

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAVANT TECHNOLOGIES LLC d/b/a GE LIGHTING and
LEDVANCE LLC,
Petitioners,

v.

FEIT ELECTRIC COMPANY, INC.,
Patent Owner.

Case IPR2024-01357
U.S. Patent No. 8,604,678

PATENT OWNER'S RESPONSE

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Patent Trial and Appeal Board
U.S. Patent and Trademark Office
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2001	Declaration of E. Fred Schubert, Ph.D.
2002	<i>Curriculum vitae</i> for E. Fred Schubert, Ph.D.
2003	U.S. Patent Publication 2002/0180351 (“McNulty”)
2004	U.S. Patent Publication 2001/0000622 (“Reeh”)
2005	Scheduling Order (Dkt. 37), <i>Feit Electric Co., Inc. v. Elong International USA Inc.</i> , No. 3:24-cv-1089 (N.D. Tex.)
2006	June 2024 United States District Courts — Federal Court Management Statistics for N.D. Tex., E.D. Ky., and N.D. Ohio (https://www.uscourts.gov/statistics-reports/federal-courtmanagement-statistics-june-2024)
2007	Case Management Order (Dkt. 19), <i>Feit Electric Co., Inc. v. Savant Technologies LLC d/b/a GE Lighting</i> , No. 1:24-cv-473 (N.D. Ohio)
2008	Scheduling Order (Dkt. 33), <i>Feit Electric Co., Inc. v. Ledvance, LLC</i> , No. 5:24-cv-31 (E.D. Ky.)
2009	Savant’s Initial Invalidity and Unenforceability Contentions, <i>Feit Electric Co., Inc. v. Savant Technologies LLC d/b/a GE Lighting</i> , No. 1:24-cv-473 (N.D. Ohio), served on September 5, 2024
2010	Ledvance’s Initial Invalidity and Unenforceability Contentions, <i>Feit Electric Co., Inc. v. Ledvance, LLC</i> , No. 5:24-cv-31 (E.D. Ky.), served on September 24, 2024
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2012	Comparison of Petition and Expert Testimony Analysis
2013	Mike Krames, <i>Light-Emitting Diode Technology for Solid-State Lighting</i> , in <i>Frontiers of Engineering: Reports on Leading-Edge Engineering from the 2009 Symposium</i> , 67 (2009)
2014	E. Fred Schubert, <i>Light-Emitting Diodes</i> (2nd ed. 2006)
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2023	Declaration of William A. Doolittle, Ph.D., dated November 6, 2024, <i>Feit Electric Company, Inc. v. Savant Technologies, d/b/a GE Lighting</i> , Case No. 24-cv-00473
2024	Rebuttal Declaration of William A. Doolittle, Ph.D., dated November 20, 2024, <i>Feit Electric Company, Inc. v. Savant Technologies, d/b/a GE Lighting</i> , Case No. 24-cv-00473
2025	Deposition Transcript of William A. Doolittle, Ph.D., dated June 10, 2025
2026	Declaration of E. Fred Schubert, Ph.D., dated June 25, 2025
2027	U.S. Provisional App. No. 61/427,411, filed on December 21, 2010
2028	U.S. Provisional App. No. 61/390,091, filed on October 5, 2010
2029	Home Depot - Feit Electric White Filament LED Light Bulbs listing
2030	Candle Power Forums article: Feit LED filament bulb with white filaments
2031	The Home Depot Announces 2024 Innovation Award Winners

Exhibit	Description
2032	Feit Electric Lighting Instagram consumer comments regarding filaments
2033	Feit Electric Lighting Instagram consumer comments regarding yellow filaments
2034	Feit Electric Lighting Instagram consumer comments: Regular Yellow Filament vs. White Filament
2035	Home Depot White Filament price point of \$29.97
2036	Home Depot Yellow Filament price point of \$21.97
2037	Reddit: Do white filament LED edison bulbs exist?

CLAIM LISTING

Independent Claim 1	
1[pre]	A wavelength conversion component for a light emitting device comprising:
1[a]	a wavelength conversion layer comprising particles of at least one photoluminescence material; and
1[b]	a light diffusing layer comprising particles of a light scattering material,
1[c]	wherein the light diffusing layer improves an off-state white appearance of the wavelength conversion component;
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.

Dependent Claim 2	
2[pre]	The component of claim 1,
2[a]	wherein the wavelength conversion layer and the light diffusing layer are in direct contact with each other.
Dependent Claim 3	
3[pre]	The component of claim 1,
3[a]	wherein the wavelength conversion layer comprises a mixture of the at least one phosphor material and a light transmissive binder and the light diffusing layer comprises a mixture of the light scattering material and the light transmissive binder.

Dependent Claim 6	
6[pre]	The component of claim 3,
6[a]	wherein the light transmissive binder comprises a curable liquid polymer selected from the group consisting of: a polymer resin, a monomer resin, an acrylic, an epoxy, a silicone and a fluorinated polymer.
Dependent Claim 7	
7[pre]	The component of claim 3,
7[a]	wherein the weight loading of light scattering material to binder selected from the group consisting of: 7% to 35% and 10% to 20%.
Dependent Claim 9	
9[pre]	The component of claim 1,
9[a]	wherein the wavelength conversion and light diffusing layers are deposited using a method selected from the group consisting of: screen printing, slot die coating, spin coating, roller coating, drawdown coating and doctor blading.
Dependent Claim 10	
10[pre]	The component of claim 1,
10[a]	wherein the light scattering material is selected from the group consisting of: titanium dioxide, barium sulfate, magnesium oxide, silicon dioxide and aluminum oxide.
Dependent Claim 16	
16[pre]	The component of claim 1
16[a]	in which the wavelength conversion layer and the light diffusing layer comprises planar shapes.
Dependent Claim 17	
17[pre]	The component of claim 1

17[a]	in which the light diffusing layer comprises a dome or elongated dome shape.
Dependent Claim 18	
18[pre]	The component of claim 17
18[a]	in which the wavelength conversion layer fills a volume formed beneath the dome or elongated dome shapes.

Independent Claim 19	
19[pre]	A light emitting device, comprising:
19[a]	at least one solid-state light emitter operable to generate excitation light; and
19[b]	a wavelength conversion component comprising:
19[b][1]	a wavelength conversion layer excitable by the excitation light, wherein the wavelength conversion layer comprises particles of at least one photoluminescence material; and
19[b][2]	a light diffusing layer comprising particles of a light scattering material,
19[b][3]	wherein the light diffusing layer improves an OFF state white appearance of the wavelength conversion component;
19[b][4]	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 solid-state light emitter is emitted through the wavelength conversion component to contribute to a final visible emission product.

Dependent Claim 20	
20[pre]	The device of claim 19,

20[a]	wherein the light emitting device is selected from the group consisting of: downlights, light bulbs, linear lamps, lanterns, wall lamps, pendant lamps, chandeliers, recessed lights, track lights, accent lights, stage lighting, movie lighting, street lights, flood lights, beacon lights, security lights, traffic lights, headlamps, taillights, and signs.
Dependent Claim 21	
21[pre]	The device of claim 19
21[a]	in which the light scattering material within the light diffusing layer corresponds to an average particle size that improves the OFF state white appearance of the wavelength conversion component.
Dependent Claim 25	
25[pre]	The device of claim 19
25[a]	in which the wavelength conversion layer and the light diffusing layer comprises planar shapes.
Dependent Claim 26	
26[pre]	The device of claim 19
26[a]	in which the light diffusing layer comprises a dome or elongated dome shape.

Independent Claim 29	
29[pre]	A light bulb comprising:
29[a]	a connector base configured to be inserted in a socket to form an electrical connection for the light bulb;
29[b]	a body comprising one or more solid-state light emitters;
29[c]	a wavelength conversion component having a three dimensional shape that is configured to enclose the one or more solid-state light emitters and to in part at least define a light mixing chamber,

29[d]	wherein the wavelength conversion component comprises a wavelength conversion layer comprising particles of at least one photoluminescence material and a light diffusing layer comprising particles of a light scattering material,
29[e]	wherein the light diffusing layer improves an off-state white appearance of the wavelength conversion component;
29[f]	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 one or more solid-state light emitters is emitted through the wavelength conversion component to contribute to a final visible emission product.

I. INTRODUCTION

U.S. Patent No. 8,604,678 (the “’678 Patent”) provides a solution to a longstanding problem with white-light LED lightbulbs. To achieve white light, many LED lightbulbs mix a combination of blue and yellow light. The blue light comes from the LED, and the yellow light comes from a phosphorous layer that absorbs a portion of the blue light, converting it to yellow light. When the LED lightbulb is turned on, this mixture of blue and yellow light appears white to the human eye. However, when the lightbulb is turned off, phosphor material in the phosphorous layer typically appears yellow. The appearance of the yellow phosphorous layer in what is supposed to be a white lightbulb is aesthetically undesirable. Moreover, because lightbulbs are naturally turned off when a consumer browses them in a retail store, the consumer may be confused by the yellow appearance of the phosphorous layer, incorrectly concluding that it is a yellow lightbulb, not a white lightbulb.

The invention of the ’678 Patent solved this longstanding problem by adding a diffusion layer that allows the LED to appear white when the lightbulb is turned off. As the ’678 Patent explains, the diffusion layer increases the efficiency of the phosphorous layer, which the ’678 Patent refers to as the wavelength conversion layer. The diffusion layer accomplishes this efficiency increase by reflecting some of the blue light back to the wavelength conversion layer. This increases the

amount of yellow light emitted for a given amount of phosphor material and thereby reduces the amount of phosphor material needed to achieve the desired mix of blue and yellow light. The diffusion layer also scatters the blue and yellow light, resulting in a more uniform mixture of white light.

Prior to institution, Patent Owner argued that the claimed diffusion layer includes all of these features as a matter of claim construction. The Board rejected this argument in its Institution Decision, preliminarily concluding that the plain and ordinary meaning of the claimed diffusion layer does not require reflecting light back to the claimed wavelength conversion layer, reducing the amount of material required in the wavelength conversion layer, or increasing the color uniformity of the emitted light. Notwithstanding the Board's decision, Patent Owner submits concurrently herewith a contingent motion to amend the challenged claims that expressly claim certain of these features.

