent No. 6,634,770 C3 (Ex.1001, "the '770 patent"). Paper 1 ("Pet."). We instituted *inter partes* review of the challenged claims on all asserted grounds. Paper 10 ("Dec."). After institution, Patent Owner filed a Patent Owner Response (Paper 31, "Resp."), Petitioner filed a Reply (Paper 42, "Reply"), and Patent Owner filed a Sur-Reply (Paper 46, "Sur-Reply"). An oral hearing was held on July 18, 2023, and a transcript of the hearing is included in the record (Paper 59, "Tr.").

We have jurisdiction under 35 U.S.C. § 6. This decision is issued pursuant to 35 U.S.C. § 318(a). For the reasons that follow, we determine that Petitioner has shown, by a preponderance of the evidence, that claims 21, 22, 25, 26, 28–30, 32–36, 40, 42–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 71–73, 77, 78, 81, 82, 85,

86, and 88–91 of the '770 patent are unpatentable. We determine that Petitioner has not shown, by a preponderance of the evidence, that claim 41 is unpatentable.

II. BACKGROUND

A. Related Matters

The parties indicate that the '770 patent is the subject of the following district court proceedings: *CAO Lighting, Inc. v. Cree, Inc. et al.*[1] No. 1:21-cv-00634 (M.D.N.C.) ("the parallel district court litigation"). Pet 115; Paper 4, 1. Patent Owner also identifies the following proceedings as related matters: *CAO Group v. GE Lighting et al.*, 2-11-cv-00426 (District of Utah), *CAO Lighting, Inc. v. GE Lighting, Inc.*, No. 1:20-cv-00681 (D. Del.), *Inter Partes* Reexamination Control No. 95/000,678, *inter partes* Reexamination Control No. 95/002,242, and *Ex Parte* Reexamination Control No. 90/012,959. Paper 4, 1.

B. The '770 Patent

The '770 patent originally issued with claims 1–17. Ex. 1001, 9:52–12:20. Claims 1–6, 8, 10–15, and 17 were disclaimed during a first reexamination. *Id.* at Dec. 3, 2013, Inter Partes Reexamination Certificate ("IPRC") 1:12–13. Claims 7, 9, and 16 were cancelled in a third reexamination, and claims 18–96 were

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[1] Petitioner states that "Cree, Inc., a named defendant in the Underlying Litigation, is now Wolfspeed, Inc." Pet. 115 n.3.

added. *Id.* at Sept. 8, 2014, Ex Parte Reexamination Certificate ("EPRC") 1:26–8:41.

The '770 patent is titled "Light Source Using Semiconductor Devices Mounted on a Heat Sink." *Id.* at code (54). According to the '770 patent, "[p]rior art semiconductor light sources have not been successfully and economically used to illuminate physical spaces." *Id.* at 1:19–21. The '770 patent states "[t]ypical prior art LED modules lack high light intensity due to the size of the LED chips used." *Id.* at 1:23–25. In view of this, the '770 patent states there is a need "in the prior art for a semiconductor light source for use in illuminating a space with single color light in the visible range and which can efficiently dissipate the heat that they produce." *Id.* at 1:46–49.

We reproduce Figure 1 of the '770 patent below.

Appendix C

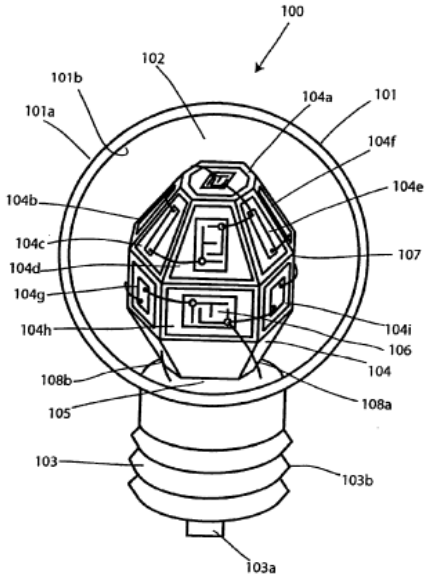

Fig. 1

Figure 1 shows a semiconductor light source that uses a high power chip or array arrangement. *Id.* at 1:65–67. Semiconductor light source 100 includes enclosure 101 having interior volume 102. *Id.* at 2:49–52, 3:9. Enclosure 101 may be mounted to support 105. *Id.* at 3:15. Semiconductor light source 100 further includes base 103, which "may be configured as a fitting or connector for use in a desired light socket." *Id.* at 3:15–18. Heat sink 104 is further located within interior volume 102. *Id.* at 3:22–23. The '770 patent describes heat sink 104 as having "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, etc. each of which may host a single or an array of semiconductor devices capable of

producing light." *Id.* at 3:24–29. In addition, at least one semiconductor device 106 is mounted on heat sink 104. *Id.* at 3:37–38. The '770 patent describes the use of "high power" LEDs by stating that "'[h]igh power' LED's means that the light output from each LED module is greater than 40 milliwatts." *Id.* at 4:6–7.

We reproduce Figure 3d of the '770 patent below.

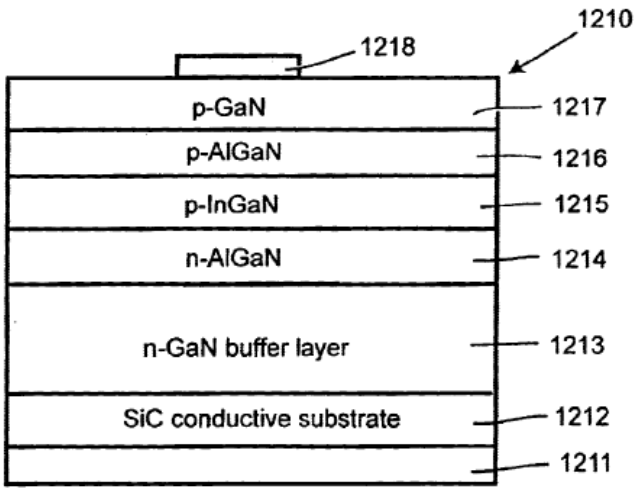

Fig. 3d

Figure 3d illustrates an LED structure on a sapphire substrate. *Id.* at 2:9–10. The structure includes electrically conductive substrate 1212, buffer layer 1213, cladding layer 1214, active layer 1215 where energy is converted to light, cladding layer 1216, and contact layer 1217. *Id.* at 5:11–20.

Appendix C

C. Illustrative Claims

Petitioner challenges claims 18, 22, 25, 26, 28–30, 32–36, 40–44, 47– 49, 52, 53, 56–59, 62, 63, 65–68, 70–73, 77, 78, 81, 82, 85, 86, and 88–91. Pet. 11. Claim 18 depends from claim 9, which was cancelled during reexamination. Ex. 1001, EPRC 1:28. Claim 9 depended from claim 1, which was also disclaimed. *Id.* at 10:52, EPRC 1:27. The remaining challenged claims directly or indirectly depend from claim 18. EPRC 1:51–8:22. Therefore, we treat claim 18 as the sole independent claim. To reflect claim 18's full scope, we reproduce claims 1, 9, and 18 below.

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

an enclosure, said enclosure being fabricated from a material substantially transparent to white light,

a base to which said enclosure is mounted,

an interior volume within said enclosure,

a secondary heat sink located in said interior volume, said secondary heat sink being capable of drawing heat from one or more semiconductors devices,

a plurality of primary heat sinks mounted on said secondary heat sink, each of said primary heat sinks being smaller than said secondary heat sink,

a semiconductor chip capable of emitting light mounted on one of said primary heat sinks, said semiconductor chip being capable of emitting monochromatic light, said semiconductor chip being selected from the group consisting of light emitting diodes, light emitting diode arrays, laser chips, and VCSEL chips,

said chip including 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 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, and

a coating for converting monochromatic light emitted by said chip to white light.

9. A device as recited in claim 1 wherein said substrate is electrically conductive.

18. The semiconductor light source as recited in claim 9 wherein:

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

said LED chip is surface mounted on said one of said primary heat sinks, and

said LED chip is configured to emit monochromatic visible light.

Ex. 1001, 9:52–10:21, 10:52–53, 32.

D. Asserted Grounds of Unpatentability

Petitioner, supported by the declaration of Michael S. Lebby, Ph.D. (Ex. 1006), asserts the following two grounds of unpatentability (Pet. 13):[2]

[2] The relevant sections of the Leahy-Smith America Invents Act ("AIA"), Pub. L. No. 112–29, took effect on March 16, 2013. The application that issued as the '770 patent was filed before this date. *See* Ex. 1001, code (22). For the purposes of this Decision, pre-AIA statutes apply.

Appendix C

Claims Challenged	**35 U.S.C. §**	**References/ Basis**
18, 22, 25, 26, 28–30, 32–36, 40–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 70–73, 77, 78, 81, 82, 85, 86, 88–91	103(a)	Begemann,[3] Krames,[4] Allen[5]
18, 22, 25, 26, 28–30, 32–36, 40–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 70–73, 77, 78, 81, 82, 85, 86, 88–91	103(a)	Begemann, Sugiura,[6] Allen, Krames

III. ANALYSIS

A. Patent Owner's Motion to Exclude Exhibit 1028

Patent Owner moves to exclude the Declaration of Michael R. Krames, Exhibit 1028 ("the Krames

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[3] WO 00/17569, published March 30, 2000, Ex. 1007 ("Begemann").

[4] Krames et al., *High-brightness AlGaInN light-emitting diodes*, Proc. SPIE 3938, LIGHT-EMITTING DIODES: RESEARCH, MANUFACTURING, AND APPLICATIONS IV (2000), Ex. 1008 ("Krames"). The publication status of the Krames reference is disputed, and we address that dispute in Section III.E, *infra*.

[5] WO 99/57945, published November 11, 1999, Ex. 1011 ("Allen").

[6] US 6,015,979, issued January 18, 2000, Ex. 1010 ("Sugiura").

declaration"). Paper 52, *passim* ("PO Mot."); *see also* Paper 57 ("Patent Owner Reply in Support of Motion to Exclude") ("PO Reply"). Petitioner opposes the motion. Paper 53 ("Pet. Opp."). Patent Owner argues that the Petition is based on the contention that the Krames reference teaches that its LED chip achieves "[a] power output of over 170 mW … at a drive current of 1.5 A dc." PO Mot. 3–4 (quoting Pet. 52–53). Patent Owner responded to the Petition, in part, by showing, via expert declarations, that use of the Krames chip at 170 mW with a drive current of 1.5 A dc "would cause the LEDs and the Begemann device to burn up." PO Mot. 5 (citing Resp. 33).

Petitioner filed the Krames declaration in support of its Reply. PO Mot. 5; *see also* Reply; Ex. 1028. The Krames declaration states that a person of ordinary skill in the art ("POSITA") would not have "entertained" a drive current of 1.5 amps in product development, and would instead use lower amperage. PO Mot. 6 (citing Ex. 1028 ¶ 22).

Patent Owner argues that the Krames declaration does not properly address the Patent Owner Response in accordance with 37 C.F.R. § 42.23(b). PO Mot. 9–10. Patent Owner argues that the declaration instead changes "the starting point from Cree's own Petition." *Id.* Patent Owner further argues that the Krames declaration is irrelevant, because it does not relate to whether or not a person of ordinary skill in the art "would have been motivated to combine the 1.5/170 milliwatt LED chip from the Krames

article with the LED light of Begemann" with "a reasonable expectation of success." *Id.* at 10–11. Patent Owner also seeks to exclude the declaration pursuant to Federal Rule of Evidence 403 because unfair prejudice outweighs probative value, and under Federal Rule of Evidence 702(d) because Dr. Krames does not apply his principles and methods to the facts of the case. *Id.* at 11–12.

Patent Owner's argument is unpersuasive because the Krames declaration addresses the Patent Owner Response and is relevant to the issues at hand. We start with an important observation: claim 18 (the only independent claim at issue) is an apparatus claim; the claim is directed to a "semiconductor light source." Ex. 1001, 9:52, EPRC 1:32. One requirement of this apparatus is that it comprise "a semiconductor chip" (*id.* at 9:66) where "said semiconductor chip is a light emitting diode (LED) chip configured to output light at greater than about 40 milliwatts." Ex. 1001, EPRC, 1:34–36. As we explain when addressing claim construction, *infra*, we adopt Patent Owner's proposed construction (Resp. 14) of "said semiconductor chip is a light emitting diode (LED) chip configured to output light at greater than about 40 milliwatts" as referring to "a semiconductor LED chip *capable of* emitting light greater than about 40 milliwatts." *See* Section III.D, *infra* (emphasis added).

Because of these recitations, Petitioner bears the burden of establishing that the prior art teaches or suggests a semiconductor LED chip "capable of

emitting light greater than about 40 milliwatts." As explained herein, we determine that in the Petition, Petitioner met this burden by establishing by a preponderance of the evidence that the Krames reference teaches an LED chip that has this capability. Pet. 53 (quoting Ex. 1008, 10). Notably, claim 18 does *not* require actual operation of anything at greater than 40 milliwatts because claim 21 is not a method claim. Petitioner never had a burden of establishing a method of running the Krames reference's LED at this power output within a semiconductor light source.

