

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

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

v.

FEIT ELECTRIC COMPANY, INC.,
Patent Owner.

Case IPR2025-00260
U.S. Patent No. 8,604,678

PATENT OWNER'S RESPONSE TO IPR2025-00260

TABLE OF CONTENTS

I.	Introduction.....	1
II.	U.S. Patent No. 8,604,678	3
	A. Technology Background.....	3
	B. Prosecution History	4
	C. Benefits of the '678 Patent.....	7
III.	Petitioners' Challenge to the '678 Patent in IPR2025-00260.....	12
IV.	Overview of Petitioners' Cited References	12
	A. Basin-2007 (EX1005)	12
	B. Basin-2005 (EX1006)	14
	C. Krummacher (EX1007).....	15
	D. Shimizu (EX1010).....	17
	E. Stokes (EX1008)	19
V.	Legal Standard	21
VI.	Level of Skill in the Art	21
VII.	Claim Construction.....	22
VIII.	Petitioners' Allegations Regarding Figure 10 Are Inflammatory and Irrelevant	22
IX.	Petitioners Have Not Shown that Claims 11-14 are Unpatentable	23

A.	Combining Stokes with Basin-2007 or Krummacher would undermine the very reason Petitioners cite for combining them.....	24
B.	Stokes expressly teaches away from both the claimed invention and the other asserted prior art.....	27
C.	The Petition fails to explain how Stokes could be combined with Basin-2007 or Krummacher to provide the features of Claims 11-14	29
X.	Claims 1 and 11-14 are not unpatentable for the same reasons Explained in IPR2024-01357	33
A.	Ground 1: Petitioners Have Not Shown that a POSITA Would Have Been Motivated to Combine Basin-2007 and Basin-2005	34
B.	Ground 3: Petitioners Have Not Shown that a POSITA Would Have Been Motivated to Combine Krummacher in view of Shimizu and Stokes.....	40
C.	Grounds 1-3: Secondary Indicia of Non-obviousness Further Undermine Petitioner’s Alleged Motivation to Combine	44
XI.	Conclusion	48

TABLE OF AUTHORITIES

Cases

<i>Akamai Techs., Inc. v. Cable & Wireless Internet Servs., Inc.</i> , 344 F.3d 1186 (Fed. Cir. 2003).....	47
<i>Allied Erecting & Dismantling Co. v. Genesis Attachments, LLC</i> , 825 F.3d 1373 (Fed. Cir. 2016).....	35
<i>Apple Inc. v. California Inst. Tech.</i> , No. IPR2017-00219, Paper 76 (P.T.A.B. Dec. 27, 2018).....	36
<i>Apple Inc. v. Samsung Elecs. Co., Ltd.</i> , 839 F.3d 1034 (Fed. Cir. 2016).....	44
<i>Depuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.</i> , 567 F.3d 1314 (Fed. Cir. 2009).....	24, 33
<i>Graham v. John Deere Co.</i> , 383 U.S. 1 (1966)	21
<i>Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.</i> , 821 F.3d 1359 (Fed. Cir. 2016).....	33
<i>KSR Int'l Co. v. Teleflex Inc.</i> , 550 U.S. 398 (2007)	21, 33
<i>Metalcraft of Mayville, Inc. v. Toro Co.</i> , 848 F.3d 1358 (Fed. Cir. 2017).....	39, 43
<i>Pers. Web Techs., LLC v. Apple, Inc.</i> , 848 F.3d 987 (Fed. Cir. 2017).....	31
<i>Phillips v. AWH Corp.</i> , 415 F.3d 1303 (Fed. Cir. 2005).....	22
<i>Tennant Co. v. Oxygenator Water Techs., Inc.</i> , No. IPR2021-00625, Paper 9 (P.T.A.B. Aug. 20, 2021)	35

IPR2024-01357

IPR2025-00260

U.S. Patent No. 8,604,678

Virtek Vision Int’l ULC v. Assembly Guidance Sys., Inc.,
97 F.4th 882 (Fed. Cir. 2024)36

WBIP, LLC v. Kohler Co.,
829 F.3d 1317 (Fed. Cir. 2016)..... 44, 45, 48

EXHIBITS

Exhibit	Description
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
2011	Elong’s Initial Invalidity and Unenforceability Contentions, <i>Feit Electric Co., Inc. v. Elong International USA Inc.</i> , No. 3:24-cv-1089 (N.D. Tex.), served on December 9, 2024
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)
2015	Matthew G. Bevan & Bruce M. Romenesko, <i>Modern Electronic Packaging Technology</i> , 20 JOHNS HOPKINS APL TECH. DIGEST 22 (1999)
2016	X. A. Cao & S. D. Arthur, <i>High-power and reliable operation of vertical light-emitting diodes on bulk GaN</i> , 85 Applied Physics Letters 3971 (2004).