Even accepting the Board's conclusion that the original claims of the '678 Patent did not capture these additional features of the diffusion layer, Petitioners have failed to demonstrate that one of skill in the art would have been motivated to combine the assorted prior art teachings upon which Petitioners rely. Petitioners' arguments concerning motivation to combine rest solely on the testimony of their expert witness, Prof. Doolittle, whose contradictory and evasive testimony during cross examination, raises serious questions of credibility. And yet, even

Prof. Doolittle acknowledged significant gaps in his opinions regarding why one of ordinary skill in the art would have been motivated to select or combine particular teachings from unrelated prior art references. Thus, independent of Patent Owner's contingent motion to amend the claims, Petitioners have failed to meet their burden of proving that the original claims were unpatentable. On the contrary, objective indicia of nonobvious—including commercial success, long-felt need, industry praise, unexpected results, and copying by competitors—all demonstrate that it was not obvious to combine Petitioners' prior art at the time of the invention.

II. U.S. PATENT NO. 8,604,678

A. Technology Background

Solid-state lighting such as light emitting devices (“LEDs”) use semiconductor chips to generate light in a broad range of colors and brightness levels. EX2026, ¶¶ 41-43. The type of light generated (generally in the ultraviolet, visible, or infrared ranges of the electromagnetic spectrum) is dependent on the material of semiconductor used and energy bandgap, which is the energy needed to move electrons from the valence band to the conduction band. *Id.*, ¶¶ 44-46. For instance, using indium gallium nitride (“InGaN” or “GaInN”) creates blue and green light, while substances such as aluminum gallium indium phosphide (“AlGaInP”) create red and orange light. *Id.*, ¶ 46 (citing EX2014). Some materials are more efficient at converting energy into light than other materials,

which can impact how the semiconductor chip is manufactured and packaged. *Id.*, ¶¶ 51-62. Additionally, the LED chip manufacturing and packaging processes are also impacted by the ultimate application and intended use of the LED. *Id.*, ¶¶ 51-62.

Light emitted from LED chips interact with surrounding materials in various ways, including by absorption, reflection, refraction, and scattering, all of which influence the efficiency and appearance of the emitted light. Absorption occurs when a material converts the light into heat. Reflection directs light back into the desired path and can cause efficiency losses if, for example, misdirected. Refraction happens when light passes through materials of differing refractive indices, such as from the LED chip into an encapsulant or lens, altering its direction and affecting beam shape. Scattering is used to impact incident light that hits the LED as well as light that is created from the LED. The overall impact with scattering is that it diffuses these types of light to create a softer, more uniform light output. *See* EX2026, ¶ 53.

B. Prosecution History

U.S. Patent No. 8,604,678, entitled “Wavelength Conversion Component with a Diffusing Layer,” (the “’678 Patent”) was filed on October 13, 2011, issued on December 10, 2013, is a continuation-in-part of Application No. 13/253,031 filed on October 4, 2011, and claims priority to Provisional Application Nos.

61/427,411 filed on December 27, 2010 and 61/390,031 filed on October 5, 2010.

EX1001, codes (22), (45), (54), 1:15-20. This patent was found novel and nonobvious over prior art with similar qualities as the prior art asserted in the Petition.

During prosecution, the Examiner issued a first non-final Office Action rejecting Claims 1-6, 9-14, 16-19, 21, 22, 25, and 26 as being anticipated by U.S. Patent Publication 2002/0180351 (“McNulty,” EX2003) and rejected the rest of the claims as being obvious over McNulty in view of a variety of references. *See* EX1004 at 122-31.

In response, the Applicant amended each of the original independent claims to recite “wherein the light diffusing layer improves an off-state white appearance of the wavelength conversion component; wherein the wavelength component is configured such that in operation a portion of excitation light generated by the light emitting device is emitted through the wavelength conversion component to contribute to a final visible emission product.” EX1004 at 144-50.

Following the amendment, the Examiner issued a final Office Action, rejecting all then-pending claims under 35 U.S.C. § 103(a) over McNulty in addition to the previous obviousness rejections. *See* EX1004 at 177-87.

In response, the Applicant submitted a request for continued examination and again amended each of the independent claims to add “comprising blue light having a wavelength of greater than or equal to 440 nm.” EX1004 at 183-205.

The Examiner then issued a non-final Office Action that rejected Claims 1-6, 9-14, 16-19, 21, 22, 25, and 26 under § 103(a) as obvious over U.S. Patent Publication 2001/0000622 (“Reeh,” EX2004) in view of McNulty and previous § 103(a) rejections. EX1004 at 1006-16.

The Examiner granted an interview with the Applicant. EX1004 at 1053. The Applicant provided an interview summary, stating that “Applicants and Examiner agreed that the McNulty reference cannot be combined to disclose the claimed limitation ‘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.’” *Id.* The Applicant further explained that because McNulty’s goal “to configure a layer of scattering material to maximize the reflection of excitation radiation back into the phosphor material in order to maximize the light output from the phosphor material,” it would frustrate the purpose of McNulty to configure McNulty to “allow[] for a portion of excitation light to be emitted through to contribute to a final visible emission product.” *Id.*

For this same reason, the Applicant demonstrated that McNulty teaches away from the '678 Patent application and thus was not combinable with other references. *Id.* at 1054-56.

The Examiner entered a Notice of Allowability of all of the then-pending claims in response to the Applicant's arguments. EX1004 at 1150-52.

C. Benefits of the '678 Patent

The '678 Patent "relates to solid-state light emitting devices" to generate a "desired color of light" such as white light. EX1001 at 1:24-26. As the '678 Patent explains, "white LEDs include one or more [] photoluminescent materials (e.g., phosphor materials), which absorb a portion of the radiation emitted by the LED and re-emit light of a different color (wavelength)." *Id.* at 1:35-38. These phosphor photoluminescent materials can be "relatively costly, and hence correspond to a significant portion of the costs for producing phosphor-based LED devices." *Id.* at 2:24-41. Additionally, these devices "are often subject to perceptible non-uniformity in color when viewed from different angles." *Id.* at 12:13-17; *see also* EX2026, ¶¶ 63-71.

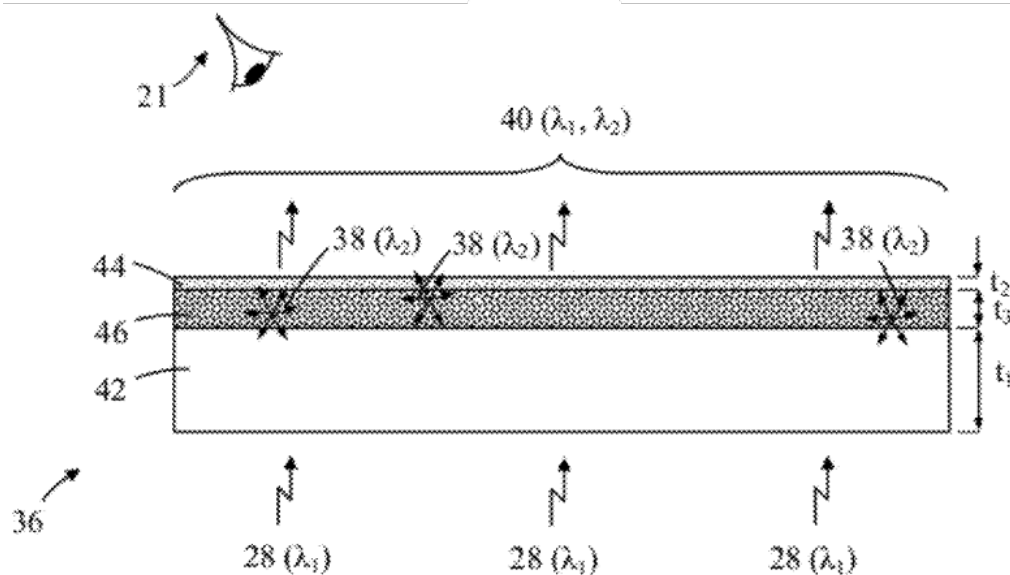
When the LED device is in the ON state, "the LED chip or die generates blue light and the phosphor(s) absorbs a percentage of the blue light and re-emits yellow light or a combination of" other yellowish colors. EX1001 at 1:65-2:3. In the ON state, the "portion of the blue light generated by the LED that is not

absorbed by the phosphor combined with the light emitted by the phosphor provides light which appears to the human eye as being nearly white in color.”

EX1001 at 2:3-6. However, “in its OFF state, the absence of the blue light that would otherwise be produced by the LED in the ON state causes the device to have a yellowish, yellow-orange, or orange-color appearance.” EX1001 at 2:6-10; *see also* EX2026, ¶ 66. This is because in the OFF state, light that is produced by the phosphor lighting apparatus is based “at least in part upon external light (e.g., sunlight or room lights) that excites the phosphor material in the wavelength conversion component, and which therefore generates a yellowish, yellow-orange or orange color in the photoluminescence light.” EX1001 at 11:5-10; *see also* EX2026, ¶ 66. This yellowish light “may be undesirable to the potential purchaser or customer that is seeking a white-appearing light” (EX1001 at 11:17-18) “since the device on a store shelf is in its OFF state” (*id.* at 2:10-16). *See also* EX2026, ¶ 66. Thus, 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” “without requiring the large quantities of photoluminescent materials (e.g. phosphor materials) that are required in the prior approaches.” EX1001 at 2:47-51.

The '678 Patent addresses this color issue by utilizing a uniform light diffusing layer, which “includes particles of a light diffractive material that can substantially reduce the passage of external excitation light that would otherwise cause the wavelength conversion component to re-emit light of a wavelength having a yellowish/orange color.” EX1001 at 11:22-27. The purpose of the light diffusing layer in the '678 Patent is three-fold: (1) to improve the OFF-state color appearance; (2) reduce the overall costs of the LED device by minimizing the amount of phosphor wavelength conversion layer needed; and (3) improve the spatial uniformity of the light color. See EX2026, ¶ 81.

As shown below in Figure 3 from the '678 Patent, the wavelength conversion component 36 comprises a light transmissive substrate 42 below a wavelength conversion layer 46 that is covered by light diffusing layer 44.

