UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SEOUL SEMICONDUCTOR CO., LTD., and
SEOUL SEMICONDUCTOR, INC.
Petitioners

v.

DOCUMENT SECURITY SYSTEMS, INC.
Patent Owner

Case No. IPR2020-00938
U.S. Patent No. 7,315,119

PETITION FOR *INTER PARTES* REVIEW OF U. S. PATENT NO. 7,315,119 UNDER 35 U.S.C. §§ 311-319 AND 37 C.F.R. § 42.100 *ET SEQ.*

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PETITIONER'S EXHIBIT LIST

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1024	U.S. Patent No. 6,509,651
1025	https://pubchem.ncbi.nlm.nih.gov/compound/1030
1026	https://pubchem.ncbi.nlm.nih.gov/compound/174
1027	https://www.lyondellbasell.com/globalassets/documents/chemicals-technical-literature/lyondellbasell-chemicals-technicalliterature-vapor-pressure-of-aqueous-propylene-glycol-solutions-2518.pdf
1028	https://www.meglobal.biz/wp-content/uploads/2019/01/Monoethylene-Glycol-MEG-Technical-Product-Brochure-PDF.pdf
1029	U.S. Patent Pub. 2003/0132701
1030	Fred Schubert "Light Emitting Diodes" 2nd edition pg. 354

I. INTRODUCTION

On behalf of Seoul Semiconductor Co., Ltd. and Seoul Semiconductor, Inc. (collectively "Petitioners") and in accordance with 35 U.S.C. § 311 and 37 C.F.R. § 42.100, *inter partes* review of claims 1-7 of United States Patent No. 7,315,119 to Ng *et al.*, entitled "Light-Emitting Device Having a Phosphor Particle Layer With Specific Thickness" (hereinafter "the '119 patent") is requested. This Petition establishes that Petitioners have a reasonable likelihood of prevailing with respect to at least one of claims 1-7. A copy of the '119 patent is provided as Ex. 1001.

II. REQUIREMENTS FOR AN *INTER PARTES* REVIEW PETITION

A. Grounds for Standing (37 C.F.R. § 42.104(a))

Petitioners certify that the '119 patent is available for *inter partes* review and that Petitioners are not barred or estopped from requesting an *inter partes* review challenging claims 1-7 of the '119 patent on the grounds identified herein.

B. Notice of Lead and Backup Counsel and Service Information (37 C.F.R. § 42.8(b)(3))

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C. Notice of Real-Parties-in-Interest (37 C.F.R. § 42.8(b)(1))

Seoul Semiconductor Co., Ltd. and Seoul Semiconductor, Inc.

D. Notice of Related Matters (37 C.F.R. § 42.8(b)(2))

Based on the information known to Petitioners, the following matters may be related: - *Document Security Systems, Inc. et al. v. Seoul Semiconductor Company., Ltd et al.* 8:19-cv-01792 (C.D. Cal.); *Document Security Systems, Inc. v. Seoul Semiconductor Co. Ltd.*, No. 8:17-cv-00981 (C.D. Cal.); *Document Security Systems, Inc. v. Cree, Inc.*, No. 2:17-cv-04263 (C.D. Cal.); *Document Security Systems, Inc. v. Everlight Electronics Co.*, Ltd. et al., No. 2:17-cv-04273 (C.D. Cal.); *Document Security Systems, Inc. v. OSRAM GmbH*, No. 2:17-cv-05184 (C.D. Cal.); and *Document Security Systems, Inc. v. Lite-On, Inc.*, No. 2:17-cv-06050 (C.D. Cal.).

E. Fee for *Inter Partes* Review

The Director is authorized to charge any extra fee specified by 37 CFR § 42.15(a) to Deposit Account No. 50-2324.

F. Proof of Service

Proof of service of this petition is provided in Attachment A.

III. IDENTIFICATION OF CLAIMS BEING CHALLENGED (§ 42.104(B))

- Ground 1: Claims 1-4 and 7 are anticipated by Nichia-614.
- Ground 2: Claim 5 is obvious based on Nichia-614 in view of Nichia-341.

- Ground 3: Claim 6 is obvious based on Nichia-614 in view of Nichia-341 and further in view of Koike.
- Ground 4: Claim 1 is obvious based on Matsushita in view of Nichia-614.
- Ground 5: Claims 1-7 are anticipated by and/or rendered obvious in view of Nichia-341.

IV. THE PURPORTED INVENTION

The ’119 patent was filed on May 7, 2004 and assigned United States Patent Application No. 10/841,755 (“the ’755 application”). No earlier effective filing date or foreign priority date is identified.

A. The Background of the Invention

The ’119 patent begins with a background description. Ex. 1001 (’119 patent) 1:13-62. The known background technologies to the ’119 patent included blue LEDs and phosphors used to convert a portion of the blue light produced to yellow. *Id*. at 1:19-23. The combination of the blue LED light output with phosphor output yellow light is described as a “‘white’ emitting light-emitting diode (LED).” *Id.* at 1:15-20.

The ’119 patent further describes a prior art design and a related prior art method:

> In one design, a transparent layer containing dispersed particles of the phosphor covers an LED chip. The phosphor particles are dispersed in a potting material that surrounds the light-emitting surfaces of the blue LED. To obtain a white emitting LED, the thickness and

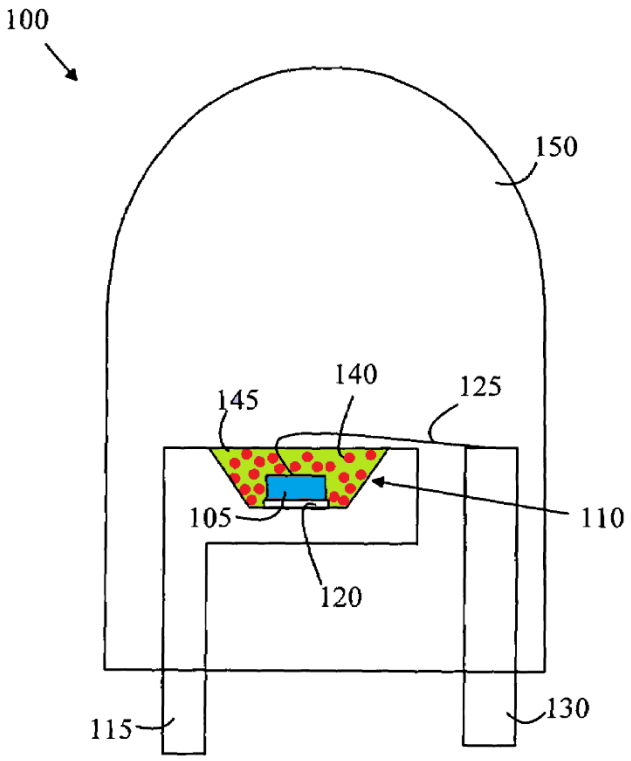
> uniformity of the dispersed phosphor particles must be tightly controlled.
>
> In one prior art method for constructing such a device, the phosphor is mixed with a resin material such as epoxy or silicone and the slurry is put over the LED chip. The phosphors are typically in the form of fine particles and usually have a distribution typically ranging from 1 um to 20 um. When the slurry is used to cover the LED chip, the phosphor particles are initially distributed throughout the coating layer and occupy a volume greater than the LED chip.

Ex. 1001 at 1:22-36. According to the patent, starting with such a slurry with phosphor mixed throughout can lead to a poor outcome. *Id.* at 1:38-62. In one example, the phosphor settles out of a relatively slow curing resin, resulting in a non-uniform distribution of phosphor. *Id.* at 1:38-43. In another example, the phosphor does not settle in a relatively faster curing resin, resulting in a non-uniform mixture of the blue light from the LED and the yellow light from the phosphor. *Id.* at 44-62.

Similar to the "Background of the Invention" section, the "Detailed Description" section begins with a description of the prior art. Ex. 1001 ('119 patent). In particular, the patent describes prior art FIG. 1 as follows:

The manner in which the present invention provides its advantages can be more easily understood with reference to FIG. 1, which is a cross-sectional view of a prior art LED light source that utilizes phosphor conversion. Light source 100 has an LED 105 mounted in a cavity 110 on the first terminal 115 of a substrate using an adhesive 120. An electrical connection 125 is made from one end of the LED to another terminal 130 of the substrate. A layer of coating is dispensed inside the cavity to cover the LED. The coating layer includes a mixture of phosphor 140 in an epoxy material 145.

Ex. 1001 ('119 patent) at 2:56-3:1. A colored version of prior art FIG. 1 is reproduced below, with the LED 105 colored blue, the phosphor 140 colored red, and the epoxy material 145 colored green. As prior art FIG. 1 shows, the particles of phosphor 140 are distributed within epoxy material 145.



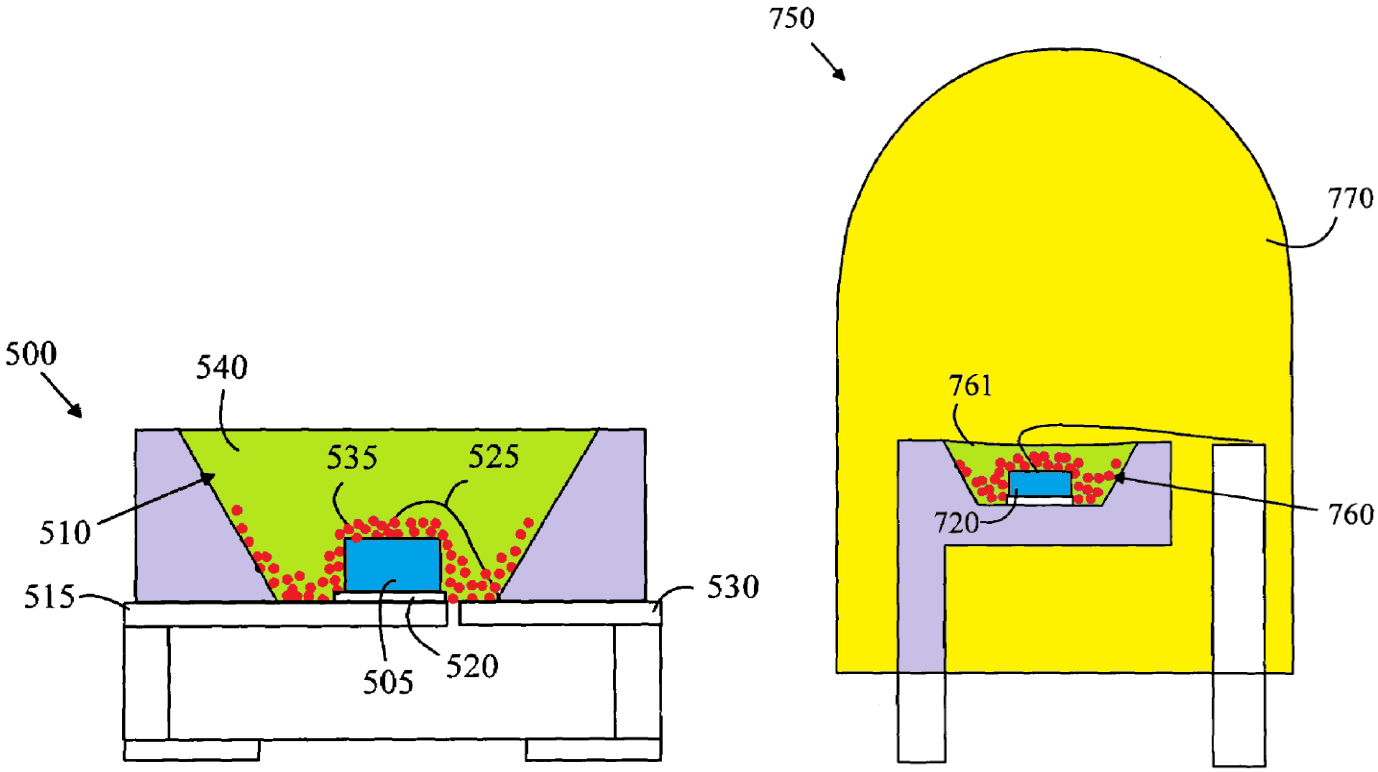
B. The Purported Solution

The '119 patent purports to improve upon the prior art:

The present invention overcomes this problem by confining the phosphor particles to a thin layer over the LED chip. In the proposed invention, a wavelength converting material such as phosphor is laid

over the LED chip in a manner such that substantially all the phosphor particles are in contact with the LED chip and the walls of the cavity where the LED is mounted.

Ex. 1001 ('119 patent) 3:14-20. The specification further describes the purported invention with respect to FIGs. 2 and 6, which are reproduced below with color added respectively left and right below.



Here again, the LED (505/720) is colored blue, the phosphor (535/760) is colored red, and the epoxy material (540/761) is colored green. *See* Ex. 1001 ('119 patent) at 3:21-32. In addition, an unlabeled "cup" having reflective sidewalls is colored purple in figures 2 and 6 above.

V. SUMMARY OF THE RELEVANT PROSECUTION HISTORY

A copy of the file history as accessed from PAIR is provided as Exhibit 1002.

The '119 patent as originally filed included 20 claims. Method claims 7 through 13 were withdrawn from consideration following a restriction requirement. Ex. 1002 ('119 File History) at 139. Original independent apparatus claims 1 and 14 provided:

> 1. A light emitting device comprising:
>
> a light source that generates light of a first wavelength; and
>
> a layer of phosphor particles covering said light source, said phosphor particles converting at least a portion of said light of said first wavelength to light of a second wavelength, said layer having a thickness of less than 100μm over said light source.
>
> 14. A light emitting device comprising:
>
> a light source that generates light of a first wavelength; and
>
> a layer of phosphor particles covering said light source, said phosphor particles converting at least a portion of said light of said first wavelength to light of a second wavelength, said layer comprising a residue of a slurry of said phosphor particles in a volatile solvent, said residue comprising the portion of said slurry that remains when a portion of said volatile solvent is removed.

Id. at 160-61.

Office Action: In a May 10, 2006 Office Action, the Examiner rejected claims 1-3, 6, 14-16 and 19 under 35 U.S.C. 102(e) as anticipated by U.S. Patent

Publication No. 2004/0104391 to Maeda ("Maeda").[1] *Id.* at 141. In particular, the Examiner relied on figures 2 and 7 of Maeda, which are reproduced respectively left and right below with colors added.

FIG. 2

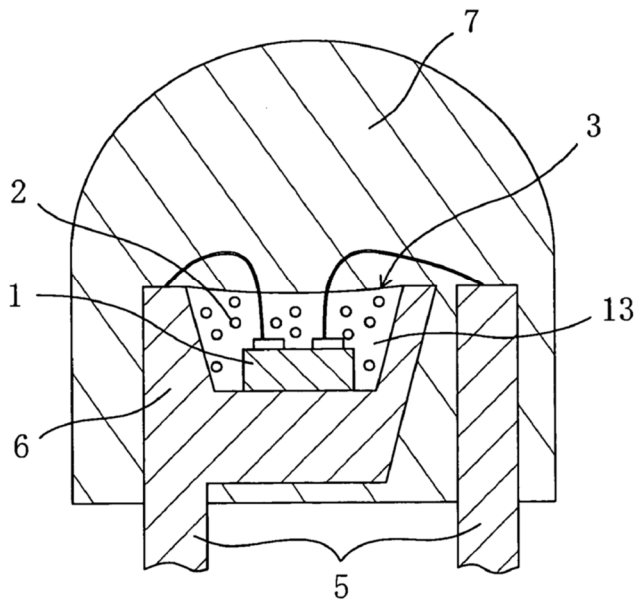
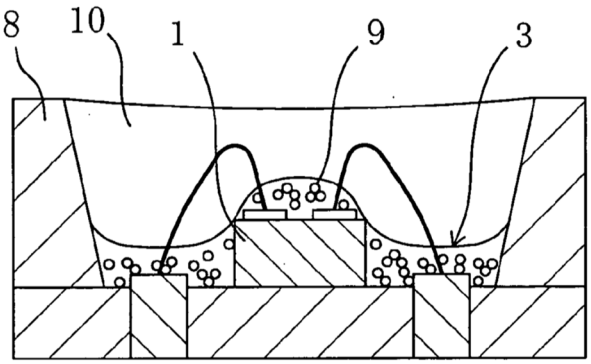


FIG. 7



As to the thickness requirement of claim 1, the Examiner cited paragraph 27 of Maeda (Ex. 1002 ('119 File History) at 141), which explains that "[t]he substantial thickness of the luminescent layer 3 is smaller than that of the upper coating 10 and is 10 to 70 μm." Ex. 1003 (Maeda) ¶27.

