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Paper 39
Date: September 10, 2021

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SATCO PRODUCTS, INC.,
Petitioner,

v.

SEOUL VIOSYS CO., LTD.,

IPR2020-00608
Patent 9,343,631 B2

Before ERICA A. FRANKLIN, JEFFREY W. ABRAHAM, and ELIZABETH M. ROESEL, *Administrative Patent Judges.*

FRANKLIN, *Administrative Patent Judge*.

DECISION
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 314

I. INTRODUCTION

This is a Final Written Decision in an *inter partes* review of claims 1, 5, 7, 8 and 13–15 ("the challenged claims") of U.S. Patent No. 9,343,631 B2 (Ex. 1001, "the '631 patent"). We have jurisdiction under 35 U.S.C. § 6, and enter this Decision pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons set forth below, we determine that Satco Products, Inc. ("Petitioner") has shown, by a preponderance of the evidence, that all of the challenged claims are unpatentable. *See* 35 U.S.C. § 316(e).

Additionally, we deny Petitioner's Motion to Exclude Evidence.

A. Procedural History

Petitioner filed a Petition requesting an *inter partes* review of claims 1, 5, 7, 8 and 13–15 of the '631 patent. Paper 1 ("Petition" or "Pet."). Petitioner supported the Petition with the Declaration of Russell D. Dupuis, Ph.D. (Ex. 1002).

Seoul Viosys Co., Ltd. ("Patent Owner") filed a Preliminary Response to the Petition. Paper 6 ("Prelim. Resp."). Patent Owner relied on the Declaration of Daniel Feezell, Ph.D. (Ex. 2001).

On September 16, 2020, pursuant to 35 U.S.C. § 314(a), we instituted trial to determine whether any challenged claim of the '631 patent is unpatentable based on the three obviousness grounds raised in the Petition. Paper 8 ("Inst. Dec."). The following table sets forth those grounds asserted for the challenged claims: [1]

[1] The Leahy-Smith America Invents Act ("AIA"), Pub. L. No. 112-29, 125 Stat. 284, 287–88 (2011), amended 35 U.S.C. § 103, effective March 16, 2013. Because the application from which the '631 patent issued has an effective filing date prior to March 16, 2013, the pre-AIA version of § 103 applies.

Claims Challenged	35 U.S.C. §	Reference(s)
1, 5, 13–15	103(a)	Zhao[2], Garbuzov[3]
7	103(a)	Zhao, Garbuzov, Niu[4]
8	103(a)	Zhao, Garbuzov, Slater[5]

Patent Owner filed a Patent Owner Response to the Petition. Paper 20 ("PO Resp."). Patent Owner supported the Patent Owner Response with a second Declaration of Dr. Feezell. Ex. 2013. Petitioner filed a Reply to the Patent Owner Response. Paper 24 ("Pet. Reply"). Patent Owner filed a Sur-reply to Petitioner's Reply. Paper 30 ("PO Sur-reply").

Petitioner filed a Motion to Exclude Evidence. Paper 34 ("Mot."). Patent Owner filed an Opposition to the motion. Paper 35 ("Mot. Opp."). Petitioner filed a Reply in support of the motion. Paper 36 ("Mot. Reply").

On June 17, 2021, the parties presented arguments at an oral hearing. Paper 33. The hearing transcript has been entered in the record. Paper 38 ("Tr.").

B. Real Parties-in-Interest

Petitioner identifies Satco Products, Inc. as the real party-in-interest. Pet. 61. Patent Owner identifies Seoul Viosys Co., Ltd. as the real party-in-interest. Paper 3, 1.

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[2] Zhao et al., *Efficiency Enhancement of InGaN/GaN Light-Emitting Diodes with a Back-Surface Distributed Bragg Reflector*, 32 (12) J. ELECTRONIC MATERIALS 1523-1526 (2003) ("Zhao," Ex. 1036).
[3] Garbuzov et al., US 6,404,125 B1, issued Jun. 11, 2002 ("Garbuzov," Ex. 1038).
[4] Niu et al., *Enhancing the Light Extraction Efficiency of GaN-based LEDs*, 6828 LIGHT-EMITTING DIODE MATERIALS AND DEVICES II: PROCEEDINGS OF SPIE 682811-1–11 (2007) ("Niu," Ex. 1035).
[5] Slater et al., US 6,791,119 B2, issued Sep. 14, 2004 ("Slater," Ex. 1039).

C. Related Proceedings

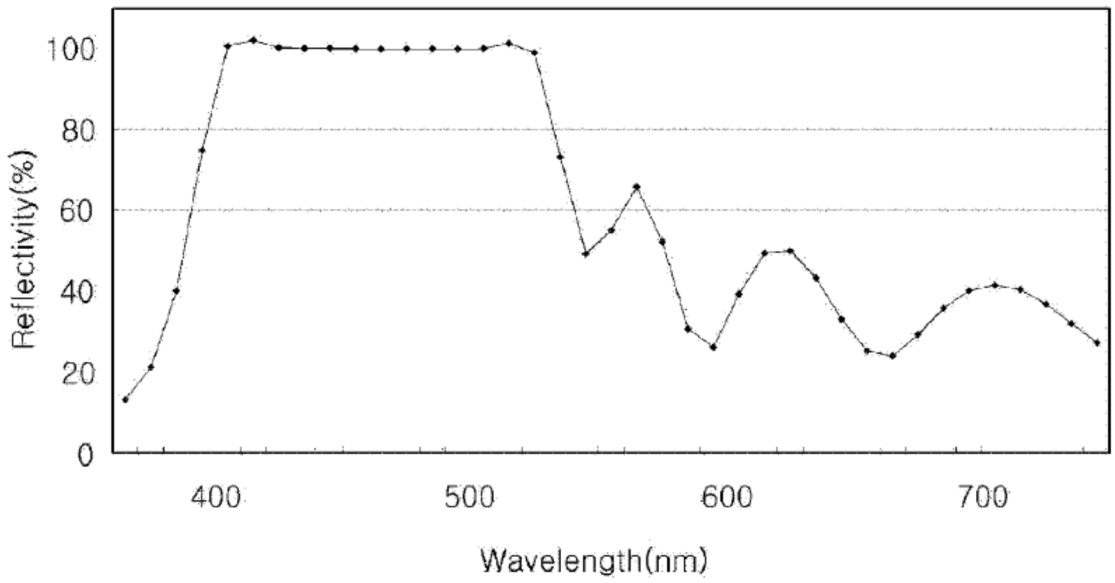
Petitioner and Patent Owner provide notice of a district court litigation involving the '631 patent: *Seoul Semiconductor Co., Ltd. v. Satco Products, Inc.*, No. 2:19-cv-04951 (EDNY). Pet. 61; Paper 3, 1. Patent Owner also notes that the '631 patent is among other patents asserted in *Seoul Semiconductor Co. Ltd., Seoul Viosys Co., Ltd. v. Fry's Electronics, Inc.*, No. 2-18-cv-00386 (EDTX). Paper 3, 1.

D. The '631 Patent

The '631 patent relates to a light emitting diode ("LED") chip having a distributed Bragg reflector ("DBR") and a method of fabricating the same. Ex. 1001, 1:24–27. The Specification explains that a gallium nitride-based LED chip that emits blue or ultraviolet wavelength light may be used for various applications, including LED packages that emit mixed color light. For example such LED packages may emit white light for a backlit unit or for general lighting. *Id.* at 1:29–34. The light output from the LED package may depend on the light emission efficiency of the LED chip. *Id.* at 1:35–36.

Attempts have been made to improve the light extraction efficiency of the LED chip, such as forming a metal reflector or a DBR on a bottom surface of a transparent substrate. *Id.* at 1:39–44. An example of such an attempt is characterized in Figure 2 of the '631 patent, set forth below.

FIG. 2



Prior Art

Figure 2 is a graph showing the reflectivity of a DBR reflector formed on the bottom surface of a sapphire substrate of an LED chip emitting light having a peak wavelength of 460 nm. *Id.* at 1:54–59, 3:3–4. As shown in Figure 2, reflectivity in the LED using the DBR may reach approximately 100% in a blue wavelength range, e.g., a wavelength of 400 to 500 nm. *Id.* at 1:59–62. The Specification explains that the DBR, however, can only increase the reflectivity for a part of the visible range. *Id.* at 1:63–64. As a result,

> when mounting the light emitting diode chip using the DBR in a [LED] package to emit white light, the DBR shows high reflectivity for the light of the blue wavelength range emitted from the [LED] chip but the DBR does not show efficient reflection characteristics for light emitted in the green and/or red wavelength ranges. Therefore, there is a limit in improving the light emission efficiency of the [LED] package.

Id. at 2:3–10. According to the Specification, "[e]xemplary embodiments of the present invention provide a [LED] chip capable of increasing the light

emission efficiency of [LED] package implementing a mixed color light, for example, white light," and a "DBR having high reflectivity over a wide wavelength range and a [LED] chip having the same." *Id.* at 2:14–22. For example, Figure 6, set forth below, illustrates an embodiment of the invention.

FIG. 6

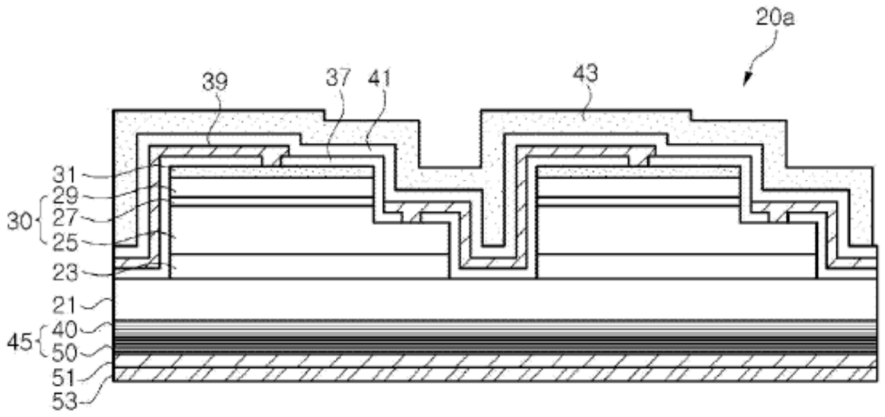


Figure 6 is a cross-sectional view showing LED chip 20*a* having a plurality of light emitting cells 30 on an upper surface of substrate 21. *Id.* at 8:1–6. The light emitting structure includes a first conductive-type semiconductor layer 25, a second conductive-type semiconductor layer 29, and an active layer 27 positioned between those layers. *Id.* at 4:12–16. A phosphor layer 43, positioned on LED chip 20*a*, converts the wavelength of light emitted from the light emitting cells 30. *Id.* at 9:42–47. The LED chip has, positioned on the lower surface of substrate 21, DBR assembly 45, comprising first DBR 40 having high reflectivity for visible light of a relatively long wavelength stacked with second DBR 50 having high reflectivity for visible light of a relatively short wavelength. *Id.* at 4:58–5:3, 5:58–66, 7:42–67, 8:7–12. The Specification explains,

> as compared to the case where the second [DBR] 50 is disposed to be closer to the substrate 21 than the first [DBR] 40, the light

> loss in the [DBR] 45 may be further reduced in the case where the first [DBR] 40 is disposed to be closer to the substrate than the second [DBR] 50.

