

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 No. IPR2025-00260
Patent No. 8,604,678

**DECLARATION OF WILLIAM A. DOOLITTLE, PH.D.
REGARDING CLAIMS 11-14 OF THE '678 PATENT**

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EXHIBIT LIST

No.	Description
EX1001	U.S. Patent No. 8,604,678
EX1002	Declaration of William A. Doolittle, Ph.D.
EX1003	Curriculum Vitae of William A. Doolittle, Ph.D.
EX1004	File History for U.S. Pat. Appl. No. 13/273,212 (excl. references)
EX1005	U.S. Pat. Pub. No. 2009/0057699 (“Basin-2007”)
EX1006	U.S. Pat. Pub. No. 2007/0045761 (“Basin-2005”)
EX1007	U.S. Pat. Pub. No. 2008/0079015 (“Krummacher”)
EX1008	U.S. Patent No. 6,791,259 (“Stokes”)
EX1009	U.S. Patent No. 5,998,925 (“Shimizu-APA”)
EX1010	U.S. Patent No. 6,069,440 (“Shimizu”)
EX1011	U.S. Pat. Pub. No. US2010/0124243 (“Hussell”)
EX1012	DuPont: Polymers, Light and the Science of TiO ₂ (2007)
EX1013	DuPont: Titanium Dioxide for Coatings (2007)
EX1014	Erik S. Thiele and Roger H. French, “Computation of Light Scattering by Anisotropic Spheres of Rutile Titania”, Adv. Mater. 1998, 10, No. 15
EX1015	Erik S. Thiele and Roger H. French, “Light-Scattering Properties of Representative, Morphological Rutile Titania Particles Studied Using a Finite-Element Method”, J. Am. Ceram. Soc., 81 [3] 469–79 (1998)
EX1016	Robert W. Johnson, Erik S. Thiele, And Roger H. French, “Light-scattering efficiency of white pigments: an analysis of model core - shell pigments vs. optimized rutile TiO ₂ ”, TAPPI JOURNAL, November 1997, Vol. 80(11)
EX1017	William D. Ross, “Theoretical Light-Scattering Power of TiO ₂ and Microvoids”, Ind. Eng. Chem., Prod. Res. Develop., Vol. 13, No. 1, 1974
EX1018	Feit Electric’s Initial Infringement Contentions - Claim Charts (May 28, 2024)
EX1019	U.S. Patent No. 8,547,010 (“Jagt”)
EX1020	Int’l Pat. Pub. No. WO 2008/044171 A2 (“Van Woudenberg”)

No.	Description
EX1021	[Intentionally Omitted]
EX1022	[Intentionally Omitted]
EX1023	Sudhakar Madhusoodhanan and Devdatt S. Nagvekar, “UV Curable High Opacity Ink Jettable White Ink”, RadTech e 5 2006 Technical Proceedings (2006)
EX1024	U.S. Pat. Pub. No. 2011/0001151 (“Toquin”)

I, William A. Doolittle, Ph.D., of Atlanta, Georgia, USA, hereby declare as follows.

I. INTRODUCTION

1. I am over the age of eighteen and otherwise competent to make this declaration.

2. I have been retained by Radulescu LLP on behalf of Savant Technologies LLC d/b/a GE Lighting and LEDVANCE LLC, to provide an analysis of the scope and content of U.S. Patent No. 8,604,678 (“the ’678 patent”) (EX1001). My analysis in this declaration relates to claims 11-14 of the ’678 patent.

3. I understand that my analysis regarding claims 1-3, 6, 7, 9, 10, 16-21, 25, 26, and 29 of the ’678 patent was submitted as EX1002 in IPR2014-01357 (“my prior declaration”). I rely on and reaffirm my prior declaration, particularly with respect to my experience and qualifications, the background information and analysis of independent claim 1, which I will not repeat here.

4. This declaration summarizes the opinions I have formed to date. I reserve the right to modify my opinions, if necessary, based on further review and analysis of information that I receive after the filing of this declaration, including in response to positions taken by Patent Owner or their experts that I have not yet seen.

II. EXPERIENCE AND QUALIFICATIONS

5. My educational background, career history, publications, and other relevant qualifications are summarized in my prior declaration.

6. As discussed in my prior declaration, based on the above education and experience, I believe that I have a detailed understanding of the state of the art during the relevant period, as well as a sound basis for opining how persons of skill in the art at that time would understand the technical issues in this case.

III. STATUS AS AN INDEPENDENT EXPERT WITNESS

7. As noted above, I have been retained in this matter by Radulescu LLP on behalf of Savant Technologies LLC d/b/a GE Lighting and LEDVANCE LLC (“Petitioners”) to provide analysis on the scope and content of the ’678 patent relative to the state of the art at the time of the earliest application underlying the ’678 patent, which I understand to be on or about October 5, 2010. My analysis in this declaration relates to dependent claims 11-14 of the ’678 patent.

8. I am being compensated at the rate of \$450 per hour (plus any expenses) for my work and testimony. My fee is not contingent on the outcome of any matter or on any of the technical positions I explain in this declaration. I have no financial interest in Petitioners.

9. I have been informed that Feit Electric Company, Inc. is the owner of the ’678 patent. I have no financial interest in Patent Owner or the ’678 patent nor

to my recollection have I ever had any contact with the Patent Owner or the listed inventors of the '678 patent.

IV. MATERIALS CONSIDERED AND BASIS OF OPINIONS

10. My opinions are based on more than 30 years of studying, teaching about, and directly working with light emitting diodes. My opinions are also based on investigation and study of the relevant materials, including the patent at issue and its file history, and the prior art. In the course of forming my opinions I have reviewed all the exhibits of record.

11. I may rely upon these materials and/or additional materials to rebut arguments raised by the Patent Owner. Further, I may also consider additional documents and information in forming any necessary opinions – including documents that may not yet have been provided to me.

12. My analysis of the materials relevant to this proceeding is ongoing and I will continue to review any new material as it is provided. This declaration presents only those opinions I have formed to date. I reserve the right to revise, supplement, and/or amend my opinions stated herein based on new information and on my continuing analysis of the materials already provided.

V. LEGAL STANDARDS

13. As discussed in my prior declaration, I have been advised by counsel regarding the relevant legal standards relating to my opinions.

14. My understanding of the relevant legal standards is set out in my prior declaration, which I rely on here.

VI. DESCRIPTION OF THE RELEVANT FIELD AND TIMEFRAME

15. As discussed in my prior declaration, I have carefully reviewed the '678 patent. For convenience, the information that I considered in arriving at my opinions is listed in the Exhibit List above.

16. My understanding of the relevant field and timeframe related to the '678 patent is set out in my prior declaration, which I rely on here.

VII. PERSON OF ORDINARY SKILL (“POSA”)

17. As discussed in my prior declaration, I have been informed that “a person of ordinary skill in the relevant field” is a hypothetical person to whom an expert in the relevant field could assign a routine task with reasonable confidence that the task would have been successfully carried out.

18. My opinions regarding the person of ordinary skill in the art related to the '678 patent is set out in my prior declaration, which I rely on here.

VIII. TECHNICAL BACKGROUND

19. My prior declaration contains a technical background meant as a primer for the reader, which remains relevant and I rely on here.