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[1] The Examiner also rejected claims 4, 5, 17, and 18 as obvious based on Maeda in view of U.S. Patent Publication No. 2004/0090180 to Shimizu ("Shimizu"). And rejected claim 20 as obvious based on Maeda in view of U.S. Patent Publication 2002/0185965 to Collins ("Collins").

With respect to claim 14, the Examiner concluded that the recitation "said layer comprising a residue of a slurry of said phosphor particles in a volatile solvent, said residue comprising the portion of said slurry that remains when a portion of said volatile solvent is removed" is [a] product-by-process claim limitation which does not differentiate from the prior art, therefore it does not have patentable weight (MPEP 2113)." *Id.* at 141-42.

Amendment: In response to the Office Action, the applicants amended claim 1 to require that the "layer of phosphor particles" have "a substantially uniform thickness." Ex. 1002 ('119 File History) at 130. The applicants sought to distinguish claim 1 from Maeda based solely on that added language. *Id.* at 134. The applicant, however, did not amend claim 14, relying instead on the argument that recitation of a "particular residue" is not a recited in "product-by-process form." *Id.*

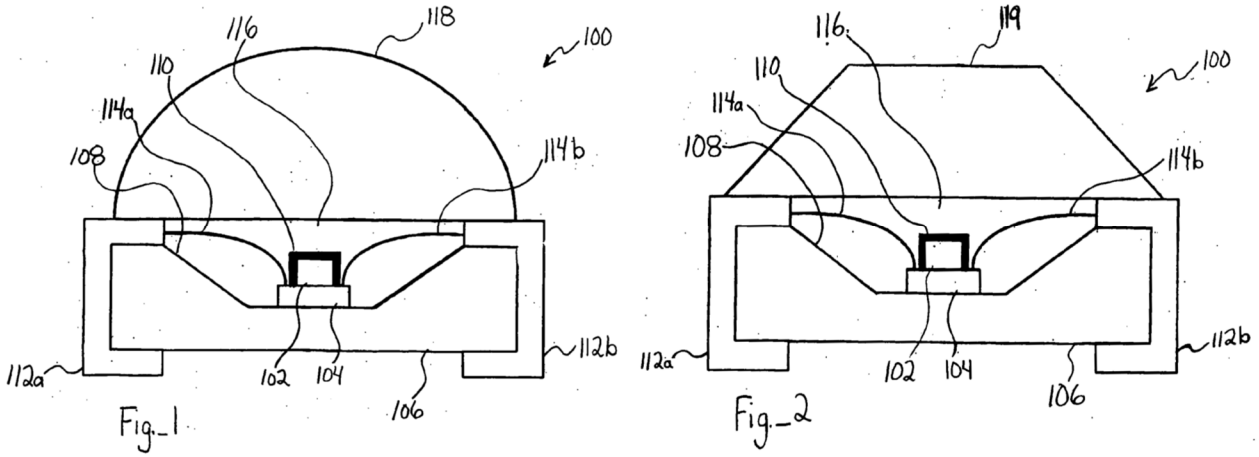
Office Action: In a second non-final Office Action dated September 12, 2006, the Examiner rejected claims 1-3, 6, 14-16, and 19 as obvious based on Maeda in view of U.S. Patent Publication No. 2004/0145312 to Ouderkirk ("Ouderkirk"). With respect to claim 1, the Examiner noted that Maeda "does not disclose the layer having substantially uniform thickness," but concluded that such a layer would have been obvious based on Ouderkirk's disclosure of "a light emitting device (fig 1) having [a] phosphor particle layer with substantially uniform thickness (para 107, 1.6 mils), for purpose of enhancing output and efficiency (para 8)." *Id.* at 112-13.

With respect to claim 14, the Examiner relied on Ouderkirk's disclosure of "a phosphor particle layer and resin (paras 106 – 108), for the purpose of having the phosphor particles intact." *Id.* at 113.

Amendment: In response to the Office Action, the applicants again amended claim 1. Ex. 1002 ('119 File History) at 103. With respect to claim 1, the applicants recited light source as a "die that emits light at a first wavelength" and recited the layer of phosphor as "a conformal layer of phosphor particles covering said die and in direct contact therewith." *Id.* In its Remarks, the applicants asserted that amended claim 1 required that "the phosphor particles form[ ] a layer of constant thickness over the LED die . . . in direct contact with said die and conform to the shape of the die." *Id.* at 106.

Again claim 14 was left without amendment. Instead, the applicants distinguished Ouderkirk's "phosphor-resin paste" from a "residue of slurry in a volatile solvent." *Id.* at 106.

Office Action: In a third non-final Office Action dated February 6, 2007, the Examiner rejected claims 1-6 as anticipated by U.S. Patent Publication No. 2004/0263073 to Baroky ("Baroky"). As to claim 1, the Examiner cited figures 1 and 2, which are reproduced below.



Ex. 1005 (Baroky) Figs. 1, 2. With respect to the phosphor recitations, the Examiner concluded that Baroky discloses "a conformal layer of phosphor particles (110) covering the die and in direct contact therewith" that has "a substantially uniform thickness of less than 100 micron over the die (paragraph 27)." Ex. 1002 (File History) at 90.

The Examiner also rejected claim 14 as obvious based on Baroky in view of U.S. Patent No. 5,653,830 to Fleig ("Fleig"). *Id.* at 92. Here again, the Examiner relied on the secondary reference to disclose and render obvious a "phosphor particle layer comprising a residue of a slurry of the particles in a volatile solvent, the residue comprising the portion of the slurry that remains when a portion of the volatile solvent is removed." *Id.*

Amendment: Rather than further amend claim 1, the applicant next combined the recitations of claim 1 with dependent claim 6. Ex. 1002 ('119 File History) at 78-79. In substance, the applicants added to claim 1 the recitation "a reflecting cup

comprising reflective sidewalls, said die being located in said cup such that a portion of said light generated by said die is reflected from said cup, said layer of phosphor particles covering a portion of said reflective sidewalls." *Id.* In the Remarks section, the applicants focused on the requirement that "the layer of phosphor particles covers a portion of the reflecting sidewalls of the cup in which the die is located." *Id.* at 82.

Rather than amend claim 14, the applicants argued against the combination of Baroky and Fleig on three separate grounds. *Id.* at 83. The applicant asserted that there would have been no expectation of success; that the combination would not have been made; and that the proposed motivation was unsupported.

Office Action: In a fourth Office Action, which was made final, the Examiner again rejected claims 4 and 5, but indicated that claims 6 and 14-20 were allowable. Ex. 1002 ('119 File History) at 65-66.

Amendment: following a proposed amendment and Advisory Action, the applicants cancelled claims 4 and 5 to allow the remaining claims to pass to issue. Ex. 1002 ('119 File History) at 37.

Notice of Allowance: In the September 11, 2007 Notice of Allowance, the Examiner provided a "statement of reasons for allowance." *Id.* at 23. With respect to claim 6, which issued at patent claim 1, the Examiner focused on the "phosphor particles covering a portion of the reflective sidewalls." *Id.* And with respect to

claim 14, which issued as patent claim 2, the Examiner reasoned that "the prior art of record does not teach or suggest the invention of a light emitting device having a layer of phosphor particles with a residue of slurry of the phosphor particles in a volatile solvent, the residue having the portion of the slurry that remains when a portion of the volatile solvent is removed, along with other claimed limitations." *Id.*

VI. CLAIM CONSTRUCTION

A. "conformal"

Claim 1 recites "a conformal layer of phosphor particles covering said die." The term "conformal" was not used in the original claims as filed (Ex. 1002 ('119 File History) at 160-62), and indeed was not used in the specification as originally filed (*id.* at 152-59). Instead, that concept was first added in the November 14, 2006 Amendment. *Id.* at 102-08. As discussed in Section V, *supra*, the applicants interpreted this recitation to require "the phosphor particles forming a layer" to "conform to the shape of the die." *Id.* at 106. This meaning as provided by in the prosecution history is consistent with the ordinary usage of the term. For example, the Modern Dictionary of Electronics (Ex. 1004 at 146) defines a "conformal coating" in relevant part to mean "[a] protective coating applied to completed printed circuit boards that conforms to the shape of the components." Similarly, the Merriam Webster's Collegiate Dictionary (Ex. 1006 at 242) defined "conform" in relevant part to mean "to give the same shape, outline, or contour to."

Conformal as used in claim 1, therefore, means that the layer of phosphor particles ***conform to the shape of the underlying die***. Support for this conclusion is provided by Professor Doolittle. *See* Ex. 1007 ¶46.

B. "substantially uniform"

Much like the term "conformal," the phrase "substantially uniform" was not used in either the original claims or written description of the '119 patent. Ex. 1002 ('119 File History) at 152-62. Instead, that requirement was added by claim amendment on May 7, 2004. *Id.* at 130. Unlike the term conformal, however, the prosecution history provides no guidance on the scope and meaning of the term.

The phrase "substantially uniform" has been disputed in a number of matters before the Federal Circuit and district courts. The Court's decision in *Medrad, Inc. v. MRI Devices Corp*., 401 F.3d 1313 (Fed. Cir. 2005) addressed two lines of cases construing "substantially uniform." The Court first acknowledged its decision in *Ecolab*, where it held that, because the claim lacked a "functional requirement," the broad plain and ordinary meaning "largely, but not wholly the same in form" was proper. *Medrad*, 401 F.3d at 1318 (citing *Ecolab*, *Inc. v. Envirochem*, *Inc.*, 264 F.3d

1358, 1369 (Fed. Cir. 2001).[2] Rather than adopt that form of generic construction, the Court held that "a 'substantially uniform magnetic field' is a field that is sufficiently uniform to obtain useful MRI images." *Id.* at 1320. In other words, the Court construed "substantially uniform" based on the function performed.[3]

The intrinsic record here is substantially similar to that in *Ecolab*, where the claims fail to link the "substantially uniform" recitation to a specific functional outcome. Moreover, the specification and prosecution history fail to describe any functional distinction obtained by using a layer that is of "substantially uniform

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[2] Similar to the Court's *Ecolab* decision, in *Cordis Corp. v. Medtronic Ave, Inc.*, 511 F.3d 1157 (Fed. Cir. 2008), the Court construed "substantially uniform thickness" to mean "of largely or approximately uniform thickness." *Id.* at 1165; *see also Mobileye Vision Technologies Ltd. v. iOnRoad, Ltd.,* 735 Fed. Appx. 1029, 1032 (Fed. Cir. 2018) (construing substantially uniform as "approximately the same"); *Lam Research Corporation v. Schunk Semiconductor*, No. C-03-1335, 2014 WL 1364980 at *19 (N.D. Cal. Apr. 7, 2014); *ShieldMark, Inc. v. InSite Solutions, LLC*, 1:12–CV–223, 2013 WL 591982 at *6 (N.D. Ohio Feb. 14, 2013).

[3] *Reckitt Benckiser Pharm. Inc. v. Teva Pharm. USA*, CV 14-1451, 2016 WL 3621632 at *3 (D. Del. Jun. 29, 2016) (construing "substantially uniform" based on the result achieved).

thickness." Instead, the intrinsic record, just as in the claims, merely links the layer to converting light. In this context, the term ***"substantially uniform" means largely or wholly the same in form.*** Support for this conclusion is provided by Professor Doolittle. *See* Ex. 1007 ¶47.

C. "said layer comprising a residue of a slurry of said phosphor particles in a volatile solvent, said residue comprising the portion of said slurry that remains when a portion of said volatile solvent is removed"

Although it is unlikely that an express construction is necessary, for purposes of completeness, Petitioner will briefly address this phrase as recited in claim 2.

Proper Construction: As an initial matter, Petitioner notes that this phrase describes the process by which "the layer of phosphor particles" was created rather than the structure thereof. In particular, the recited slurry is not a structure within the recited "light emitting device," but instead is a material from which the layer of phosphor materials was created. Indeed, when presenting a restriction requirement between the as-filed method and process claims, the Examiner cited MPEP § 806.05(f) and explained "[i]n the instant case as opposed to applying a volatile carrier material and phosphor material, and evaporate the volatile carrier material thereafter to form a phosphor layer, the phosphor layer can be formed using sputtering method or spin coating method." Ex. 1002 (File History) at 139. The applicants did not traverse the restriction requirement or later seek rejoinder as permitted under MPEP § 806.05(f)

Moreover, the term "residue" simply implies that the final material started as a greater amount of material (*i.e.*, is the residual amount of the slurry that remains). At least a portion of the volatile solvent is removed, but that provides no structural requirement for the physical structure that remains. Thus, for purposes of validity (as distinct from infringement), whether the layer of phosphor particles started as part of a "slurry" and became a "residue" is irrelevant. *Amgen Inc. v. F. Hoffman-La Roche Ltd.,* 580 F.3d 1340, 1370 n. 14 (Fed. Cir. 2009); *see also* MPEP § 806.05(f).

As discussed in Section V. above, the Examiner initially interpreted this recitation as a "product-by-process limitation which does not differentiate from the prior art, therefore it does not have patentable weight (MPEP 2113)." Ex. 1002 (File History) at 141. The applicants disagreed, arguing that "[t]he residue differentiates the present invention as claimed from the prior art." *Id.* at 134. The applicants, however, failed to explain what structural characteristic allegedly provides that "differentiat[ion]." *Id.* at 134-35. The Examiner did not expressly withdraw the initial interpretation, but tacitly withdrew it by subsequently addressing the process steps by which the prior art structures were created. Petitioner asserts that the Examiner's initial position was correct, and therefore, for purposes of validity, the Board need determine solely whether the prior art discloses a "layer of phosphor particles covering said light source," *i.e.*, ***a non-limiting product-by-process***

recitation. Support for this conclusion is provided by Professor Doolittle. *See* Ex. 1007 ¶¶48-50.

Alternative Physical Construction: Petitioner assumes that Patent Owner will argue (as it did during initial prosecution) that the recited process provides distinct physical properties that limit the claim. Although Petitioner disputes that those properties necessarily result from the recited process steps, the only disclosed physical properties that could be linked to those steps are the "conformal" and "substantially uniform thickness" aspects of the disclosed structure.[4] Ex. 1001 ('119 patent) at 5:30-35. For completeness, therefore, Petitioner will provide an analysis based on these additional physical characteristics.

Additional Comments: Although not relevant to the validity analysis, which is properly based on the final structure rather than process steps, a brief discussion of an inconsistency between the terms "slurry" and "solvent" may be helpful.

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[4] The maximum thickness aspect of the disclosed invention cannot be said to necessarily result from the process, as a thicker layer could clearly be created by simply providing more material. As to the "direct contact" aspect of the disclosed layer, that requirement conflicts with dependent claim 8 and the embodiment depicted in figure 5, and therefore, cannot be said to result from the recited method.

