

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAVANT TECHNOLOGIES LLC d/b/a GE LIGHTING,
ELONG INTERNATIONAL USA INC., and
XIAMEN LONGSTAR LIGHTING CO. LTD.,
Petitioner,

v.

FEIT ELECTRIC COMPANY, INC.,
Patent Owner.

IPR2025-00698
Patent 8,614,539 B2

Before BENJAMIN D. M. WOOD, KEVIN W. CHERRY, and
SCOTT B. HOWARD, *Administrative Patent Judges*.

CHERRY, *Administrative Patent Judge*.

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

I. INTRODUCTION

Savant Technologies LLC d/b/a GE Lighting, Elong International USA Inc., and Xiamen Longstar Lighting Co. Ltd. (“Petitioner”) filed a petition to institute *inter partes* review of claims 1–11, 18–20, 23–25, and 28 of U.S. Patent No. 8,614,539 B2 (Ex. 1101, “the ’539 patent”). Paper 5 (“Pet.”). Feit Electric Company, Inc. (“Patent Owner”) filed a Preliminary Response. Paper 10. We instituted *inter partes* review under 35 U.S.C. § 314(a). Paper 11 (“Inst. Dec.”).

During the trial, Patent Owner filed a Response (Paper 14, “PO Resp.”), Petitioner filed a Reply (Paper 21, “Reply”), and Patent Owner filed a Sur-Reply (Paper 24, “Sur-Reply”).

Patent Owner requested oral argument. Paper 25. A hearing was conducted on July 16, 2026. Paper 28 (“Tr.”).

We have jurisdiction under 35 U.S.C. § 6. This Final Written Decision is entered pursuant to 35 U.S.C. § 318(a). Having reviewed the complete trial record, we determine that Petitioner has shown, by a preponderance of the evidence, that the challenged claims are unpatentable.

II. BACKGROUND

A. *Real Parties in Interest*

Petitioner identifies Savant Technologies LLC d/b/a GE Lighting, Elong International USA Inc., Xiamen Longstar Lighting Co. Ltd., and Seoul Semiconductor Co. Ltd. as real parties in interest. Pet. 80. Petitioner further states that “LEDVANCE LLC is not a Real Party-in-Interest, but it does have a business relationship with Seoul Semiconductor Co. Ltd. and is identified here for Board assessment of internal conflicts of interest.” *Id.*

Patent Owner identifies Feit Electric Company, Inc. as its real party in interest. Paper 8, 1.

B. *Related Matters*

The parties identify the following district-court proceeding as a related matter involving the '539 patent: *Feit Electric Co., Inc. v. Savant Technologies LLC d/b/a GE Lighting*, No. 1:24-cv-473 (N.D. Ohio). Pet. 80; Paper 8, 1 (Patent Owner's Mandatory Notices). The parties also identify the following petitions for *inter partes* review involving U.S. Patent No. 8,604,678 B2 ("the '678 patent"), which is related to the '539 patent: IPR2024-01357; IPR2025-00258; and IPR2025-00260. Pet. 80–81; Paper 8, 1–2. Patent Owner also identifies the following proceedings involving the '678 patent: *Feit Electric Co., Inc. v. Savant Technologies LLC d/b/a GE Lighting*, No. 1:24-cv-473 (N.D. Ohio); *Feit Electric Co., Inc. v. LEDVANCE, LLC*, No. 5:24-cv-31 (E.D. Ky.); and *Feit Electric Co., Inc. v. Elong International USA Inc.*, No. 3:24-cv-1089 (N.D. Tex.). Paper 8, 1.

C. *The '539 Patent (Ex. 1101)*

The '539 patent is titled "Wavelength Conversion Component with Scattering Particles." Ex. 1101, code (54).

The '539 patent relates to light-emitting diode (LED) devices that use photoluminescent materials to generate a desired color of light—generally white. *Id.* at 1:24–26. The background section explains that traditional LED devices work by using a diode that emits blue or ultraviolet (UV) light and photoluminescent materials, e.g., phosphors, that absorb the blue/UV light and re-emit light of a different color. *Id.* at 1:30–42, 1:46–50. The combination of the unabsorbed blue/UV light from the diode and the light

emitted by the phosphors appears nearly white to the human eye. *Id.* at 1:42–46.

The problem with these systems, the '539 patent explains, is that the devices do not look white when the diode is in the OFF state. *Id.* at 1:64–2:10. This is because the phosphors continue converting the ambient light to a different wavelength even as the diode is not emitting any blue light. *Id.* The result is that, in the OFF state, traditional LED devices do not look white—they have a yellowish, yellow-orange, or orange-color appearance—which some potential consumers may find is “off-putting or undesirable.” *Id.* at 2:6–16. The patent lists several other problems with traditional LED devices as well: the color of the emitted light changes depending on the emission angle and the phosphors being used are relatively costly. *Id.* at 2:17–41.

The '539 patent proposes to solve these problems in light emitting devices by modifying the wavelength-conversion component—the component that includes the luminescent material—to include a “a light diffusing layer comprising particles of a light diffractive material” such as TiO₂. *Id.* at 2:55–3:14. The particles in the light diffusing layer are designed to scatter external blue light, “decreasing the probability of externally originated photons interacting with a phosphor material.” *Id.* at 11:40–47. The patent asserts that, if properly assembled, this arrangement leads to various improvements in LED devices: the devices have a “white color appearance” even in their OFF state; there is greater “color uniformity of emitted light from an LED device for emission angles over a $\pm 60^\circ$ range from the emission axis”; and there is a “substantial[] reduc[tion in] the

quantity of phosphor material required to generate a selected color of emitted light” by as much as 40%. *Id.* at 3:15–32.

D. *Challenged Claims*

Petitioner challenges claims 1–11, 18–20, 23–25, and 28 of the ’539 patent. Pet. 1. Of the challenged claims, claims 1, 18, and 28 are independent and are reproduced below, with Petitioner’s identifiers for the claim limitations, as illustrative of the subject matter recited in the challenged claims.

1[pre] A wavelength conversion component for a light emitting device comprising:

[a] at least one photoluminescence material; and

[b] a light scattering material, [c] wherein the light scattering material has an average particle size that is selected such that the light scattering material will scatter excitation light from a radiation source relatively more than the light scattering material will scatter light generated by the at least one photoluminescence material,

[d] wherein the wavelength conversion component is configured such that in operation a portion of the excitation light comprising blue light having a wavelength of greater than or equal to 440 nm is emitted through the wavelength conversion component to contribute to a final visible emission product;

[e] wherein the light scattering material scatters the blue light at least twice as much as light generated by the at least one photoluminescence material.

Ex. 1101, 26:14–31.

E. *Asserted Grounds*

Petitioner asserts the following grounds of unpatentability:

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–11, 18–20, 23–25	103(a) ¹	Krummacher ² , Stokes ³ , Shimizu ⁴
18, 28	103(a)	Hussell ⁵ , Krummacher, Stokes, Van Woudenberg ⁶

Petitioner submits its Petition with the Declaration of William A. Doolittle, Ph.D. (Ex. 1102).

Patent Owner supports its contentions with the Declaration of E. Fred Schubert, Ph.D. (Ex. 2001).

III. ANALYSIS

A. *Legal Standards*

A patent claim is unpatentable under 35 U.S.C. § 103(a) if “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

¹ The Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) (“AIA”), amended 35 U.S.C. § 103. The ’539 patent issued from Application Serial No. 13/273,215, which was filed October 13, 2011, before the effective date of the applicable AIA amendments. Ex. 1101, code (22). Thus, we refer to the pre-AIA version of 35 U.S.C. § 103.

² Krummacher, US 2008/0079015 A1 (published Apr. 3, 2008, filed Sep. 18, 2007) (Ex. 1107, “Krummacher”).

³ Stokes et al., U.S. Patent No. 6,791,259 B1 (issued Sep. 14, 2004, filed Aug. 22, 2000) (Ex. 1108, “Stokes”).

⁴ Shimizu et al., U.S. Patent No. 6,069,440 (issued May 30, 2000, filed Apr. 28, 1999) (Ex. 1110, “Shimizu”).

⁵ Hussell et al., US 2010/0124243 A1 (published May 20, 2010, filed Nov. 18, 2008) (Ex. 1111, “Hussell”).

⁶ Van Woudenberg et al., WO 2008/044171 A2 (published Apr. 17, 2008, filed Oct. 4, 2007) (Ex. 1120, “Van Woudenberg”).

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 skill in the art; and (4) objective evidence of non-obviousness, i.e., secondary considerations. *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

In conducting an obviousness analysis, one must determine whether the claimed elements are present in the prior art. *PAR Pharm., Inc. v. TWI Pharms., Inc.*, 773 F.3d 1186, 1194–98 (Fed. Cir. 2014) (citing *Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1164 (Fed. Cir. 2006)). However, a patent claim “is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art.” *KSR*, 550 U.S. at 418. 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.’” *Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1367–68 (Fed. Cir. 2016); *see also KSR*, 550 U.S. at 418. Further, an assertion of obviousness “cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.” *KSR*, 550 U.S. at 418; *see also In re NuVasive, Inc.*, 842 F.3d 1376, 1383 (Fed. Cir. 2016) (a finding of a motivation to combine “must be supported by a ‘reasoned explanation’”).

“In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.” *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3)); *see also Intelligent Bio-Sys.*, 821 F.3d at 1369. Therefore, to prevail in an *inter partes* review, Petitioner must explain how the proposed combinations of prior art would have rendered the challenged claims unpatentable.

B. *Level of Ordinary Skill in the Art*

We consider the asserted ground of unpatentability in view of the understanding of a person of ordinary skill in the art (“POSITA”). 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) (quoting *Custom Accessories, Inc. v. Jeffrey-Allan Indus., Inc.*, 807 F.2d 955, 962 (Fed. Cir. 1986)). “[O]ne or more factors may predominate.” *Id.*

Relying on the declaration testimony of Dr. Doolittle, Petitioner contends that an ordinarily skilled artisan for the ’539 patent “would have had an undergraduate degree (i.e., B.S., B.S.E. or the equivalent) in electrical engineering, materials science, physics, or a similar discipline” and “would also have one to two years of experience in the field of LED packaging design.” Pet. 6. Petitioner additionally contends that “[m]ore education could substitute for experience, and vice versa.” *Id.* Petitioner further contends that “[t]his person would have been capable of understanding and applying the teachings of the ’539 patent and the prior-art

references discussed herein,” and “[m]oreover, the prior art reflects the level of skill at the time of the claimed invention.” *Id.* (citing *Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001); Ex. 1102 ¶¶ 38–42).

Patent Owner states that “solely for the purposes of this proceeding, Patent Owner and its technical expert employ the same level of skill in the art as Petitioners.” PO Resp. 23.