Petitioner's unpatentability grounds are not based upon Krames alone. Pet. 13. Claim 18 is directed to a greater lightbulb structure and also a structure related to the semiconductor chip for the semiconductor light source. Ex. 1001, 9:52–10:21, EPRC 1:32–40. Petitioner relies on Begemann as teaching semiconductor light source aspects aside from structure of the chip. *See, e.g.,* Pet. 31–42. Petitioner relies on Krames as teaching semiconductor chip structure. *See, e.g.,* Pet. 42–54.

Because Petitioner's unpatentability ground relies on both Krames and Begemann, Petitioner also bears the burden of establishing by a preponderance of the evidence that a person of ordinary skill in the art would have used Krames's semiconductor chip as the chip in Begemann's lightbulb structure. To meet this burden, Petitioner establishes that Begemann teaches use of an LED chip but does not teach a

specific chip. Pet. 27–28 (citing, e.g., Ex. 1007, 2:3–5; 4:30–32). Petitioner also establishes that Krames teaches an appropriate chip that has the same goal as Begemann. *Id.* at 28 (citing, e.g., Ex. 1008, 6; Ex. 1007, 2:3–5). We determine that Petitioner's evidence, absent rebuttal evidence, is sufficient to establish that a person of ordinary skill in the art would have had a "high expectation of success" in mounting Krames's chips as LEDs 4 of Figure 3 of Begemann. *Id.* (citing Ex. 1006 ¶ 86).

Against this backdrop, Patent Owner argues that a person of ordinary skill in the art would *not* have combined Krames's LEDs with Begemann's device. Resp. 30–35. Of particular relevance here, Patent Owner argues that a person of ordinary skill in the art "would not have expected Begemann's heat dissipating structure to be able to handle the heat generated by Krames' higher-powered LEDs." *Id. 31–32.*

In Reply, Petitioner uses the Krames declaration (Ex. 1028) to argue, for example, that a person of ordinary skill in the art would have used a lower amperage than the 1.5 A dc that Patent Owner's Response focuses on. Reply 6 (citing Ex. 1028 ¶ 22). This use of the Krames declaration is timely because it responds to an argument Patent Owner makes in the Patent Owner Response. 37 C.F.R. § 42.23(b) ("A reply may only respond to arguments raised in . . . patent owner response.").

As to relevancy and whether the Krames declaration is applicable to the facts of this case, the issues at hand are (1) whether or not a person having ordinary skill would have had reason to use the Krames LED with Begemann with a reasonable expectation of success and (2) whether or not the Krames LED is capable of outputting light at greater than about 40 milliwatts. Again, we emphasize that claim 18 does not recite a method where the LED within the recited semiconductor light source actually outputs greater than about 40 milliwatts.

The Krames declaration is relevant to the facts of this case because the declaration has bearing on whether or not a person of ordinary skill in the art would have combined the Krames reference's LED with Begemann's lightbulb design. *See, e.g.*, Ex. 1028 ¶ 22. Patent Owner argues that evidence must be relevant to motivation to combine "an LED chip from the Krames article (operating at 1.5 amps to produce 170 milliwatts of output)" but claim 21 has no "operating at 1.5 amps to produce 170 milliwatts of output" requirement. What is relevant is that Krames discloses a single chip that has the capability of outputting more or less light depending on operating conditions. Pet. Opp. 3; *see also* Ex. 1008, 8 (providing that Figure 12 of the Krames reference is described as illustrating "[l]ight output vs. current characteristic of a blue … 1x1 mm2 AlGaInN LED in a power package, compared to a conventional AlGaInN LED in a 5 mm lamp a package"). Because claim 18 does not require

actually running the recited LED at any particular wattage or amperage, it is appropriate for the Krames declaration to rebut Patent Owner's argument that a person of ordinary skill would not have considered using the Krames LED with Begemann at high amperage by explaining that a person of ordinary skill in the art would have considered using the exact same Krames LED with Begemann at a low amperage instead and that this lower amperage would not generate excessive heat. The fact that the Krames LED is configured to run at the high amperage if desired for a different application does not negate the rationale for combining the Krames LED to run at a lower amperage.

With respect to prejudice outweighing probative value, the probative value is high because the Krames declaration directly bears on a key issue: reason to combine with reasonable expectation of success. Also, the prejudice is minimal because Patent Owner could have, in the Patent Owner Response, addressed the general issue of whether a person having ordinary skill in the art would have had reason to combine Begemann's teachings with the Krames reference LED under *any* operating conditions.

In the Reply Brief, Patent Owner argues that the statement of material facts in Patent Owner's motion should be considered admitted because Petitioner did not specifically deny them. PO Reply 2. As explained above, Petitioner refutes Patent Owner's framing of the motion to exclude in relevant respects.

Also, 37 C.F.R. § 42.23(a) states, with our emphasis added, that "[a]ny material fact not specifically denied *may* be considered admitted." In the interest of justice, we decline to consider the statement of material facts admitted; *see also* 37. C.F.R. § 42.5(b) ("The Board may waive or suspend a requirement of parts 1, 41, and 42.").[7]

Thus, for the reasons explained above, we deny Patent Owner's motion to exclude Exhibit 1028.

B. Petitioner's Motion to Exclude Exhibits 2017 and 2030

Petitioner seeks to exclude Exhibit 2017 as hearsay. Paper 51, 1 ("Pet. Mot."); see also Paper 56 (Petitioner's Reply in support of Motion to Exclude). Exhibit 2017 is entitled "SOLID STATE LIGHTING CATALOG," and Patent Owner states that the catalog is from 2015. Resp. 48. Patent Owner argues that the catalog shows "expansion and breadth of its patented Dynasty LED lamp business." *Id.* Patent Owner argues that Exhibit 2017 is an admissible business record. Paper 54, 2–4 ("PO Opp.").

As explained herein, we ultimately determine that Petitioner meets its burden of establishing by a preponderance of the evidence that claims 18, 22, 25, 26, 28–30, 32–36, 40–44, 47–49, 52, 53, 56–59, 62, 63,

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[7] The parties also dispute whether or not Patent Owner's motion to exclude is procedurally proper. Pet. Opp. 9; PO Reply 4–5. We need not address this issue because we deny the motion to exclude for the reasons we explain here.

65–68, 70–73, 77, 78, 81, 82, 85, 86, and 88–91 of the '770 patent are unpatentable even if we fully consider Exhibit 2017. Moreover, we determine that Petitioner does not meet its burden of establishing that claim 41 of the '770 is unpatentable, and our determination would be the same even if we do not consider Exhibits 2017. As such, we dismiss Petitioner's Motion to Exclude as moot.

C. 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 v. John Deere Co.*, 383 U.S. 1, 17 (1966). 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. *Innovention 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 proposes a level of ordinary skill in the art as follows:

> As of the '770 Patent's claimed priority date (August 24, 2001), a POSITA would have had at least a bachelor's degree in an engineering discipline with coursework in semiconductors and/or optoelectronics, and three or more years of experience working in the semiconductor and/or optoelectronics fields. Less work experience may be compensated by a higher level of education with the foregoing coursework.

Pet. 19–20 (citing Ex. 1006 ¶ 34). Patent Owner provides a different description of the level of ordinary skill in the art:

> The POSITA for the '770 Patent would have at least a bachelor of science degree in electrical engineering, physics, materials science, or a similar area of study, so as to understand the basic principles of light and LED design and operation. Ex. 2018 at ¶19. The POSITA would also have experience related to LED lighting products, LED chip technology and applications, and/or LED packaging techniques for a period of at least one year. *Id.* In addition, the POSITA would understand, generally, how to implement LED chips and packages in the design

> and/or application of general-purpose lighting products for use in residential and commercial (or industrial) buildings and structures as well as outdoor spaces used by humans (such as roads, streets, parking lots, pathways, etc.). *Id.* Resp. 15–16.

We agree with Patent Owner that the challenged claims relate to light fixtures, LED packaging, and LED chip layer structure and that the '770 patent claims reflect "a hybrid of the light bulb art and semiconductor art." Resp. 16. The prior art of record, for example, Begemann, likewise reflects "a hybrid of the light bulb art and semiconductor art." *Id.* (quoting Pet. 28). Petitioner's expert, Dr. Lebby, agreed that a person having ordinary skill in the art would need to be "familiar with thermal issues." Ex. 2015, 26:15–28:16.

While Petitioner's proposed description of a person having ordinary skill in the art could, in some instances, be sufficient to qualify a person as having ordinary skill, Patent Owner's proposal is a more complete and accurate description of the level of skill commensurate with the scope of the challenged '770 patent claims. Patent Owner's description appears consistent with the prior art and patent specification before us and is supported by witness testimony. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (prior art itself may reflect an appropriate level of skill). For the purpose of this Decision, we adopt Patent Owner's description. We further note that the

outcome of our decision would be the same under either party's asserted skill level.

D. 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 contends that "[t]he terms in the Challenged Claims should receive their ordinary and customary meaning as understood by a POSITA in the context of the patent specification and prosecution history." Pet. 19 (citing Ex. 1006 ¶ 69).

Patent Owner argues the U.S. District Court for the District of Delaware held, with respect to related U.S. Patent 6,465,961, construed "a light emitting diode (LED) chip configured to output light at greater than about 40 milliwatts" as "at least one LED chip is capable of emitting light greater than

about 40 milliwatts." Resp. 14 (citing Ex. 1024, 15–18). Petitioner responds that the phrase "needs no construction" and that Petitioner's grounds meet this construction. Reply 1.

We note that the language of claim 18 does not precisely match the language the District Court considered, it is substantively the same. The record supports a construction very similar to the construction the District Court adopts, and we reference the District Court's reasoning. Ex. 1024, 15–18. We, thus, construe claim 18's recitation that "said semiconductor chip is a light emitting diode (LED) chip configured to output light at greater than about 40 milliwatts" as referring to "a semiconductor LED chip that is capable of emitting light greater than about 40 milliwatts."

It is unnecessary to construe any other claim terms in this Decision because none of the parties' disputes turn on the meaning of other terms. *See, e.g.*, *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017).

E. Prior Art Status of the Krames Reference

Patent Owner argues that Petitioner fails to demonstrate that the Krames reference is prior art. Resp. 18–25. A reference may qualify as prior art if, for example, it is a printed publication. 35 U.S.C. § 102(a)(1); *see also* 35 U.S.C. § 103 (referring back to Section 102 when referencing prior art). Whether a reference qualifies as a "printed publication" is a legal

conclusion based on underlying factual determinations. *Suffolk Techs., LLC v. AOL Inc.*, 752 F.3d 1358, 1364 (Fed. Cir. 2014) (citation omitted). The determination of whether a document is a "printed publication" under 35 U.S.C. § 102(b) "involves a case-by-case inquiry into the facts and circumstances surrounding the reference's disclosure to members of the public." *In re Klopfenstein*, 380 F.3d 1345, 1350 (Fed. Cir. 2004). "Because there are many ways in which a reference may be disseminated to the interested public, 'public accessibility' has been called the touchstone in determining whether a reference constitutes a 'printed publication' bar under 35 U.S.C. § 102(b)." *Blue Calypso, LLC v. Groupon, Inc.*, 815 F.3d 1331, 1348 (Fed. Cir. 2016) (quoting *In re Hall*, 781 F.2d 897, 898–99 (Fed. Cir. 1986)). "A reference will be considered publicly accessible if it was 'disseminated or otherwise made available to the extent that persons interested and ordinarily skilled in the subject matter or art exercising reasonable diligence, can locate it.'" *Id.* (quoting *Kyocera Wireless Corp. v. Int'l Trade Comm'n*, 545 F.3d 1340, 1350 (Fed. Cir. 2008)).

The '770 patent was filed on August 24, 2001, and does not claim any earlier priority date. Ex. 1001, (22). We find that the record supports the following facts, and we determine that these facts, cumulatively, support that the Krames reference is prior art because it was a printed publication at least as of June 29, 2000:

Appendix C

1. The Krames reference, on its face, indicates that it is an "Invited Paper." Ex. 1008, 1.

2. The face of the Krames reference bears these indicia: "In *Light-Emiting Diodes: Research, Manufacturing, and Applications IV*, H. Walter Yao, Ian T. Ferguson, E. Fred Schubert, Editors, Proceedings of SPIE[8] Vol. 3938 (2000)・0277-786X/00/$15.00." *Id.* These indicia suggests that the Krames reference was published in the SPIE Proceedings volume ("the Proceedings") and the Proceedings were available to the public for fifteen dollars.

3. Rachel J. Watters is a librarian and "Head of Resource Sharing for the University of Wisconsin-Madison's General Library System" located in Madison, Wisconsin. Ex. 1020, 1. Ms. Watters worked as a librarian with the University of Wisconsin library system since 1998. *Id.* Ms. Watters has a master's degree in Library and Information Studies. *Id.*

4. When the University of Wisconsin-Madison Libraries received a volume, it was checked in, added to library holdings records, and made available to readers as soon as possible and, at most, within 2 to 3 weeks. *Id.* at 1–2.

5. The University of Wisconsin-Madison Libraries catalogued the Proceedings as of June 29, 2000. *Id*. at

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[8] SPIE refers to "The International Society for Optical Engineering" or "The Society of Photo-Optical Instrumentation Engineers." Ex. 1020, Ex. A, 6, 8.

2; *see also id.* at Exhibit B, 27[9] (library record indicating June 29, 2000 "Receiving date" for the Proceedings).