The term "slurry" as used in the '119 patent refers to the combination of a solid (phosphor particles) and a liquid (volatile carrier material, which is also referred to as a volatile solvent). Ex. 1001 ('119 patent) at Abstract; 2:18-31; 4:13-44. Importantly, the solid particles do not dissolve in the liquid, but instead the solid and liquid phases remain separate. *Id.* This usage is consistent with the ordinary meaning of slurry, which implies that the solid is insoluble in the liquid. *See* Ex. 1009 (Wiley Electrical and Electronics Engineering Dictionary) at 718 (defining "slurry" as "[a] diluted mixture of a liquid . . . and finely divided particles or substances which are mostly insoluble in said liquid"); Ex. 1010 (Oxford Dictionary of Science) at 850 (defining "slurry" as "[a] paste consisting of a suspension of a solid in a liquid."); Ex. 1011 (Concise Oxford American Dictionary) at 852 (defining "slurry" as "a semiliquid mixture, typically of fine particles of manure, cement, or coal suspended in water").

In contrast, the ordinary meaning of the term "solvent" refers to a liquid that dissolves substances. *See* Ex. 1012 (Wiley Electrical and Electronics Engineering Dictionary) at 726 (defining "solvent" as "[t]he substance into which a solute is dissolved to form a solution"); Ex. 1010 (Oxford Dictionary of Science) at 863 (defining "solvent" as "a liquid that dissolves another substance or substances."); Ex. 1013 (Concise Oxford American Dictionary) at 862 (defining "solvent" as "the

liquid in which a solute is dissolved to form a solution"); *see also* Ex. 1007 (Doolittle Decl.) ¶¶53-54.

Rather than placing the phosphor particles into a "solvent," what the '119 patent describes is placing them into a volatile carrier material that can be partially evaporated to leave a residue including phosphor particles behind. Abstract; 2:18-31; 4:13-44. The partial evaporation, however, characterizes material that is at least partially absent from the final product, but does not characterize what is necessarily present in the final product. Ex. 1007 (Doolittle Decl.) ¶¶49-50. Indeed, the specification identifies no physical characteristic that follows from the partial evaporation of that material as used during processing, and therefore, should be deemed irrelevant to the structural claims. *Id.*

VII. PERSON HAVING ORDINARY SKILL IN THE ART

As explained in M.P.E.P. § 2141.03, a number of factors may be considered in determining the proper level of skill:

> The person of ordinary skill in the art is a hypothetical person who is presumed to have known the relevant art at the time of the invention. Factors that may be considered in determining the level of ordinary skill in the art may include: (A) "type of problems encountered in the art;" (B) "prior art solutions to those problems;" (C) "rapidity with which innovations are made;" (D) "sophistication of the technology; and" (E) "educational level of active workers in the field. In a given

case, every factor may not be present, and one or more factors may predominate."

A person of ordinary skill in the art at the time of the purported invention would have had at least a B.S. in mechanical or electrical engineering or a related field, and two years' experience designing LED packages. Ex. 1007 (Doolittle Decl.) ¶¶27-30. This description is approximate, and a higher level of education or skill might make up for less experience, and vice-versa. *Id.* For example, a M.S. in the above fields and two years' experience would suffice. *Id.*

VIII. BRIEF DESCRIPTION OF THE PRIOR ART

A. Japanese Patent Publication No. 2003-115614

Japanese Patent Publication No. 2003-115614 ("Nichia-614") is entitled "Method Of Fabricating Light Emitting Device." Ex. 1014. Nichia-614, which was not of record during the prosecution of the '119 patent, was published on April 18, 2003, which is more than one year prior to the filing date of the '119 patent. Ex. 1014[5] (Nichia-614) (cover page item (43)). Nichia-614, therefore, is prior art against the '119 patent under pre-AIA 35 U.S.C. § 102(b).

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[5] Exhibit 1014 includes Nichia-614, an English language translation of Nichia-614, and a supporting declaration for the translation. Citations other than to the figures are to the paragraphs of the English language translation.

As will be apparent throughout this Petition's descriptions of Nichia-614, the invention disclosed and claimed in the '119 patent is, for all relevant purposes, indistinguishable from the purported invention of the Nichia-614 patent. Figure 2 of Nichia-614 is reproduced below with color added.

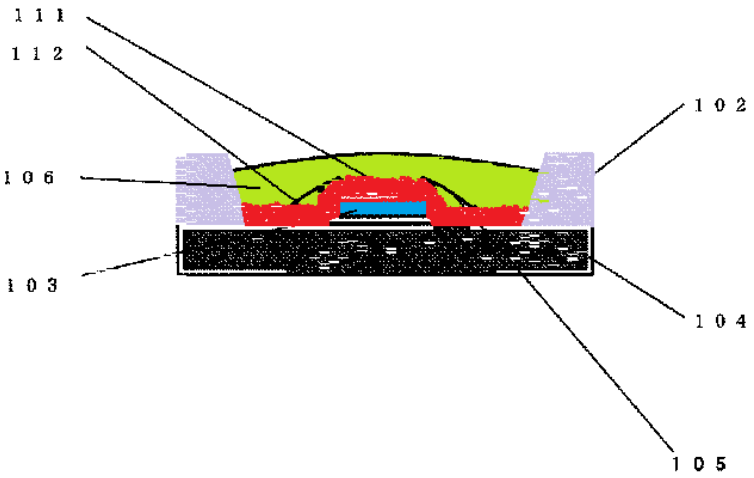

Figure 2 is a cross-section through a package for a light emitting diode (LED) die. Ex. 1014 (Nichia-614) at Abstract, ¶16. The LED die (103) is colored blue in the figure above. The LED is mounted within a cup formed in the package. *Id.* at ¶18. The walls surrounding the cup are colored purple. In addition, the inner surfaces of the cup facing the LED die are described as reflective. *Id.*

A conformal layer of phosphor particles (111) directly contacts and covers the surface of the LED die (103) and portions of the cup's walls. Ex. 1014 (Nichia-614) ¶¶16, 38, 43. The layer of particles is colored red in the figure above. The function of the phosphor particles is to convert light of a first wavelength received from the LED die (103) into a second longer wavelength. *Id.* at ¶17. Nichia-614 also

identifies 20 μm as an exemplary thickness and explains that the thickness should be "substantially equal" over the die. *Id.* at ¶¶33, 74.

Figure 2 also shows a layer of clear material (106) covering the layer of phosphor particles (111). *Id.* at ¶52. The clear material may include a diffusing material for scattering light. *Id.*

B. United States Patent Publication No. 2003/0080341

United States Patent Publication No. 2003/0080341 ("Nichia-341") is entitled "Light Emitting Diode, Optical Semiconductor Element and Epoxy Resin Composition Suitable for Optical Semiconductor Element and Production Methods Thereof." Ex. 1015. Nichia-341, which was not of record during the prosecution of the '119 patent, was published on May 1, 2003, which is more than one year prior to the filing date of the '119 patent. Ex. 1015 (Nichia-341) (cover page item (43)). Nichia-341, therefore, is prior art against the '119 patent under pre-AIA 35 U.S.C. § 102(e).

Again, as will be apparent throughout the descriptions of Nichia-341, the invention disclosed and claimed in the '119 patent is, for all relevant purposes, indistinguishable from the purported invention of the Nichia-341 patent. Figures 1 (top) and 10A and 10B (bottom left and right) of Nichia-614 are reproduced below with color added.

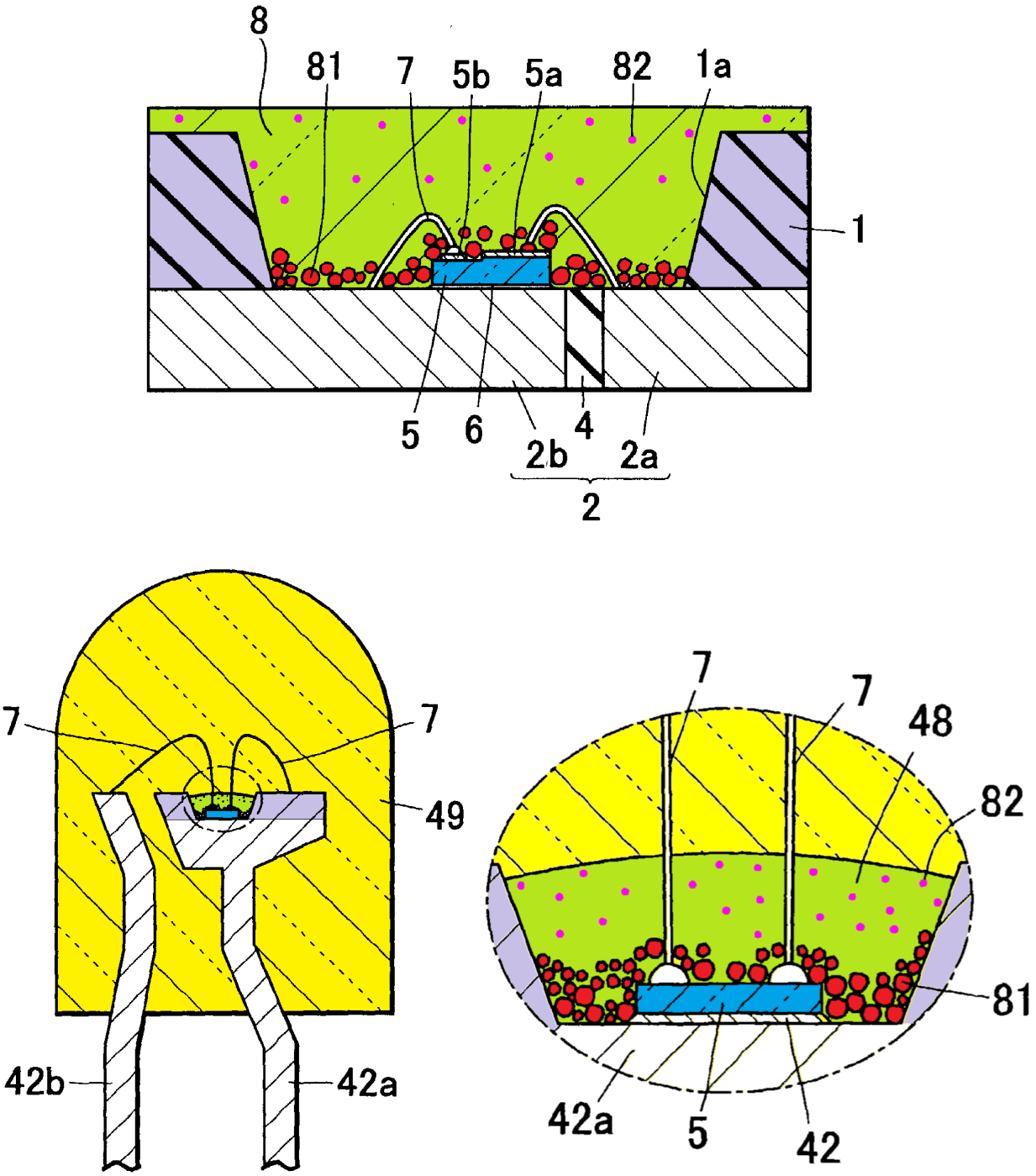

Figure 1 and 10A/B show two different embodiments of the inventive concept disclosed in Nichia-341. In the figures above, the LED dies (5) are colored blue. In all three figures, the LED is shown mounted within a cup. Ex. 1015 (Nichia-341) at

¶162. The walls surrounding the cup are colored purple. In addition, the inner surfaces of the cup facing the LED die are described as reflective. *Id.* at ¶¶81-82, 158-62, 270.

A conformal layer of phosphor particles (81) directly contacts and covers the surface of the LED die (5) and portions of the cup's walls. Ex. 1015 (Nichia-341) ¶¶18, 20, 34, 108-13, 117. In a preferred embodiment, Nichia-341 describes providing a single layer of phosphor particles ranging from 15 μm to 30 μm in size, which would result in a layer of substantially uniform thickness of less than 100 μm. *Id.* The function of the phosphor particles is to convert light of a first wavelength received from the LED die (5) into a second longer wavelength. *Id.* at Abstract, ¶¶112.

Figure 1 and 10A/B also shows a layer of clear material (8 or 48) covering the layer of phosphor particles (111). *Id.* at ¶52. The clear material may include a diffusing material (82) for scattering light emitted by the LED die (5) or the phosphor (81). *Id.* In the images above, the clear material is colored green and the diffusing material is colored pink. Finally, a transparent bulk encapsulating material (49) is shown over the clear material in figure 10A/B. The transparent bulk encapsulating material is colored yellow in the figures above.

C. Japanese Publication No. 2000-150966 ("Matsushita")

Japanese Patent Publication No. 2000-150966 ("Matsushita") is entitled "Semiconductor Light Emitting Device And Manufacturing Method Thereof."[6] Ex. 1016. Matsushita, which was not of record during the prosecution of the '119 patent, was published on May 30, 2000, which is more than one year prior to the filing date of the '119 patent. Ex. 1016 (Matsushita) (cover page item (43)). Matsushita, therefore, is prior art against the '119 patent under pre-AIA 35 U.S.C. § 102(b).

Just as with the previous two references, the overlap in subject matter between Matsushita and the '119 patent is clear and striking.

Figure 3 of Matsushita is reproduced below with color added to indicate the relevant features.

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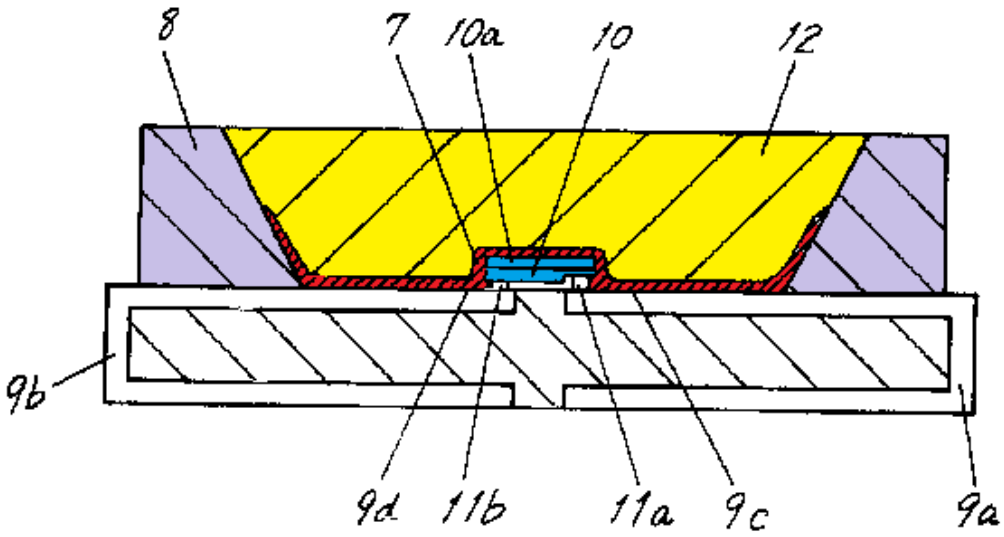
[6] Exhibit 1016 includes Matsushita, an English language translation of Matsushita, and a supporting declaration for the translation. Citations other than to the figures are to the paragraphs of the English language translation.