Id. at 6:15–21.

E. Illustrative Claim

Petitioner challenges independent claim 1 and dependent claims 5, 7, 8 and 13–15 of the '631 patent. Independent claim 1, set forth below, is illustrative.

> 1. A light-emitting diode chip configured to emit light of a first wavelength range and light of a second wavelength range, comprising:
> a substrate;
> a light-emitting structure disposed on a first surface of the substrate, the light-emitting structure comprising an active layer disposed between a first conductivity-type semiconductor layer and a second conductivity-type semiconductor layer, and configured to emit light of the first wavelength range;
> first and second distributed Bragg reflectors (DBRs) disposed on a second surface of the substrate; and
> a phosphor disposed on the light-emitting structure,
> wherein:
> the first DBR is disposed closer to the substrate than the second DBR;
> the first wavelength range comprises a blue wavelength range;
> light of the second wavelength range is converted by the phosphor;
> the first DBR comprises a higher reflectivity for light of the second wavelength range than for light of the first wavelength range; and
> the second DBR comprises a higher reflectivity for light of the first wavelength range than for light of the second wavelength range.

Ex. 1001, 14:12–37.

II. PATENTABILITY ANALYSIS

A. Principles of Law

To prevail in its challenges to the patentability of all claims of the '631 patent, Petitioner must demonstrate by a preponderance of the evidence that the claims are unpatentable. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d) (2019). "In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable." *Harmonic Inc. v. Avid. Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016); *see also* 35 U.S.C. § 312(a)(3) (2012) (requiring *inter partes* review petitions to identify "with particularity . . . the evidence that supports the grounds for the challenge to each claim"). That burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015); *see also In re Magnum Oil Tools Int'l, Ltd.*, 829 F.3d 1364, 1375–78 (Fed. Cir. 2016) (discussing the burden of proof in *inter partes* review).

A claim is unpatentable for obviousness if, to one of ordinary skill in the pertinent art, "the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made." 35 U.S.C. § 103(a) (2006); *see also KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). "If a person of ordinary skill in the art can implement a predictable variation, § 103 likely bars its patentability." *Id.* at 417.

The question of obviousness is resolved on the basis of underlying factual determinations including the scope and content of the prior art, any differences between the claimed subject matter and the prior art, the level of ordinary skill in the art, and objective evidence of nonobviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). "An obviousness

determination requires finding both 'that a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention, and that the skilled artisan would have had a reasonable expectation of success in doing so.'" *CRFD Research, Inc. v. Matal*, 876 F.3d 1330, 1340 (Fed. Cir. 2017) (quoting *Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1367–1368 (Fed. Cir. 2016)).

We analyze Petitioner's asserted grounds of unpatentability in accordance with the above-stated principles.

B. Person of Ordinary Skill in the Art

The level of skill in the art is a factual determination that provides a primary guarantee of objectivity in an obviousness analysis. *Al-Site Corp. v. VSI Int'l Inc.*, 174 F.3d 1308, 1324 (Fed. Cir. 1999) (citing *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966); *Ryko Mfg. Co. v. Nu-Star, Inc.*, 950 F.2d 714, 718 (Fed. Cir. 1991)).

Petitioner asserts that a person of ordinary skill in the art at the time of the invention would have had

> at least a master's degree in chemical engineering, materials engineering, electrical engineering, optics, or physics, or similar advanced postgraduate education in at least one of these areas, and two years of experience designing the structure and process for manufacturing light emitting diode chips and packaging for those chips.

Pet. 24 (citing Ex. 1002 ¶¶ 23–24; Ex. 1001, 1:24–27). Petitioner notes also that "[a] person with less education but more relevant practical experience, depending on the nature of that experience and degree of exposure to LED design and fabrication techniques, could also qualify as a person of ordinary skill in the field of the '631 patent." *Id.* at 24–25. In the Preliminary

Response, Patent Owner did not address Petitioner's description of the level of ordinary skill in the art or provide its own description.

At the institution stage, we preliminarily adopted Petitioner's definition. Inst. Dec. 8. Patent Owner did not address the level of ordinary skill in the art or provide its own description in its Response.

Accordingly, for this Decision we adopt the same definition, again recognizing that this level of ordinary skill in the art is reflected in the prior art of record. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (explaining that specific findings regarding ordinary skill level are not required "where the prior art itself reflects an appropriate level and a need for testimony is not shown" (quoting *Litton Indus. Prods., Inc. v. Solid State Sys. Corp*., 755 F.2d 158, 163 (Fed. Cir. 1985))).

We have reviewed the credentials of Petitioner's declarant, Dr. Dupuis, and Patent Owner's declarant, Dr. Feezell, and consider each of them to be qualified to provide their opinion on the level of skill in the art and the knowledge of a person of ordinary skill in the art at the time of the invention ("POSITA"). As discussed in the our Consolidated Trial Practice Guide,

> An expert witness must be qualified as an expert by knowledge, skill, experience, training, or education to testify in the form of an opinion. Fed. R. Evid. 702. There is, however, no requirement of a perfect match between the expert's experience and the relevant field. *SEB S.A. v. Montgomery Ward & Co.*, 594 F.3d 1360, 1373 (Fed. Cir. 2010). A person may not need to be a person of ordinary skill in the art in order to testify as an expert under Rule 702, but rather must be "qualified in the pertinent art." *Sundance, Inc. v. DeMonte Fabricating Ltd.*, 550 F.3d 1356, 1363–64 (Fed. Cir. 2008).

Patent Trial and Appeal Board Consolidated Trial Practice Guide November 2019 ("CTPG") (available at https://www.uspto.gov/sites/default/files/documents/tpgnov.pdf), 34.

C. Claim Construction

Having defined the ordinarily skilled artisan, we now turn to claim construction. The Board applies the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b). 37 C.F.R. § 42.100(b) (2021). Under that standard, claim terms "are generally given their ordinary and customary meaning" as understood by a person of ordinary skill in the art at the time of the invention. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc). "In determining the meaning of the disputed claim limitation, we look principally to the intrinsic evidence of record, examining the claim language itself, the written description, and the prosecution history, if in evidence." *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 469 F.3d 1005, 1014 (Fed. Cir. 2006) (citing *Phillips*, 415 F.3d at 1312–17). Extrinsic evidence is "less significant than the intrinsic record in determining 'the legally operative meaning of claim language.'" *Phillips*, 415 F.3d at 1317.

Petitioner asserts that the claim terms in the challenged claims should receive their plain and ordinary meanings and that no express constructions of the terms is needed. Pet. 25. In the Preliminary Response, Patent Owner agreed that no claim terms require construction. Prelim. Resp. 13. At the institution stage, we agreed with the parties and determined that express construction of claim terms was unnecessary for purposes of rendering an institution decision. Inst. Dec. 9.

In the Patent Owner Response, Patent Owner again confirms its position that "no construction is necessary for any term." *See* PO Resp. 5.

In view of the parties' positions, and our consideration of the issues, we determine that express construction of claim terms is unnecessary for purposes of deciding whether Petitioner has shown that the challenged claims are unpatentable over the cited art. *See Wellman, Inc. v. Eastman Chem. Co.*, 642 F.3d 1355, 1361 (Fed. Cir. 2011) ("[C]laim terms need only be construed 'to the extent necessary to resolve the controversy.'") (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc*., 200 F.3d 795, 803 (Fed. Cir. 1999)).

D. Obviousness over Zhao and Garbuzov

Petitioner asserts that claims 1, 5 and 13–15 are rendered obvious by the combined teachings of Zhao and Garbuzov. Pet. 30–54; Pet. Reply 1–26. Patent Owner disagrees. PO Resp. 1–85; PO Sur-reply 1–26.

1. Zhao

Zhao is a journal article describing the design and fabrication of a double DBR mirror deposited on the backside of an InGaN/GaN LED chip to increase external quantum efficiency for InGaN/GaN blue and green LEDs. Ex. 1036, 1523–1525.[6] Zhao explains that blue and green LEDs based on the InGaN/GaN material system are commercially available, but are "inherently inefficient because photons are generated through a spontaneous emission process and emit in all directions. A large fraction of light emitting downward toward the substrate and to the side does not contribute to useable light output." *Id.* at 1523. Zhao notes that "[f]or a blue or green multiple quantum well (MQW) InGaN/GaN LED, 99% of the emitted light lies within a bandwidth approximately 120-nm wide." *Id.*

[6] Our citation to the Petitioner's exhibits refers to the original page numbers of the exhibit and not those added by Petitioner.

at 1524. To maximize the redirection of all emitted photons upwards, Zhao describes combining two TiO_2/SiO_2 DBR stacks into a single DBR structure, wherein each stack is optimized for a different peak wavelength, i.e., 470 nm and 520 nm. *Id.* Zhao's Figure 2 is set forth below.

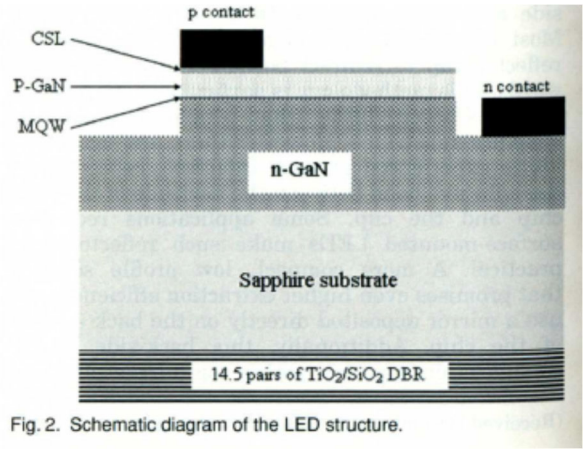


Fig. 2. Schematic diagram of the LED structure.

Zhao's Figure 2 is a schematic diagram of its fabricated LED structure. *Id.* at 1524. According to Zhao, the DBR-enhanced LEDs with wavelengths from 455 nm to 525 nm demonstrate a 65% improvement in emitted light intensity at the chip level for blue LEDs, with comparable enhancements in green LED emission. *Id.* at 1525–26.