6. The Kurt Wendt Library at the University of Wisconsin-Madison owns the Proceedings of SPIE, 3938 that the Krames reference appears in. *Id.* at 2; *see also id.* at Ex. A (copy of excerpt of the Kurt Wendt Library's copy of the Proceedings).

7. The Proceedings, on their face, indicate that papers from the Proceedings were presented at "26-27 January 2000 San Jose, California." Ex. 1020, Exhibit A, 6.

8. Dr. Lebby attended this January 2000 conference. Ex. 1006 ¶ 75. Dr. Lebby also confirms that "proceedings from this conference were distributed to all members of SPIE as well as to libraries which had a subscription to the *Proceedings of SPIE*, so it was widely available to and accessible by those with skill in the art." *Id.*[10]

9. The Proceedings indicate that papers included in the Proceedings volume "were selected by the conference program committee to be presented in oral or poster format." Ex. 1020, Exhibit A, 7.

10. The Proceedings indicate a 2000 copyright date and further indicate that the volume was publicly

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[9] Reference is made to the page number of Exhibit 1020: page 27 of 28.

[10] We note that Dr. Lebby does not directly state *when* the Proceedings were widely available. *See* Sur-Reply 14.

available from the Copyright Clearance Center for fifteen dollars per article. *Id.*

11. The excerpt of the library's Proceedings volume has a sticker in the upper left corner: "TK 7871.89 L53 2000." *Id.* at 6. The sticker suggests the volume was catalogued by the library in 2000. The table of contents page also bears hand writing that repeats similar indicia including "2000." *Id.* at 8–9.

12. The library catalog record of the University of Wisconsin-Madison indicates that the Proceedings volume "was properly catalogued and could be found by or requested by a person of skill in the art of the subject matter of the foregoing article exercising reasonable diligence." Ex. 1020, 3.

13. Members of the interested public could locate the Proceedings volume on June 29, 2000, the date it was catalogued, "by searching the public library catalog or requesting a search through [Wisconsin TechSearch] WTS." *Id.*

The facts above are evidence of the Krames reference's publication as of June 29, 2000, because the facts tend to make the Krames reference's publication as of June 29, 2000, more probable than it would be without the evidence. *See* Fed. R. Evid. 401(a) (defining evidence as relevant "if it has any tendency to make a fact more or less probable than it would be without the evidence"). The evidence is sufficient to support publication. Meanwhile, no evidence of record suggests that Krames was *not* a printed publication as of June 29, 2000. Thus, a

preponderance of the evidence supports Krames's prior art status.

Patent Owner argues that Ms. Watters "never establishes a firm date when Krames was purportedly available to the relevant public." Resp. 21. Patent Owner bases this argument by taking a tortured reading of Ms. Watters's statement that "[m]embers of the interested public could locate a copy of [the Proceedings] on or after June 29, 2000, the date it was catalogued." *Id.* (quoting Ex. 1020, 3); *see also* Sur-Reply 12–13. The best understanding of Ms. Watters's statement, in view of the context of Ms. Watters explaining the library's cataloguing process, is that a member of the interested public had two options: the person could choose to locate the Proceedings on June 29, 2000, or the person could choose to locate the Proceedings after June 29, 2000. Thus, the statement supports public availability as of June 29, 2000.

Patent Owner also argues that Exhibits A and B to the Watters declaration also do not establish when the Proceedings were available. Resp. 21–22. The Exhibits, however, serve to corroborate Ms. Watters's credible testimony as to when the Proceedings were available.

Patent Owner also argues that a person of ordinary skill in the art would not have been able to find the Krames article and argues that a prior, non-precedential board decision, *Salesforce.com, Inc. v. WSOU Investments, LLC*¸ IPR2022-00357, Paper 12 (PTAB July 13, 2022), is analogous. Resp. 20–21. But

the *Salesforce* decision is distinguishable. The *Salesforce* patent claims related to, for example, interfacing two network environments via a message gateway and content reformatted in a vectorized format. *Salesforce.com, Inc.*, IPR2022-00357 at 3. Given this context, the panel determined that Petitioner did not establish a reasonable likelihood the Fox article was publicly accessible before the critical date because the MARC record was only "keyed to the title of the entire conference proceedings." *Id.* at 14. Because the conference proceedings were entitled "Proceedings of the 2002 International Conference on International Computing," the panel reasonably determined that a person having ordinary skill in the art would not have, with reasonable diligence, known to look in these proceedings to find information relevant to the claimed subject matter. *Id.* In *Salesforce*, the topic of the proceedings was very broad compared to the subject matter of the claims at issue.

In contrast, a person of ordinary skill in the art could have reasonably located the Krames article based on the title of the Proceedings. As a starting point, there is no dispute that Begemann is prior art. Begemann teaches an LED lamp fixture that makes use of LED chips, but it does not give very many details about the design of those chips. Ex. 1007, 1:1–14, 2:22–23, 5:13-18, Figs. 2, 3A, 3B. A person having ordinary skill in the art at the relevant time (August 24, 2001) would have sought out more information

about what different kinds of light emitting diodes could be manufactured for application with Begemann. *See* Section III.F.4.a, *infra*. As such, a person having ordinary skill in the art would have been very interested in a recent (2000) publication from a known technical society entitled "Light-Emitting Diodes: Research, Manufacturing, and Applications IV." Ex. 1008, 1; *see also* Ex. 1020, Exhibit A, 6. The evidence supports that the Proceeding's title was indexed such that a person of ordinary skill could find it, and this would have been sufficient to lead a person having ordinary skill in the art to the Krames article. Ex. 1020, 2–3; *see also* Reply 2–3.

Patent Owner also notes that the barcode on the back of Proceedings volume (Ex. 1020, Exhibit A, 24) has a different number than the barcode the ExLibris system states (Ex. 1020, Exhibit B, 26). Resp. 27. Patent Owner does not provide evidence explaining the import of this distinction. It is possible, for example, that the book has different barcodes for different purposes (for example, one for the manufacturer and another assigned to the library). Given that other indicia do not indicate any conflict or controversy regarding publication date, the evidence supports Ms. Watters's testimony establishing June 29, 2000, library indexing. Ex. 1020, 2–3.

Patent Owner further argues that Exhibit B has some unexplained features related to page number and volume availability. Resp. 23. Again,

Patent Owner lacks evidence regarding the import of these observations.

Patent Owner argues that Ms. Watters does not provide evidence that she personally knew about publication of the Krames article. Resp. 24–25; Sur-Reply 11. This does not undermine Ms. Watters's credible testimony regarding her library's systems and when, based on the library's records, Krames was publicly available (indexed by the library in a useful fashion).

To summarize, the record provides sufficient evidence supporting that Krames published by June 29, 2000. The record provides no evidence to the contrary. The weight of the evidence supports Krames's June 29, 2000, publication. As such, Petitioner has established by a preponderance of the evidence that Krames is a printed publication.

F. Obviousness Analysis

1. Obviousness: 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 evidence of nonobviousness.. *Graham*, 383 U.S. at 17–18.

2. Objective Indicia of Non-Obviousness

Patent Owner argues that commercial success and the combination of long-felt need, failure of others in the industry, and industry skepticism weigh in favor of patentability. Resp. 46–52. Petitioner argues that Patent Owner fails to show that commercial products embody and are coextensive with the challenged claims. Reply 19–21. For objective indicia of nonobviousness to be accorded substantial weight, its proponent must establish a nexus between the evidence and the merits of the claimed invention. *Lectrosonics, Inc. v. Zacom, Inc.*, IPR2018–01129, Paper 33 at 32 (PTAB Jan. 24, 2020) (precedential); *see also Fox Factory Inc. v. SRAM, LLC, 944 F.3d 1366, 1373 (Fed. Cir. 2019) (to establish objective indicia of non-obviousness, Patent Owner bears the burden of tying the objective evidence that embodies the claimed features).*

Here, as to commercial success and industry praise, Patent Owner argues that Cree's "Embodying Products" meet the limitations of claim 18 of the '770 patent. Resp. 47. Then, Patent Owner argues that "Cree's Lighting Products segment" has been commercially successful. Id. at 48. Patent Owner also argues that Cree received praise "for its LED light bulbs." Id. Patent Owner does not establish, however,

that the "Embodying Products" are the same as "Cree's Lighting Products segment" or "its LED light bulbs."

Just to the contrary, Patent Owner provides, for example, sales figures for lighting products "including the embodying products" (and, presumably, including other products as well). Ex. 2019 ¶ 46. Patent Owner's witness, Ms. Kindler, admits to assessing only revenues associated "with [Patent Owner's] Embodying Products as part of its Lighting Products segment." *Id.* Although Patent Owner provides evidence that Cree states that its "Lighting Products segment 'primarily consist[ed] of LED lighting systems and lamps,' which would include the Embodying Products," the record is unclear what other products the "Lighting Products segment" includes. *Id.* In sum, the evidence fails to persuasively connect patented features to commercial success or praise.

Patent Owner also argues that "there is a nexus between the industry's LED lighting products eventually introduced and the ['770 patent]." Resp. 47. Patent Owner does not argue, however, that "the industry's LED lighting products" enjoyed commercial success, praise, or indicia supporting non-obviousness.

Patent Owner argues that its 2015 catalog shows "expansion and breadth" of its patented Dynasty LED lamp business. Resp. 48 (citing Ex. 2017). The catalog establishes what Patent Owner

offered for sale and how Patent Owner advertised Dynasty LED lamps. But the catalog does not persuasively establish commercial success or success relative to any competitors in the market.

Patent Owner further argues that Patent Owner's "Dynasty LED lamps" are covered by the '770 patent and had "notable examples of installation" at two stores. Resp. 48 (citing Ex. 2019 ¶¶ 30–31, 48). These examples, at best, provide very limited evidence of some commercial success.

With regard to long-felt but unmet need, Patent Owner argues that others in the industry failed to develop "a monochromatic general illumination light source that uses a semiconductor LED chip while also dissipating heat" and cites problems others in the industry had in developing such a light both before and after filing of the '770 patent. Resp. 48–52. The record, however, suggests that the '770 patent did not solve particular industry problems. Rather, Patent Owner's witness testified, for example, that he purchased an off-the-shelf LED as a prototype, that attaching heat sinks was well known, and that phosphor coatings for white light were well known. Reply 21 (citing Ex. 1030, 291:20–295:6 (testimony of '770 inventor)).[11]

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[11] Petitioner also argues that attaching heat sinks and adding phosphor coatings was well known. Reply 21. Petitioner cites the Ex. 1030 trial transcript at 126:25–127:6 and 134:17–21 for testimony supporting this argument, but these pages appear to be omitted from the present record. Nonetheless, the prior art discussed herein (for example, Begemann, Krames, and Allen)

In sum, the evidence of objective indicia of non-obviousness is weak and, therefore, has little influence on our obviousness conclusions in either direction. All of our obviousness determinations, as we discuss *infra*, are made after considering all evidence in the record, including all evidence relating to objective indicia of non-obviousness.

3. Overview of the Asserted Art

a. *Begemann (Exhibit 1007)*

Begemann describes "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. 1007, 1:1–3.

We reproduce Begemann's Figure 2 below.

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establishes that heat sinks and phosphor coatings were known in the art.

Appendix C

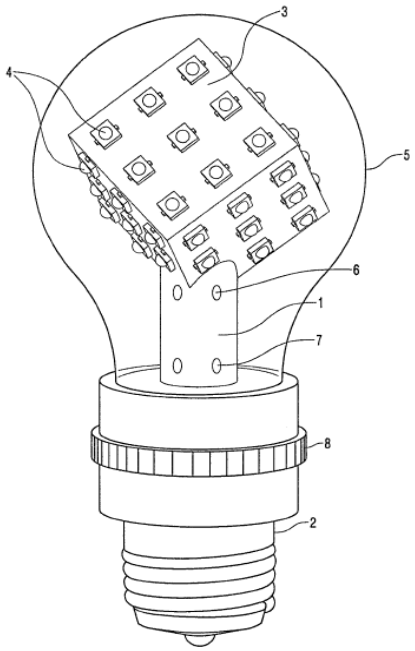

FIG. 2

Figure 2 depicts an embodiment of a LED lamp. *Id.* at 4:11. LED lamp includes gear column 1, metal lamp cap 2, metal substrate 3 having LEDs 4, envelope 5, and outlet holes 6 and inlet holes 7 for air flow. *Id.* at 5:13–16. Begemann describes substrate 6 as cube-shaped and states that each one of the faces has a number of LEDs 4. *Id.* at 5:17–18, 21–22. Begemann explains that multiple-chip LEDs are used in this embodiment, "which each have three light points (green, red and blue) per LED or four light points (green, red, yellow, blue) per LED" and "[t]hese colors

are mixed so as to obtain white light in the secondary optical system of each of the LEDs." *Id.* at 5:22–25.

We reproduce Begemann's Figure 3A below.