【図３】



The embodiment shown in figure 3 depicts an LED (10), which is colored blue. Ex. 1016 (Matsushita) ¶42. The LED is described as mounted within "reflective case 8," which is colored purple. *Id.* The inner walls of the reflective case (8) present a reflective cup to the LED 2. *Id.*

A conformal layer of phosphor (7), which is colored red in the image above, directly contacts and covers the surface of the LED die (10) and portions of the cup's walls. Ex. 1016 (Matsushita) ¶43. The specification of Matsushita further explains that the method of forming the phosphor film layer is based on the method described with respect to figure 2. *Id.* That earlier embodiment explains that "the phosphor film layer 7 is formed by precipitation of a phosphor material in a solvent, the phosphor film layer 7 can be formed to a very thin film thickness of about 7 to 30

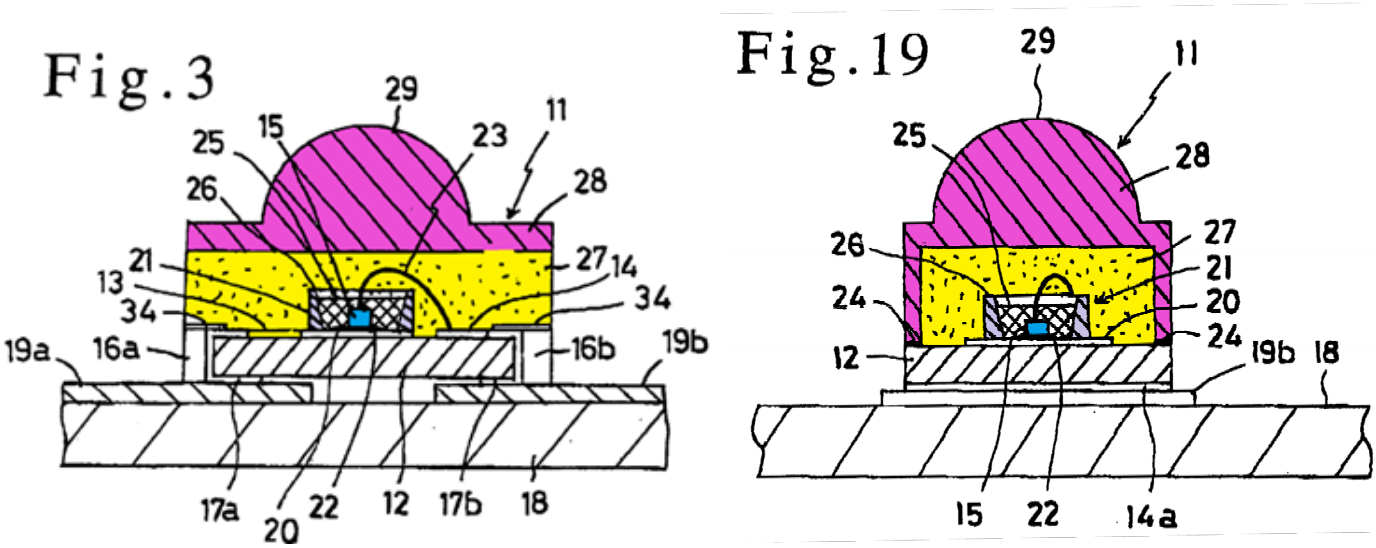
μm." *Id.* at ¶37. Example solvents described in Matsushita include "methyl alcohol or another highly volatile organic solvent." *Id.* at ¶34. The function of the phosphor layer is to convert light of a first wavelength received from the LED die (10). *Id.* at ¶¶38, 44.

Figure 3 also shows a layer of clear epoxy resin material (12) that covers the layer of phosphor particles (7). *Id.* at ¶43. The clear material is colored yellow in the version of Figure 3 above.

D. United States Patent 6,345,903 ("Koike")

United States Patent No. 6,345,903 ("Koike") is entitled "Surface-Mount Type Emitting Diode and Manufacturing Same." Ex. 1017. Koike which was not of record during the prosecution of the '119 patent, issued on February 12, 2002, which is more than one year prior to the filing date of the '119 patent. Ex. 1001. Koike, therefore, is prior art against the '119 patent under pre-AIA 35 U.S.C. § 102(b).

Figures 3 and 19 of Koike are reproduced below with color added.



Element 15 of both embodiments is a light emitting diode that outputs blue light. Ex. 1017 (Koike) at 5:22-38. The light from the LED first passes through a first resin encapsulant (25) containing a wavelength converting material. *Id.* at 5:39-67. The light then passes through a second resin encapsulant (27) containing a diffusing agent. *Id.* at 6:1:13. The diffusing agent provides improved color uniformity. *Id.* at 10-13. Finally, a third resin encapsulant (28) is provided that includes a semi-spherical condenser lens (29). The lens portion serves for "condensing or gathering light." *Id.* at 6:33-40. The third resin encapsulant comprises a transparent bulk encapsulating material over a layer of clear material containing diffusing material. The second and third encapsulants are colored yellow and pink respectively in the versions of figures 3 and 19 above.

IX. PRECISE REASONS FOR THE RELIEF REQUESTED

A. Ground 1: Claims 1-4 and 7 Are Anticipated by Nichia-614

1. Independent Claim 1

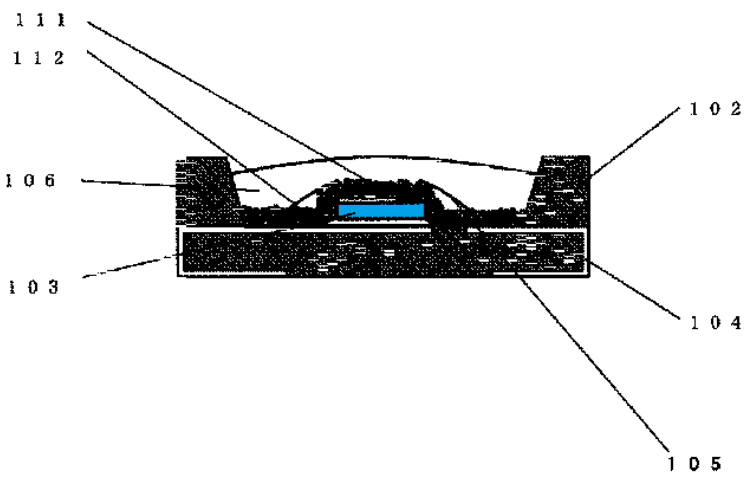
"1. A light emitting device comprising"

To the extent that the preamble is found to limit the claims, Nichia-614 discloses "[a] manufacturing method of a light emitting device including a light emitting element." Ex. 1014 at Abstract, *see also id.* at Title ("Manufacturing Method of Light Emitting Device"); Abstract, ¶6; *see also* Ex. 1007 (Doolittle Decl.) ¶56.

"[a] a light source that generates light of a first wavelength, said light source comprising a die that emits light at said first wavelength"

Nichia-614 discloses a light source that generates light of a first wavelength, said light source comprising a die that emits light at said first wavelength. Ex. 1014 at Abstract ("A manufacturing method of a light emitting device including a light emitting element arranged above a support, a phosphor which absorbs at least a part of the light emitted from the light emitting element and emits light after wavelength conversion"). Figure 2 of Nichia-614 is reproduced to the right, with the light emitting die 103 colored blue. Ex. 1014 (Nichia-614) ¶¶16, 83 ("103 is an LED chip"). The specification explains that the LED emits light in of a first wavelength. *Id.* at ¶33 ("it is possible to convert a wavelength and extract to the exterior light which is emitted from the entire surface of a nitride semiconductor light emitting

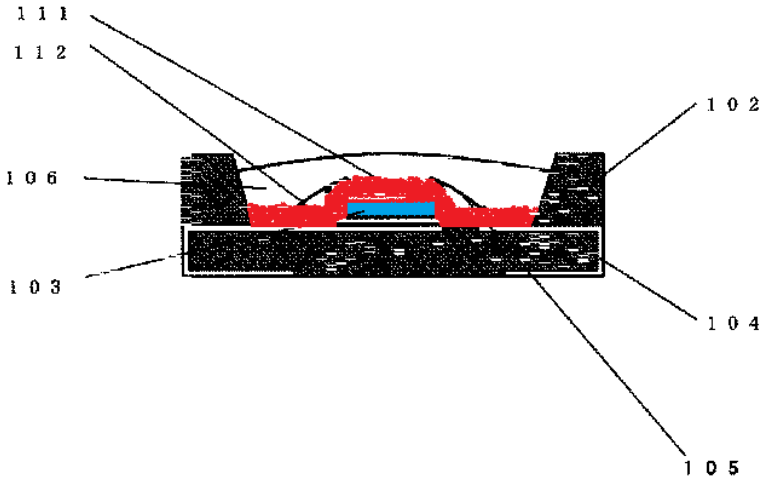
device"); ¶37 (describing "the light emission wavelength of the LED chip"); ¶43 (describing an example of the LED as made of "a nitride compound semiconductor (general formula $In_i Ga_j Al_k N$ . . .) capable of efficiently emitting a relatively short wavelength and exciting the phosphor"). In the Examples section of Nichia-614, which begins at paragraph 59, the light output from the light emitting element is identified as "blue." Ex. 1014 (Nichia-614) ¶75; *see also* Ex. 1007 (Doolittle Decl.) ¶57.



"[b] a conformal layer of phosphor particles covering said die and in direct contact therewith, said phosphor particles converting at least a portion of said light of said first wavelength to light of a second wavelength, said layer having a substantially uniform thickness of less than 100µm over said die"

As discussed in Section VI.A. above, the term conformal as used in the '119 patent means ***conform to the shape of the underlying die***. The presence of a layer of phosphor particles 111 that is in direct contact with and conforms to the shape of the underlying die is shown, for example in figure 2, a colored version of which is reproduced to the right (phosphor colored red). Ex. 1007 (Doolittle Decl.) ¶58. The disclosure of direct contact is also provided. Ex. 1014 (Nichia-614) ¶38 (describing a

phosphor "arranged in contact with or close to the LED chip"); *see also id.* at ¶43 (describing "phosphors . . . in a coating layer formed from a single layer on the surface of the light emitting device"); *id.* at ¶73 (describing "a coating layer . . . fixed to the surface of the light emitting element"). Nichia-614 also explains that "111 is a coating layer on the LED chip and 112 is a coating layer on a support." Ex. 1014 ¶16. The reference further explains that "[t]he coating layers 111, 112 used in the present invention are arranged in the mount lead cup or within an opening part of the package arranged separately from the mold member, and are phosphors for converting light emitted by the LED 103 or resin or glass which bind phosphors." *Id.* at ¶17; *see also* Ex. 1007 (Doolittle Decl.) ¶¶60-61.



That the phosphor particles 111 are provided in a layer of substantially uniform thickness over the die is also described. *Id.* at ¶17 ("The thickness of the coating layer 111 of the present invention arranged on the upper surface, side surface and corner of the LED chip 103 and a thickness of the coating layer 112 arranged on a support other than the LED chip **are substantially equal**.") (emphasis added); *id.* at ¶33 ("since a coating layer in which a phosphor having a wavelength conversion

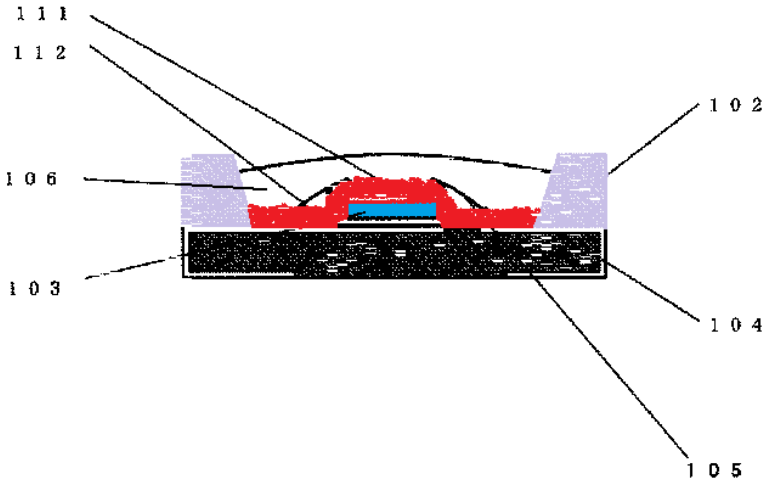
function is bound by spray coating can be formed at the same film thickness on the entire surface of the light emitting element, that is, on the upper surface, side surface, and corner parts, a phosphor is uniformly dispersed on the entire surface of the light emitting element"). Because the thickness of the phosphor-containing layer on the chip is described as "substantially equal" and "formed at the same film thickness," Nichia-614 discloses that the layer is largely or wholly the same in form. *see also* Ex. 1007 (Doolittle Decl.) ¶60. And to the extent that a functional interpretation is necessary, the thickness of the phosphor layer provides a wavelength conversion function. *Id.* at ¶61.

Finally, as to the specific layer thickness, Nichia-614 explains that "[b]y the steps described above, a phosphor is contained uniformly in the coating layer and the coating layer having layer thickness of about 20 μm is formed on the upper surface, side surfaces, and corner parts of the light emitting device." Ex. 1014 (Nichia-614) ¶74. The exemplary thickness of 20 μm over the upper surface of the LED meets the language less than 100 μm over the die. Ex. 1007 (Doolittle Decl.) ¶62.

"[c] a reflecting cup comprising reflective sidewalls, said die being located in said cup such that a portion of said light generated by said die is reflected from said cup, said layer of phosphor particles covering a portion of said reflective sidewalls"

Nichia-614 discloses a reflecting cup comprising reflective sidewalls, said die being located in said cup such that a portion of said light generated by said die is

reflected from said cup, said layer of phosphor particles covering a portion of said reflective sidewalls. Ex. 1014 (Nichia-614) ¶18 ("the high energy light which is emitted from the LED chip is reflected by a cup or the like"). Figure 2 of Nichia-614 is reproduced to the right, with the reflector cup part of the package 102 colored purple.



Ex. 1014 (Nichia-614) ¶47; *see also* Ex. 1007 (Doolittle Decl.) ¶63. The concave part of the package 102 is identified by reference number 103, which contains the LED chip. *Id.* In addition, figure 2 of Nichia-614 shows the layer of phosphor particles covering a portion of the reflective sidewalls.

In addition to the express disclosure of a reflective cup (Ex. 1014 ¶18), Nichia-614 further explains that the material of the package can be selected to be "gray." *Id.* at ¶47. The variation in shade between white and black can be understood to comprise various degrees of reflectivity across the visible spectrum (*i.e.*, color neutral reflectivity). Ex. 1007 (Doolittle Decl.) ¶64. In particular, an object perceived as white has relatively strong reflectivity across a broad range of the visible spectrum. *Id.* Relatedly, the transition from white to gray to black can be understood as progressively weaker reflectivity across the visible range. In other

words, the reflected light from a "gray" object (as disclosed in Nichia-614) is essentially white light, but with lower intensity. Indeed, an object that appears "white" in one context may instead appear "gray" when contrasted with an object that has stronger reflectivity, *i.e.*, is "whiter." *Id.*

This description is consistent with the disclosure in Nichia-614 of providing "white light" by combining the color output by an LED with phosphor converted light:

> In the case when the light emitted from the LED chip 103 and the light emitted from the phosphor are in a complementary color relationship, white light can be emitted by mixing each light respectively. Specifically, in the case where the light from the LED chip 103 and the light of the phosphor excited and emitted thereby, correspond to the three primary colors of light (red, green, and blue) or blue light emitted from the LED chip 103 and yellow light of a phosphor excited emitted are examples.

Ex. 1014 (Nichia-614) ¶36. Such "white light" incident on a "gray" package would be absorbed in part and reflected in part, with the reflected part being perceived as a portion of the white light output by the device as a whole. Ex. 1007 (Doolittle Decl.) ¶65.

2. Independent Claim 2

"2. A light emitting device comprising"

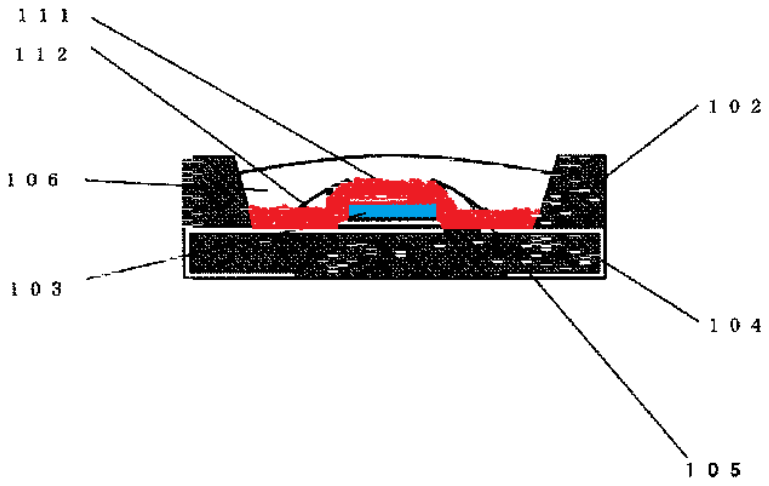
To the extent that the preamble of claim 2 is found to limit the claims, the language of the preamble is identical to the preamble of claim 1, and therefore the same analysis provided in Section IX.A.1. applies here. Ex. 1007 (Doolittle Decl.) ¶67.