Thus, we adopt Petitioner’s articulation of the level of ordinary skill in the art, which is consistent with the ’539 patent and the asserted prior art, and we apply it in our obviousness analysis below.

C. *Claim Construction*

In an *inter partes* review, claims are 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); *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005). This standard includes “construing the claim in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.” 37 C.F.R. § 42.100(b). “Any prior claim construction determination concerning a term of the claim in a civil action, or a proceeding before the International Trade Commission, that is timely made of record in the *inter partes* review proceeding will be considered.” *Id.*

“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.

“The Board is required to construe ‘only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.’” *Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)). We determine that no terms require express construction to resolve the parties’ disputes in this case.⁷ *See id.*

D. *Prior Art*

Before turning to Petitioner’s asserted grounds of unpatentability, we provide brief summaries of the asserted references.

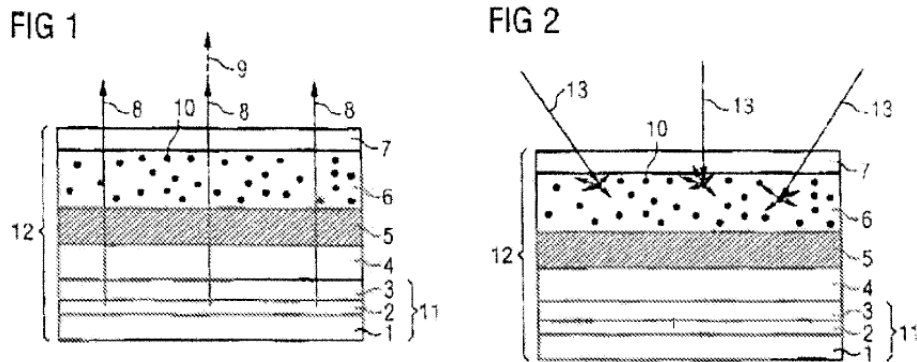
1. *Krummacher (Ex. 1107)*

Krummacher is titled “Optoelectronic Component Having a Luminescence Conversion Layer.” Ex. 1107, code (54). Krummacher, too, is directed at the OFF-state problem mentioned above. *See* Ex. 1107 ¶¶ 3, 4. Krummacher explains that it was known to combine a component that contains an LED that generates blue or UV light with a luminescence conversion layer to convert some of the light to yellow, “such that the blue

⁷ Patent Owner argues that Petitioner took inconsistent claim construction positions in district court and this proceeding. *See* PO Resp. 23–27; Sur-Reply 10–12. We note that Patent Owner did not raise this issue until its Patent Owner Response at the end of December, almost two months after the Director’s initial decisions in *Revvo Techs., Inc. v. Cerebrum Sensor Techs., Inc.*, IPR2025-00632, Paper 20 at 3–5 (Director Nov. 3, 2025) (precedential); *Tesla, Inc., v. Intellectual Ventures II LLC*, IPR2025-00340, Paper 18 (Director Nov. 5, 2025) (informative). We decline to entertain these arguments because they are reserved for the Director to decide. *See Savant Techs. LLC v. Feit Elec. Co., Inc.*, IPR2024-01357, Paper 69, 8–10 (PTAB Apr. 9, 2026).

or ultraviolet radiation emitted by the active region is superimposed on the fraction converted to the complementary color to yield white light.” *Id.* ¶¶ 3, 4, 33.

The problem with this approach, Krummacher explains, is that the luminescence conversion layer emits yellow light even when the light-emitting component is in its OFF state, so the surface looks yellow, “which is often found unattractive by observers.” *Id.* ¶ 4. Krummacher suggests solving this problem by including scattering particles, “[p]articularly . . . TiO_2 or Al_2O_3 .” *Id.* ¶ 39; *see id.* code (57); ¶ 6. Krummacher’s Figures 1 and 2, reproduced below, are particularly relevant to this case.



Figures 1 and 2 depict “a schematic graphic representation of a cross section through an optoelectronic component” in the ON and OFF state, respectively. *Id.* ¶¶ 27, 28. In these figures, reference number “5” depicts the “luminescence conversion layer,” and reference number “6” depicts the “light-scattering translucent layer.” *Id.* ¶¶ 37–39. Krummacher explains that “the light-scattering translucent layer 6 contains light-scattering particles 10, which, as illustrated in FIG. 2, serve to scatter environmental light 13 striking the optoelectronic component from the outside. . . . Particularly suitable are particles of TiO_2 or Al_2O_3 .” *Id.* ¶ 39. According to

Krummacher, “the distribution, size and material of the light-scattering particles 10 in light-scattering translucent layer 6 are selected such that the surface of light scattering translucent layer 6 appears white,” and “the luminescence conversion layer 5 is advantageously prevented from exhibiting a yellowish hue, in the off state of the optoelectronic component depicted in FIG. 2.” *Id.* ¶ 41.

2. *Stokes (Ex. 1108)*

Stokes is entitled “Solid State Illumination System Containing a Light Emitting Diode, a Light Scattering Material and a Luminescent Material.” Ex. 1108, code (54). Stokes “relates generally to a white light illumination system, and specifically to a solid state lamp containing a semiconductor light emitting diode (‘LED’) or laser diode, a light scattering material, and a luminescent phosphor or dye material.” Ex. 1108, 1:11–15.

Stokes explains that “LEDs are used in a number of commercial applications such as automotive, display, safety/emergency and directed area lighting,” and that “[r]ecently, a white light emitting lamp was developed which includes a blue light emitting diode and a yellow emitting phosphor.” *Id.* at 1:18–22. According to Stokes, “[t]he blue light emitted by the LED excites the phosphor, causing it to emit yellow light,” and “[t]he blue light emitted by the LED is transmitted through the phosphor and is mixed with the yellow light emitted by the phosphor.” *Id.* at 1:31–35. Stokes explains that “[t]he viewer perceives the mixture of blue and yellow light as white light.” *Id.* at 1:35–38. However, according to Stokes, “these white LED lamps suffer from the undesirable halo effect and the penumbra effect.” *Id.* at 1:36–38.

Stokes explains that the halo effect occurs due to the separation of blue and yellow light as the LED emits blue light in a directional, anisotropic fashion and the phosphor emits yellow light isotropically (i.e., in all directions). *Id.* at 1:39–42. Therefore, according to Stokes, when the light output is viewed straight on, it appears bluish white, but when the light output is viewed at an angle, the light appears yellowish. *Id.* at 1:42–47. Stokes further explains that when the light output is directed onto a flat surface, it appears as a yellowish halo surrounding a bluish area. *Id.* at 1:48–50. Stokes indicates that “[t]he penumbra effect is similar to the halo effect, except that the halo effect is a color separation effect, while the penumbra effect is a non-uniform intensity effect.” *Id.* at 1:51–53. Stokes explains that “[t]he penumbra effect causes the white LED lamp emission to appear brighter at the center than at the edges.” *Id.* at 1:53–55.

Stokes teaches “in order to obtain a significant decrease in the halo and/or penumbra effects, [a] radiation scattering material is placed between the radiation source, such as an LED or a laser diode, and the luminescent material, such as a phosphor or a dye.” *Id.* at 3:57–61. According to Stokes, “[w]hen the radiation scattering material is placed between the radiation source and the luminescent material, the radiation source radiation being scattered isotropically, is made substantially uniform and diffuse prior to being incident on the phosphor,” and “the lamp emits white light with high far field color and intensity uniformity.” *Id.* at 3:63–4:2.

Stokes discloses, in one preferred embodiment, that “the radiation scattering particles have a size such that the particles preferentially scatter blue or UV LED light as compared to yellow, green, red or white light from

the luminescent material.” *Id.* at 7:1–4. Figure 6 of Stokes is reproduced below.

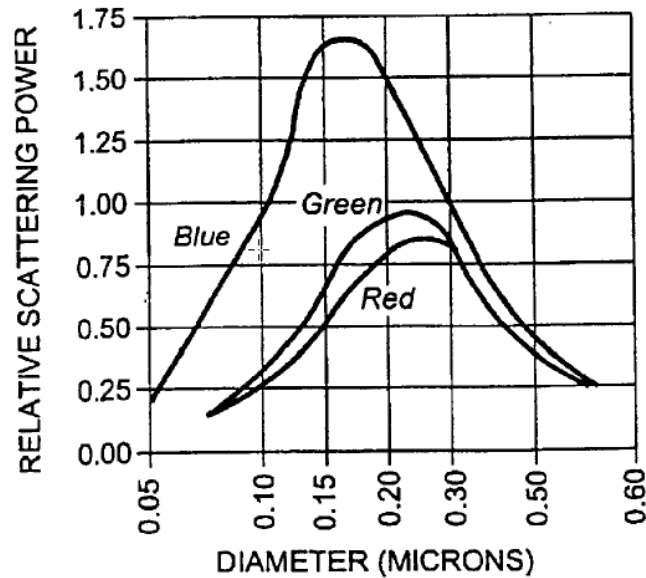


Figure 6 of Stokes “illustrates the relationship between the particle diameter and the wavelength of the Scattered light for Ti-Pure(R) rutile TiO_2 particles made by DuPont.” *Id.* at 7:7–9. Stokes explains that

As illustrated in FIG. 6, the relative scattering power of 100 to 200 nm TiO_2 particles is above 1 for blue incident radiation, while it is below 1 for green and red incident radiation. Therefore, as illustrated in FIG. 6, 100 to 200 nm particles have at least a 50% greater scattering power for blue radiation (i.e., such as that emitted by a blue emitting LED) than green or red (or for that matter yellow) radiation (i.e., Such as that emitted by the phosphor or dye). This particle size range is advantageous because it enhances the scattering of the radiation source radiation while it decreases the amount of scattering of the luminescent material radiation.

Id. at 7:9–22.

3. *Shimizu (Ex. 1110)*

Shimizu is titled “Light Emitting Device Having a Nitride Compound Semiconductor and a Phosphor Containing a Garnet Fluorescent Material.”

Ex. 1110, code (54). Shimizu discloses “a light emitting device (LED) comprising a phosphor, which converts the wavelength of light emitted by a light emitting component and emits light.” *Id.* at 1:15–17.

Shimizu discloses a molding 104 material that has the function to protect the light emitting component 102, a conductive wire, and a coating material 101 which contains phosphor from external disturbance. *Id.* at 16:59–62. According to Shimizu, “it is preferable that the molding material . . . further contain a dispersant, which can unsharpen the directivity of light from the light emitting component . . . , resulting in increased angle of view.” *Id.* at 16:62–66.