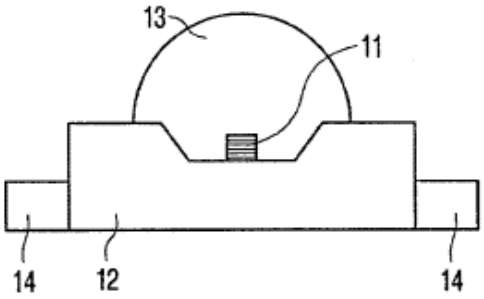

FIG. 3A

Figure 3A shows an LED that includes single-chip LEDs, which each has only one light point 11 per LED. *Id.* at 6:3–5. Begemann explains that "[l]ight point (11) is provided with a primary optical system(13), by means of which the radiation characteristic of the LED can be influenced." *Id.* at 6:6–8.

b. *Krames (Exhibit 1008)*

Krames is a paper titled "High-brightness AlGaInN light-emitting diodes." Ex. 1008, 1. Specifically, Krames describes AlGaInN LEDs grown via organometallic vapor phase epitaxy ("OMVPE"). *Id.* Krames describes a light output versus current characteristic for a blue (wavelength of about 470 nm) 1 x 1 mm2 AlGaInN LED. *Id.* at 10. Krames explains that a power output over 170 mW is obtained at a drive current of 1.5 A DC. *Id.*

Appendix C

Krames's Figure 3 is reproduced below.

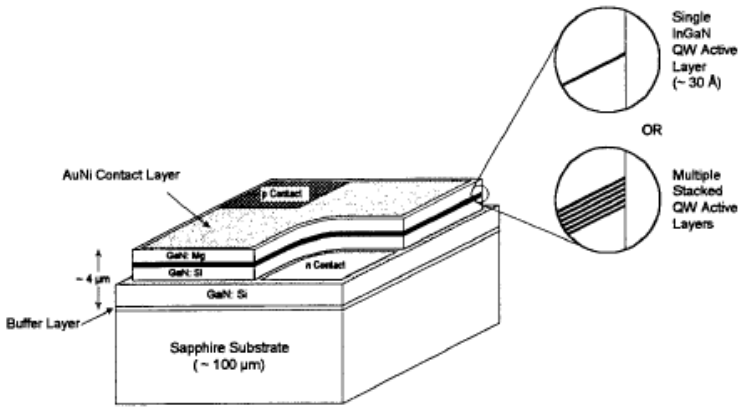

Fig. 3. Typical AlGaInN LED structure.

Figure 3 depicts a typical AlGaInN LED structure. *Id.* at 4. Krames discloses that "[t]he two most common substrates used for OMVPE growth of AlGaInN are sapphire and SiC." *Id.* Krames explains that "[s]apphire is insulating and therefore both p and n Ohmic contacts must be formed on the top surface of the LED chip." *Id.* The n-type contact is formed by mesa etching the AlGaInN LED structure to expose n-type GaN layers beneath the active region and then applying an ohmic n-contact metallization (e.g., Ti/Al) to the n-type GaN. *Id.* Krames states that the p-type contact is formed "by depositing a semi-transparent Ni/Au Ohmic contact metallization across the GaN:Mg surface." *Id.*

c. Allen (Exhibit 1011)

Appendix C

Allen describes a lamp that includes one or more monolithic LED devices that each has an array of LED dies. Ex. 1011 code (57). Allen states that the "[t]he array of LED dies may comprise a mixture of RGB sub-dies or 'white dies' or a mixture of both types of dies" and that "[w]hite dies may be, for example, blue dies with phosphorescent coating to produce a wideband spectrum." *Id.* at 4:9–12.

We reproduce Allen Figures 6A and 6B below.

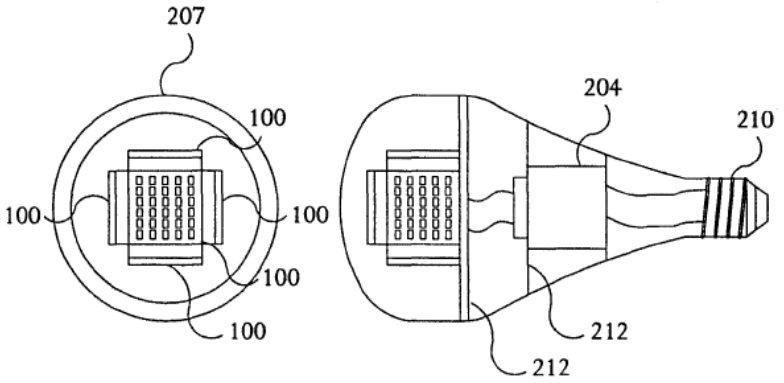

FIG. 6A FIG. 6B

Figure 6A depicts a top view of an "A-type" screw-in hemispherical lamp configuration. *Id.* at 3:17–18. Figure 6B shows a side view of the hemispherical lamp. *Id.* at 3:19–20. The lamp includes monolithic LED device 100, lamp housing 207, mounting brackets 212, voltage converter 204, and base 210. *Id.* at 6:10–12. Allen states that voltage converter 204 "may be a transformer, such as step-down transformer, series resistor, or other type of voltage

converter employed in the art to convert from a supply voltage such as an AC or DC supply followed by a bridge rectifier circuit." *Id.* at 6:16–18.

d. *Sugiura (Ex. 1010)*

Sugiura describes "a nitride-based semiconductor element such as a semiconductor laser, a light-emitting diode, an electronic device, or the like." Ex. 1010, 1:6–8. Sugiura's Figure 7 is reproduced below.

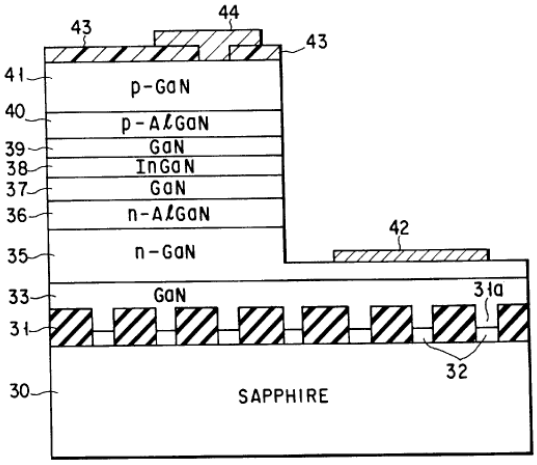

FIG. 7

Figure 7 illustrates a sectional view of a nitride-based semiconductor laser. *Id.* at 9:1–3. The nitride-based semiconductor laser includes sapphire substrate 30, mask 31 having grooves 31a, low-temperature GaN buffer layer 32, undoped underlying GaN layer 33, n-type GaN contact layer 35, n-type AlGaN current injection layer 36, n-type GaN optical guide layer 37, InGaN active layer 38, p-side GaN optical guide layer

39, p-type AlGaN current injection layer 40, and p-type GaN contact layer 41. *Id.* at 12:24–36. Sugiura states that "[a]lthough this embodiment has been described above with reference to the case it is applied to a laser, . . . the present invention can be applied not only to a nitride-based semiconductor laser but also to a light-emitting diode." *Id.* at 14:58–61.

4. Ground One: Unpatentability over Begemann, Krames, and Allen

Petitioner asserts that claims 18, 22, 25, 26, 28–30, 32–36, 40–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 70–73, 77, 78, 81, 82, 85, 86, and 88–91 are unpatentable under 35 U.S.C. § 103(a) as obvious over Begemann, Krames, and Allen, citing the Declaration of Dr. Michael S. Lebby for support. Pet. 31–98 (citing Ex. 1006). Below, we first address Petitioner's argued reasons to combine the references' teachings. We then address independent claim 18. Next, we address disputed recitations of dependent claims. Finally, we address the remaining dependent claims collectively.

a. *Combining the teachings of Begemann, Krames, and Allen*

We first address the combination of Begemenan and Krames. Pet. 27–28. Begemann teaches that "[c]ustomary incandescent lamps can only be replaced by LED lamps which are provided with LEDs having . . . a high luminous flux." Ex. 1007, 2:3–5. Begemann discloses LEDs mounted to surfaces within the interior of its bulb and as part of an LED package. *Id.*

at Figs. 2, 3A. Begemann does not, however, disclose what specific LED chip should be used with its device. Pet. 28. A person having ordinary skill in the art would have naturally searched LED chip references to determine what existing chips could be combined with Begemann's disclosure.

Krames teaches an LED chip that a person of ordinary skill in the art would have recognized as useful in Begemann's LED package. Krames notes that "by increasing the chip size and providing low-thermal-resistance power packages capable of dissipating several Watts, LEDs should be able to compete more favorably with conventional lighting technologies in many applications." Ex. 1008, 6. Krames thus has a goal similar to that of Begemann. Ex. 1007, 2:3–5. A person of ordinary skill in the art would have had a reasonable expectation of success in mounting the LED chips Krames teaches into the Figure 3 apparatus of Begemann. Ex. 1006 ¶ 93.

Patent Owner argues that a person of ordinary skill in the art would have recognized that Begemann's heat sink is inadequate to handle the heat of Begemann's suggested RGB LEDs. Resp. 31–32. This argument does not squarely respond to the ground of challenge. Petitioner's unpatentability grounds are based upon combining Begemann's teachings with Krames's LED and Allen's phosphor coating. Moreover, Begemann teaching a heat sink along with teaching its LEDs suggests, by a preponderance of the evidence, that Begemann's heat

sinks are adequate for Begemann's LEDs. *See, e.g.*, Ex. 1007, Fig. 2, 2:17–19, 5:17–18.

Patent Owner argues that a person having ordinary skill in the art would not have combined the Krames LED with the Begemann device because Begemann's structure would not be able to handle the heat of the Krames "higher-powered LEDs." Resp. 31–33. This argument does not persuasively undermine Petitioner's evidence because it is premised on the Krames LED chips being driven at 1.5 amperes and producing 390 lumens. Reply 5 (citing Ex. 2021 ¶¶ 48–64 (Patent Owner witness, Mr. McCreary, considering heat based on these conditions); Ex. 2022 ¶¶ 86–109 (Patent Owner witness, Mr. York, referring to Mr. McCreary's modeling)). A preponderance of the evidence supports that a person of ordinary skill in the art would have utilized the Krames LED chip in conjunction with Begemann at a lower drive current and with lower lumens. *See*, *e.g.*, Ex. 1034, 107:6–25 (Patent Owner's witness, Mr. York, testifying that the practical drive current for the Krames chip was somewhere around 350 milliamps); Ex. 1028 ¶¶ 22, 28 (Petitioner's witness, Dr. Krames, testifying that an output of 136 lumens would be a reasonable output and a drive current near 350 mA would be reasonable).

Patent Owner argues that it focused on a drive current of 1.5 amps because Petitioner relied on this amperage in the Petition. Sur-Reply 15–16. This argument is unpersuasive because it reflects a

misunderstanding of the scope of claim 18 and how the Petition addresses claim 18. Claim 18 recites "said semiconductor chip. . .configured to output light at greater than about 40 milliwatts." Ex. 1001, EPRC 1:34–36. Patent Owner agrees that claim 18's "configured to" language requires that the chip be "capable of" outputting light at greater than about 40 milliwatts. Resp. 14–15. The claim does not require a chip that, when placed in the bulb, actually operates at more than about 40 milliwatts. Thus, to show that the Krames chip meets this claim language, Petitioner explained that "Krames teaches its LED chip achieves '[a] power output of over 170 mW . . . at a drive current of 1.5 A dc.'" Pet. 53 (quoting Ex. 1008, 10). In other words, Petitioner proved the *capability* of the Krames chip.

Petitioner never, however, insisted that a person of skill in the art would run the Krames chip within Begemann at such a high power output. Rather, Petitioner's reason to combine is that Begemann teaches use of LED chips with high luminous flux, and Krames teaches such a chip. Pet. 27–28. When Patent Owner attempted to refute this reason to combine by arguing that the Krames chip would overheat at 170 mW and 1.5 A dc, Petitioner appropriately responded by establishing that the Krames chip could operate at a variety of power and amperage conditions. Reply 4–7; *see also Rembrandt Diagnostics, LP, v. Alere, Inc.*, 76 F.4th 1376, 1382–84 (Fed. Cir. 2023) (holding that Board did not err by

considering Petitioner arguments responsive to Patent Owner assertions regarding motivation to successfully combine). Figure 12 of Krames illustrates possible operating conditions for the Krames chip, and we reproduce that figure below.

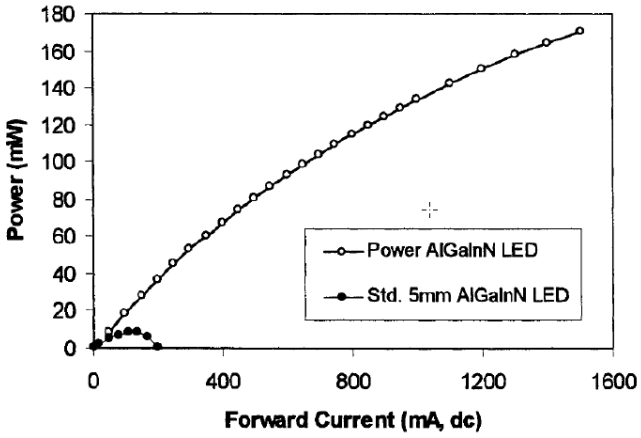

Fig. 12. Light output vs. current characteristic of a blue (λ_p ~470 nm), 1x1 mm^2 AlGaInN LED in a power package, compared to a conventional AlGaInN LED in a 5 mm lamp package.