"[a] a light source that generates light of a first wavelength"

The first element of claim 2 is identical to the first ten words of the first element of claim 1. The analysis of that portion of claim 1 as provided in Section IX.A.1., therefore, applies equally here. Ex. 1007 (Doolittle Decl.) ¶68.

"[b] a layer of phosphor particles covering said light source, said phosphor particles converting at least a portion of said light of said first wavelength to light of a second wavelength, said layer comprising a residue of a slurry of said phosphor particles in a volatile solvent, said residue comprising the portion of said slurry that remains when a portion of said volatile solvent is removed"

The presence of a layer of phosphor particles 111 covering said light source is shown, for example in figure 2, a colored version of which is again reproduced to the right (phosphor colored red). Nichia-614 also explains that "111 is a coating layer on the LED chip



and 112 is a coating layer on a support." Ex. 1014 ¶16. The reference further explains that "[t]he coating layers 111, 112 used in the present invention are arranged in the mount lead cup or within an opening part of the package arranged separately from the mold member, and are phosphors for converting light emitted by the LED 103 or resin or glass which bind phosphors." *Id.* at ¶17; *see also* Ex. 1007 (Doolittle Decl.) ¶69. That disclosure is sufficient to establish anticipation under the proper construction as addressed in Section VI.C. above.

Further, even if the process recited in element 2[b] is narrowly interpreted to require a conformal layer that is substantially uniform in thickness (*i.e.*, the Alternative Physical Construction addressed in Section VI.C.) those physical requirements are also met by Nichia-614. The analysis of those physical properties is provided above with respect to the corresponding express recitations in claim 1, and therefore, no further analysis is necessary. Ex. 1007 (Doolittle Decl.) ¶70.

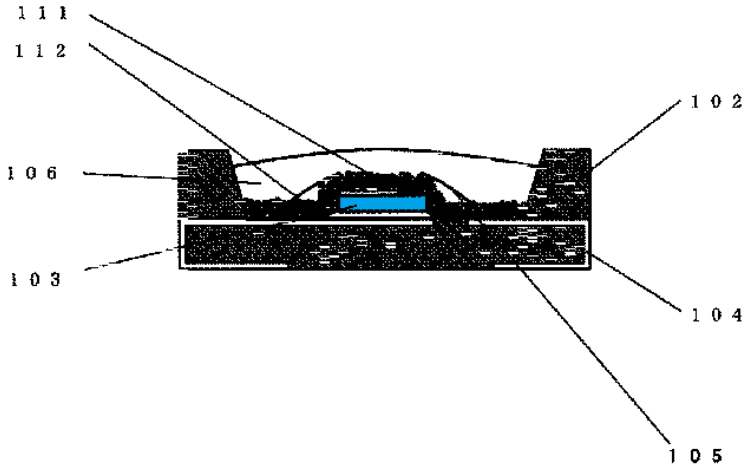
Finally, to the extent that the recited process is deemed relevant (which Petitioner disputes), anticipation by Nichia-614 is still met. In particular, the slurry in Nichia-614 comprises "a mixed solution of an ethyl silicate hydrolyzed solution, ethylene glycol and a phosphor in a weight ratio of 1:1:1 is prepared, and the coating liquid was adjusted and stirred so that the phosphor is uniformly dispersed in the coating liquid." Ex. 1014 (Nichia-614) ¶66; Ex. 1007 (Doolittle Decl.) ¶71. The ethylene glycol is "an organic solvent" (*id.* at 66), and therefore, the coating liquid is

a mixture including the solid phosphor particles and a volatile solvent. Moreover, after the coating step is completed, the coating is "dried at a temperature of 300°C for 2 hours, whereby ethanol generated during hydrolysis of ethyl silicate, and a solvent are completely evaporated." Ex. 1014 (Nichia-614) ¶73; Ex. 1007 (Doolittle Decl.) ¶71. The remaining coating, therefore, is a residue of the 1:1:1 slurry of the phosphor particles after the volatile solvent has been removed by evaporation.

3. Dependent Claim 3

"3. The light emitting device of claim 2 wherein said light source comprises an LED"

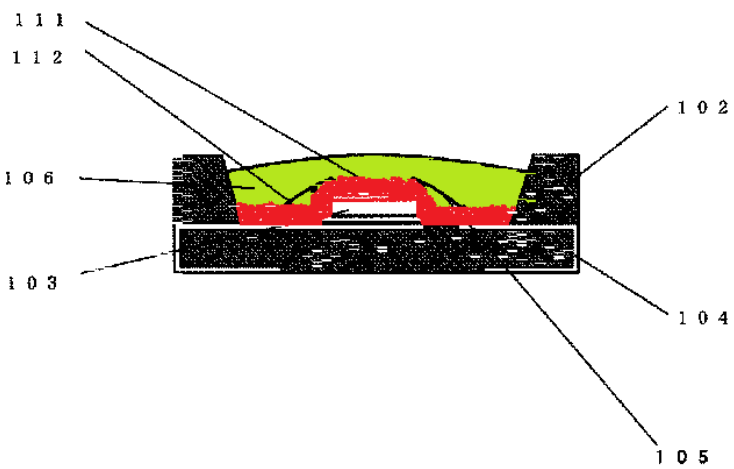
The additional requirement that the light emitting device of claim 2 is an LED is also expressly met by Nichia-614. In particular, figure 2 of Nichia-614 is reproduced to the right, with the LED 103 colored blue. Ex. 1014 (Nichia-614) ¶16 ("103 is an LED chip"); *see also* Ex. 1007 (Doolittle Decl.) ¶72.



4. Dependent Claim 4

"4. The light emitting device of claim 2 further comprising a layer of clear material covering said layer of phosphor particles"

Nichia-614 also discloses a layer of clear material covering said layer of phosphor particles. The clear layer is called a "mold member 106" and is colored green in the version of figure 2 reproduced to the right. "The mold member 106 can be formed using . . . [a] transparent resin or glass." Ex. 1014 (Nichia-614) ¶52 *see also* Ex. 1007 (Doolittle Decl.) ¶73.



5. Dependent Claim 7

"7. The light emitting device of claim 2 further comprising a reflecting cup comprising reflective sidewalls, a die located in said cup such that a portion of said light generated by said die is reflected from said cup, said layer of phosphor particles covering a portion of said reflective sidewalls"

The language of claim 7 is provided side-by-side with the language of the final element of claim 1 below.

Claim 7	Claim 1 Element [c]
The light emitting device of claim 2 further comprising a reflecting cup comprising reflective sidewalls, a die located in said cup such that a portion of said light generated by said die is reflected from said cup, said layer of phosphor particles covering a portion of said reflective sidewalls	a reflecting cup comprising reflective sidewalls, said die being located in said cup such that a portion of said light generated by said die is reflected from said cup, said layer of phosphor particles covering a portion of said reflective sidewalls

There being no substantive difference between claim 7 and the final element of claim 1, the same analysis provided in Section IX.A.1. applies equally here. Ex. 1007 (Doolittle Decl.) ¶74.

B. Ground 2: Claim 5 Is Obvious based on Nichia-614 in view of Nichia-341

1. Dependent Claim 5

"5. The light emitting device of claim 4 wherein said clear material further comprises a diffusing material for scattering light generated by said light source and said phosphor particles."

a) The Prior Art's Scope and Content and Differences

As discussed in Section IX.A.4. *surpa*, Nichia-614 discloses a clear material as recited in claim 4. With respect to claim 5, Nichia-614 describes providing diffusing material in the clear material for scattering light generated by said light source. More specifically, Nichia-614 explains that "it is possible to relax the directivity and increase the viewing angle from the LED chip 103 by containing a

diffusing agent in the mold member." Ex. 1014 (Nichia-614) ¶52 (emphasis added); Ex. 1007 (Doolittle Decl.) ¶75.

Although Nichia-614 specifically links the diffusing agent to the output from the LED 103, no express linkage to the wavelength converted output from the phosphor particles is provided. As explained by Professor Doolittle, however, the reference to diffusing agent would have been understood to be a broadly reflective material that would diffuse light regardless of whether the light was the relatively shorter wavelength from the LED or the relatively longer wavelength from the phosphor. Ex. 1007 (Doolittle Decl.) ¶76. More specifically, if the diffusing agent were not broadly reflective of both the light from the LED and from the phosphor, the improved color and intensity uniformity desired by Nichia-614 would have been harmed. *Id.* at ¶¶76-77. In other words, it would have been at least obvious to try a conventional diffusing agent that scattered both types of light, which should be deemed obvious. *Id.*

Nichia-341 discloses various diffusing agents that may be added to the light transmitting resin provided over a light emitting diode. Ex. 1015 (Nichia-341) ¶¶ 232-36. A preferred diffusing agent in Nichia-341 is described as follows:

> It is preferable to use the diffusing agent having median particle size within a range from 1 μm to 5 μm, since it causes satisfactory random reflection of light emitted by the LED chip and the fluorescent material and suppression of irregular color that tends to occur when

> the fluorescent particles of large particle size is used. Use of the diffusing agent also makes it possible to make the half width of the light emission spectrum narrower and obtain the light emitting diode having high color purity.

Id. at ¶235 (emphasis added). Thus, the diffusing agent of Nichia-341 diffuses (*i.e.*, scatters into a broader angular range) both the LED output and the output from the wavelength converting material resulting in light with high color purity.[7] Ex. 1007 (Doolittle Decl.) ¶78.

b) Level of Ordinary Skill

The level of ordinary skill in the art is discussed in Section VII above. Just as in Section IX.B. above, the sole issue here is about the selection of a known prior art material for the same purpose that it was known in the prior art – to scatter light. Ex. 1007 (Doolittle Decl.) ¶79. Indeed, although the specification of Nichia-614

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[7] Nichia-614 refers to the wavelength converting material as a phosphor and Nichia-341 refers to the wavelength converting material as fluorescent. Because Nichia-614 specifically calls its wavelength converting material a phosphor, the specific terminology used in Nichia-341 is not relevant here. In addition, as discussed in Section IX.E. below, the fluorescent material of Nichia-341 is a phosphor as that term is used in the '119 patent.

specifies that the light from the LED is scattered, the sole difference is whether wavelength converted light would also be scattered. On this issue, there are only two possibilities, that the diffusing agent would be specific to the wavelength of the LED or instead would scatter light from a broader range including the wavelengths from both the LED and the wavelength converted light. The selection of the specific material would have been well within the skill of a person having ordinary skill in the art, in that it would have comprised the use of a known material for the very same purpose for which it was used in the prior art, *i.e.*, to diffuse light. Ex. 1007 (Doolittle Decl.) ¶79.

c) Obviousness Rationale

Although Nichia-614 only expressly refers to scattering light from the LED, there is no express exclusion from scattering wavelength converted light as well. Nichia-341 provides reasons for scattering both the light from the LED and the wavelength converted light – to suppress uneven color, provide good directivity, and improve color uniformity. Ex. 1015 (Nichia-341) at ¶¶27, 198, 235; Ex. 1007 (Doolittle Decl.) ¶79. More specifically, the diffusing agent ensures that both the light from the LED and the wavelength converted light are spread more evenly to provide a broader and more consistent color output from the device.

That purpose is consistent with the purpose of Nichia-614, which seeks to avoid "color tone unevenness." Ex. 1014 (Nichia-614) at Abstract; *see also id.* at

¶¶6, 12. Indeed, the specific use for which the diffusing agent was used in Nichia-614 – diffusing the light output to relax directivity – applies directly to the light from both the LED and the wavelength converting particles.

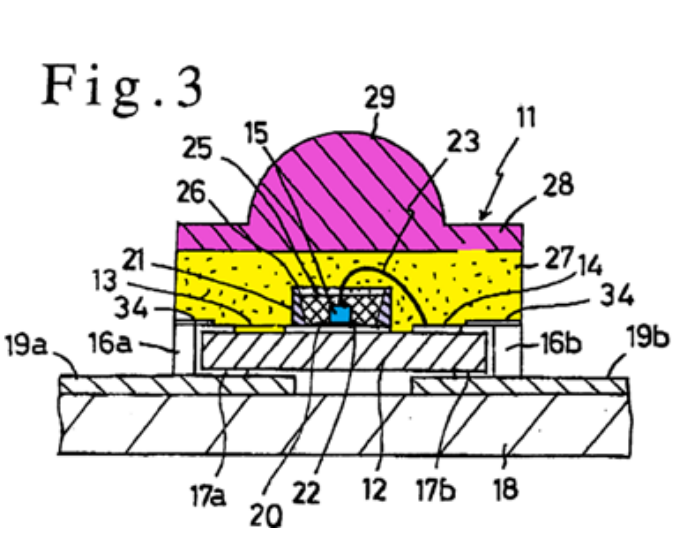
C. Ground 3: Claim 6 Is Obvious based on Nichia-614 in view of Nichia-341 and Further In View of Koike

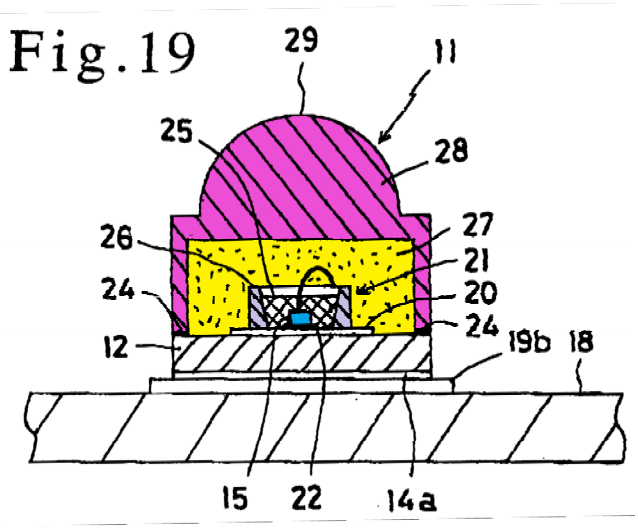
"6. The light emitting device of claim 5 further comprising a layer of transparent bulk encapsulating material over said layer of clear material."

a) The Prior Art's Scope and Content and Differences

As discussed in Section IX.B.2. *surpa*, Nichia-614 discloses a clear material containing a diffusing material for scattering light. A citation was provided to Nichia-341 solely to explain that it would have been obvious that the diffusing material should scatter light from LED and the wavelength converted light, and therefore, this obviousness analysis is unaffected by Nichia-341.

Like Nichia-614 and Nichia-341, Koike discloses a layer of transparent material (27) containing a diffusing agent for scattering light. Ex. 1007 (Doolittle Decl.) ¶¶84-85. That layer is colored yellow in the versions of exemplary figures 3 and 19 reproduced below.