Shimizu explains that “adding the dispersant and/or a coloration agent in the molding material has the effects of masking the color of the fluorescent material.” *Id.* at 17:25–28. According to Shimizu, “the fluorescent material absorbs blue component of extraneous light and emits light thereby to give such an appearance as though colored in yellow,” but “the dispersant contained in the molding material gives milky white color to the molding material and the coloration agent renders a desired color.” *Id.* at 17:29–34. Thus, Shimizu explains, “the color of the fluorescent material will not be recognized by the observer.” *Id.* at 17:34–35.

4. *Hussell (Ex. 1111)*

Hussell is entitled “Semiconductor Light Emitting Apparatus Including Elongated Hollow Wavelength Conversion Tubes and Methods of Assembling Same.” Ex. 1111, code (54).

Hussell discloses a “semiconductor light emitting apparatus includes an elongated hollow wavelength conversion tube that includes an elongated wavelength conversion tube wall having wavelength conversion material,

such as phosphor, dispersed therein.” *Id.* at code (57). Hussell explains that high efficiency white light production may be obtained by causing almost all of the light that is emitted by a semiconductor light emitting device to strike the elongated wavelength conversion tube wall 112 at an oblique angle. *Id.* ¶ 38.

Hussell indicates that various embodiments may be “regarded as providing a semiconductor light emitting filament that may be analogized to the filament of a conventional incandescent lamp or to a miniature fluorescent bulb.” *Id.* ¶ 52. According to Hussell, a bulb and a screw-type base may be provided, so that the combination of the elongated hollow wavelength conversion tube and packaged semiconductor light emitting devices at opposite ends thereof provides a filament for a drop-in replacement for an incandescent bulb. *Id.*

5. *Van Woudenberg (Ex. 1120)*

Van Woudenberg is entitled “LED Based Luminaire and Lighting Device.” Ex. 1120, code (54). Van Woudenberg relates to a lighting device comprising a phosphor coated light emitting diode (“pc-LED”). *Id.* at code (57), 1:9–10.

According to Van Woudenberg, “[t]he distinguished yellowish appearance of pc-LEDs and the luminaire in their functional off state is in a large number of applications a disturbing feature.” *Id.* at 1:27–28.

Van Woudenberg discloses “a lighting device that still provides a very minute amount of light in the functional off state of the device,” noting that “this amount of light is so small that the device in this functional off state can in almost all practical circumstances not be used for its intended purpose.” *Id.* at 2:17–19. Van Woudenberg explains that

[a]s a result of the residual current running through the pc-LED in the functional off state of the lighting device, the tiny amount of light produced by the pc-LED outshines the reflected ambient light—which due to the optical characteristics of the phosphor is filtered to become yellowish—from the pc-LED. Hence, the pc-LED will appear to have a neutral white color to the human eye.

Id. at 2:19–23.

E. *Secondary Considerations of Non-obviousness*

Objective evidence of non-obviousness includes: (1) commercial success, (2) copying, (3) industry praise, (4) skepticism, (5) long-felt but unsolved need, and (6) failure of others. *See, e.g., Transocean Offshore Deepwater Drilling, Inc. v. Maersk Drilling U.S., Inc.*, 699 F.3d 1340, 1349–56 (Fed. Cir. 2012). When presented, objective indicia or secondary considerations “must always . . . be considered in the overall obviousness analysis.” *Adapt Pharma Operations Ltd. v. Teva Pharms. USA, Inc.*, 25 F.4th 1354, 1372 (Fed. Cir. 2022). However, “a strong showing of obviousness may stand even in the face of considerable evidence of [secondary considerations].” *Id.*

I. Nexus

For secondary considerations to be awarded “substantial weight” “in an obviousness analysis,” the Federal Circuit has advised that the “secondary considerations must have a nexus to the claims.” *Fox Factory, Inc. v. SRAM, LLC*, 944 F.3d 1366, 1373 (Fed. Cir. 2019) (internal quotations omitted). The Federal Circuit has further instructed that “[t]he patentee bears the burden of showing that a nexus exists.” *Id.* (quoting *WMS Gaming Inc. v. Int’l Game Tech.*, 184 F.3d 1339, 1359 (Fed. Cir. 1999)). Finally, the Federal Circuit instructs that “[t]o determine whether the patentee has met

that burden, we consider the correspondence between the objective evidence and the claim scope.” *Id.* (quoting *Henny Penny Corp. v. Frymaster LLC*, 938 F.3d 1324, 1332 (Fed. Cir. 2019)).

“A showing of nexus can be made in two ways: (1) via a presumption of nexus, or (2) via a showing that the evidence is a direct result of the unique characteristics of the claimed invention.” *Volvo Penta of the Ams., LLC v. Brunswick Corp.*, 81 F.4th 1202, 1210 (Fed. Cir. 2023). A rebuttable presumption of nexus arises “when the patentee shows that the asserted objective evidence is tied to a specific product and that product ‘embodies the claimed features and is coextensive with them.’” *Fox Factory*, 944 F.3d at 1373 (quoting *Polaris Indus., Inc. v. Arctic Cat, Inc.*, 882 F.3d 1056, 1072 (Fed. Cir. 2018)). Whether a rebuttable presumption of nexus arises “turns on the nature of the claims and the specific facts.” *Teva Pharms. Int’l GmbH v. Eli Lilly & Co.*, 8 F.4th 1349, 1362 (Fed. Cir. 2021).

Patent Owner contends that it is entitled to a presumption of a nexus because “[e]ach of the . . . secondary considerations [identified by Patent Owner] is directly related to white filament style light emitting devices including Petitioners’ products that practice the claimed invention.” PO Resp. 44 (citing Ex. 1138). In its Sur-Reply, Patent Owner also contends that it has shown a nexus because commercial success and industry praise are the “direct result of the unique characteristics of the claimed invention.” Sur-Reply 12 (quotations omitted). Patent Owner argues that “[t]he ’539 Patent recognized that there was a need for improved LED lighting apparatuses that ‘maintains the desired color properties of the devices,’ ‘without requiring the large quantities of photoluminescent materials,’ ‘addresses perceptive variations in color of emitted light with emission

angle,’ and ‘addresses the non-white color appearance of the LED lighting apparatus while in an OFF state.’” *Id.* at 13 (citing Ex. 1101, 2:42–51).

Patent Owner argues that “[e]ach of these factors is important to perception of the light in both the ON and OFF states, and the ’539 Patent described and claimed its novel combination of components to satisfy those factors.”

Id.

Patent Owner contends that “[t]he evidence . . . presented goes directly to that perception.” *Id.* Patent Owner argues that “[it] developed and has sold a bulb that appears white in the OFF state but also provides uniform light output in the ON state.” *Id.* (citing Ex. 2029 (retailer statements “These clear glass LED bulbs with exposed white filament offer a sleek aesthetic that easily assimilates into any home décor style. Where traditional clear glass LED bulbs stand out with their yellow filaments, these bulbs contain a discreet, white-colored core that blends in better, while still providing a smooth glow meant for chandeliers, pendants, and lamps without shades”)).

We find that Patent Owner has failed to show that it is entitled to a presumption of a nexus. The only evidence cited by Patent Owner to establish a presumption of a nexus is to Exhibit 1138. But Exhibit 1138 does not relate to Patent Owner’s products or to the challenged patent. Exhibit 1138 only maps Petitioner’s products to the claims of the ’687 patent, not Patent Owner’s products or to the claims of the ’539 patent. Thus, we find that Patent Owner has failed to show that its products embody the claimed features and are coextensive with them.

We also find that Patent Owner has failed to show a nexus independent of the presumption of a nexus. Patent Owner identifies the

unique characteristics of the '539 patent of “LED lighting apparatuses that ‘maintains the desired color properties of the devices,’ ‘without requiring the large quantities of photoluminescent materials,’ ‘addresses perceptive variations in color of emitted light with emission angle,’ and ‘addresses the non-white color appearance of the LED lighting apparatus while in an OFF state.’” Sur-Reply 13 (citing Ex. 1101, 2:42–51). Patent Owner points to Exhibit 2029, a webpage sales listing from the Home Depot website for the Feit Electric White Filament LED Light Bulbs, to support its contention that these bulbs “appear[] white in the OFF state but also provide[] uniform light output in the ON state.” *Id.* (citing Ex. 2029). Setting aside that Patent Owner has provided no evidence that the Feit White Filament LED Bulbs are covered by the claims of the '539 patent, there are several other problems with Patent Owner's nexus evidence. First, neither “appearing white in the OFF state” nor “providing uniform light output in the ON state” is claimed. Thus, the alleged unique characteristics are not commensurate with the scope of the challenged claims. However, even if those alleged unique characteristics were claimed, we find that they were already present in the prior art. A nexus may not exist where, for example, the merits of the claimed invention were “readily available in the prior art.” *Richdel, Inc. v. Sunspool Corp.*, 714 F.2d 1573, 1580 (Fed. Cir. 1983); *see also Tokai Corp. v. Easton Enters., Inc.*, 632 F.3d 1358, 1369 (Fed. Cir. 2011). Here, we find that Patent Owner has failed to show a nexus based on off-state white appearance and uniform light output because those features existed in the prior art. *See Yita LLC v. MacNeil IP LLC*, 69 F.4th 1356, 1364 (Fed. Cir. 2023); *ClassCo, Inc. v. Apple, Inc.*, 838 F.3d 1214, 1220 (Fed. Cir. 2016). For example, Krummacher teaches an LED with a white appearance in the

OFF state (Ex. 1107 ¶ 3, 4) and Stokes teaches uniform light from a blue LED, Ex. 1108, 3:57–61. Thus, we find that Patent Owner has failed to show that there is a nexus between the objective evidence and the claimed invention.

2. Long-Felt Need

“Evidence of a long felt but unresolved need tends to show non-obviousness because it is reasonable to infer that the need would have not persisted had the solution been obvious.” *WBIP, LLC v. Kohler Co.*, 829 F.3d 1317, 1332 (Fed. Cir. 2016). “Establishing long-felt need requires objective evidence that an art-recognized problem existed in the art for a long period of time without solution.” *Ex Parte Jellá*, 90 USPQ2d 1009, 1019 (BPAI 2008) (precedential).

Patent Owner argues that “[t]he ’539 Patent itself identifies the long-felt need for the claimed invention.” PO Resp. 41. Patent Owner submits that “the ’539 Patent explained that ‘there is a need for an improved approaches to implement LED lighting apparatuses . . . which also addresses the non-white color appearance of the LED lighting apparatuses while in an OFF state.’” *Id.* (citing Ex. 1101, 2:42-51; Ex. 2037; Ex. 2001 ¶ 121). Patent Owner contends that this long-felt need demonstrates the non-obviousness of the claimed invention. *Id.* at 42.