2. Garbuzov

Garbuzov relates to methods and apparatus for performing wavelength-conversion using phosphors with LEDs. Ex. 1038, 1:13–16. Garbuzov explains that its apparatus comprises an active region, a phosphor layer, and a substrate. *Id.* at 1:44–45. "The active region is configured to emit light having a first band of wavelengths selected from a first group of wavelengths." *Id.* at 1:45–47. The phosphor layer includes a plurality of wavelength-converting phosphors and is "configured to convert the first band of wavelengths of light emitted from the active region to a second band

of wavelengths." *Id.* at 1:49–52. An embodiment of Garbuzov is depicted in Figure 6, set forth below.

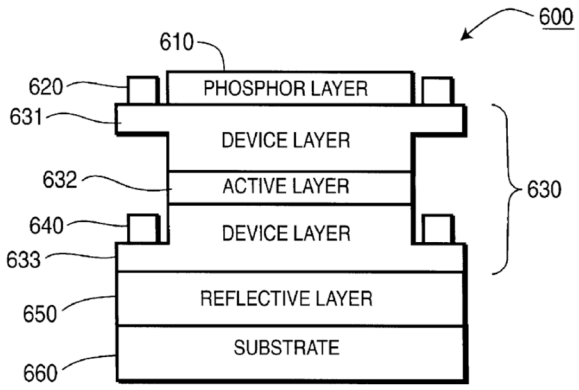


FIG. 6

Figure 6 illustrates a light-emitting device having a reflective layer according to an embodiment of Garbuzov. *Id.* at 8:34–35. Light-emitting device 600 includes, in particular, phosphor layer 610, active region 630, reflective layer 650, and substrate 660. *Id.* at 8:36–40. Garbuzov states that "[r]eflective layer 650 is configured to reflect light having the first band of wavelengths (e.g., light produced by active layer 632 of active region 630) and light having a second band of wavelengths (e.g., light produced through wavelength-conversion by phosphor layer 610)." *Id.* at 8:41–45.

3. Discussion

a) Independent Claim 1

Addressing claim 1 of the '631 patent, Petitioner asserts that Zhao teaches a commercial grade LED chip comprising a substrate, a light-emitting structure disposed on a first surface of the substrate and comprising an active layer disposed between a first conductivity-type semiconductor layer and a second conductivity-type semiconductor layer, wherein the light-emitting structure is configured to emit light of a first wavelength range. Pet. 30–33 (citing Ex. 1036, 1523–1525, and Fig. 2; Ex. 1002 ¶¶ 102–109).

Petitioner asserts that Zhao teaches a first wavelength range comprising a blue wavelength range because Zhao discloses the light generated by its LEDs "lies within a bandwidth of approximately 120-nm wide," refers to its LEDs as "blue and green LEDs," and provides two examples of an LED with a blue wavelength range, Samples A and B, in Table 1. *Id.* at 30–31, 39 (citing Ex. 1036, 1524, 1525, Table 1; Ex. 1002 ¶ 119).

Regarding the second wavelength range recited in claim 1, Petitioner asserts, in one iteration of its argument, that Zhao's disclosure of a spectral range of 120 nm also teaches that its LEDs generate light in a second wavelength range comprising a green wavelength range. Pet. 30. According to Petitioner, a person having ordinary skill in the art would have understood that a spectral range of 120 nm encompasses multiple wavelength ranges, including a first blue wavelength range around 450 nm, and a second green wavelength range around 550 nm. *Id.* at 30–31.

In an alternative argument, Petitioner considers claim 1 to require that the second wavelength range is a phosphor-converted wavelength range. Pet. 31. To reach that requirement, Petitioner relies on the combination of Zhao and Garbuzov. Pet. 31, 34–35, 41–44. Petitioner asserts that "the use of phosphors in LED design to convert light of a second wavelength range based on light of a first wavelength range was well-known" in the art. *Id.* at 35. As an example, Petitioner relies upon Garbuzov as teaching the use of "a wavelength-converting phosphor to convert light emitted from the active region into another, longer wavelength of light." *Id.* (citing Ex. 1038, Abstract, 2:18–23, 2:60–67, 3:27–33, 8:34–53). Petitioner asserts that "Garbuzov provides a variety of phosphors that may be disposed on the light emitting structures to convert light of various wavelengths ranging from 400 nm to 610 nm." *Id.* (citing Ex. 1038, 3:1-20). According to Petitioner,

adding such a known element, i.e., phosphor layer, on the device layers of Zhao's LED device would have been obvious to a skilled artisan because the use of phosphors to convert blue light LEDs into other wavelengths, including green, red, and yellow, had been done in the art, as evidenced by Garbuzov. *Id.* at 41 (citing Ex. 1002 ¶ 134; Ex. 1038, 1:35–41, 3:1–20).

Further, Petitioner contends that modifying Zhao's blue-light LED was a predictable variation of Zhao that would have led to predictable results, because: (a) Garbuzov was directed to blue InGaN/GaN LEDs similar to those in Zhao, and (b) Garbuzov taught that depositing phosphors on such an LED chip could convert some blue light into light of another wavelength. Pet. 41. According to Petitioner, that modification amounts to no more than the use of a known manner of improving one device to improve a similar device in a similar way, which was within the skill in the art to do. *Id.* at 43 (citing *KSR*, 550 U.S. at 417; Ex. 1002 ¶¶ 138–139).

For the DBR recitations in claim 1, Petitioner begins by asserting that Zhao teaches that its LED chip has disposed on a second surface of its substrate first and second DBRs, i.e., a "double quarter-wave stack design composed of TiO_2 and SiO_2 layers." Pet. 33–34 (citing Ex. 1036, 1523–1524, and Fig. 2; Ex. 1002 ¶¶ 110–112). Petitioner asserts also that Zhao teaches that the first DBR has a peak reflectivity at 470 nm, i.e., in a blue wavelength range, and the second DBR has a peak reflectivity at 520 nm, i.e., in a green wavelength range. *Id.* at 36 (citing Ex. 1036, 1524; Ex. 1002 ¶ 116). According to Petitioner, those disclosures provide one DBR having a higher reflectivity for the light of a second wavelength range than the light of the first wavelength range, and another DBR having a higher reflectivity for the light of the first wavelength range than for the light of the second wavelength range. *Id.*

As for the recited DBR arrangement in claim 1, Petitioner recognizes that Zhao does not expressly teach that "the first DBR is disposed closer to the substrate than the second DBR," as recited in claim 1. Pet. 37. Petitioner asserts, however, the claimed positioning of the first and second DBRs in relation to the substrate "would have been a predictable variation of Zhao's implementation of a tandem backside DBR structure." *Id.* at 44.[7] According to Petitioner, a skilled artisan would have understood that there were a finite number of predictable ways to implement Zhao's tandem back-surface DBRs. Specifically, Petitioner asserts that there would only be two possible arrangements of the two DBRs stacks disclosed by Zhao, either arrangement would have been obvious, and that swapping or rearranging the order was well within the technical grasp of the artisan. *Id.* at 46 (citing Ex. 1002 ¶¶ 131, 137).

Further, referring to *In re Japiske*, 181 F.2d, 1019, 1023 (C.C.P.A. 1950), Petitioner asserts that "rearrangement of prior art components does not render a claim nonobvious where the new arrangement does not modify the operation of the device." *Id.* at 44. According to Petitioner, "[h]ere, regardless of the arrangement of the DBRs, the operation within the claimed LED is not materially different." *Id.* In support of that position, Petitioner asserts that a skilled artisan would have known of simulation software that could simulate the performance of optical thin-film devices, including

[7] We understand Petitioner's sentence on page 44 of the Petition stating that "positioning the second DBR closer to the substrate than the first DBR also would have been obvious" inadvertently refers to the second DBR as being closer to the substrate, rather than the first DBR being closer to the substrate, as required by claim 1. *See* Pet. 44. It also appears that Petitioner mistakenly refers to Ex. 1002 ¶ 39 instead of Ex. 1002 ¶ 36 in support of that assertion. *See id.*

DBRs. *Id.* (citing Ex. 1002 ¶¶ 59, 121–130, 136–137; Ex. 1036, 1524). According to Petitioner, a skilled artisan would have been able to use such software to determine that the order of Zhao's DBR stacks with respect to the substrate had "virtually no difference in performance over wavelength range 380nm-780nm." *Id.* at 44–45 (citing Ex. 1002 ¶ 137). Petitioner asserts that the literature suggests the same finding. *Id.* at 45 (citing Ex. 1028,[8] 382); *see also id.* at 18 (citing Ex. 1028, 382) ("For stacks of the reverse sequence where the thinnest pair is on the substrate, almost the same reflective spectra are obtained."). Petitioner contends that Dr. Dupuis modeled the performance of Zhao's DBRs using that type of software and "concluded that inverting the DBRs of Zhao 'has no significant effect on the DBR performance at 0°, 30°, and 50°.'" *Id.* at 45 (citing Ex. 1002 ¶¶ 128, 131).

Patent Owner does not challenge Petitioner's assertions that Zhao teaches or suggests a LED chip configured to emit light of a blue wavelength range comprising a substrate, a light-emitting structure disposed on a first surface of the substrate, wherein the light-emitting structure comprises an active layer disposed between two conductivity-type semiconductor layers, and is configured to emit light of the blue wavelength range. *See* generally PO Resp. 10–13. Nor does Patent Owner challenge Petitioner's assertion that Zhao's LED comprises first and second DBRs disposed on a second surface of the substrate. *Id.*

Patent Owner asserts, however, that Petitioner has not shown that Zhao's LEDs emit light of both a first (blue) and second (green) wavelength

[8] Saka et al., *Bragg Reflector of GaAlAs/AlAs Layers with Wide Bandwidth Applicable to Light Emitting Diodes*, 73(1) J. APPL. PHYS. 380–383 (1993).

range. PO Resp. 77–83. Patent Owner also challenges Petitioner's combination of Zhao and Garbuzov, asserting that Petitioner has not provided sufficient motivation for modifying Zhao's LED to include Garbuzov's phosphor and a "matching" DBR. *Id.* at 20–42, 84–85. Additionally, Patent Owner asserts that Petitioner has not demonstrated persuasively that a skilled artisan would have had any motivation to arrange Zhao's DBR layers in the manner recited by claim 1. *Id.* at 42–77. Thus, we focus our attention in the following discussion on those disputes.

(1) Zhao's Disclosure of Light Emission

As noted above, Petitioner asserts, in one iteration of its argument, that Zhao discloses the claim limitation requiring the LED chip "to emit light of a first wavelength range and light of a second wavelength range" by describing an LED chip configured to emit both blue and green light, i.e., light of first and second wavelength ranges. Pet. 30–31. Patent Owner disagrees by asserting that Zhao does not describe a single LED that emits light at both blue and green wavelength ranges, or any multi-colored LED. PO Resp. 77. Rather, according to Patent Owner, Zhao is directed to LEDs that output either a blue or a green light. *Id.* at 78; Ex. 2001 ¶¶ 38–42.

