

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Nichia Corp.,
Petitioner

v.

BX LED LLC,
Patent Owner

Case No. IPR2024-00544
Patent No. 7,973,465

DECLARATION OF NAN MARIE JOKERST, PHD

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I. ENGAGEMENT AND COMPENSATION

1. My name is Nan Marie Jokerst, PhD. I have been retained by Nichia Corp. (“Petitioner”) for the purpose of providing my opinion with respect to the patentability of claims 1-12 of U.S. Patent No. 7,973,465 (the “’465 Patent”).

2. I am being compensated for my time in preparing this declaration at my standard hourly rate, and my compensation is not dependent upon my opinions or the outcome of the proceedings. I have no stake in the outcome of this proceeding.

3. I am not an employee of Petitioner or any affiliate or subsidiary thereof.

4. This declaration summarizes the opinions I have formed to date. I reserve the right to modify my opinions, if necessary, based on further review and analysis of information that I receive subsequent to the filing of this declaration, including in response to positions that parties to the *inter partes* review proceeding, or their experts, may take that I have not yet seen.

II. QUALIFICATIONS

5. I have summarized in this section my educational background, career, publications, and other relevant qualifications. My full curriculum vitae is provided as Exhibit 1004, which I incorporate into this declaration by reference.

6. I am currently the J. A. Jones Distinguished Professor of Electrical and Computer Engineering at Duke University, and the Executive Director of the Duke University Shared Materials Instrumentation Facility, which includes the Duke

University Cleanroom and Materials Characterization infrastructure. I completed a six-year appointment as the Associate Dean for Faculty Affairs and Community Engagement in the Pratt School of Engineering at Duke University in June, 2023. I received my B.S. in Physics from Creighton University in 1982, and my M.S. and Ph.D. degrees in Electrical Engineering from the University of Southern California in 1984 and 1989, respectively.

7. I am a Fellow of the Institute of Electrical and Electronics Engineers (IEEE), a Fellow of the Optical Society of America (OSA), and I received an IEEE Third Millennium Medal in 2000.

8. I served on the U.S. National Academies Board on Global Science and Technology from 2010-2014, and I have served the IEEE Photonics Society as the Vice President for Technical Affairs, the Vice President for Conferences, and as an elected member of the Board of Directors. I also served the Atlanta IEEE Section as the Chair, Vice Chair, Treasurer, and Secretary over a four-year timespan. I was a member of the Editorial Board of IEEE Proceedings from 2016-2018. I served the OSA as the Chair of the Engineering Council, and I am currently an Associate Editor of *Optica*. I was awarded a National Science Foundation Presidential Young Investigator Award in 1990, a DuPont Young Professor Award in 1989, a Newport Research Award in 1986, and a Hewlett Packard Fellowship in 1983. I received the University of Southern California Alumni in Academia award from the Viterbi

School of Engineering in their 100th anniversary year, 2006. From 2015 through 2017 I served as the Chair of the Duke Academic Council, which is the Duke faculty senate.

9. I have served on the Duke University Electrical and Computing Engineering faculty as a full tenured Professor for 21 years (since 2003) after 14 years on the Electrical and Computer Engineering faculty at the Georgia Institute of Technology, where my ultimate rank was that of the Joseph Pettit Chaired Distinguished Professor of Electrical and Computer Engineering. A significant amount of my effort at Georgia Tech involved leadership and research in the National Science Foundation (NSF) funded Engineering Research Center at Georgia Tech: the Packaging Research Center. This Center was funded for 11 years by NSF for \$35M and involved over 30 faculty researchers and their research groups. I served as the co-Leader of the Optoelectronics and High Speed Electronics Thrust Area of the Packaging Research Center. In that role, I supervised multiple faculty researchers and led significant efforts in the integration and advanced packaging of optoelectronic devices, with support from companies that included Intel, Panasonic-Matsushita, Broadcom, National Semiconductor, Hitachi Chemical, Kyocera, and Sony. For two years of the 9 years, I served as the Research Director of the entire Packaging Research Center. When I joined the Duke faculty in 2003, I supervised the design and upfit of Duke's new Shared Materials Instrumentation Facility

(SMIF), a shared facility that has Duke, local, regional, and international users. SMIF is part of the Research Triangle Nanotechnology Network (RTNN), a partnership that I developed with North Carolina State University and the University of North Carolina at Chapel Hill, which is one of 16 sites funded by the National Science Foundation to serve as national resources for research, education, workforce development, and outreach in nanotechnology.

10. My research work has focused on the design, simulation, fabrication, integration, packaging, and application of semiconductor optoelectronic devices and waveguide devices for integrated fiber and planar optical interconnect systems, medical diagnostic systems, “smart pixel” systems, and chip scale integrated sensors and systems. I hold 7 patents and have authored over 295 peer reviewed journal and conference publications. Much of my research, many of my published papers, my IEEE Fellow and my OSA Fellow citations, and the majority of my patents are in the field of optical devices and integrated optoelectronic devices. I have consulted for the design and commercialization of optical and optoelectronic telecommunication and interconnection products with companies that include Cypress Semiconductor and Broadcom, as well as performed technology evaluations for Windermere and the American Society for the Advancement of Science (AAAS). My research has been supported by companies that include BellSouth, Ford, Intel, Sony, Panasonic-Matsushita, Kyocera, National Semiconductor, Hitachi Chemical,

Ford Visteon, and Delco, as well as government agencies that include the Defense Advanced Research Projects Agency (DARPA), the Army Research Office, the Office of Naval Research, the Naval Air Warfare Center, the Air Force Office of Scientific Research, the National Institutes of Health, and the National Science Foundation.

11. In addition to my research awards, I have also been recognized for my teaching accomplishments, which include the award for Best Teacher in Electrical Engineering at Georgia Tech in 1990, and the IEEE Education Society/Hewlett Packard Harriet B. Rigas Medal in 2002. I am a co-author of the three-volume book set “Microelectronics Packaging Handbook,” and I am an internationally recognized expert and speaker in optics, photonics, and integration/packaging. I have served on and Chaired review panels for organizations that include the Army Research Office in 2017 and the Scientific Foundation of Ireland in 2015 and 2017, as well as serving as a plenary speaker initiating the new Indian Institute of Technology Nanotechnology Center in Mandi, India in 2018. My undergraduate and graduate classes focus on optics and photonics, optoelectronic devices, and optical systems, as well as First Year Design and Senior Capstone Design courses. These classes contain both theoretical groundwork as well as practical, hands-on design/build/operate content. I also created and originated the massively online

Coursera course “Nanotechnology: A Maker’s Course,” which has had over 40,000 active learners since its release.

12. As a researcher, teacher, and consultant in the area of optoelectronic devices and integration/packaging, I am intimately familiar with the hardware technology associated with LEDs and LED packaging. I have personally led the design, fabrication, testing, and publication of original research in the area of optoelectronic devices that include LEDs, lasers, and photodetectors for applications such as transceivers, optical interconnections, and medical instruments. Through my research and leadership in the NSF-funded Packaging Research Center, I focused on many key challenges facing integrated electronic and optoelectronic systems, including thermal management. My activities in the Packaging Research Center focused on the packaging and integration of optoelectronic devices, however, as a co-Leader of the Center I followed all aspects of the Center research, and during my time as Research Director, I had oversight over the research activities of the entire Center, including the thermal management work, which was located in the Assembly, Reliability, and Thermal Management or “ART” research group. Thus, while I have not personally published in the field of thermal management, I am knowledgeable in that technology area.

III. SUMMARY OF OPINIONS

13. In my opinion, a person of ordinary skill in the art (“POSA” or “POSITA”) would have found the subject matter of claims 1-12 of the ’465 Patent (Ex. 1001), to be anticipated and/or obvious in view of the following prior art:

- **Ground 1:** Japanese Patent App. Pub. No. 2005-57089A to Shoji (“Shoji”; Ex. 1005) anticipates claims 1-5 and 7-11;
- **Ground 2:** Shoji (Ex. 1005) alone or in view of U.S. Patent App. Pub. No. 2006/0022211 to Yatsuda *et al.* (“Yatsuda”; Ex. 1008) renders claims 2 and 4-12 obvious;
- **Ground 3:** Yatsuda (Ex. 1008) renders claims 1 and 3-6 obvious;
- **Ground 4:** U.S. Patent App. Pub. No. 2011/0006668 to Hussell *et al.* (“Hussell”; Ex. 1006) anticipates claims 1 and 3-5;
- **Ground 5:** Hussell (Ex. 1006) renders claims 2 and 6-12 obvious;
- **Ground 6:** U.S. Patent App. Pub. No. 2005/0224830 to Blonder *et al.* (“Blonder”; Ex. 1010) renders claims 1-5 and 7-11 obvious;
- **Ground 7:** Blonder (Ex. 1010) alone or in view of Yatsuda (Ex. 1008) renders claims 6 and 12 obvious;
- **Ground 8:** U.S. Patent App. Pub. No. 2007/0287208 to Thompson *et al.* (“Thompson”; Ex. 1009) anticipates claims 1-3 and 7-9; and
- **Ground 9:** Thompson (Ex. 1009) alone or in view of Yatsuda (Ex. 1008) and/or U.S. Patent App. Pub. No. 2008/0037252 to Nii *et al.* (“Nii”; Ex. 1026) renders claims 1-12 obvious.

IV. MATERIALS REVIEWED

14. In forming my opinions, I have relied on my knowledge of the field and my experience, and have specifically reviewed the following exhibits:

Ex. No.	Description	Abbreviation
1001	U.S. Patent No. 7,973,465	'465 Patent
1002	File History of U.S. Patent No. 7,973,465	
1005	Japanese Patent App. Pub. No. 2005-57089A to Shoji (with certified translation)	Shoji
1006	U.S. Patent App. Pub. No. 2011/0006668 to Hussell <i>et al.</i>	Hussell
1007	U.S. Patent App. Pub. No. 2008/0179611 to Chitnis <i>et al.</i>	Chitnis
1008	U.S. Patent App. Pub. No. 2006/0022211 to Yatsuda <i>et al.</i>	Yatsuda
1009	U.S. Patent App. Pub. No. 2007/0287208 to Thompson <i>et al.</i>	Thompson
1010	U.S. Patent App. Pub. No. 2005/0224830 to Blonder <i>et al.</i>	Blonder
1011	U.S. Patent No. 8,004,172 to Hussell <i>et al.</i>	Hussell172
1012	U.S. Patent No. 6,949,772 to Shimizu <i>et al.</i>	Shimizu772
1013	U.S. Patent App. Pub. No. 2008/0055901 to Sanpei <i>et al.</i>	Sanpei
1014	Schubert, F., <u>Light Emitting Diodes</u> , Cambridge Univ. Press (2006) (excerpt)	Schubert
1015	Tummala, Rao R., <u>Microelectronics Packaging Handbook</u> , Van Nostrand Reinhold (1989) (excerpt)	Tummala
1016	U.S. Patent App. Pub. No. 2005/0174753 to Cao <i>et al.</i>	Cao
1017	Patent Owner's Responsive Claim Construction Brief, Dkt. 28, dated Feb. 17, 2023, in <i>BX LED LLC v. Walmart Inc.</i> , No. 6:22-cv-00445 (W.D. Tex.) (excerpt)	
1018	Patent Owner's Sur-Reply Claim Construction Brief, Dkt. 32, dated Mar. 24, 2023, in <i>BX LED LLC v. Walmart Inc.</i> , No. 6:22-cv-00445 (W.D. Tex.) (excerpt)	
1019	Notice of Resolution of Claim Construction Dispute, Dkt. 39, dated Apr. 28, 2023, in <i>BX LED LLC v. Walmart Inc.</i> , No. 6:22-cv-00445 (W.D. Tex.)	

Ex. No.	Description	Abbreviation
1020	Declaration of John K. Roberts in Support of Patent Owner's Responsive Claim Construction Brief, Dkt. 28-1, dated Feb. 17, 2023, in <i>BX LED LLC v. Walmart Inc.</i> , No. 6:22-cv-00445 (W.D. Tex.) (excerpt)	
1021	Amended Claim Construction Order, Dkt. 43, dated May 3, 2023, in <i>BX LED LLC v. Walmart Inc.</i> , No. 6:22-cv-00445 (W.D. Tex.)	
1022	Sergent, Jeremy, <u>Thermal Management Handbook for Electronic Assemblies</u> , McGraw-Hill (1998) (excerpt)	Sergent
1023	Suryanarayana, C., <u>X-Ray Diffraction, A Practical Approach</u> , Plenum Press (1998) (excerpt)	Suryanarayana
1024	<u>McGraw-Hill Dictionary of Scientific and Technical Terms</u> , 6th Ed., McGraw-Hill (2003) (excerpt)	
1025	U.S. Patent App. Pub. No. 2005/0212008 to Miyoshi	Miyoshi
1026	U.S. Patent App. Pub. No. 2008/0037252 to Nii <i>et al.</i>	Nii
1027	Chung, Yip-Wah, <u>Introduction to Materials Science and Engineering</u> , CRC Press (2007) (excerpt)	Chung
1028	U.S. Patent App. Pub. No. 2004/0104391 to Maeda <i>et al.</i>	Maeda
1029	U.S. Patent App. Pub. No. 2006/0105485 to Basin <i>et al.</i>	Basin
1030	U.S. Patent App. Pub. No. 2007/0075325 to Baek <i>et al.</i>	Baek
1031	U.S. Patent No. 5,998,925 to Shimizu <i>et al.</i>	Shimizu925

V. UNDERSTANDING OF THE RELEVANT LAW

A. Anticipation

15. I have been informed and understand that a patent claim is anticipated when a single piece of prior art describes every element of the claimed invention, arranged in the same way as in the claim, either expressly or inherently. I have been told to consider elements to be inherently described only if they are necessarily present in the piece of prior art.

B. Obviousness

16. I have been informed and understand that a patent claim is unpatentable and invalid if the subject matter of the claim as a whole would have been obvious to a person of ordinary skill in the art in the field of the patent as of the time of the invention at issue.¹ I have been informed and understand that the following factors must be evaluated to determine whether the claimed subject matter is obvious: (i) the scope and content of the prior art; (ii) the difference or differences, if any, between each claim of the patent and the prior art; (iii) the level of ordinary skill in the art at the time the patent was filed; and (iv) any objective indicia of non-obviousness.

17. I have been informed and understand that the objective indicia of non-obviousness (or “secondary considerations”) that should be considered include, for example, the following: (i) commercial success; (ii) long-felt but unresolved needs; (iii) copying of the invention by others in the field; (iv) initial expressions of disbelief by experts in the field; (v) failure of others to solve the problem that the inventor solved; and (vi) unexpected results. I have been informed and understand that evidence of these objective indicia must be commensurate in scope with the

¹ As I discuss in Section VI, below, I use the shorthand “POSA” (or “POSITA”) to describe this person.

claimed subject matter. I am not aware of any objective indicia of non-obviousness relevant to the claims of the '465 Patent.

18. I have been informed and understand that independently made, simultaneous inventions, made within a comparatively short space of time, are evidence that the claimed apparatus was the product only of ordinary mechanical or engineering skill.

19. In determining whether the subject matter as a whole would have been obvious at the time that the invention was made to a person having ordinary skill in the art, I have been informed of and understand certain principles regarding the combination of elements of the prior art. A combination of familiar elements according to known methods is likely to be obvious when it yields predictable results. Also, if a person of ordinary skill in the art can implement a predictable variation in a prior art device, and would see the benefit from doing so, such a variation would be obvious. In particular, when there is pressure to solve a problem and there are a finite number of identifiable, predictable solutions, it would be reasonable for a person of ordinary skill to pursue those options that fall within his or her technical grasp. If such a process leads to the claimed invention, then the latter is not a patentable invention, but the result of ordinary skill and common sense.