The purpose of the diffusing agent is to improve color uniformity. Ex. 1017 (Koike) at 6:1:13. Koike further discloses an additional layer of transparent encapsulating material (28) provided over the diffusing-agent-containing layer (27). The third encapsulating material provides specific optical properties to improve the operation of the device, including converging outgoing light rays and blocking incoming ultraviolet rays. *Id.* at 6:14-54; Ex. 1007 (Doolittle Dec.) ¶¶84-85. The convergence is provided by a converging lens (29) structure formed on the surface of the third encapsulating layer. Ex. 1007 (Doolittle Dec.) ¶85. The example third encapsulating materials (28) as shown in figures 3 and 19, along with the corresponding descriptions in the specification, comprises a transparent bulk encapsulating material over a layer of clear material containing a diffusing agent. *Id.*

b) Level of Ordinary Skill

The level of ordinary skill in the art is discussed in Section VII above. The same basic methods of forming encapsulating materials as disclosed in Nichia-614 would have been within the level of ordinary skill in the art. More specifically, Koike provides detailed instructions on how encapsulating layers may be formed, including by adoption of resin molding steps. Ex. 1017 (Koike) at 7:43-65; Ex. 1007 (Doolittle Decl.) ¶88.

c) Obviousness Rationale

Koike discloses a number of benefits provided by the bulk encapsulating layer (28) provided over the transparent layer (27) containing a diffusing agent. For example, Koike explains that the bulk encapsulating layer may be shaped to provide a converging lens to provide a light gathering function. Ex. 1017 (Koike) at 6:33-54. As explained by Professor Doolittle, by shaping the lens using a separately layer of material above the package as described by Koike, there is freedom to shape the lens to provide a broader array of optical properties. Ex. 1007 (Doolittle Decl.) ¶85. For example, the lens can be shaped with sufficient curvature to provide strong convergence, and thereby, focus and direct its light output in a desired manner. *Id.* The same basic package design, therefore, could have been modified to provide distinct optical properties. *Id.*

Koike further explains that additional materials may be added to the encapsulating material (28) to provide other optical improvements. For example, Koike describes providing an ultraviolet absorber to protect the lower layers of encapsulant from the discoloration (aging) that such environmental ultraviolet light would have caused. *Id.* at 6:14-32; Ex. 1007 (Doolittle Decl.) ¶86.

The benefits presented by Koike would have been understood by a person having ordinary skill in the art to have had direct application to Nichia-614. In particular, Nichia-614 describes a number of different use cases, including "illumination light sources, LED displays, backlight sources, traffic lights, illumination switches, various sensors and various indicators." Ex. 1014 (Nichia-614) ¶1. Those use cases implicate the distribution of light both narrowly and broadly, suggesting the application of corresponding optical elements to provide the desired distribution. LEDs used as illumination light sources, for example, can provide either spot lighting (narrow) or general room lighting (broad). Ex. 1007 (Doolittle Decl.) ¶87. Similarly, traffic lights might utilize a relatively broader or narrower distribution depending on the lumens per device and the number of devices used to provide the needed output. *Id.*

In addition, the use of an additional layer containing an ultraviolet absorber would have been an obvious choice for the use cases in Nichia-614 that imply outdoor usage, including at least illumination, traffic lights and indicators. Such

protection against aging would have been understood as a direct benefit in the resulting product, again supporting obviousness. *Id.* A person having ordinary skill in the art, therefore, would have had reason to use a bulk encapsulating layer as disclosed in Koike positioned above a transparent layer containing a diffusing agent as disclosed in Nichia-614 in order to improve the light distribution from the device and/or to provide additional protection to the device. *Id*.

D. Ground 4: Claim 1 Is Obvious Based On Matsushita Alone or in View of Nichia-614

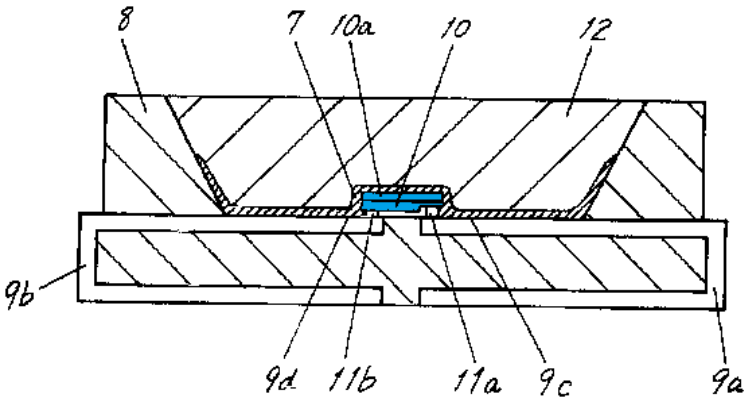
"1. A light emitting device comprising"

To the extent that the preamble is found to limit the claims, figure 3 of Matsushita is "is a schematic longitudinal cross-sectional view of a semiconductor light emitting device." Ex. 1016 ¶40.

"[a] a light source that generates light of a first wavelength, said light source comprising a die that emits light at said first wavelength"

Matsushita discloses a light source (10) that generates light in the blue wavelength range. Ex. 1016 ¶42. The die includes a substrate 10a and GaN-based layers for emitting

【図３】

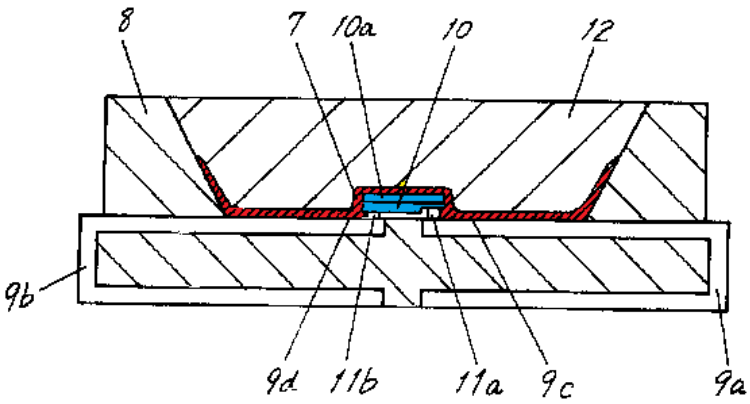


blue light. *Id.*; *see also* Ex. 1007 (Doolittle Decl.) ¶91. The light source (10) is colored blue in the version of figure 3 reproduced to the right.

> **"[b] a conformal layer of phosphor particles covering said die and in direct contact therewith, said phosphor particles converting at least a portion of said light of said first wavelength to light of a second wavelength, said layer having a substantially uniform thickness of less than 100µm over said die"**

As discussed in Section VI.A. above, the term conformal as used in the '119 patent means ***conform to the shape of the underlying die***. The presence of a layer of phosphor particles (7) in direct contact with and conforming to the shape of the die is shown in figure 3. The layer of phosphor particles (7), which is largely or wholly the same in form (*i.e.*, substantially uniform) over the top of the LED die (10), are colored red and blue respectively in the version of figure 3 reproduced to the right. Ex. 1016 (Matsushita) ¶¶35-36.

【図３】



The method of forming the phosphor layer is described with respect to figure 2, which is also expressly linked to the embodiment depicted in figure 3. *Id.* at ¶43. The result of the method is a phosphor layer provided as a "thin film layer." *Id.* at ¶37. The resulting layer is described as having "a very thin film thickness of about 7

to 30 μm." *Id.* The depiction of phosphor layer 7 having largely or wholly the same in form in figure 3 should be deemed adequate disclosure of the "substantially uniform thickness" recitation. Ex. 1007 (Doolittle Decl.) ¶91. At a minimum, that disclosure should render the requirement obvious whether considered alone or in combination with Nichia-614.

(1) The Prior Art's Scope and Content and Differences

Matsushita depicts a substantially uniform layer in figure 3 that can be in the range from 7 to 30 micrometers.

Nichia-614 discloses an invention for "reducing color tone unevenness as seen from a light emission observation surface." Ex. 1014 at Abstract. In particular, the problem addressed by the invention of Nichia-614 was that "the thickness of a coating layer (amount of phosphor) is different in each part of the surface of the light emitting element." *Id.* at ¶4. The unevenness of the phosphor resulted in "the amount of light from the light emitting element and the amount of light from the phosphor [being] partially different." *Id.* To address this problem, Nichia-614 described an invention for "substantially uniformly distributing phosphors on the upper surface, side surfaces and corners of a light emitting element." *Id.* at ¶12; Ex. 1007 (Doolittle Decl.) ¶94.

(2) Level of Ordinary Skill

The level of ordinary skill in the art is discussed in Section VII above. It would have been well within the skill of a person having ordinary skill to achieve a substantially uniform phosphor layer based on the combined teachings of Matsushita and Nichia-614. Ex. 1007 (Doolittle Decl.) ¶96. Indeed, although the specific method steps to form such a layer are not relevant to the validity of claim 1, the express disclosure of process steps in at least Nichia-614 would have brought it within the scope of the person having ordinary skill. *Id.* In fact, any argument that a person having ordinary skill in the art could not have achieved a substantially uniform layer would necessarily call into question the level of enablement provided by the '119 patent.

(3) Obviousness Rationale

The rationale for providing a substantially uniform phosphor layer can be understood based on the combined teachings of Matsushita and Nichia-614. Ex. 1007 (Doolittle Decl.) ¶95. In particular, both references disclose the use of an LED outputting blue light, a portion of which is converted to longer wavelength light so that an observer will perceive white light. Ex. 1016 (Matsushita) ¶¶1, 38; Ex. 1014 (Nichia-614) ¶¶36, 39. Nichia-614, however, identifies a potential problem if the thickness of the phosphor layer lacks uniformity:

> As a result [of the lack of phosphor uniformity in the prior art], the emission color from the light emitting element partially becomes strong on the emission observation surface, and the emission color from the phosphor becomes strong which produces an uneven color tone . . . . In the present invention, by uniformly arranging the phosphors formed on the light emitting element and other parts, it is possible to improve uneven color tone and directivity.

Ex. 1014 (Nichia-614) ¶15. Nichia-614 further explains:

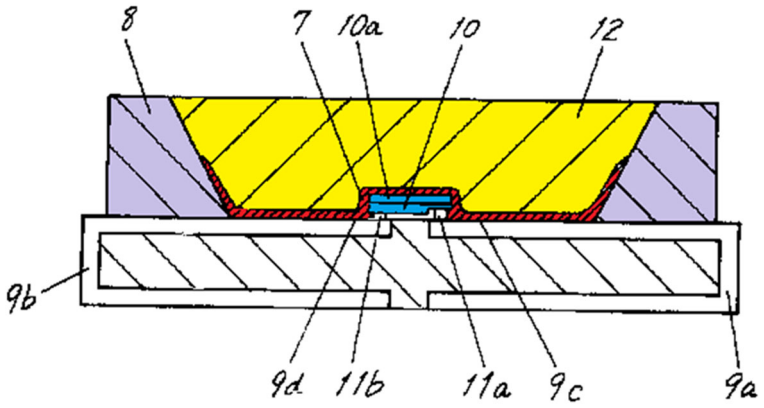
> According to the present invention, it is possible to provide a light emitting device in which chromaticity shifts due to each direction is reduced and has no color deviation when viewed from the light emission observation surface by the light emitting device of the present invention in which the coating thickness is substantially uniform on the top surface, side surface, and corners of the light emitting element.

Id. at ¶83 (emphasis added). Ex. 1007 (Doolittle Decl.) ¶95. In other words, improving the uniformity of phosphor thickness results in an improvement in the perceived color uniformity from the perspective of a viewer. *Id.* And conversely, a device according to Matsushita without uniformity in the layer thickness would, according to Nichia-614, perceive white light that various in color rather than being uniform. *Id.*

"[c] a reflecting cup comprising reflective sidewalls, said die being located in said cup such that a portion of said light generated by said die is reflected from said cup, said layer of phosphor particles covering a portion of said reflective sidewalls"

Matsushita discloses a reflecting cup comprising reflective sidewalls, the die being located in said cup such that a portion of said light generated by said die is reflected from said cup, said layer of phosphor particles covering a portion of said reflective sidewalls. Ex. 1016 (Matsushita) ¶¶40-41; Ex. 1007 (Doolittle Decl.) ¶¶97-98. In figure 3, the cup is formed by the inner walls of the reflective case (8), which is colored purple in the version of figure 3 above right. *Id*.

【図３】



E. Ground 5: Claims 1-7 Are Rendered Obvious in view of Nichia-341

For each recitation below, Petitioner relies upon the general inventive description from Nichia-341 as well as exemplary figures 1 and 10A/B. Those two embodiments individually render the relevant claims obvious in view of the knowledge of a person having ordinary skill in the art.

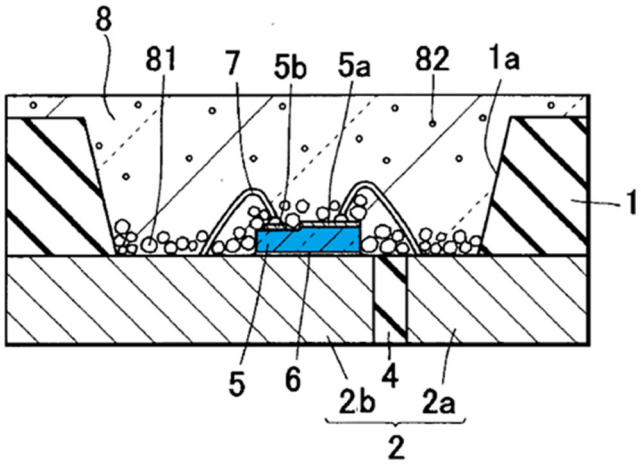
1. Independent Claim 1

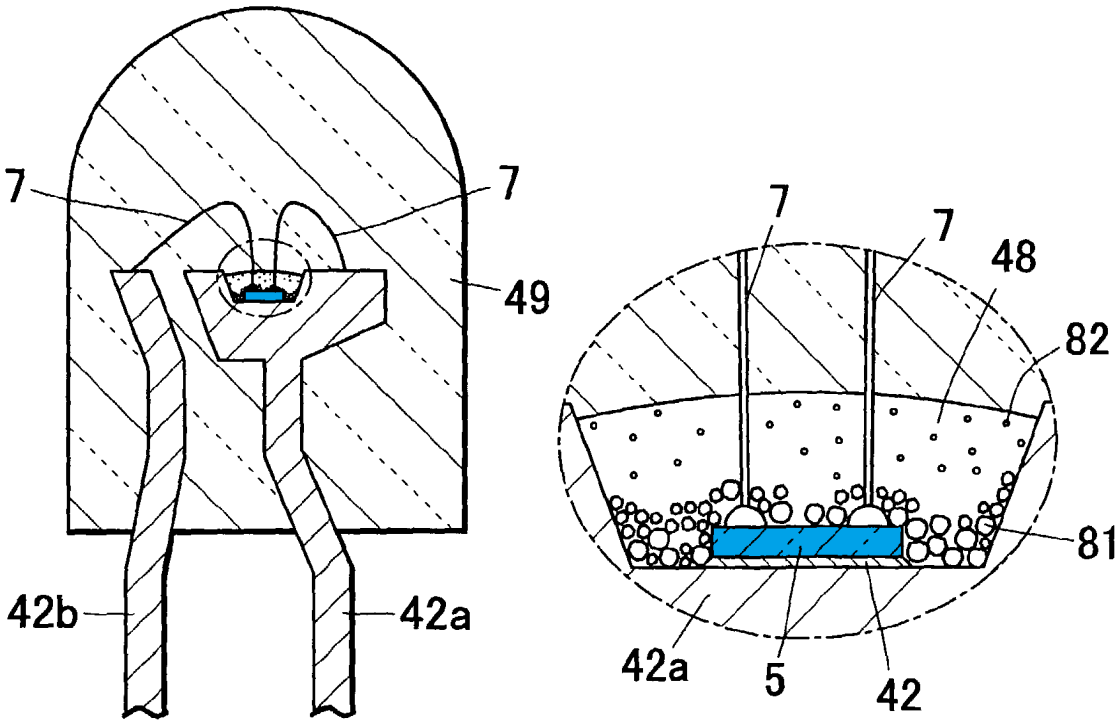
"1. A light emitting device comprising"

To the extent that the preamble is found to limit the claims, Nichia-341 discloses "[a] light emitting diode comprising an LED chip." Ex. 1015 at Abstract, *see also id.* at Title ("Light Emitting Diode, Optical Semiconductor Element And Epoxy Resin Composition Suitable For Optical Semiconductor Element and Production Methods Therefor"); Abstract, ¶¶14, 17, 59, 71-72, 82; figs. 1, 10A/B; Ex. 1007 (Doolittle Decl.) ¶100.

