UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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

v.

FEIT ELECTRIC COMPANY, INC.,
Patent Owner.

Case IPR2025-00698
U.S. Patent No. 8,614,539

PATENT OWNER'S PRELIMNARY RESPONSE

Mail Stop Patent Board
Patent Trial and Appeal Board
U.S. Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

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TABLE OF AUTHORITIES

Cases

EXHIBITS

Exhibit	Description
2001	Declaration of E. Fred Schubert, Ph.D.
2002	*Curriculum vitae* for E. Fred Schubert, Ph.D.
2003	U.S. Patent Publication 2002/0180351 ("McNulty")
2004	U.S. Patent Publication 2001/0000622 ("Reeh")
2005-2012	RESERVED
2013	Mike Krames, *Light-Emitting Diode Technology for Solid-State Lighting*, *in* Frontiers of Engineering: Reports on Leading-Edge Engineering from the 2009 Symposium, 67 (2009)
2014	E. Fred Schubert, Light-Emitting Diodes (2nd ed. 2006)
2015	Matthew G. Bevan & Bruce M. Romenesko, *Modern Electronic Packaging Technology*, 20 JOHNS HOPKINS APL TECH. DIGEST 22 (1999)
2016	X. A. Cao & S. D. Arthur, *High-power and reliable operation of vertical light-emitting diodes on bulk GaN*, 85 Applied Physics Letters 3971 (2004).
2017	Michael R. Krames et al., *Status and Future of High-Power Light-Emitting Diodes for Solid-State Lighting*, 3 J. Display Tech. 160 (2007)
2018	Mehmet Arik et al., *Thermal Management of LEDs: Package to System*, 5187 Proc. SPIE 64 (2004)
2019	U.S. Dep't Energy, Critical Materials Strategy (Dec. 2010)
2020	Zongyuan Liu et al., *Measurement and numerical studies of optical properties of YAG:Ce phosphor for white light-emitting diode packaging*, 49 Applied Optics 247 (2010)
2021-2028	RESERVED
2029	Home Depot - Feit Electric White Filament LED Light Bulbs listing
2030	Candle Power Forums article: Feit LED filament bulb with white filaments
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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]	at least one photoluminescence material; and
1[b]	a light scattering material, wherein the light scattering material has an average particle size that is selected such that the light scattering material will scatter excitation light from a radiation source relatively more than the light scattering material will scatter light generated by the at least one photoluminescence material,
1[c]	wherein the wavelength conversion component is configured such that in operation a portion of the excitation light comprising blue light having a wavelength of greater than or equal to 440 nm is emitted through the wavelength conversion component to contribute to a final visible emission product;
1[d]	wherein the light scattering material scatters the blue light at least twice as much as light generated by the at least one photoluminescence material.

Dependent Claim 2	
2[pre]	The component of claim 1,
2[a]	wherein the light scattering material has an average particle size that is less than about 150 nm.
Dependent Claim 3	
3[pre]	The component of claim 1,
3[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 4	
4[pre]	The component of claim 1
4[a]	wherein the at least one photoluminescence material is located in a wavelength conversion layer and the light scattering material is located in a diffusing layer.
Dependent Claim 5	
5[pre]	The component of claim 4,
5[a]	wherein the wavelength conversion layer and the light diffusing layer are in direct contact with each other.
Dependent Claim 6	
6[pre]	The component of claim 4,
6[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 7	
7[pre]	The component of claim 6,
7[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 8	
8[pre]	The component of claim 6,
8[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 4,

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 4
10[a]	in which the wavelength conversion layer and the light diffusing layer comprises planar shapes.
Dependent Claim 11	
11[pre]	The component of claim 4
11[a]	in which the light diffusing layer comprises a dome or elongated dome shape.

Independent Claim 18	
18[pre]	A light emitting device, comprising:
18[a]	at least one solid-state light emitter operable to generate excitation light; and
18[b][1]	a wavelength conversion component comprising:
18[b][2]	at least one photoluminescence material; and
18[b][3]	a light scattering material, wherein the light scattering material has an average particle size that is selected such that the light scattering material will scatter excitation light from the at least one solid-state light emitter relatively more than the light scattering material will scatter light generated by the at least one photoluminescence material,

18[c]	wherein the wavelength conversion component is configured such that in operation a portion of the excitation light comprising blue light having a wavelength of greater than or equal to 440 nm is emitted through the wavelength conversion component to contribute to a final visible emission product;
18[d]	wherein the light scattering material scatters the blue light at least twice as much as light generated by the at least one photoluminescence material.