IPR2024-01357

IPR2025-00260

U.S. Patent No. 8,604,678

Exhibit	Description
2017	Michael R. Krames et al., <i>Status and Future of High-Power Light-Emitting Diodes for Solid-State Lighting</i> , 3 J. Display Tech. 160 (2007)
2018	Mehmet Arik et al., <i>Thermal Management of LEDs: Package to System</i> , 5187 Proc. SPIE 64 (2004)
2019	U.S. Dep’t Energy, <i>Critical Materials Strategy</i> (Dec. 2010)
2020	Zongyuan Liu et al., <i>Measurement and numerical studies of optical properties of YAG:Ce phosphor for white light-emitting diode packaging</i> , 49 Applied Optics 247 (2010)
2021	March 2024 United States District Courts — Federal Court Management Statistics for N.D. Tex., E.D. Ky., and N.D. Ohio (https://www.uscourts.gov/data-news/reports/statisticalreports/federal-court-management-statistics/federal-courtmanagement-statistics-march-2024)
2022	September 2024 United States District Courts — Federal Court Management Statistics for N.D. Tex., E.D. Ky., and N.D. Ohio (https://www.uscourts.gov/data-news/reports/statisticalreports/federal-court-management-statistics/federal-courtmanagement-statistics-september-2024)
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

IPR2024-01357

IPR2025-00260

U.S. Patent No. 8,604,678

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?
2038	Deposition Transcript of William A. Doolittle, Ph.D., dated July 17, 2025
2039	Declaration of E. Fred Schubert, Ph.D., dated July 25, 2025

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 11	
11[pre]	The component of claim 1,
11[a]	wherein the light scattering material has an average particle size that is selected such that the light scattering material will scatter the excitation light relatively more than the light scattering material will scatter light generated by the at least one photoluminescence material.

Dependent Claim 12	
12[pre]	The component of claim 11,
12[a]	wherein the light scattering material scatters the excitation light at least twice as much as light generated by the at least one photoluminescence material.
Dependent Claim 13	
13[pre]	The component of claim 11,
13[a]	wherein the excitation light comprises blue light.
Dependent Claim 14	
14[pre]	The component of claim 13,
14[a]	wherein the light scattering material has an average particle size that is less than about 150 nm.
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,

IPR2024-01357

IPR2025-00260

U.S. Patent No. 8,604,678

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 longstanding problems with white-light LED lightbulbs. To achieve white light, many LED lightbulbs mix light from a blue LED, and light emitted 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 the emitted light is yellow and not white.

An embodiment of the ’678 Patent solved this longstanding problem by adding a diffusion layer that covers the yellow phosphorous layer and causes the LED to appear white when the lightbulb is turned off. The diffusion layer also increases the efficiency of the phosphorous layer, which the ’678 Patent refers to as the wavelength conversion layer. Claims 11-14 additionally focus on limitations that further enhance the wavelength conversion component of claim 1 by

IPR2024-01357
IPR2025-00260
U.S. Patent No. 8,604,678

configuring the light scattering material of the light diffusing layer to reduce the amount of phosphor material needed, including by selecting for advantageous particle sizes. The diffusion layer reflects some of the blue light back to the wavelength conversion layer, increasing 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.

On June 23, 2025, the Board instituted IPR2025-00260 and consolidated the proceeding with IPR2024-01357 (which challenges claims 1-3, 6, 7, 9, 10, 16-21, 25, 26, and 29 of the '678 patent). Paper 25. On June 25, 2025, Patent Owner submitted (i) a Patent Owner Response relating to claims 1-3, 6, 7, 9, 10, 16-21, 25, 26, and 29 of the '678 Patent based on the grounds presented in IPR2024-01357 (Paper 26) and (ii) a contingent motion to amend claims 1-3, 6, 7, 9, 10, 16-21, 25, 26, and 29 based on the grounds presented in IPR2024-01357 (Paper 27). Patent Owner hereby supplements its Patent Owner Response (Paper 26) to address challenged claims 11-14 and concurrently submits a supplemental contingent motion to amend claims 11-14.

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.

IPR2024-01357
IPR2025-00260
U.S. Patent No. 8,604,678

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.

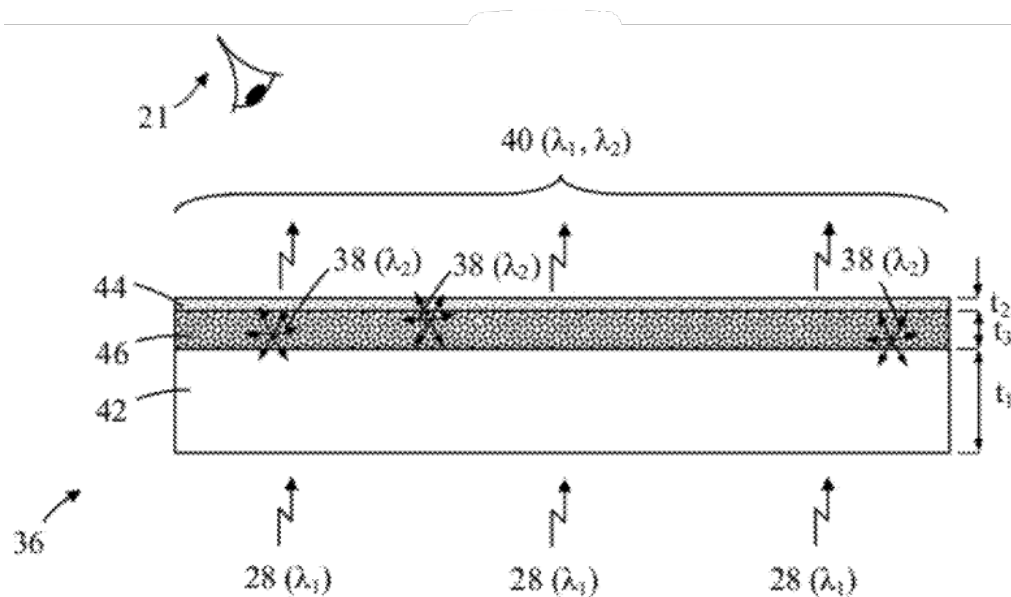


FIG. 3

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 IN IPR2025-00260

Ground	Claims	Basis	References
1	1	35 U.S.C. § 103	Basin-2007 in view of Basin-2005
2	11-14	35 U.S.C. § 103	Basin-2007 in view of Basin-2005 and Stokes
3	1, 11-14	35 U.S.C. § 103	Krummacher in view of Shimizu and Stokes