20. I have also been informed and understand that a teaching, suggestion or motivation is a useful guide in establishing a rationale for combining elements of the

prior art. The test poses the question as to whether there is an explicit teaching, suggestion, or motivation in the prior art to combine prior art elements in a way that realizes the claimed invention. Though useful to the obviousness inquiry, I understand that this test should not be treated as a rigid rule. It is not necessary to seek out precise teachings; it is permissible to consider the inferences and creative steps that a person of ordinary skill in the art (who is considered to have an ordinary level of creativity and is not an automaton) would employ.

C. Claim Construction

21. I have been informed and understand that the United States Patent and Trademark Office interprets claim terms in an *inter partes* review proceeding under the same claim construction standard that is used in a United States federal court. I have been informed and understand that under this standard, the meaning of claim terms is considered from the viewpoint of one of ordinary skill in the art at the time of the invention.

22. I have been informed and understand that claim terms are generally given their plain and ordinary meaning as understood by one of ordinary skill in the art in light of the specification and the prosecution history pertaining to the patent. I have been informed and understand, however, that claim terms are generally not limited by the embodiments described in the specification.

23. I have been informed and understand that in addition to the claims, specification, and prosecution history, other evidence may be considered to ascertain the meaning of claim terms, including textbooks, encyclopedias, articles, and dictionaries. I have been informed and understand that this other evidence is often less significant and less reliable than the claims, specification, and prosecution history.

VI. LEVEL OF ORDINARY SKILL IN THE ART

24. I have been informed and understand that the disclosure of patents and prior art references are to be viewed from the perspective of a person having ordinary skill in the art at the time of the alleged invention. I use the shorthand “POSA” (or “POSITA”) to describe this person. I have provided my opinions from this perspective. I understand that the relevant time period is around November 2009, the filing date of the application to which the ’465 Patent claims priority.

25. I have been informed and understand that prior art references can provide evidence of the level of ordinary skill in the art, and that factors that may be considered in determining this level of skill can include the educational level of the inventors and active workers in the field, the types of problems encountered in the art, the prior art solutions to those problems, the rapidity with which innovations are made, and the sophistication of the technology.

26. Based on my education and experience, as described above and in my CV, as well as consistent with the '465 Patent and the prior art described below, it is my opinion that those of ordinary skill in the art during the relevant period would have had at least a bachelor's degree in electrical engineering, materials science, or a related field, and three years' experience in the field of LED package design. However, I note that this description is approximate, and a higher level of education or skill might make up for less experience, and additional experience could make up for a lower education level.

27. Given my experience in the field, I am familiar with the knowledge that a person of ordinary skill in the art would have had at the time and how such a person would have viewed the available information at the time. My testimony is offered from this perspective, even if it does not specifically refer to the perspective of a person of ordinary skill in the art in every instance.

VII. OVERVIEW OF THE '465 PATENT

28. The '465 Patent "relates to light emitting diodes with a thin phosphor layer." Ex. 1001 at 1:16-17.

29. The '465 Patent provides a "Background" section. Ex. 1001 at 1:18-51.

30. According to the "Background" of the '465 Patent:

Solid state devices, such as light emitting diodes (LED)s, are attractive candidates for replacing conventional light sources such as incandescent and fluorescent lamps. LEDs have substantially higher light conversion efficiencies than

incandescent lamps and longer lifetimes than both types of conventional light sources. In addition, some types of LEDs now have higher conversion efficiencies than fluorescent light sources and still higher conversion efficiencies have been demonstrated in the laboratory. Finally, LEDs require lower voltages than fluorescent lamps, and therefore, provide various power saving benefits.

LEDs produce light in a relatively narrow spectrum. To replace conventional lighting systems, LED-based sources that produce broad-spectrum (e.g., white) light are needed. One way to produce white light is to encapsulate blue or ultra-violet (UV) LEDs in a phosphor material. The phosphor material converts monochromatic light emitted from the blue or UV LEDs to white light.

Ex. 1001 at 1:19-36.

31. The '465 Patent further states, in its "Background" section, that "The phosphor material is generally formed by introducing a suspension of phosphor particles into a carrier (e.g., silicone), encapsulating the LEDs in the carrier, and curing the carrier to provide a solid layer of material in which the phosphor particles will remain suspended." Ex. 1001 at 1:37-41.

32. The '465 Patent states this leads to certain problems:

Unfortunately, silicone is a poor thermal conductor, and when illuminated, phosphors generate heat. Thus, when a phosphor-coated LED with a cured silicone carrier is used in a high-power application, the cured silicone may crack and/or have a reduced lifetime.

This property limits their use in high power LED applications which use temperature sensitive phosphor. Further, cracks in the phosphor and silicone composition reduce the efficiency of the device.

Ex. 1001 at 1:41-49.

33. Thus, according to the '465 Patent, "there is a need in the art for simplified and improved processes for applying a phosphor material to LEDs and other solid state lighting devices." Ex. 1001 at 1:49-51.

34. The '465 Patent provides four "aspects of the disclosure":

In one aspect of the disclosure, a method of manufacturing a film includes dispensing a mixture including phosphor and an uncurable fluid onto a surface, and at least partially drying the mixture. A curable fluid is dispensed onto the at least partially dried mixture, and the curable fluid is cured.

In another aspect of the disclosure, an article of manufacture is prepared by a process including dispensing a mixture including phosphor and an uncurable fluid onto a surface, and at least partially drying the mixture. A curable fluid is dispensed onto the at least partially dried mixture, and the curable fluid is cured.

In yet another aspect of the disclosure, an apparatus includes a phosphor bearing film including phosphor and a carrier, and a rigid film on the phosphor bearing film. The phosphor bearing film is 60%-80% phosphor.

In yet another aspect of the disclosure, an apparatus includes a phosphor bearing film including phosphor and an uncurable silicone carrier, and a cured silicone film on the phosphor bearing film. The cured silicone film is substantially free of phosphor.

Ex. 1001 at 1:55-2:7.

35. The '465 Patent includes figures, Figures 1-3. Figures 1 and 2 are flow charts; Figure 3 "is a schematic illustration showing a cross section of a light emitting device." Ex. 1001 at 2:26-31.

36. In my declaration, for ease of reference, coloring has been added to certain figures to highlight certain elements (*i.e.*, the figures in the patent are all black-and-white, and so any coloring in the figures in my declaration has been added to the figures from the patent), with the exception of coloring that was already present in a figure; these exceptions are identified through footnotes herein.

37. Figure 3, below, “is a schematic illustration showing a cross section of a light emitting device.” Ex. 1001 at 2:30-31. In Figure 3, “A **light emitting diode 301** is coated with a film including a **phosphor bearing layer 302** and a **rigid layer 303**.” Ex. 1001 at 6:12-15 (color added). “The **light emitting diode** may be a semiconductor device or any other suitable device for emitting light.” Ex. 1001 at 6:15-17 (color added). “The **phosphor bearing layer 302** may include a high concentration of phosphor (e.g., from 60% to 80% phosphor), and may include treated silica and an uncureable fluid such as uncureable silicone.” Ex. 1001 at 6:17-20 (color added). “The **rigid layer 303** may be a silicone material that has been subjected to a curing process such that it provides a mechanical protective layer over the phosphor bearing layer 302”, and “In some embodiments, the **rigid silicone layer 303** is substantially free of phosphor, by virtue of it having been deposited after at least partially drying the **phosphor bearing layer 302**.” Ex. 1001 at 6:24-30 (color added).

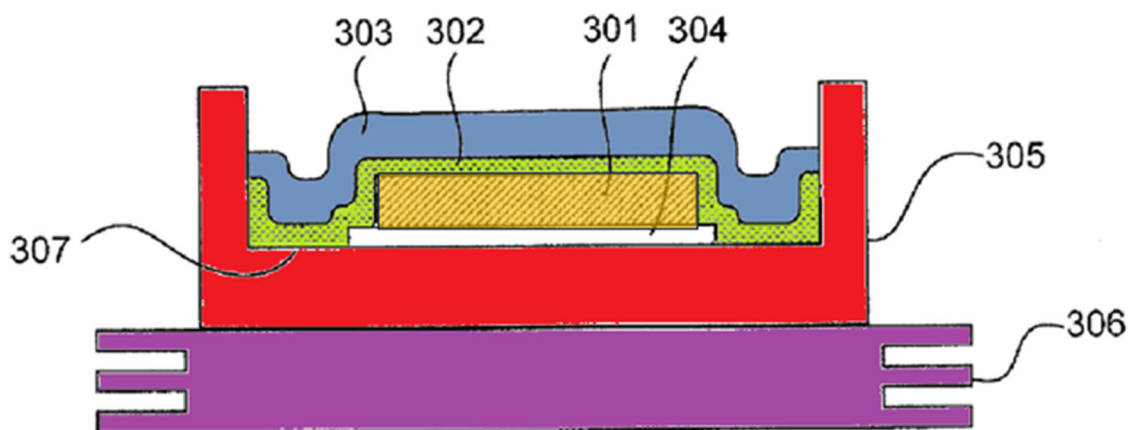


FIGURE 3

Ex. 1001, FIG. 3 (coloring added to figure).

38. “The **LED 301** may be attached to a **package 305** utilizing an adhesive 304.” Ex. 1001 at 6:31-32 (color added). “The **package 305** may be any suitable material for potting or enclosing the light emitting device”, and “In some embodiments, the **package 305** is a metallic material, that is, any material with metal-like properties including a high thermal conductivity, thus enabling the dissipation of heat from the device to a **heat sink 306**.” Ex. 1001 at 6:33-39 (color added). “The **heat sink 306** may be a thermally conductive apparatus for transferring heat from the light emitting device to the environment.” Ex. 1001 at 6:39-41 (color added).

39. I have also reviewed the file history (Ex. 1002) for the application leading to the '465 Patent. I note that during prosecution, the applicant stated the following regarding "carrier":

The Examiner has rejected claims 1-7 under 35 U.S.C. § 112, second paragraph, as allegedly being indefinite for failing to particularly point out and distinctly claim the subject matter which the Applicant regards as the invention. The Examiner states that in claim 1, line 2, it is not clear as to what exactly is "carrier." Dependent claims are rejected as indefinite for the same reasons by dependency on claim 1. Applicants respectfully traverse.

The term "carrier" is adequately described in the specification, e.g., "silicone," "silicone carrier," "uncurable silicone carrier." Applicant respectfully submits that it is obvious to one of ordinary skill in the art from the context of the specification, and common language usage, that "carrier" is a medium for "carrying," a another substance, which in this case is, for example, phosphor (see ¶s [0005], [0009], [0010], [0024], [0025], [0030] of the specification as filed). Therefore, it is respectfully submitted that claims 1-7 are patentable under 35 U.S.C. 112, second paragraph.

Ex. 1002 at 52-53.

VIII. CLAIM CONSTRUCTION

40. In comparing the claims of the '465 Patent to the prior art, I have carefully considered the '465 Patent and its file history based upon my experience and knowledge in the relevant field (discussed in Section II above and in my CV (Ex. 1004)). As relevant to determining the patentability of the claims of the '465 Patent in this proceeding, the proper interpretation of the claim terms of the '465 Patent is consistent with the terms' plain and ordinary meaning in view of the evidence of record (including the intrinsic evidence of record, *i.e.*, the patent and file

history, as well as any extrinsic evidence), as a POSA would understand them, as of the time of the invention of the '465 Patent.

41. In my analysis of the prior art in comparison to the claims, I have at times explained how the prior art would anticipate or render obvious the relevant claims, regardless of the particular construction adopted (for example, related to the claim limitation “the phosphor bearing film is 60%-80% phosphor” in dependent claim 2, independent claim 7, and by dependency, dependent claims 8-12).

42. Although it does not impact my opinions on patentability, because the prior art discloses the limitations regardless of the construction, I discuss two terms that have been involved in prior claim construction (Exs. 1017-1021).

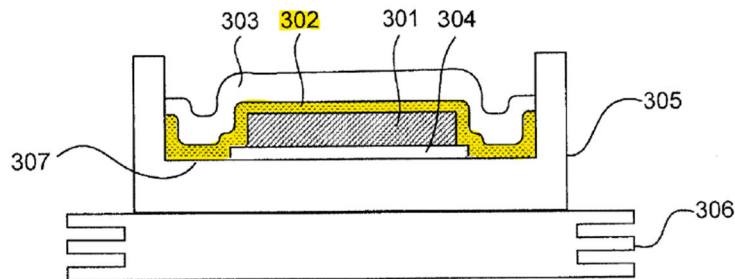
Term No. 1: “a phosphor bearing film arranged with the light emitting device”

43. During a district court case, the parties disputed the meaning of the claim limitation, “*a phosphor bearing film arranged with the light emitting device*”. The Patent Owner asserted that the claim limitation should be given its plain and ordinary meaning. Ex. 1017 at 9-14; Ex. 1018 at 6-8.

44. The district court agreed with the Patent Owner and found the term to have its plain and ordinary meaning. Ex. 1021 at 3.

45. I note that the Patent Owner and its expert stated that the “light emitting device” corresponded to LED 301 in Figure 3 of the '465 Patent:

The concept of how the phosphor bearing film is “arranged with the light emitting device” is adequately described in the intrinsic evidence and the ’465 Claims and specification provide reasonable certainty regarding its scope. Ex. A, “Roberts Declaration” ¶ 54). For example, as the specification shows in Figure 3 and its corresponding description, the phosphor bearing film 302 “coats” the LED and thus supports a POSITA’s reasonable understanding of the term and how the film is “arranged” with respect to the LED.



Ex. D, ’465 at Fig. 3; ’465 at 6:13-18 (“A light emitting diode 301 is **coated with a film including a phosphor bearing layer 302** and a rigid layer 303.”) (emphasis added). Moreover, the specification states that specifically with respect to the phosphor bearing film that “[v]arious modification to, and alternative configurations of, the multilayer bearing films presented throughout this disclosure will be readily apparent to those skilled in the art.” ’465 Patent at 6:50-54. Indeed, there are a number of possible arrangements that would have been known to a POSITA. Ex. A, “Roberts Declaration” at ¶¶ 52, 54.

Ex. 1017 at 12-13²; Ex. 1020 ¶¶52-54.

Term No. 2: “the phosphor bearing film is 60%-80% phosphor”

46. During a district court case, the parties disputed the meaning of the claim limitation, “*the phosphor bearing film is 60%-80% phosphor*”. The Patent Owner asserted that the claim limitation should be given its plain and ordinary

² Coloring in Figure 3 is original in Ex. 1017.

meaning, or “Alternatively, ‘the phosphor bearing film is 60%-80% phosphor *by weight*’”. Ex. 1017 at 14-15 (emphasis in original); Ex. 1018 at 8-9.

47. After briefing, the parties resolved their dispute and agreed that the plain and ordinary meaning applied. Ex. 1019 at 1. The district court then found the term to have its “Plain and Ordinary Meaning (as agreed to by the parties, see ECF No. 39 [Ex. 1019]).” Ex. 1021 at 4.