Petitioner does not respond to Patent Owner's argument in the Reply or to our preliminary finding in the Institution Decision, Inst. Dec. 16, that Zhao does not disclose any LED emitting light at both a first and a second wavelength range.

Having considered the record as a whole, we agree with Patent Owner that Zhao does not disclose or describe an LED that additionally emits light at a second wavelength range, as claimed. As Patent Owner notes, Zhao discusses and exemplifies blue or green LEDs and does not mention or suggest LEDs that emit light at more than a single wavelength range. PO

Resp. 77–78 (citing Ex. 1036, 1523–1525; Ex. 2001 ¶¶ 38–42). Further, consistent with Patent Owner's arguments, we understand Zhao's teaching of a 120-nm wide emission bandwidth for its LEDs (Ex. 1036, 1524) refers to an emission spectrum having a single peak wavelength and a single wavelength range, not first and second wavelength ranges, as claimed. In particular, Zhao explains that 99% of the emitted light lies within this bandwidth and that "there can be a 20-nm variation in the peak emission wavelength" depending on how the LED is fabricated. *Id.*

(2) Combining Garbuzov's Phosphor with Zhao's LED

As set forth above, Petitioner alternatively argues in the Petition that the combination of Zhao and Garbuzov provides an LED chip that emits light of a first wavelength range and light of a second wavelength range. In this alternative argument, Petitioner proposes a modification of Zhao's LED chip to include a phosphor layer configured to convert a first band of wavelengths of light emitted to a second band of wavelengths, i.e., to emit light of a second wavelength, as taught by Garbuzov. Pet. 31, 35–36, 41–44. Petitioner also relies on that modification to reach the claim limitation reciting a "phosphor disposed on the light-emitting structure," wherein "light of the second wavelength range is converted by the phosphor." *See id.*

Patent Owner challenges Petitioner's proposed combination of Zhao and Garbuzov for a number of reasons. Patent Owner's arguments are largely premised upon its contention that Petitioner's modification of Zhao with a phosphor, as taught by Garbuzov, must be compatible with Zhao's disclosure of only two DBRs, wherein one is optimized for maximum reflection at 470 nm, while the other DBR has a peak reflectance at 520 nm. PO Resp. 18–19 (citing Ex. 1036, 1524). Patent Owner asserts that because Zhao discloses only those two DBRs, wherein one is tuned for blue and the

other is tuned for green, "[t]here is no room in Zhao's disclosure for any other allegation than the 'second wavelength range' is green."[9] *Id.* at 19. Further, Patent Owner notes that "[t]he Petition clearly identifies Zhao's green wavelength range as the claimed 'second wavelength range' for the first DBR." *Id.* (citing Pet. 33–34, 36). Patent Owner asserts that because Petitioner relies on the "second wavelength range" being green for the first DBR claim limitation, then it cannot rely on a different color range, e.g., red or yellow, for the phosphor-converted "second wavelength range" limitation. *Id.* at 19. However, according to Patent Owner, the Petition fails to present a rationale for why a skilled artisan would have added a "green-converting phosphor" to Zhao. *Id.* at 2, 21–28.[10]

Further, Patent Owner asserts that neither Zhao nor Garbuzov provides any motivation to add a green-converting phosphor to Zhao's LED. PO Resp. 21–34. For example, Patent Owner contends that if a person of ordinary skill in the art looking at Zhao wanted a green LED, the artisan would have simply used the green active layer, provided by Zhao. *Id.* at 24. Patent Owner asserts also that Garbuzov suggests that a phosphor is not needed if an active layer provides the desired color. *Id.* at 25 (citing Ex. 1038, 7:25–35; Ex. 2013 ¶ 55). Additionally, Patent Owner asserts that a skilled artisan would not have been motivated to combine Garbuzov's green-converting phosphor with Zhao's LED for reasons such as: (a) Garbuzov's green phosphor is designed to work in the ultraviolet to lower end of the

[9] Petitioner's position is that Zhao's blue wavelength range at around 455 nm represents the recited "first wavelength range." Pet. 33.
[10] We understand Patent Owner's reference to "green-converting phosphor" as describing a phosphor that converts ultraviolet (UV) and shorter wavelengths of blue light to green light. *See* PO Resp. 25 (describing Garbuzov's green-converting phosphor).

blue-light spectrum and not the 454 nm to 473 nm wavelength region taught by Zhao, *id.* at 25–26 (citing Ex. 1038, Table I; Ex. 2013 ¶ 58); (b) Garbuzov's green phosphor inefficiently converts only a fraction of light, *id.*; and (c) green would not be effectively realized because Zhao's DBR is blue-shifted such that it is "most efficient in the blue wavelength region," and Zhao's DBR exhibits "some loss of high-angle green photons," *id.* at 26 (quoting Zhao 1524–1525).[11]

In the Reply, Petitioner asserts that Patent Owner "improperly limits the Petition when it contends that the claimed 'first DBR' must be a green DBR," and "misinterpret[s] the Petition by limiting Petitioner's theory to a green second wavelength range." Pet. Reply 3–4. Petitioner notes that the Petition describes modifying Zhao by adding phosphors to Zhao's DBR and "ensuring that the DBRs were designed to reflect both light generated by the device layers and the phosphors . . . ." *Id.* at 4 (quoting Pet. 38). In support of that position, Petitioner also refers to portions of its Petition "explaining why adding phosphors and designing the DBRs 'with a peak reflectivity for the light generated by the semiconductor device (e.g., blue light) and the light emitted by the phosphor (e.g., red or yellow light)' would have been obvious." *Id.* (citing Pet. 40–44).

[11] Patent Owner also asserts that a skilled artisan "would not have been motivated to add [Garbuzov's] green-converting phosphor to provide a mixed blue/green light to provide a cyanish output" because this color range ***would not match*** the green color that the first DBR is optimized for and would, thus, "fail to meet the claims they [sic] require that the phosphor-converted 'second wavelength range' must match the 'second wavelength range' that the 'first DBR' is tuned for." *Id.* at 27. Based upon our review, Patent Owner has not identified, nor do we see, any argument from Petitioner that involves providing a cyanish output color. *See id.*

Petitioner asserts also in the Reply that it "does not concede that adding a green-converting phosphor to an LED with a blue active region would have been nonobvious over Zhao in view of Garbuzov." *Id.* at 4 n.1. We view that issue differently. Because Petitioner has not substantively addressed Patent Owner's arguments and evidence that a person of skill in the art would not have been motivated to combine a green-converting phosphor with Zhao's LED, *see* PO Resp. 21–34, we determine that Petitioner has conceded that point. Accordingly, in view of Patent Owner's arguments and evidence, we find that Petitioner has failed to demonstrate sufficiently that a skilled artisan would have been motivated to combine a green-converting phosphor with Zhao's LED.

Insofar as Petitioner asserts that its challenge of claim 1 is not limited to combining green-converting phosphors, we agree. As recognized by Patent Owner, Petitioner describes the use of red, yellow, and orange phosphors in the Petition. *See* PO Resp. 2; Pet. 1, 6, 40. When describing its proposed modification of Zhao, Petitioner asserts that a person of ordinary skill "would have found the addition of phosphors to the active device layers of Zhao to be an obvious modification to allow Zhao's device to produce different colors of light, including, for example, white light." Pet. 40. Additionally, Petitioner asserts that "[p]hosphors had been added to blue light LEDs to convert that light into other wavelengths including green, red, and yellow." *Id.* at 41 (citing Ex. 1002 ¶ 134; Ex. 1038, 1:35–41, 3:1–20). In that regard, the Petition relies on Garbuzov as disclosing "a variety of phosphors that may be disposed on light emitting structures to convert light of various wavelengths ranging from 400 nm to 610 nm," *id.* at 35 (citing Ex. 1038, 3:1–20, Table 1), and teaching the placement of a phosphor layer on the device layers of blue LEDs, similar to the LEDs

disclosed in Zhao, *id.* at 41 (citing Ex. 1002 ¶ 134; Ex. 1038, 2:30–46, 1:25–30; 8:34–40).

Insofar as Petitioner asserts that its challenge of claim 1 is not limited to Zhao's DBR design comprising a green active layer, we again agree. In the Petition, Petitioner explains that its modification of Zhao includes not only adding a phosphor layer, but also modifying Zhao's stacked DBR configuration to "ensur[e] that at least one DBR was designed to reflect phosphor-converted light," which Petitioner contends would have been a predictable variation of Zhao. *Id.* at 42, *see also id.* at 40 (asserting that the skilled artisan "would have found it obvious to design a DBR structure in which the first and second DBRs were . . . designed with a peak reflectivity for the light generated by the semiconductor device (e.g., blue light) and the light emitted by the phosphor (e.g., red or yellow light).").

Thus, we next consider whether Petitioner has established that it would have been obvious to a person of ordinary skill in the art to make those two proposed modifications of Zhao. According to Patent Owner, Petitioner's proposed use of white, orange or yellow phosphors would have been "untenable with Petitioner's prior art combination" because Garbuzov does not teach the use of white, orange, or yellow phosphors. PO Resp. 39. Patent Owner acknowledges that Garbuzov teaches the use of red phosphors. *Id.* However, Patent Owner asserts that use of red phosphors in Petitioner's prior art combination also would have been untenable because doing so would require a red-reflecting DBR and Zhao does not teach a red-reflecting DBR. *Id.* Patent Owner contends that "Petitioner cannot satisfy its burden with a general premise that phosphors or (DBRs) existed, when the actual DBRs or phosphors advocated for have no explicit teaching in the prior art actually presented. *Id.* at 41 (citing 35 U.S.C. § 312 (a)(3)).

In the Reply, Petitioner asserts that Patent Owner's arguments improperly attack the prior art individually, rather than considering their combined teachings as presented in the Petition. Pet. Reply 5. In particular, Petitioner reiterates that its combination involves modifying Zhao's DBR structure such that it is "designed with a peak reflectivity for the light generated by the semiconductor device (e.g., blue light) and the light emitted by the phosphor (e.g., red or yellow light)." *Id.* at 5–6 (quoting Pet. 40). According to Petitioner, the obviousness of its proposed modification of Zhao in this manner stands unrebutted. *Id.* at 6 (citing Pet. 40–44).