IX. OPINIONS ON CLAIM CONSTRUCTION

20. As discussed in my prior declaration, I have considered how a person having ordinary skill in the art would have understood certain claim terms after reviewing the '678 patent and file history.

21. My explanation of my opinions regarding how a person having ordinary skill in the art would have understood those claim terms is set out in my prior declaration, which I rely on here.

X. SUMMARY OF INVALIDITY POSITIONS

22. I understand that Petitioners are requesting review of claims 1 and 11-14 of the '678 patent. I understand that independent claim 1 is being challenged for purposes of completeness in reaching the dependent claim features of claims 11-14, and that the challenge to claim 1 is identical to that set out in my prior declaration. Accordingly, I understand that the grounds are as follows:

Ground	Claims	Description
1	1	Obvious over Basin-2007 in view of Basin-2005 ¹ (duplicate of IPR2024-01357 ground)

¹ U.S. Patent Publication No. US2007/0045761 to Basin (“Basin-2005”), was filed on August 26, 2005 and published on March 1, 2007 (EX1006), is prior art under pre-AIA 35 U.S.C. § 102(b). (See also EX1002, ¶¶89-91.)

Ground	Claims	Description
2	11-14	Obvious over Basin-2007 in view of Basin-2005 and Stokes ²
3	1, 11-14	Obvious over Krummacher in view of Shimizu and Stokes (duplicate of IPR2024-01357 ground with respect to independent claim 1)

23. It is my opinion that the identified prior art renders the challenged claims obvious.

XI. PRIOR ART REFERENCES

24. My prior declaration contains a discussion of relevant prior art references, which remains relevant and I rely on here.

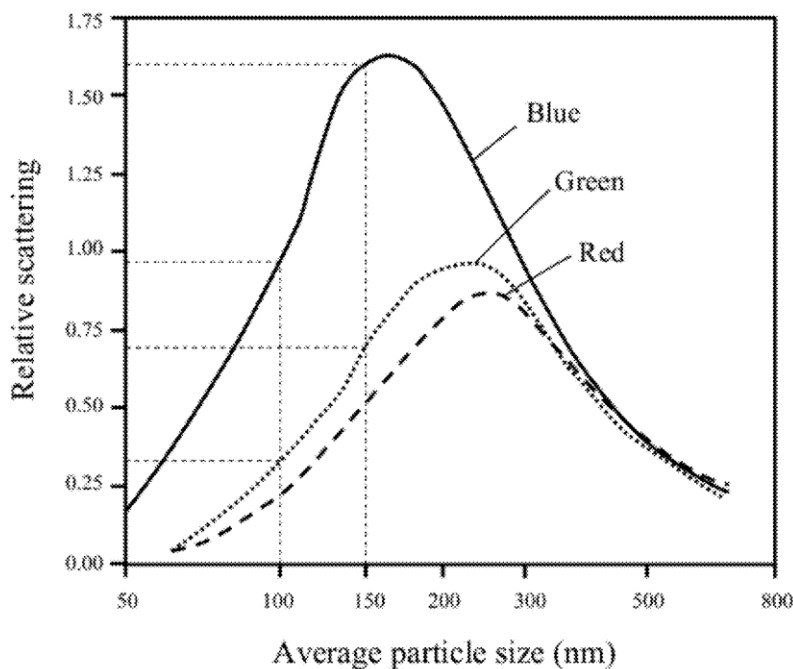
XII. BACKGROUND REGARDING NEW CLAIMS

25. Claim 11 depends from claim 1 and further requires an “average particle size” that scatters relatively more of the “excitation light” generated by the LED (e.g., blue light) than the converted light “generated by the at least one photoluminescence material” (e.g., yellow light). Claims 12, 13, and 14 all depend

² U.S. Patent No. 6,791,259 to Stokes, filed on August 22, 2000 and issued on September 14, 2004 (EX1008), is prior art under pre-AIA 35 U.S.C. § 102(b). (See also EX1002, ¶¶98-100.)

from claim 11 and cover subsets of average particle sizes or the use of a blue-light LED chip.

26. These claims relate to the unattributed and theoretical disclosure in the '678 patent that the size of the particles in the light scattering material could be selected to scatter more blue light than red or green light. (EX1001, 11:37-12:12.) The alleged benefits include more efficient conversion of the blue light generated by the LED chip. (*Id.*) This disclosure is supported by Figure 10, which purports to show “plots of relative light scattering versus TiO₂ average particle size (nm) for red, green and blue light.” (*Id.*) As mentioned briefly in my prior declaration and discussed in more detail here, Figure 10 appears to have been appropriated from prior art DuPont research and marketing materials for TiO₂.



'678 Patent, Figure 10

27. In May 1997, two DuPont researchers, Erik S. Thiele and Roger H. French, presented the paper “Light-Scattering Properties of Representative, Morphological Rutile Titania Particles Studied Using a Finite-Element Method.” (EX1015.) Until then, the light-scattering properties of TiO_2 particles had been modeled using Mie theory, which was overly simplistic and had significant limitations. (*Id.*, p.469)

28. Accordingly, the paper proposed a finite-element method to theoretically determine the light-scattering properties of certain types of TiO_2 particles. (*Id.*) Among other things, this finite-element method depended on the “wavelength of interest.” (*See, e.g., id.*, p.471 (“The wavelength of interest for tint strength tests of paint films is 560 nm, the center of the visible spectrum. This wavelength is used in the computations performed throughout this study.”).) In other words, it could be used to model the light-scattering properties of certain types of TiO_2 for selected wavelengths of light.

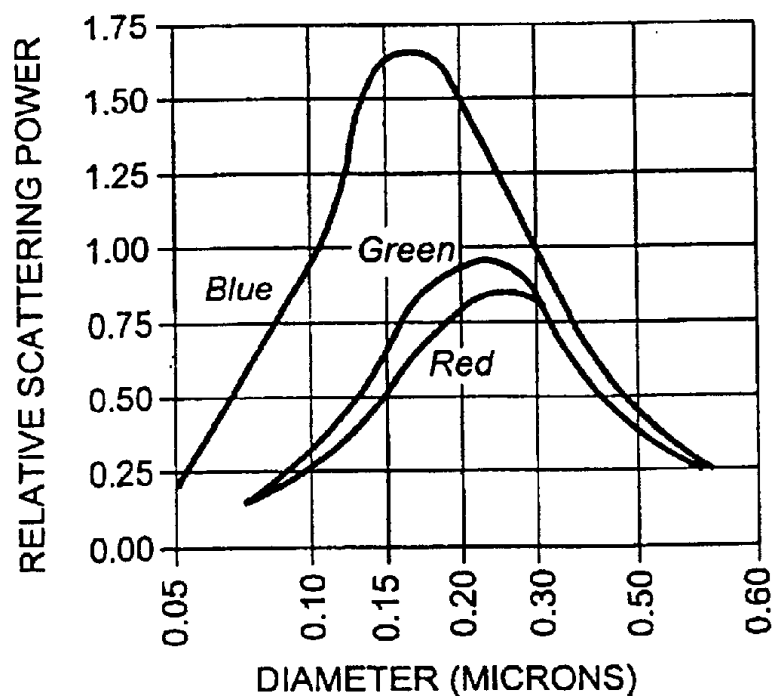
29. U.S. Patent No. 6,791,259 to Stokes was filed on August 22, 2000, issued on September 14, 2004, and was assigned to the General Electric Company (EX1008). Stokes provides a figure labeled “prior art”³ (fig. 6, shown below) that

³ It is unclear if the figure was provided by DuPont originally or if it was created by the General Electric engineers using the DuPont model. Based on similarity to

uses the DuPont finite-element method to “illustrate[] the relationship between the particle diameter and the wavelength of the scattered light for Ti-Pure[®] rutile TiO₂ particles made by DuPont.” (*Id.*, 7:7-9.)