48. I note that the Patent Owner asserted that “by weight” was correct based on the ’465 Patent’s “detailed example” being in grams (which is the only example provided in the ’465 Patent):

Here, Walmart’s indefiniteness argument is based on a non-standard interpretation of how a POSITA would understand a percentage (i.e., concentration) of phosphor in the phosphor bearing film that is only supported by attorney argument and the unsupported opinion of its expert and not supported by any intrinsic evidence. Walmart and its expert do not argue that a POSITA would be unable to ascertain how a 60-80% concentration of phosphor could be determined in light of the specification. That is because the ’465 Patent provides a “detailed example” of combining the film’s components referencing the weight of each component. Ex. D, the ’465 Patent at 5:50-68. This is also consistent with how a POSITA would describe concentrations of phosphor in relation to the field of solid-state lighting. Ex. A, “Roberts Declaration” at ¶¶ 55-56.

Ex. 1017 at 14; Ex. 1020 ¶¶ 55-56; Ex. 1001 at 5:50-6:67³.

³ I note that the Patent Owner cited to 5:50-6:68 of the ’465 Patent. However, “68” appears to be a typo and it appears that it was intended to refer to line 67.

49. The Patent Owner also stated that, although “by weight” was correct, “the concentration 60-80% could be by either weight or volume, thus encompassing both ‘embodiments’ with definite boundaries”:

Contrary to Walmart’s foundational argument, this dispute is not about an “embodiment”, but its manufactured confusion over a unit of measure. The only method suggested by the intrinsic evidence (i.e., the units used in the specification) is by weight, which alone should resolve the alleged confusion. Notwithstanding, even if Walmart and Dr. Eden suggest, wrongly, that the ’465 Patent also encompasses an embodiment where the unit of measure is “by volume,” then the term *is still not indefinite* because, as Dr. Eden indisputably testifies, the concentration 60-80% could be by either weight or volume, thus encompassing both “embodiments” with definite boundaries. Consequently, Walmart has not met its clear and convincing burden to prove indefiniteness.

Ex. 1018 at 9.

50. I note that, while the ’465 Patent does not provide any units of measurement when discussing the “concentration” of phosphor, or the 60%-80% phosphor range, the only “example” provided in the ’465 Patent is in grams before the drying process. Ex. 1001 at 2:1-2, 4:4-12, 4:40-45, 5:50-67, 6:18-20.

51. Again, as I explain below in Section IX, the prior art discloses the claimed percentage, regardless of which interpretation is used (by weight or by volume).

IX. ANALYSIS OF THE PATENTABILITY OF THE '465 PATENT CLAIMS

A. Overview of the State of the Art

1. Technical Overview: LED Fundamentals

52. Light emitting diodes (“LEDs”) are typically made of semiconductor or organic materials (organic LEDs, or oLEDs). The following aspects of LEDs and LED packages are noteworthy and were known to a POSA:

- Efficient removal of heat from an LED - a known goal in LED packaging - could increase optical power output, package reliability and the lifetime of the LED, and efficient heat removal was often accomplished using highly thermally conductive LED package materials (like copper or aluminum nitride) as substrates and heat sinks. Ex. 1008 at [0033]; Ex. 1005 at [0033]-[0034]; Ex. 1010 at [0019], [0022]; Ex. 1012 at 2:26-29, 4:34-39, 8:43-9:8; Ex. 1014 at 192-193; Ex. 1016 at [0017], [0027]-[0028].
- LEDs could be used to emit light into phosphors (for example, doped yttrium aluminum garnet (“YAG”) phosphors) that convert some of the LED light into a different color that then combines with the LED color to create, for example, white light, *e.g.*, blue or ultraviolet (“UV”) LEDs were used with phosphor to create white light. Ex. 1005 at [0006]; Ex. 1006 at [0002], [0032], [0041]; Ex. 1007 at [0007], [0016], [0077], [0135]; Ex. 1008 at [0038]-[0040]; Ex. 1009 at [0061], [0063]; Ex. 1010 at [0002], [0009]; Ex. 1011 at 2:4-23; Ex. 1026 at [0128], [0135]; Ex. 1028 at Abstract, [0001]-[0002]; Ex. 1029 at [0052].
- Encapsulants (including, for example, cured silicone) were commonly and advantageously used to protect the LED and components within the package. Ex. 1005 at [0001]-[0002], [0012]; Ex. 1008 at [0034], [0041]; Ex. 1009 at [0008], [0016], [0019]-[0020]; Ex. 1026 at [0111]-[0112].
- Multi-layer encapsulants - with a first layer containing phosphor in a carrier (such as silicone) and a second layer (such as cured silicone without phosphor) - were commonly and advantageously used to, for

example: (i) protect the LED and components; (ii) seal and encapsulate the LED and components; (iii) create a lens to minimize total internal reflection; (iv) prevent adhesion of foreign matter or the like; (v) resist scratching or other types of physical defects; (vi) disperse light uniformly through the phosphor-containing layer without scattering loss or low efficacy; and (vii) improve the light extraction from the LED package and lengthen the service life of the LED package. Ex. 1005, [0001], [0003]-[0012]; Ex. 1008 at [0041]; Ex. 1009 at [0015]; Ex. 1010 at [0026], [0035]; Ex. 1026 at [0090]-[0091], [0112].

- The phosphor concentration in the carrier was variable, and could be adjusted to optimize application requirements, including luminance, desired color temperature, desired color, and film/layer thickness. Ex. 1005 at [0006]-[0007], [0020]; Ex. 1009 at [0008], [0054]; Ex. 1011 at 8:1-3.

2. Exemplary Prior Art

53. I have provided a brief overview in this Section of six prior art references: Shoji, Yatsuda, Hussell, Blonder, Thompson, and Nii. I discuss these (and other) references in more detail in Sections IX.B-J.

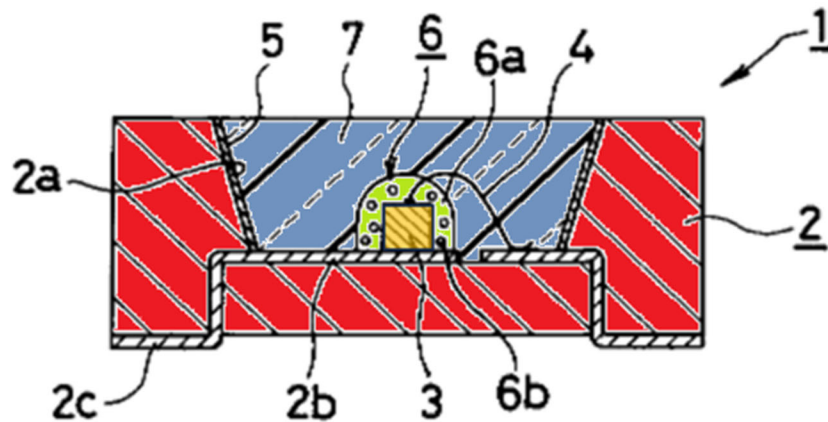
a. Shoji

54. Shoji, in its “Technical Field”, states that “The present invention pertains to LED lamps, and more particularly to the structure of a white LED in which a blue light emitting [chip] is adopted for the LED chip and, by dispersing a phosphor excited by the light from the LED chip to emit yellow light within a resin which covers the perimeter while also protecting the LED chip, obtains the emission of white light, being a mixture of blue and yellow, when illuminated.” Ex. 1005 at [0001] (alteration in original).

55. Shoji includes 11 figures, of which Figures 2 and 5 are particularly noteworthy.

56. Figure 2, below, shows a “cross section” of “white LED lamp 1” with **inner molding layer 6** that covers **LED chip 3** mounted in **package 2**, and **outer molding layer 7** that covers **inner molding layer 6** within the package recess. Ex. 1005 at [0008]-[0012], “Brief Description of Drawings”.

FIG. 2



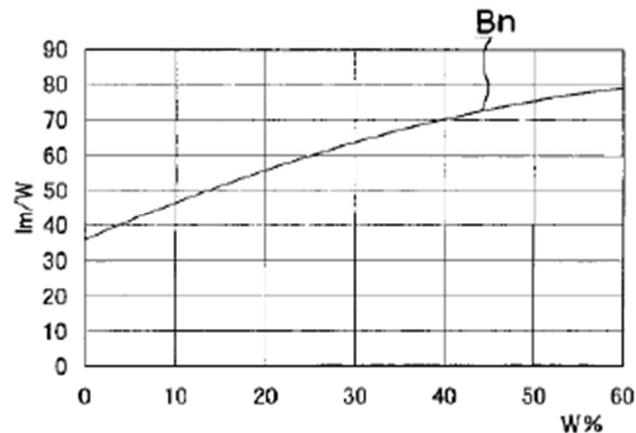
Ex. 1005, FIG. 2 (coloring added to figure).

57. More particularly, Shoji discloses in Figure 2, above, that “**inner molding layer 6** is formed by covering **LED chip 3** with a member in which a **phosphor 6b** is dispersed in a **transparent silicone resin 6a**.” Ex. 1005 at [0008]-[0010], [0020] (emphases added; color added). “After inner molding layer 6 is formed, it is heated to about 80°C, which is less than the curing temperature, to be temporarily cured, with reaction groups left in place.” Ex. 1005 at [0011]. Then,

“transparent silicone resin into which no phosphor 6b is added is then injected into the remaining portion of the chip housing recess 2a to form an **outer molding layer 7.**” Ex. 1005 at [0012] (emphasis added; color added). “The entire area is thereafter heated at a temperature of $\geq 80^{\circ}\text{C}$ to implement the *curing* process.” Ex. 1005 at [0012] (emphasis added). **Package 2** may be ceramic with a “reflector 5 [that] is formed on the side surface of chip housing recess 2a by a reflective treatment such as silver plating (vapor deposition).” Ex. 1005 at [0008]-[0009].

58. As seen in Figure 5, below, Shoji discloses that “the state in which the ratio of phosphor 6b, mixed and dispersed into transparent silicone resin 6a in the inner molding layer 6, is gradually increased by weight % is captured as the change in luminance; luminance improves as the percentage added increases, and at an approximately 60 (wt.%) addition the sum of the luminous flux emitted from the LED chip and the amount of wavelength-converted light from the phosphor reaches approximately 80 (lm/W), which is considered to be the maximum value.” Ex. 1005 at [0020].

FIG. 5



Ex. 1005, FIG. 5.

b. Yatsuda

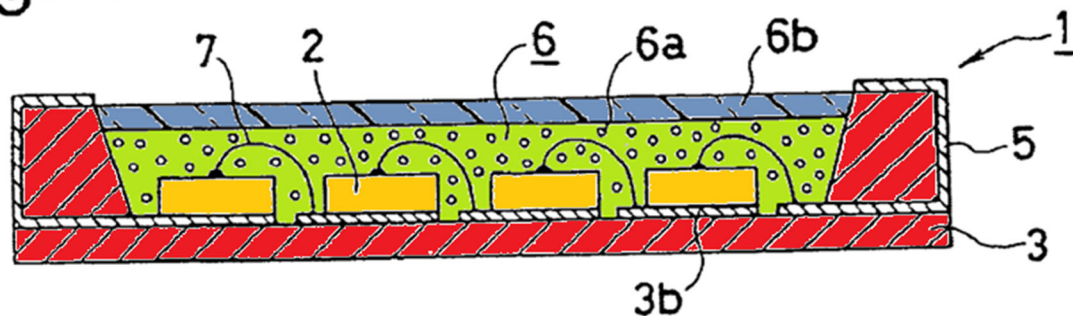
59. Yatsuda, in its “Field of the Invention” section, states: “The invention relates to an LED lamp. In particular, the invention relates to LED lamps for use in general applications, including vehicle lamps, street sign lamps, communication lamps, display lamps, etc. With regard to vehicle lamps, the invention relates to an LED lamp for a light source of a vehicle headlight which is used as an alternative to an incandescent lamp, a halogen lamp, or the like.” Ex. 1008 at [0003].

60. Yatsuda includes 10 figures, of which Figures 2-4 are particularly noteworthy.

61. In Figure 4, below, Yatsuda discloses “LED lamp 1” with **LED chips 2** mounted in a cavity of **base 3**, and “**transparent silicone resin 6**, into which a **phosphor 6a** is mixed to obtain white light”, which is covered by “**a film of a hard silicone resin 6b**.” Ex. 1008 at [0033]-[0034], [0041] (emphasis added; color

added). I note that paragraphs [0033]-[0034] of Yatsuda are discussing Figures 2 and 3, but Yatsuda explains (for example, at paragraph [0041]) that Figure 4 - which I note has similar numbering and structure to Figures 2 and 3 - is like Figure 3 except for the addition of hard silicone resin 6b.

Fig. 4



Ex. 1008, FIG. 4 (coloring added to figure).

62. Figures 2 and 3 have similar structures as Figure 4, with the main difference that Figure 4 has the additional hard silicone resin 6b. Ex. 1008 at [0033]-[0041].

63. I have similarly colored Figures 2 and 3, below:

Fig. 2

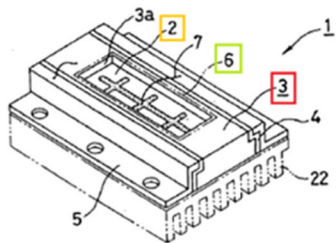
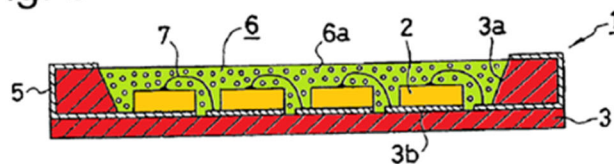


Fig. 3



Ex. 1008, FIGs. 2-3 (coloring added to figures).

64. According to Yatsuda, “In the LED lamp 1, an electric current can be applied to the LED chip 2 (as much as possible), to obtain as much amount of light as possible.” Ex. 1008 at [0033]. “Accordingly, in this case, the base 3 on which the LED chip 2 is mounted should be made of **a material being superior in heat conductivity, such as a metal like copper (refer to FIG. 2), a ceramic like AlN (aluminum nitride) (refer to FIG. 3), and the like.**” Ex. 1008 at [0033] (emphasis added). Yatsuda further discloses that “The thickness of the base 3 should be sufficient, if desired, for thermal diffusion after connecting with a **heat sink 22** in its rear surface.” Ex. 1008 at [0033] (emphasis added).

c. Hussell

65. Hussell discloses, in its Abstract:

A lighting structure may include a semiconductor light emitting device configured to generate light responsive to an electrical signal applied thereto. In addition, an encapsulating material may be configured to transmit light generated by the semiconductor light emitting device, and the encapsulating material may include yttrium aluminum garnet (YAG) diffuser particles and phosphor particles therein. More particularly, the yttrium aluminum garnet (YAG) diffuser particles and the phosphor particles may have different compositions.

Ex. 1006 at Abstract.

66. Hussell includes four figures, of which Figure 1B and Figure 3 are particularly noteworthy.

67. Hussell discloses that “Lighting structure 100*b* of FIG. 1B is the same as lighting structure 100*a* with the exception that phosphor particles 115 and non-luminescent phosphor host diffuser particles 111 are provided in separate layers of encapsulating material 109*a* and 109*b*. Further discussion of elements of FIG. 1B that have already been discussed with respect to FIG. 1A will [sic: be] omitted for the sake of conciseness. Instead, discussion relating to FIG. 1B will focus on elements thereof that are different than FIG. 1B [sic: FIG. 1A].” Ex. 1006 at [0033]. That is, the discussion regarding Figure 1A in Hussell applies to Figure 1B.