"[a] a light source that generates light of a first wavelength, said light source comprising a die that emits light at said first wavelength"

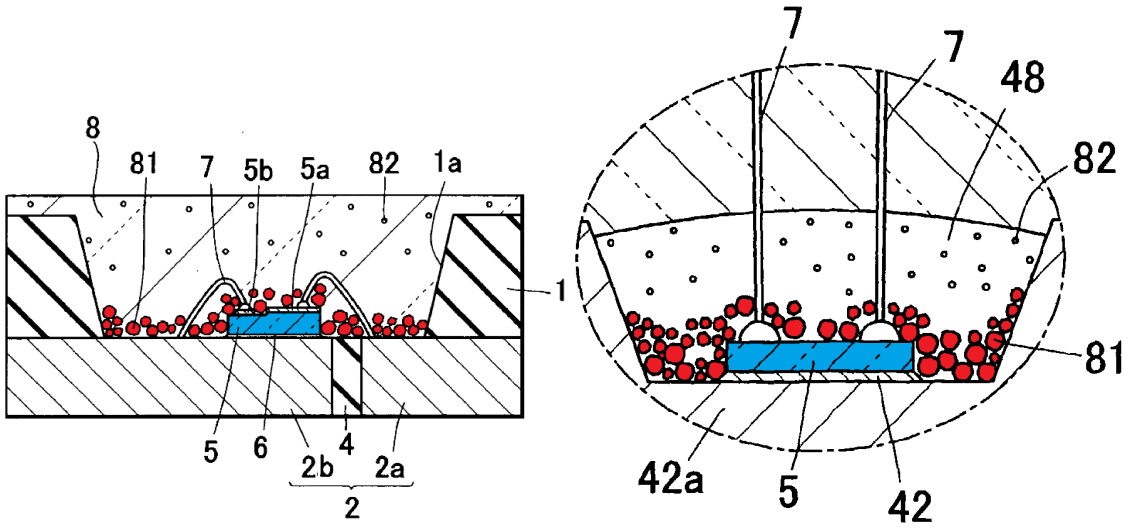
Nichia-341 discloses a light source that generates light of a first wavelength, said light source comprising a die that emits light at said first wavelength. Ex. 1015 at Abstract. Figure 1 of Nichia-341 is reproduced to the right, with the light emitting die 5 colored blue. Ex. 1015 (Nichia-341) ¶16 ("103 is an LED chip"); Ex. 1007 (Doolittle Decl.) ¶101. Figures 10A /B are reproduced below left and right respectively, with the light emitting die colored blue.





"[b] a conformal layer of phosphor particles covering said die and in direct contact therewith, said phosphor particles converting at least a portion of said light of said first wavelength to light of a second wavelength, said layer having a substantially uniform thickness of less than 100µm over said die"

As discussed in Section VI.A. above, the term conformal as used in the '119 patent means ***conform to the shape of the underlying die***. The presence of a layer of wavelength converting particles (81) in direct contact with and conforming to the shape of the underlying die is shown in figures 1 and 10B, colored versions of which are reproduced below with the wavelength converting particles (81) colored red.



Like the nearly identical figures in the '119 patent,[8] the particles that exist above the chip comprise either a single or at most two stacked particles. As is clear from both sets of figures, however, the structures are not to scale, but instead are merely representative of a conformal layer that is of substantially uniform thickness over the surface of the chip. Ex. 1007 (Doolittle Decl.) ¶102.

In addition to the figures, the properties of the particle layer in Nichia-341 can also be understood based on the corresponding description in the text. In particular, that the layer (1) is conformal, (2) directly contacts the die, and (3) has substantially

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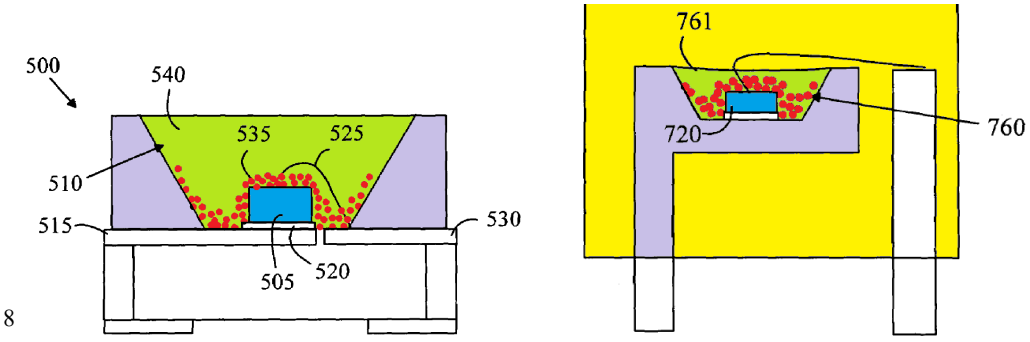

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uniform thickness of less than 100μm over the die, can all be understood from Nichia-341's characterization of that layer. *See*, *e.g.*, Ex. 1015 (Nichia-341) at Abstract, ¶¶18, 112. Nichia-341 explains that the particle layer is created when particles (81) precipitate down to the bottom onto the underlying surfaces, *i.e.*, the top of LED (5) and the surrounding cup. *See* Ex. 1015 (Nichia-341) ¶117 ("particles of large particle size (81) precipitated around the LED chip"); Ex. 1007 (Doolittle Decl.) ¶¶106-107.

In addition, the thickness and uniformity of the particles layer (81) can be understood based on the exemplary size ranges of those particles as well as the express desire to avoid particles "piled up one on another" Ex. 1015 (Nichia-341) ¶¶20, 34, 110, 113. In particular, the most preferred range of particles (81) is from 15μm to 30μm. *Id.* at ¶113. By controlling the range of particle sizes, Nichia-341 explains that "particles of large particle size (81) will not be disposed one on another around the LED chip 5." *Id.* at ¶108. Instead, the contact between the particles will be limited to avoid particles piled on another. *Id.*; *see also id.* at ¶110; Ex. 1007 (Doolittle Decl.) ¶¶106-107. In other words, the goal of Nichia-341 is to provide a single layer of particles. Ex. 1007 (Doolittle Decl.) ¶¶106-107. Even if some unwanted piling up of particles would result as shown in figures 1 and 10B, based on the preferred size range from 15μm to 30μm, the resulting wave converting layer would have a substantially uniform thickness of less than 100μm over the die by

being largely comprised of a single layer of such particles as shown most clearly by the three relatively large particles in the center of die (5) in figure 10B. *Id*.

As to the requirement – "phosphor particles" – Petitioner notes that Nichia-341 refers to its wavelength-converting particles as a "fluorescent material." Among the "fluorescent materials" described in Nichia-341 are yttrium aluminum garnet (YAG). Ex. 1015 ¶122. Nichia-614 describes that same material as a phosphor. Ex. 1014 ¶38. In other words, the terms fluorescent material and phosphor were used interchangeably during the relevant timeframe, and therefore, Nichia-341's description of the fluorescent material yttrium aluminum garnet is sufficient to, at a minimum, render obvious the use of a phosphor. Ex. 1007 (Doolittle Decl.) ¶103; *see also id.* at ¶¶31-39.

Moreover, the interchangeable use of a fluorescent material and a phosphor is evidenced throughout the contemporaneous patent literature. *See, e.g.*, Ex. 1018 (U.S. Patent No. 6,069,440) at Abstract (describing a "phosphor [that] contains garnet fluorescent material"); Ex. 1019 (U.S. Patent No. 6,137,217) at Abstract (describing a "fluorescent lamp [that] comprises at least one layer of a four-component phosphor blend"); Ex. 1020 (U.S. Patent No. 6,351,069) at Abstract (describing a "Ce:YAG phosphor" as a "fluorescent material"); Ex. 1024 (U.S. Patent No. 6,509,651) at 5:21-33 (describing a phosphor as emitting fluorescent light); Ex. 1021 (U.S. Patent No. 6,982,045) at Title (disclosing a "Light Emitting

Device Having Silicate Fluorescent Phosphor"). Given this background, the description of particles of "fluorescent material" in Nichia-341 is sufficient to render obvious the use of a phosphor particles as recited. Ex. 1007 (Doolittle Decl.) ¶104; *also id.* at ¶¶31-39.

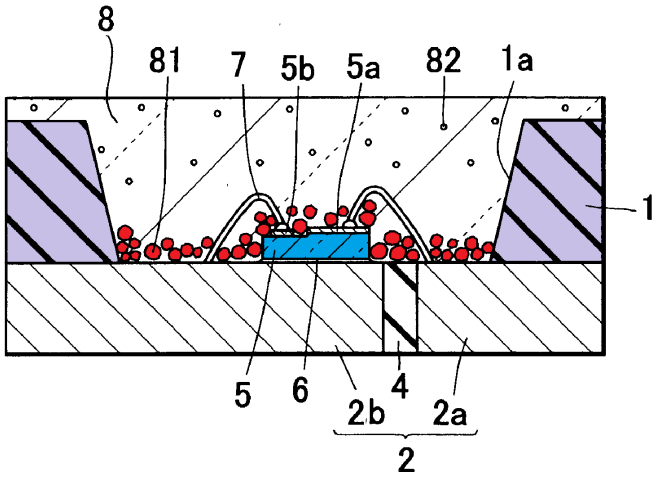
To the extent that the Patent Owner asserts or the Board concludes that a meaningful distinction exists between a phosphor and a fluorescent material in the context of the '119 patent, that distinction would still fall within the scope of obvious variations. Ex. 1007 (Doolittle Decl.) ¶105. The use of phosphor particles would have been nothing more than "[t]he combination of familiar elements according to known methods." *Corning v. Fast Felt Corp*., 873 F.3d 896, 902 (Fed. Cir. 2017) (citing *KSR Int'l Co. v. Teleflex Inc*., 550 U.S. 398, 416 (2007)). Under those circumstances, the purported invention "is likely to be obvious when it does no more than yield predictable results." *Id.* In addition, a relevant fact when considering obviousness is whether the modification fell within the scope of "known substitutes, with success predictable as to materials covered by the claims." *Id.* at 903; *see also In re* Mouttet, 686 F.3d 1322, 1331 (Fed. Cir. 2012) ("Where 'a patent claims a structure already known in the prior art that is altered by the mere substitution of one element for another known in the field, the combination must do more than yield a predictable result.'") (quoting *KSR*, 550 U.S. at 416). These legal precedents support concluding that the substitution of a phosphor in place of a fluorescent material in

Nichia-341 would not have been well within the level of ordinary skill in the art, in that the sole difference would have been the specific chemical composition of the particles selected. Ex. 1007 (Doolittle Decl.) ¶105.

"[c] a reflecting cup comprising reflective sidewalls, said die being located in said cup such that a portion of said light generated by said die is reflected from said cup, said layer of phosphor particles covering a portion of said reflective sidewalls"

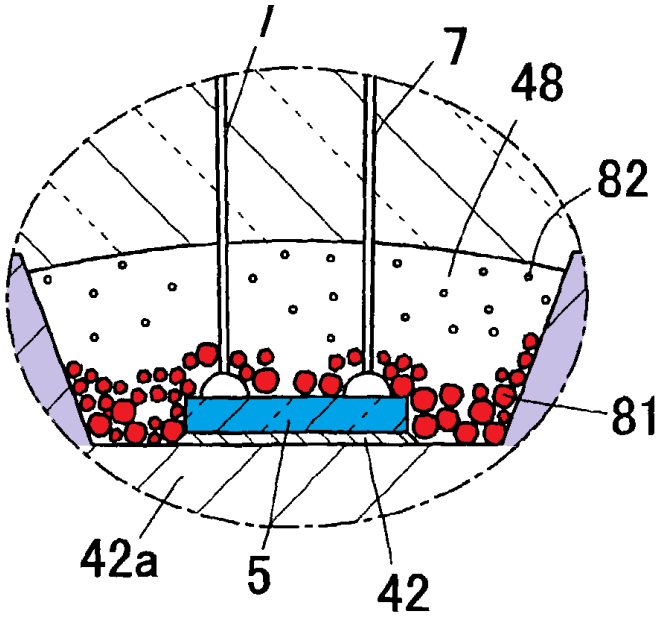
Nichia-341 discloses a reflecting cup comprising reflective sidewalls, with the die being located in the cup such that a portion of said light generated by the die is reflected from the cup, the layer of phosphor particles covering a portion of the reflective sidewalls. Ex. 1015 (Nichia-341) at figs. 1, 10B; ¶162.

With respect to figure 1, the reflecting characteristic is disclosed in connection with the description of embodiment 1's manufacturing method, the final result of which is depicted in figure 1. Ex. 1015 (Nichia-341) ¶81-82 (describing embodiment 1 and figure 1); *id.* at ¶¶158-62 (describing the manufacturing method of embodiment 1). More specifically, the cup where the die (5) is mounted is labeled (1a) in figure 1 (reproduced to the right) and is also referred to as a through hole 101a. *Id.* at ¶161-62. The sidewalls of the cup (*i.e.*, 1a in figure



1 and 101a in figure 5) are described as reflective. *Id.* at ¶162 ("[w]hen the inner wall of the through hole (101a) is tapered, light emitted by the LED chip toward the inner wall can be reflected thereon and directed upward") (emphasis added) Ex. 1007 (Doolittle Decl.) ¶108. In addition, the particles (81) cover a portion of the sidewalls. *Id.* at Fig. 1. *Id.*

A similar description is provided with respect to figures 10A and 10B.[9] Ex. 1015 (Nichia-341) ¶270. In particular, Nichia-341 describes the location of LED chip (5) as within "the cup portion of the mount lead (42a) made of bright plated copper." *Id.* Bright plated copper is a description of a reflective material. *See* Ex. 1022 (U.S. Patent No. 7,402,232, filed Oct. 30, 2003) at 1:24-32 (explaining that "bright" in the context of plating means "becoming close to mirror surfaces"); Ex. 1023 (U.S. Patent App. 2003/0150735 filed Nov. 12,



[9] The differences between the embodiment depicted in figure 1 and figure 10A/B relate solely to the package type rather than the wavelength converting layer, which is a general aspect of the disclosed invention. Ex. 1007 (Doolittle Decl.) ¶106.

2002) at ¶3 (explaining that "bright" in reference to plating refers to the brightness of the metal."); Ex. 1007 (Doolittle Decl.) ¶109. And here again, the particles cover a portion of the sidewalls. *Id.* at Fig. 10B. *Id.*

2. Independent Claim 2

"2. A light emitting device comprising"

To the extent that the preamble of claim 2 is found to limit the claims, the language of the preamble is identical to the preamble of claim 1, and therefore the same analysis provided in Section IX.E.1. applies here. Ex. 1007 (Doolittle Decl.) ¶111.

"[a] a light source that generates light of a first wavelength"

The first element of claim 2 is identical to the first ten words of the first element of claim 1. The analysis of that portion of claim 1 as provided in Section IX.E.1., therefore, applies equally here. Ex. 1007 (Doolittle Decl.) ¶112.

"[b] a layer of phosphor particles covering said light source, said phosphor particles converting at least a portion of said light of said first wavelength to light of a second wavelength, said layer comprising a residue of a slurry of said phosphor particles in a volatile solvent, said residue comprising the portion of said slurry that remains when a portion of said volatile solvent is removed"

The disclosure and/or obviousness of a layer of phosphor particles covering the light source was addressed above with respect to element 1[b] above. That analysis is sufficient to establish anticipation under the proper construction as addressed in Section VI.C. above, which looks to the properties of the recited device

rather than its method of formation. Ex. 1007 (Doolittle Decl.) ¶113.