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:

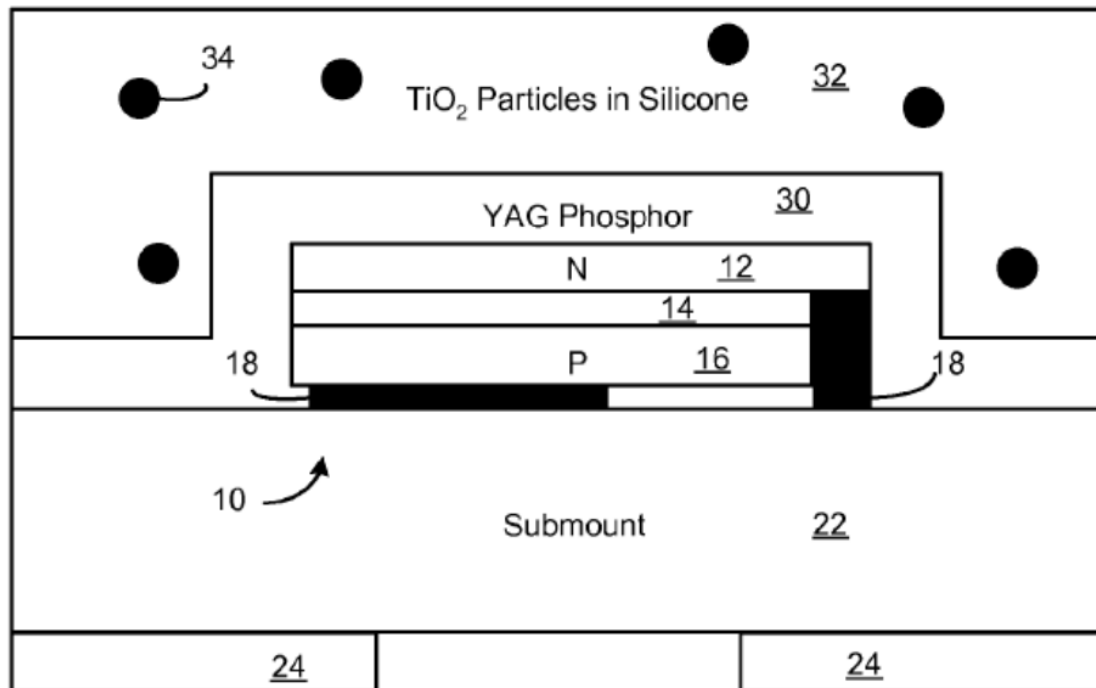


Fig. 2

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:

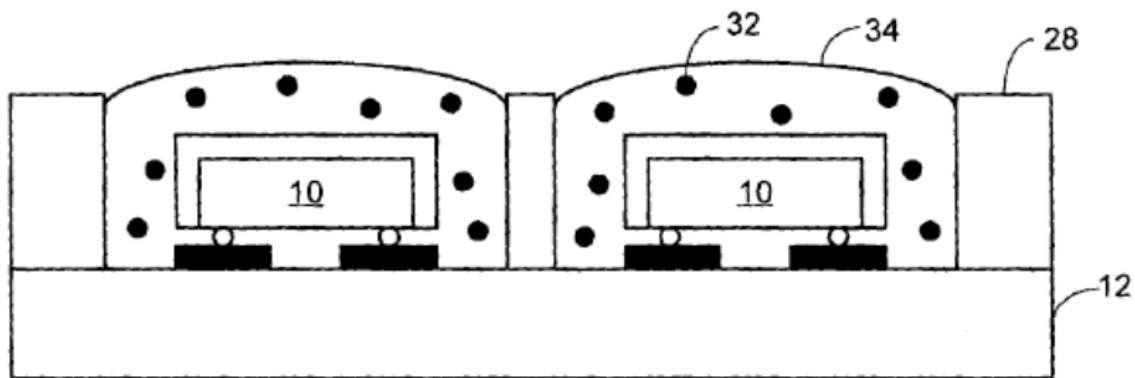


Fig. 5

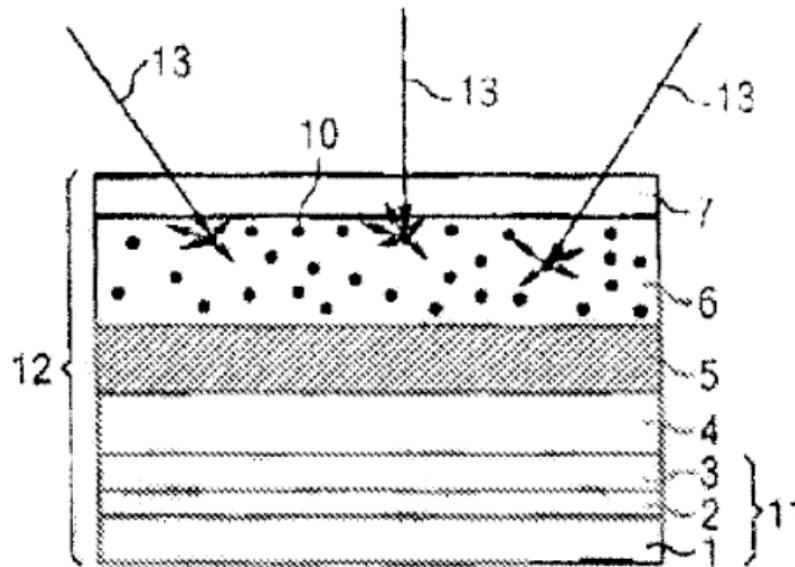
Id. at FIG. 5, ¶¶ 40-43. The LED dies 10 are coated in a “first phosphor for producing red, yellow, or yellow-green light” that “is deposited to conformably