In its Sur-reply, Patent Owner asserts that Petitioner has not provided any evidence that a person of ordinary skill in the art would have made any modifications to Zhao, beyond a conclusory opinion from its expert. PO Sur-reply 2. According to Patent Owner, "Petitioner must demonstrate, and articulate a compelling reason that a POSITA would have added a phosphor from Garbuzov that emits light at a specific wavelength—that Zhao's DBRs were designed to have a higher reflectivity for—to Zhao." *Id.* Patent Owner contends, "[t]o the extent that Petitioner attempts to provide a reasoned motivation, it provides nothing more than a thin veneer for the fact that Petitioner merely seeks to recreate the '631 Patent itself, without relying on the [sic] its own prior art." *Id.* In that respect, Patent Owner asserts that Petitioner's modification is based on impermissible hindsight bias. *Id.*

Based on our review of the record as a whole, we find that Petitioner has persuasively articulated sound reasoning for combining the teachings of Zhao and Garbuzov to provide a modified version of Zhao's LED that includes a red phosphor and a "matching" DBR layer designed to comprise a higher reflectivity for light converted by the phosphor, i.e., light of the second wavelength range. In particular, Petitioner demonstrates how

Garbuzov teaches adding phosphors to blue light LEDs to convert that light into other wavelengths. Pet. 41 (citing Ex. 1038, 1:35–41, 3:1–20; Ex. 1002 ¶ 134). In view of that teaching, we find that Petitioner reasonably asserts, and Dr. Russel credibly testifies, that a person of ordinary skill in the art would have been motivated to add a phosphor layer to Zhao's LED "to convert light from blue to some other wavelength such as red light," and that such an addition to Zhao's LED would have been a "predictable use of phosphor layers in semiconductor devices as disclosed by Garbuzov." *See* Pet. 42; Ex. 1002 ¶ 138; *see also* Pet. 43 (asserting that "the addition of a phosphor layer to an LED designed according to Zhao would have been nothing more than the use of a known improvement used to improve a similar device in similar ways," and "[a]pplying Garbuzov's teachings to Zhao's devices was nothing more than the common and well-understood use of phosphors in connection with blue-light LED devices to produce light of a different wavelength.").

We address Petitioner's modification of Zhao's DBR in the next sections.

(3) Tuning Zhao's DBR to Match the Added Phosphor

We next consider whether Petitioner has established that it would have been obvious to a person of ordinary skill in the art to modify Zhao's stacked DBR configuration to ensure "that at least one DBR was designed to reflect phosphor-converted light" and "the DBR stack could reflect both light from the phosphor and light from the semiconductor device using a stacked DBR configuration." Pet. 42. Patent Owner and Dr. Feezell challenge the combination of Garbuzov's red phosphor with Zhao's LED because Zhao does not explicitly teach or suggest tuning any of its DBRs to match the color of the phosphor-converted wavelength. *See, e.g.*, PO

Resp. 22, 39–42; Ex. 2013 ¶ 62. That challenge is not compelling, however, because Petitioner does not rely only on Zhao for that suggestion. Petitioner notes that Zhao discloses stacked DBRs, wherein one of the DBRs "has 'a higher reflectivity for light of the second wavelength range than for the light of the first wavelength range,' and another DBR that has a higher reflectivity for 'light of the first wavelength rang[e] than for light of the second wavelength range.'" Pet. 36 (citing Ex. 1036, 1524; Ex. 1002 ¶ 116). However, Petitioner then refers to Garbuzov's teaching the use of a reflector to reflect both light emitted by the semiconductor device and light emitted by a phosphor layer on the device. *Id.* at 37 (citing Ex. 1038, 8:34–53). Specifically, Garbuzov discloses,

> Reflective layer 650 is configured to reflect light having the first band of wavelengths (e.g., light produced by active layer 632 of active region 630) *and light having a second band of wavelengths (e.g., light produced through wavelength-conversion by phosphor layer 610)*. In other words, light produced by active layer 632 can propagate in the direction of reflective layer 650 and light produced through wavelength-conversion in phosphor layer 610 can also be propagated in the direction of reflective layer 650. Light having either of these bands of wavelengths are reflected by reflective layer 650 are redirected towards phosphor layer 610 where the light can ultimately exit light emitting 600.

Ex. 1038, 8:41–53 (emphasis added). From that teaching in Garbuzov, we find that Petitioner persuasively demonstrates why, in view of the prior art, a person of ordinary skill in the art would have had a reason to similarly configure Zhao's DBRs structure, "ensuring that at least one DBR was designed to reflect phosphor-converted light," and understanding that doing so would have been a predictable variation of Zhao. *See* Pet. 38–42; Ex. 1002 ¶¶ 134, 140. Because Patent Owner's arguments and Dr. Feezell's

testimony in this regard do not consider that Petitioner's proposed combination involves *designing* one of Zhao's DBRs to reflect the phosphor-converted light, i.e., to "match" the added phosphor, and that Garbuzov provides the suggestion to do so, we agree with Petitioner that those arguments are misdirected.

(4) Ordering Zhao's Modified DBR Stacks

Claim 1 requires that the first DBR is disposed closer to the substrate than the second DBR. We refer to this as the claimed "DBR ordering limitation." The first DBR in claim 1 "comprises a higher reflectivity for light of the second wavelength range," and the "light of the second wavelength range is converted by the phosphor." The second DBR in claim 1 "comprises a higher reflectivity for light of the first wavelength range" and the "first wavelength range comprises a blue wavelength range." In our analysis of Petitioner's combination, the first DBR is the one tuned to match the red phosphor added to Zhao's LED, and the second DBR is tuned to the blue color that the active layer emits. Thus, to read on the claimed DBR ordering limitation, Petitioner must demonstrate that it would have been obvious to a person of ordinary skill in the art to arrange Zhao's DBR stack such that the "red DBR" layer is disposed closer to the substrate than the "blue DBR" layer.

As noted above, Petitioner asserts and Dr. Dupuis testifies that the claimed positioning of the first and second DBRs in relation to the substrate would have been a predictable variation of Zhao's tandem DBR structure because a skilled artisan would have understood that there would only be two possible ways to stack the two DBRs, and that swapping or rearranging the order was within the skill of the artisan. *Id.* at 44, 46 (citing Ex. 1002 ¶¶ 131, 137). Additionally, as noted above, Petitioner relies on Dr. Dupuis'

testimony that inverting the DBRs of Zhao did not have a significant effect on the DBR performance. *Id.* at 45 (citing Ex. 1002 ¶¶ 128, 131).

Patent Owner challenges Petitioner's assertion that arranging Zhao's DBR layers in the manner recited by claim 1, such that the first DBR is disposed closer to the substrate than the second DBR, would have been obvious. PO Resp. 42–73. Specifically, Patent Owner contends that: (a) a skilled artisan would have understood Zhao's DBRs are arranged in the opposite manner as is recited in claim 1; (b) the claimed DBR arrangement matters and provides an unexpected and material benefit; (c) Petitioner's red-reflecting DBR is not taught in the prior art; and (d) Petitioner's evidence is demonstrably unreliable. *Id.* at 43. We consider those challenges, in turn.

To begin, Patent Owner asserts that a skilled artisan would have understood Zhao's DBRs are arranged in the opposite manner as is recited in claim 1 because Zhao refers to its blue-reflective DBR as the "first DBR stack." PO Resp. 44. According to Patent Owner and Dr. Feezell, a skilled artisan would have considered Zhao's use of the term "first DBR stack" as referencing the order of formation on the substrate and, thus, would have understood "Zhao's 'first DBR' (i.e., the blue-reflective DBR) to be the closest to the substrate." *Id.* (quoting Ex. 2013 ¶ 48). In further support of that position, Patent Owner refers to the deposition testimony of Petitioner's declarant, Dr. DuPuis. *Id.* When asked during his deposition why Zhao uses the term "first DBR stack," Dr. DuPuis responded, "I assume they mean it's the first set of layers they deposited on the back side of the sapphire substrate." Ex. 2014, 39:6–11. Accordingly, we determine that Patent Owner has persuasively demonstrated that a person of skill in the art would have understood that Zhao's blue-reflecting DBR stack is closer to the

substrate than its green-reflecting DBR stack. In any event, Petitioner does not allege that Zhao's DBRs are arranged as recited by claim 1. Rather, Petitioner asserts that because there are only two possible arrangements for the two DBRs in its modified DBR design, the recited order merely represents a predictable variation of the other. Pet. 44–46.

Patent Owner disagrees with Petitioner, asserting that "a POSITA would have thought that Zhao's arrangement with the blue-DBR on top would generally be advantageous and thus preferred" because "Zhao's DBRs are made of alternatively stacked SiO_2 and TiO_2 layers . . . and TiO_2 has a higher extinction coefficient for shorter wavelength lights (and absorbs more light) than it does for longer wavelengths." PO Resp. 45–46 (citing Ex. 2013 ¶¶ 36–40). Patent Owner asserts that "[u]nder this design in Zhao, TiO_2 will absorb more blue light than it will absorb green or red light." *Id.* at 46. Patent Owner asserts that a skilled artisan "would have also understood scattering to be more pronounced for shorter wavelength light," and that "typically, having a blue DBR on top would result in less scattering." *Id.* at 48 (citing Ex. 2013 ¶¶ 36, 40).

Although Dr. Feezell testifies that "the extinction coefficient and scattering . . . confirms that a POSITA would have expected the blue-reflective DBR on top of the green-reflective DBR to be preferable (and expected) in view of Zhao," *see* Ex. 2013 ¶¶ 34–43, 50, he then clarifies and qualifies that testimony a number of times. For example, in his declaration, Dr. Feezell clarifies that consideration of the DBR's extinction coefficient and scattering being higher for blue only means that "[a] *starting point* position for a POSITA would be to put a blue DBR first." *Id.* ¶ 42 (emphasis added). According to Dr. Feezell, "particular design considerations, considering particular materials and *designs may result in*

different configurations." *Id.* (emphasis added). Further he describes the blue DBR on top in Zhao as being "the supposed optimal DBR configuration," and confirms that "optimal DBR ordering depends on materials used." *Id.* ¶ 43. Additionally, during his deposition, Dr. Feezell admitted that "in a vacuum given no other tools that I would likely select putting the blue DBR before the green DBR for these reasons," but that initial selection may change based on additional considerations such as light source and materials involved. *See* Ex. 1048, 78:4–79:21.

Based on the foregoing, we find that Dr. Feezell's testimony recognizes not only that there are options for layering the DBR stacks, but also that either of those layering options may be selected by a skilled artisan as the optimal arrangement, depending on the circumstances.

Although Dr. Feezell's testimony addresses the order of a blue DBR and a green DBR, Petitioner's proposed modification of Zhao's LED includes a phosphor layer and a matching DBR layer, which could be a red or yellow DBR. Pet. 40–44. However, we do not see that Dr. Feezell has addressed or accounted for those modifications in his testimony that the blue DBR would be positioned closer to the substrate. In any event, we agree with Petitioner that Dr. Feezell's testimony supports finding that, based on known variables, such as the spectrum of the light source and the DBR materials used, "an optimal design might cause the DBR ordering to be flipped." Pet. Reply 2 (citing Ex. 1048, 79:6–21). In other words, a skilled artisan would have understood that the "optimal configuration" of the DBR order is a function of certain design choices involved. Accordingly, based on the evidence as a whole, we agree with Petitioner that choosing the best or optimal order for the DBRs for a particular application would have been routine and predictable. Pet. 44; Pet. Reply 2, 20.