68. In Figure 1B, below, Hussell discloses **light emitting device 107** (also referred to as **LED 107**) mounted in the cavity of **substrate 103**. Ex. 1006 at [0029]-[0032], [0034]. Hussell discloses that a “**layer of encapsulating material 109*a*** may include *phosphor particles 115*, and **layer of encapsulating material 109*b*** may include non-luminescent phosphor host diffuser particles 111”, and the “**layer of encapsulating material 109*b*** may be *substantially free of phosphor particles 115*.” Ex. 1006 at [0034] (emphases added; color added). The layers may be silicone that have been “cured/hardened”. Ex. 1006 at [0034], [0039]. The “phosphor particles 115 may be luminescent cerium doped yttrium aluminum garnet (YAG:Ce) phosphor particles.” Ex. 1006 at [0026].

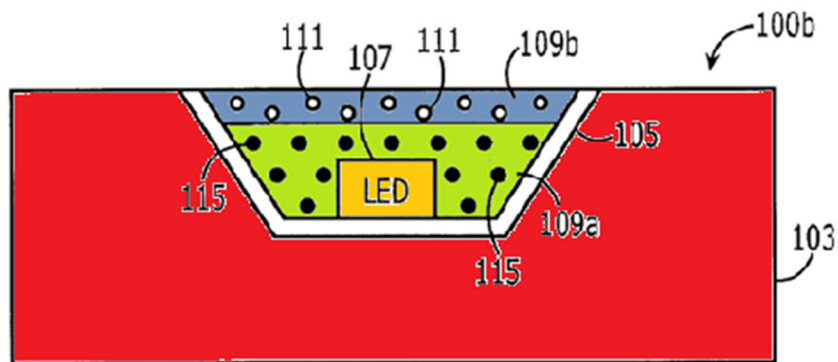


FIG. 1B

Ex. 1006, FIG. 1B (coloring added to figure).

69. Figure 3, below, shows **LED 307** mounted on **substrate 303**, with **encapsulating layer 309a** including phosphor particles 315 and **encapsulating layer 309b** being “substantially free of phosphor particles 315.” Ex. 1006 at [0044]. Figure 3 further shows **encapsulant layer 317** that “may be substantially free of both YAG diffuser particles and phosphor particles.” Ex. 1006 at [0044]. The layers can be silicone that have been “cured/hardened”. Ex. 1006 at [0046].

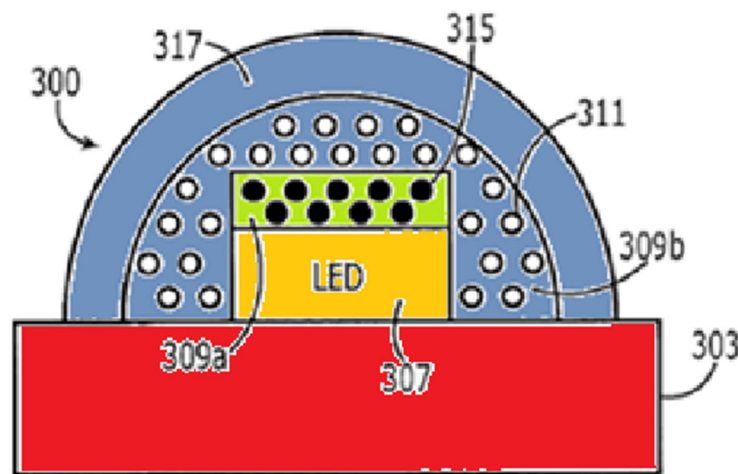


FIG. 3

Ex. 1006, FIG. 3 (coloring added to figure).

70. Hussell incorporates by reference several other prior art references, including: (i) U.S. Patent App. No. 12/273,216, which led to U.S. Patent No. 8,004,172 (“Hussell172”; Ex. 1011); and (ii) U.S. Patent App. Pub. No. 2008/0179611 (“Chitnis”; Ex. 1007). Ex. 1006 at [0051]-[0052]. I discuss these further in Section IX.F.

d. Blonder

71. Blonder discloses, in its Abstract:

In accordance with the invention, an illumination device comprises a substrate having a surface and a cavity in the surface. At least one light emitting diode (“LED”) is mounted within the cavity, and a monolayer comprising phosphor particles overlies the LED. The phosphor monolayer is adhered to the LED by a monolayer of transparent adhesive material. An optional optical thick layer of transparent material overlies the phosphor monolayer to encapsulate the LED and optionally to form a lens.

Methods and apparatus for efficiently making the devices are disclosed.

Ex. 1010 at Abstract.

72. Blonder includes six figures, of which Figure 2 is particularly noteworthy.

73. According to Blonder, Figure 2, below, “illustrates a multiple LED array assembly 200 in which several **LEDs 201**, are placed inside a ceramic **cavity 202** similar to the cavity 104 described above” (referring to Figure 1). Ex. 1010 at [0018] (color added). **Substrate 203** can be metal, ceramic, etc. and “advantageously comprises a highly thermally conductive metal such as copper, tungsten or molybdenum and/or a highly thermally conductive ceramic such as aluminum nitride (ALN), silicon carbide (SiC) or aluminum oxide (Al₂O₃).” Ex. 1010 at [0019]. “A transparent adhesive monolayer 205 is placed on top of the multiple LED bodies 201 and a layer 206 of phosphor particles 207 is adhered overlying and over the sides of the bodies 201.” Ex. 1010 at [0018]. “In fabrication, all LEDs 201 can simultaneously be coated with the first tacky transparent material 205. The particles 207 of the phosphor layer coating can attach to the tacky layer 205 creating a **closed [sic: close] packed⁴ dense film layer 206**.” Ex. 1010 at [0018] (color added). “Then assembly 200 comprising wirebonded LEDs 201 can

⁴ The correct terminology is “close packed,” rather than “closed packed.”

then optionally be sealed as by covering with a **second transparent material 209** that can optionally create a dome or lens.” Ex. 1010 at [0018] (color added). Layers 206 and 209 can be made of silicone. Ex. 1010 at [0024], [0026].

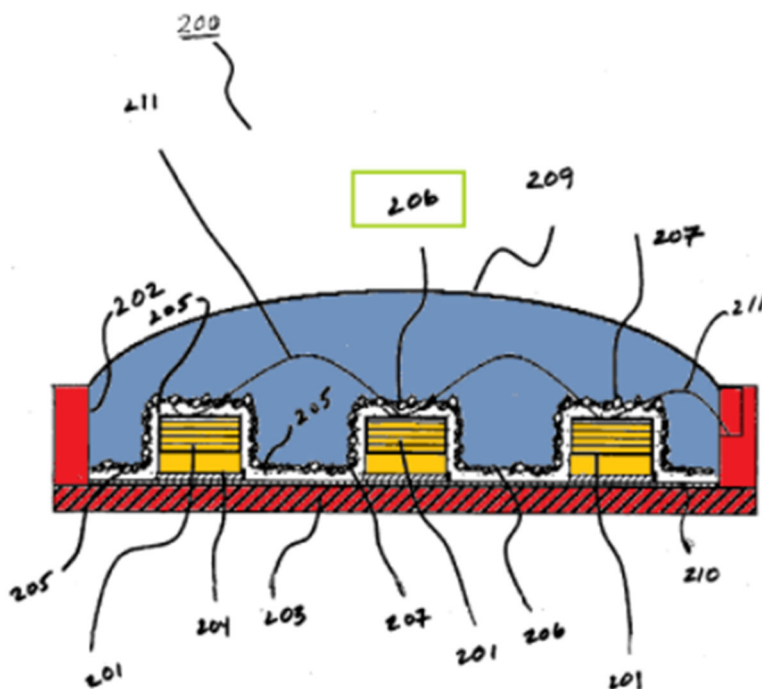


FIG. 2

Ex. 1010, FIG. 2 (coloring added to figure).

74. According to Blonder, “The monolayer of frequency converting particles can be a layer of particles or an organic film layer that includes the particles.” Ex. 1010 at [0028]. “The adhesion mechanism that holds the particle layer can involve many mechanisms of particle-to-particle bonding.” Ex. 1010 at [0028]. Blonder discloses that “Among them are mechanical interlocking, molecular forces, Vanderwaals adhesion forces, capillary, electrostatic, magnetic, and free chemical

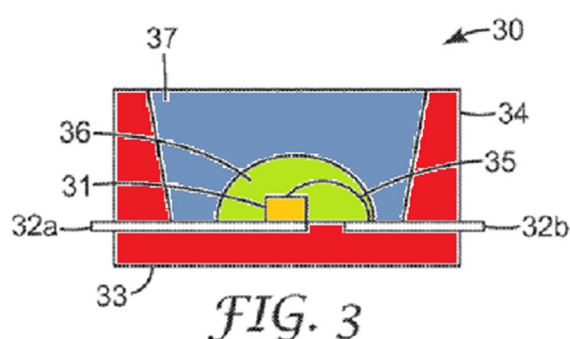
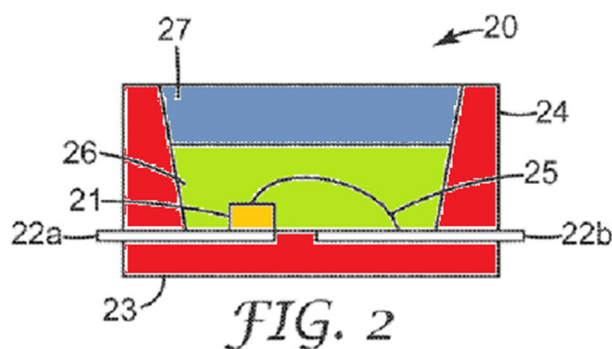
forces. In most cases, the strength of the particle-to-particle bond depends on the contact pressure and surface area of contact between particles.” Ex. 1010 at [0028].

e. Thompson

75. Thompson states, in its “Field” section, that “This disclosure relates to a method of making a light emitting device, and more particularly, to a method of making a light emitting device having a light emitting diode (LED) and a multilayer silicon-containing encapsulant.” Ex. 1009 at [0002].

76. Thompson includes three figures, of which Figures 2 and 3 are particularly noteworthy.

77. In Figures 2 and 3, below, Thompson discloses **LED dies (21, 31)** “encapsulated with a multilayer encapsulant” and “disposed on **substrate [23, 33]** **in reflecting cup [24, 34].**” Ex. 1009 at [0015], [0058] (color added). The multilayer encapsulant comprises **first encapsulant layer (26, 36)** and **second encapsulant layer (27, 37)**. Ex. 1009 at [0015], [0058].



Ex. 1009, FIGs. 2-3 (coloring added to figures).

78. According to Thompson, the **first encapsulant** may comprise “silicone gel, silicone gum, [or] silicone fluid.” Ex. 1009 at [0017], [0019]. The **second encapsulant** may be cured silicon-containing resin, preferably silicone. Ex. 1009 at [0022]-[0025]. The first and/or second encapsulants can comprise one or more additives, including phosphors such as doped garnets (*e.g.*, YAG:Ce). Ex. 1009 at [0050], [0054]. “If used, the phosphor particles are preferably included in the encapsulating material in an amount of no greater than 85 wt-%, and in an amount of at least 1 wt-%, based on the total weight of the encapsulating material.” Ex. 1009 at [0054]. Thompson discloses that “The amount of phosphor used will be adjusted according to the thickness of the siloxane layer containing the phosphor and the desired color of the emitted light.” Ex. 1009 at [0054].

f. Nii

79. Nii states, in its “Field of Invention” section, that “The present invention relates to a light emitting device, and particularly to a light emitting device having high heat resistance and high durability.” Ex. 1026 at [0001]-[0002].

80. Nii includes eleven figures, of which Figures 1A-1C and 2A-2B are particularly noteworthy. Figures 1A-1C are to a first embodiment, and Figures 2A-2B are to a variation of the first embodiment. Ex. 1026 at [0031]-[0035]. I note that

both have similar structures, with a two-layer encapsulant, such as in Figures 1C and 2B, below. I focus on Figures 1A-1C in my summary.

Fig. 1C

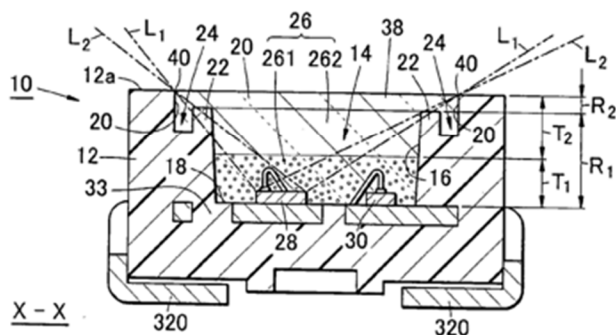
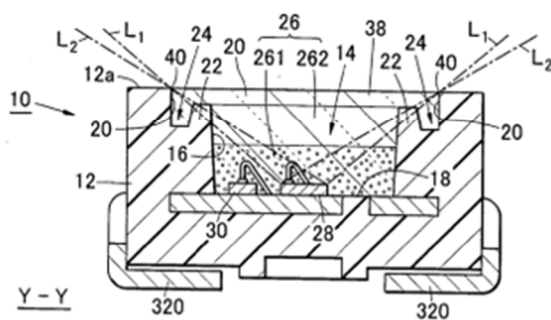


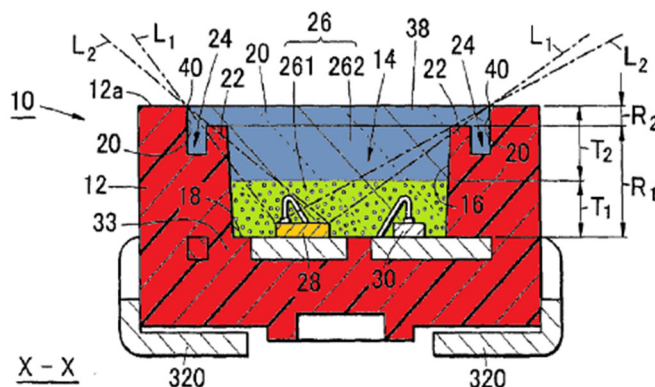
Fig. 2B



Ex. 1026, FIGs. 1C, 2B.

81. In Figure 1C, below, Nii discloses **light emitting element 28** in a recess 14 of **housing 12**. Ex. 1026 at [0075]. Figure 1 further shows a **first sealing layer 261** and a **second sealing layer 262** made of sealing material 26. Ex. 1026 at [0090]-[0091].

Fig. 1C



Ex. 1026, FIG. 1C (coloring added to figure).

82. Nii discloses that “The first sealing layer 261 is formed from a transparent sealing material which contains granular additives, and is disposed on the side of bottom 18 of the recess 14 (in the vicinity of the light emitting device 28)” and “The second sealing layer 262 is formed from a sealing material which does not include granular additives or contains granular additives of a quantity less than the predetermined quantity, and is disposed above the first sealing layer 261 (namely on the side of the light emitting surface 12a).” Ex. 1026 at [0090], [0113]. Nii further discloses that “Since the sealing material 26 having such a stacked structure is formed by filling the first sealing layer 261 and then forming the second sealing layer 262, the first sealing layer 261 and the second sealing layer 262 are separated by a clear borderline.” Ex. 1026 at [0091]. The sealing layers 261 and 262 (made of sealing material 26) are transparent and “Silicone resin, which is better in translucency and heat resistance, is particularly suitably used as the sealing material.” Ex. 1026 at [0112].