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. 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

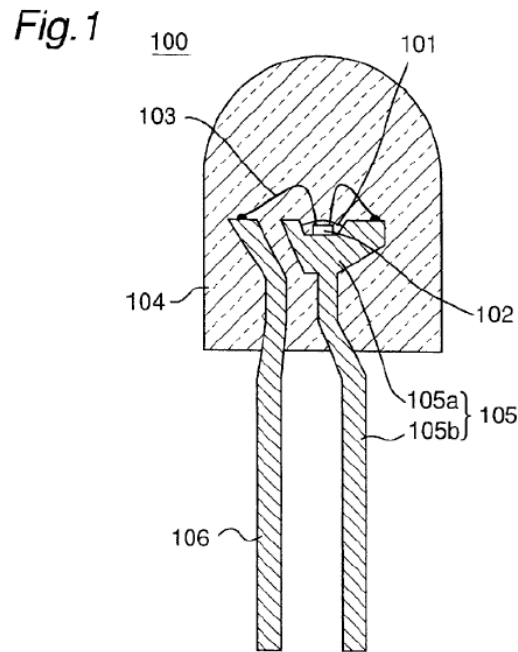


Id. at FIG. 2. Krummacher's Figure 2, as shown above, depicts an optoelectronic component in the OFF state with an active layer 2 that emits blue light. *Id.*, ¶¶ 31-32. Active layer 2 is covered by a layer sequence 11 comprising additional layers 2 and 3 and a passivating layer 4 that protects layer 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.

D. 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.

E. 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:

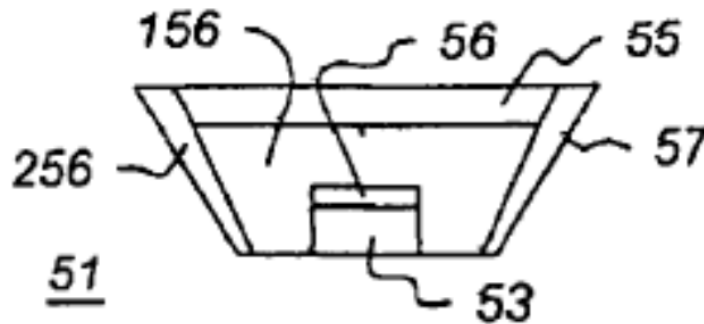


fig 7

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

IPR2024-01357
IPR2025-00260
U.S. Patent No. 8,604,678

the teachings of the '678 patent and the prior-art references discussed herein.”

IPR2025-00260 Pet. at 8-9. 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. PETITIONERS’ ALLEGATIONS REGARDING FIGURE 10 ARE INFLAMMATORY AND IRRELEVANT

As a preliminary matter, Patent Owner addresses Petitioners’ continue to mischaracterize the source and nature of the '678 Patent’s Figure 10. In particular, Petitioners assert that the inventors of the '678 Patent “lifted [information] directly from prior art DuPont research.” IPR2025-00260 Pet. at 22. This is a completely unjustified and baseless *ad hominem* attack on the inventors and a

mischaracterization of the claimed invention. Tellingly, the DuPont reference does not form the basis for any ground advanced by Petitioners, rather it is only cited to bias the reader in advance of presenting the actual grounds for challenging the '678 Patent claims.

IX. PETITIONERS HAVE NOT SHOWN THAT CLAIMS 11-14 ARE UNPATENTABLE

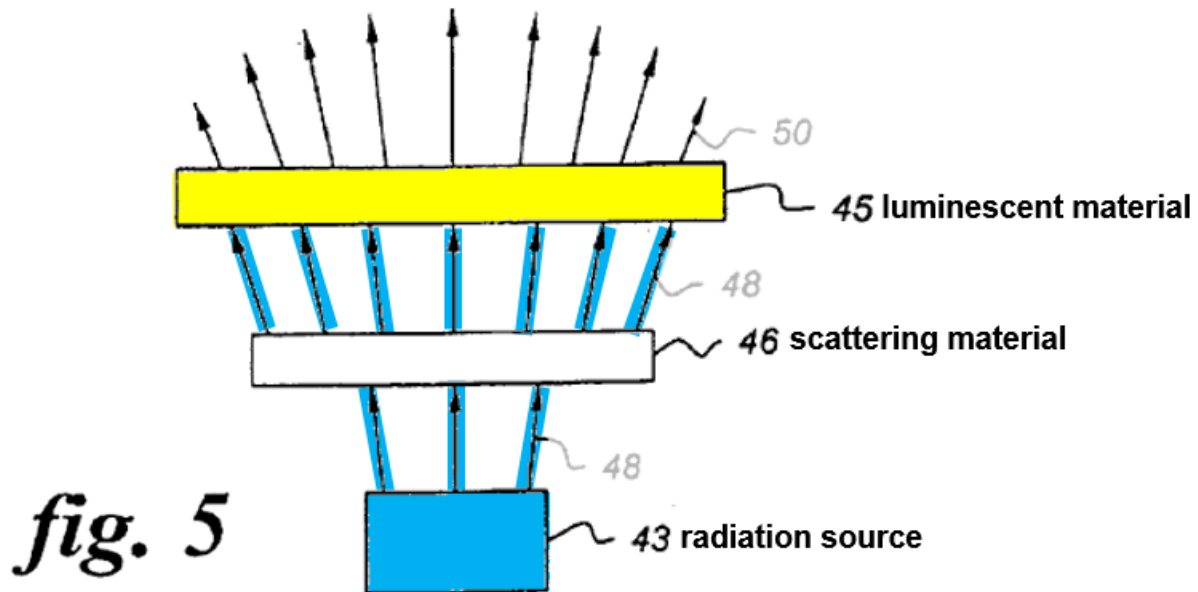
Patent Owner previously addressed the deficiencies in Petitioners' grounds as they relate to independent claim 1 in its response to the petition in IPR2024-01357 (Paper 26). Those same reasons apply here, and they are repeated below in Section X for the sake of completeness.