Dependent Claim 19	
19[pre]	The device of claim 18,
19[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 20	
20[pre]	The device of claim 18
20[a]	in which the average particle size of the light scattering material is selected to improve an OFF state white appearance of the light emitting device.
Dependent Claim 23	
23[pre]	The device of claim 18,
23[a]	wherein the light scattering material has an average particle size that is less than about 150 nm.
Dependent Claim 24	
24[pre]	The device of claim 18

24[a]	in which the wavelength conversion layer and the light diffusing layer comprises planar shapes.
Dependent Claim 25	
25[pre]	The device of claim 18
25[a]	in which the light diffusing layer comprises a dome or elongated dome shape.

Independent Claim 28	
28[pre]	A light bulb comprising:
28[a]	a connector base configured to be inserted in a socket to form an electrical connection for the light bulb;
28[b]	a body comprising one or more solid-state light emitters;
28[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,
28[d][1]	wherein the wavelength conversion component comprises
28[d][2]	at least one photoluminescence material; and
28[d][3]	a light scattering material, wherein the light scattering material has an average particle size that is selected such that the light scattering material will scatter excitation light from the one or more solid-state light emitters relatively more than the light scattering material will scatter light generated by the at least one photoluminescence material,
28[e]	wherein the wavelength conversion component is configured such that in operation a portion of the excitation light comprising blue light having a wavelength of greater than or equal to 440 nm is emitted through the wavelength conversion component to contribute to a final visible emission product;

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

I. INTRODUCTION

Institution should be denied because Petitioners have failed to identify the specific combination of prior art teachings they propose combining and failed to identify at least one key claim limitation in the prior art. In a futile effort to show some prior art teaching of the claimed "average particle size" limitation, Petitioners cited to teachings in two different references yet fail to identify which of these teachings they rely upon. In the end, it does not matter because Petitioners have cited no teaching of the claimed "average particle size" limitation in either of the two references. Petitioners have thus failed to show a reasonable likelihood of prevailing on any challenged claim.

II. RELATED PROCEEDINGS

U.S. Patent No. 8,614,539 is asserted and/or challenged in the following additional proceeding:

- *Feit Electric Co., Inc. v. Savant Technologies LLC d/b/a GE Lighting*, No. 1:24-cv-473 (N.D. Ohio).

Additionally, U.S. Patent No. 8,604,678, which is related to U.S. Patent No. 8,614,539, is the asserted and/or challenged in the following proceedings:

- *Feit Electric Co., Inc. v. Savant Technologies LLC d/b/a GE Lighting*, No. 1:24-cv-473 (N.D. Ohio);
- *Feit Electric Co., Inc. v. LEDVANCE, LLC*, No. 5:24-cv-31 (E.D. Ky.);

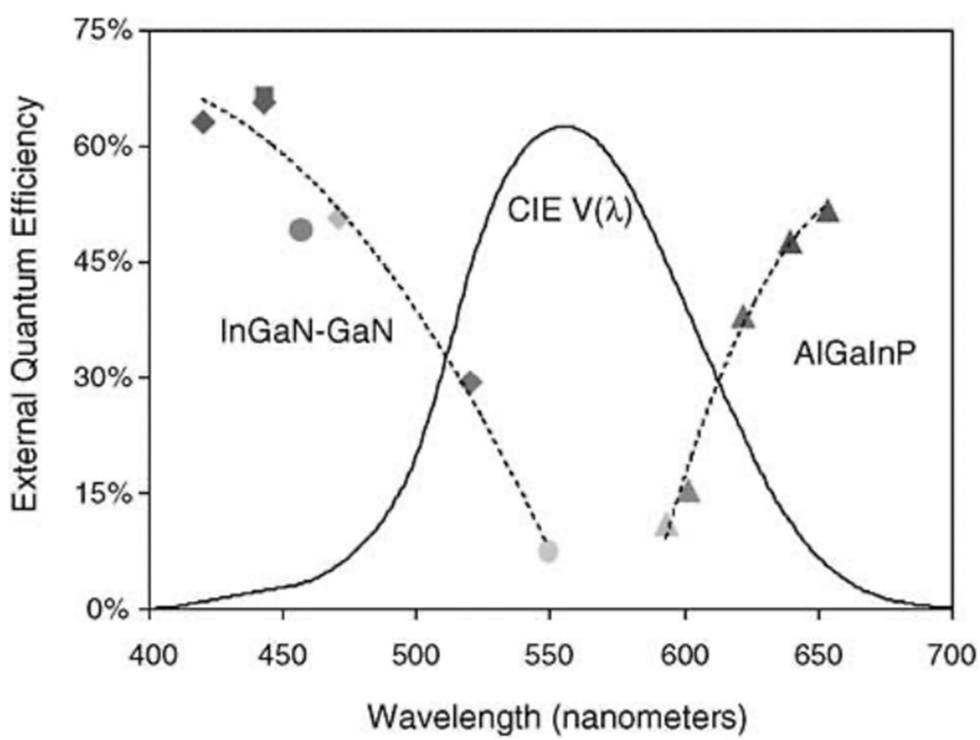
- *Feit Electric Co., Inc. v. Elong International USA Inc. and Xiamen Longstar Lighting Co. Ltd.*, No. 3:24-cv-1089 (N.D. Tex.);
- *Savant Technologies LLC d/b/a GE Lighting and LEDVANCE LLC v. Feit Electric Company, Inc.*, IPR2024-01357 (P.T.A.B) (consolidated with IPR2025-00260); and
- *Savant Technologies LLC d/b/a GE Lighting, Elong International USA Inc. and Xiamen Longstar Lighting Co. Ltd. v. Feit Electric Company, Inc.*, IPR2025-00260 (P.T.A.B.) (consolidated with IPR2024-01357).