30. Stokes applies this information to a white-light LED light source to suggest preferentially scattering “blue radiation (i.e., such as that emitted by a blue emitting LED)” as compared to “green or red (or for that matter yellow) radiation (i.e., such as that emitted by the phosphor or dye).” (*Id.*, 7:1-26.) In particular, Stokes explains that selecting an appropriate particle size “enhances the scattering of the radiation source radiation while it decreases the amount of scattering of the luminescent material radiation” such that “the lamp radiation output is rendered more uniform because a greater amount of radiation source radiation is scattered toward the luminescent material[.]” (*Id.*, 7:10-26.)

later marketing materials, it appears to be derived from early DuPont marketing materials.



Stokes (EX1008), Figure 6

31. Research papers were also published during the relevant time period containing a similar graph. For example, a paper (EX1023) was presented at the RadTech e|5 2006 conference containing the following figure.

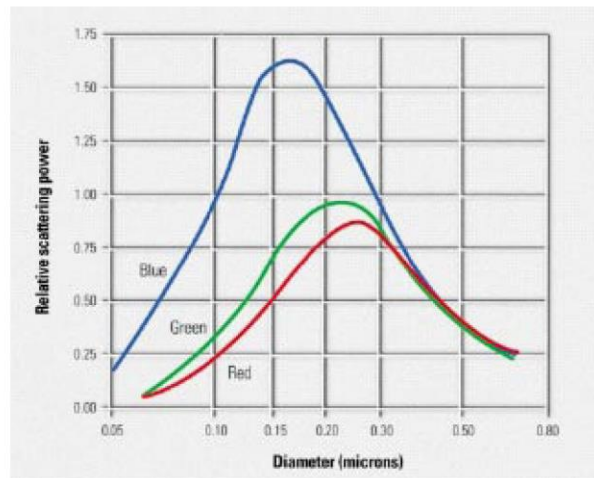
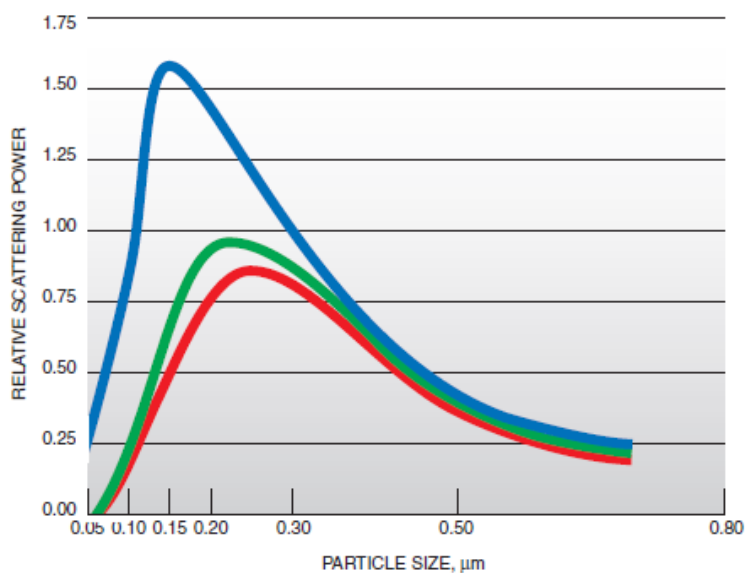


Figure 5. Relationship between TiO₂ particle size and light scattering (Courtesy: Dupont Titanium Technologies).

32. Noting that Stokes cites the DuPont web page as it appeared in 2000 (“DuPont Ti-Pure Titanium Dioxide Web Page,” DuPont Home Page, visited Aug. 3, 2000) and other references credit DuPont, a graph similar to Figure 6 of Stokes was widely distributed in DuPont marketing materials for TiO₂ that were published in 2007. As the marketing materials explain, the graph is “derived from theoretical considerations in highly dilute systems [and] show[s] the relative scattering power of rutile^[4] TiO₂ for blue, green and red light as a function of particle size.” (EX1012, p.4; EX1013, p. 8.)

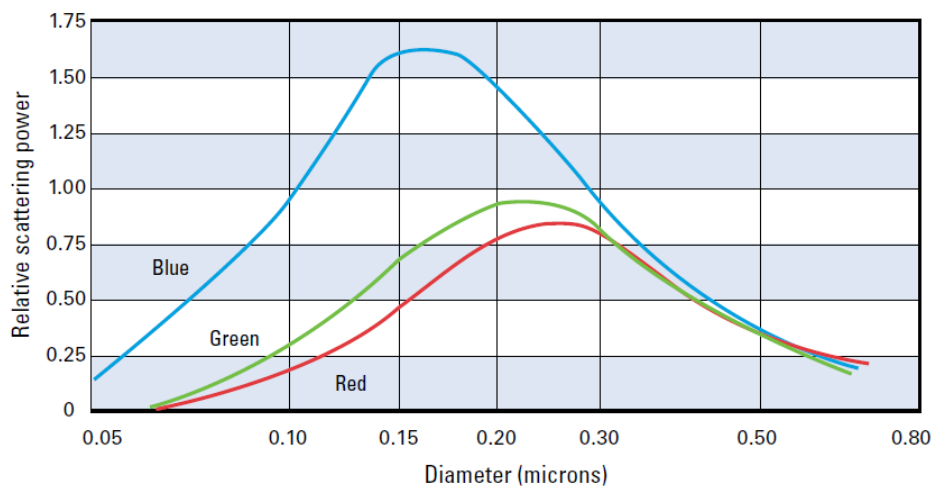
⁴ Titanium dioxide comes in various forms (in other words, polymorph forms having the same chemical formula: TiO₂). The “rutile” form is the most common