Patent Owner begins here instead with the two new grounds, Grounds 2 and 3, in which Petitioners challenge claims 11-14. Each of these grounds specifically relies upon the Stokes reference for the particle size limitations of claims 11-14. However, Petitioners have failed to show: (1) that one of skill in the art would have sought to combine Stokes with the other primary references and (2) *how* one of skill in the art would have actually combined Stokes with the other cited references to arrive at a device with the claimed benefits of the '678 Patent. In reality, the teachings of Stokes are incompatible with the cited prior art and cannot be combined to arrive at the claimed invention.

A. Combining Stokes with Basin-2007 or Krummacher would undermine the very reason Petitioners cite for combining them

“An inference of nonobviousness is especially strong where the prior art’s teachings undermine the very reason being proffered as to why a person of ordinary skill would have combined the known elements.” *Depuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 567 F.3d 1314, 1326 (Fed. Cir. 2009). That is precisely the case here. Petitioners’ reliance on Stokes would violate the purpose of Stokes, or the requirements of claims 11-14, or both. The Petition fails entirely to explain how Stokes could be combined with Basin-2007 or Krummacher to arrive at the invention of claims 11-14. The reason is that no such combination is possible.

Stokes describes a lamp containing a radiation source (*e.g.*, a blue LED chip), a luminescent material (*e.g.*, a phosphor) and—notably different from both the ’678 Patent and the other asserted prior art—a radiation scattering material located *between* the radiation source and the luminescent material, as illustrated in Figure 5.



EX1008 at Abst., FIG. 5; EX2039 at ¶ 16; *see* EX2039 at ¶ 13.

The goal of Stokes is to improve the lamp by reducing the directionality of the LED, thus reducing the “halo” or “penumbra” effect in the final emission product. EX1008 at 1:37-38 (“white LED lamps suffer from the undesirable halo effect and the penumbra effect”), 1:48-50 (“when the light output by such a system is directed onto a flat surface, it appears as a yellowish halo surrounding a bluish area”), 1:51-53 (“the 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”), 2:62-63 (“the present invention is directed to overcoming or at least reducing the problems set forth above”); *see* EX2039 at ¶ 13. Stokes accomplishes this goal in a very specific way, by positioning the scattering material

46 between the radiation source 43 and the luminescent material 45, as shown above in Figure 5.

More particularly, Stokes addresses the halo / penumbra effect by making the blue LED light emission less directional (*i.e.*, more isotropic). EX1008 at 3:51-57 (“the present inventors have realized that one of the causes of the halo effect is that due to the directional nature of the blue LED emission, a non-uniform source of blue light is incident on the phosphor layer.”). EX2039 at ¶ 15. Stokes repeatedly and consistently explains that this is accomplished by placing a radiation scattering material *between* the radiation source (*e.g.*, the blue LED) and the luminescent material (*e.g.*, the phosphor). EX1008 at 3:63-4:2 (“When 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 Thus, the lamp emits white light with high far field color and intensity uniformity.”) (emphasis added). Contrary to every claim of the ’678 patent, Stokes does nothing to improve an off-state white appearance of the wavelength conversion layer. Instead, Stokes places the white scattering material between the LED and the luminescent material, leaving the non-white luminescent material on the outside layer visible to an observer when the device is turned off. The Stokes

approach is also incompatible with both Basin-2007 and Krummacher, which describe the scattering material as the outside layer. The Petition fails to reconcile this incompatibility, and that alone is fatal to Grounds 2 and 3.

B. Stokes expressly teaches away from both the claimed invention and the other asserted prior art

Stokes is expressly critical of prior art in which the scattering material 46 is above, rather than below, the luminescent material 45. For example, Stokes acknowledges the Shimizu reference (EX1010, Pat. 6,069,440) as one method that discloses placing the light scattering material above the luminescent (phosphor) material, and Stokes expressly criticizes the resulting penumbra effect of the Shimizu approach. EX1008 at 2:23-64. Stokes similarly criticizes other prior art embodiments that placed the light scattering material above the luminescent material. *Id.* at 1:36 – 2:22; EX2039 at ¶ 17. Teaching away from the approach disclosed in Shimizu and these other prior art embodiments, which Stokes explains will all result in the undesirable penumbra effect, Stokes instead urges positioning the scattering material 46 between the radiation source 43 and the luminescent material 45, as discussed above and illustrated in Figure 5.