We find that Patent Owner has not shown sufficient evidence to establish that there was a long-felt need. Patent Owner cites two pieces of evidence to support its contention that there was a long-felt need. First, it cites statements in the Specification stating that

Therefore, there is a need for improved approaches to implement LED lighting apparatuses that maintains the desired color properties of the devices, but without requiring the large

quantities of photoluminescent materials (e.g. phosphor materials) that are required in the prior approaches. In addition, there is a need for an improved approach to implement LED lighting apparatuses which addresses perceptible variations in color of emitted light with emission angle, and which also addresses the non-white color appearance of the LED lighting apparatuses while in an OFF state.

Ex. 1101, 2:42–51.

A “long-felt need is analyzed as of the date of an articulated identified problem and evidence of efforts to solve that problem.” *Texas Instruments Inc. v. Int’l Trade Comm’n*, 988 F.2d 1165, 1178 (Fed. Cir. 1993). This statement provides nothing that would establish any date when “an articulated identified problem” existed. Moreover, we note that the mere passage of time, does not, by itself, sufficient to establish a long-felt need. *See Iron Grip Barbell Co., Inc. v. USA Sports, Inc.*, 392 F.3d 1317, 1325 (Fed. Cir. 2005) (“Absent a showing of long-felt need or the failure of others, the mere passage of time without the claimed invention is not evidence of nonobviousness.”). Thus, this statement does not amount to “objective evidence that a recognized problem existed in the art for a long period of time without solution,” as required to establish a long-felt need. *See Vandenberg v. Dairy Equip. Co.*, 740 F.2d 1560, 1567 (Fed. Cir. 1984).

Exhibit 2037 provides no assistance in this regard. Patent Owner contends that Exhibit 2037 “express[es] a need for white filament lighting devices.” PO Resp. 42. Exhibit 2037 is a post in the “r/Lighting” forum on the website reddit.com. Ex. 2037, 1. Exhibit 2037 does not contain any date, but post indicates it is from “5 yr. ago” and seeks information about whether “white filament LED edison bulbs exist.” *Id.* As an initial matter, it is unclear when exactly this post is from. Patent Owner has provided no

evidence in that regard. If Exhibit 2037 is from approximately five years before it was filed as an exhibit (i.e., 2020), we find that it is not probative of long-felt need because it is from nearly 10 years after the priority date of the '539 patent. *See Vandenberg*, 740 F.2d at 1567. As discussed above, off-state white appearance is not claimed. Moreover, we note that it does not express a need merely for LED bulbs that appear white in the off state, but Edison-style LED lightbulb filaments that appear white, which is not commensurate with the scope of the claims in this case.

Finally, Patent Owner cites to paragraph 121 of Dr. Schubert's declaration, but that merely states "I understand that consumers express a need for white filament products over the traditional yellow filament counterparts." Ex. 2001 ¶ 121 (citing Ex. 2037). However, this merely relies on Exhibit 2037 and suffers from the same deficiencies discussed with respect to that exhibit. Thus, we give no weight to Patent Owner's evidence of long-felt need.

3. Commercial Success

"When a patentee can demonstrate commercial success, usually shown by significant sales in a relevant market, and that the successful product is the invention disclosed and claimed in the patent, it is presumed that the commercial success is due to the patented invention." *J.T. Eaton & Co. v. Atlantic Paste & Glue Co.*, 106 F.3d 1563, 1571 (Fed. Cir. 1997).

Patent Owner contends that "[s]ince the first introduction of its patented white-filament bulbs, Patent Owner has prominently advertised the feature in its marketing and sales materials." PO Resp. 42 (citing Ex. 2032; Ex. 2033, Ex. 2034; Ex. 2001 ¶ 119). Patent Owner argues that "Retailers who sell Patent Owner's patented products have likewise emphasized the

white filaments.” *Id.* (citing Ex. 2029 (indicating that “These clear glass LED bulbs with exposed white filament offer a sleek aesthetic that easily assimilates into any home décor style. Where traditional clear glass LED bulbs stand out with their yellow filaments, these bulbs contain a discreet, white-colored core that blends in better, while still providing a smooth glow meant for chandeliers, pendants, and lamps without shades.”), Ex. 2031, Ex. 2035; Ex. 2001 ¶¶ 119–20. Patent Owner asserts that “[t]hose retailers have also priced Patent Owner’s patented products at a premium compared to similar bulbs with yellow filaments, demonstrating that customers desire and appreciate the white filament and are willing to pay more for it.” *Id.* (citing Ex. 2035 (Patent Owner’s white-filament product priced at \$29.97); Ex. 2036 (similar yellow-filament product priced at \$21.97); Ex. 2001 ¶ 120).

Commercial success requires a nexus to the claimed invention. *Transocean*, 699 F.3d at 1350. As we discussed above, Patent Owner has failed to show any nexus between the evidence offered and the claimed invention. However, even if Patent Owner had shown a nexus, we give this evidence little weight. The mere difference in price, at one retailer, is very weak evidence of commercial success. Patent Owner provides no sales figures, no market share figures, or any other evidence that would give the context that would lead us to give significant weight to the alleged commercial success. *See Tec Air, Inc. v. Denso Mfg. Mich. Inc.*, 192 F.3d 1353, 1360–61 (Fed. Cir. 1999) (“Although sales figures coupled with market data provide stronger evidence of commercial success, sales figures alone are also evidence of commercial success.”).

4. *Industry Praise*

“Evidence that the industry praised a claimed invention or a product that embodies the patent claims weighs against an assertion that the same claimed invention would have been obvious.” *Apple Inc. v. Samsung Elecs. Co., Ltd.*, 839 F.3d 1034, 1053 (Fed. Cir. 2016) (en banc). “Industry participants, especially competitors, are not likely to praise an obvious advance over the known art. Thus, if there is evidence of industry praise of the claimed invention in the record, it weighs in favor of the non-obviousness of the claimed invention.” *Id.*; *see also Institut Pasteur & Universite Pierre Et Marie Curie v. Focarino*, 738 F.3d 1337, 1347 (Fed. Cir. 2013) (“[I]ndustry praise . . . provides probative and cogent evidence that one of ordinary skill in the art would not have reasonably expected [the claimed invention].”); *Power–One, Inc. v. Artesyn Techs., Inc.*, 599 F.3d 1343, 1352 (Fed. Cir. 2010) (noting that industry praise, and specifically praise from a competitor, tends to indicate that the invention would not have been obvious).

To show industry praise, Patent Owner submits that “Home Depot last year announced Patent Owner’s patented white-filament bulbs as one of its 2024 Innovation Awards Winners, specifically emphasizing that they ‘help create a timeless look by blending into any décor with lower profile white filaments.’” PO Resp. 43 (citing Ex. 2031; Ex. 2001 ¶ 118). Patent Owner also points to “[i]ndustry forums” that “tout the benefits of Patent Owner’s white filament products, noting that ‘[t]he white filaments make the bulb look less obtrusive when it’s off.’” *Id.* (citing Ex. 2030). Patent Owner argues that “[t]his is the very response the ’539 Patent inventors sought to achieve.” *Id.* (citing Ex. 1101, 11:15–22).

We find that Patent Owner’s evidence of industry praise is entitled to little weight. First, as discussed above, Patent Owner has failed to show that there is a nexus between the challenged claims and the products that were the subject of the alleged praise. Second, even if a nexus was shown, none the evidence of industry praise submitted by Patent Owner is entitled to significant weight.

Patent Owner cites Dr. Schubert’s declaration, but that declaration merely repeats what is stated in other exhibits without any additional analysis, so we will focus on those other exhibits rather than Dr. Schubert’s declaration. *See* Ex. 2001 ¶¶ 118, 119.

Patent Owner cites Exhibit 2030, which consists of posts from an internet forum called “Candle Power Flashlight Forum” titled “Feit LED filament bulb with white filaments,” dated between December 18, 2022 and January 8, 2023. One of the posts mentions that “[t]he white filaments make the bulb look less obtrusive when it’s off—it kind of blends into the surroundings. Interesting concept.” Ex. 2030, 1. Another post states “[i]t probably won’t be long before other manufacturers copy this design.” *Id.* There is a final post that states that the poster “found the patent that describes what’s going on here.” *Id.* However, it is unclear from the post what patent the poster is referring to.⁸

We find that, even if Patent Owner had shown a nexus between the Feit bulbs in question and the challenged patent, Exhibit 2030 is not entitled

⁸ We note that clicking on the link in Dr. Schubert’s declaration (Ex. 2001 ¶ 118) takes you to the post shown in Exhibit 2030, and, based on our review of the actual post, the patent referenced is Canadian Patent 3 021 307, which is not related to the challenged patent and lists GE Lighting Solutions LLC as the applicant.

to substantial weight as industry praise. Exhibit 2030 only includes posts by two anonymous users that calls the white filament bulb, “an interesting concept.” *Id.* Although the poster does mention that they found “the patent that describes what’s going on here,” Exhibit 2030 does not mention to what patent the poster is referring. Thus, we find this alleged praise entitled to little weight.

Patent Owner also cites Exhibit 2031, which is a webpage of a new release from Home Depot, which is titled “The Home Depot Announces 2024 Innovation Award Winners,” and is dated October 9, 2024. The press release begins by stating “The Home Depot announced the winners of its annual Innovation Awards, recognizing products that have transformed the home improvement landscape,” and “[t]his year’s winners represent a cross-array of innovation that have provided unparalleled benefits to both Pro and DIY customers.” Ex. 2031, 1. The press release also mentions that “[i]n addition to the top award-winners, the following products received honorable mentions for the benefits they bring to Home Depot customers.” *Id.* Among the products listed as “honorable mentions” is “Feit White Filament LED,” which are described as “help[ing] create a timeless look by blending into any décor with lower profile white filaments.” *Id.* Patent Owner provides no information about the criteria or basis of selection for the Home Depot Innovation Awards. Thus, it is difficult to assess the significance of this award. As discussed above, OFF state white appearance is not claimed and was known in the prior art. *See, e.g.*, Ex. 1107 ¶¶ 3, 4. Moreover, we agree with Petitioner that the praise here is more tied to the particular aesthetic of the filament or “Edison” style light bulbs, not the

claimed particle size distribution. *See* Reply 13–14. Thus, we find that this award is entitled to little weight.