83. For its Figures 1A-1C embodiment, Nii provides an example of the materials:

For the sealing resin 26, a silicone resin (specific gravity 1.4, Young’s modulus 0.3 to 4 MPa, linear expansion coefficient 200 to 400 ($10^{-6}/^{\circ}\text{C.}$) and viscosity 1,000 to 20,000 ($\text{mPa}\cdot\text{s}$)) was used. For the fluorescent material particles, $(\text{Y}_{0.98}\text{Gd}_{0.02})_{2.85}\text{Ce}_{0.15}\text{Al}_5\text{O}_{12}$ having a mean particle size of $5.0\pm 0.7\ \mu\text{m}$ and specific gravity of 4.6 was used.

Ex. 1026 at [0164].

B. Ground 1: Shoji Anticipates Claims 1-5 and 7-11

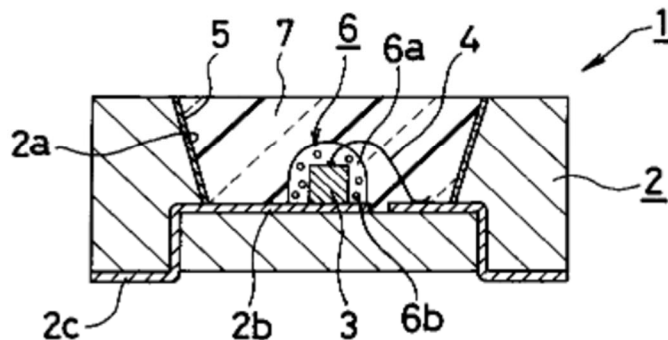
84. In my opinion, Shoji discloses all of the limitations of claims 1-5 and 7-9, arranged as in the claims, in its Figure 2 embodiment. Thus, it is my opinion that Shoji anticipates these claims.

1. Claim 1

1[pre] “An apparatus comprising:”

85. Regardless of whether the preamble of claim 1 is found to be a limitation, Shoji discloses “*An apparatus*”, such as “LED lamp 1” in Figure 2, below. Ex. 1005 at [0008].

FIG. 2



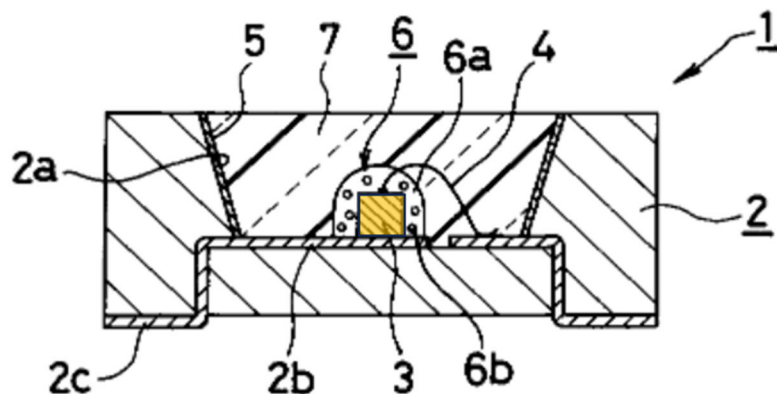
Ex. 1005, FIG. 2.

1[a] “a light emitting device;”

86. Shoji discloses the claimed “*a light emitting device*”, in particular, LED chip 3 in Figure 2. Ex. 1005 at [0007], [0009].

87. As shown in Figure 2, below, Shoji discloses **LED chip 3**. Ex. 1005 at [0007], [0009]. Shoji explains that “light [is] emitted from the LED chip” and that “LED chip 3 can be illuminated by supplying power”. Ex. 1005 at [0007], [0009].

FIG. 2



Ex. 1005, FIG. 2 (coloring added to figure).

88. A POSA would have understood that the claimed “*light emitting device*” in the context of the ’465 Patent corresponds to at least a light emitting diode (LED). I note, for example, that the ’465 Patent uses “light emitting diode” and “light emitting device” interchangeably at times. For example, the ’465 Patent describes: (i) a “packaged and wire-bonded light emitting device”, Ex. 1001 at 5:8-9; (ii) “Solid state devices, such as light emitting diodes (LED)s”, Ex. 1001 at 1:18-19; and (iii) that “The LED 301 may be attached to a package 305 utilizing an adhesive 304. The adhesive may be any suitable material for fastening the die 301 to the package 305, such as epoxy. The package 305 may be any suitable material for potting or

enclosing the light emitting device.” Ex. 1001 at 6:31-35. I also note that, during prosecution, the Examiner and the applicant appeared to use the terms interchangeably. For example, the Examiner issued a rejection of the claims for failure to include a “light emitting diode”, Ex. 1002 at 39; and the applicant responded to this rejection using the term “light emitting device”, Ex. 1002 at 52. And I note this is also consistent with the position the Patent Owner took in district court, as I explained in Section VIII (discussing Term No. 1).

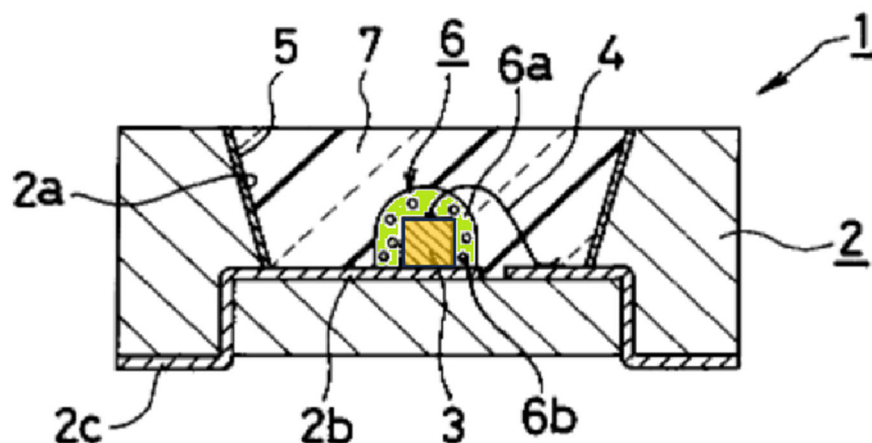
1[b] “a phosphor bearing film arranged with the light emitting device, the phosphor bearing film comprising phosphor and a silicone carrier; and”

89. Shoji discloses the claimed “*a phosphor bearing film arranged with the light emitting device, the phosphor bearing film comprising phosphor and a silicone carrier*”, for example, the inner molding layer 6 in Figure 2 with phosphor 6b dispersed in a silicone resin 6a that covers LED chip 3. Ex. 1005 at [0010], [0020], [0023].

90. In Figure 2, below, Shoji discloses that “an **inner molding layer 6** is formed by covering **LED chip 3** with a member in which a *phosphor 6b* is dispersed in a transparent *silicone resin 6a*.” Ex. 1005 at [0010] (emphases added; color added). Shoji further discloses that phosphor 6b is “mixed and dispersed into transparent silicone resin 6a in the inner molding layer 6.” Ex. 1005 at [0020]. Shoji also discloses that “an inner molding layer 6 is formed wherein transparent silicone

resin 6a and phosphor 6b are mixed in an appropriate ratio, and outer molding layer 7 is formed solely of transparent silicone resin on the outside [of inner molding layer 6], thus enabling, firstly, the placement of an appropriate amount of phosphor 6b at an appropriate transmission distance for the light from the LED chip, so that the light amount extractable to the outside can be increased without excessive scattering.” Ex. 1005 at [0023] (alteration in original).

FIG. 2



Ex. 1005, FIG. 2 (coloring added to figure).

91. As can be seen in Figure 2, above, a POSA would have understood that inner molding layer 6 with phosphor 6b mixed and dispersed in silicone resin and that covers LED chip 3 corresponds to the “*phosphor bearing film arranged with the light emitting device*” and “*comprising phosphor and a silicone carrier*”. I note that this is consistent with: (i) the position the Patent Owner took in district court (as I

explained in Section VIII (regarding Term No. 1)); (ii) the applicant during prosecution describing a “carrier” as “a medium for ‘carrying,’ [] another substance, which in this case is, for example, phosphor”, Ex. 1002 at 53; and (iii) the ’465 Patent which describes “mixing” phosphor and silicone and a “phosphor bearing *layer* 302” and “phosphor bearing *film* 302” comprising phosphor and silicone (*i.e.*, it uses “film” and “layer” interchangeably), Ex. 1001 at 5:50-6:47 (emphases added).

1[c] “a cured silicone film on the phosphor bearing film, the cured silicone film being substantially free of phosphor.”

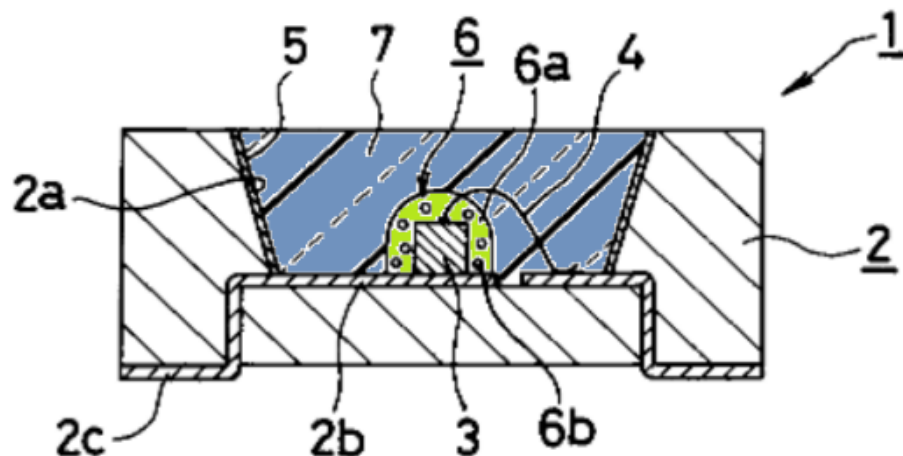
92. Shoji discloses the claimed “*a cured silicone film on the phosphor bearing film, the cured silicone film being substantially free of phosphor*”. For example, in Figure 2, outer molding layer 7 is (i) made of a cured transparent silicone resin, (ii) contains no phosphor 6b, and (iii) covers and is “on” inner molding layer 6. Ex. 1005 at [0012], [0023].

93. Shoji discloses that “Only **transparent silicone resin into which no phosphor 6b is added** is then injected into the remaining portion of the chip housing recess 2a to form an **outer molding layer 7**” and that “The entire area is thereafter heated at a temperature of $\geq 80^{\circ}\text{C}$ to implement the **curing** process.” Ex. 1005 at [0012] (emphases added; color added).

94. Figure 2, below, shows that “**outer molding layer 7**” is on “**inner molding layer 6**.” Ex. 1005 at [0010]-[0012] (color added). Shoji also discloses that “outer molding layer 7 is formed solely of transparent silicone resin on the outside

[of inner molding layer 6]”. Ex. 1005 at [0023] (alteration in original). I note that layer 7 being on layer 6 would also be true even if there were intervening elements (here, there are not), consistent with the ’465 Patent’s teaching that “It will be understood that when an element such as a region, layer, section, substrate, or the like, is referred to as being ‘on’ another element, it can be directly on the other element or intervening elements may also be present.” Ex. 1001 at 3:1-4.

FIG. 2



Ex. 1005, FIG. 2 (coloring added to figure).

95. Based on the above, a POSA would thus have understood that **outer molding layer 7** is: (i) a cured silicone film; (ii) on **inner molding layer 6** (*i.e.*, the claimed “*phosphor bearing film*”); and (iii) substantially free of phosphor (according to Shoji, layer 7 has no phosphor 6b at all).

2. Claim 2

“2. The apparatus of claim 1, wherein the phosphor bearing film is 60%-80% phosphor.”

96. Shoji discloses the claimed “*wherein the phosphor bearing film is 60%-80% phosphor*”, for example, that inner mold layer 6 of Figure 2 should be 60% by weight of phosphor 6b. Ex. 1005 at [0020]. Shoji also discloses claim 1, from which claim 2 depends, as I explained above.

97. Shoji discloses that inner mold layer 6 (*i.e.*, the claimed “*phosphor bearing film*”) may comprise “approximately 60 (wt.%)” of phosphor 6b (*i.e.*, the claimed “*phosphor*”). Ex. 1005 at [0020]. That is, Shoji teaches to a POSA a particular point (60% by weight) for phosphor 6b to be added to inner molding layer 6 of Figure 2. Shoji discloses that, at this point, the luminance has improved to reach a maximum value. Ex. 1005 at [0020]. In other words, a POSA would have understood Shoji to be teaching to use phosphor at this particular point (60% by weight), because it results in luminance reaching “the maximum value.” Ex. 1005 at [0020]. I note that this point is within the claimed range in claim 2.

98. Shoji further discloses a range that overlaps with the claimed range:

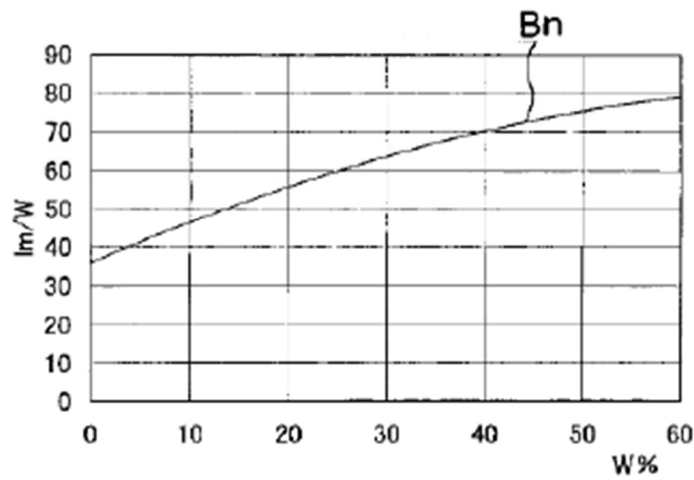
First, in the present invention (see Figure 5), the state in which the ratio of phosphor 6b, mixed and dispersed into transparent silicone resin 6a in the inner molding layer 6, is gradually increased by weight % is captured as the change in luminance; luminance improves as the percentage added increases, and at an approximately 60 (wt.%) addition the sum of the luminous flux emitted from the LED chip and the amount of wavelength-

converted light from the phosphor reaches approximately 80 (lm/W), which is considered to be the maximum value.

Ex. 1005 at [0020].

99. Figure 5, discussed in paragraph [0020] of Shoji, is below:

FIG. 5



Ex. 1005, FIG. 5.

100. I further note that the '465 Patent does not place any particular significance on the 60%-80% range, nor does it explain why that range is important or critical. *See generally* Ex. 1001. For example, the '465 Patent simply states the range in a few places, but not why it is important. Ex. 1001 at 1:66-2:2, 4:40-45, 6:17-20.

101. I also note that the '465 Patent treats the percentage as optional, which further confirms to a POSA that there is nothing important or critical about the range. For example, the '465 Patent states that "The phosphor bearing layer 302 may

include a high concentration of phosphor (e.g., from 60% to 80% phosphor), and may include treated silica and an uncured fluid such as uncured silicone.” Ex. 1001 at 6:17-20. The use of “e.g.” indicates that it is an example, optional, but not necessary or critical. The ’465 Patent also states that the “phosphor-bearing layer having a concentration that may be from 60% to 80% phosphor.” Ex. 1001 at 4:40-45. The use of “may be” likewise indicates that it is optional, but not necessary or critical.