For instance, Stokes explains that:

[O]ne purpose of the scattering layer between the radiation source, such as the LED or a laser diode, and the luminescent material, such as a phosphor, is to make the blue light source appear more similar to the

yellow light source. Thus, the blue light source effectively loses the memory of the LED or laser diode chip geometry, and the resulting collimation, by virtue of having been scattered by the scattering layer.

EX1008 at 4:3-10. Stokes further touts the advantages of placing the scattering material between the LED and the luminescent material:

If the radiation source is a higher intensity laser diode, then the scattering layer serves the additional purpose of lowering the intensity of the radiation incident on the phosphor, so as not to allow the intense, highly collimated and coherent laser radiation to damage the phosphor layer.

EX1008 at 4:10-15. Another benefit Stokes cites for placing the scattering material 46 between the LED and the phosphor is to maintain the integrity of the phosphor itself. Stokes explains that:

By placing material 46 between the phosphor 45 and the LED 43, the phosphor 45 will remain cooler than if the phosphor 45 was in direct contact with the heat emitting LED 43. Stokes explains that this configuration is advantageous because it reduces or eliminates the reversible thermal quantum efficiency degradation of the phosphor 45 during the operation of the lamp 41.”

EX1008 at 6:13-19.

Thus, in addition to expressly criticizing prior art that placed the scattering material in the outside layer, Stokes repeatedly emphasizes the benefits of placing it between the LED and the luminescent material. Further reinforcing its teachings, Stokes discloses no embodiment in which the scattering material is in the outer layer, which would only frustrate the purpose of the Stokes approach.

C. The Petition fails to explain how Stokes could be combined with Basin-2007 or Krummacher to provide the features of Claims 11-14

One of skill in the art could not have combined Stokes with any of the other cited references in order to arrive at the '678 Patent claims because Stokes teaches positioning the phosphor on the *exterior* of the filament. *See* EX1008 at FIG. 5; EX2039 at ¶¶ 16, 19; EX2038 at 43:3-5. In other words, an observer looking at the Stokes filament would see the phosphor layer on the outside—which is exactly what the '678 Patent sought to avoid. EX2039 at ¶ 19; EX2038 at 41:9-12, 43:3-5. The '678 Patent makes clear that the yellowish appearance of an off-state phosphor “may be undesirable to the potential purchaser or customer that is seeking a white-appearing light” (EX1001 at 11:17-18), explaining 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 2:47-51). Placing the phosphor on the outside of the LED filament would eviscerate one of the stated purposes of the '678 Patent and would fail to “improve an off-state white appearance of the wavelength conversion component,” as *all* claims of the '678 Patent require. An observer would not see an improved off-state white appearance. Instead, an observer would see the same undesirable phosphor color that the '678 Patent criticized in the prior art

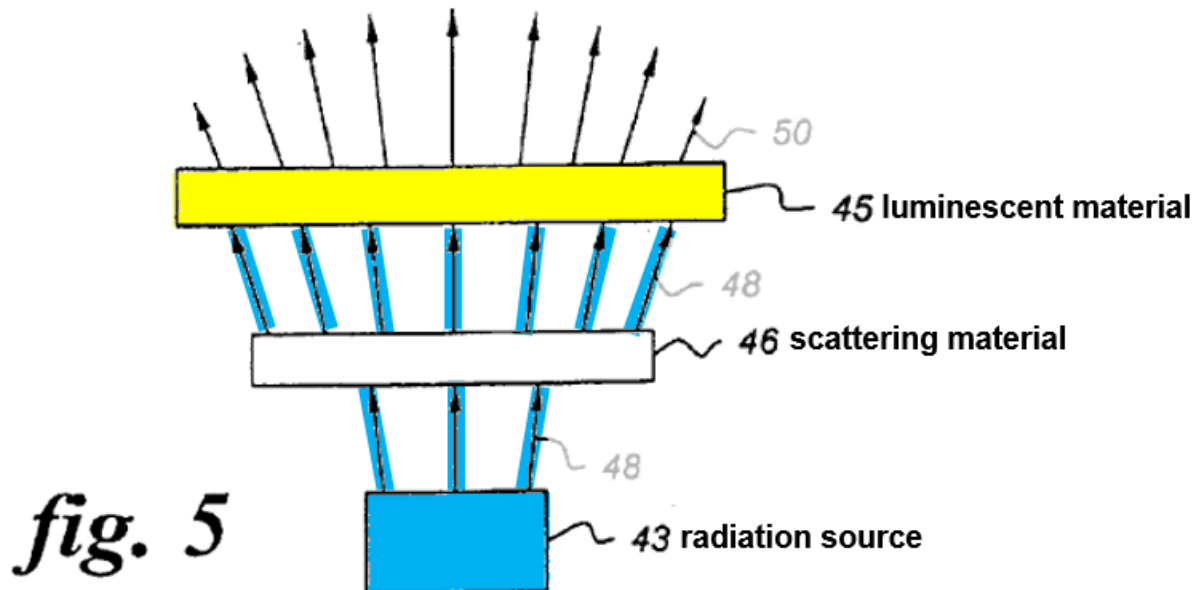
embodiments. *See* EX1001 at 11:17-18, 2:47-51; EX2039 at ¶ 19; EX2038 at 43:3-5. Petitioners have not reconciled this fundamental incompatibility with the stated purpose of the '678 Patent.