We are not persuaded otherwise upon considering the simulations discussed by Petitioner and Patent Owner. Petitioner and Patent Owner each submit expert testimony describing simulations modeling the performance of Zhao's DBRs using software such as the TFCalc software mentioned in Zhao. *See* Ex. 1036, 1524; Ex. 1002 ¶¶ 122–137; Ex. 2013 ¶¶ 19–34. Petitioner asserts that a person of skill in the art would have known that such simulation software existed "for simulating the performance of optical thin-film devices such as filters and reflectors, including DBRs." Pet. 44 (citing Ex. 1002 ¶¶ 59, 121–130, 136–137; Ex. 1036, 1524). Petitioner asserts also that by "[u]sing such software, a [POSITA] would have easily been able to determine that the order of the DBR stacks with respect to the substrate had produced 'virtually no difference in performance over [the] wavelength range 380nm-780nm.'" *Id.* at 44–45.

In support of those assertions, Petitioner relies on the testimony of Dr. Dupuis. *Id.* (citing Ex. 1002 ¶ 137). Dr. Dupuis used a thin-film modeling application from Filmetrics to perform his evaluations of Zhao's DBRs to determine if their ordering had any material impact on the operation or performance of Zhao's LED. Ex. 1002 ¶¶ 121, 122. In particular, Dr. Dupuis modeled the dual-mirror structure described in Zhao using the optical properties of TiO_2, SiO_2, and polyacrylate from the Filmetrics website. *Id.* ¶ 125. He performed modeling for angles of incidence of 0°, 30°, and 50°. *Id.* Using the output from the Filmetrics database, Dr. Dupuis created "plots of the performance of Zhao's dual-DBR structure when the blue DBR is closer to the substrate and when the blue DBR is further from the substrate." *Id.* (citing Ex. 1002, App'x B). Based upon those results, Dr. Dupuis testified that the performance of the two filter layers is materially the same. *Id.* ¶¶ 126, 128, 129.

Dr. Dupuis explains that "[s]imulations such as these were well within the skill level of someone of ordinary skill in the art as of November 2009, and would have been a tool available to the POSITA when designing a system according to the teachings of Zhao." *Id.* ¶ 131. According to Dr. Dupuis, his simulations demonstrate that a person of ordinary skill in the art "would [have] seen that the order of the DBR stacks with respect to the substrate produced virtually no difference in performance over the wavelength range 380nm-780nm." *Id.* ¶ 137. Dr. Dupuis explains that "[s]wapping the order of the DBRs certainly was an option that a POSITA had available and could have easily done; it was a relatively simple and obvious experiment to both simulate and to perform experimentally." *Id.*

Patent Owner challenges Dr. Dupuis' DBR simulations asserting that they "bear no resemblance to Zhao and are unreliable." PO Resp. 55. In particular, Patent Owner asserts that Dr. Dupuis' simulations assumed zero light scattering and loss. *Id.* Patent Owner asserts that light loss and scattering are a "material property of a DBR that must be considered." *Id.* Patent Owner also takes issue with assumptions Dr. Dupuis made regarding Zhao's indices of refraction and the epoxy used by Zhao. *Id.* at 57 (citing Ex. 2001 ¶ 67; Ex. 1002 ¶¶ 123, 124). Patent Owner also criticizes Dr. Dupuis for not giving consideration to the DBR thicknesses in different embodiments of Zhao. *Id.* (citing Ex. 1002 ¶¶ 121–131).

Additionally, Patent Owner questions Dr. Dupuis' use of rutile TiO_2 based on Dr. Feezell's explanation that Zhao's double DBR mirror was evaporated from TiO_2 and SiO_2 sources on the back surface of the sapphire which would likely result in amorphous TiO_2 instead. *Id.* (citing Ex. 2013 ¶ 18). According to Patent Owner, Petitioner's simulated DBRs are materially different from Zhao's DBRs and do not provide any reliable

indication that a skilled artisan would have considered the DBR ordering in Zhao as being irrelevant. *Id.* at 68.

Patent Owner contends that its expert provided more accurate simulations using TFCalc and Filmetrics software. *Id.* at 69 (citing Ex. 2013 ¶¶ 19–33). Patent Owner asserts that Dr. Feezell "made his best attempt to closely match Zhao's DBRs" and used amorphous TiO_2 instead of rutile TiO_2. *Id.* According to Patent Owner, "Dr. Feezell found that there is a wide variety of reflectance results depending on the order of the DBRs, and the TiO_2/SiO arrangements." *Id.* at 70 (citing Ex. 2013 ¶¶ 19–33). Patent Owner asserts that "the materials chosen (and order) makes a significant difference in the DBR reflectivity for longer wavelength regions . . . for light at a normal incidence." *Id.* In particular, Dr. Feezell testifies that "[i]t is clear that the arrangement of the DBRs and materials used does have a significant effect on the reflectance spectrum. Whether one design (as opposed to another) would be more optimal, depends on the materials used and the spectrum of the output desired." Ex. 2013 ¶ 24.

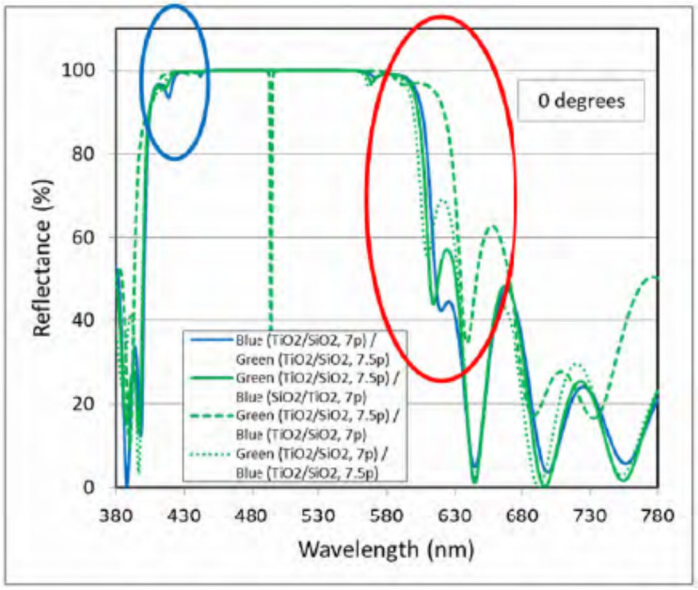
Referring to the an embodiment in the '631 patent wherein the DBR for the shorter wavelength range is centered at blue and the DBR for the longer wavelength range is centered at red, Dr. Feezell explains that he also performed a number of blue and red DBR simulations using TFCalc. Ex. 2013 ¶ 26. Based on those simulations, Dr. Feezell testifies,

> It is my opinion that it is not obvious which of the two configurations a designer would prefer without knowledge of the specific LED spectrum the designer was aiming to reflect. For some active region and phosphor combinations, the red-blue arrangement may be preferred and for other active region and phosphor combinations, the blue-red arrangement may be preferred.

Id. ¶ 30.

In the Reply, Petitioner asserts that Dr. Dupuis' simulations are reliable and do not suffer the flaws that Patent Owner itemized. Pet. Reply 6. In addition to addressing those items, Petitioner directs us to Dr. Feezell's deposition testimony confirming that his only disagreement with Dr. Dupuis' simulations was his use of rutile TiO_2. *Id.* at 7 (citing Ex. 1048, 44:1–7). Specifically, when asked about Dr. Dupuis' simulations during the deposition, Dr. Feezell explained that he had "no reason to believe there's a fundamental issue with the simulations other than the rutile selection." Ex. 1048, 44:1–7. Petitioner asserts that Dr. Dupuis used rutile TiO_2 because that was the form of TiO_2 available in Filmetrics. Pet. Reply 8 (citing Ex. 2014, 82:16–20). According to Petitioner, that selection did not impact the conclusion that DBR ordering would have no significant impact on performance or that Dr. Dupuis' simulations simply confirmed what the prior art suggests. *Id.*; *see also id.* at 8 n.2 (referring to the reference to Exhibit 1028 in the Petition "as confirming that 'the placement of the DBRs with respect to the substrate does not impact device performance.'").

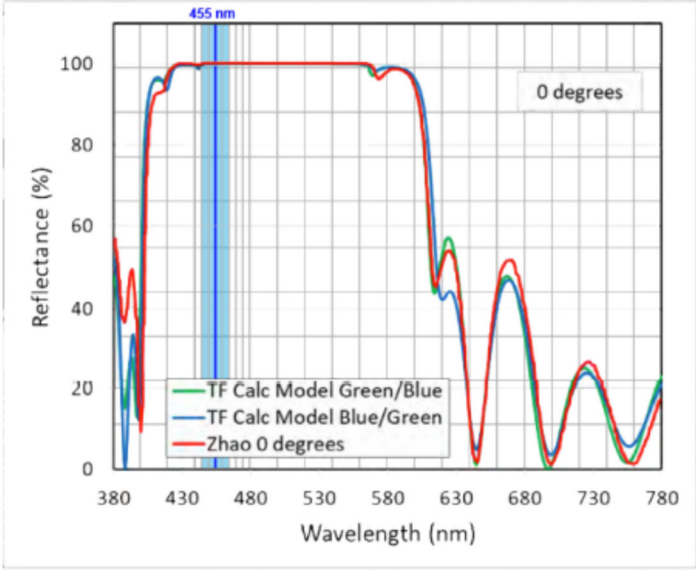
Further, Petitioner asserts that Dr. Feezell's simulations actually support Petitioner's contentions, as revealed in his deposition testimony. *Id.* at 9–15. Specifically, Petitioner asserts that "Zhao's longer-wavelength DBR is designed for a peak reflection of 520 nm—well outside of the red circle" emphasized in Dr. Feezell's plot and relied upon by Patent Owner as showing that DBR ordering "makes a significant difference in DBR reflectivity for longer wavelength regions." *Id.* at 9–10 (citing PO Resp. 70–71; Ex. 1036, 1524). The plot referenced by Petitioner is Figure 6 in Dr. Feezell's Supplemental Declaration (Ex. 2013) and is set forth below:



Ex. 2013, Fig. 6; Pet. Reply 9; PO Resp. 71. Figure 6 is Dr. Feezell's "TFCalc simulations of the reflectance spectrum at 0 degree incidence for four interpretations of Zhao DBR configuration." *Id.* The figure shows a plot of the reflectance percentage (y-axis) at certain wavelengths between 380 nm and 780 nm (x-axis). *Id.* Dr. Feezell states in his declaration that "Figure 6 shows that the reflectance characteristics are quite different in the red region of the spectrum from about 590–650 nm." *Id.* ¶ 22. He states also that Figure 6 shows that "some configurations of the DBR arrangements interpreted from Zhao would lead to either better or worse reflectance in the red region." *Id.* He notes that "some small differences in the reflectance spectra are observed in the violet/blue region from about 410-440 nm, which would affect the efficiency of reflecting blue light." *Id.* He notes also that "Zhao does not explicitly teach a DBR that is optimally tuned for the red wavelength range, it only explicitly teaches DBRs tuned for 470 and 520 nm." *Id.*

Petitioner asserts that Dr. Feezell admitted in his deposition that this figure does not depict a DBR designed to reflect light at 630 nm within the red circle. Pet. Reply 10 (citing Ex. 1048, 71:9–18). Instead, Dr. Feezell testified that to reflect light at that wavelength, "I think they would design a different DBR for that purpose." Ex. 1048, 71:9–14. Petitioner asserts that, "[i]n essence, Patent Owner has shown that the performance of DBRs at wavelengths they *were not designed to reflect* might be order-dependent," and not "that any one particular DBR order would have been better at the wavelengths the DBRs *were designed to be used at*." Pet. Reply 10–11.