102. I also note that the ’465 Patent itself appears to actually confirm that the range is not particularly important or critical. Other than the optional 60%-80%, the only other percentage disclosed in the ’465 Patent is “33-35%” that the ’465 Patent describes prior art devices as being “generally limited to”, in contrast to the ’465 Patent’s possible “high concentration” that “may be from 60% to 80% phosphor”:

This issue may be addressed in part by utilizing a metallic package, which may include a metal or any metal-like structure with high thermal conductivity, for example, aluminum or copper, mounted on a heat sink. In this configuration, heat from the phosphor can travel downward, that is, through the LED die or directly through the package, to escape to the environment by way of the heat sink. However, in thick layers of phosphor suspended in a cured silicone carrier, the poor thermal conductivity of the silicone can limit the effectiveness of this configuration.

While thin phosphor layers may improve this situation, they are not without their own difficulties. **A relatively thin phosphor layer may be created by suspending the phosphor within a**

low viscosity silicone (e.g., having a viscosity of 300-320 cP). However, the percentage of phosphor dispersed in this silicone is generally limited to 33-35%. Increases in phosphor concentration above this range may lead to difficulties in dispensing such as incomplete coverage of the die or dies, uneven surfaces, etc.

An improved thin layer of phosphor may be achieved by sedimentation. That is, the phosphor is dispensed into the package and/or onto the LED in a low viscosity silicone vehicle, and left (e.g., at room temperature) for a period of time to allow the phosphor to slowly sediment. As a result, a thin layer of phosphor is created on the die or dies, and on the surrounding areas, with a protective clear silicone layer on top. However, with this method, the sides of the dies are generally not covered with phosphor. It is well known that a significant portion of the light emitted by LED dies comes from the wall sides (e.g., up to 40%), so products produced utilizing this process may have inadequate efficiency. Further, a non-negligible amount of the phosphor remains in the clear silicone layer, resulting in compromised strength and hardness and reduced effectiveness of thermal dissipation.

A further improvement to an apparatus having a thin phosphor layer may be achieved by utilizing a process such as electrophoresis, in which an electric field applied to the suspension of phosphor in the silicone creates motion of the phosphor toward the surfaces on which it is desired that they settle, allowing a portion of the phosphor to settle on the side walls of the die. However, this process utilizes specialized equipment and generally implies a high level of investment. Further, the process may result in an only partial sedimentation, wherein the clear silicone layer is relatively soft and/or flexible, and again, the thermal dissipation is less effective than desired.

Moreover, neither of these processes appears to be capable of producing a satisfactorily thin phosphor layer including a high concentration of phosphor. An article of manufacture produced according to the process described below includes

a phosphor-bearing layer having a concentration that may be from 60% to 80% phosphor.

Ex. 1001 at 3:61-4:45 (emphases added).

103. As can be seen from the above excerpt, and more generally the '465 Patent, the '465 Patent places no particular importance or criticality to the 60%-80%. Rather, as shown in the above excerpt, the '465 Patent simply asserts that the prior art process resulted in a percentage that was too low (33-35%) and a higher percentage was desired (which “may be from 60% to 80%”). That simply indicates the '465 Patent's view that something higher than 33%-35% was useful for “a satisfactorily thin phosphor layer including a high concentration of phosphor”, but in no way explains why 40%, 45%, 50%, 55%, etc. would not be sufficient, why 60% - 80% is important, or even why greater than 80% could not be effectively used.

104. I further note that claims 1-12 are apparatus claims, which I understand do not require any particular process or an article manufactured or prepared using a process. Instead, they require only the end result (an apparatus), regardless of the particular process that may have been used to create the result. That is, of the four “aspects” of the disclosure I discussed in Section VII, only the third or fourth could have applicability to the claims (the first two are a process and article of manufacture prepared using a process). Ex. 1001 at 1:55-2:7.

105. I also note that only certain claims include a range. That is, independent claim 1 and dependent claims 3-6 do not include a percentage, while dependent

claim 2, independent claim 7, and dependent claims 8-12 (by dependency) include a percentage. The fact that all claims do not require a percentage provides even further confirmation, consistent with the '465 Patent and the understanding of a POSA, that the particular range is not important or critical. That is, the '465 Patent asserts, and the claims confirm, that the invention disclosed in the '465 Patent can be practiced at other percentages.

3. Claim 3

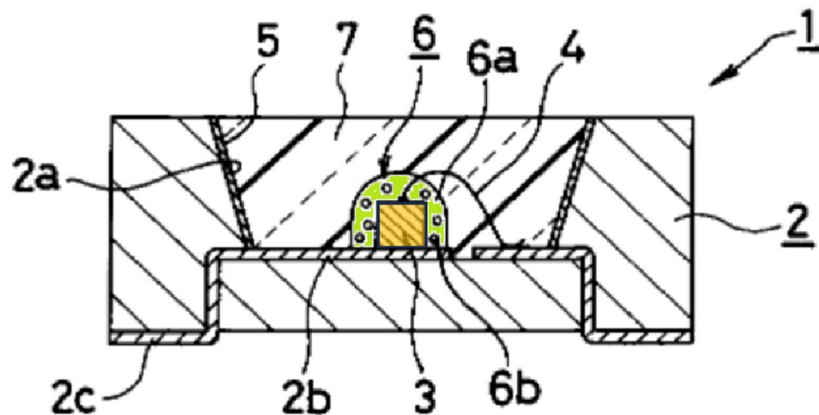
“3. The apparatus of claim 1, wherein the phosphor bearing film is at least partially on the light emitting device.”

106. Shoji discloses the claimed “*wherein the phosphor bearing film is at least partially on the light emitting device*”, for example, inner mold layer 6 is at least partially on LED chip 3. Shoji also discloses claim 1, from which claim 3 depends, as I explained above.

107. Shoji discloses that “**inner molding layer 6** is formed by covering **LED chip 3**”. Ex. 1005 at [0010] (color added).

108. Figure 2, below, shows that **inner molding layer 6** is at least partially on **LED chip 3**. Ex. 1005 at [0010]. I again note the '465 Patent's teaching that “It will be understood that when an element such as a region, layer, section, substrate, or the like, is referred to as being ‘on’ another element, it can be directly on the other element or intervening elements may also be present.” Ex. 1001 at 3:1-4. In other words, Shoji's disclosure is consistent with the '465 Patent.

FIG. 2



Ex. 1005, FIG. 2 (coloring added to figure).

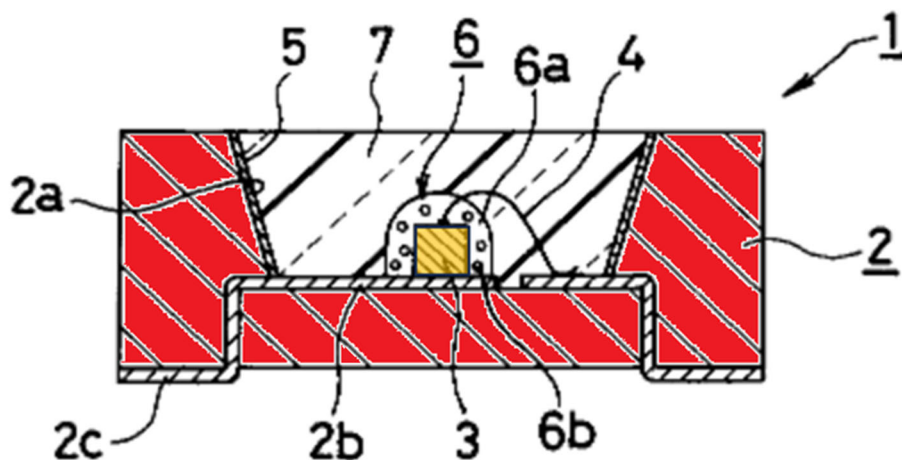
4. Claim 4

“4. The apparatus of claim 3, further comprising a metallic package, wherein the light emitting device is in the metallic package.”

109. Shoji discloses the claimed “*a metallic package, wherein the light emitting device is in the metallic package*”. Shoji also discloses claims 1 and 3, from which claim 4 depends, as I explained above.

110. Figure 2, below, shows **package 2** in which **LED chip 3** is housed (that is, **LED chip 3** is in **package 2**, as required by claim 4) (*i.e.*, the claimed “*wherein the light emitting device is in the metallic package*”). Ex. 1005 at [0008]-[0009].

FIG. 2



Ex. 1005, FIG. 2 (coloring added to figure).

111. Shoji discloses that package 2 may be, for example, ceramic, or alternatively, a metal. Ex. 1005 at [0008]-[0009], [0033]-[0034]. When the former is used (*i.e.*, when package 2 is formed of, for example, ceramic), “a reflector 5 is formed on the side surface of chip housing recess 2a by a reflective treatment such as silver plating (vapor deposition).” Ex. 1005 at [0009].

112. As to the latter alternative disclosed in Shoji for package 2 (*i.e.*, package 2 consists of a metal), Shoji explains that “The above-described first to fifth embodiments were all shown with examples adopting a surface-mount package 2 formed of a resin member or the like, however the present invention is not limited thereto, and in recent years white LED lamps of this type have also been considered for use as a light source for flashlights or other lighting applications to replace incandescent lamps.” Ex. 1005 at [0033]. In this paragraph [0033] of Shoji, Shoji is

describing “The above-described” embodiments, which embodiments include Figure 2. Ex. 1005 at [0008] (“Figs. 1 and 2 show a first embodiment”).

113. Shoji then explains in paragraph [0034]: “In this case, since a quantity of light is required and drive power is increased, cooling of the LED chip 3 is more necessary than before, and the part where an LED chip 3 is die-mounted may be formed, for example, **as a metal block with excellent heat conduction**. The present invention can naturally be implemented in such cases, i.e., there is no limitation on the shape of package 2 or the like.” Ex. 1005 at [0034] (emphasis added). In this paragraph [0034], Shoji is referring back to its discussion in paragraph [0033]. In other words, this disclosure in paragraph [0034] also applies to Figure 2.

114. A POSA would thus have understood that package 2 corresponds to the claimed “*metallic package*”, at least when the package is a “metal block with excellent heat conduction.” Ex. 1005 at [0034]. I note that this is consistent with the ’465 Patent’s disclosure of its “metallic package”: a metallic package “may include a metal or any metal-like structure with high thermal conductivity, for example, aluminum or copper, mounted on a heat sink.” Ex. 1001 at 3:61-64, 6:35-39.

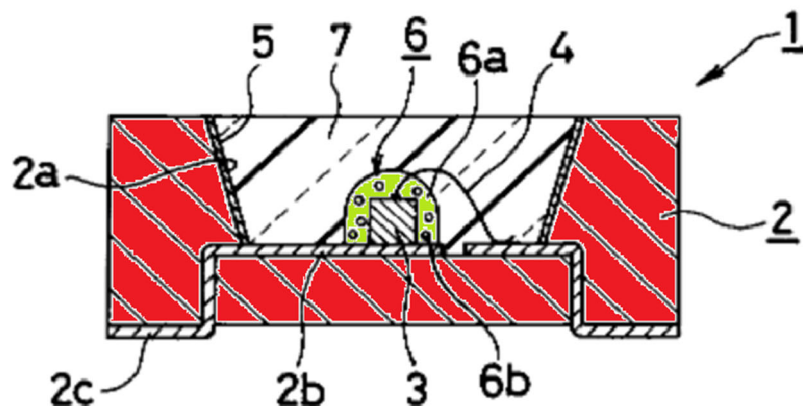
5. Claim 5

“4. The apparatus of claim 4, wherein the phosphor bearing film is at least partially on a surface of the metallic package.”

115. Shoji discloses the claimed “*wherein the phosphor bearing film is at least partially on a surface of the metallic package.*” Shoji also discloses claims 1, 3, and 4, from which claim 5 depends, as I explained above.

116. Figure 2, below, shows that the **inner molding layer 6** (*i.e.*, the claimed “*phosphor bearing film*”) is at least partially on a surface of **package 2** (*i.e.*, the claimed “*metallic package*”). Ex. 1005 at [0008]-[0010]. And I again note the ’465 Patent’s teaching that “It will be understood that when an element such as a region, layer, section, substrate, or the like, is referred to as being ‘on’ another element, it can be directly on the other element or intervening elements may also be present.” Ex. 1001 at 3:1-4. In other words, Shoji’s disclosure is consistent with the ’465 Patent.

FIG. 2



Ex. 1005, FIG. 2 (coloring added to figure).

6. Claims 7-11

117. Claims 7-11 are highly similar to claims 1, 2, 4, and 5. This can be seen in the following table comparing the claims. I have underlined certain terms for emphasis.

Claims 1-2, 4-5	Claims 7-11
1[pre] An apparatus comprising:	7[pre] An apparatus comprising:
1[a] a light emitting device;	7[a] a light emitting device;
1[b] a phosphor bearing film arranged with the light emitting device, the phosphor bearing film comprising phosphor and a <u>silicone</u> carrier; and	7[b] a phosphor bearing film arranged with the light emitting device, the film comprising phosphor and a carrier, 8. The apparatus of claim 7 wherein the carrier comprises <u>silicone</u> .
2. The apparatus of claim 1, wherein the phosphor bearing film is 60%-80% phosphor.	7[c] wherein the phosphor bearing film is 60%-80% phosphor.
1[c] a <u>cured silicone</u> film on the phosphor bearing film, <u>the cured silicone film being substantially free of phosphor</u> .	7[d] a <u>rigid</u> film on the phosphor bearing film. 9. The apparatus of claim 7 wherein the rigid film comprises a <u>transparent cured silicone</u> film.
4. The apparatus of claim 3, further comprising a metallic package, wherein the light emitting device is in the metallic package.	10. The apparatus of claim 7, further comprising a metallic package, wherein the light emitting device is in the metallic package.
5. The apparatus of claim 4, wherein the phosphor bearing film is at least partially on a surface of the metallic package.	11. The apparatus of claim 10, wherein the phosphor bearing film is at least partially on a surface of the package.

118. The table above confirms the following points that are relevant to my analysis and opinions. First, claims 7-9 are collectively of the same relevant - or broader - scope than claims 1 and 2. Second, claims 10 and 11 correspond to claims 4 and 5, but are broader given their relative dependencies (*i.e.*, note that claim 5 depends from claim 4, which depends from claim 3, which depends from claim 1; on the other hand, claim 11 depends from claim 10, which depends from independent claim 7).

119. The table above also shows the differences between the claims, for example, between claims 1 and 2 and 7-9. For example, I note the following:

120. First, independent claim 7 is broader than claim 1 in the following ways:

- claim 7 does not specify the type of “carrier” (rather, dependent claim 8 requires the carrier to “comprise[] silicone”);
- claim 7 requires only a “rigid film” rather than a “cured silicone film” required in claim 1 (note that dependent claim 9 claims that “rigid film comprises a transparent cured silicone film” and thus by claim differentiation, the “rigid film” in claim 7 encompasses “cured silicone film”); and
- claim 7 does not require that the “rigid film” is “substantially free of phosphor” (in fact, neither do any of the claims that depend from claim 7).

121. Second, claim 9 is slightly narrower than claim 1 because requires the “cured silicone film” to be “transparent”, which is not found in claims 1, 2, 4, or 5.

However, I note that transparency is typical of the film. In fact, such transparency is

consistently found in the prior art - as the purpose of the film is to allow light to pass through - including as expressly disclosed in Shoji (“transparent silicone resin” which is subjected to a “curing process”). Ex. 1005 at [0012].

122. Third, claim 9 is broader than claim 1 because it does not require the film to be “substantially free of phosphor”.

123. Fourth, claim 7 is narrower than claim 1 because it requires that the phosphor bearing film is 60%-80% phosphor (that limitation is found in dependent claim 2).