III. U.S. PATENT NO. 8,614,539

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. EX2001, ¶¶ 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.

Though blue light is generally emitted in the range of 380 nm to 480 nm, the quantum efficiency of blue LEDs decreases with the longer wavelengths. *Id.*, ¶¶ 49-50, 108; EX2014 at 86–87, 222, 292–300, 313–15. External quantum efficiency is the number of photons that escape from the LED chip per number of electrons injected. EX2001, ¶¶ 49-50, 107 (citing EX2014 at 86–87). Blue light emitting Indium Gallium Nitride ("InGaN") semiconductors decrease in external quantum efficiency as emitted light wavelengths lengthen:



EX2001, ¶¶ 49-50, 107; EX2013 at 70. The figure above shows that the external quantum efficiency continuously decreases when going from shorter wavelengths (e.g. 400 nm, efficiency about 70%) to longer wavelengths (e.g., 500 nm, efficiency about 30%). In the green spectral range (~525 nm) the quantum efficiency is very low. This fact is occasionally referred to as the "green gap." EX2001, ¶¶ 49-50, 107.

It is typically advantageous to utilize LEDs emitting light at shorter wavelengths near to the UV-to-visible boundary where the quantum efficiency is higher because the LED is more effective at converting electrical input into light particles at this wavelength. EX2001, ¶¶ 49-50, 109. It is also important to note that while quantum efficiency decreases when going to longer wavelengths (*e.g.*, from 400 nm to 500 nm), the luminous efficacy increases when going to longer wavelengths (*e.g.*, from 400 nm to 500 nm). EX2001, ¶¶ 49-50, 110. A POSITA would understand that quantum efficiency is more relevant because approximately 90% of the primary light photons (from the LED chip) are used to excite the phosphor and only 10% of the primary light photons (from the LED chip) are transmitted through the phosphor. *Id.* Because approximately 90% of the primary light is absorbed (and does not reach the human eye), the quantum efficiency and not the luminous efficacy is a relevant metric to a POSITA. *Id.*

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. *See* EX2001, ¶ 53.

B. Prosecution History

U.S. Patent No. 8,614,539 (the "'539 patent"), entitled "Wavelength Conversion Component with Scattering Particles," was filed on October 13, 2011, issued on December 24, 2013, and claims priority to Provisional Application No. 61/390,031, which was filed on October 5, 2010. EX1101, codes (22), (45), (54), 1:15–20. The issued claims were found novel and nonobvious over prior art that had similar qualities as the prior art asserted in the Petition.

The first non-final Office Action issued by the United States Patent and Trademark Office ("USPTO") rejected Claims 1–9, 11-15, 18-20, 22, 23, and 25-28 as being anticipated by U.S. Patent Publication 2002/0180351 ("McNulty," EX2003). The remaining claims were rejected as being obvious over McNulty in view of other prior art references. *See* Ex. 1104, 122–33.