**FIG. 3**

EX1001 at Fig. 3, 10:19-23. The light diffusing layer 44 “comprises a uniform thickness layer of particles of a light diffractive material.” *Id.* at 8:19-20. In the ON state, blue light 28 from LED chips moves through the light transmissive substrate 42 and wavelength conversion layer 46, which will either scatter or absorb and re-emit the light photons that strike particles that make up the wavelength conversion layer 46. *Id.* at 10:28-47. The re-emitted photoluminescence light 38 from wavelength conversion layer 46 in addition to the scattered blue light 28 contributes to the overall emission product 40 that is visible to observer 21 in the form of a cool white light. *Id.* at 10:47-11:3. Additionally, the light diffusive layer 44 has a ratio of light diffractive material to binder “in a range [of] 7% to 35% and more preferable in a range of 10% to 20%.” *Id.* at 3:54-

57. This range is aimed at striking a balance “between improving emission color uniformity with emission angle and the decrease in luminous efficacy” (*id.* at 13:19-21), as more light diffractive material “increases the angular emission color uniformity of the device by blending the red, blue and phosphor generated light” (*id.* at 20:49-51).

However, in the OFF state, the wavelength conversion layer 46 may absorb photons from external light sources and emit an undesirable yellow/orange color. EX1001 at 11:19-27. By introducing light diffusing layer 44, “particles of a light diffractive material can substantially reduce the passage of external excitation light” by having a size range of particles that “increases its probability of scattering blue light, which means that less of the external blue light passes through the light diffusing layer 44 to excite the wavelength conversion layer 46.” *Id.* at 11:28-33. Thus, the “lighting apparatus will have more of a white appearance in an OFF state since the wavelength conversion component is emitting less yellow/red light.” *Id.* at 11:33-36.

Notably, “the use of a light diffusing layer having an appropriate particle size and concentration per unit area of the light diffractive material can substantially reduce the quantity of phosphor material” because “the light diffusing layer increases the probability that a photon will result in the generation of photoluminescence light by directing light back into the wavelength conversion

layer.” EX1001 at 3:21-28. Utilizing a light diffusing layer that directly contacts the wavelength conversion layer “can reduce the quantity of phosphor material required to generate a given color emission product, e.g., by up to 40%” (*id.* at 14:18-24; *see also id.* at 3:29-32), while also improving the color uniformity of light emitted from the LED (*see id.* at 12:19-22). Thus, “it will be much less costly to manufacture lighting apparatuses that employ such wavelength conversion components.” *Id.* at 14:15-17.

III. PETITIONERS’ CHALLENGE TO THE ’678 PATENT

Ground	Claims	Basis	References
1	1-3, 6, 7, 9, 10, 16-21, 25, and 26	35 U.S.C. § 103	Basin-2007 in view of Basin-2005
2	19, 20, and 29	35 U.S.C. § 103	Hussell in view of Basin-2007 and Van Woudenberg
3	1-3, 6, 10, 16, 19, 21, and 25	35 U.S.C. § 103	Krummacher in view of Shimizu and Stokes
4	19, 20, and 29	35 U.S.C. § 103	Hussell in view of Krummacher and Van Woudenberg

IV. OVERVIEW OF PETITIONERS’ CITED REFERENCES

A. Basin-2007 (EX1005)

U.S. Patent Publication No. 2009/0057699 (“Basin-2007”), entitled “LED with Particles in Encapsulant for Increased Light Extraction and Non-Yellow Off-

State Color” is directed to “techniques for improving light extraction” in thin-film flip chips for “[h]igh power LEDs [] now commonly used as flashes in small cameras, including cell phone cameras” by using a white non-phosphor inert material that is “mixed with the substantially transparent encapsulant for LEDs.”

EX1005, ¶¶ 1, 3, 5; *see also* EX2026, ¶¶ 85-88. Because the inert material is white, a byproduct of these techniques allows for “the appearance of the LED with a YAG [(yttrium aluminum oxide garnet)] phosphor coating [to] appear[] much white when the LED is off.” *Id.*, ¶ 10. As shown in Figure 2 below, Basin-2007 discloses TiO₂ particles 34 mixed with a silicone encapsulant 32 before encapsulating LED 10 with a phosphor layer 30:

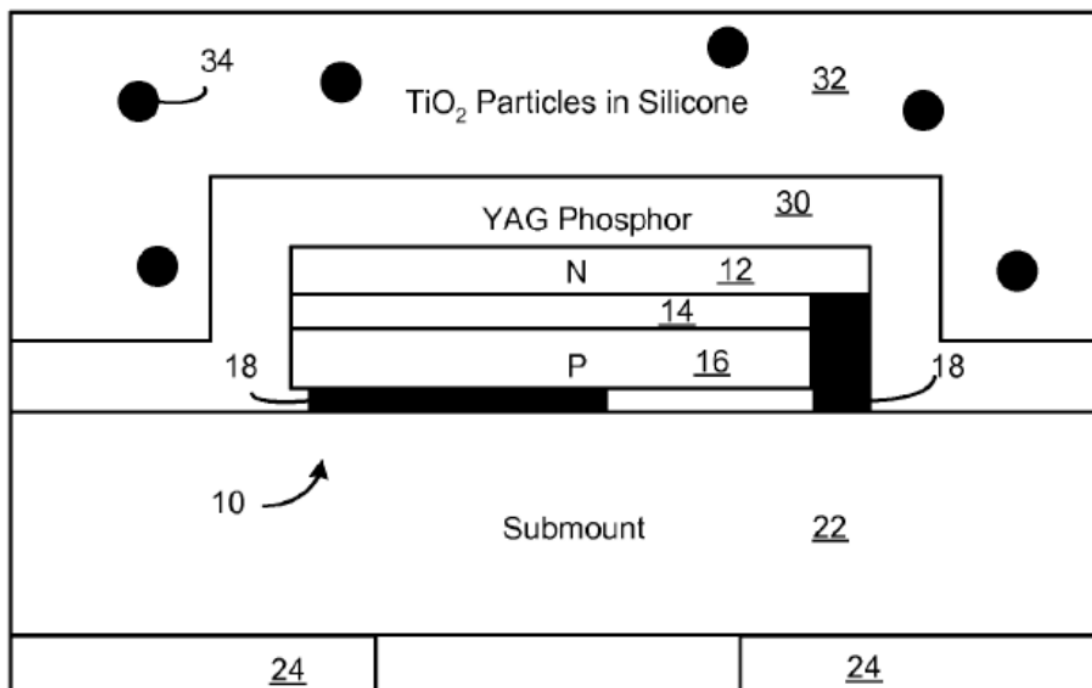


Fig. 2

EX1005 at FIG. 2, ¶¶ 27, 31. The encapsulant is outside of and separate from the phosphor layer because it “protects the semiconductor LED die.” *Id.*, ¶ 2. Basin-2007 notes that “[a] range of TiO₂ in the encapsulant from 0.5%-10% generally increases the brightness, depending on the actual LED used. A higher percentage begins to significantly reduce the transmission through the encapsulant.” *Id.*, ¶ 5. The inventors believed “that the color of the TiO₂ (white) causes the appearance of the LED/phosphor to be closer to pure white.” *Id.*, ¶ 36. Basin-2007 is primarily directed to thin-film flip-chip (“TFFC”) architecture based on the described embodiments and applications. *See, e.g.*, EX2026, ¶¶ 57-58, 63, 87-88.

B. Basin-2005 (EX1006)

U.S. Patent Publication No. 2007/0045761 (“Basin-2005”), entitled “Color Converted Light Emitting Diode” is directed to a “technique for generating white light using phosphors and a blue, UV, or near UV LED that is relatively easy to implement and consistently produces the desired . . . warm white light (more red) in the temperature range of 2000K-5000K” in LEDs with long energization times in environments requiring high efficiency such as headlamps for automobiles. EX1006, ¶¶ 6, 10; *see also* EX2026, ¶¶ 89-90. As shown below, Basin-2005 discloses a lens 34 comprising of blue LED dies 10 on a support structure 12:

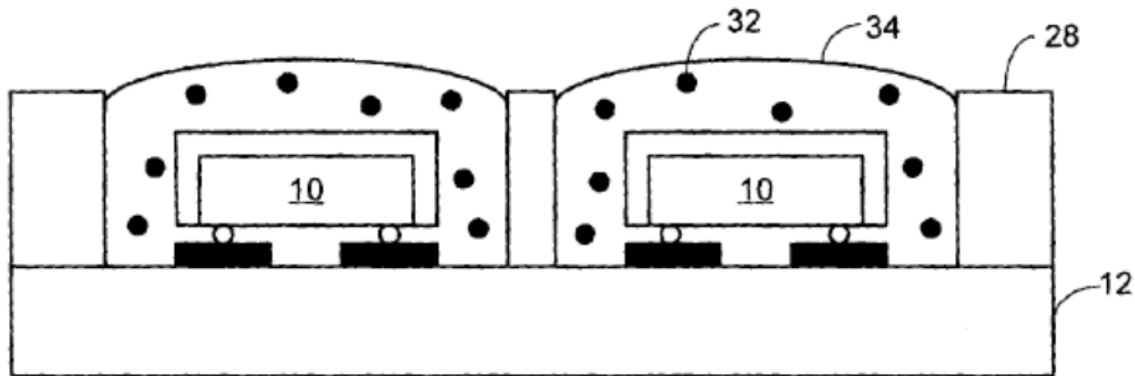
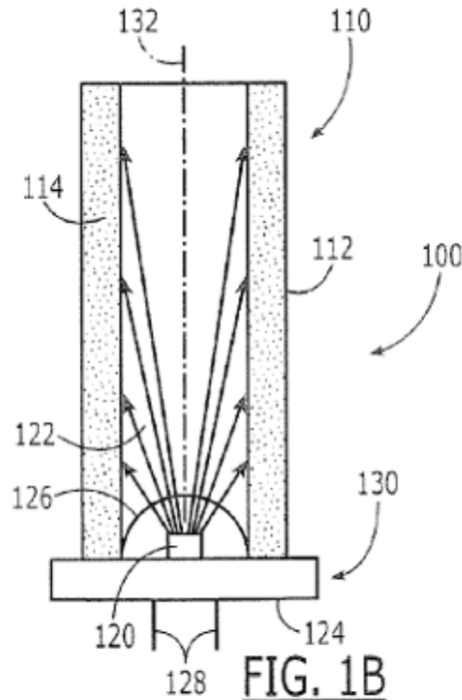


Fig. 5

Id. at FIG. 5, ¶¶ 40-43. The LED dies 10 are coated in a “first phosphor for producing red, yellow, or yellow-green light” that “is deposited to conformably coat the LED die.” *Id.*, ¶ 7. Each LED die is then optionally coated with a layer of photoresist 28 that is subsequently removed around each LED die 10 to create a mold. *Id.*, ¶¶ 11, 40. A liquid silicone infused with a second phosphor 26 is then “deposited in the mold to form an encapsulant over each LED.” *Id.*, ¶¶ 11, 40. Once the silicone is cured, the photoresist is removed. *Id.*, ¶¶ 11, 43-44. Using two different deposition techniques that “are, separately, easily controllable to contribute the desired color component, since the phosphors’ physical and chemical compatibility is not a factor, the resulting white light temperature (e.g., 2000K-5000K) is highly controllable and the emission color is uniform.” *Id.*, ¶ 9. Basin-2005 is primarily directed to a flip chip based on the described embodiments and applications. *See, e.g.*, EX2026, ¶¶ 57-58, 63, 90.