Figure 4. Relative Light Scattering Power vs. Rutile Particle Size



DuPont: Polymers, Light and the Science of TiO₂ (2007) (EX1012), p.4

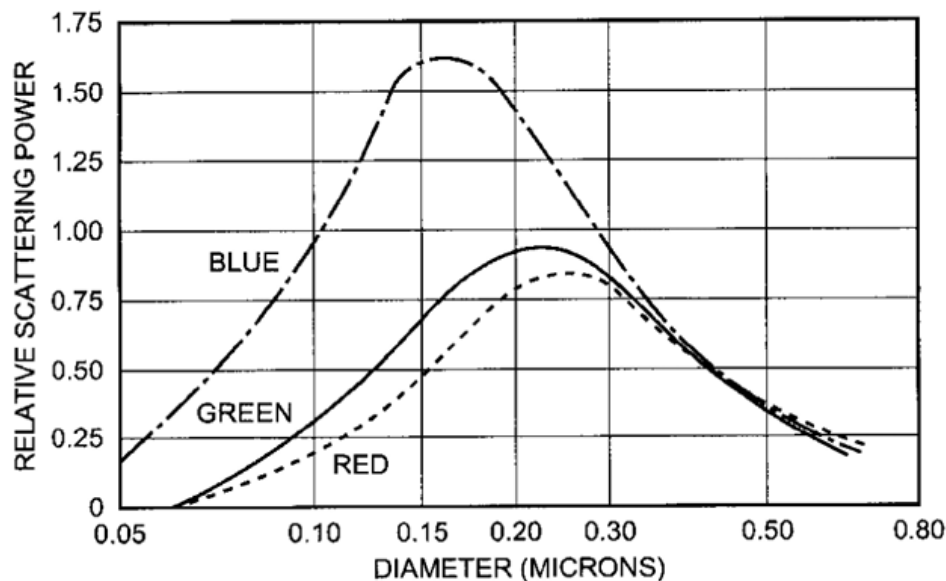
Figure 7. Relative Light Scattering Power versus Rutile Particle Size.



DuPont: Titanium Dioxide for Coatings (2007) (EX1013), p.8

natural form, is the form used for white pigments, and is thus the form studied by Dupont in their early theoretical work cited above.

33. U.S. Patent Application No. 12/498,253 to Toquin was filed on July 6, 2009, published as Pub. No. 2011/0001151 on January 6, 2011, and was assigned to Cree, Inc. (EX1024). Toquin provides a similar figure “showing the relative light scattering power vers[us] the scattering particle size for TiO₂ scattering particles commercially available from different sources, such as from Dupont, Inc.” (EX1024, ¶[0080].)



Toquin (EX1024), Figure 4

34. These prior art figures are all similar and all either reference DuPont or were published by DuPont. Figure 10 of the '678 patent also bears a striking similarity to these prior art figures. In addition to graphing the same theoretical model, the figures all share certain unusual design decisions, such as using: the

same nonlinear or nonstandard scale for the x-axis (particle size) of the graph;⁵ the same vertical axis scale, 0 to 1.75; and the same data range, from 0.05 microns (50nm) to around 0.65 microns (650 nm).

XIII. GROUNDS OF OBVIOUSNESS

[GROUND 1] Claim 1 is rendered obvious by Basin-2007 and Basin-2005

35. As discussed in my prior declaration, I have considered whether claim 1 of the '678 patent is rendered obvious by the prior art.

36. My explanation of my opinion that claim 1 of the '678 patent is rendered obvious by Basin-2007 in view of Basin-2005 is set out in detail in my prior declaration, which I rely on here.

[GROUND 2] Claim 11-14 are rendered obvious by Basin-2007, Basin-2005, and Stokes

37. As discussed in my prior declaration, Ground 1 renders obvious independent claim 1 of the '678 patent.

38. Ground 2 further includes the teaching from Stokes that selecting an appropriate particle size “enhances the scattering of the radiation source radiation while it decreases the amount of scattering of the luminescent material radiation”

⁵ The graph in EX1012 has a linear x-axis while the graphs in EX1013, EX1023, Stokes, Toquin, and the '678 patent each have a logarithmic x-axis.

such that “the lamp radiation output is rendered more uniform because a greater amount of radiation source radiation is scattered toward the luminescent material[.]” (EX1008, 7:10-26.)

39. As discussed above, the prior art discloses conventional white-light LED light sources with light diffusing layers as required by independent claim 1. Claims 11-14 further require the TiO₂ particles in the light diffusing layer be sized to preferentially scatter blue light relative to yellow light. Thus, Basin-2007 in view of Basin-2005 and Stokes renders obvious claims 11-14.

Claim 11: Scattering Relatively More Excitation Light

40. Claim 11 requires “[t]he component of claim 1, 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.”

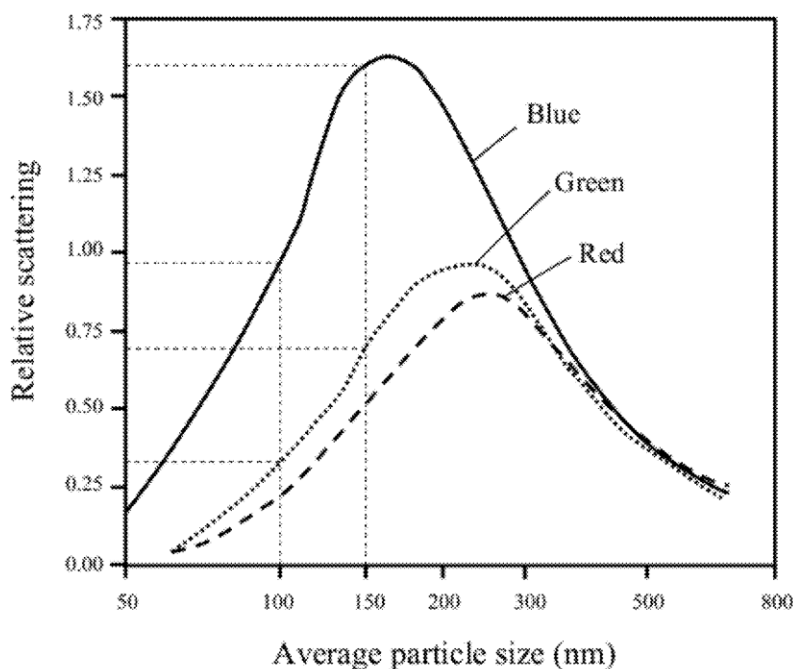
41. As discussed above, Basin-2007 in view of Basin-2005 renders obvious claim 1.

42. Consistent with claim 11, Stokes discloses:

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.

(EX1008, 7:1-4.)

43. As discussed in detail above, Figure 10 of the '678 patent is essentially the same as graphs found in the prior art, including Figure 6 of Stokes, that were derived from the DuPont model described in the background regarding claims 11-14 above. In particular, the graphs purport to show the relative scattering power of TiO_2 based on particle size for different colors of light.



'678 Patent, Figure 10

44. Basin-2007 discloses a light scattering material with an average TiO_2 particle size that is “sub-micron” (less than 1000 nm). (EX1005, ¶[0005].) It further discloses that “[i]n one embodiment, the average TiO_2 particle size is 0.25 micron[(250 nm).]” (EX1005, ¶[0032].) According to the DuPont model, TiO_2 particles smaller than a micron generally scatter more blue light (e.g., excitation

light) than red or green light (e.g., light emitted by the phosphor), including at 0.25 microns. Accordingly, Basin-2007 renders obvious claim 11 by literally disclosing the selection of average particle sizes that preferentially scatter blue light.

45. I understand that the basis on which a design decision is made is not a proper claim limitation. Nonetheless, to the extent that the claim language “an average particle size that is selected such that [it preferentially scatters blue light]” requires an average particle size selected for that reason (rather than an average particle size that leads to that outcome), this claim element is rendered obvious by Stokes. As discussed above, Stokes explicitly discloses the selection of an average particle size “such that the particles preferentially scatter blue ... LED light as compared to yellow ... light from the luminescent material.” (EX1008, 7:1-4.)