124. Based on the above and the relevant disclosure in Shoji, claims 7-11 are anticipated by Shoji for essentially the same reasons as claims 1, 2, 4, and 5. Further, because claims 7-11 are broader in certain respects as shown above, it further demonstrates that Shoji anticipates these claims. I have summarized my analysis below, beginning with claim 7.

7[pre] “An apparatus comprising:”

125. The preambles of claims 1 and 7 are the same. Thus, regardless of whether the preamble of claim 7 is found to be a limitation, Shoji discloses “*An apparatus*” for the reasons as the preamble of claim 1 (1[pre]).

7[a] “a light emitting device;”

126. Limitations 1[a] and 7[a] are the same. Thus, Shoji discloses “*a light emitting device*” in claim 7 for the same reasons as claim 1, limitation 1[a].

7[b] “a phosphor bearing film arranged with the light emitting device, the film comprising phosphor and a carrier,”

127. Limitation 7[b] is broader than limitation 1[b]. Thus, Shoji discloses “*a phosphor bearing film arranged with the light emitting device, the film comprising phosphor and a carrier*” in claim 7 for the same reasons as claim 1, limitation 1[b].

7[c] “wherein the phosphor bearing film is 60%-80% phosphor; and”

128. Limitation 7[c] is the same as claim 2. Thus, Shoji discloses “*wherein the phosphor bearing film is 60%-80% phosphor*” in claim 7 for the same reasons as claim 2.

7[d] “a rigid film on the phosphor bearing film.”

129. Limitation 7[d] is covered by limitation 1[c]. Thus, Shoji discloses “*a rigid film on the phosphor bearing film*” in claim 7 for the same reasons as claim 1, limitation 1[c].

130. As I explained above in this section when discussing the claim-comparison table, claim 9 depends from claim 7 and requires that “*the rigid film comprises a transparent cured silicone film*.” As I explained above regarding limitation 1[c], Shoji discloses that its outer molding layer 7 corresponds to a “*cured silicone film*.” Thus, because a cured silicone film, per the claims, is one type of rigid film, Shoji’s disclosure also meets the claimed “*rigid film*.”

131. I also note that a cured silicone film being a rigid film is consistent with the '465 Patent, which describes “The curable silicone 901 may be any suitable fluid such as silicone, which hardens or becomes more rigid when subjected to a curing process”, and that “The curable silicone 901 may be any suitable fluid such as silicone, which hardens or becomes more rigid when subjected to a curing process.” Ex. 1001 at 5:32-34, 6:24-27.

132. I also note that claim 7 does not require that the film be substantially phosphor free, and thus Shoji would disclose claim 7 regardless of whether its outer molding layer 7 is substantially phosphor free, though it is, as I explained in Section IX.B.1 (regarding limitation 1[c]).

“8. The apparatus of claim 7 wherein the carrier comprises silicone.”

133. The limitation of claim 8 is found in limitation 1[b]. Thus, Shoji discloses “*wherein the carrier comprises silicone*” in claim 8 for the same reasons as claim 1, limitation 1[b]. Shoji also discloses claim 7, from which claim 8 depends, as I explained above.

“9. The apparatus of claim 7 wherein the rigid film comprises a transparent cured silicone film.”

134. The limitation of claim 9 is found in limitation 1[c] (except for the “*transparent*” requirement). Shoji discloses “*wherein the rigid film comprises a*

transparent cured silicone film” in claim 9 for the same reasons as claim 1, limitation 1[c]. Shoji also discloses claim 7, from which claim 9 depends, as I explained above.

135. I again note, as I discussed above regarding limitation 1[c], that Shoji discloses that the cured outer molding layer 7 (*i.e.*, the claimed “*cured silicone film*”) is made of “**transparent** silicone resin.” Ex. 1005 at [0012] (emphasis added).

“10. The apparatus of claim 7, further comprising a metallic package, wherein the light emitting device is in the metallic package.”

136. The limitation of claim 10 is the same as claim 4. Thus, Shoji discloses “*a metallic package, wherein the light emitting device is in the metallic package*” in claim 10 for the same reasons as claim 4. Shoji also discloses claim 7, from which claim 10 depends, as I explained above.

“11. The apparatus of claim 10, wherein the phosphor bearing film is at least partially on a surface of the package.”

137. The limitation of claim 11 is the same as claim 5. Thus, Shoji discloses “*wherein the phosphor bearing film is at least partially on a surface of the package*” in claim 11 for the same reasons as claim 5. Shoji also discloses claims 7 and 10, from which claim 11 depends, as I explained above.

C. Ground 2: Shoji Alone or in View of Yatsuda Renders Claims 2 and 4-12 Obvious

138. In my opinion, Shoji by itself or in view of Yatsuda renders claims 2 and 4-12 obvious. I explain in this section how Shoji by itself, or when viewed with

Yatsuda, renders claims 2 and 4-12 obvious. I first provide an overview of a POSA's motivation to combine the references, and why a POSA would have had no technical difficulty and expected it to work. I then explain how Shoji by itself or with Yatsuda renders the claims obvious.

1. Motivation to Combine and Reasonable Expectation of Success

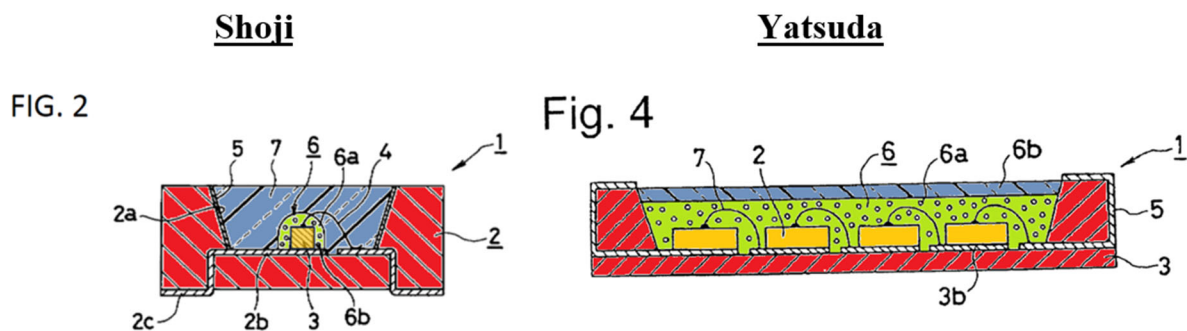
139. A POSA would have been motivated and had a reasonable expectation of success in combining the references - and in fact, a high expectation - for example, to apply the teachings of Yatsuda regarding its metallic package and heat sink to Figure 2 of Shoji.

140. As an initial matter, Shoji and Yatsuda are in the same field as each other and the '465 Patent (LED packaging for lighting devices). Ex. 1005 at Abstract, [0001]; Ex. 1008 at Abstract, [0003]-[0009]; Ex. 1001 at 1:15-51.

141. Shoji and Yatsuda are directed to the same problem: improved LED packages for efficient light extraction in, for example, white LED packages including phosphors in silicone. Ex. 1005 at Abstract, [0001]-[0005]; Ex. 1008 at [0005]-[0015]. The '465 Patent is also directed to the same problem. Ex. 1001 at 1:18-51. And they all solve the problem in the same way: an LED apparatus with a first film comprising phosphor in a silicone carrier and a second film that may be, for example, a rigid or transparent cured silicone film that may be substantially

phosphor free. Ex. 1005 at [0008]-[0012]; Ex. 1008 at [0033]-[0041]; Ex. 1001 at 6:12-47.

142. As is evident by my explanation in Section IX.A.2, Shoji and Yatsuda also have highly similar and complementary disclosures. This is evident, for example, by comparing figures and disclosure in the references, such as comparing Shoji's Figure 2, below left, to Yatsuda's Figure 4, below right. Note, for example, in both disclosures, the **LED chip** mounted in a **package well**, with a **first film** that comprises phosphor in a silicone carrier and a **second hardened/cured transparent silicone film** that is free of phosphor.



Ex. 1005, FIG. 2 (left, coloring added to figure); Ex. 1008, FIG. 4 (right, coloring added to figure).

143. The similarities are further evident in view of Figures 2 and 3 of Yatsuda, shown below (which are just like Figure 4 of Yatsuda, without the additional second film applied):

Fig. 2

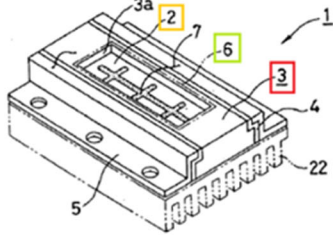
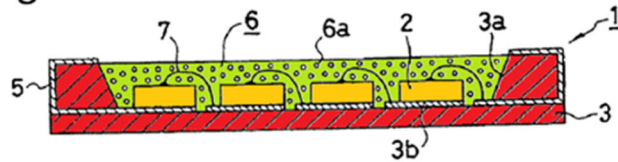


Fig. 3



Ex. 1008, FIGs. 2-3 (coloring added to figures).

144. A POSA would also have had a motivation to (i) construct Shoji's metal block with excellent heat conduction or Shoji's metal-plated ceramic package 2 (above, left, in Paragraph 142) of a high thermal conductivity material (that is, a metallic material per the '465 Patent) and (ii) mount the package to a heat sink, in order to further improve heat dissipation - a known goal and method in the LED packaging field to dissipate heat generated by the LED chip. Ex. 1008 at [0033], FIGs. 2-4; Ex. 1005 at [0034]; Ex. 1013 at [0117], [0127]-[0128], [0137]-[0138]; Ex. 1014 at 192; Ex. 1016 at [0017], [0019]-[0020], [0024], [0027]-[0028]; Ex. 1030 at [0083]-[0087]. Indeed, it would have been readily apparent from Shoji itself - which teaches to mount the LED chip on "a metal block with excellent heat conduction" when the LED package is used in high-powered applications. Ex. 1005 at [0033]-[0034]. It is further confirmed by Yatsuda, which similarly teaches that - in such high-powered LED package applications where as much electric current as possible is applied to the LED chip to obtain as much light as possible - to use a metallic package that "should be made of a material being superior in heat

conductivity” such as copper or aluminum and attached to an additional heat sink to efficiently dissipate the generated heat:

In the LED lamp 1, an electric current can be applied to the LED chip 2 (as much as possible), to obtain as much amount of light as possible. Accordingly, in this case, the base 3 on which the LED chip 2 is mounted **should be made of a material being superior in heat conductivity, such as a metal like copper (refer to FIG. 2), a ceramic like AlN (aluminum nitride) (refer to FIG. 3), and the like.** The thickness of the base 3 should be sufficient, if desired, **for thermal diffusion after connecting with a heat sink 22 in its rear surface.**

Ex. 1008 at [0033] (emphases added).

145. A POSA would also have understood that there were known advantages to a metallic package and heat sink, including to improve heat dissipation and package performance, and that it would have been a simple modification to select the material of Shoji’s package 2 (such as copper or aluminum nitride that are highly thermally conductive) and to mount that package to a heat sink. Ex. 1008 at [0033], [0036], FIGs. 2-4; Ex. 1016 at [0017], [0019]-[0020], [0024], [0027]-[0028]; Ex. 1015 at 493-494; Ex. 1022 at 3.7-3.16; Ex. 1010 at [0019]; Ex. 1030 at [0083]-[0087]. If a metal was used for the metallic package, a POSA would have understood to add an insulating layer to prevent a short circuit, as taught by Yatsuda and generally known to a POSA. Ex. 1008 at [0034], FIG. 2.

146. I note that the ’465 Patent does not explain how to construct its metallic package or heat sink, but rather states only to include them (consistent with the

knowledge of a POSA that such methods were readily known). *See generally* Ex. 1001.

147. I explain below further reasons why a POSA would have applied the teachings of Yatsuda to Shoji.

2. Claims 2 and 7-12: “Phosphor Bearing Film is 60%-80% Phosphor” Limitation

148. Claim 2 depends from independent claim 1 and requires “*wherein the phosphor bearing film is 60%-80% phosphor.*” Shoji discloses claim 1, as I explained above. Independent claim 7 (and by dependency, claims 8-12) similarly requires “*wherein the phosphor bearing film is 60%-80% phosphor.*”

149. I explained above in Section IX.B that Shoji discloses claims 1-5 and 7-11, and I explain below in Section IX.C.3 how Shoji alone or in view of Yatsuda also renders claims 4-6 and 10-12 obvious.

150. Regarding the requirement in the claims, “*wherein the phosphor bearing film is 60%-80% phosphor.*”, to the extent Shoji is found not to disclose this limitation, incorporating the range into the inner molding layer 6 of Shoji’s Figure 2 would still have been obvious to a POSA.

151. I explained in Section IX.B.2 above that Shoji discloses both a point within the claimed range and a range that overlaps with the claimed range. This is evident, for example, in paragraph [0020] and corresponding Figure 5, as I discussed in Section IX.B.2.

152. I also explained above in Section IX.B.2 that there was nothing important or critical about the claimed range, which is further confirmed by the '465 Patent itself.

153. Moreover, consistent with the knowledge of a POSA, a POSA would have readily understood how to adjust the phosphor concentration in order to optimize it for the particular application and LED package (for example, simply by increasing the phosphor concentration in the first film). A POSA would have understood the need and desire to do so, for example, based on film thickness, desired color temperature, and/or desired color of light to be emitted (*e.g.*, if a POSA desired for the package to emit a color other than white disclosed in Shoji). Ex. 1009 at [0008], [0054], [0061]; Ex. 1011 at 7:47-8:3; Ex. 1005 at [0006]-[0007]; Ex. 1007 at [0103], [0145]; Ex. 1031 at 7:48-52, 10:36-44, 15:2-10, FIG. 17, Table 1. This is evidenced by the state of the art (including in each of Thompson, Hussell¹⁷², Chitnis, and Shimizu⁹²⁵). For example, Thompson teaches to adjust - in a two-layer LED package - the amount of phosphor (up to 85% by weight) “according to the thickness of the siloxane layer containing the phosphor and the desired color of the emitted light.” Ex. 1009 at [0054]. As another example, Hussell¹⁷² teaches - also in a two-layer LED package - “various concentrations of phosphors may be used to obtain the desired color temperature”. Ex. 1011 at 7:47-8:3. As a further example, Chitnis teaches to adjust the phosphor concentration in a silicone binder coating an

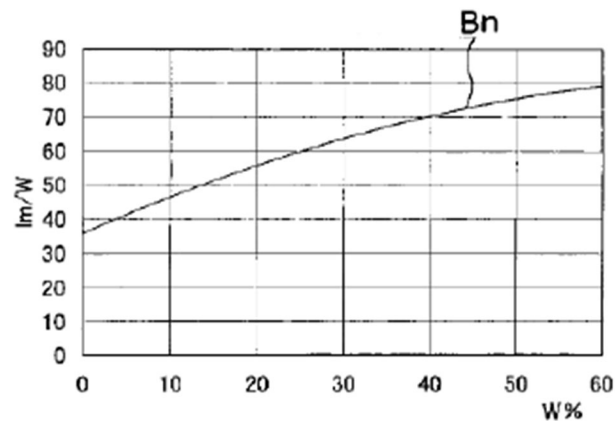
LED in the “range of 30-70% by weight” and at “approximately 65% by weight,” and to use concentration depending on, *e.g.*, “the desired LED chip emission color point.” Ex. 1007 at [0103], [0145]. Chitnis also teaches “use of different layer thicknesses and composition for different desired emission characteristics for the LED chips”. Ex. 1007 at [0145]. In yet a further example, Shimizu925 discloses that “the change in color tone when the concentration of fluorescent material is changed in the light emitting diode which combines the fluorescent materials shown in Table 1 and blue LED having peak wavelength at 465 nm,” where the fluorescent materials are phosphor such as YAG phosphor. Ex. 1031 at 7:48-52, FIG. 17, Table 1. Shimizu925 explains that, in Figure 17, the “color of the light approaches that of the fluorescent materials when the content of fluorescent material is increased and approaches that of blue LED when the content of fluorescent material is decreased [sic: decreased].” Ex. 1031 at 15:2-10, FIG. 17 (depicting range of “phosphor content” including at 30%, 60%, and 70% by weight to the “resin used in the coating material”). Shimizu925 further discloses that “because the phosphor is used by blending with a resin which makes the coating resin 101 and the coating material 201 (detailed later), color tone of the light emitting diode can be adjusted including white and incandescent lamp color by controlling the mixing proportion with the resin or the quantity used in filling the cup 105 or the recess of the casing 204 in

accordance to the wave length of light emitted by the gallium nitride light emitting component.” Ex. 1031 at 10:36-44.