Ex. 1008, 9. Krames Figure 12 depicts a graph comparing the light output versus current characteristics of the Krames LED chip versus a conventional LED. *Id.*

Krames Figure 12 illustrates that the Krames chip can operate at amperages much lower than 1.5 A. Indeed, Krames indicates "excellent reliability performance" at 350 mA. *Id.* at 10; *see also* Ex. 1028 ¶ 22. The preponderance of the evidence also establishes that, at lower amperage, a person of ordinary skill in the art would have recognized that any heat issues

would have been manageable. *See* Reply 6–7 (citing Ex. 1028 ¶¶ 22–23; Ex. 1008, 9).

Patent Owner also argues that a person having ordinary skill in the art would not have utilized the Krames LED with Begemann because the Krames LED is less energy efficient than an incandescent light bulb and less efficient than the Begemann RGB LEDs. Resp. 33–35. Krames, however, teaches, at 350 mA, "the best performance in terms of power conversion efficiency" and "excellent reliability performance." Reply 6 (quoting Ex. 1008, 7); see also Ex. 1008, 9 (teaching excellent reliability performance at 350 mA). Petitioner persuasively argues that the combination of Begemann and Krames could output 136 lumens which exceeds the light output of many commercial bulbs (while dissipating resulting heat). Reply 9–10 (citing Ex. 1028 ¶¶ 27–29). Also, Krames teaches that its LEDs "should be able to compete more favorably with conventional lighting technologies in many applications." Ex. 1008, 6; see also id. at 10 (explaining that the Krames chip offers advantages where "high flux density is important" and may offer unique advantages in "traffic signaling"), 11 (noting "long-life of solid-state emitters").

A person having ordinary skill in the art would have recognized potential advantages of using the Krames LED chip and would have been able to weigh the advantages against any disadvantages. The existence of advantages and disadvantages does not make the combination of Begemann and Krames less

obvious in view of Begemann suggesting use of LED chips and Krames providing an appropriate LED chip that provides at least some advantages. See Medichem, S.A. v. Rolabo, S.L., 437 F.3d 1157, 1165 (Fed. Cir. 2006) ("a given course of action often has simultaneous advantages and disadvantages, and this does not necessarily obviate motivation to combine"). In sum, the preponderance of the evidence, as explained above, supports that a person of ordinary skill in the art would have had reason to combine the teachings of Begemann and Krames with a reasonable expectation of success.

With respect to Allen, Begemann teaches a "white LED" for at least one embodiment. Pet. 29 (quoting Ex. 1007, 3:6–9). Krames teaches conversion of blue light into white "via phosphors" and Allen teaches that "blue dies with phosphorescent coating" may be used. Ex. 1008, 11; Ex. 1011, 4:11–12; Ex. 1006 ¶¶ 88–90. A preponderance of the evidence supports Petitioner's position that a person of skill in the art would have combined the teachings of Begemann, Allen, and Krames to reach claim 1's recited coating.

Patent Owner argues that Petitioner's proposed obviousness combination is inconsistent because it "argues for the purported obviousness of replacing Begemann's LEDs with Krames' LED chips" but "also argues for the purported obviousness of replacing Begemann's LEDS with Allen's chips." Resp. 26. Patent Owner further argues that neither the Krames chip nor the Allen chip alone teach all recitations of

claim 18. Id. at 26–28. This argument is unpersuasive because the Petition is reasonably clear that ground one asserts the Begemann with the Krames chip and Allen's phosphor coating. See Pet. 26–28 (explaining why it would be obvious to use the Krames chip with Begemann), 29–31 (explaining why it would have been obvious to modify the Krames chip by using a coating of phosphors). When Petitioner maps claim 18 to the asserted art, Petitioner refers to Begemann for the greater lightbulb structure and Krames for the chip. Id. at 31–54. For claim 18, Petitioner refers to Allen only for the phosphor coating. Id. at 51.[12] Petitioner does not rely on only the chip of Krames or only the chip of Allen to meet claim 18, and, as we further address below, Petitioner accounts for each recitation of claim 18.

To summarize, the preponderance of the evidence establishes that a person of ordinary skill in the art would have had good reason to combine implement the Krames chip in the Begemann device while also making use of a phosphor coating as Allen teaches and that a person of ordinary skill in the art would have had a reasonable expectation of success in combining the references' teachings in this manner.

b. *Independent Claim 18*

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[12] When addressing dependent claims, Petitioner also refers to Allen for certain aspects of the bulb structure. See, e.g., Pet. 61–74, 76–77.

Claim 18 depends from cancelled claims 1 and 9. The preamble of claim 1 recites, "A semiconductor light source for emitting light to illuminate a space used by humans, the semiconductor light source comprising." Petitioner argues that Begemann discloses this recitation. Pet. 31–32. The preponderance of the evidence supports that Begemann teaches or suggests this recitation. Ex. 1007, 1:1, 6:23–24, Fig. 2; Ex. 1006 ¶ 91.

Claim 1 next recites "an enclosure, said enclosure being fabricated from a material substantially transparent to white light." Petitioner argues that Begemann teaches this recitation. Pet. 32–33. The preponderance of the evidence supports that Begemann teaches or suggests this recitation. Begemann states, for example, that "during operation of the LED lamp shown, white light is obtained" and that the Begemann device has an "envelope … made of glass [or] synthetic resin." Ex. 1007, 2:23–24, 5:26; see also id. at Fig. 2; Ex. 1006 ¶ 92.

Claim 1 next recites "a base to which said enclosure is mounted." Petitioner asserts that Begemann lamp cap 2 and the structure surrounding adjusting ring 8 of Begemann Figure 2 is such a base. Pet. 33–34. The preponderance of the evidence supports that Begemann teaches or suggests this recitation. Ex. 1007, Fig. 2; Ex. 1006 ¶ 93.

Claim 1 next recites "an interior volume within said enclosure." As Petitioner asserts, the preponderance of the evidence supports that

Begemann teaches or suggests this recitation. Pet. 34–35, Ex. 1007, Fig. 2; Ex. 1006 ¶ 94.

Claim 1 next recites "a secondary heat sink located in said interior volume." Petitioner identifies such a sink by annotating Figure 2. Pet. 35–36. We reproduce that annotated figure below.

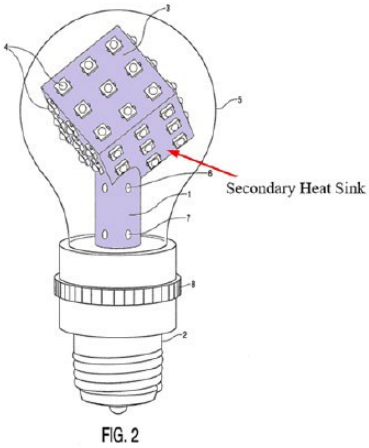

FIG. 2

Pet. 35–36 (reproducing Ex. 1007, Fig. 2). Begemann Figure 2 is a view of a second embodiment of Begemann's LED lamp. Ex. 1007, 4:11. Petitioner annotates the Figure to "Secondary Heat Sink" areas. The preponderance of the evidence supports that Begemann teaches or suggests this recitation. Begemann teaches, for example, that substrate 3 is "made of a metal or metal alloy, thereby enabling a god heat conduction" and that "[t]he outer surface of the gear column (1) of the LED lamp is made of a metal or a metal alloy … enable[ing] good heat

conduction." Id. at 4:28–29, 5:1–3; see also Ex. 1006 ¶ 95.

Claim 1 recites "said secondary heat sink being capable of drawing heat from one or more semiconductors devices." For the reasons we address above, the preponderance of the evidence supports that Begemann teaches or suggests this recitation. Pet. 37.

Claim 1 recites "a plurality of primary heat sinks mounted on said secondary heat sink." Petitioner asserts that the MC-PCP elements 12 of Begemann Figure 3A are primary heat sinks. Pet. 37–39. The preponderance of the evidence supports that Begemann teaches or suggests this recitation. Begemann teaches, for example, that the MC-PCB elements are "responsible for good heat transfer." Ex. 1007, 6:5–6, Fig. 3A; see also Ex. 1006 ¶¶ 97– 98.

Claim 1 recites "each of said primary heat sinks being smaller than said secondary heat sink." Petitioner asserts that Begemann teaches this recitation as illustrated, for example by Begemann Figure 2. Pet. 39–40. The preponderance of the evidence supports that Begemann teaches or suggests this recitation. Ex. 1007, Figs. 2, 3A; Ex. 1006 ¶ 99.

Claim 1 recites "a semiconductor chip capable of emitting light mounted on one of said primary heat sinks." Petitioner asserts that Begemann Figure 3A depicts such a chip. Pet. 40–41. The preponderance of the evidence supports that Begemann teaches or

suggests this recitation. Ex. 1007, 6:3–5, Fig. 3A; Ex. 1006 ¶ 100.

Claim 1 recites "said semiconductor chip being capable of emitting monochromatic light." Petitioner argues that Begemann teaches this recitation. Pet. 41–42. The preponderance of the evidence supports that Begemann teaches or suggests this recitation. Begemann teaches that its "single chip LEDs" have "only one light point per LED." Ex. 1007, 4:32–34.[13] Begemann explains, for example, that its green, red, yellow, blue light points may be mixed to obtain white light. Id. at 5:17–26. Petitioner's witness, Dr. Lebby, testifies that these statements indicate the LED is monochromatic. Ex. 1006 ¶ 101. Moreover, as we explain herein, Petitioner persuasively explains why it would have been obvious to use a phosphor coating in conjunction with Begemann to achieve monochromatic white light.

Claim 1 recites "said semiconductor chip being selected from the group consisting of light emitting diodes, light emitting diode arrays, laser chips, and VCSEL chips." The preponderance of the evidence supports that Begemann teaches or suggests this recitation. As Petitioner asserts, Begemann teaches that its chips are LEDs. Pet. 42; Ex. 1007, 6:4–5, Fig. 3A; Ex. 1006 ¶ 102.

Claim 1 recites "said chip including a substrate on which epitaxial layers are grown." Petitioner

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[13] Petitioner mistakenly cites 3:32–35 (Pet. 40), but the quote is easily located on the next page.

asserts that Krames discloses this limitation by showing a "sapphire substrate" on which epitaxial layers have grown. Pet. 42–43. The preponderance of the evidence supports that Begemann teaches or suggests this recitation. Ex. 1008, 4 ("the two most common substrates used for OMVPE growth of AlGa1nN are sapphire and SiC"), Fig. 3; Ex. 1006 ¶¶ 103–104.

Claim 1 recites "a buffer layer located on said substrate." Petitioner asserts that Krames discloses this limitation. Pet. 43–44. The preponderance of the evidence supports that Krames teaches or suggests this recitation. Krames Figure 3 shows a "buffer layer" located on a "sapphire substrate." Ex. 1008, Fig. 3; Ex. 1006 ¶ 105. Also, as we explain supra, Petitioner adequately establishes that it would have been obvious to combine Krames' LED chip with Begemann.

Claim 1 recites "said buffer layer serving to mitigate differences in material properties between said substrate and other epitaxial layers." Petitioner argues that Krames's buffer layers would serve this function. Pet. 44–46. The preponderance of the evidence supports that Krames teaches or suggests this recitation. Ex. 1008, Fig. 3; Ex. 1006 ¶¶ 106–107; Ex. 1014, 353 (reference Krames cites explaining that mismatch between substrate and film makes film difficult to grow).

Claim 1 recites "a first cladding layer serving to confine electron movement within the chip."

Petitioner asserts that Krames discloses a cladding layer that serves to perform the recited function. Pet. 46. The preponderance of the evidence supports that Krames teaches or suggests this recitation. Ex. 1008, 5, Fig. 3; Ex. 1006 ¶ 108.

Claim 1 recites "said first cladding layer being adjacent said buffer layer." Petitioner asserts that Krames Figure 3 discloses this recitation. Pet. 47. The preponderance of the evidence supports that Krames teaches or suggests this recitation. Ex. 1008, Fig. 3; Ex. 1006 ¶ 109.

Claim 1 recites "an active layer." Petitioner asserts that Krames teaches this layer as "either the single InGaN QW active layer or the multiple stacked QW active layers" of Krames Figure 3. Pet. 47–48. The preponderance of the evidence supports that Krames teaches or suggests this recitation. Ex. 1008, Fig. 3; Ex. 1006 ¶ 110.

Claim 1 recites "said active layer emitting light when electrons jump to a valance state." Petitioner asserts that Krames's active layer will meet this function. Pet. 48–49. The preponderance of the evidence supports that Krames teaches or suggests this recitation. Ex. 1006 ¶ 111.

Claim 1 recites "a second cladding layer." Petitioner asserts that Krames discloses this limitation. Pet. 49–50. The preponderance of the evidence supports that Krames teaches or suggests this recitation. Ex. 1008, 5, Fig. 3; Ex. 1006 ¶ 112.

Appendix C

Claim 1 recites "said second cladding layer positioned so that said active layer lies between cladding layers." Petitioner asserts that Krames Figure 3 discloses this recitation. Pet. 50. The preponderance of the evidence supports that Krames teaches or suggests this recitation. Ex. 1008, Fig. 3; Ex. 1006 ¶ 113.

Claim 1 recites "a contact layer on which an electron [sic, electrode] may be mounted for powering said chip." Petitioner asserts that Krames Figure 3 discloses this recitation. Pet. 50–51. The preponderance of the evidence supports that Krames teaches or suggests this recitation. Ex. 1008, Fig. 3; Ex. 1006 ¶¶ 114–115.