Finally, Dr. Schubert’s declaration also cites to Exhibits 2032, 2033, and 2034, which he cites as support for his contention that “various consumers have reacted positively to Patent Owner’s white filament products.” *See* Ex. 2001 ¶ 119 (citing Exs. 2032, 2033, 2034). Exhibits 2032, 2033, and 2034 are Feit Electric Instagram posts touting the company’s white filament products. *See* Exs. 2032, 2033, 2034. Exhibit 2034 includes advertising statements that tout the white filaments and picture purporting compare yellow filament and white filament bulbs. *See* Ex. 2034. Exhibits 2032 and 2033 include alleged user comments instead of the comparison picture. Exs. 2032, 2033. Exhibit 2032 reproduces what an alleged five-star review by “HomeDepotCustomer” stating “[y]ou can barely see the filament . . . in this case it’s a good thing to overlook the product.” Ex. 2032. Exhibit 2033 includes a five-star review from “Barbara B.” stating “[f]inally, someone figured out that yellow filaments in a bulb look awful when not lit!” Ex. 2033. We find these selected anonymous reviews from posts that are essentially advertisements to be entitled to little weight as industry praise. It is unclear whether these reviews are even real customers or simply generated for these advertisements and it is unclear whether these comments are representative or simply outliers. Thus, we give this evidence little weight as industry praise.

5. Copying

Copying by a competitor is a relevant consideration in the secondary considerations analysis. *Iron Grip Barbell Co. v. USA Sports, Inc.*, 392 F.3d

1317, 1325 (Fed. Cir. 2004). “Copying requires duplication of features of the patentee’s work based on access to that work, lest all infringement be mistakenly treated as copying.” *Institut Pasteur*, 738 F.3d at 1347–48.

Evidence of copying may include internal documents, direct evidence such as photos of patented features or disassembly of products, or access and similarity to a patented product. *Iron Grip Barbell*, 392 F.3d at 1325.

“[C]opying requires the replication of a specific product.” *Id.* And a “competing product that arguably fa[lls] within the scope of a patent” is not necessarily evidence of copying. *Id.* “Otherwise, every infringement suit would automatically confirm the nonobviousness of the patent.” *Id.* Thus, “if the only evidence of copying was a competitor’s abandonment of one product design and subsequent adoption of a design similar to that of a patented product after issuance of the patent, that did ‘not establish that [the competitor] engaged in copying.’” *Liqwd, Inc. v. L’Oreal USA, Inc.*, 941 F.3d 1133, 1137 (Fed. Cir. 2019). In other words, more is needed than merely showing that similarity exists between the patent and the competitor’s accused product. *See id.*

Patent Owner argues that “the subject proceeding was filed in response to district court actions asserting the ’539 Patent against Petitioners’ products.” PO Resp. 43 (citing Pet. 1–2). Patent Owner contends that “Petitioners’ accused white filament products all infringe the ’539 patent, all were introduced after Patent Owner’s patented products, and all mirror Patent Owner’s own white filament design.” *Id.* (citing Ex. 1138). Patent Owner submits that “[t]his copying of the invention shows that the challenged claims are not obvious,” and “[i]f the claims were obvious as

Petitioners claim, then Petitioners would have introduced their competing products years earlier to meet the long-felt need.” *Id.* at 43–44.

Patent Owner’s evidence and attorney argument are insufficient to show copying. To begin with, the only evidence cited to support its allegations of copying are infringement contentions for a different patent (U.S. Patent No. 8,604,678). *See* Ex. 1138. Patent Owner provides no comparison between its products and the accused products. Without even that basic foundation, we give no weight to Patent Owner’s attorney argument of copying.

6. Unexpected Results

Patent Owner argues that “Petitioners assert that the claimed invention is nothing more than the expected result of combining various prior art teachings.” PO Resp. 44. Patent Owner contends that “[t]he market shows otherwise,” and “[i]f the claimed invention were as obvious and expected as Petitioners contend, then they and others would have introduced white-filament LED bulbs to the market long before 2010 to meet the demonstrated consumer demand.” *Id.* (citing Ex. 2029; Ex. 2030; Ex. 2031; Ex. 2032; Ex. 2033; Ex. 2034; Ex. 2037). Patent Owner asserts that “[t]he fact that none of the Petitioners did so demonstrates that the results were unexpected.” *Id.*

“[W]hen unexpected results are used as evidence of nonobviousness, the results must be shown to be unexpected compared with the closest prior art.” *In re Baxter Travenol Labs.*, 952 F.2d 388, 392 (Fed. Cir. 1991). “It is well settled that unexpected results must be established by factual evidence. Mere argument or conclusory statements in the specification does not suffice.” *In re Soni*, 54 F.3d 746, 750 (Fed. Cir. 1995) (quoting *In re De*

Blauwe, 736 F.2d 699, 705 (Fed. Cir. 1984)). A showing of “unexpected results” requires that “the claimed invention exhibits some superior property or advantage that a person of ordinary skill in the relevant art would have found surprising or unexpected.” *Soni*, 54 F.3d at 750.

Patent Owner’s contentions of unexpected results fall well short of these requirements. Patent Owner provides no comparison to any prior art or any factual support besides its contention that no one introduced white-filament LED bulbs before 2010. We cannot conclude that the results were unexpected when Patent Owner has provided no evidence of what a person of ordinary skill would have expected. *See Pfizer, Inc. v. Apotex, Inc.*, 480 F.3d 1348, 1371 (Fed. Cir. 2007) (“Here, Pfizer’s evidence must fail because the record is devoid of any evidence of what the skilled artisan would have expected.”). Indeed, the prior art that Petitioner has provided suggests that the dispersion properties of titania were well known, and the use of such particles to obtain an off-state white appearance for LED lightbulbs was also known. *See* Ex. 1107; Ex. 1108.

Moreover, Patent Owner’s contentions are not commensurate with the scope of the claims. The claims do not require “white filaments” or any “filaments” at all. Thus, Patent Owner’s evidence that “white-filament LED bulbs” were not introduced before 2010 has little, if any probative value for the non-obviousness of the challenged claims. *See In re Greenfield*, 571 F.2d 1185, 1189 (CCPA 1978) (“Establishing that one (or a small number of) species gives unexpected results is inadequate proof, for ‘it is the view of this court that objective evidence of non-obviousness must be commensurate in scope with the claims which the evidence is offered to support.’” (quoting *In re Tiffin*, 448 F.2d 791, 792, (CCPA 1971))).

7. Summary

As discussed above, we find that Patent Owner has failed to show a nexus between the evidence of secondary considerations and the claimed invention. Moreover, we find that even if a nexus were to be shown, the evidence is entitled to little weight.

F. Obviousness of Claims 1–11, 18–20, and 23–25 Over Krummacher, Stokes, and Shimizu

Petitioner contends that claims 1–11, 18–20, and 23–25 of the '539 patent are unpatentable under 35 U.S.C. § 103(a) as obvious over Krummacher, Stokes, and Shimizu. Pet. 20–53. Patent Owner opposes. PO Resp. 27–38.

1. Claim 1

a) Petitioner's Contentions

Petitioner argues that “Krummacher discloses every element of the independent claims except which particle sizes were known to preferentially scatter blue light and the specific wavelength of blue light emitted by the LED chip.” Pet. 20. Petitioner asserts that “light defusing layers that preferentially scatter blue light and LED chips emitting blue light at greater than or equal to 440 nm were well known in the art as evidenced by Stokes and Shimizu (incorporated by reference in Stokes).” *Id.* at 20–21. Petitioner submits that Krummacher discloses “[a] wavelength conversion component for a light emitting device comprising,” *id.* at 21–22 (citing Ex. 1107 ¶¶ 34, 38, Figs. 1, 2; Ex. 1102 ¶¶ 110–114); “at least one photoluminescence material,” *id.* at 22–23 (citing Ex. 1107 ¶¶ 23, 36, 37, Figs. 1, 2; Ex. 1102 ¶¶ 95, 115–118); and “a light scattering material,” *id.* at 24 (citing Ex. 1107 ¶¶ 38, 39; Ex. 1102 ¶¶ 119–121).

With respect to limitation 1[c]

wherein the light scattering material has an average particle size that is selected such that the light scattering material will scatter excitation light from a radiation source relatively more than the light scattering material will scatter light generated by the at least one photoluminescence material,

Petitioner notes that Stokes discloses certain sizes of particles preferentially scatter blue or UV LED light as compared to yellow, green, red, or white light. *Id.* at 25 (citing Ex. 1108, 7:1–4). Petitioner further notes that Figure 10 of the '539 patent and Figure 6 of Stokes are “essentially the same,” and “show the relative scattering power of TiO₂ based on particle size for different colors of light.” *Id.* (citing Ex. 1102 ¶¶ 122–123).

Petitioner offers two theories for how the combination of Krummacher and Stokes teaches this limitation. Pet. 26–28. First, Petitioner argues that Krummacher discloses a light-scattering material with TiO₂ particles “preferably having a radius between 50 nm inclusive and 1000 nm inclusive.” *Id.* at 26 (citing Ex. 1107 ¶ 39). Petitioner asserts that “[a]ccording to the DuPont model, TiO₂ particles of such a size generally scatter more blue light (e.g., excitation light) than red or green light (e.g., light emitted by the phosphor).” *Id.* (citing Ex. 1102 ¶ 124). Thus, Petitioner contends that Krummacher teaches this claim limitation through its disclosure of the selection of average size particles that preferentially scatter blue light. *Id.*

Second, Petitioner argues that “[t]o the extent that the claim language ‘an average particle size that is selected such that [it preferentially scatters blue light]’ requires an average particle size selected for that reason (rather than an average particle size that leads to that outcome), this claim element

is rendered obvious by Stokes.” *Id.* at 26–27 (citing Ex. 1102 ¶ 125) (second alteration in original). Petitioner notes that Stokes discloses selection of particles of a size that preferentially scatters blue light. *Id.* at 27 (citing Ex. 1108, 7:1–4). Petitioner asserts that a person of ordinary skill in the art “would have had reason to use such a basis for selecting average particle size as taught by Stokes.” *Id.* (citing Ex. 1102 ¶¶ 126–128; Ex. 1108, 7:17–26). Petitioner contends that a person of ordinary skill in the art “would have been motivated to apply this principle to Krummacher, because it would increase the conversion of blue light to yellow light and improve the uniformity of the light source.” *Id.* (citing Ex. 1102 ¶ 128). Petitioner argues that “[c]onversion of blue light to yellow light is improved by maximizing the scattering of blue light,” and “[u]niformity is improved by preferentially scattering the concentrated light from the blue-light LED chip instead of the diffuse light emitted by the phosphor.” *Id.* at 27–28. Thus, a person of ordinary skill would have been motivated to combine the references. Petitioner also submits that a person of ordinary skill would have had a reasonable expectation of success in applying Stokes’s teachings regarding particle size to Krummacher. *Id.* at 28 (citing Ex. 1102 ¶ 129).