In response to the rejections, the Applicant amended the independent claims to include the limitation "wherein the wavelength conversion component is configured such that in operation a portion of the excitation light comprising blue light is emitted through the wavelength conversion component to contribute to a final visible emission product; wherein the light scattering material scatters the blue light at least twice as much as light generated by the at least one photoluminescent material." EX1104, 151–58. The Examiner issued a final Office Action in response to this amendment and rejected all then-pending claims under 35 U.S.C. § 103(a) over McNulty and maintained the previous obviousness rejections. *See* EX1104, 174-85.

In response to the final Office Action, the Applicant submitted a request for continued examination and amended each of the independent claims to add "blue light having a wavelength of greater than or equal to 440 nm." EX1104, 188-90, 253-66.

The amendments caused the Examiner to issue a non-final Office Action that rejected Claims 1, 4-24, and 26-31 under § 103(a) as obvious over U.S. Patent Publication 2001/0000622 ("Reeh," EX2004) in view of McNulty and the previous § 103(a) rejections. EX1104, 312-24.

The Examiner subsequently granted an interview with the Applicant. *See* EX1104, 392. In the Applicant's interview summary, the Applicant noted 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 argued 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 '539 Patent application and thus was not combinable with other references. *Id.*, 392-97.

In response to the Applicant's arguments, the Examiner entered a Notice of Allowability, which allowed all of the then-pending claims. In the Notice of Allowability, the Examiner stated that "[t]he prior art fails to teach the presently claimed invention comprising the claimed wavelength conversion component and scattering particles. The reasons for allowance are clearly set forth in Applicant's remarks." EX1104, 400-07.

C. Benefits of the ’539 Patent

U.S. Patent No. 8,614,539 provides a solution to enhancing the efficiency and reducing the cost of 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.

The invention of the ’539 Patent improved the standard white-light LED lightbulb reducing the amount of phosphor needed in any given white-light LED lightbulb. As the ’539 Patent explains, the diffusion layer increases the efficiency of the phosphorous layer, which the ’539 Patent refers to as the wavelength conversion layer. EX1101, 3:21–28. 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.

The ’539 Patent relates to solid-state light emitting devices (“LEDs”) that use a phosphor wavelength conversion component to generate a desired color of light. EX1101, 1:24–26. The Specification explains that phosphor photoluminescent materials can be "relatively costly, and hence correspond to a significant portion of the costs for producing phosphor-based LED devices," particularly for remote phosphor LED devices, which require "a much greater amount of phosphor." *Id.*, 2:24–41. Additionally, some phosphor LED devices "are often subject to perceptible non-uniformity in color when viewed from different angles." *Id.*, 12:13–17. This is consistent with the issues facing white light emitting LEDs at the time of filing. *See* EX2001, ¶¶63–71.

When an 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. EX1101, 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." EX1101, 2:3–6. "However, for a remote phosphor device 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." EX1101, 2:6–10. This is because in the OFF state, "light that is produced by the remote 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." EX1101, 11:5–10. This yellowish light "may be undesirable to the potential purchaser or customer that is seeking a white-appearing light" (EX1101, 11:17–18) "since the device on a store shelf is in its OFF state" (*id.* 2:10–16). Thus, at the time of filing, there was "a need for an improved approach to implement LED lighting apparatuses which addresses perceptible variations in color of emitted light with emission angle, "without requiring the large quantities of photoluminescent materials (e.g. phosphor materials) that are required in the prior approaches)." EX1101, 2:47–51.

The '539 Patent addresses these color issues without requiring large quantities of phosphor materials by utilizing a light scattering material with average particle sizes selected such that the excitation light from the radiation source is scattered relatively more than the light generated by the phosphor. EX1101, 25:57-60. Though light diffusing particles were known in the art (*see, e.g.*, EX2003, 2004), the purpose of the light diffusing layer in the '539 Patent minimizes the amount of phosphor needed and thereby reducing the overall costs of the LED device, improves the spatial uniformity of the light color with emission angle, while improving its appearance.

As depicted in Figure 3 below, the ’539 Patent describes a wavelength conversion component 36 that comprises a light transmissive substrate 42 below a wavelength conversion layer 46 that is covered by light diffusing layer 44.