Additionally, Petitioner asked Dr. Feezell at his deposition about differences in DBR performance at wavelengths Zhao was designed to reflect, e.g., 455 nm and 471 nm. *Id.* at 11 (citing Ex. 1036, 1525). Petitioner asserts that it based its inquiries on Dr. Feezell's earlier testimony that: (a) 70% of the light emitted by a blue LED will be found in a 20 nm band around its center wavelength; (b) a "*blue LED does not have any useful amount of light that extends into the green region*;" and (c) green is around 520 or 530 nm. *Id.* (quoting Ex. 2001 ¶ 48 (emphasis added by Petitioner); Ex. 1048, 82:23–83:9). According to Petitioner, "the question of which DBR order performs better—if any—involves looking at the regions around the peak LED wavelength as Dr. Feezell admits." *Id.* During the deposition of Dr. Feezell, Petitioner presented to him illustrations showing Zhao's 455 nm emission, as set forth below.



Ex. 1049, 4; Pet. Reply 12 (referring to a wavelength of 455 nm, as in Zhao's Sample A of its experiment to determine "the intensity enhancement caused by the backside DBR for LEDs obtained from different fabrication runs with peak emission wavelengths from 455 nm to 525 nm at an applied current of 20 mA." (Ex. 1036 at 1524, 1525, Table 1)). Petitioner's illustration is Figure 4 from Dr. Feezell's Supplemental Declaration (Ex. 2013 ¶ 20) and includes a dark blue vertical line placed at approximately 455 nm and a light blue box centered on it to indicate about 20 nm added by Petitioner for use at Dr. Feezell's deposition. Pet. Reply 12 (citing Ex. 1048, 55:22–56:1, 57:5–13). Referring to the illustration, Petitioner asked Dr. Feezell "which DBR is best for reflecting light within the 20-nanometer band, which of the three on your graph?" *Id.* (citing Ex. 1048, 60:1–8). Dr. Feezell responded that "[i]t appears that within that particular narrow band of wavelengths that all three of the DBRs have simple [sic similar] reflectance characteristics." *Id.* Petitioner notes that Dr. Feezell responded similarly for Petitioner's illustration highlighting 471 nm for 0 degree angle of incidence in Zhao's sample B, and for Petitioner's

illustrations highlighting 455 nm and 471 nm for the 30 angle of incidence in Zhao's samples A and B, confirming that "all of the DBRs have similar reflectance characteristics," *id.* at 13 (quoting Ex. 1048, 60:21–61:1), and that "the blue and green appear to be right on top of each other . . . you could pick either blue or green," *id.* at 14 (quoting Ex. 1048, 63:21–64:10).

Based on the foregoing, we agree with Petitioner, that Dr. Feezell's conclusions support Petitioner's assertion and Dr. Dupuis' testimony that, at least for "DBRs designed to reflect light in a particular wavelength band, the order of those DBRs does not make a substantial difference in overall performance of the reflector and resulting device." Pet. Reply 14 (citing Pet. 45–46). More broadly, we agree with Petitioner that the experts agree that a person of skill in the art "would have known how to determine which ordering of DBRs (if any) was optimal for a particular application." *Id.* at 20 (citing Pet. 44–46; Ex. 1002 ¶¶ 122–131; Ex. 2013 ¶ 24). In other words, we determine that, based on the record as a whole, the knowledge and use of the simulation software exemplified by the experts provided a tool to predict the results of alternative ordering of DBRs for specific applications, in view of the materials used.

Accordingly, having considered the evidence and the arguments, and for the reasoned discussed above, we determine that Petitioner has shown by a preponderance of the evidence that based on the combined teachings of Zhao and Garbuzov, along with the knowledge and skill in art, a person having ordinary skill in the art would have had a reason to combine Garbuzov's red phosphor with Zhao's LED chip and to modify Zhao's DBR structure to include a DBR stack designed to reflect the light of the second wavelength range converted by the phosphor, i.e., to include a matching DBR. Further, based on the foregoing, we also determine that the

preponderance of the evidence demonstrates that the skilled artisan would have known that there were only two options for ordering the DBR stacks in relation to their position on the substrate, either the blue-reflecting DBR disposed closer to the substrate, or the alternative order with the red-reflecting DBR disposed closer to the substrate, and that the latter order embodied a predictable variation that was within the skill in the art to implement and to optimize to achieve a desired and predictable result. *See* KSR, 550 U.S. at 416–417.

(5) Secondary Considerations

Patent Owner asserts that "[t]he claimed DBR arrangement provides a material benefit (which is unexpected): placing the longer-wavelength DBR on top of the blue DBR reduces light loss, and this benefit is specifically described as a novel aspect of the '631 Patent." PO Resp. 46 (citing Ex. 1001, 6:15–21); *see also id.* at 43 (asserting that the '631 Patent provides an unexpected and material benefit"). Referring to the '631 patent, Patent Owner asserts that "putting a longer wavelength DBR on top of the blue-reflecting DBR actually improves light efficiency." *Id.* at 50 (citing Ex. 1001, 6:15–21; Ex. 2001 ¶ 58; Ex. 2013 ¶ 43). Dr. Feezell describes this as a "specific benefit" of the claimed ordering. Ex. 2001 ¶ 58.

Petitioner asserts that Patent Owner has not supported its claim of unexpected results with sufficient evidence. Pet. Reply 24. In particular, Petitioner asserts that the "Patent Owner offers nothing to corroborate the statement in the patent that the light loss in the DBRs is reduced by the claimed ordering." *Id.* at 26.

The description in the '631 referenced by parties is set forth below:

> In addition as compared to the case where the second distributed Bragg reflector 50 is disposed to be closer to the substrate 21 than

> the first distributed Bragg reflector 40, the light loss in the distributed Bragg reflector 45 may be further reduced in the case where the first distributed Bragg reflector 40 is disposed closer to the substrate than the second distributed Bragg reflector 50.

Ex. 1001, 6:15–21. We do not see any indication in that description that the reduction in light loss based on the first DBR being disposed closer to the substrate was an unexpected or surprising result. Nor do we find that Patent Owner has adequately argued that such result would have been unexpected or surprising. Instead, the alleged effect of the recited ordering of the DBRs is described in the challenged patent, by Patent Owner, and by Dr. Feezell in terms of the degree of the reduction in light loss, or the degree of light efficiency. The '631 patent recites that the light loss may be "further reduced." *Id.* Patent Owner and Dr. Feezell assert light loss in a similar manner, or light efficiency as being improved, or as noted below, in terms of the percentage of improvement. In other words, Patent Owner's alleged unexpected results amount to a difference in the degree rather than a difference in kind. As our reviewing Court has explained, "[unexpected results that are probative of nonobviousness are those that are 'different in kind and not merely in degree from the results of the prior art.'" *Galderama Labs., L.P. v. Tolmar, Inc.*, 737 F.3d 731, 739 (Fed. Cir. 2013) (quoting *Iron Grip Barbell Co. v. USA Sports, Inc.*, 392 F.3d 1317, 1322 (Fed. Cir. 2004)).

Additionally, the Court has specifically described "results which differ by percentages are differences in degree rather than kind, where the modification of the percentage is within the capabilities of one skilled in the art at the time." *Id.* (citing *In re Harris*, 409 F.3d 1339, 1344 (Fed. Cir. 2005) (finding increased efficiency, measured by percentages, to be a difference in degree and not of kind)). That is precisely the form of the evidence, i.e., percentages of reflectance based on the recited ordering of

DBRs, presented by Dr. Feezell and relied upon by Patent Owner to support its assertion of unexpected results based on the recited ordering of DBRs.

Accordingly, we do not find that Patent Owner has demonstrated unexpected results sufficient to support nonobviousness of the challenged claim.

(6) Conclusion as to Obviousness

We base our final determination regarding obviousness upon an analysis of the foregoing arguments and evidence. We have considered each of the *Graham* factors and determine that Petitioner has met its overall burden of proving obviousness for the challenged claims. As part of that analysis, we have considered the asserted secondary considerations of nonobviousness and, as explained above, we determined that Patent Owner has not demonstrated unexpected results in a manner sufficient to outweigh our determination that Petitioner has shown by a preponderance of the evidence that claim 1 of the '631 patent would have been obvious over the combination of Zhao and Garbuzov.

b) Dependent Claims 5 and 13–15

Petitioner has also addressed the additional limitations in dependent claims 5 and 13–15 by demonstrating persuasively how the teachings of Zhao and Garbuzov, alone or in combination, teach or suggest those limitations. *See* Pet. 47–54. Patent Owner challenges Petitioner's showing for those claims for the same reasons argued regarding claim 1. *See* PO Resp. Patent Owner does not address the additional limitations of the challenged dependent claims. *Id.*

Accordingly, for the same reasons discussed regarding the challenge of claim 1, from which claims 5 and 13–15 depend, along with the arguments and evidence that Petitioner has set forth for the additional

limitations of those dependent claims, we conclude that Petitioner has shown by a preponderance of the evidence that claims 5 and 13–15 of the '631 patent would have been unpatentable as obvious over the combination of Zhao and Garbuzov.

E. Additional Obviousness Grounds

In its remaining two obviousness grounds, Petitioner asserts that: dependent claim 7 is rendered obvious over a combination of Zhao, Garbuzov, and Niu; and dependent claim 8 is rendered obvious over a combination of Zhao, Garbuzov, and Slater. Pet. 54–61. For each of those grounds, Petitioner relies upon the combination of Zhao and Garbuzov, as applied to claim 1. Pet. 57, 60. Petitioner relies on the teachings of Niu to reach the additional limitations of claim 7, and relies on Slater for the additional limitations of claim 8. *Id.* at 54–61.