With respect to claim limitation 1[d]—

wherein the wavelength conversion component is configured such that in operation a portion of the excitation light comprising blue light having a wavelength of greater than or equal to 440 nm generated by the light emitting device is emitted through the wavelength conversion component to contribute to a final visible emission product,

Petitioner asserts that the combination of Krummacher, Stokes, and Shimizu teaches or suggests this limitation, and that a person of ordinary skill in the art would have been motivated to combine the references with a reasonable

expectation of success. *See id.* at 28–31 (citing Ex. 1102 ¶¶ 131–136; Ex. 1110, 23:43, 27:4–5, 28:55, 25:24–25; 29:45; Ex. 1108, 4:37–40; Ex. 1107 ¶ 3). Petitioner notes that Stokes and Shimizu provide details of the conventional white light source used in Krummacher. *Id.* at 31.

Finally, Petitioner argues that the combination of Krummacher and Stokes teaches limitation 1[e]—“wherein the light scattering material scatters the blue light at least twice as much as light generated by the at least one photoluminescence material.” Pet. 32–37 (citing Ex. 1102 ¶¶ 137–144; Ex. 1108, 7:4–17; Ex. 1101, 8:50–54). Petitioner submits that Stokes discloses ranges that overlap with those disclosed in the ’539 patent. *Id.* at 32–33. Furthermore, Petitioner argues that “Stokes discloses the routine optimization of average particle size to preferentially scatter blue light.” *Id.* at 35 (citing Ex. 1102 ¶¶ 140–141) (footnote omitted). Petitioner asserts that “Stokes explicitly discloses selecting an average particle size that scatters excitation light at least 1.5 times as much as light emitted by the phosphor and gives an exemplary range of 0.10 to 0.20 microns (100 to 200 nm).” *Id.* at 35–36 (citing Ex. 1108, 7:4–17; Ex. 1124 ¶¶ 80–81). Thus, Petitioner submits that it would have been obvious to a person of ordinary skill to select an average particle size based on, among other things, the light scattering properties of the particles to arrive at the claimed range. *Id.* at 36–37 (citing Ex. 1102 ¶¶ 143–144).

b) Patent Owner’s Contentions

Patent Owner argues that Petitioner has failed to carry its burden because it does not adequately show “an average particle size that is selected such that the light scattering material will scatter excitation light . . . relatively more than the light scattering material will scatter light generated

by the at least one photoluminescence material,” which is recited by all the independent claims. PO Resp. 27–32. Patent Owner raises several reasons for this contention. First, Patent Owner asserts that Petitioner fails to explain what theory it is relying on. *Id.* at 27–29. Second, Patent Owner argues that Krummacher “describes a vast range of particle sizes without identifying any part of that range as particularly beneficial or what the resulting benefits might be.” *Id.* at 29. Patent Owner asserts that Krummacher is silent as to average particle size, and its disclosed range “would cover particle sizes where the blue light scattering is near equal with either green or red light.” *Id.* at 29–30. Thus, Patent Owner argues that “there is no teaching of the claimed ‘average particle size’ from Krummacher’s disclosure, and Petitioners’ statement that ‘Krummacher renders obvious this claim element’ necessarily fails.” *Id.* at 30–31.

With respect to Stokes, Patent Owner argues that the cited passages identify “no specific particle sizes,” and “Stokes does not address *average* particle sizes.” *Id.* at 31. Patent Owner also contends that “the Petition also fails to explain *how* a POSITA would have modified Krummacher in view of Stokes” nor “does the Petition explain why a POSITA would have been motivated to combine *any* of the teachings from these two very different prior art references, much less the additional teachings upon which Petitioners rely from the Shimizu reference.” *Id.* at 31–32.

Patent Owner also argues that Petitioner “has not articulated any meaningful motivation to combine or a reasonable expectation of success.” *Id.* at 32. Patent Owner asserts that Petitioner fails to account for the differences among the references and offers only conclusory statements. *See id.* at 33–34. Patent Owner contends that Krummacher, Shimizu, and Stokes

are all different applications of LEDs. Patent Owner submits that “Krummacher discloses vertical flow chip configurations utilized in large area lighting units . . . , which is entirely different than the applications disclosed in Shimizu and Stokes.” *Id.* at 34. Patent Owner notes that “Shimizu discloses DIP and lead-frame SMD LEDs in industrial applications such as LED displays, back light sources, traffic signals, railway signals, etc. . . . , and Stokes also discloses DIP and lead-frame SMD LEDs involved in commercial applications such as automotive, display, and safety/emergency uses.” *Id.* Patent Owner argues that “[t]hese applications require different packaging approaches than Krummacher, and Petitioners have not demonstrated how a POSITA would easily incorporate the LEDs of Shimizu or Stokes into Krummacher beyond so-called ‘simple substitution.’” *Id.*

Finally, Patent Owner argues that “Prof. Doolittle’s theory of swapping the Stokes or Shimizu LED into the application of Krummacher would have been counterintuitive to a POSITA at the time of the invention because it would have resulted in lower light output.” *Id.* at 36. Patent Owner asserts that “[t]he quantum efficiency of blue light LEDs decreases with longer wavelengths.” *Id.* (citing Ex. 2001 ¶¶ 47–50, 107–110). Patent Owner submits that “[e]xternal quantum efficiency is the number of photons that escape from the LED device per number of electrons.” *Id.* Patent Owner contends that “[a] POSITA generally would have been interested in LEDs emitting light at shorter wavelengths (UV and near-UV) where the quantum efficiency is higher because the LED is more effective at converting electrical input into light particles.” *Id.* at 37 (citing Ex. 2001 ¶¶ 107–110). Patent Owner argues that “[o]ther than improper hindsight,

Petitioners offer no explanation as to why a POSITA would have found it obvious to accept the lower light output that comes with wavelengths longer than 440 nm.” *Id.* As for the particle size limitation, Patent Owner argues that Stokes provides no reason to adopt its particle size range. *Id.* at 37–38.

c) Analysis

With respect to the undisputed limitations of claim 1, we find that Petitioner has shown that the combination of Krummacher, Stokes, and Shimizu accounts for those limitations. *See* Pet. 20–37. We focus our discussion on limitation 1[c]—“wherein the light scattering material has an average particle size that is selected such that the light scattering material will scatter excitation light from a radiation source relatively more than the light scattering material will scatter light generated by the at least one photoluminescence material,” and the motivation to combine. We find that Petitioner has shown by a preponderance of the evidence that the combination of Krummacher and Stokes teaches limitation 1[c] and that would be a motivation to combine the references in the manner suggested.

First, we disagree with Patent Owner that Petitioner fails to identify which specific teachings the grounds rely upon. PO Resp. 27–28. Petitioner sets out two theories for how the references teach this limitation, with citations to each reference and supporting explanation. *See* Pet. 26–27. In addition, the Petition provides additional explanation in its discussion of limitation 1[e]. *See id.* at 32–37. Thus, we find that the Petition has sufficient particularity.

Indeed, we find that Krummacher teaches the use of TiO₂ nanoparticles with a radius of between 50 nm and 1000 nm. Ex. 1107 ¶ 39. As Petitioner notes, Stokes teaches that “the radiation scattering particles

have a size such that the particles preferentially scatter blue or UV LED light as compared to yellow, green, red or white light from the luminescent material.” Ex. 1108, 7:1–4. Thus, we find that the combination of Stokes and Krummacher discloses selecting a particle size to preferentially scatter the light generated by the radiation source (i.e., the blue LED). *See* Ex. 1102 ¶¶ 124–128.

We also find that Petitioner has shown sufficiently that Stokes discloses selecting an “average” particle size. As the Petition explains in the context of limitation 1[e], Stokes teaches selecting an exact particle size, and that “the average particle size of a set of exact theoretical particles is the same as the exact particle size.” *See* Pet. 35 n.4 (citing Ex. 1102 ¶ 140 n.6). We find this disclosure and evidence more than sufficient to teach this limitation, but as Petitioner notes in the Reply, Stokes unambiguously discloses average particle size. *See* Reply 5 (citing Ex. 1108, 6:60–7:8⁹)

As for the motivation to combine Krummacher and Stokes for limitation 1[d], Petitioner notes that Krummacher already discloses a light scattering material with TiO₂ particles “preferable having a radius of between 50 nm inclusive and 1000 nm inclusive.” Pet. 26 (citing Ex. 1107

⁹ We note part of this portion of Stokes (6:62–67) was cited with respect to limitation 1[d], even if it was not cited with respect to limitation 1[c]. We further note that we find Petitioner’s identification of this portion of column 6 of Stokes to be responsive to Patent Owner’s assertion that “[n]owhere in Stokes . . . is there any discussion of *average* particle size.” Sur-Reply 10. However, Stokes in column 6 (Ex. 1108, 6:53–67) does discuss the preferred “mean diameter” of the light-scattering particles for LEDs with different peak wavelengths. As Patent Owner acknowledged at the oral hearing that a “mean” is an average. Tr. 23:22–23. Thus, we consider this citation to be responsive to Patent Owner’s assertions regarding Stokes.

¶ 39). Petitioner further relies on Stokes to teach an average particle size that preferentially scatter blue . . . LED light as compared to yellow . . . light from the luminescent material.” *Id.* at 26–27 (citing Ex. 1108, 7:1–4). Petitioner argues that “a POSA would have been motivated to apply this principle to Krummacher, because it would increase the conversion of blue light to yellow light and improve the uniformity of the light source.” *Id.* at 27 (citing Ex. 1102 ¶ 237). Petitioner notes that “[c]onversion of blue light to yellow light is improved by maximizing the scattering of blue light.” *Id.* In addition, Petitioner asserts that “[u]niformity is improved by preferentially scattering the concentrated light from the blue-light LED chip instead of the disperse light emitted by the phosphor.” *Id.* at 28 (citing Ex. 1102 ¶ 237). Petitioner contends that “[a] POSA would have had a reasonable expectation of success applying this principle to Krummacher, because the relevant particle size range includes the range disclosed by Krummacher.” *Id.* Petitioner argues that “[a] POSA would have recognized selecting an average particle size as a design decision to be made based on a number of factors, including the light scattering properties of the particles, and well within the skill of the art.” *Id.* (citing Ex. 1102 ¶ 238). We find this explanation and the supporting testimony of Dr. Doolittle well-reasoned and supported and entitled to significant weight. Thus, we find that Petitioner has shown by a preponderance of the evidence that the combination of Krummacher and Stokes teaches limitation 1[c], and that a person of ordinary skill in the art would have been motivated to combine the references in the manner proposed.