46. As discussed in detail in my prior declaration, Ground 1 (Basin-2007 and Basin-2005) discloses white-light LED light sources with TiO₂-containing light diffusing layers, meeting every requirement of claim 11, including the claimed average particle size. To the extent that claim 11 is understood to also claim the basis for selecting a particular average particle size, a POSA would have had reason to use such a basis for selecting average particle size as taught by Stokes.

47. For example, Stokes discloses:

[The relevant] 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.

(EX1008, 7:17-26.)

48. Thus, a POSA would have been motivated to apply this principle to Basin-2007, because it would increase the conversion of blue light to yellow light and improve the uniformity of the light source. Conversion of blue light to yellow light is improved by maximizing the scattering of blue light. Uniformity is improved by preferentially scattering the concentrated light from the blue-light LED chip instead of the disperse light emitted by the phosphor.

49. A POSA would have had a reasonable expectation of success applying this principle to Basin-2007, because the relevant particle size range is encompassed by the range disclosed by Basin-2007. A POSA would have recognized selecting an average particle size as a design decision to be made based on a number of factors, including the light scattering properties of the particles, and well within the skill of the art.

50. Thus, it is my opinion that Ground 1 (Basin-2007 and Basin-2005) in further view of Stokes teaches all of the elements of claim 11 and renders claim 11 obvious as a whole.

Claim 12: Scattering Excitation Light Twice as Much

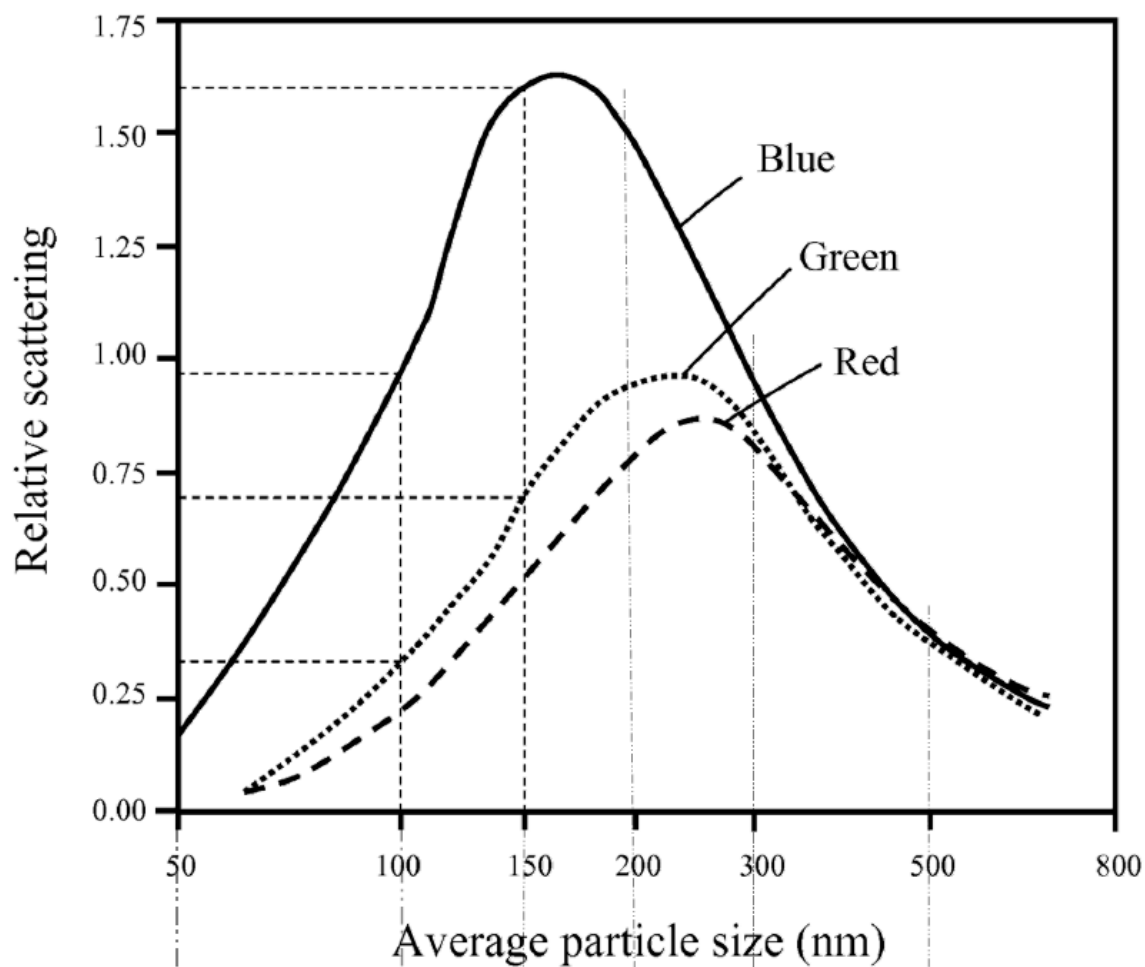
51. Claim 12 requires “[t]he component of claim 11, wherein the light scattering material scatters the excitation light at least twice as much as light generated by the at least one photoluminescence material.”

52. As discussed above, Basin-2007 in view of Basin-2005 and Stokes renders obvious claim 11. Claim 12 only further requires that the “relatively more” of claim 11 be “at least twice as much.” The ’678 patent discloses no particular significance to “at least twice as much” which represents a straightforward narrowing of the claimed average particle size range from claim 11 so that it extends only up to around 175 nm, with the ’678 patent disclosing a preferred range of 0.10 to 0.15 microns (100 nm to 150 nm). (EX1001, 11:65-12:2.)

53. I have been advised by counsel that a *prima facie* case of obviousness typically exists when the ranges of a claimed composition overlap the ranges disclosed in the prior art, and that, in the absence of evidence indicating that there is something special or critical about the claimed range, an overlap shows that the claimed range was disclosed in, and therefore obvious in light of, the prior art.

54. The following annotated Figure 10 compares the ranges claimed in

the '678 patent to the ranges disclosed by Stokes:



Stokes, 7:4-17 – “preferentially scatter” blue light

Stokes, *id.* – “scatter at least 50% more” (up to ≈ 225 nm)

Stokes, *id.* – “100 to 200 nm” (exemplary range)

'678 patent, claims 11 and 13 – scatter “relatively more” blue light than red/green

'678 patent, claim 12 – “scatter at least twice as much” (up to ≈ 175 nm, *see* 12:5-8)

'678 patent, claim 14 – “less than 150 nm”

'678 patent, 11:65-12:2 – “100 to 150 nm” (exemplary range)

Annotated Figure 10

55. Consistent with claim 12, Stokes discloses the routine optimization of average particle size⁶ to preferentially scatter blue light. In particular, as reflected in the annotated Figure 10 of the '678 patent above, Stokes explicitly discloses selecting an average particle size that scatters excitation light at least 1.5 times as much as light emitted by the phosphor and gives an exemplary range of 0.10 to 0.20 microns (100 to 200nm).