C. Hussell (EX1011)

U.S. Patent Publication No. 2010/0124243 (“Hussell”), entitled “Semiconductor Light Emitting Apparatus Including Elongated Hollow Wavelength Conversion Tubes and Methods of Assembling Same” discloses a way to “integrate a semiconductor light emitting device with wavelength conversion material to provide a semiconductor light emitting apparatus” to convert light from a single-color LED to white light by orienting the LED “to emit light inside [an] elongated hollow wavelength conversion tube to impinge upon the elongated wavelength conversion tube wall and the wavelength conversion material dispersed therein” in conventional incandescent replacement applications. EX1011, ¶¶ 3, 7, 8; *see also* EX2026, ¶¶ 91-93. As illustrated in Hussell’s Figure 1B below, elongated wavelength conversion tube 110 “comprises an elongated wavelength conversion tube wall 112 having wavelength conversion material 114 uniformly or nonuniformly dispersed therein.”



Id. at FIG. 1B, ¶ 32. The wavelength conversion material 114 refers to “any material that absorbs light at one wavelength and re-emits light at a different wavelength, regardless of the delay between absorption and re-emission and regardless of the wavelengths involved,” such as phosphor particles. *Id.*, ¶ 6. The semiconductor LED 120 “is oriented to emit light 122 inside the elongated hollow wavelength conversion tube 110 to impinge upon the elongated wavelength conversion tube wall 112,” where “the tube wall 112 defines a tube axis 132, and the semiconductor light emitting device 120 is configured to emit light 122 generally symmetrically about an emission axis and is oriented such that the emission axis is generally coincident with the tube axis 132.” *Id.*, ¶ 32.

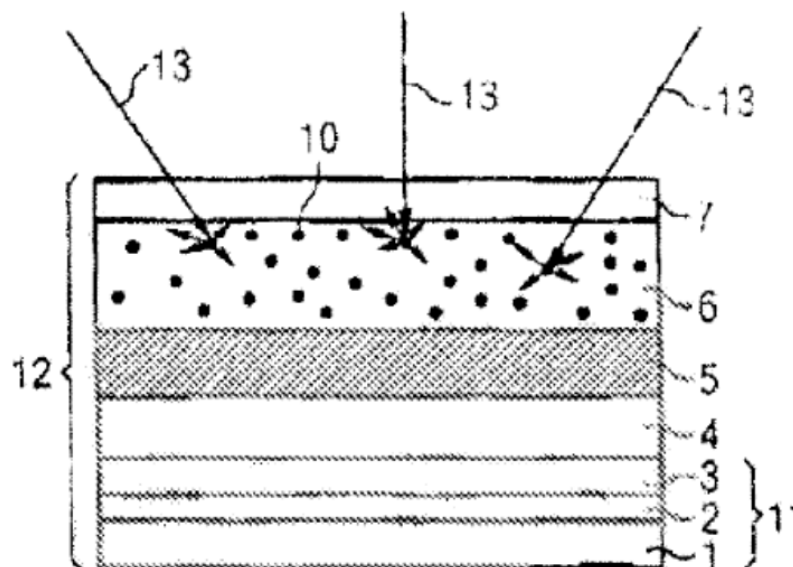
D. Van Woudenberg (EX1020)

International Patent Publication No. WO 2008/044171 (“Van Woudenberg”), entitled “LED Based Luminaire and Lighting Device” is directed to a phosphor-coated LED (“pc-LED”) package that “is controlled to appear neutral white in the functional OFF state of the lighting device” in “auxiliary lights in mobile phones or down-light units.” EX1020 at Abstract, 2:9-11; *see also* EX2026, ¶¶ 94-95. To offset yellow appearance, Van Woudenberg utilizes “residual current running through the pc-LED in the functional off state of the lighting device” to cause “the tiny amount of light produced by the pc-LED [to] outshine[] the reflected ambient light” (*id.* at 1:27-28, 2:19-21). As a result, the functionally off pc-LED will have “a neutral white color to the human eye.” *Id.* at 2:22-23. Van Woudenberg is primarily directed to DIP and SMD LEDs based on the described embodiments and applications. *See, e.g.,* EX2026, ¶¶ 55-56, 95.

E. Krummacher (EX1007)

U.S. Patent Publication No. 2008/0079015 (“Krummacher”), entitled “Optoelectronic Component Having a Luminescence Conversion Layer” is directed to “an improved optoelectronic component having a luminescence conversion layer, in which areas covered by the luminescence conversion layer give an improved color impression in the off state” in large area lighting units. EX1007, ¶¶ 3, 5; *see also* EX2026, ¶¶ 96-98.

FIG 2



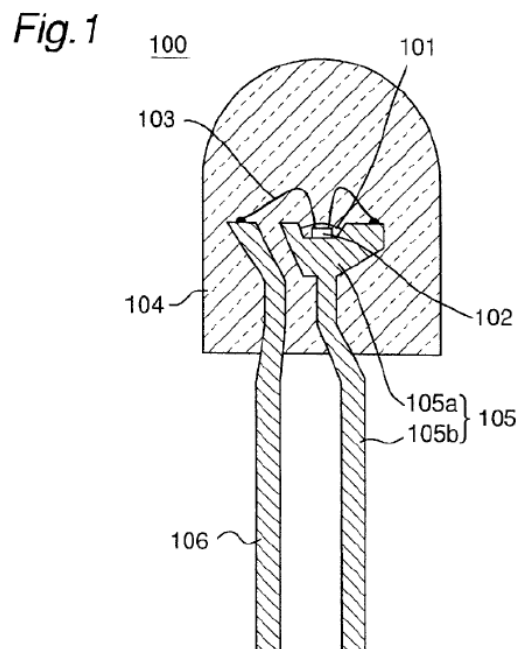
Id. at FIG. 2. Krummacher's Figure 2, as shown above, depicts an optoelectronic component in the OFF state with an active layer 2 that emits blue light. *Id.*, ¶¶ 31-32. Active layer 2 is covered by a layer sequence 11 comprising additional layers 2 and 3 and a passivating layer 4 that protects layer sequence 11 from environmental influences. *Id.*, ¶ 33. Krummacher notes that in one embodiment, "a light-scattering translucent layer 6 contains light-scattering particles 10, which . . . serve to scatter environmental light 13 striking the optoelectronic component from the outside." *Id.*, ¶ 39. The light-scattering translucent layer 6 contains light-scattering particles 10 with particular sizes, distributions, and materials such that "the surface of light-scattering translucent layer 6 appears white." *Id.*, ¶ 41. As a result, "the luminescence conversion layer 5 is advantageously prevented from

exhibiting a yellowish hue, in the off state” “due to stimulation of the luminescence conversion materials by environmental light 13 incident from the outside.” *Id.*

Krummacher appears to be primarily directed to a vertical chip based on the described embodiments and applications. *See, e.g.,* EX2026, ¶¶ 57-58, 63, 98.

F. Shimizu (EX1010)

U.S. Patent No. 6,069,440 (“Shimizu”), entitled “Light Emitting Device Having a Nitride Compound Semiconductor and a Phosphor Containing a Garnet Fluorescent Material” aims to limit “the degradation of characteristics during long period of use and reduce deterioration due to light of high intensity emitted by the light emitting component as well as extraneous light . . . , thereby to provide a light emitting device which experiences extremely less color shift and less luminance decrease” in industrial lighting applications such as LED displays, back light sources, traffic signals, and railway signals. EX1010 at 1:12-14, 3:54-61; *see also* EX2026, ¶¶ 99-100. Shimizu claims to achieve this by utilizing a “light emitting component [102] made of a nitride compound semiconductor” that is “capable of emitting light with high luminance” and a phosphor contained in a coating resin 101 and/or molding material 104 that has “excellent resistance against light so that the fluorescent properties thereof experience less change even when used over an extended period of time while being exposed to light of high intensity.”



Id. at FIG. 1, 3:46-54, 8:35-52. The phosphor accomplishes this by containing “a garnet fluorescent material comprising 1) at least one element selected from the group consisting of Y, Lu, Sc, La, Gd, and Sm, and 2) at least one element selected from the group consisting of Al, Ga and In, and being activated with cerium.” *Id.* at 3:32-37. The coating material 101 or molding material 104 may also include a dispersant such as titanium dioxide that “gives a milky white color” to aid in obscuring the color of the fluorescent material and improving the color mixing performance.” *Id.* at 17:25-35. When the light emitting component 102 is installed in a cup 105a that “is filled with the fluorescent material, light emitted by the fluorescent material is, even if isotropic, reflected by the cup in a desired direction and therefore erroneous illumination due to light from other light emitting diode mounted nearby can be prevented.” *Id.* at 15:46-52. Shimizu also explains that

erroneous illumination may include “a phenomenon as other light emitting diode mounted nearby appearing as though lighting despite not being supplied with power.” *Id.* at 17:52-55. Shimizu is primarily directed to dual in-line package (“DIP”) and lead-frame surface mounted device (“SMD”) LEDs based on the described embodiments and applications. *See, e.g.,* EX2026, ¶¶ 55-56, 100.