Further, even if the process recited in element 2[b] is narrowly interpreted to require a conformal layer that is substantially uniform in thickness (*i.e.*, the Alternative Physical Construction addressed in Section VI.C.) those physical requirements are also met by Nichia-341. The analysis of those physical properties is provided above with respect to the corresponding express recitations in claim 1, and therefore, no further analysis is necessary. Ex. 1007 (Doolittle Decl.) ¶113.

Finally, to the extent that the recited process is deemed relevant (which Petitioner disputes), anticipation by Nichia-341 is still met. In particular, the slurry in Nichia-341 comprises a mixture of solid particles in a light transmitting resin solution. Ex. 1015 (Nichia-341) ¶¶44, 136. Examples of the carrier solution include an epoxy resin and an acid anhydride. *Id.* at 136. Nichia-341 expressly recognizes that acid anhydrides have high volatility. *Id.* at ¶9; *see also id.* at ¶144; Ex. 1029 (U.S. Patent Pub. 2003/0132701 hereinafter "Nichia-701") ¶¶14, 45 (identifying four specific acid anhydrides identified in Nichia-341 as having "high volatility" – "hexahydrophthalic anhydride, methylhexahydrophthalic anhydride,

trialkyltetrahydrophthalic anhydride and hydrogenated methylnadic anhydride").[10] Nichia-341 recognizes that volatilization of the acid anhydride curing agents may occur. Ex. 1015 (Nichia-341) ¶42. By recognizing that the material is volatile, Nichia-341 recognizes that some portion of that material will evaporate during curing. That recognition is sufficient to establish disclosure and/or obviousness of the removal of a portion of a volatile solvent. Ex. 1007 (Doolittle Decl.) ¶116.

In addition, Nichia-341 describes other volatile solvents that may be added to the slurry before the curing process, including, for example, ethylene glycol and propylene glycol. Ex. 1015 (Nichia-341) ¶47; *see also* Ex. 1025 (https://pubchem.ncbi.nlm.nih.gov/compound/1030) (identifying propylene glycol as a solvent and identifying its vapor pressure, *i.e.*, its volatility); Ex. 1026 (https://pubchem.ncbi.nlm.nih.gov/compound/174) (identifying ethylene glycol as a solvent and identifying its vapor pressure, *i.e.*, its volatility); Ex. 1027 (https://www.lyondellbasell.com/globalassets/documents/chemicals-technical-literature/lyondellbasell-chemicals-technicalliterature-vapor-pressure-of-aqueous-

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[10] As explained by Professor Doolittle, the term "high volatility" does not refer to "unstable" or "explosive" materials, but instead refers to the tendency to evaporate, *i.e.*, have a high vapor pressure, under the relevant conditions. Ex. 1007 (Doolittle Decl.) ¶102.

propylene-glycol-solutions-2518.pdf) (identifying the high vapor pressure – ~200 mm Hg (Torr) – of propelene glycol at 150°C); Ex. 1028 (https://www.meglobal.biz/wp-content/uploads/2019/01/Monoethylene-Glycol-MEG-Technical-Product-Brochure-PDF.pdf) (identifying the high vapor pressure – ~152 mm Hg (Torr) – of ethylene glycol at 150°C). Ex. 1007 (Doolittle Decl.) ¶117.

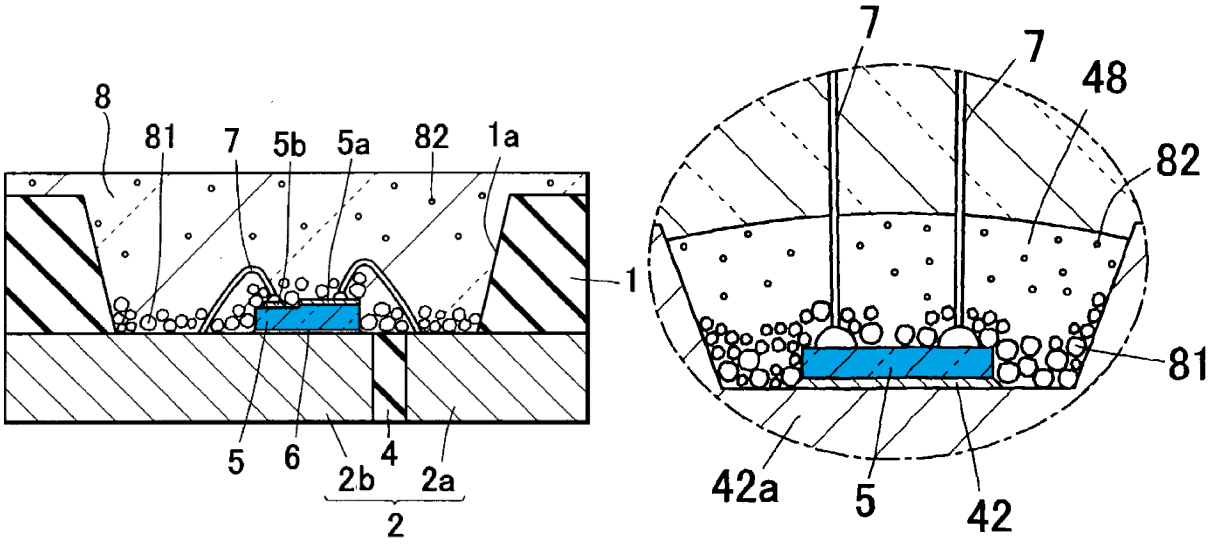
During curing, some portion of these volatile substances will evaporate. More specifically, the curing process includes the application of heat, which results in the formation of a solid residue. Ex. 1015 (Nichia-341) ¶155 ("the mixed solution is subjected to primary curing by heating at 80 to 100° C. for 2 to 4 hours and then subjected to secondary curing by heating at 140 to 150° C. for 2 to 4 hours"). Because the curing process occurs during an hours-long process of applying heat, some portion of the volatile solvents will necessarily evaporate during one or both of the curing phases. The claim recitation directed to removal of a portion of the volatile solvent, therefore, is met by Nichia-341. Ex. 1007 (Doolittle Decl.) ¶117.

3. Dependent Claim 3

"3. The light emitting device of claim 2 wherein said light source comprises an LED"

The additional requirement that the light emitting device of claim 2 is an LED is also expressly met by Nichia-341. In particular, figures 1 and 10B of Nichia-341 are reproduced below, with the LED 5 colored blue. Ex. 1015 (Nichia-341) ¶82 ("A light emitting diode of the first embodiment is of surface mounted type (SMD)

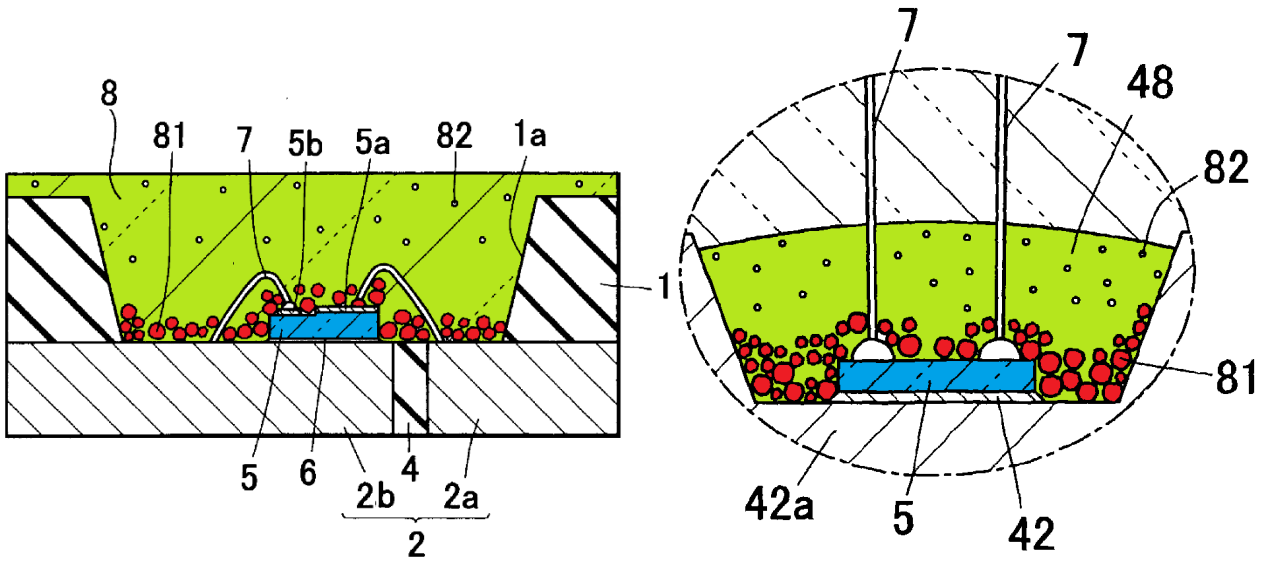
comprising a light emitting diode chip (LED chip) 5 sealed in a package"); Ex. 1007 (Doolittle Decl.) ¶118.



4. Dependent Claim 4

"4. The light emitting device of claim 2 further comprising a layer of clear material covering said layer of phosphor particles"

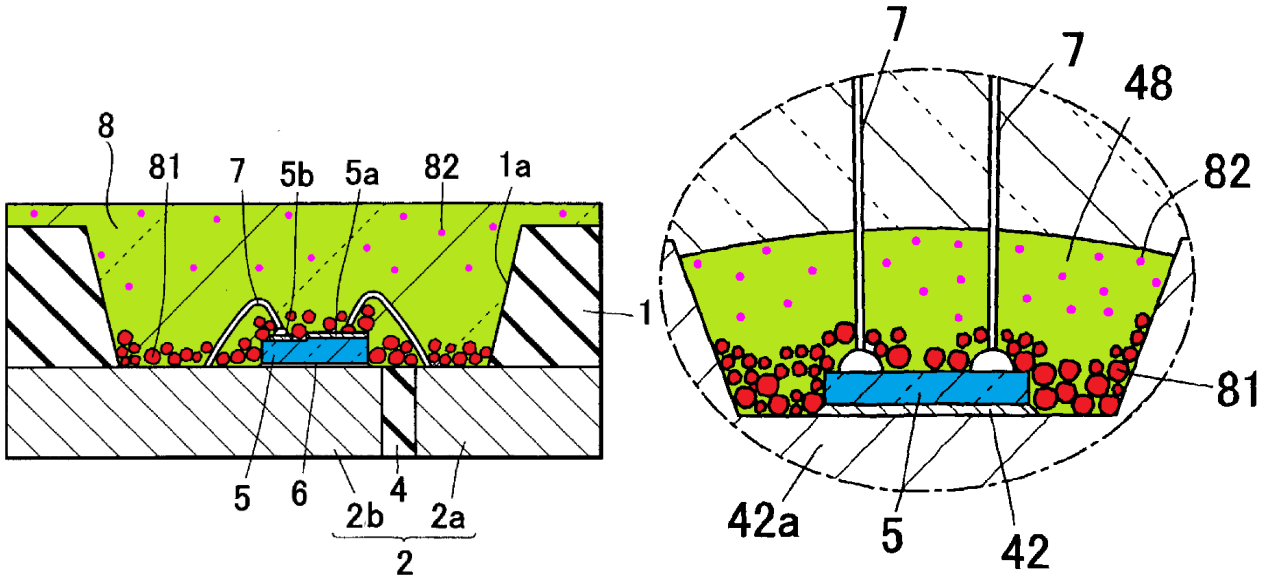
Nichia-341 also discloses a layer of clear material covering said layer of phosphor particles. The clear layer is called a "light transmitting resin 8" in figure 1 and is labeled 48 in figure 10B. The clear material, which is colored green in the versions of figures 1 and 10B below, is shown covering the phosphor particles 81. Ex. 1007 (Doolittle Decl.) ¶119.



5. Dependent Claim 5

> **"5. The light emitting device of claim 4 wherein said clear material further comprises a diffusing material for scattering light generated by said light source and said phosphor particles."**

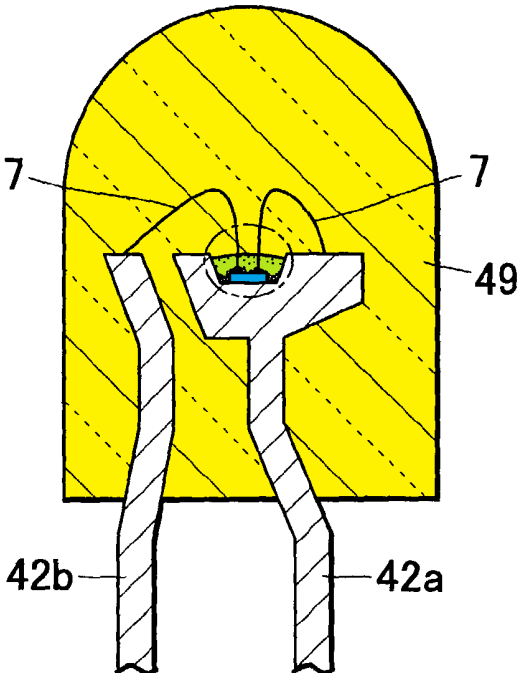
Nichia-341 discloses various diffusing agents 82 that may be added to the light transmitting resin provided over a light emitting diode to scatter light. Ex. 1015 (Nichia-341) ¶¶104-05; *see also id.* at ¶¶232-36. Nichia-341 further explains that a preferred diffusing agent "causes satisfactory random reflection of light emitted by the LED chip and the fluorescent material [*i.e.*, phosphor particles 81]." *Id.* at ¶235 (emphasis added). Ex. 1007 (Doolittle Decl.) ¶120. The diffusing agent particles 82, which are colored pink in versions of figures 1 and 10B below, are within the clear material 8 and 48 (colored green).



6. Dependent Claim 6

"6. The light emitting device of claim 5 further comprising a layer of transparent bulk encapsulating material over said layer of clear material."

Nichia-341 also discloses a layer of transparent bulk encapsulating material over said layer of clear material in at least the embodiment depicted in figures 10A/B. The bulk encapsulant in Nichia-341 is a transparent epoxy resin 49, which is colored yellow in the version of figure 10A provided below. Ex. 1015 (Nichia-341) ¶270. The bulk encapsulant is a layer of material over the clear material, which is again colored green. Ex. 1007 (Doolittle Decl.) ¶121.



7. Dependent Claim 7

> **"7. The light emitting device of claim 2 further comprising a reflecting cup comprising reflective sidewalls, a die located in said cup such that a portion of said light generated by said die is reflected from said cup, said layer of phosphor particles covering a portion of said reflective sidewalls"**

As discussed above in Section IX.A.5, the same analysis of the final element of claim 1 also applies here. Ex. 1007 (Doolittle Decl.) ¶122.

X. CONCLUSION

Substantial, new and noncumulative technical teachings have been presented for each of claims 1-7 of the '119 patent, which are unpatentable for the reasons set forth above. There is a reasonable likelihood that Petitioners will prevail as to each of the claims. *Inter Partes* Review of claims 1-7 is accordingly requested.

Dated: May 15, 2020

Respectfully submitted,

Holland & Knight LLP

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CERTIFICATE OF SERVICE

The undersigned certifies that a complete copy of this Petition for *Inter Partes* Review of U.S. Patent No. 7,315,119, including any exhibits and other documents filed together with this Petition were served upon the attorney of record for the patent at the following email delivery addresses:

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CERTIFICATE OF COMPLIANCE WITH 37 C.F.R. § 42.24

I hereby certify that this Petition complies with the word count limitation of 37 C.F.R. § 42.24(a)(1)(i) because the Petition contains 13,615 words, excluding the cover page and the parts of the Petition exempted by 37 C.F.R. § 42.24(a)(1).

Date: May 15, 2020

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