Claim 1 recites "a coating for converting monochromatic light emitted by said chip to white light." Petitioner asserts that Allen teaches this recitation and that, additionally, Krames teaches conversion of blue light "into white via phosphors." Pet. 51–52. The preponderance of the evidence supports that Allen and Krames teaches or suggests this recitation. See Ex. 1011, 4:11–12 (Allen stating that "[w]hite dies may be, for example, blue dies with phosphorescent coating to produce a wideband spectrum"); Ex. 1008, 11 (Krames explaining "conversion of blue light into white via phosphors"); Ex. 1006 ¶¶ 116–117. Also, as we explain supra, the preponderance evidence supports that a person having ordinary skill in the art would have had reason

to combine the teachings of Allen with Krames and Begemann

We next address elements of claim 9 which depend from claim 1. Claim 9 recites "[a] device as recited in claim 1 wherein said substrate is electrically conductive." Petitioner asserts that Krames teaches an electrically conductive SiC substrate. Pet. 52.

Patent Owner argues that Petitioner relies on Figure 3 of Krames as teaching a sapphire substrate but never establishes that a sapphire substrate is a conductive substrate. Resp. 28; see also Surreply 21. Patent Owner's argument is unpersuasive because it does not squarely address the Petition. While Petitioner relies on Krames Figure 3 for some elements, Petitioner also relies on Krames teaching that the substrate can be "sapphire (as depicted) or SiC." Pet. 23 (citing Ex. 1008, 4); Reply 10–11. Petitioner further explains that Krames teaches OMVPE growth for "the two most common substrates … sapphire and SiC." Pet 43; see also Ex. 1006 ¶¶ 103– 104. In other words, Krames reasonably suggests that the Figure 3 substrate, instead of being sapphire, could be SiC. Petitioner explains that sapphire or SiC could be used for growing an epitaxial layer (Pet. 42) and explains that, between these two choices that Krames offers, Krames teaches that the SiC option is conductive (id. at 52).

Krames further teaches that sapphire is less expensive but is "insulating" which poses "design challenges." Id. Krames, thus, provides evidences that

SiC substrate is conductive. Dr. Lebby's testimony further supports this position. Id. at 52 (citing Ex. 1006 ¶ 118). As such, the preponderance of the evidence supports that Krames teaches it would have been obvious to use a SiC layer and that such a layer would have both been conductive and would have permitted growing an epitaxial layer.

We next address elements of claim 18. Claim 18 depends from claim 9. Claim 18 recites "[t]he semiconductor light source as recited in claim 9 wherein: said semiconductor chip is a light emitting diode (LED) chip configured to output light at greater than about 40 milliwatts." The preponderance of the evidence supports that Krames teaches or suggests this recitation. Ex. 1008, 10; Ex. 1006 ¶ 119. Importantly, this claim language requires a semiconductor chip capable of the recited output, and Patent Owner does not persuasively dispute that the Krames chip is capable of meeting this recitation.

Claim 18 recites "said LED chip is surface mounted on said one of said primary heat sinks." Petitioner asserts that Begemann Figure 3A depicts LED chips (elements 11) surface mounted on the primary heat sink. Pet. 53–54. The preponderance of the evidence supports that Begemann teaches or suggests this recitation. Ex. 1007, Fig. 3A; Ex. 1006 ¶ 120.

Claim 18 also recites "said LED chip is configured to emit monochromatic visible light." Petitioner asserts that Krames discloses the

limitation. Pet. 54. The preponderance of the evidence supports that Krames teaches or suggests this recitation. Ex. 1008, 5; Ex. 1006 ¶ 121.

To summarize, Petitioner has shown by a preponderance of the evidence that the combined teachings of Begemann, Krames, and Allen teach or reasonably suggest all of the elements of claim 18 in the manner claim 18 (and the claims that claim 18 depends from) recites. Thus, we are persuaded that Petitioner has established by a preponderance of the evidence that the combination of Begemann, Krames, and Allen renders claim 18 obvious.

c. *Dependent Claim 29*

Claim 29 recites, "[t]he semiconductor light source as recited in claim 28 wherein: said opening defined in said dome-shaped enclosure is large enough for said heat sink to pass through said opening." Ex. 1001, EPRC 2:21–25. The "opening" of claim 29 is defined in claim 28 which refers to "said enclosure [referring back to the enclosure of claim 1] is shaped as a dome that defines an opening." Id. at 2:18–20.

Petitioner reproduces Figure 6B of Allen to illustrate that the opening of Allen is large enough for Allen's heat sink to pass through. Pet. 62–63. Petitioner further argues that a person having ordinary skill in the art would incorporate this aspect of Allen "to achieve an LED lamp with improved

performance and manufacturability that could replace conventional incandescent lamps. Pet. 30–31 (citing Ex. 1006 ¶ 90).

Patent Owner argues that Petitioner relies only on Begemann as providing a heat sink and that "Cree provides absolutely no explanation why a POSITA would have been motivated to use or combine Allen's enclosure with Begemann." Resp. 35–36. This argument does not persuasively undermine Petitioner's position. Petitioner provides a rationale for combining the teachings of Allen and Begemann, and the rationale is supported by sufficient evidence, namely the declaration of Dr. Lebby. Pet. 30–31 (citing Ex. 1006 ¶ 90); see also Reply 13–15. Patent Owner provides no evidence that would undermine or weigh against Petitioner's stated reasons to combine.

Patent Owner further argues that a person having ordinary skill in the art would understand that Allen's "dome-shaped enclosure" would not function for its intended purpose with Begemann's lightbulb because it "does not fit the geometry of Begemann's light bulb." Resp. 36 (citing Ex. 1007, Figs. 1–2; Ex. 1011, Figs. 6A–6B). This argument is unpersuasive because it does not squarely address Petitioner's contentions; Petitioner's combination relies on using Allen's bulb shape having Allen's opening rather than relying on Begemann's lightbulb shape. See Reply 13–15.

Thus, Petitioner has shown by a preponderance of the evidence that the combined teachings of

Begemann, Krames, and Allen teach or reasonably suggest all of the elements of claim 29 in the manner claim 29 recites. Ex. 1006 ¶ 90; Ex. 1011, Fig. 6B. Thus, we are persuaded that Petitioner has established by a preponderance of the evidence that the combination of Begemann, Krames, and Allen renders claim 29 obvious.

d. *Dependent Claim 32*

Claim 32 recites, "[T]he semiconductor light source as recited in claim 18 wherein: the semiconductor light source further comprises an AC/DC converter, said AC/DC converter is configured to convert AC power into DC power that is usable by said LED chip, and said AC/DC converter is positioned outside said interior volume." Ex. 1001, EPRC 2:37–44.

Petitioner argues that Allen teaches the recited voltage converter. Pet. 65 (citing Ex. 1011, 6:15-18). Petitioner further argues that Allen teaches that voltage converter 204 is located outside of the interior volume. Id. at 65–67 (citing Ex. 1011, 6:15–18, Fig. 6B). Petitioner also provides evidence, namely testimony from Dr. Lebby, supporting that a person of ordinary skill in the art would have been motivated to put circuitry outside of the interior volume to avoid obscuring emitted light. Id. at 66–67 (citing Ex. 1006 ¶ 139).

Patent Owner argues that Allen's voltage converter 204 is not "outside said interior volume" as claim 32 recites. Resp. 37–38. Patent Owner argues

that Petitioner "incorrectly limits the interior volume within the enclosure to only the space to the left of the leftmost "support 212." Id. at 37. This argument is unpersuasive because the preponderance of the evidence supports Petitioner.

As Petitioner argues, claim 1 (which claim 32 ultimately depends from) states that the recited "enclosure" is "fabricated from a material substantially transparent to white light." Reply 16. Allen's structure to the right of the leftmost "support 212" (where the converter 204 is located) is opaque: "[t]he mounting 212 supporting the five monolithic LED devices 100 is preferably transparent or translucent, whereas the mounting 212 that supports the voltage converter 204 is preferably opaque." Ex. 1011, 9:32–34 (emphasis added). Allen continues: "the parts of the bulb housing 207 forming the globular front face 206 and form the side up to the mounting support for the power supply is likely to be transparent or frosted, whereas the remaining parts of the housing 207 forming the base 210 are preferably opaque." Id. at 9:34–10:2.

Patent Owner argues that the entire enclosure need not be opaque. Sur-Reply 24–25. This argument does not squarely address Petitioner's position. The preponderance of the evidence supports that Allen's enclosure for the LEDs is the transparent portion to the left of support 212 while the opaque portion is a base rather than being part of that same enclosure. The opaque portion to the right of support 212 is

separated from the transparent portion to the right of support 212 and, thus, does not enclose the same components and is not the same enclosure. Ex. 1011, Fig. 6B.

Patent Owner also argues that Petitioner's alleged reason to combine Allen with Begemann "to avoid the emitted light from being obscured by such circuitry or structures" would not be a concern. Resp. 38. Patent Owner argues that Begemann does not identify this problem and places components in its interior volume. Id. This argument is unpersuasive because Allen discloses a workable and advantage design; a person having ordinary skill in the art would have understood that Begemann would benefit from having electronic components outside the interior lighting volume for the same reason Allen benefits from this design. KSR Int'l. Co., 550 U.S. at 417 ("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"); see also Ex. 1006 ¶ 148.

Petitioner has shown by a preponderance of the evidence that the combined teachings of Begemann, Krames, and Allen teach or reasonably suggest all of the elements of claim 32 in the manner claim 32 recites. Ex. 1006 ¶ 148; Ex. 1011, 9:32–10:2, Fig. 6B. We are persuaded Petitioner has established by a preponderance of the evidence that the combination of

Begemann, Krames, and Allen renders claim 32 obvious.

e. *Dependent Claim 34*

Claim 34 recites:

> The semiconductor light source as recited in claim 32 wherein: the semiconductor light source further comprises a positive lead wire and a negative lead wire configured to provide power from said AC/DC converter to said LED chip, and said positive lead wire and said negative lead wire run from said AC/DC converter, through an interior of said base, into said interior volume, and over an exterior surface of said secondary heat sink.

Ex. 1001, EPRC 2:48–57. Petitioner argues that Allen Figure 6B illustrates positive and negative lead wires. Pet. 68 (citing Ex. 1011, Figs. 6A, 6B; Ex. 1006 ¶ 141). Petitioner argues that it would have been obvious to include Allen's AC/DC converter in Begemann's base and to connect those wires as recited in order to power the LEDs. Id. at 68–70 (citing Ex. 1006 ¶ 142).

Patent Owner argues that the identified structures do not "run from said AC/DC converter, through an interior of said base." Resp. 39. We disagree. As we explain with regard to claim 32, Allen's structure to the right of leftmost "support 212"

is the recited base. Reply 16–17. Figure 6B shows the wires running through this base.

Patent Owner also argues that Petitioner does not provide a reason why a person having ordinary skill in the art would combine Allen's voltage converter 204 and lead wires with Begemann's device or place Allen's voltage converter 204 within Begemann's base. Resp. 39–40. Petitioner, when addressing claim 33, provides a persuasive reason why a person of ordinary skill in the art would use Allen's voltage converter and position it in the base. Pet. 67 ("A POSITA would have been motivated and found it obvious to put circuitry or other electronic structures in Begemann's base to avoid the emitted light from being obscured by such circuitry or structures"). Patent Owner does not present evidence persuasively undermining this reasoning or evidence. A preponderance of the evidence supports Petitioner's position. Ex. 1011, Fig. 6B, 6:15–18; Ex. 1006 ¶ 140. We are persuaded Petitioner has established by a preponderance of the evidence that the combination of Begemann, Krames, and Allen renders claim 34 obvious.

f. *Dependent Claim 36*

Claim 36 recites: "[t]he semiconductor light source as recited in claim 18 wherein: said coating is directly applied to a face of said LED chip." Ex. 1001, EPRC 2:63-65. Petitioner argues that Allen teaches "[w]hite dies may be, for example, blue dies with phosphorescent coating to produce a wideband

spectrum." Pet. 70 (citing Ex. 1011, 4:11–12). Petitioner also provides evidence that a "die" is a way of referring to an LED chip. Id. (citing Ex. 1006 ¶ 144).

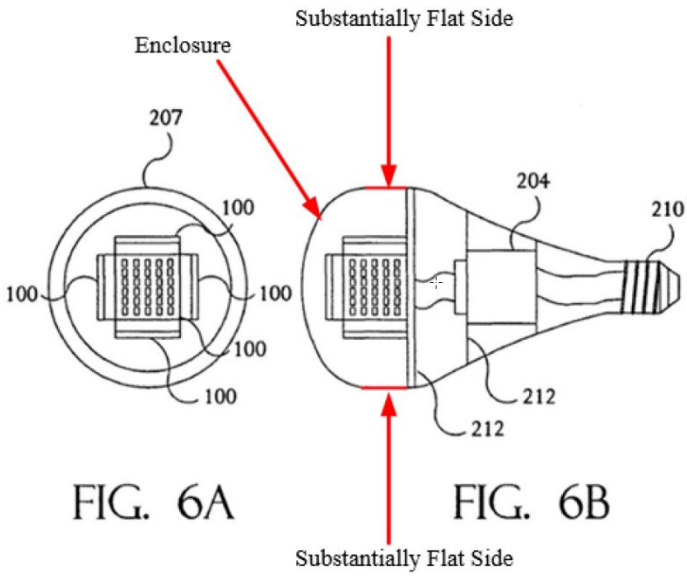
Patent Owner argues that this passage does not teach applying the coating directly to the face of an LED chip because the coating could instead encapsulate the LED chip as taught by U.S. Patent No. 5,959,316. Resp. 40–41 (citing Ex. 2024, Fig. 3, 3:6–11).