We also find that Petitioner has shown by a preponderance of the evidence that a person of ordinary skill in the art would have been motivated

to combine Krummacher with Shimizu and Stokes to arrive at limitation 1[d]—“wherein the wavelength conversion component is configured such that in operation a portion of excitation light comprising blue light having a wavelength of greater than or equal to 440 nm generated by the light emitting device is emitted through the wavelength conversion component to contribute to a final visible emission product.” A motivation to combine may be found “explicitly or implicitly in market forces; design incentives; the ‘interrelated teachings of multiple patents’; ‘any need or problem known in the field of endeavor at the time of invention and addressed by the patent’; and the background knowledge, creativity, and common sense of the person of ordinary skill.” *ZUP, LLC v. Nash Mfg., Inc.*, 896 F.3d 1365, 1371 (Fed. Cir. 2018) (quoting *Plantronics, Inc. v. Aliph, Inc.*, 724 F.3d 1343, 1354 (Fed. Cir. 2013)).

As the Petition explains, Krummacher discloses the use of blue LED, but does not specify the wavelength at which the chip operates. Pet. 28–30 (citing Ex. 1107 ¶¶ 3, 22, 31–32). We agree with Petitioner that a person of ordinary skill would turn to known references, such as Shimizu, which is acknowledged as conventional and known by ’539 patent, and Stokes. See Ex. 1101, 1:34–38. Indeed, Petitioner notes that Shimizu, in summarizing the state of the art, discloses a dozen examples with blue-light LED chips having emission peaks greater than 440 nm. See Pet. 30–31 (citing Ex. 1110, Figs., 23:43 (450 nm), 27:4–5 (450 nm), 28:55 (450 nm), 25:24–25 (460 nm), 29:45 (470 nm)). In addition, Petitioner notes that “Stokes discloses an LED chip that ‘emits blue light 48 having a wavelength between about 420 and 480 nm’ along with ‘blue emitting LEDs having a

peak emission wavelength of $\lambda=450$ nm’ or ‘peak emission wavelength of $\lambda=480$ nm.’” *Id.* at 30–31 (Ex. 1108, 4:37–40, 6:62–67).

Particularly when viewed in the context of the background references Petitioner provided, the evidence strongly supports the notion that the wavelength range claimed (blue light with a wavelength greater than 440 nm) was “nothing more than the ‘combination of familiar elements according to known methods,’ ‘each performing the same function it had been known to perform,’ ‘yield[ing] predictable results.’” *Randall Mfg. v. Rea*, 733 F.3d 1355, 1363 (Fed. Cir. 2013) (citing *KSR*, 550 U.S. at 416–17).

Patent Owner’s arguments to the contrary are not availing. First, as we explain above, we disagree with Patent Owner that Petitioner failed to explain why a person of ordinary skill would combine Krummacher, Stokes, and Shimizu. PO Resp. 32. Second, we disagree with Patent Owner that the different LED applications of Krummacher, Shimizu, and Stokes would dissuade a person of ordinary from combining these references. *Id.* at 34–36. As an initial matter, “[t]he test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference.” *Allied Erecting & Dismantling Co. v. Genesis Attachments, LLC*, 825 F.3d 1373, 1381 (Fed. Cir. 2016). Petitioner has shown that white-light LED assemblies that used blue-light LEDs with wavelengths greater than 440 nm were well known and conventional. There is no need to show that the LEDs from Shimizu or Stokes can be bodily incorporated into Krummacher. Contrary to Patent Owner’s suggestions, we disagree that the Petition proposes such bodily incorporation. PO Resp. 34–36 (“These applications require different packaging approaches than Krummacher, and Petitioners have not demonstrated how a POSITA would

easily incorporate the LEDs of Shimizu or Stokes into Krummacher beyond so-called ‘simple substitution.’”). Petitioner merely relies on these references for their teachings regarding wavelengths and suggests only using an LED “like” that disclosed in Shimizu and Stokes. *See* Pet. 31.

Finally, we do not agree with Patent Owner that “quantum efficiency” would have dissuaded a person of ordinary skill from making the combination. PO Resp. 36–38. To begin with, “[i]t’s not necessary to show that a combination is the best option, only that it be a suitable option.” *Intel Corp. v. Qualcomm Inc.*, 21 F.4th 784, 800 (Fed. Cir. 2021). Here, as demonstrated by, at least, Shimizu and Stokes, blue LEDs in this wavelength range were known to work as light sources for white-light LEDs. *See* Pet. 30–31. Additionally, we find persuasive Petitioner’s evidence that a person of ordinary skill in the art would not have been concerned solely with quantum efficiency, but also with overall luminous efficacy of a complete white LED package. Reply 9. As Dr. Schubert’s textbook explains,

A fundamental drawback of UV pumped white LEDs is the energy loss (Stoke’s shift). The potential luminous efficacy of UV pumped white LED lamps is, therefore, markedly lower than that of white sources based on a blue LED exciting a yellow phosphor.

Ex. 2014, 358–59; *see also* Ex. 1148, 87:5–88:4 (acknowledging Stokes shift).

Thus, the evidence shows that, whatever gain in quantum efficiency a lower wavelength might offer, there were other drawbacks that a person of ordinary skill would have to balance. But “a given course of action often has simultaneous advantages and disadvantages, and this does not necessarily obviate motivation to combine.” *Medichem*, 437 F.3d at 1165.

Indeed, Petitioner has shown several references—including, Shimizu and Stokes—that made this tradeoff. Moreover, “[o]bviousness does not require absolute predictability of success. . . . [A]ll that is required is a reasonable expectation of success.” *In re O’Farrell*, 853 F.2d 894, 903–04 (Fed. Cir. 1988). We find that the prior art of record demonstrates that a person of ordinary skill in the art at the time of the invention would have such an expectation in making the combination of Krummacher, Stokes, and Shimizu. Accordingly, we find that Petitioner has shown by a preponderance of the evidence that there would have been motivation to combine Krummacher, Stokes, and Shimizu with a reasonable expectation of success.

d) Summary as to Claim 1

We find that Petitioner has shown by a preponderance of the evidence that the combination of Krummacher, Stokes, and Shimizu accounts for all the limitations of claim 1 and that a person of ordinary skill in the art would have been motivated to combine Krummacher, Stokes, and Shimizu with a reasonable expectation of success. Weighing Petitioner’s strong showing on the scope and content of the prior art and the motivation to combine the references against Patent Owner’s evidence of objective indicia of non-obviousness, we find that Petitioner has shown by a preponderance of the evidence that claim 1 would have been obvious over the combination of Krummacher, Stokes, and Shimizu.

2. Claims 2–11, 18–20, and 23–25

Patent Owner does not raise any other separate arguments regarding claims 2–11, 18–20, and 23–25 other than those we have considered above with respect to claim 1. *See* PO Resp. 27–38 (presenting arguments for

ground 1). We do not find Patent Owner's arguments availing, as explained above. We have reviewed Petitioner's contentions regarding claims 2–11, 18–20, and 23–25 (Pet. 37–53), and find that Petitioner has shown by a preponderance of the evidence that Krummacher, Stokes, and Shimizu teach the limitations of those claims, and that there would have been a motivation to combine the references in the manner suggested with a reasonable expectation of success. Accordingly, we find that Petitioner has shown by a preponderance of the evidence that claims 2–11, 18–20, and 23–25 would have been obvious over Krummacher, Stokes, and Shimizu, for the reasons stated in the Petition.

G. *Obviousness of Claims 18 and 28 Over Hussell, Krummacher, Stokes, and Van Woudenberg*

Petitioner contends that claims 18 and 28 of the '539 patent are unpatentable under 35 U.S.C. § 103(a) as obvious over Hussell, Krummacher, Stokes, and Van Woudenberg. Pet. 53–78. Patent Owner opposes. PO Resp. 27–32, 38–41.

1. *Petitioner's Contentions*

Petitioner submits that Hussell discloses every element in claims 18 and 28 except which particle sizes were known to preferentially scatter blue light and the specific wavelength of the blue light emitted by the LED chip. Pet. 53. Petitioner contends that light diffusing layers preferentially scattering blue light and LED chips emitting blue light at great than or equal to 440 nm were well known in the art as evidenced by Krummacher, Stokes, Van Woudenberg. *Id.* Thus, Petitioner contends that claims 18 and 28 would have been obvious over the combination of Hussell, Krummacher, Stokes, and Van Woudenberg.

Petitioner argues that Hussell discloses a “light-emitting device” or “light bulb” comprising “at least one solid-state emitter.” *See* Pet. 55–57 (citing Ex. 1111, code (57), ¶¶ 14, 52, Fig. 17; Ex. 1102 ¶¶ 216, 217). Petitioner submits that Hussell discloses LED devices configured so that the claimed wavelength conversion component defines a light mixing chamber. *See id.* at 57–59 (citing Ex. 1111 ¶ 14, 17, 32, 41, 52, Figs. 1, 17; Ex. 1102 ¶¶ 219, 220, 221). Petitioner asserts that Hussell¹⁰ discloses a “photoluminescence material.” *Id.* at 59–61 (citing Ex. 1111, code (57), ¶¶ 37, 42, Fig. 1B; Ex. 1102 ¶ 222). Petitioner argues that the combination of Hussell and Krummacher and Van Woudenberg teaches the “light scattering material.” *Id.* at 61–65 (citing Ex. 1107 ¶¶ 11, 31, 34, 36, 41; Ex. 1111 ¶¶ 6, 36, 48; Ex. 1120, code (57), 1:14–28; Ex. 1102 ¶¶ 224–230). Petitioner argues that a person of ordinary skill in the art would have been motivated to add a light diffusing layer on the outer surface of Hussell’s wavelength conversion tube to create an off-state white appearance as disclosed in Krummacher and Van Woudenberg. *Id.*

Petitioner submits that Krummacher in view of Stokes, similar to limitation 1[e] discussed above, discloses “wherein the light scattering material has an average particle size that is selected such that the light scattering material will scatter excitation light from a radiation source relatively more than the light scattering material will scatter light generated by the at least one photoluminescence material.” *Id.* at 65–69 (citing

¹⁰ Although the section begins by stating that the “combination of Hussell and Krummacher discloses these limitations,” all the citations in this section are to Hussell and the section concludes by stating Hussell discloses the photoluminescence material.” Thus, we consider the discussion of the combination for this limitation to be a typographic error.

Ex. 1108, 7:1–4, 7:17–26; Ex. 1107 ¶ 39; Ex. 1102 ¶¶ 231–238). Petitioner submits that a person of ordinary skill in the art would have been motivated to look to Stokes as a basis for selecting an average particle sized based on Stokes teachings about the advantages its disclosed particle size range. *Id.* at 68 (citing Ex. 1108, 7:17–26). Petitioner asserts that the combination of Hussell, Krummacher, Stokes, and Van Woudenberg teaches the limitation “wherein the wavelength conversion component is configured such that in operation a portion of light comprising blue light having a wavelength of greater than or equal to 440 nm generated by the [at least one/ one or more] solid-state light emitter[s] is emitted through the wavelength conversion component to contribute to a final visible emission product.” *Id.* at 69–72 (citing Ex. 1111 ¶¶ 6, 37, 41, 42; Ex. 1120, 5:14–24, Fig. 2; Ex. 1102 ¶¶ 240–243).