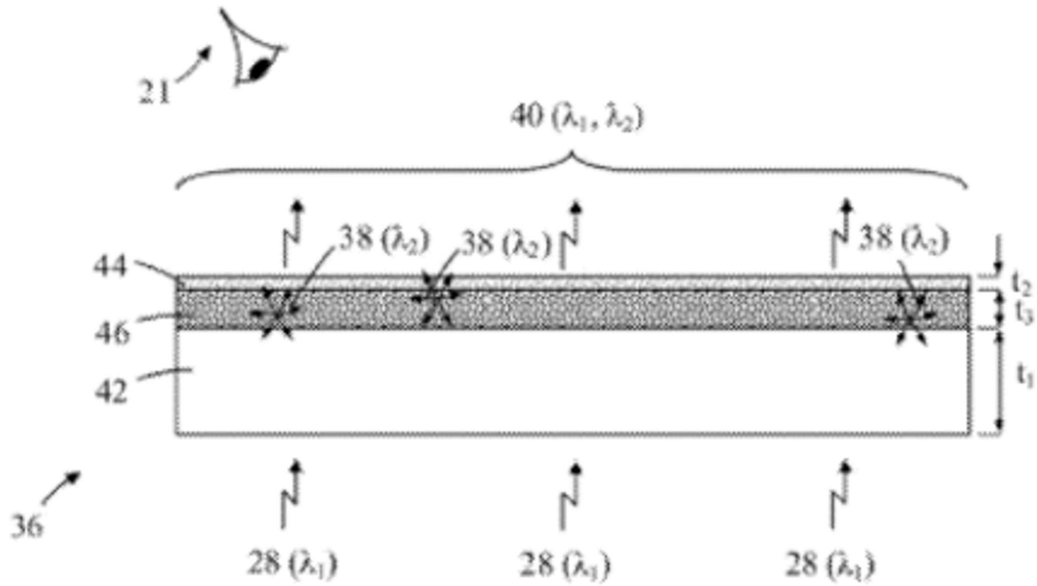


FIG. 3

EX1101, Fig. 3, 10:19–23. As shown above, the light diffusing layer 44 “comprises a uniform thickness layer of particles of a light diffractive material.” *Id.*, 8:19–20. When the LED is 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 reemit the light photons that strike particles that make up the wavelength conversion layer 46. *Id.*, 10:28–47. As a result, both the reemitted photoluminescence light 38 from wavelength conversion layer 46 and the scattered blue light 28 contribute to the overall emission product

40 that is visible to observer 21 in the form of a cool white light. *Id.*, 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.*, 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.*, 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.*, 20:49–51).

As the '539 Patent explains, "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." EX1101, 3:21–28. Additionally, 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.*, 14:18–24; *see also id.*, 3:29–32), while also improving the color uniformity of light emitted from the LED (*see id.*, 12:19–22). Thus, "it will be much less costly to manufacture lighting apparatuses that employ such wavelength conversion components, particularly for remote phosphor lighting devices." *Id.*, 14:15–17.

IV. PETITIONERS' CHALLENGE TO THE '539 PATENT

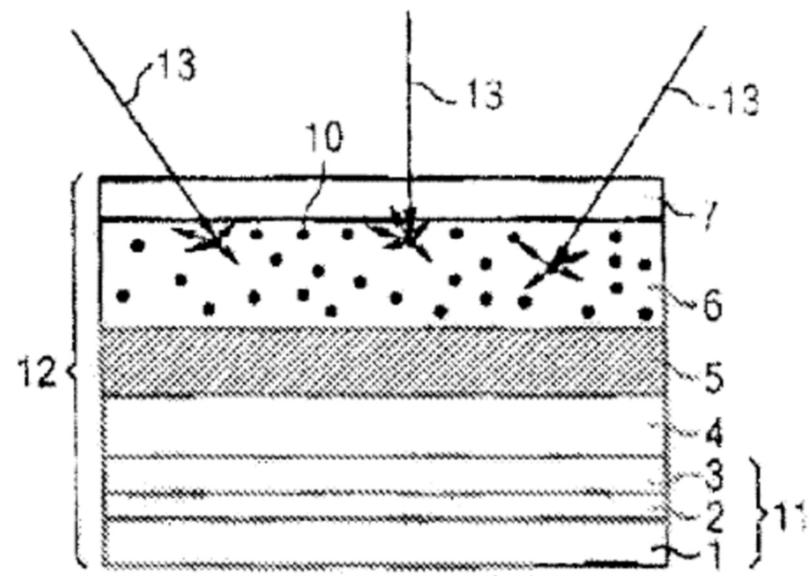
Ground	Claims	Basis	References
1	1-11, 18-20, 23-25	35 U.S.C. § 103	Krummacher in view of Stokes and Shimizu
2	18 and 28	35 U.S.C. § 103	Hussell in view of Krummacher, Stokes, and Van Woudenberg

V. OVERVIEW OF PETITIONERS' CITED REFERENCES

A. Krummacher (EX1107)

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. EX1107, ¶¶ 3, 5; *see also* EX2001, ¶¶ 96-98.