Patent Owner challenges Petitioner's showing for those claims for the same reasons argued regarding claim 1. *See* PO Resp. Patent Owner does not address the additional limitations of challenged dependent claims 7 and 8, or Petitioner's evidence demonstrating a person of ordinary skill in the art would have had reason to combine the teachings of Niu and Slater with Zhao and Garbuzov with a reasonable expectation of success. *Id.*

Accordingly, for the same reasons discussed regarding the challenge of claim 1, from which claims 7 and 8 depend, along with the arguments and evidence that Petitioner has set forth for the additional limitations of those dependent claims and the combination of the teachings of the references, we conclude that Petitioner has shown by a preponderance of the evidence that claim 7 and of the '631 patent would have been unpatentable as obvious over the combination of Zhao, Garbuzov, and Niu, and that claim 8 of

the'631 patent would have been unpatentable as obvious over the combination of Zhao, Garbuzov, and Slater.

III. PETITIONER'S MOTION TO EXCLUDE

Petitioner moves to exclude portions of the Patent Owner's Response and portions of Dr. Feezell's declarations that allegedly rely on the '631 patent for what Petitioner deems to be improper hearsay purposes. Mot. 1–7; Mot. Reply 1–5. Patent Owner opposes the motion. PO Opp. 1–7. As the moving party, Petitioner has the burden of proof to establish that it is entitled to the requested relief. 37 C.F.R. § 42.20(c).

Petitioner alleges that Patent Owner refers to the following description in the '631 patent for improper hearsay use:

> In addition as compared to the case where the second distributed Bragg reflector 50 is disposed to be closer to the substrate 21 than the first distributed Bragg reflector 40, the light loss in the distributed Bragg reflector 45 may be further reduced in the case where the first distributed Bragg reflector 40 is disposed closer to the substrate than the second distributed Bragg reflector 50.

Ex. 1001, 6:15–21; Mot. 1. We refer to this at the "reduced light loss statement." Petitioner asserts that Patent Owner relies upon that statement as evidence of its truth, i.e., that light loss in the DBR may be further reduced when the first DBR is disposed closer to the substrate than the second DBR, as recited in claim 1 of the patent. Mot. 1. In particular, Petitioner asserts that Patent Owner improperly relies on that statement in the Patent Owner Response at pages 6, 46, and 50, and that Dr. Feezell improperly relies on the statement in his first declaration, Ex. 2001 ¶ 28, and his supplemental declaration, Ex. 2013 ¶ 98. Mot. 1. Petitioner contends that the '631 patent "does not present any corroborating data, plots, or other support" for the reduced light loss statement. *Id.* Additionally, Petitioner

contends that the Patent Owner has not "presented any witness testimony from a person with first-hand knowledge of the supposed benefit provided by the '631 patent." *Id.*

Patent Owner asserts that the reduced light loss statement in the '631 patent "describe[s] a material benefit to a POSITA—which a POSITA can verify and prove—and does not constitute hearsay." Mot. Opp. 1. Patent Owner asserts that even if it is considered hearsay, it would fall under the residual exception of FRE [Federal Rule of Evidence] 807 because Patent Owner's expert, Dr. Feezell "proved the trustworthiness" of the statement. *Id.* at 5. Additionally, Patent Owner asserts that even if FRE 807 does not apply, Patent Owner's expert is allowed to rely on it under FRE 703. *Id.* at 6.

Petitioner responds by asserting that Patent Owner incorrectly characterizes Petitioner's motion as seeking to exclude a portion of the challenged patent. Mot. Reply 1 (citing Mot. Opp. 1, 3). Petitioner reiterates that its motion seeks to exclude Patent Owner's reliance on the '631 patent for an improper hearsay use and not any portion of the patent itself. *Id.* (citing Mot. 1, 7). Additionally, Petitioner reiterates its position that Patent Owner relies on the reduced light loss statement as hearsay because it contends that the statement is true, i.e., that the claimed subject matter, in fact, "provides a material benefit," and "actually improves light efficiency." *Id.* at 1–2 (quoting PO Resp. 46, 50).

Hearsay is a statement that (1) the declarant does not make while testifying at the current trial or hearing; and (2) a party offers in evidence to prove the truth of the matter asserted in the statement. Fed. R. Evid. 801(c). Such a statement includes a "written assertion." *Id.* 801(a). Hearsay is not

admissible unless an exception applies. *Id.* 802. The "Residual Exception" provides:

> (a) In General. Under the following conditions, a hearsay statement is not excluded by the rule against hearsay even if the statement is not admissible under a hearsay exception in Rule 803 or 804: under which a hearsay statement is not excluded by the rule against hearsay if the :
>
> (1) the statement is supported by sufficient guarantees of trustworthiness—after considering the totality of circumstances under which it was made and evidence, if any, corroborating the statement; and
>
> (2) it is more probative on the point for which it is offered than any other evidence that the proponent can obtain through reasonable efforts.
>
> (b) Notice. The statement is admissible only if the proponent gives an adverse party reasonable notice of the intent to offer the statement—including its substance and the declarant's name—so that the party has a fair opportunity to meet it. The notice must be provided in writing before the trial or hearing—or in any form during the trial or hearing if the court, for good cause, excuses a lack of earlier notice.

Id. 807.

Our Rules address the admissibility of a specification or drawing of a United States patent. 37 C.F.R. 42.61(c) is set forth below:

> (c) *Specification and drawings*. A specification or drawing of a United States patent application or patent is admissible as evidence only to prove what the specification or drawing describes. If there is data in the specification or a drawing upon which a party intends to rely to prove the truth of the data, an affidavit by an individual having first-hand knowledge of how the data was generated must be filed.

As Petitioner explains, it does not seek to exclude the reduced light loss statement in the '631 patent from the record in this proceeding. Indeed, Petitioner does not contend that the '631 patent has generally been submitted in this proceeding to prove the truth of the matter asserted in it. Rather,

Petitioner alleges that Patent Owner has misused a particular statement in the patent as evidence to prove the truthfulness of the following assertions in the Patent Owner Response:

> This arrangement of the first and second DBRs improves the optical reflectivity across the spectrum of the mixed color light, and thus provides optimal light emission for while light out of the LED chip.

PO Resp. 6 (citing to Ex. 1001, 2:14–19, 6:8–21; Ex. 2001 ¶ 28).

> The claimed DBR arrangement provides a material benefit (which is unexpected): placing the longer-wavelength DBR on top of the blue DBR reduces light loss, and this benefit is specifically described as a novel aspect of the '631 patent.

Id. at 46 (citing to Ex. 1001, 6:15–21).

> The inventors of the '631 patent found that putting a longer wavelength DBR on top of the blue-reflecting DBR actually improves light efficiency.

Id. at 50 (citing Ex. 1001, 6:15–21; Ex. 2001 ¶ 58; Ex. 2013 ¶ 43).

Additionally, Petitioner contends that the following statement appearing in Dr. Feezell's declarations constitute hearsay:

> The '631 Patent further states that its DBRs are positioned in order to improve light performance. *Id.* at 6:15-21. The first DBR 40 (annotated green) is positioned on top of the second DBR 50 (annotated blue) so that it is closer to the substrate 21 (annotated light blue). *Id.* at 6:15-21. Also provided is a reflective metal layer 51 (grey). *See, e.g., id.* at 3:63-67. This structure provides optimal light emission for white light. *See, e.g., id.* at 2:14-19. The whole excerpt of 6:15-21 is provided below:
>
> > "In addition, as compared to the case where the second distributed Bragg reflector 50 is disposed to be closer to the substrate 21 than the first distributed Bragg reflector 40, the light loss in the distributed Bragg reflector 45 may be further reduced in the case where the first distributed

> Bragg reflector 40 is disposed to be closer to the substrate than the second distribute Bragg reflector 50."

Ex. 2001 ¶ 28; Ex. 2013 App'x.

Based on our consideration of the evidence and the arguments, we do not find that the above-noted statement in Dr. Feezell's declarations constitutes an improper hearsay use of the reduced light loss statement. Instead, Dr. Feezell directly sets forth what the '631 patent states. Indeed, he begins by stating, "The '631 Patent further states . . . ." Ex. 2001 ¶ 28.

The above-noted statements in the Patent Owner Response are more difficult to decipher. Based upon our review, one may consider them merely to be presenting what is in the Specification and relying on them as statements that exist in the Specification, and not for their truthfulness. Read differently, those statements may appear to rely on the reduced light loss statement to prove the truth of the matter asserted in the statement.

Patent Owner's Opposition is largely misdirected, as it argues that the '631 patent itself should not be excluded. However, to the point of whether the Patent Owner Response improperly relies on the reduced light loss statement for hearsay purposes, Patent Owner asserts that it relies on reduced light loss limitation "as evidence that the '631 Patent describes a material benefit." Mot. Opp. 3. According to Patent Owner, the challenged statements are admissible as evidence only to prove what the Specification describes. *Id.* (citing 37 C.F.R. § 42.61(c)).

Petitioner's argument that the challenged statements should be excluded is essentially based on the following assertion:

> Patent Owner offers the statement as proof that the claimed DBR ordering: (1) "improves the optical reflectivity," POR, 6; (2) "provides optimal light emission for white light out of the LED chip," *id.*; (3) "provides a material benefit (which is

> unexpected)," *id.*, 46; (4) "reduces light loss," *id.*; and (5) "actually improves light efficiency." POR, 50. This is hearsay.

Mot. 5. The motion does not offer additional rationale for considering the challenged statements to have improperly relied on the reduced light loss statement for hearsay purposes. Here, in view of Petitioner's burden, we find that assertion to be insufficient to demonstrate that the challenged statements should be excluded. For purposes of this proceeding, and consistent with our patentability analysis above, we consider the challenged statements in Patent Owner's Response to merely refer to what the '631 patent describes and not as evidence to prove the truth of the matter asserted therein.

IV. CONCLUSIONS

For the foregoing reasons, we conclude that Petitioner has shown by a preponderance of the evidence that claims 1, 5, 7, 8 and 13–15 of the '631 patent are unpatentable.[12] Additionally, we deny Petitioner's Motion to Exclude.

[12] 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).

In summary:

Claims	35 U.S.C. §	References	Claims Shown Unpatentable	Claims Not shown Unpatentable
1, 5, 13–15	103(a)	Zhao, Garbuzov	1, 5, 13–15	
7	103(a)	Zhao, Garbuzov, Niu	7	
8	103(a)	Zhao, Garbuzov, Slater	8	
Overall Outcome			1, 5, 7, 8, 13–15	

V. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that based on a preponderance of the evidence claims 1, 5, 7, 8 and 13–15 of the ’631 patent are unpatentable;

FURTHER ORDERED Petitioner’s Motion to Exclude is *denied*; and

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

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