Nor have Petitioners explained *how* one of skill in the art allegedly would have modified the primary references in light of Stokes to arrive at the invention recited in claims 11-14. For example, claim 11 adds the limitation that “the light scattering material has an average particle size that is selected such that the light scattering material will scatter the excitation light relatively more than the light scattering material will scatter light generated by the at least one photoluminescence material.” But, as shown in Stokes Figure 5, the light scattering material 46 in Stokes cannot effectively scatter any excitation light because it is *between* the radiation source 43 and the luminescent material 45. EX1008 at FIG. 5.

Similarly, claim 12 further requires that “the light scattering material scatters the excitation light at least twice as much as light generated by the at least one photoluminescence material.” Again, **this is impossible with the Stokes arrangement** because the scattering material is between the LED and the luminescent material. EX2039 at ¶ 21. Petitioners’ silence with respect to the actual method and details of how to combine the Stokes configuration with the

other cited references is fatal to both Grounds 2 and 3. *See Pers. Web Techs., LLC v. Apple, Inc.*, 848 F.3d 987, 994 (Fed. Cir. 2017) (vacating and remanding Board decision of obviousness because there was no clear explanation “or cited evidence showing, *how* the combination of the two references was supposed to work.” (emphasis in original)).

Further, the '678 Patent explains that the purpose of these particle size limitations is to “substantially reduce the quantity of phosphor material required to generate a selected color of emitted light, since 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 3:24-28; EX2039 at ¶ 22. By contrast, the Stokes arrangement cannot accomplish this purpose because the scattering material 46, which is between the radiation source 43 and the luminescent material 45, *cannot* “direct light back into” the luminescent material. EX2039 at ¶ 22. As shown in Stokes Figure 5 (reproduced again below), light from the luminescent material 45 does not pass through the scattering material 46.



EX1008 at FIG. 5 (annotated); EX2039 at ¶ 16. Stokes therefore fails to suggest the use of particular particle sizes in the type of structures described in Basin-2007 or Krummacher, which use the *opposite* arrangement as Stokes. Indeed, they use the arrangement that Stokes expressly criticized and taught away from using. See EX1008 at 1:36 – 2:64. The Petition fails to explain this incongruity, and that failure is fatal to Grounds 2 and 3.

Worse yet, Petitioners' *only* stated motivation to combine Krummacher and Stokes is that "a POSA would have been motivated to apply [Stokes] to [Basin-2007 / Krummacher], because it would increase the conversion of blue light to yellow light and improve the uniformity of the light source." IPR2025-00260 Pet. at 39, 60. But as explained above, this alleged benefit of Stokes would not be available to the device in Basin-2007 or Krummacher because it would require

reversing the core teaching in Stokes and instead adopting the approach that Stokes expressly criticized. The Federal Circuit has made it clear that “[a]n inference of nonobviousness is especially strong where the prior art’s teachings undermine the very reason being proffered as to why a person of ordinary skill would have combined the known elements.” *Depuy Spine*, 567 F.3d at 1326.

Accordingly, Petitioners have failed to meet their burden of proving that claims 11-14 are unpatentable.

X. CLAIMS 1 AND 11-14 ARE NOT UNPATENTABLE FOR THE SAME REASONS EXPLAINED IN IPR2024-01357

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 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, 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 X.C, 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 specifically disclose blue light at the claimed wavelength equal to or greater than 440 nm. *See generally* IPR2025-00260 Pet. at 32-35; 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.” IPR2025-00260 Pet. at 33. 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

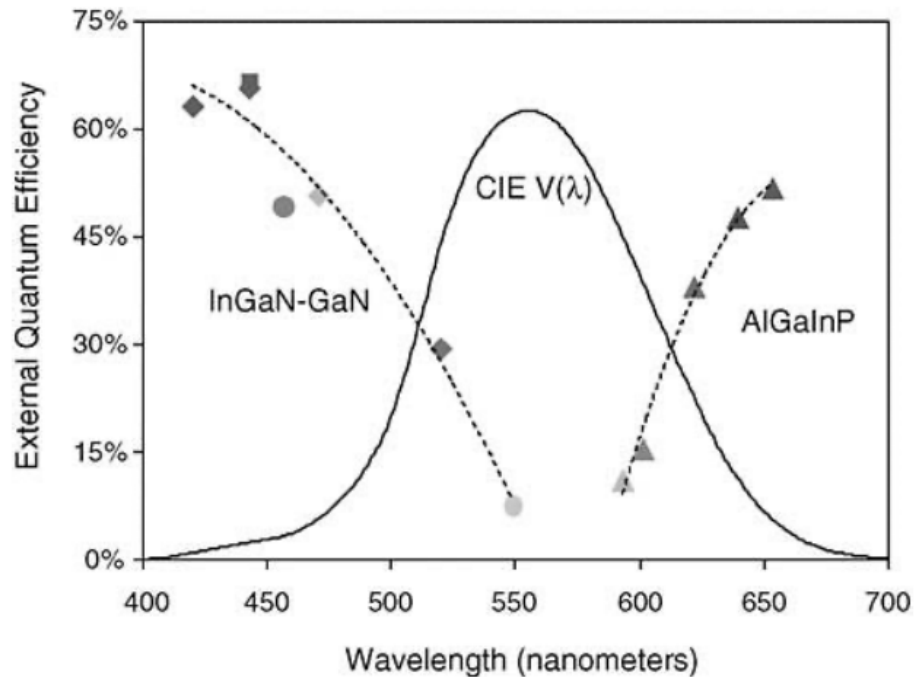
was no motivation to combine two references with similar structures. *See supra* Section II.B.