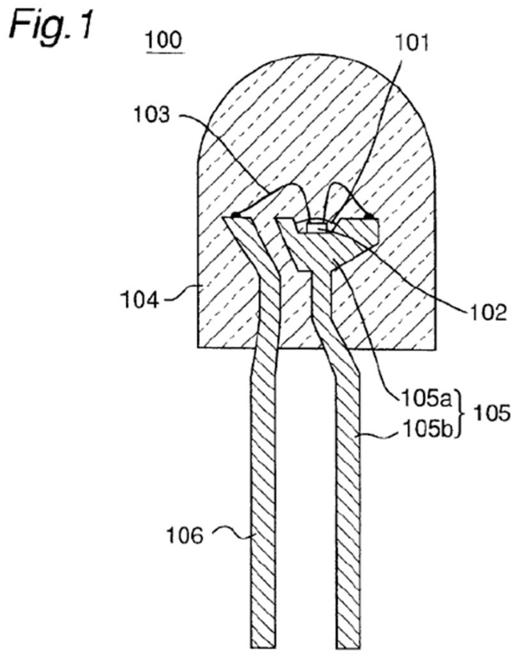
FIG 2



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.*, EX2001, ¶¶ 59-60, 84-86.

B. Shimizu (EX1110)

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 trailway signals. EX1110 at 1:12-14, 3:54-61; *see also* EX2001, ¶¶ 87-88. 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.,* EX2001, ¶¶ 55-56, 87-88.

C. Stokes (EX1108)

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. EX1108 at 1:19-20, 3:49-51; *see also* EX2001, ¶¶ 89-90. 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:

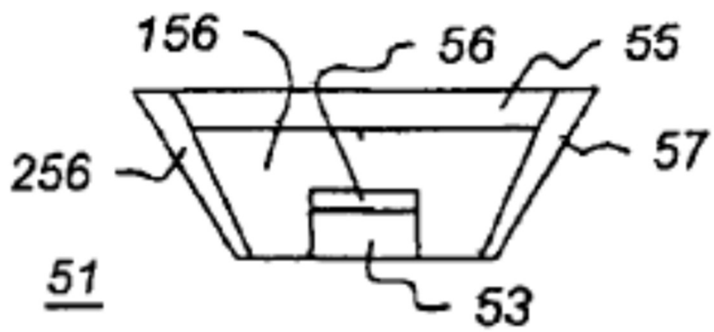


fig 7

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.*, EX2001, ¶¶ 55-56, 89-90.

A. Hussell (EX1111)

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. EX1111, ¶¶ 3, 7, 8; *see also* EX2001, ¶¶ 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."

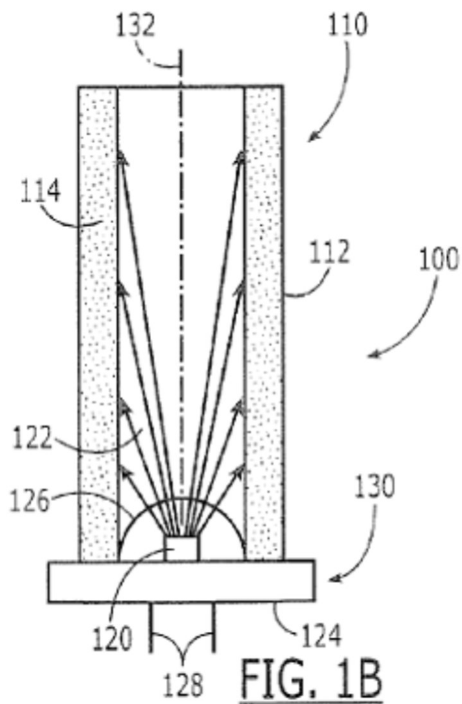


FIG. 1B

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.

B. Van Woudenberg (EX1120)

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." EX1120 at Abstract, 2:9-11; *see also* EX2001, ¶¶ 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.*, EX2001, ¶¶ 55-56, 95.

VI. 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.

VII. 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 ’539 patent and the prior-art references discussed herein.” Pet. at 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* EX2001, ¶¶ 28-32.