56. In particular, Stokes discloses:

Preferably, the particle size is selected such that the particles scatter ***at least 50% more*** radiation source radiation than luminescent material radiation. FIG. 6 illustrates the relationship between the particle diameter and the wavelength of the scattered light for Ti-Pure® rutile TiO₂ particles made by DuPont. As illustrated in FIG. 6, the relative scattering power of 100 to 200 nm TiO₂

⁶ Consistent with the DuPont model being theoretical, the DuPont graphs and related prior art such as Stokes are based on exact particle size, not the more practical average particle size. A broad distribution of particle sizes may have the same average particle size as a narrower distribution while having very different scattering properties. Given that the average particle size of a set of exact theoretical particles is the same as the exact particle size, the distinction does not matter for obviousness.

particles is above 1 for blue incident radiation, while it is below 1 for green and red incident radiation. Therefore, as illustrated in FIG. 6, **100 to 200 nm particles have at least a 50% greater scattering power** for blue radiation (i.e., such as that emitted by a blue emitting LED) than green or red (or for that matter yellow) radiation (i.e., such as that emitted by the phosphor or dye).

(EX1008, 7:4-17; *see also* EX1024 (Toquin) at ¶¶[0080]-[0081] (disclosing preferentially scattering blue light using particles of approximately 150 nm).)

57. The set of particle sizes that scatter blue light at least 1.5 times as much as red/green light necessarily includes all the particle sizes that scatter blue light at least 2 times as much as red/green light. Thus, as illustrated in the annotated Figure 10 of the '678 patent above, the range of average particle size disclosed by Stokes based on preferentially scattering blue light overlaps and entirely encompasses the similar range required by claim 12, rendering claim 12 obvious.

58. Neither Stokes nor the '678 patent assign any particular significance to the disclosed ranges, other than that they are based on preferentially scattering blue light. The values recited for the endpoints of both ranges appear to be based on rough estimations in reading DuPont's chart. And the difference between the disclosed ranges is one of degree rather than kind.

59. As discussed above, a POSA would have recognized selecting an average particle size as a design decision to be made based on a number of factors, including the light scattering properties of the particles, and well within the skill of the art. For example, a POSA would weigh the benefits of maximizing the ratio of blue light scattered compared to yellow light with the potential downsides, including not maximizing blue light scattered, decreasing light output due to increased internal reflection, and limiting the commercially-practical options for rutile TiO₂ by requiring a narrower range of average particle size.

60. Thus, it is my opinion that Ground 1 (Basin-2007 and Basin-2005) in further view of Stokes teaches all of the elements of claim 12 and renders claim 12 obvious as a whole.

Claim 13: Excitation Light is Blue Light

61. Claim 13 requires “[t]he component of claim 11, wherein the excitation light comprises blue light.”

62. As discussed above, Basin-2007 in view of Basin-2005 and Stokes renders obvious claim 11.

63. Independent claim 1 already requires “excitation light comprising blue light.” As discussed in detail in my prior declaration with respect to claim element 1d, Basin-2007 in view of Basin-2005 discloses excitation light comprising blue light. (See, e.g., EX1005, ¶[0021-22]; EX1006, ¶[0030].)

64. Thus, it is my opinion that Ground 1 (Basin-2007 and Basin-2005) in further view of Stokes teaches all of the elements of claim 13 and renders claim 13 obvious as a whole.

Claim 14: Average Particle Size Less Than 150 nm

65. Claim 14 requires “[t]he component of claim 13, wherein the light scattering material has an average particle size that is less than about 150 nm.”

66. As discussed above, Basin-2007 in view of Basin-2005 and Stokes renders obvious claim 13.

67. Claim 14 claims a range of average particle sizes with the lower bound of claim 11 (“relatively more”) and the upper bound of the exemplary range disclosed by the ’678 patent (150 nm), as illustrated in the annotated Figure 10 above. The ’678 patent discloses no particular significance to any of these ranges.

68. With respect to the 150 nm bound, the ’678 patent simply states:

Light diffractive particles within the light diffusing layer are selected to have a size such that the particles will scatter blue light generated by the LED relatively more than they will scatter light generated by a wavelength conversion layer, e.g., where the particles have an average particle size that is less than about 150 nm.

(EX1001, 25:53-58.)

69. As discussed in detail above, consistent with claim 14, Stokes discloses the routine optimization of average particle size to preferentially scatter

blue light and discloses a preferred range of about 100 to 200 nm. (See, e.g., EX1008, 7:4-17.)

70. Thus, as shown in the annotated Figure 10 above, Stokes discloses ranges of average particle size that encompass and overlap the claimed range of average particle sizes—including the 100 to 150 nm range that is described as advantageous (EX1001, 8:53-54) and essentially the same as the range required by claim 12—rendering claim 14 obvious.

71. As discussed above, these ranges have no particular significance, other than that they are based on preferentially scattering blue light. As also discussed above, a POSA would have recognized selecting an average particle size as a design decision to be made based on a number of factors, including the light scattering properties of the particles, and well within the skill of the art.

72. Thus, it is my opinion that Ground 1 (Basin-2007 and Basin-2005) in further view of Stokes teaches all of the elements of claim 14 and renders claim 14 obvious as a whole.

[GROUND 3] Claims 1 and 11-14 are rendered obvious by Krummacher, Shimizu, and Stokes

73. As discussed in my prior declaration, I have considered whether claim 1 of the '678 patent is rendered obvious by the prior art.

74. My explanation of my opinion that claim 1 of the '678 patent is rendered obvious by Krummacher in view of Shimizu and Stokes is set out in detail in my prior declaration, which I rely on here.

75. Similar to Ground 2, Ground 3 applies the teaching from Stokes that selecting an appropriate particle size “enhances the scattering of the radiation source radiation while it decreases the amount of scattering of the luminescent material radiation” such that “the lamp radiation output is rendered more uniform because a greater amount of radiation source radiation is scattered toward the luminescent material[.]” EX1008, 7:10-26.) Thus, Krummacher in view of Shimizu and Stokes also renders obvious claims 11-14.

Claim 11: Scattering Relatively More Excitation Light

76. Claim 11 requires “[t]he component of claim 1, 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.”

77. As discussed above, Krummacher in view of Shimizu and Stokes renders obvious claim 1.

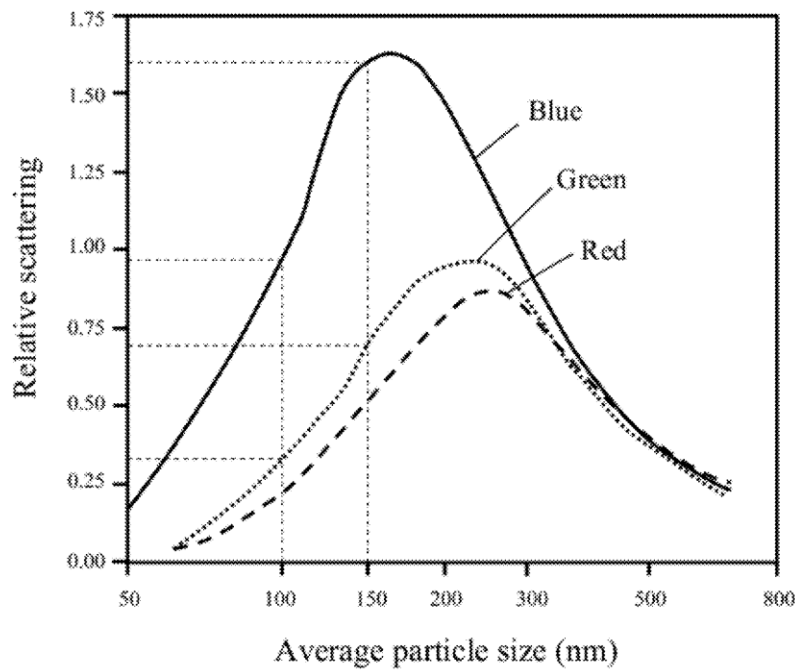
78. Consistent with claim 11, Stokes discloses:

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.