G. Stokes (EX1008)

U.S. Patent No. 6,791,259 (“Stokes”), entitled “Solid State Illumination System Containing a Light Emitting Diode, a Light Scattering Material and a Luminescent Material” is directed to obtaining “a significant decrease in the halo and/or penumbra effects” in LED lights used in commercial applications such as automotive, display, and safety/emergency uses. EX1008 at 1:19-20, 3:49-51; *see also* EX2026, ¶¶ 101-02. The halo effect occurs when there is separation between the directional blue light emitted from the LED chip and yellow light emitted from the phosphor in all directions. *Id.* at 1:39-42. Thus, depending on the angle of the viewer, the light may appear bluish-white when viewed straight on, yellow when viewed at an angle, or blue surrounded by a yellowish halo when the LED is on a flat surface. *Id.* at 1:42-50. The penumbra effect “is a non-uniform intensity effect” that “causes the white LED lamp emission to appear brighter at the center than at the edges” due to the directional nature of the LED emission. *Id.* at 1:51-59. The edges appear less white “due to the stray and/or reflected LED light and

the phosphor emission excited by such LED light.” *Id.* at 1:59-62. These effects “cause the white LED lamps to fail to meet applicable commercial quality standards required for illumination devices.” *Id.* at 1:62-65. Thus, Stokes overcomes this problem by placing a layer 56 of radiation scattering material between a radiation source, such as an LED chip 53, and a luminescent material (e.g., phosphor) 55 as shown below:

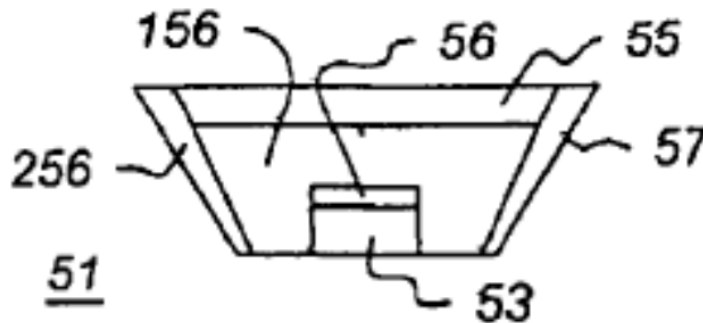


fig 7

Id. at FIG. 7, 3:57-61, 7:41-46. Stokes is primarily directed to DIP and lead-frame SMD LEDs based on the described embodiments and applications. *See, e.g.*, EX2026, ¶¶ 55-56, 102.

V. LEGAL STANDARD

A patent claim is unpatentable for obviousness if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having

ordinary skill in the art to which said subject matter pertains. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). In *Graham v. John Deere Co.*, 383 U.S. 1 (1966), the Supreme Court set out a framework for assessing obviousness that requires consideration of four factors: (1) the “level of ordinary skill in the pertinent art,” (2) the “scope and content of the prior art,” (3) the “differences between the prior art and the claims at issue,” and (4) “secondary considerations” of non-obviousness such as “commercial success, long felt but unsolved needs, failure of others, etc.” 383 U.S. at 17-18; *KSR*, 550 U.S. at 407.

VI. LEVEL OF SKILL IN THE ART

Petitioners define a person of ordinary skill in the art (“POSITA”) as an individual who “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. A [POSITA] would also have one to two years of experience in the field of LED packaging design. More education could substitute for experience, and vice versa. This person would have been capable of understanding and applying the teachings of the ’678 patent and the prior-art references discussed herein.” Pet. at 5-6. Because it does not affect the ultimate analysis, Patent Owner takes no position with respect to Petitioners’ proposed level of ordinary skill in the art. Thus, solely for the purposes of this proceeding, Patent Owner and its technical

expert employ the same level of skill in the art as Petitioners. See EX2026, ¶¶ 28-32.

VII. CLAIM CONSTRUCTION

In an *inter partes* review filed on or after November 13, 2018, claim terms are construed based on their ordinary and customary meaning. 37 C.F.R.

§ 42.100(b). Further, the Board should always construe claims to sustain their validity, if possible. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1329 (Fed. Cir. 2005).

Patent Owner requests that the Board adopt the ordinary and customary meaning of the claim terms as understood by one of ordinary skill in the art.

VIII. WITNESS CREDIBILITY

Before addressing Petitioners' arguments concerning the patentability of the challenged claims, Patent Owner urges the Board to consider carefully the credibility of Petitioners' witness, Prof. Doolittle. All of Petitioners' arguments concerning alleged motivation to select and combine teachings from the assorted prior art references rest on Prof. Doolittle's testimony, and that testimony has proven unreliable. On cross examination, Prof. Doolittle repeatedly contradicted himself, dodged questions, and tried to shoehorn new and non-responsive opinions into his answers to Patent Owner's questions.

A. Prof. Doolittle's Contradictory Testimony on Claim Construction

For example, Prof. Doolittle testified in this proceeding that “for all of the claim terms considered in this declaration, I have applied the plain and ordinary meaning of those terms unless otherwise specifically indicated.” EX1002, ¶ 32. Nowhere in Prof. Doolittle's declaration did he “specifically indicate” that he applied anything other than the plain and ordinary meaning. During cross examination, Prof. Doolittle could not recall any claim term for which he did *not* apply the plain and ordinary meaning. EX2025 at 17:7-18. Of course, this necessarily means that Prof. Doolittle was able to understand and apply the plain and ordinary meaning of every claim term.

Yet, Prof. Doolittle took the opposite position under oath in a parallel district court proceeding. There, Prof. Doolittle opined that certain claim terms are indefinite, meaning that he was unable to determine any plain and ordinary meaning. *See generally* EX2025 at 19:2 – 22:9, 24:7 – 50:4. In one example, Prof. Doolittle told the district court under oath that the claim term “improves an off-state white appearance of the wavelength conversion component” is indefinite. EX2025 at 36:18 – 40:1; EX2024, ¶ 12; *see also* EX2025 at 21:7 – 22:9, 24:7 – 25:7; EX2023, ¶ 66 *et seq.* In another example, Prof. Doolittle told the district court under oath that the claim term “corresponds to an average particle size that improves the off-state white appearance of the wavelength conversion component”

is indefinite. EX2025 at 41:20 – 45:14; EX2024, ¶¶ 20-21. Prof. Doolittle based this testimony to the district court on his understanding that indefiniteness means that “claims read in light of the specification delineating the patent and the prosecution history failed to inform with reasonable certainty those skilled in the art about the scope of the invention.” EX2025 at 46:9 – 47:17; EX2024, ¶ 31.

The contrast to Prof. Doolittle’s testimony in this proceeding is stark and inexplicable. Prof. Doolittle provided his testimony about alleged indefiniteness to the district court on November 6, 2024, and November 20, 2024. EX2025 at 49:5-8; EX2023; EX2024. Just three months earlier, in his August 26, 2024 sworn declaration to this Board, Prof. Doolittle said exactly the opposite. EX1002, ¶ 32. To this Board, Prof. Doolittle testified that he *was* able to understand *and* apply the plain and ordinary meaning of both terms to the prior art. EX2025 at 39:14 – 41:19, 45:11-21, 48:4 – 49:1; EX1002, ¶ 32. Neither Petitioners nor Prof. Doolittle made any effort to inform the Board that Prof. Doolittle contradicted his own sworn testimony just three months after submitting it in this proceeding.

On cross examination, Prof. Doolittle tried to explain himself, testifying that he did not tell the Board those claim terms are indefinite “because indefiniteness is not something that the PTAB can rule on, as I understand it.” EX2025 at 40:3-7; *see also id.* at 40:11 – 41:19, 45:15-21. But the scope of the Board’s jurisdiction has nothing to do with whether one of ordinary skill in the art can understand and

apply the challenged claim language. The bottom line is that Prof. Doolittle told the Board under oath that he could understand and apply all of the challenged claim terms and then, just three months later, he told the district court under oath that he cannot understand or apply that claim language. Even worse, Prof. Doolittle still stands by *both* positions today. EX2025 at 49:16 – 50:4.

B. Prof. Doolittle's Nonresponsive and Obstructionist Testimony

Beyond his inexplicable contradictions on claim construction, Prof. Doolittle repeatedly dodged questions and tried to shoehorn new and nonresponsive opinions into his answers to Patent Owner's questions. During cross examination Patent Owner was forced to object to Prof. Doolittle's nonresponsive answers no less than eighteen times. EX2025 at 22:10 – 23:15 (once), 25:9 – 26:14 (twice), 30:14-22 (once), 40:3-9 (once), 58:12 – 59:1 (once), 60:18 – 61:13 (once), 65:1-10 (once), 83:15 – 84:16 (once), 92:15 – 95:20 (three times), 96:18 – 99:9 (twice), 102:22 – 106:16 (twice), 135:3 – 136:22 (twice). In many of these instances, Prof. Doolittle dodged the question and then tried to inject new and nonresponsive arguments that he had not disclosed in his declaration. *Id.*

Patent Owner is aware that the Board disfavors motions to strike or exclude nonresponsive expert witness testimony and prefers to account for such testimony

in analyzing its weight.¹ Accordingly, Patent Owner highlights Prof. Doolittle's contradictory and evasive testimony so that the Board may account for it in assessing Prof. Doolittle's credibility.

IX. THE CHALLENGED CLAIMS ARE NOT UNPATENTABLE

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 based on a combination of references also 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) (citation omitted); *see KSR*, 550 U.S. at 418.

Petitioners have failed to show that the cited prior art renders obvious the Challenged Claims and has not articulated any meaningful motivation to combine or a reasonable expectation of success. Petitioners also fail to account for secondary indicia of non-obviousness, which further demonstrate that the original

¹ See generally Daniel S. Block, *Expert Bad Behavior: The Problem and Potential Solutions*, Mar. 7, 2022, <https://www.sterneckessler.com/news-insights/insights/expert-bad-behavior-problem-and-potential-solutions/>.

claims of the '678 Patent were patentable. For these and the reasons stated below, the Petition fails.