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 X.C.

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.

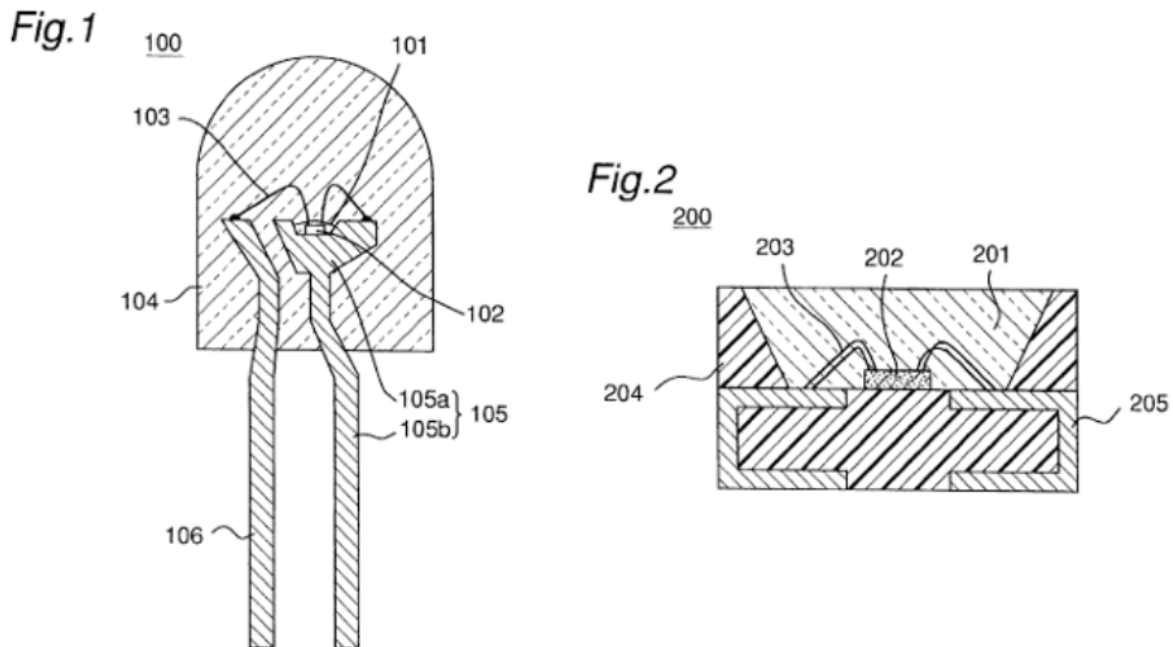
B. Ground 3: Petitioners Have Not Shown that a POSITA Would Have Been Motivated to Combine Krummacher in view of Shimizu and Stokes.

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 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, 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 X.C, Petitioners' alleged motivation to combine also contradicts the numerous secondary considerations of non-obviousness that demonstrate the significance of the claimed invention.

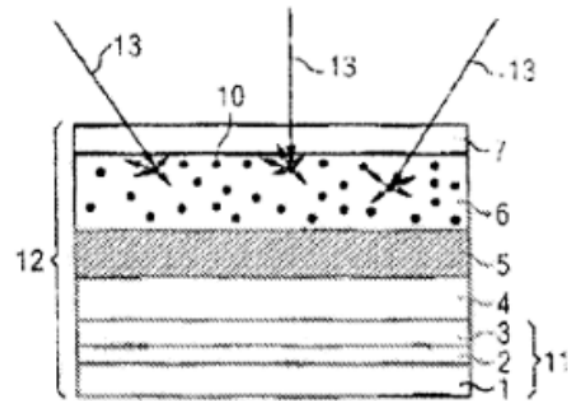
Petitioners claim that “[a POSITA] would have been motivated to use a blue-light LED chip like that disclosed by Stokes and Shimizu in a conventional white-light LED light source called for by Krummacher.” IPR2025-00260 Pet. at 55. However, Petitioners fail to explain why a POSITA would want to import a blue-light LED chip from Stokes or Shimizu into Krummacher. *See Id.* at 55-56. 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.* 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:



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



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 X.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 X.C.

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.

C. Grounds 1-3: 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*

IPR2024-01357
IPR2025-00260
U.S. Patent No. 8,604,678

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* IPR2024-1357 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.

XI. 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.

IPR2024-01357
IPR2025-00260
U.S. Patent No. 8,604,678

Date: July 25, 2025

Respectfully submitted,

/Charles M. McMahon/

Charles M. McMahon
USPTO Reg. No. 44,926
Thomas DaMario
USPTO Reg. No. 77,142
BENESCH FRIEDLANDER
COPLAN & ARONOFF LLP
71 South Wacker Drive, Suite 1600
Chicago, IL 60606
Tel: (312) 312-4949
Fax: (312) 767-9192
Email: FeitElectricIPR@beneschlaw.com

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 9,276 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 July 25, 2025, a true and correct copy of the foregoing was served by electronic mail upon the following counsel of record for

Petitioners:

David C. Radulescu, Ph.D., david@radip.com

Etai Lahav, etai@radip.com

Andrew S. Brown, andy@radip.com

Savant_IPR_Service@radip.com

/Charles M. McMahon/

Charles M. McMahon