VIII. 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.

IX. THE PETITION FAILS ON THE MERITS

All of the claims challenged in Grounds 1 and 2 require an average particle size that meets certain criteria. In particular, independent claims 1, 18, and 28 each recite “an average particle size that is selected such that the light scattering material will scatter excitation light . . . relatively more than the light scattering material will scatter light generated by the at least one photoluminescence material." The Petition fails to point out exactly which theory Petitioners are advancing in support of the "average particle size" limitation. The Petition states both that: (i) "Krummacher renders obvious this claim element" (Pet. at 26) and (ii) "Stokes explicitly discloses the selection of an average particle size." Pet. at 27. But the Petition fails to pick one or the other. Instead, conflicting with Federal Circuit guidance, the Petition presupposes that readers will figure it out for themselves. *See Netflix, Inc. v. DivX, LLC*, 84 F.4th 1371, 1380 (Fed. Cir. 2023) ("[W]e emphasize that it is the petitioner's burden to make clear when alternative arguments are being presented and to sufficiently expound on each one. The Board should not have to work [hard] to identify all arguments fairly presented in a petition.").

For both Grounds 1 and 2, Petitioners fail to identify which specific teaching—from either Krummacher or Stokes—the grounds rely upon for allegedly teaching the claimed "average particle size." Instead, Petitioners cite alleged teachings from both references, stating repeatedly in a conclusory manner that "Krummacher in view of Stokes discloses" the claimed average particle size. (Pet. at 24, 28, 66, 69.) Petitioners bear the burden of identifying the specific prior art teachings that they propose combining, and it is not clear from the Petition whether Petitioners are relying on Krummacher or Stokes for the alleged teaching of the "average particle size" limitation. Nor is it clear, to the extent Petitioners are relying on Stokes, ***how*** exactly Petitioners expect that a POSITA would have used teachings from Stokes to modify Krummacher. For this reason alone, Grounds 1 and 2 are doomed to fail, and the Board should deny institution.

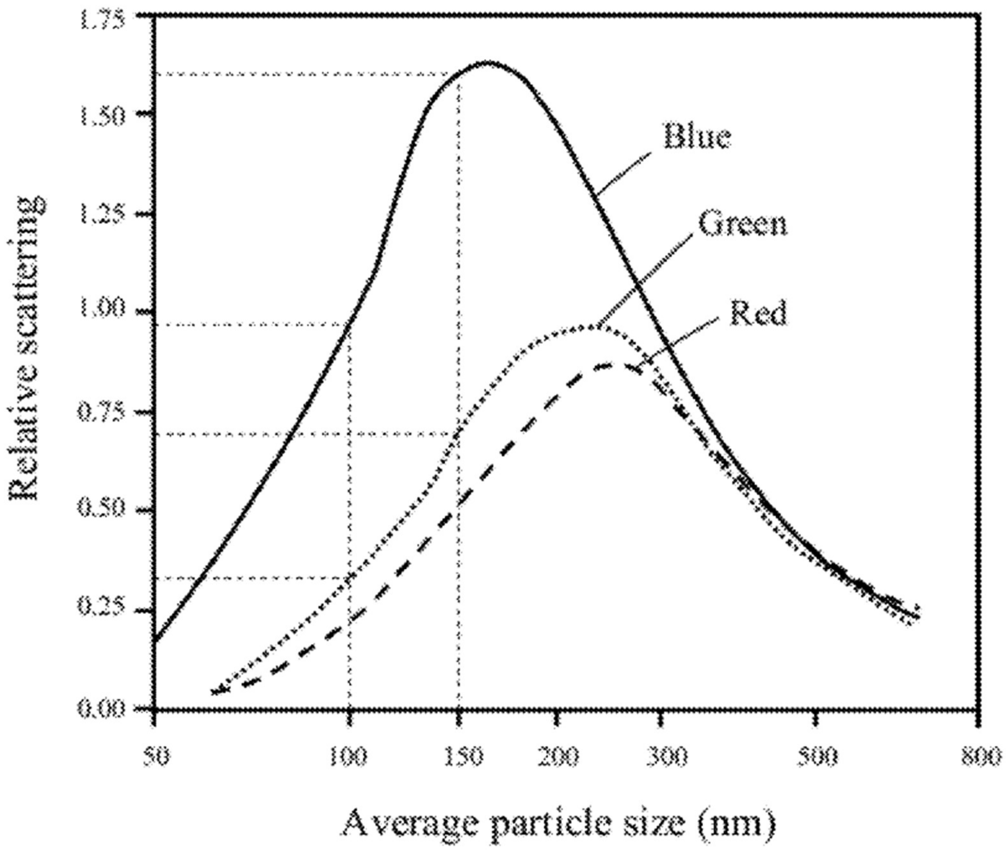
While the failure to present a cogent theory is dispositive, Petitioners have also failed to demonstrate that the cited disclosures from either Krummacher ***or*** Stokes teach the "average particle size" limitation. Regarding Ground 1, the Petition cites to Krummacher at paragraph 39 and Stokes at lines 7:1-4, 7:17-26. Pet. at 24-28, 49. In Ground 2, Petitioners incorporate by reference their arguments from Ground 1, again relying on the same cited portions of Krummacher and Stokes. Pet. at 65-69. None of the cited portions of Krummacher or Stokes discloses the claimed "average particle size." *See* EX2001, ¶¶ 97-101.