(EX1008, 7:1-4.)

79. As discussed in detail above, Figure 10 of the '678 patent is essentially the same as graphs found in the prior art, including Figure 6 of Stokes, that were derived from the DuPont model described in the background regarding claims 11-14 above. In particular, the graphs purport to show the relative scattering power of TiO₂ based on particle size for different colors of light.



'678 Patent, Figure 10

80. Krummacher discloses a light scattering material with TiO₂ particles “preferably having a radius of between 50 nm inclusive and 1000 nm inclusive.”

(EX1007, ¶[0039].) According to the DuPont model, TiO₂ particles of such a size generally scatter more blue light (e.g., excitation light) than red or green light (e.g., light emitted by the phosphor). Accordingly, Krummacher renders obvious claim 11 by literally disclosing the selection of average particle sizes that preferentially scatter blue light.

81. The basis on which a design decision is made is not a proper claim limitation, particularly for a system claim. Nonetheless, to the extent that the claim language “an average particle size that is selected such that [it preferentially scatters blue light]” requires an average particle size selected for that reason (rather than an average particle size that leads to that outcome), this claim element is rendered obvious by Stokes. As discussed above, Stokes explicitly discloses the selection of an average particle size “such that the particles preferentially scatter blue ... LED light as compared to yellow ... light from the luminescent material.” (EX1008, 7:1-4.)

82. As discussed above, Krummacher in view of Shimizu and Stokes discloses white-light LED light sources with TiO₂-containing light diffusing layers, meeting every requirement of claim 11, including the claimed average particle size. To the extent that claim 11 is understood to also claim the basis for selecting a particular average particle size, a POSA would have had reason to use such a basis for selecting average particle size as taught by Stokes.

83. For example, Stokes discloses:

[The relevant] 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.

(EX1008, 7:17-26.)

84. Thus, a POSA would have been motivated to apply this principle to Krummacher, because it would increase the conversion of blue light to yellow light and improve the uniformity of the light source. Conversion of blue light to yellow light is improved by maximizing the scattering of blue light. Uniformity is improved by preferentially scattering the concentrated light from the blue-light LED chip instead of the disperse light emitted by the phosphor.

85. A POSA would have had a reasonable expectation of success applying this principle to Krummacher, because the relevant particle size range includes the range disclosed by Krummacher. A POSA would have recognized selecting an average particle size as a design decision to be made based on a number of factors,

including the light scattering properties of the particles, and well within the skill of the art.

86. Thus, it is my opinion that Krummacher in view of Shimizu and Stokes teaches all of the elements of claim 11 and renders claim 11 obvious as a whole.

Claim 12: Scattering Excitation Light Twice as Much

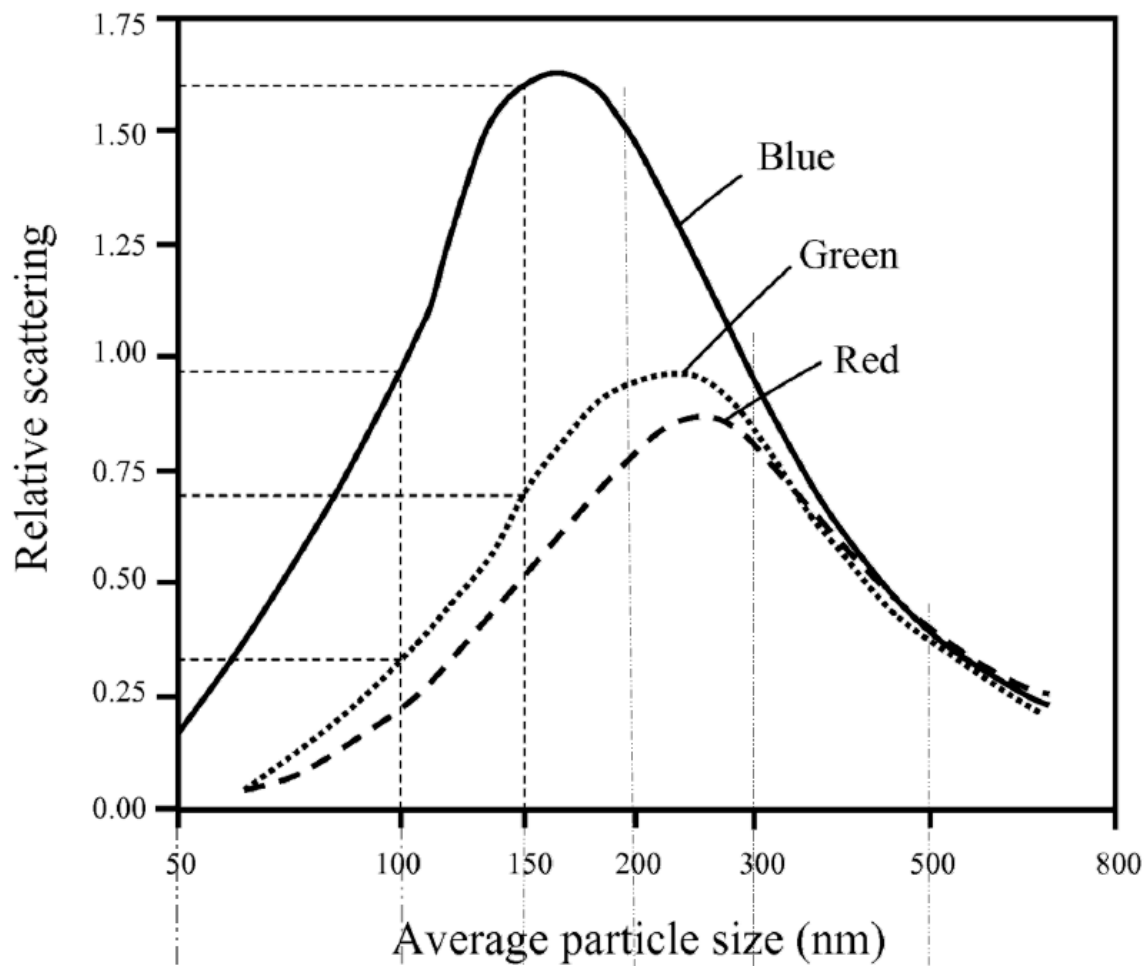
87. Claim 12 requires “[t]he component of claim 11, wherein the light scattering material scatters the excitation light at least twice as much as light generated by the at least one photoluminescence material.”