The preponderance of the evidence supports Petitioner's position. Allen suggests that it is its die that has a coating rather than suggesting that there is a spacer adjacent to the die that is coated. Reply 17 (citing Ex. 1011, 4:11–12). The die is the LED chip. Ex. 1006 ¶ 144. We are persuaded Petitioner has established by a preponderance of the evidence that the combination of Begemann, Krames, and Allen renders claim 36 obvious.

g. *Dependent Claim 41*

Dependent claim 41 recites, "[T]he semiconductor light source as recited in claim 40 wherein: said enclosure includes a substantially flat side." Ex. 1001, EPRC 3:21–23. Petitioner annotates Figure 6B of Allen to argue that Allen's enclosure has a substantially flat side. Below, we reproduce Figure 6A alongside Figure 6B as Petitioner annotates that figure.

Appendix C



Pet. 71–72 (reproducing Ex. 1011, Figs. 6A, 6B). Allen Figure 6A shows a top view of an exemplary embodiment of Allen "employed in an 'A-type' screw-in hemispherical lamp configuration," and Figure 6B shows a side view of the same embodiment. Ex. 1011, 3:17–20. Petitioner annotates Figure 6B by pointing to the enclosure and top and bottom portions labeled as "[s]ubstantially flat side." Pet. 72.

Patent Owner argues that Petitioner does not establish that Allen's Figure 6B enclosure has a "substantially flat side" because "the two purportedly 'flat sides' are actually part of a cylindrical—not flat—portion of Allen's enclosure." Resp. 41–42. The preponderance of the evidence supports Patent Owner's position.

Appendix C

The ’770 patent addresses use of a “flat” enclosure in the context of Figure 10. We reproduce Figure 10 below for reference.

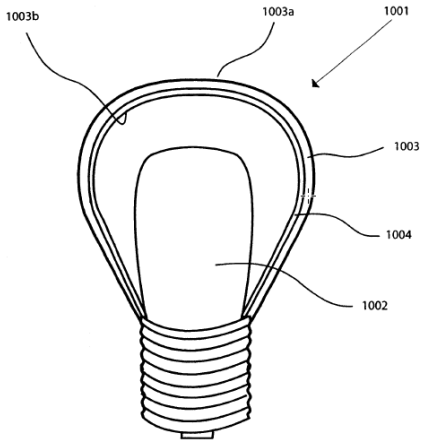


Fig. 10

Ex. 1001, Fig. 10. Figure 10 “depicts an LED or laser light source located in a light enclosure having a phosphor coating.” Id. at 2:42–43. The ’770 patent distinguishes Figure 10 from a flat shape by stating that “[t]he depicted shape is that of a bulb, but flat, arcuate, rounded or other shapes may be used depending on the application.” Id. at 8:41–43.

Petitioner argues that Figure 6B depicts a disclosure with a “substantially flat side” because, even though the disclosure is cylindrical, it still “comprises a flat side which encircles the lamp.” Reply 18–19. We disagree. The surface of the Figure 6B bulb is cylindrical. Given the context of the ’847 patent, “flat” describes a three-dimensional object being flat—

in other words being flat in three dimensions. The '770 patent does not indicate that "flat" or "substantially flat" can be understood so broadly that it includes a curved three-dimensional surface that only appears flat based on viewing the surface from a particular direction.

We further emphasize that Petitioner's position is based upon combining Allen's teachings with Begemann (as opposed to, for example, modifying the art's teachings based on what is generally known in the art). Pet. 72 ("[a] POSITA would have found it obvious to use Allen's enclosure with two substantially flat sides as the enclosure of Begemann"); Reply 19 ("a POSITA would have found it obvious to use Allen's enclosure with two substantially flat sides as the enclosure of Begemann"). Because Allen does not teach a substantially flat surface, combining the teachings will also not result in a substantially flat surface.

Thus, for the reasons explained above, Petitioner has not adequately established by a preponderance of the evidence that claim 41 would have been obvious in view of the cited art.

h. *Dependent Claims 22, 25, 26, 28, 30, 33, 35, 40, 42–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 70–73, 77, 78, 81, 82, 85, 86, and 88–91*

Petitioner accounts for the limitations recited in claims 22, 25, 26, 28, 30, 33, 35, 40, 42–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 70–73, 77, 78, 81, 82, 85,

86, and 88–91. Pet. 54–98. Petitioner provides detailed explanations as to how the combined teachings of Begemann, Krames, and Allen disclose, teach, or suggest the limitations of these claims and why it would have been obvious to combine those teachings with a reasonable expectation of success, citing Dr. Lebby's testimony for support. Id. (citing Ex. 1006).

We are persuaded that Petitioner has demonstrated that all of the limitations recited in claims 22, 25, 26, 28, 30, 33, 35, 40, 42–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 70–73, 77, 78, 81, 82, 85, 86, and 88–91 would have been obvious over Begemann, Krames, and Allen. Patent Owner provides no arguments regarding these claims outside of the arguments discussed above. See generally Resp. Having reviewed Petitioner's arguments and supporting evidence, we are persuaded that Petitioner has established by a preponderance of the evidence that claims 22, 25, 26, 28, 30, 33, 35, 40, 42–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 70–73, 77, 78, 81, 82, 85, 86, and 88–91 are unpatentable under § 103(a) over Begemann, Krames, and Allen.

5. Ground Two: Unpatentability over Begemann, Sugiura, Allen, and Krames

Petitioner asserts that claims 18, 22, 25, 26, 28–30, 32–36, 40–44, 47– 49, 52, 53, 56–59, 62, 63, 65–68, 70–73, 77, 78, 81, 82, 85, 86, and 88–91 are unpatentable under 35 U.S.C. § 103(a) as obvious over Begemann, Sugiura, Allen, and Krames, citing the

Declaration of Dr. Michael S. Lebby for support. Pet. 98–112 (citing Ex. 1006). To the extent Petitioner's assertions and Patent Owner's counter arguments do not relate to Suguira, we address those issues above when addressing Ground One and, for brevity, we do not repeat that analysis here. Below, we first address Petitioner's argued reasons to combine the references' teachings. We then address independent claim 18. Next, we address disputed recitations of dependent claims. Finally, we address the remaining dependent claims collectively.

a. *Combining the teachings of Begemann, Sugiura, Krames, and Allen*

Petitioner argues that it would have been obvious to combine Sugiura's chip with Begemann's bulb structure while increasing the area and operating current of Sugiura's LED chips, as taught by Krames. Pet. 28–29. Begemann teaches that "[c]ustomary incandescent lamps can only be replaced by LED lamps which are provided with LEDs having … a high luminous flux." Ex. 1007, 2:3–5. Begemann discloses LEDs mounted to surfaces within the interior of its bulb and as part of an LED package. Id. at Figs. 2, 3A. Begemann does not, however, disclose what specific LED chip should be used with its device. Pet. 28. A person having ordinary skill in the art would have naturally searched LED chip references to determine what existing chips could be combined with Begemann's disclosure.

Sugiura teaches LED chip structures meant to achieve improved luminous output. Ex. 1006 ¶ 87; see also, e.g., Ex. 1010, 14:58–67 (explaining that the Sugiura LED provides various advantages). Petitioner provides evidence that a person having ordinary skill in the art would have had reason to increase the area and operating current of the Sugiura chips to achieve the goal of Begemann. Pet. 29; Ex. 1006 ¶ 87.

Patent Owner argues that Petitioner fails to consider how increasing size or drive current could impact output or efficiency of the Sugiura chips. Resp. 43. This argument does not persuasively undermine Petitioner's position. The details of how to increase size or drive current are not relevant to claim recitations, and Patent Owner lacks persuasive no evidence that a person having ordinary skill in the art would have had difficulty or lack or reason to modify Sugiura to an appropriate size and drive current. Reply 12– 13. Also, Krames teaches increasing chip size to, in line with Begemann's goals, "compete more favorably with conventional lighting technologies in many applications." Ex. 1008, 1 (abstract), 6.

Patent Owner also argues that driving the Sugiura chip at 1.5 amps and 40 milliwatts would create too much heat. Resp. 45. This argument does not persuasively undermine Petitioner's rationale and evidence regarding reason to combine because, as we explain in ground one, the claims only require a chip capable of a 40 milliwatt output.

To summarize, the preponderance of the evidence establishes that a person of ordinary skill in the art would have had good reason to combine implement the Sugiura chip (as modified as Krames suggests) in the Begemann device while also making use of a phosphor coating as Allen teaches, and that a person of ordinary skill in the art would have had a reasonable expectation of success in combining the references' teachings in this manner.

b. *Independent Claim 18*

For brevity, we address only claim recitations that relate to Sugiura. For other recitations, we refer to our assessment of Ground One.

Claim 18 depends from cancelled claims 1 and 9. Claim 1 recites "said chip including a substrate on which epitaxial layers are grown." Petitioner asserts that Sugiura discloses this limitation by showing an n-type silicon substrate 60 on which epitaxial layers have been grown. Pet. 100. The preponderance of the evidence supports that Begemann teaches or suggests this recitation. Ex. 1010, Fig. 10, 17:12; Ex. 1006 ¶¶ 222.

Claim 1 recites "a buffer layer located on said substrate." Petitioner asserts that Sugiura discloses this limitation. Pet. 101–102. The preponderance of the evidence supports that Sugiura teaches or suggests this recitation. Sugiura Figure 10 shows the buffer layer as n-type contact layer 63. Ex. 1010, Fig. 10, 17:28, 17:30–33; Ex. 1006 ¶¶ 223–225; See also Ex.

1005, 1/24/2014 Action, 22 (reexamination examiner recognizing this layer).

Claim 1 recites "said buffer layer serving to mitigate differences in material properties between said substrate and other epitaxial layers." Petitioner argues that Sugiura's buffer layers would serve this function. Pet. 102. The preponderance of the evidence supports that Sugiura teaches or suggests this recitation. Ex. 1010, Fig. 10, 17:28, 17:30–33; Ex. 1006 ¶¶ 223–225.

Claim 1 recites "a first cladding layer serving to confine electron movement within the chip." Petitioner asserts that Sugiura discloses a cladding layer that serves to perform the recited function. Pet. 103. The preponderance of the evidence supports that Sugiura teaches or suggests this recitation. Ex. 1010, Fig. 3, 17:34; Ex. 1006 ¶¶ 227–229; see also Ex. 1005, 1/24/2014 Action, 23.

Claim 1 recites "said first cladding layer being adjacent said buffer layer." Petitioner asserts that Sugiura Figure 10 discloses this recitation. Pet. 105. The preponderance of the evidence supports that Sugiura teaches or suggests this recitation. Ex. 1010, Fig. 10; Ex. 1006 ¶ 230.

Claim 1 recites "an active layer." Petitioner asserts that Sugiura teaches this layer as active layer 65. Pet. 105–106. The preponderance of the evidence supports that Krames teaches or suggests this recitation. Ex. 1010, Fig. 10, 17:34; Ex. 1006 ¶ 231

Claim 1 recites "said active layer emitting light when electrons jump to a valance state." Petitioner asserts that Sugiura's active layer will meet this function. Pet. 106. The preponderance of the evidence supports that Sugiura teaches or suggests this recitation. Ex. 1006 ¶ 232.

Claim 1 recites "a second cladding layer." Petitioner asserts that Sugiura discloses this limitation as current injection layer 66. Pet. 106–107. The preponderance of the evidence supports that Sugiura teaches or suggests this recitation. Ex. 1010, Fig. 10, 17:36–37; Ex. 1006 ¶¶ 233–235; see also Ex. 1005, 1/24/2014 Action, 18–19, 23.

Claim 1 recites "said second cladding layer positioned so that said active layer lies between cladding layers." Petitioner asserts that Sugiura Figure 10 discloses this recitation. Pet. 109. The preponderance of the evidence supports that Sugiura teaches or suggests this recitation. Ex. 1010, Fig. 10; Ex. 1006 ¶ 236.

Claim 1 recites "a contact layer on which an electron [sic, electrode] may be mounted for powering said chip." Petitioner asserts that Sugiura teaches contact layer 67. The preponderance of the evidence supports that Sugiura teaches or suggests this recitation. Ex. 1010, Fig. 10, 17:37–38, 44; Ex. 1006 ¶ 237.

We next address elements of claim 9 which depends from claim 1. Claim 9 recites "[a] device as recited in claim 1 wherein said substrate is electrically

conductive." Petitioner asserts that Sugiura teaches N-type silicon substrate 60 and that silicon is electrically conductive. Pet. 111. The preponderance of the evidence supports that Suguira teaches or suggests this recitation. Ex. 1010, 17:12; Ex. 1006 ¶ 239.

We next address elements of claim 18. Claim 18 depends from claim 9. Claim 18 recites "[t]he semiconductor light source as recited in claim 9 wherein: said semiconductor chip is a light emitting diode (LED) chip configured to output light at greater than about 40 milliwatts." This claim language requires a semiconductor chip capable of the recited output. Petitioner argues that the combination of Suguira and Krames discloses this claim recitation.