Petitioner notes that Hussell discloses emitting light through its wavelength conversion component from a blue LED, but does not disclose the specific wavelength of that blue LED. *Id.* at 69–70. Petitioner argues that a person of ordinary skill in the art would have understood that the wavelength emitted from blue LED of the combination would be greater than or equal 440 nm, based on the teachings of Van Woudenberg. *See id.* at Finally, Petitioner contends that the combination of Hussell, Krummacher, and Stokes teaches the limitation of “wherein the light scattering material scatters the blue light at least twice as much as light generated by the at least one photoluminescence material.” *Id.* at 73–78 (citing Ex. 1102 ¶¶ 244–251; Ex. 1108, 7:4–17; Ex. 1124 ¶¶ 80–81).

2. Patent Owner's Contentions

Patent Owner argues that, as with Ground 1, Petitioner has failed to show that the combination teaches the claimed “average particle size.” PO Resp. 27–32; Sur-Reply 8–10.

Patent Owner also argues that Petitioner did not meet its burden to show that there would be a motivation to combine these references. *See* PO Resp. 38–41; Sur-Reply 7–8. Patent Owner asserts that Petitioner fails to address the “very different lighting applications disclosed in these three separate references or explain why one of ordinary skill in the art would have selectively combined the cited teachings from these references.” PO Resp. 38. Patent Owner contends that “Petitioners’ arguments for combining these *four* references are either: (i) non-existent or (ii) cherry-picked to identify only two references at a time.” *Id.* at 39. For example, Patent Owner argues that for one limitation there is no motivation provided to combine Hussell and Krummacher, and for another limitation, there is only a motivation to combine Krummacher and Stokes. *Id.* Patent Owner asserts that “[s]uch haphazard combinations without relevant motivation to combine each of the four references to arrive at the claimed invention is insufficient.”

Patent Owner further argues that Hussell, Krummacher, Stokes, and Van Woudenberg “are all different applications of LEDs.” *Id.* Patent Owner submits that “Hussell involves conventional incandescent replacement applications,” “Krummacher depicts vertical chip configurations utilized in large area lighting units,” “Stokes involves DIP and SMD LEDs in commercial applications such as automotive, display, and safety emergency uses,” and “Van Woudenberg involves ‘auxiliary lights in

mobile phones or down-light units’ using DIP and SMD LEDs.” *Id.* at 39–40. Patent Owner contends that “Petitioners offer nothing to meaningfully address how a POSITA would accommodate these differences to apply Krummacher’s light-scattering translucent layer in a vertical chip configuration to Hussell’s incandescent replacement application or Stokes or Van Woudenberg’s DIP and SMD LEDs beyond generic ‘laminat[ing] or glu[ing].” *Id.* at 40. Patent Owner argues that “[a] POSITA would not find the packaging requirements for each structure and application able to be combined with a reasonable expectation of success.” *Id.* Finally, Patent Owner reiterates its arguments addressed above regarding the quantum efficiency of blue light LEDs. *Id.*

3. Analysis

Petitioner provides a mapping of claims 18 and 28 to the disclosures of Hussell, Krummacher, Stokes, and Van Woudenberg. *See* Pet. 55–79. Patent Owner does not dispute that the combination accounts for the limitations of claims 18 and 28 besides the “average particle size” limitation. We have reviewed Petitioner’s mapping and find that Petitioner has shown by a preponderance of the evidence that combination accounts for the undisputed limitations of these claims. We focus our analysis on “average particle size” and the motivation to combine the references.

Patent Owner makes the same arguments considered above with respect to the “average particle size” limitation. For the reasons discussed above, we do not find those arguments persuasive. *See supra* at 39–41.

We find that Petitioner has shown by a preponderance of the evidence that a person of ordinary skill in the art would be motivated to make the combination and modifications proposed. As Petitioner explains, Hussell

discloses that it uses “blue light emitting LED” but does not disclose the wavelength of this blue LED. Pet. 69–72. As Petitioner explains, Van Woudenberg, which also creates white light through YAG phosphor conversion using blue-light LEDs, teaches that the “primary light” emitted by an LED chip typically has a wavelength between 430 and 480 nm with the greatest distribution at around 440 nm. *Id.* at 71 (citing Ex. 1120, 5:14–24). Van Woudenberg further provides teachings explaining that the light hitting the phosphor is converted into a much longer wavelength. *Id.* (citing Ex. 1120, Fig. 2). We find that Petitioner has shown sufficiently that a person of ordinary skill in the art seeking to understand the operating wavelength for blue LEDs in YAG phosphor systems, like those used in Hussell and Van Woudenberg, would look to a reference, such as Van Woudenberg, which provides detailed teachings, in the form of Figure 2, for the operating wavelengths for such systems. *See Realtime Data LLC v. Iancu*, 912 F.3d 1368, 1374 (Fed. Cir. 2019) (finding a motivation to combine where a POSITA would be encouraged to look to reference to understand and interpret another reference’s teachings).

Petitioner then proposes applying the light scattering layer of Krummacher, as modified by Stokes, to the combined device of Hussell and Van Woudenberg. *See* Pet. 61–69. As the Petition explains, Van Woudenberg and Krummacher both explicitly teach that there was a desire to improve the off-state white appearance of the wavelength conversion layer. *See* Ex. 1120, 1:14–28; Ex. 1107 ¶¶ 4, 41; Ex. 1102 ¶¶ 224–226. Krummacher also expressly teaches that its light scattering layer can be applied to the wavelength conversion layer and teaches how to do so. *Id.* ¶¶ 42–45. Thus, as the Petition explains, a person of ordinary skill would be

motivated to turn to Krummacher to address the known problem of off-state white appearance of the Hussell/Van Woudenberg wavelength conversion component. *See* Ex. 1102 ¶¶ 227–228. Indeed, the combination of Krummacher’s light scattering layer with the combined device of Hussell and Van Woudenberg is nothing more than “the predictable use of prior art elements according to their established functions.” *KSR*, 550 U.S. at 417.

As discussed above with respect to claim 1, Petitioner further proposes modifying Krummacher’s light diffusing layer in view of Stokes’s teachings regarding average particle size to preferentially scatter blue light from the LED. *See* Pet. 73–78. As discussed above, we have found that Petitioner has shown by a preponderance of the evidence that person of ordinary skill in the art would have been motivated to modify Krummacher’s light diffusing layer in this manner in view of Stokes. *See supra* at 41–43.

Patent Owner’s arguments to the contrary are not availing. We disagree with Patent Owner’s assertion that Petitioner’s arguments are brief or conclusory. Here, the reason to combine is found in the references themselves. Hussell discloses it uses a blue LED (*see* Ex. 1111 ¶ 6) but does not disclose the precise wavelength of that LED. Van Woudenberg, however, explains in detail wavelengths that work with a YAG phosphor system. *See* Ex. 1120, 5:14–24, Fig. 2. Krummacher expressly acknowledges the problem of off-state white appearance and provides a solution and explains how to apply that solution generally. *See* Ex. 1107 ¶¶ 41–45. Finally, Krummacher discloses the use of TiO₂ nanoparticles of between 50 nm and 1000 nm, and Stokes discloses that within that range it is advantageous to select a particle size that preferentially scatters blue light more than yellow, green, or red. *See* Ex. 1107 ¶ 39; Ex. 1108, 7:1–7, 7:17–

26. Thus, we find that Dr. Doolittle’s testimony that a person of ordinary skill in the art would have been motivated to combine the references in the manner suggested, well supported by the references cited. *See* Ex. 1102 ¶¶ 211–238.

As for Patent Owner’s arguments about the differences in the references, Patent Owner ignores that the actual combination proposed in the Petition. Petitioner does not propose wholesale combination of these three devices, but rather Petitioner incorporates specific teachings from each. Moreover, we fail to see how gluing a plastic film (Krummacher’s light scattering layer) to a tube (Hussell/Van Woudenberg’s wavelength conversion tube) and selecting a particular particle size range (as taught by Stokes)—as proposed in the Petition—is beyond the level of skill in the art. *See KSR*, 550 U.S. at 421 (“A person of ordinary skill is also a person of ordinary creativity, not an automaton.”). Finally, we addressed Patent Owner’s quantum efficiency arguments above, and did not find them persuasive. *See supra* at 43–44.

Thus, we find that Petitioner has shown by a preponderance of the evidence that a person of ordinary skill in the art would have been motivated to combine Hussell, Krummacher, Stokes, and Van Woudenberg in the manner proposed with a reasonable expectation of success.

We find that Petitioner has shown by a preponderance of the evidence that the combination of Hussell, Krummacher, Stokes, and Van Woudenberg accounts for all the limitations of claims 18 and 28, and that a person of ordinary skill in the art would have been motivated to combine Hussell, Krummacher, Stokes, and Van Woudenberg with a reasonable expectation of success. Weighing Petitioner’s strong showing on the scope and content

of the prior art and the motivation to combine the references against Patent Owner's evidence of objective indicia of non-obviousness, we find that Petitioner has shown by a preponderance of the evidence claims 18 and 28 would have been obvious over the combination of Hussell, Krummacher, Stokes, and Van Woudenberg.

IV. CONCLUSION

After considering the evidence and arguments presented in the Petition, we determine that Petitioner has established by a preponderance of the evidence that the challenged claims of the '539 patent are unpatentable as obvious over the combinations of Krummacher, Stokes, and Shimizu and Hussell, Krummacher, Stokes, and Van Woudenberg, notwithstanding Patent Owner's arguments.

V. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that, pursuant to 35 U.S.C. § 318(a), claims 1–11, 18–20, 23–25, and 28 of the '539 patent have been shown to be unpatentable; and

FURTHER ORDERED that any party seeking judicial review must comply with the notice and service requirements of 37 C.F.R. § 90.2.¹¹

¹¹ 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:

Claim(s)	35 U.S.C. §	Reference(s)/Basis	Claim(s) Shown Unpatentable	Claim(s) Not shown Unpatentable
1–11, 18–20, 23–25	103(a)	Krummacher, Stokes, Shimizu	1–11, 18–20, 23–25	
18, 28	103(a)	Hussell, Krummacher, Stokes, Van Woudenberg	18, 28	
Overall Outcome			1–11, 18–20, 23–25, 28	

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Patent 8,614,539 B2

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