A. Ground 1: Petitioners Have Not Shown that a POSITA Would Have Been Motivated to Combine Basin-2007 and Basin-2005

Petitioners have failed to establish that a POSITA would have been motivated to combine Basin-2007 with Basin-2005 for several reasons. EX2026, ¶¶ 104-16. Petitioners rely exclusively on the testimony of Prof. Doolittle, who fails to address the very different lighting applications disclosed in Basin-2007 and Basin-2005 or explain why one of ordinary skill in the art would have selectively combined the cited teachings from these references. In addition, as discussed above in Section VIII, Patent Owner respectfully submits that the Board should give little if any credit to Prof. Doolittle's testimony given his many contradictions and evasive testimony on cross examination. As discussed below in Section IX.E, Petitioners' alleged motivation to combine also contradicts the numerous secondary considerations of non-obviousness that demonstrate the significance of the claimed invention.

Petitioners rely on Basin-2007 for Ground 1, but they acknowledge that Basin-2007 did not teach blue light at the specifically claimed wavelength equal to or greater than 440 nm. *See generally* Pet. at 19-39; EX2023 at 126:6-139:12. Relying solely on Prof. Doolittle's say-so, Petitioners argue that "[a POSITA]

would have understood the blue light disclosed in Basin-2007 to include blue light with a wavelength greater than 440 nm” because “a [POSITA] would understand that blue light LEDs used in conventional white-light LED light sources typically had wavelengths greater than 440 nm.” Pet. at 24. However, Petitioners have not presented any ground based on Basin-2007 alone. Instead, Petitioners seem to recognize the weakness of that argument and therefore propose combining teachings from two references by substituting the LED from Basin-2005 in place of the LED in Basin-2007. Petitioners argue that Basin-2007 and Basin-2005 have similar structures and therefore would have been obvious to combine. However, the fact that Basin-2007 and Basin-2005 may share similar structures is not enough to establish a motivation to combine. *See Tennant Co. v. Oxygenator Water Techs., Inc.*, No. IPR2021-00625, Paper 9 at 39 (P.T.A.B. Aug. 20, 2021) (“[M]ere demonstration that a reference may be analogous art is insufficient to show motivation to combine”). “The 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). Indeed, as described above, the ’678 Patent was granted because the Examiner acknowledged that there was no motivation to combine two references with similar structures. *See supra* Section II.B.

Petitioners and Prof. Doolittle have also failed to explain why a POSITA would have been motivated to combine Basin-2007 and Basin-2005 in the particular arrangement Petitioners allege. In particular, Petitioners explained why one of ordinary skill in the art would have been dissatisfied with the LED in Basin-2007 or motivated to consider any other LED, much less the particular LED disclosed in Basin-2005. Nor have Petitioners supported their assertion that it would have been “relatively easy” to swap and configure Basin-2005’s LED in Basin-2007’s system. A generic reason to combine references fails to “explain why a person of ordinary skill in the art would have combined elements from specific references in the way the claimed invention does” as required. *Apple Inc. v. California Inst. Tech.*, No. IPR2017-00219, Paper 76 at 16 (P.T.A.B. Dec. 27, 2018) (finding “Petitioner’s argument and evidence regarding research motivating the combination to be vague and not supported adequately by the declarant testimony” where no arguments or evidence explained how the reference “supports its contention about how or why a person of ordinary skill in the art would have modified or combined the [asserted references]”); *Virtek Vision Int’l ULC v. Assembly Guidance Sys., Inc.*, 97 F.4th 882, 888 (Fed. Cir. 2024).

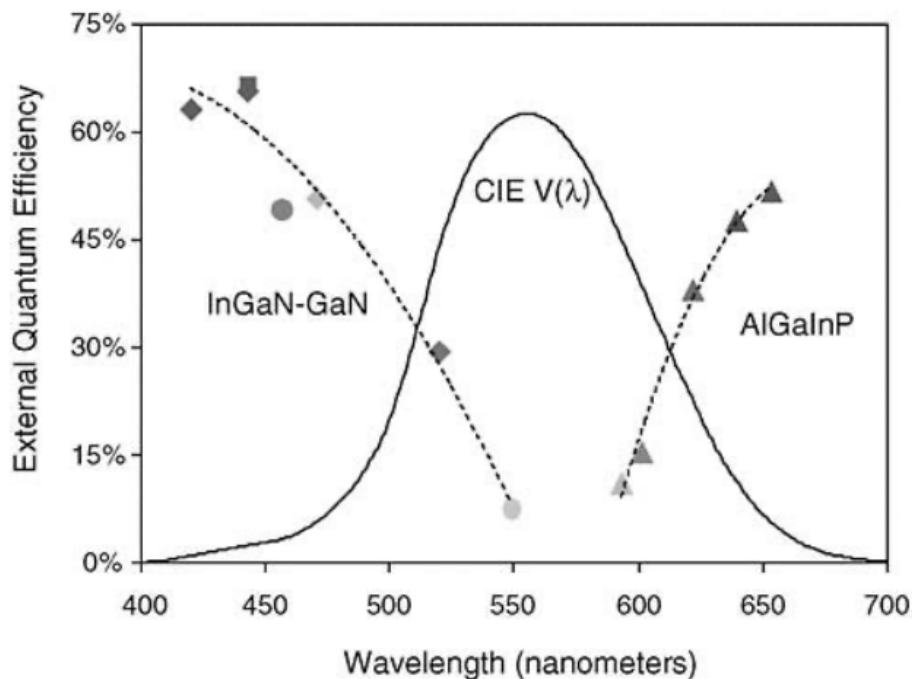
Further, a POSITA would not have been motivated to combine Basin-2007 and Basin-2005 in the particular way Petitioners allege with a reasonable expectation for success because these references provide solutions for entirely

different LED applications. Basin-2007 is generally directed to LEDs used in momentarily energized lighting devices (*i.e.*, camera flashes) (*see, e.g.*, EX1005, ¶ 3), whereas Basin-2005 discusses LEDs used in long energization or outdoor environments (*i.e.*, headlamps for automobiles) (*see, e.g.*, EX1006, ¶ 10). EX2026, ¶¶ 62, 111. LEDs with momentarily energized lighting needs such as camera flashes require a quick response to the energization stimuli. EX2026, ¶¶ 62, 111. In contrast, LEDs used for long energization periods or in outdoor environments do not require an instantaneous perception of the light being used. *Id.* These differences lead to diverging approaches to LED design and packaging. *Id.* Petitioners' expert, Prof. Doolittle, was unable to point to a single instance in his sworn testimony where he analyzed the rationale for combining these references in light of their completely different intended applications. EX2023 at 84:20-85:11 ("Q: is there any place in your declaration that you talked about the motivation for one of ordinary skill in the art to combine the teachings involving a flash lamp, a camera flash, with the teach—with other teachings involving an automobile headlight? A: I—I find the question irrelevant to the claims that I was analyzing."). Prof. Doolittle overlooks the fact that the application is important and that it is Petitioners' burden to establish the motivation to combine teachings from these two different prior art references. *See Broadcom Corp. v. Emulex Corp.*, 732 F.3d 1325, 1334 (Fed. Cir. 2013) ("While a prior art reference may

support any finding apparent to a person of ordinary skill in the art, prior art references that address different problems may not, depending on the art and circumstances, support an inference that the skilled artisan would consult both of them simultaneously.”).

Further, Prof. Doolittle’s theory of swapping Basin-2005’s LED into the application of Basin-2007 would have been counterintuitive to a POSITA at the time of the invention because it would have resulted in lower light output. The quantum efficiency of blue light LEDs decreases with longer wavelengths.

EX2026, ¶¶ 43-45, 50, 112-14. External quantum efficiency is the number of photons that escape from the LED device per number of electrons. EX2026, ¶¶ 50, 112-14. As shown in the figure below, the light produced from blue light emitting Indium Gallium Nitride (“InGaN”) semiconductors decreases in external quantum efficiency as wavelengths lengthen:



EX2026, ¶¶ 48-50, 112-14 (citing EX2013, 70). 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. EX2026, ¶ 112-14. Other 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. See *Metalcraft of Mayville, Inc. v. Toro Co.*, 848 F.3d 1358, 1367 (Fed. Cir. 2017) (“[W]e cannot allow hindsight bias to be the thread that stitches together prior art patches into something that is the claimed invention.”). If Petitioners’ proposed combination were as obvious as Petitioners contend, then

LED bulb suppliers would have introduced the claimed bulbs many years ago to meet the long-felt need. *See* Section IX.E.

Thus, a POSITA would not have been motivated or had a reasonable expectation of success to arrive at the present invention by combining Basin-2007 with Basin-2005. EX2026, ¶ 116.

B. Ground 2: Petitioners Have Not Shown that a POSITA Would Have Been Motivated to Combine Hussell in view of Basin-2007 and Van Woudenberg.

Petitioners have failed to establish that a POSITA would have been motivated to combine Hussell, Basin-2007, and Van Woudenberg for several reasons. EX2026, ¶¶ 117-24. As with Ground 1, Petitioners rely exclusively on the testimony of Prof. Doolittle, who again 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. In addition, as discussed above in Section VIII, Patent Owner respectfully submits that the Board should give little if any credit to Prof. Doolittle's testimony given his many contradictions and evasive testimony on cross examination. As discussed below in Section IX.E, Petitioners' alleged motivation to combine also contradicts the numerous secondary considerations of non-obviousness that demonstrate the significance of the claimed invention.

Petitioners argue that “[i]t would have been obvious to a [POSITA] to add a light diffusing layer on the outer surface of the tube wall in the wavelength conversion tube in Hussell in order to create an off-state white appearance in the ‘filament’ disclosed in Hussell” because a “[POSITA] would understand that the YAG phosphor disclosed in Hussell has the same yellowish appearance in the off state as the YAG phosphors in Basin-2007.” Pet. at 47-48 (citing EX1002, ¶¶ 184-85; EX1011, ¶¶ 6, 36). Petitioners have not met their burden. As discussed previously, generic assertions are not enough to establish a motivation to combine because “mere demonstration that a reference may be analogous art is insufficient to show motivation to combine.” *Tennant*, No. IPR2021-00625, Paper 9 at 39; *see also Apple*, No. IPR2017-00219, Paper 76 at 16. Petitioners’ expert again offers only conclusory restatements of the Petition. *See Xerox Corp. v. Bytemark, Inc.*, IPR2022-00624, Paper 9 at 15 (P.T.A.B. Aug. 24, 2022).