88. As discussed above, Krummacher in view of Shimizu and Stokes renders obvious claim 11. Claim 12 only further requires that the “relatively more” of claim 11 be “at least twice as much.” The ’678 patent discloses no particular significance to “at least twice as much” which represents a straightforward narrowing of the claimed average particle size range from claim 11 so that it extends only up to around 175 nm, with the ’678 patent disclosing a preferred range of 0.10 to 0.15 microns (100 nm to 150 nm). (EX1001, 11:65-12:2.)

89. I have been advised by counsel that a *prima facie* case of obviousness typically exists when the ranges of a claimed composition overlap the ranges disclosed in the prior art, and that, in the absence of evidence indicating that there

is something special or critical about the claimed range, an overlap shows that the claimed range was disclosed in, and therefore obvious in light of, the prior art.

90. The annotated Figure 10 on the following page compares the ranges claimed in the '678 patent to the ranges disclosed by Stokes.



Stokes, 7:4-17 – “preferentially scatter” blue light

Stokes, *id.* – “scatter at least 50% more” (up to ≈ 225 nm)

Stokes, *id.* – “100 to 200 nm” (exemplary range)

'678 patent, claims 11 and 13 – scatter “relatively more” blue light than red/green

'678 patent, claim 12 – “scatter at least twice as much” (up to ≈ 175 nm, *see* 12:5-8)

'678 patent, claim 14 – “less than 150 nm”

'678 patent, 11:65-12:2 – “100 to 150 nm” (exemplary range)

Annotated Figure 10

91. Consistent with claim 12, Stokes discloses the routine optimization of average particle size⁷ to preferentially scatter blue light. In particular, as reflected in the annotated Figure 10 of the '678 patent above, Stokes explicitly discloses selecting an average particle size that scatters excitation light at least 1.5 times as much as light emitted by the phosphor and gives an exemplary range of 0.10 to 0.20 microns (100 to 200nm).

92. In particular, Stokes discloses:

Preferably, the particle size is selected such that the particles scatter ***at least 50% more*** radiation source radiation than luminescent material radiation. FIG. 6 illustrates the relationship between the particle diameter and the wavelength of the scattered light for Ti-Pure® rutile TiO₂ particles made by DuPont. As illustrated in FIG. 6, the relative scattering power of 100 to 200 nm TiO₂

⁷ Consistent with the DuPont model being theoretical, the DuPont graphs and related prior art such as Stokes are based on exact particle size, not the more practical average particle size. A broad distribution of particle sizes may have the same average particle size as a narrower distribution while having very different scattering properties. Given that the average particle size of a set of exact theoretical particles is the same as the exact particle size, the distinction does not matter for obviousness.

particles is above 1 for blue incident radiation, while it is below 1 for green and red incident radiation. Therefore, as illustrated in FIG. 6, **100 to 200 nm particles have at least a 50% greater scattering power** for blue radiation (i.e., such as that emitted by a blue emitting LED) than green or red (or for that matter yellow) radiation (i.e., such as that emitted by the phosphor or dye).

(EX1008, 7:4-17; *see also* EX1024 (Toquin) at ¶¶[0080]-[0081] (disclosing preferentially scattering blue light using particles of approximately 150 nm).)

93. The set of particle sizes that scatter blue light at least 1.5 times as much as red/green light necessarily includes all the particle sizes that scatter blue light at least 2 times as much as red/green light. Thus, as illustrated in the annotated Figure 10 above, the range of average particle size disclosed by Stokes based on preferentially scattering blue light overlaps and entirely encompasses the similar range required by claim 12, rendering claim 12 obvious.

94. Neither Stokes nor the '678 patent assign any particular significance to the disclosed ranges, other than that they are based on preferentially scattering blue light. The values recited for the endpoints of both ranges appear to be based on rough estimations in reading DuPont's chart. And the difference between the disclosed ranges is one of degree rather than kind.

95. As discussed above, a POSA would have recognized selecting an average particle size as a design decision to be made based on a number of factors,

including the light scattering properties of the particles, and well within the skill of the art. For example, a POSA would weigh the benefits of maximizing the ratio of blue light scattered compared to yellow light with the potential downsides, including not maximizing blue light scattered, decreasing light output due to increased internal reflection, and limiting the commercially-practical options for rutile TiO₂ by requiring a narrower range of average particle size.

96. Thus, it is my opinion that Krummacher in view of Shimizu and Stokes teaches all of the elements of claim 12 and renders claim 12 obvious as a whole.

Claim 13: Excitation Light is Blue Light

97. Claim 13 requires “[t]he component of claim 11, wherein the excitation light comprises blue light.”

98. As discussed above, Krummacher in view of Shimizu and Stokes renders obvious claim 11.

99. Independent claim 1 already requires “excitation light comprising blue light.” As discussed in detail in my prior declaration with respect to claim element 1d, Krummacher in view of Shimizu and Stokes discloses excitation light comprising blue light. (See, e.g., EX1005, ¶[0021-22]; EX1006, ¶[0030].)

100. Thus, it is my opinion that Krummacher in view of Shimizu and Stokes teaches all of the elements of claim 13 and renders claim 13 obvious as a whole.

Claim 14: Average Particle Size Less Than 150 nm

101. Claim 14 requires “[t]he component of claim 13, wherein the light scattering material has an average particle size that is less than about 150 nm.”

102. As discussed above, Krummacher in view of Shimizu and Stokes renders obvious claim 13.

103. Claim 14 claims a range of average particle sizes with the lower bound of claim 11 (“relatively more”) and the upper bound of the exemplary range disclosed by the ’678 patent (150 nm), as illustrated in the annotated Figure 10 above. The ’678 patent discloses no particular significance to any of these ranges.

104. With respect to the 150 nm bound, the ’678 patent simply states:

Light diffractive particles within the light diffusing layer are selected to have a size such that the particles will scatter blue light generated by the LED relatively more than they will scatter light generated by a wavelength conversion layer, e.g., where the particles have an average particle size that is less than about 150 nm.

(EX1001, 25:53-58.)

105. As discussed in detail above, consistent with claim 14, Stokes discloses the routine optimization of average particle size to preferentially scatter

blue light and discloses a preferred range of about 100 to 200 nm. (See, e.g., EX1008, 7:4-17.)

106. Thus, as shown in the annotated Figure 10 above, Stokes discloses ranges of average particle size that encompass and overlap the claimed range of average particle sizes—including the 100 to 150 nm range that is described as advantageous (EX1001, 8:53-54) and essentially the same as the range required by claim 12—rendering claim 14 obvious.

107. As discussed above, these ranges have no particular significance, other than that they are based on preferentially scattering blue light. As also discussed above, a POSA would have recognized selecting an average particle size as a design decision to be made based on a number of factors, including the light scattering properties of the particles, and well within the skill of the art.

108. Thus, it is my opinion that Krummacher in view of Shimizu and Stokes teaches all of the elements of claim 14 and renders claim 14 obvious as a whole.

XIV. SECONDARY CONSIDERATIONS

109. There is no evidence of nonobviousness which I am aware that affects—let alone overcomes—the strong cases of obviousness set out above.

XV. CONCLUSION

110. In signing this declaration, I recognize that the declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

111. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Date: December 9, 2024

A handwritten signature in black ink, appearing to read "W. A. Doolittle", written over a horizontal line.

William A. Doolittle, Ph.D.