Patent Owner argues that Petitioner never establishes that the modified Suguira chip "would output light at greater than 40 milliwatts." Resp. 44. Patent Owner's argument misses the mark because claim 18 is not a method claim and does not require a particular light output. A preponderance of the evidence, as Petitioner cites, supports that a person of ordinary skill in the art would have been motivated to modify Suguira to increase area and operating current. Pet. 28–29; Ex. 1007, 2:3–5; Ex. 1006 ¶ 87. The preponderance of the evidence supports that the modified Suguira chip would, like Krames, be capable of outputting light at greater than 40 milliwatts. Ex. 1008, Abstract, Fig. 12, 5 (Table I, Fig. 12), 10; Ex. 1006 ¶¶ 87, 119.

Claim 18 recites "said LED chip is configured to emit monochromatic visible light." Petitioner asserts that Suguira in combination with Krames discloses the limitation. Pet. 111. The preponderance of the evidence supports that Petitioner's assertion for the reasons we explain when addressing this element with regard to ground 1 and when addressing reasons to combine the references' teachings.

To summarize, Petitioner has shown by a preponderance of the evidence that the combined teachings of Begemann, Suguira, Krames, and Allen teach or reasonably suggest all of the elements of claim 18 in the manner claim 18 (and the claims that claim 18 depends from) recites. Thus, we are persuaded that Petitioner has established by a preponderance of the evidence that the combination of Begemann, Suguira, Krames, and Allen renders claim 18 obvious.

c. *Dependent Claims 22, 25, 26, 28–30, 32–36, 40–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 70–73, 77, 78, 81, 82, 85, 86, and 88–91*

Petitioner adequately accounts for the limitations recited in claims 22, 25, 26, 28–30, 32–36, 40, 42–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 70– 73, 77, 78, 81, 82, 85, 86, and 88–91. Pet. 54–98, 111. Petitioner's position with respect to these claims is essentially the same as for Ground One except that claim elements relating to LED chip emission characteristics rely on the combination of Suguira and Krames. Patent Owner does not separately dispute

these dependent claims except to the extent Patent Owner's arguments with respect to Ground One still apply. Resp. 46. For the reasons we explain when addressing ground one, Patent Owner's arguments do not persuasively undermine Petitioner's showing of unpatentability except with regard to claim 41. As to claim 41, Petitioner does not adequately establish unpatentability for the reason we explain when addressing ground one.

We are persuaded that Petitioner has demonstrated that all of the limitations recited in claims 22, 25, 26, 28–30, 32–36, 40, 42–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 70–73, 77, 78, 81, 82, 85, 86, and 88–91 would have been obvious over Begemann, Suguira, Krames, and Allen. Having reviewed Petitioner's arguments and supporting evidence, we are persuaded that Petitioner has established by a preponderance of the evidence that claims 22, 25, 26, 28–30, 32–36, 40, 42–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 70–73, 77, 78, 81, 82, 85, 86, and 88–91 are unpatentable under § 103(a) over Begemann, Suguira, Krames, and Allen. Petitioner has not established by a preponderance of the evidence that claim 41 is unpatentable under § 103(a) over Begemann, Suguira, Krames, and Allen.

IV. CONCLUSION

Based on the evidence presented with the Petition, the evidence introduced during the trial, and the parties' respective arguments, Petitioner has

shown by a preponderance of the evidence that claims 21, 22, 25, 26, 28–30, 32–36, 40, 42–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 71–73, 77, 78, 81, 82, 85, 86, and 88–91 of U.S. Patent No. 6,634,770 C3 are unpatentable.[14] Petitioner has not shown by a preponderance of the evidence that claim 41 of U.S. Patent No. 6,634,770 C3 is unpatentable.

In summary:

[14] 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).

Appendix C

Claims	**35 U.S.C. §**	**References/ Basis**	**Claims Shown Unpatent-able**	**Claims Not Shown Unpatent-able**
21, 22, 25, 26, 28–30, 32–36, 40– 44, 47–49, 52, 53, 56– 59, 62, 63, 65–68, 71– 73, 77, 78, 81, 82, 85, 86, 88–91	103 (a)	Begemann, Krames, Allen	21, 22, 25, 26, 28–30, 32–36, 40, 42–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 71–73, 77, 78, 81, 82, 85, 86, 88–91	41

Appendix C

Claims	35 U.S.C. §	References/ Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
21, 22, 25, 26, 28–30, 32–36, 40–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 71–73, 77, 78, 81, 82, 85, 86, 88–91	103 (a)	Begemann, Sugiura, Allen, Krames	21, 22, 25, 26, 28–30, 32–36, 40, 42–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 71–73, 77, 78, 81, 82, 85, 86, 88–91	41

V. ORDER

For the foregoing reasons, it is

ORDERED that Petitioner establishes by a preponderance of the evidence that claims 21, 22, 25, 26, 28–30, 32–36, 40, 42–44, 47–49, 52, 53, 56–59, 62, 63, 65–68, 71–73, 77, 78, 81, 82, 85, 86, and 88–91 of U.S. Patent No. 6,634,770 C3 are unpatentable;

FURTHER ORDERED that Petitioner does not establish by a preponderance of the evidence that claim 41 of U.S. Patent No. 6,634,770 C3 is unpatentable;

FURTHER ORDERED that Patent Owner's Motion to Exclude Exhibit 1028 is *denied*;

FURTHER ORDERED that Petitioner's Motion to Exclude Exhibits 2017 and 2030 is *dismissed as moot*; and

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

APPENDIX D – DENIAL OF REHEARING OF THE UNITED STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT DATED NOVEMBER 6, 2025

UNITED STATES COURT OF APPEALS
FOR THE FEDERAL CIRCUIT

CAO LIGHTING, INC.,
Appellant

v.

WOLFSPEED, INC., CREE LIGHTING USA LLC F/K/A IDEAL INDUSTRIES LIGHTING LLC, LEDVANCE LLC, GENERAL ELECTRIC COMPANY, CONSUMER LIGHTING (U.S.), LLC, DBA GE LIGHTING, CURRENT LIGHTING SOLUTIONS, LLC, OSRAM SYLVANIA, INC., FEIT ELECTRIC COMPANY, INC.,
Cross-Appellants

2024-1194, 2024-1221

Appeals from the United States Patent and Trademark Office, Patent Trial and Appeal Board in Nos. IPR2022-00847, IPR2023-00123, IPR2023-00129

CAO LIGHTING, INC.,
Appellant

Appendix D

v.

WOLFSPEED, INC., CREE LIGHTING USA LLC
F/K/A IDEAL INDUSTRIES LIGHTING LLC,
Cross-Appellants

2024-1222, 2024-1223

Appeals from the United States Patent and Trademark Office, Patent Trial and Appeal Board in No. IPR2022-00848.

ON PETITION FOR PANEL REHEARING AND REHEARING EN BANC

Before MOORE, *Chief Judge*, LOURIE, DYK, PROST, REYNA, TARANTO, CHEN, HUGHES, STOLL, CUNNINGHAM, and STARK, Circuit Judges.[1]

PER CURIAM.

ORDER

CAO Lighting, Inc. filed a combined petition for panel rehearing and rehearing en banc. The petition was first referred as a petition to the panel that heard the appeal, and thereafter the petition was referred to the circuit judges who are in regular active service.

[1] Circuit Judge Newman did not participate.

Appendix D

Upon consideration thereof,

It Is Ordered That:

The petition for panel rehearing is denied.

The petition for rehearing en banc is denied.

FOR THE COURT

/s/ Jarrett B. Perlow
Jarrett B. Perlow
Clerk of Court

November 6, 2025
Date

APPENDIX E – UNITED STATES CONSTITUTION FIFTH AMENDMENT

No person shall be held to answer for a capital, or otherwise infamous crime, unless on a presentment or indictment of a Grand Jury, except in cases arising in the land or naval forces, or in the Militia, when in actual service in time of War or public danger; nor shall any person be subject for the same offence to be twice put in jeopardy of life or limb; nor shall be compelled in any criminal case to be a witness against himself, nor be deprived of life, liberty, or property, without due process of law; nor shall private property be taken for public use, without just compensation.

APPENDIX F – RELEVANT STATUTORY PROVISIONS

5 U.S.C. § 554(b)

(b) Persons entitled to notice of an agency hearing shall be timely informed of—

(1) the time, place, and nature of the hearing;

(2) the legal authority and jurisdiction under which the hearing is to be held; and

(3) the matters of fact and law asserted.

When private persons are the moving parties, other parties to the proceeding shall give prompt notice of issues controverted in fact or law; and in other instances agencies may by rule require responsive pleading. In fixing the time and place for hearings, due regard shall be had for the convenience and necessity of the parties or their representatives.

Appendix F

5 U.S.C. § 554(c)

(c) The agency shall give all interested parties opportunity for-

(1) the submission and consideration of facts, arguments, offers of settlement, or proposals of adjustment when time, the nature of the proceeding, and the public interest permit; and

(2) to the extent that the parties are unable so to determine a controversy by consent, hearing and decision on notice and in accordance with sections 556 and 557 of this title.

Appendix F

5 U.S.C. § 556

(a) This section applies, according to the provisions thereof, to hearings required by section 553 or 554 of this title to be conducted in accordance with this section.

(b) There shall preside at the taking of evidence-

(1) the agency;

(2) one or more members of the body which comprises the agency; or

(3) one or more administrative law judges appointed under section 3105 of this title.

This subchapter does not supersede the conduct of specified classes of proceedings, in whole or in part, by or before boards or other employees specially provided for by or designated under statute. The functions of presiding employees and of employees participating in decisions in accordance with section 557 of this title shall be conducted in an impartial manner. A presiding or participating employee may at any time disqualify himself. On the filing in good faith of a timely and sufficient affidavit of personal bias or other disqualification of a presiding or participating employee, the agency shall determine the matter as a part of the record and decision in the case.

(c) Subject to published rules of the agency and within its powers, employees presiding at hearings may-

(1) administer oaths and affirmations;

(2) issue subpenas authorized by law;

(3) rule on offers of proof and receive relevant evidence;

(4) take depositions or have depositions taken when the ends of justice would be served;

(5) regulate the course of the hearing;

(6) hold conferences for the settlement or simplification of the issues by consent of the parties or by the use of alternative means of dispute resolution as provided in subchapter IV of this chapter;

(7) inform the parties as to the availability of one or more alternative means of dispute resolution, and encourage use of such methods;

(8) require the attendance at any conference held pursuant to paragraph (6) of at least one representative of each party who has authority to negotiate concerning resolution of issues in controversy;

(9) dispose of procedural requests or similar matters;

(10) make or recommend decisions in accordance with section 557 of this title; and

(11) take other action authorized by agency rule consistent with this subchapter.

(d) Except as otherwise provided by statute, the proponent of a rule or order has the burden of proof. Any oral or documentary evidence may be received, but the agency as a matter of policy shall provide for the exclusion of irrelevant, immaterial, or unduly repetitious evidence. A sanction may not be imposed or rule or order issued except on consideration of the whole record or those parts thereof cited by a party and supported by and in accordance with the reliable, probative, and substantial evidence. The agency may, to the extent consistent with the interests of justice and the policy of the underlying statutes administered by the agency, consider a violation of section 557(d) of this title sufficient grounds for a decision adverse to a party who has knowingly committed such violation or knowingly caused such violation to occur. A party is entitled to present his case or defense by oral or documentary evidence, to submit rebuttal evidence, and to conduct such cross-examination as may be required for a full and true disclosure of the facts. In rule making or determining claims for money or benefits or applications for initial licenses an agency may, when a party will not be prejudiced thereby, adopt procedures for the submission of all or part of the evidence in written form.

(e) The transcript of testimony and exhibits, together with all papers and requests filed in the proceeding, constitutes the exclusive record for decision in accordance with section 557 of this title and, on

payment of lawfully prescribed costs, shall be made available to the parties. When an agency decision rests on official notice of a material fact not appearing in the evidence in the record, a party is entitled, on timely request, to an opportunity to show the contrary.

Appendix F

5 U.S.C. § 706

To the extent necessary to decision and when presented, the reviewing court shall decide all relevant questions of law, interpret constitutional and statutory provisions, and determine the meaning or applicability of the terms of an agency action. The reviewing court shall-

(1) compel agency action unlawfully withheld or unreasonably delayed; and

(2) hold unlawful and set aside agency action, findings, and conclusions found to be-

(A) arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law;

(B) contrary to constitutional right, power, privilege, or immunity;

(C) in excess of statutory jurisdiction, authority, or limitations, or short of statutory right;

(D) without observance of procedure required by law;

(E) unsupported by substantial evidence in a case subject to sections 556 and 557 of this title or otherwise reviewed on the record of an agency hearing provided by statute; or

(F) unwarranted by the facts to the extent that the facts are subject to trial de novo by the reviewing court.

In making the foregoing determinations, the court shall review the whole record or those parts of it cited by a party, and due account shall be taken of the rule of prejudicial error.

Appendix F

35 U.S.C. § 144

The United States Court of Appeals for the Federal Circuit shall review the decision from which an appeal is taken on the record before the Patent and Trademark Office. Upon its determination the court shall issue to the Director its mandate and opinion, which shall be entered of record in the Patent and Trademark Office and shall govern the further proceedings in the case.