With respect to Krummacher, the Petition relies solely on the following disclosure:

> "Particularly suitable are particles of TiO_2 or Al-O, preferably having a radius of between 50 nm inclusive and 1000 nm inclusive." (EX1107, ¶ 39)

Pet. at 24-28, 49. In this sentence, Krummacher describes a vast range of particle sizes without identifying any part of that range as particularly beneficial or what the resulting benefits might be. This falls far short of teaching the use of "an average particle size that is selected such that the light scattering material will scatter excitation light from a radiation source relatively more than the light scattering material will scatter light generated by the at least one photoluminescence material."

In fact, Krummacher is completely silent with respect to an *average* particle size, and instead merely provides one-sentence of the broad range spanning from 50 nm to 1000 nm. But even if one assumes that Krummacher's disclosure is the *average* particle size, this teaching does not disclose the claimed "average particle size," which must be selected to "scatter[] the blue light at least twice as much as light generated by the at least one photoluminescence material." EX1101, cls. 1, 18, 28. According to the teachings of Figure 10 in the '539 patent, if the scattering material has Krummacher's "radius of between 50 nm inclusive and 1000 nm inclusive" blue light will not be scattered preferentially. *See* EX2001, ¶ 99.



EX1101, FIG. 10. Indeed, Krummacher's disclosure would cover particle sizes where the blue light scattering is near equal with either green or red light (*see, e.g.*, EX1101, FIG. 10, 500 nm particle size). Thus, there is no teaching of the claimed "average particle size" from Krummacher's disclosure, and Petitioners' statement that "Krummacher renders obvious this claim element" necessarily fails. *See* Pet. at 26.

Petitioners also fail to show that Stokes teaches the "average particle size" element of claims 1, 18, and 28. With respect to Stokes, the Petition relies solely on the following disclosure:

> In one preferred embodiment, the radiation scattering particles have a size such that the particles preferentially scatter blue or UV LED light as compared to yellow, green, red or white light from the luminescent material. (EX1108 at 7:1-4.)
>
> This particle size range is advantageous because it enhances the scattering of the radiation source radiation while it decreases the amount of scattering of the luminescent material radiation. Therefore, the lamp radiation output is rendered more uniform because a greater amount of radiation source radiation is scattered toward the luminescent material, while a lesser amount of the luminescent material radiation that is emitted downward toward the radiation source is scattered back toward the luminescent material. (EX1108 at 7:17-26.)

Pet. at 24-28, 49.

Petitioners incorrectly claim that "Stokes *explicitly* discloses the selection of an average particle size." Pet. at 27 (emphasis added). Yet the passage Petitioners cite identifies **no particle sizes at all**. Therefore, like Krummacher, Stokes also does not address *average* particle sizes. Accordingly, the Petition fails to show that either Krummacher or Stokes discloses the claimed "average particle size."

Assuming the Petition relies on Stokes to teach the claimed "average particle size"—which is not at all clear—the Petition also fails to explain ***how*** a POSITA would have modified Krummacher in view of Stokes. Nor, as explained in the following sections, does the Petition explain why a POSITA would have been motivated to combine ***any*** teachings from these two very different prior art references, much less the additional alleged teachings upon which Petitioners rely from the Shimizu reference. Indeed, secondary indicia of non-obviousness strongly indicate that there was no such motivation to combine.

X. CONCLUSION

For the reasons stated above, Patent Owner respectfully asks the Board to deny institution of IPR2025-00698.

Date: July 15, 2025

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 5,315 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 15, 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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