Regardless of Petitioners’ claims, a POSITA would not be motivated to combine Hussell, Basin-2007, and Van Woudenberg because these references are directed to different applications of LEDs. Hussell involves conventional incandescent replacement applications (*see* EX1011, ¶ 3; EX2023 at 74:8-10), Basin-2007 involves momentarily energized lighting devices (*i.e.*, camera flashes) using TFFCs (*see* EX1005, ¶ 3; *see also* EX2026, ¶¶ 87-88), and Van Woudenberg involves “auxiliary lights in mobile phones or down-light units” using DIP and

lead-frame SMD LEDs (*see* EX1020 at Abstract, FIG. 4; *see also* EX2026, ¶ 95). LED packaging varies depending on the LED and its application. *See* EX2026, ¶¶ 54-63, 119. Petitioners do not address how *or why* a POSITA would be motivated to apply Basin-2007's silicone encapsulant designed for momentarily energized lighting devices using TFFC configurations to Hussell's incandescent replacement application or Van Woudenberg's auxiliary lights using DIP or SMD LEDs beyond utilizing the same phosphor. A POSITA would not find it obvious to combine Hussell, Basin-2007, and Van Woudenberg's LEDs because both the structural differences of the LEDs themselves in addition to the differing applications from one reference to the next require vastly different packaging approaches that would prevent a POSITA from having the motivation to combine these references. EX2026, ¶¶ 54-63, 119. In short, neither Petitioners' nor Prof. Doolittle have identified any motivation for their proposed Frankenstein combination of features from these three disparate references.

Petitioners also fail to explain how a POSITA would have overcome the various challenges to combining these three references. For example, a POSITA would not be motivated to combine Hussell with Basin-2007 or Van Woudenberg because Hussell is directed to remote-phosphor devices and Basin-2007 and Van Woudenberg are directed to non-remote phosphor devices. Remote phosphor devices contain a phosphor element that is physically separate from the light

emitter. EX2026, ¶ 120. Prof. Doolittle expressly stated that there would be multiple challenges to overcome in attempting to combine remote phosphor devices with non-remote phosphor devices because “by definition, a remote phosphor device is going to require more phosphor than a non-remote phosphor device.” EX2023 at 115:3-8. Petitioners have not explained how a POSITA would overcome this challenge in order to combine Basin-2007 and Van Woudenberg, which are directed to non-remote phosphor devices (*see, e.g.*, EX1005 at FIGs. 1-2 (showing phosphor coating applied directly upon the light emitting element); EX1020 at Abst. (describing a “phosphor coated” light emitting diode)) with Hussell, which is directed to a remote phosphor device (*see e.g.*, EX1011 at FIG. 1B (showing light emitting device physically separated from the wavelength conversion tube, the tube wall containing the phosphor element)).

Furthermore, embodiments of the “conventional incandescent lamp” style light emitting filaments described in Hussell (*see* EX1011, ¶ 52) available as of the filing date of the ’678 Patent included *frosted* bulbs. EX2026, ¶ 121. There would be no motivation to incorporate any TiO₂ encapsulant described in Basin-2007 in a frosted bulb embodiment because the “undesirable” yellow color of the phosphor conversion layer would not be visible, thus eliminating one of the claimed benefits of the ’678 Patent. *Id.* As for any unfrosted, Hussell-style bulbs, if Petitioners’ proposed combination were as obvious as Petitioners contend, bulb suppliers

would have been making and selling them years earlier to meet the long-felt need.

See Section IX.E.

Additionally, as Petitioners note, “Hussell also teaches that it is desirable to increase the light scattering properties of the wavelength conversion tube by texturing the exterior surface.” Pet. at 51. If Hussell’s LED includes texturing that “may enhance scattering of light” (*see* EX1011, ¶ 48), such texturing would be redundant to a POSITA because both the texturing and the light diffusing layer increase scatter. EX2026, ¶ 121 (“[I]n my opinion, a POSITA would not have the motivation to add a redundant feature such as a light diffusing layer to Hussell’s textured tube.”); *see also* *S-Tek Sys., LLC v. Engineered Corrosion Sols., LLC*, 748 F. App’x 1003, 1007 (Fed. Cir. 2018) (finding no motivation to combine because a POSITA would find it redundant to add a vent from a secondary prior art reference to an already-vented device of a primary reference).

Van Woudenberg is similarly redundant because provides for a completely different method for producing a “neutral white appearance of a lighting device and/or luminaire in the functional off-state” by providing for “a residual current to the (phosphor coated) light emitting diode in the functional off-state.” EX1020 at Abstract. As such, there would be no need to incorporate any silicone encapsulant described in Basin-2007 with either of these references. EX2026, ¶ 121; *see also* EX2023 at 76:14-77:8.

Additionally, as discussed above in Section VIII.A, the quantum efficiency of blue light LEDs decreases with longer wavelengths. See EX2026, ¶ 123.

Petitioners do not offer any explanation as to why a POSITA would combine Hussell with other high efficiency LEDs like in Basin-2007 just to limit the LED chip's quantum efficiency by shifting the blue emission to longer wavelengths (equal to or greater than 440 nm). See EX2026, ¶¶ 49-50, 112-15, 123. This is using impermissible hindsight to make an obviousness argument. See *Personal Web Techs., LLC v. Apple, Inc.*, 848 F.3d 987, 993-94 (Fed. Cir. 2017).

Thus, a POSITA would not have been motivated or had a reasonable expectation of success to arrive at the present invention by combining Hussell with Basin-2007 and Van Woudenberg. EX2026, ¶ 124.

C. Ground 3: Petitioners Have Not Shown that a POSITA Would Have Been Motivated to Combine Krummacher in view of Shimizu and Stokes.

Petitioners have failed to establish that a POSITA would have been motivated to combine Krummacher, Shimizu, and Stokes for several reasons. EX2026, ¶¶ 125-30. As with Grounds 1 and 2, Petitioners rely exclusively on the testimony of Prof. Doolittle, who again 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. In addition, as discussed above in Section VIII, Patent Owner

respectfully submits that the Board should give little if any credit to Prof. Doolittle's testimony given his many contradictions and evasive testimony on cross examination. As discussed below in Section IX.E, Petitioners' alleged motivation to combine also contradicts the numerous secondary considerations of non-obviousness that demonstrate the significance of the claimed invention.

Petitioners claim that "[a POSITA] would have been motivated to use a blue-light LED chip like that disclosed by Stokes and Shimizu in a conventional white-light LED light source called for by Krummacher." Pet. at 62 (citing EX1002, ¶ 215). However, Petitioners fail to explain why a POSITA would want to import a blue-light LED chip from Stokes or Shimizu into Krummacher. *See Id.* at 62-63. Petitioners also assert that a POSITA would have had a reasonable expectation of success in combining these references "because they would simply be using the conventional white light LED disclosed in the prior art as directed by Krummacher." *Id.* at 63. But again, Petitioners have not met their burden, and Petitioners' expert offers only conclusory restatements of the Petition without supporting evidence. *See Xerox*, IPR2022-00624 at 15.

Krummacher, Shimizu, and Stokes are all different applications of LEDs. Krummacher discloses vertical flow chip configurations utilized in large area lighting units (*see* EX1007, ¶ 4; *see also* EX2026, ¶ 97), which is entirely different than the applications disclosed in Shimizu and Stokes. Shimizu discloses DIP and

lead-frame SMD LEDs in industrial applications such as LED displays, back light sources, traffic signals, railway signals, etc. (see EX1010 at 1:12-14; see also EX2026, ¶ 100), and Stokes also discloses DIP and lead-frame SMD LEDs involved in commercial applications such as automotive, display, and safety/emergency uses (see EX1008 at 1:19-20; see also EX2026, ¶ 102). 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.” EX2026, ¶ 128. For instance, Shimizu’s LED utilizes bond wires 103, 203 that face upward as shown here:

Fig. 1

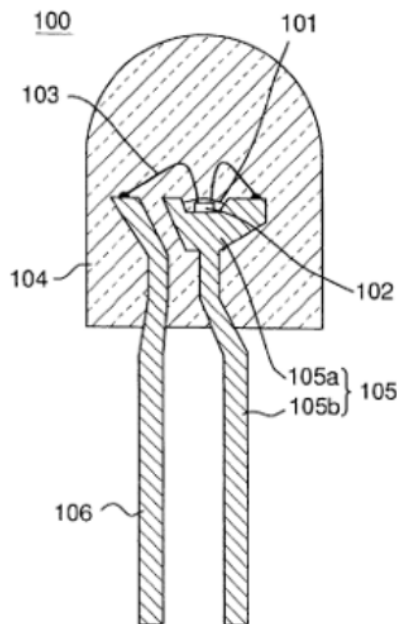
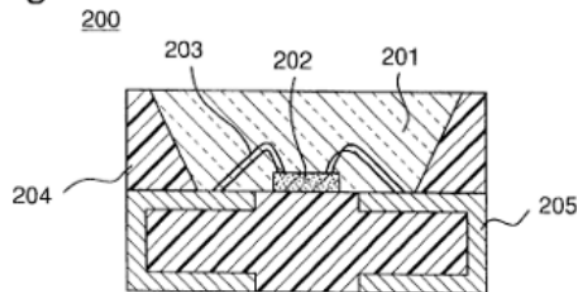


Fig. 2



EX1010 at FIGs. 1, 2. Krummacher’s LED does not have wires, and does not require the housing seen in DIP and SMD LEDs:

FIG 1

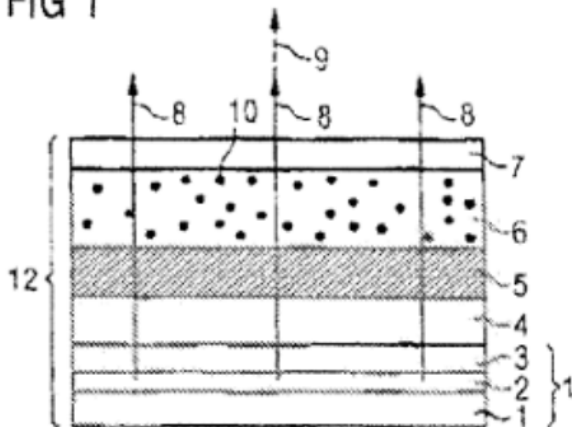
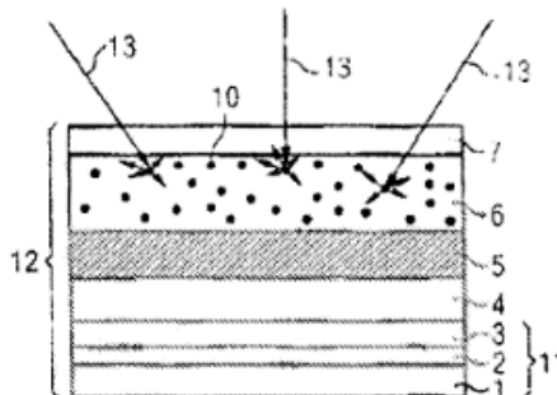


FIG 2



EX1007 at FIGs. 1, 2. Because these LEDs require different packaging considerations, a POSITA would not understand that it would be a “simple substitution” to use Shimizu’s LED with the more efficient chip in Krummacher. EX2026, ¶¶ 54-63, 128.

Furthermore, as discussed above in Section VIII.A, the quantum efficiency of blue light LEDs decreases with longer wavelengths. See EX2026, ¶¶ 49-50, 112-15, 129. Petitioners do not offer any explanation as to why a POSITA would have combined Krummacher with other lower efficiency LEDs like Shimizu and Stokes just to limit the LED and LED chip to a lower quantum efficiency. See EX2026, ¶ 129. This is using impermissible hindsight to make an obviousness argument. See *Metalcraft*, 848 F.3d at 1367. Moreover, if Petitioners’ proposed combination were as obvious as Petitioners contend, then LED bulb suppliers would have introduced the claimed bulbs many years ago to meet the long-felt need. See Section IX.E.

Thus, a POSITA would not have been motivated or had a reasonable expectation of success to arrive at the present invention by combining Krummacher with Shimizu and Stokes. *See* EX2026, ¶ 130.

D. Ground 4: Petitioners Have Not Shown that a POSITA Would Have Been Motivated to Combine Hussell, Van Woudenberg, and Krummacher.

Petitioners have failed to establish that a POSITA would have been motivated to combine Hussell, Van Woudenberg, and Krummacher for several reasons. EX2026, ¶¶ 131-34. As with Grounds 1-3, Petitioners rely exclusively on the testimony of Prof. Doolittle, who again 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. In addition, as discussed above in Section VIII, Patent Owner respectfully submits that the Board should give little if any credit to Prof. Doolittle's testimony given his many contradictions and evasive testimony on cross examination. As discussed below in Section IX.E, Petitioners' alleged motivation to combine also contradicts the numerous secondary considerations of non-obviousness that demonstrate the significance of the claimed invention.

Petitioners' arguments for combining these references are brief and conclusory. Petitioners' only argument for motivation to combine these references is that "[t]he teachings in [Hussell and Van Woudenberg] also demonstrate why a

person skilled in the art would be motivated to modify the ‘wavelength conversion tube’ in Hussell to create an off-state white appearance.” Pet. at 78. This is simply insufficient. *See, e.g., Tennant*, No. IPR2021-00625, Paper 9 at 39.

Hussell, Krummacher, and Van Woudenberg are all different applications of LEDs. Hussell involves conventional incandescent replacement applications (*see* EX1011, ¶ 3), Krummacher depicts vertical chip configurations utilized in large area lighting units (*see* EX1007, ¶ 4; *see also* EX2026, ¶ 97), and Van Woudenberg involves “auxiliary lights in mobile phones or down-light units” using DIP and SMD LEDs (*see* EX1020 at Abstract; *see also* EX2026, ¶ 95). 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 Van Woudenberg’s auxiliary lights in DIP and SMD LEDs beyond generic “laminat[ing] or glu[ing].” Pet. 78 (quoting EX1007, ¶¶ 42-43). A POSITA would not find the packaging requirements for each structure and application able to be combined with a reasonable expectation of success. EX2026, ¶ 132.

Furthermore, as discussed above in Section VIII.A, the quantum efficiency of blue light LEDs decreases with longer wavelengths. *See* EX2026, ¶¶ 49-50, 112-15, 133. Petitioners do not offer any explanation as to why a POSITA would combine Krummacher with lower efficiency LEDs like Van Woudenberg just to

limit the LED and LED chip to a lower quantum efficiency. *See* EX2026, ¶ 133.

Petitioners use impermissible hindsight to make their obviousness argument. *See Personal Web Techs.*, 848 F.3d at 993-94. Again, if Petitioners' proposed combination were as obvious as Petitioners contend, then LED bulb suppliers would have introduced the claimed bulbs many years ago to meet the long-felt need. *See* Section IX.E.

Thus, a POSITA would not have been motivated or had a reasonable expectation of success to arrive at the present invention by combining Krummacher with Basin-2007 and Van Woudenberg. EX2026, ¶ 134.

E. Grounds 1-4: Secondary Indicia of Non-obviousness Further Undermine Petitioner's Alleged Motivation to Combine

Multiple secondary indicia of non-obviousness further show that it would not have been obvious at the time of the invention to selectively combine particular teachings from the cited references, as Petitioners urge. "Objective indicia of nonobviousness must be considered in every case where present." *Apple Inc. v. Samsung Elecs. Co., Ltd.*, 839 F.3d 1034, 1048 (Fed. Cir. 2016). As explained below, Patent Owner's LED lightbulbs incorporating the claimed invention satisfy multiple secondary indicia of non-obviousness.

Satisfying a long-felt but unresolved 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). The ’678 Patent itself identifies the long-felt need for the claimed invention. In particular, the ’678 Patent explained that “there is a need for an improved approach to implement LED lighting apparatuses which addresses the non-white color appearance of the LED lighting apparatuses while in an OFF state.” EX1001 at 2:46-52; *see also* EX2037 (expressing a need for white filament lighting devices); EX2026, ¶ 139. The existence of this long-felt need is further evidenced by the commercial success, unexpected results, and industry praise that Patent Owner’s patented products have enjoyed, as well as the many copycat products that now compete against Patent Owner’s products.

Achieving commercial success. “Demonstrating that an invention has commercial value, that it is commercially successful, weighs in favor of its non-obviousness.” *WBIP*, 829 F.3d at 1337. Since the first introduction of its patented white-filament bulbs, Patent Owner has prominently advertised the feature in its marketing and sales materials. *See* EX2032, EX2033, EX2034; *see also* EX2026, ¶ 137. Retailers who sell Patent Owner’s patented products have likewise emphasized the white filaments. *See* EX2029 (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.”), EX2031, EX2035; *see also* EX2026, ¶¶ 136, 138. Those 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. *Compare* EX2035 (Patent Owner’s white-filament product priced at \$29.97) *with* EX2036 (similar yellow-filament product priced at \$21.97); *see also* EX2026, ¶ 138.

Generating industry praise. In addition to commercial success, Patent Owner’s patented white-filament bulbs have received praise from the industry. For example, 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.” EX2031; *see also* EX2026, ¶ 136. Industry forums also 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.” EX2030. This is the very response the ’678 Patent inventors sought to achieve. *See* EX1001 at 11:15-22.

Drawing copycat products from competitors. As the Board is aware, the subject proceeding was filed in response to district court actions asserting the '678 Patent against Petitioners' products. See Pet. at 16-17. Specifically, Petitioners' accused white filament products all infringe the '678 patent, all were introduced after Patent Owner's patented products, and all mirror Patent Owner's own white filament design. See EX1018, EX1037, EX1038, EX1039. This copying of the invention shows that the challenged claims are not obvious. See *Akamai Techs., Inc. v. Cable & Wireless Internet Servs., Inc.*, 344 F.3d 1186, 1196 (Fed. Cir. 2003). If the claims were obvious as Petitioners claim, then Petitioners would have introduced their competing products years earlier to meet the long-felt need.

Providing unexpected results. Petitioners assert that the claimed invention is nothing more than the expected result of combining various prior art teachings. The market shows otherwise. If 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. See EX2029, EX2030, EX2031, EX2032, EX2033, EX2034, EX2037. The fact that none of the Petitioners did so demonstrates that the results were *unexpected*.

Demonstrated Nexus. "[T]here is a presumption of nexus for objective considerations when the patentee shows that the asserted objective evidence is tied

to a specific product and that product ‘is the invention disclosed and claimed in the patent.’” *WBIP*, 829 F.3d at 1329. Each of the above listed secondary considerations is directly related to white filament style light emitting devices, including Petitioners’ products that practice the claimed invention (*see* EX1018, EX1037, EX1038, EX1039).

Beyond the inherent deficiencies in Petitioners’ alleged motivation to combine, all five of these secondary considerations further demonstrate that a POSITA had no motivation to selectively combine the particular teachings of Petitioners’ cited references. Had there been any such motivation, then Patent Owner’s competitors—including Petitioners—long ago would have addressed the need in the market.

X. CONCLUSION

For the reasons stated above, Patent Owner respectfully asks the Board to find that the challenged claims of the ’678 Patent are not unpatentable.

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Respectfully submitted,

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CERTIFICATE OF WORD COUNT UNDER 37 C.F.R. § 42.24(b)(1)

I, the undersigned, do hereby certify that the foregoing Patent Owner Preliminary Response, including footnotes, contains 10,229 words, as measured by the Word Count function of Microsoft Word as specified by 37 C.F.R. § 42.24(b)(1).

/Charles M. McMahon/
Charles M. McMahon

CERTIFICATE OF SERVICE

I hereby certify that on June 25, 2025, a true and correct copy of the foregoing was served by electronic mail upon the following counsel of record for Petitioners:

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