154. I also note that the x-axis in Figure 5 of Shoji cuts off at 60%, although the data of Bn at the 60% by weight point (all the way to the right in Figure 5, shown below) must have continued beyond the cut-off point because Shoji describes 60% by weight phosphor concentration as the maximum luminance value (in paragraph [0020] of Shoji). A POSA would have understood Shoji to have evaluated higher concentrations in order to make such a determination. Thus, although not shown in Figure 5, a POSA would have understood that the concentration of phosphor can be higher than 60% by weight (with a relatively lower luminance compared to 60% by weight). A POSA would have optimized such concentration - whether above, below, or at 60% by weight - based on the various factors that the POSA was concerned with and the goal of the particular package, as I discussed above in the prior Paragraph 153 (*e.g.*, if the POSA wanted something other than a white LED package at maximum luminance). In other words, when a POSA was seeking to create a package with characteristics other than maximum luminance as the sole end-goal or main focus, a POSA would have thought to vary the concentration of phosphor - including to select a higher phosphor concentration - to achieve such characteristics. Further, as with my above explanation, a POSA would have understood the maximum luminance result of Shoji to simply be the result of the application

requirements for the LED package of interest to Shoji. Other application requirements will result in different concentrations of phosphor that will vary based on factors such as desired light output or intensity, color, color temperature, and film thickness, as I have discussed, instead of maximum luminance. Ex. 1009 at [0008], [0054], [0061]; Ex. 1011 at 7:47-8:3; Ex. 1005 at [0006]-[0007]; Ex. 1007 at [0103], [0145]; Ex. 1031 at 7:48-52, 10:36-44, 15:2-10, FIG. 17, Table 1.

FIG. 5



Ex. 1005, FIG. 5.

3. Claims 4-6 and 10-12: “Metallic Package” Limitation

“4. The apparatus of claim 3, further comprising a metallic package, wherein the light emitting device is in the metallic package.”

“5. The apparatus of claim 4, wherein the phosphor bearing film is at least partially on a surface of the metallic package.”

“6. The apparatus of claim 5, further comprising a heat sink, wherein the package is on the heat sink.”

155. As can be see above, claim 4 (and by dependency, claims 5 and 6) require *“a metallic package, wherein the light emitting device is in the metallic package.”*

156. The limitations in claims 10-12 correspond to the limitations in claims 4-6:

Claims 4-6	Claims 10-12
4. The apparatus of claim 3, further comprising a metallic package, wherein the light emitting device is in the metallic package.	10. The apparatus of claim 7, further comprising a metallic package, wherein the light emitting device is in the metallic package.
5. The apparatus of claim 4, wherein the phosphor bearing film is at least partially on a surface of the metallic package.	11. The apparatus of claim 10, wherein the phosphor bearing film is at least partially on a surface of the package.
6. The apparatus of claim 5, further comprising a heat sink, wherein the package is on the heat sink.	12. The apparatus of claim 10, further comprising a heat sink, wherein the package is on the heat sink.

157. I explained above in Section IX.B that Shoji discloses claims 1-5 and 7-11, and I explain below in Section IX.C.3 how Shoji alone or in view of Yatsuda also renders claims 4-6 and 10-12 obvious.

158. However, to the extent that Shoji is found not to disclose the claimed “*metallic package*”, claims 4-6 and 10-12 would be obvious over Shoji alone or in view of Yatsuda (*e.g.*, it would have been obvious to make package 2 in Figure 2 of Shoji from either metal or, alternatively - in view of the ’465 Patent’s description of “metallic” and “metallic package” - from another highly thermally conductive material such a highly thermally conductive ceramic). As to the latter alternative (a highly thermally conductive material such as a highly thermally conductive ceramic), I note the ’465 Patent’s focus regarding “metallic material” and “metallic package”: (i) “a metallic package, which may include a metal or any metal-like structure with high thermal conductivity”, Ex. 1001 at 3:61-64; and (ii) “a metallic material, that is, any material with metal-like properties including a high thermal conductivity, thus enabling the dissipation of heat from the device to a heat sink 306”, Ex. 1001 at 6:35-39. For example, in the portion I quoted in subpart (i) in the previous sentence at column 3, lines 61-64, the ’465 Patent provides two alternatives for a “metallic package” (either including “a metal”, or alternatively, “any metal-like structure with high thermal conductivity”). Thus, to the extent that the claimed “*metallic package*” encompasses materials with high thermal conductivity (*e.g.*, that

enable heat dissipation from the device), a highly thermally conductive ceramic package would qualify as the claimed “*metallic package*”.

159. As I explained in Section IX.B.4, Shoji discloses (i) a ceramic package (which may include silver-plated walls of the package’s recess), Ex. 1005 at [0008]-[0009], and (ii) “a metal block with excellent heat conduction”, which can be alternatively used as the package in Figure 2 of Shoji, Ex. 1005 at [0033]-[0034].

160. I note that Shoji does not explain the particular ceramic to be used in its ceramic alternative in Figure 2. However, a POSA would have understood the known need and desirability of efficiently dissipating heat generated by the LED out of the package (as I explained in Section IX.C.1) and sought out known ceramics used for LED packages to select such a package that resulted in high heat conductivity, thus achieving the heat-dissipation goal (*e.g.*, aluminum nitride or silicon carbide commonly known to be used in LED packages for this purpose). Ex. 1008 at [0033], [0036], FIGs. 2-3; Ex. 1015 at 493-494; Ex. 1022 at 3.7-3.16; Ex. 1012 at 13:39-42, 14:54-61.

161. A POSA would also have understood that it was a matter of simple material selection to choose the ceramic (or metal) as the package 2 in Shoji’s Figure 2 (as I explained in Section IX.C.1). When a metal (*e.g.*, copper) is selected, package 2 would meet the claimed “*metallic package*”. Similarly, when a highly thermally conductive ceramic is selected, package 2 would also meet the claimed “*metallic*”

package” where “metallic” encompasses materials that are highly thermally conductive that enable heat dissipation from the device, as stated in the ’465 Patent and as I discussed above. Ex. 1001 at 3:61-64, 6:35-39.

4. Claims 6 and 12: “Heat Sink” Limitation

162. As I have discussed, claims 6 and 12 require “*a heat sink, wherein the package is on the heat sink.*”

163. I explained above that Shoji discloses claims 1-5 and 7-11, and that how Shoji alone or in view of Yatsuda renders claims 2-5 and 7-11 obvious. Shoji alone or in view of Yatsuda also renders claims 6 and 12 obvious.

164. As I discussed above in Sections IX.B.4 and IX.C.3, Shoji discloses that, where “a quantity of light is required and drive power is increased, cooling of the LED chip 3 is more necessary than before, and the part where an LED chip 3 is die-mounted may be formed, for example, as a metal block with excellent heat conduction.” Ex. 1005 at [0034]. I note that Shoji does not explicitly disclose that the package is on a heat sink.

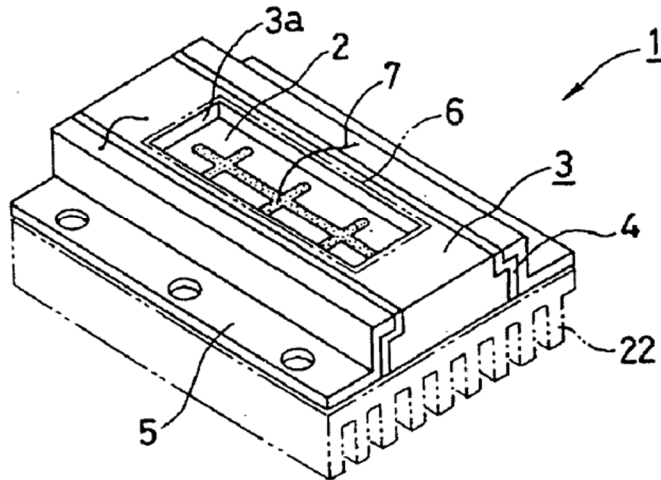
165. Like Shoji, Yatsuda teaches that when maximizing light output (and therefore applying as much electrical current as possible to the LED chip), it is advantageous to include a metal or highly thermally conductive base package to improve heat dissipation, and Yatsuda further teaches a heat sink on which this package is mounted:

In the LED lamp 1, an electric current can be applied to the LED chip 2 (as much as possible), to obtain as much amount of light as possible. Accordingly, in this case, the base 3 on which the LED chip 2 is mounted should be made of a material being superior in heat conductivity, such as a metal like copper (refer to FIG. 2), a ceramic like AlN (aluminum nitride) (refer to FIG. 3), and the like. The thickness of the base 3 should be sufficient, if desired, for thermal diffusion after connecting with a heat sink 22 in its rear surface.

Ex. 1008 at [0033].

166. Base 3 on heat sink 22 can be seen in Figure 2 of Yatsuda, below:

Fig. 2



Ex. 1008, FIG. 2.

167. As I explained in Section IX.C.1, a POSA would also have understood the known advantages and ease of implementation in applying such a heat sink to a package to improve heat dissipation. Indeed, the advantages and known implementation were well known in the LED packaging field (and more generally as well), as I explained in Section IX.C.1. This is further evidenced by the state of

the art in the LED packaging field: (i) Cao explains that heat sinks in LED packages improve thermal dissipation and can be mounted using various conventional means, Ex. 1016 at [0017], [0024], [0027]-[0028]; (ii) Baek explains to mount a “heat radiating plate”, *i.e.*, a heat sink, to the underside of a base member, *e.g.*, a metal substrate, to “further enhance heat dissipating characteristics of the high power LED package”, Ex. 1030 at [0086]-[0087]; (iii) Baek also explains that the base member may be, *e.g.*, a metal substrate or metal lead frame to dissipate heat, Ex. 1030 at [0065]-[0066]; (iv) Sanpei explains that including a heat sink improves the heat-radiating property of a metal baseboard and “thus is preferable in suppressing increase in temperature of the semiconductor light-emitting devices”, Ex. 1013 at [0117], [0127]-[0128], [0137]-[0138]; and (v) Schubert explains that “Power [LED] packages have a *direct, thermally conductive path* from the LED chip, through the package, to a heat sink, *e.g.* a printed circuit board. The power package shown in the figure has several advanced features. Firstly, the package contains an Al or Cu heatsink slug with low thermal resistivity to which the LED submount is soldered by a metal-based solder.” Ex. 1014 at 192 (emphasis in original).

D. Ground 3: Yatsuda Renders Claims 1 and 3-6 Obvious

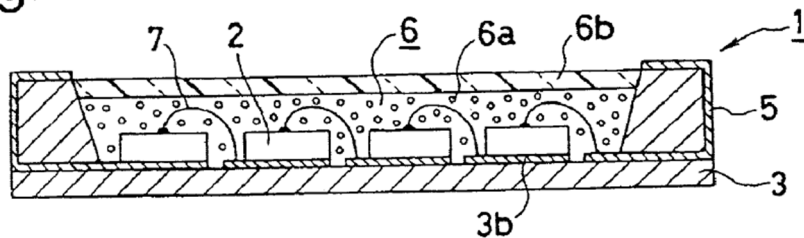
168. In my opinion, Yatsuda renders claims 1-3 and 6 obvious.

1. Claim 1

1[pre] “An apparatus comprising:”

169. Regardless of whether the preamble of claim 1 is found to be a limitation, Yatsuda discloses “*An apparatus*”, such as “LED lamp 1” in Figure 4, below. Ex. 1008 at [0032]-[0041].

Fig. 4

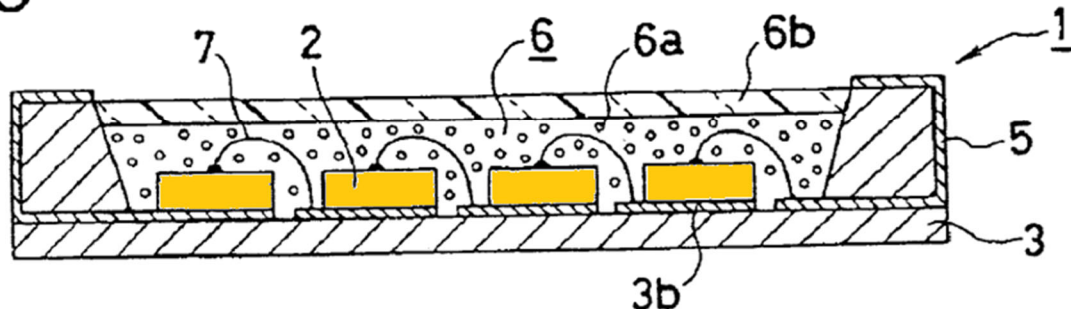


Ex. 1008, FIG. 4.

1[a] “a light emitting device;”

170. Yatsuda discloses the claimed “*a light emitting device*”, in particular, **LED chips 2** in Figure 4, below, that are used to generate visible light. Ex. 1008 at [0033]-[0041].

Fig. 4



Ex. 1008, FIG. 4 (coloring added to figure).

171. As I explained above in Section IX.B.1, a POSA would have understood that the claimed “*light emitting device*” in the context of the ’465 Patent corresponds to at least a light emitting diode (LED).

1[b] “a phosphor bearing film arranged with the light emitting device, the phosphor bearing film comprising phosphor and a silicone carrier; and”

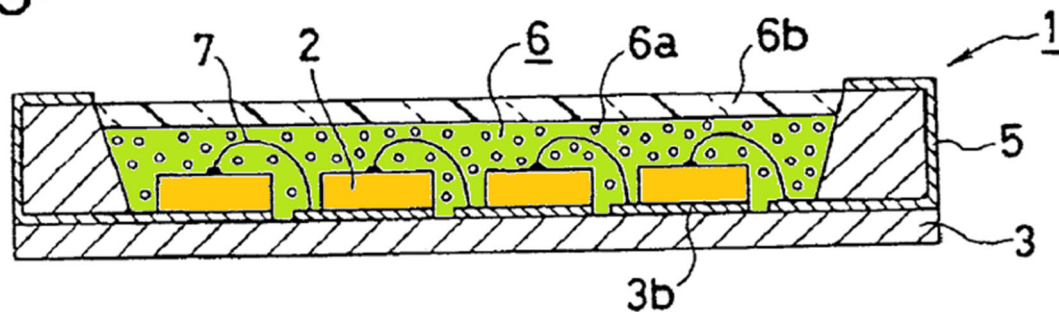
172. Yatsuda discloses the claimed “*a phosphor bearing film arranged with the light emitting device, the phosphor bearing film comprising phosphor and a silicone carrier*”, for example, transparent silicone resin 6 into which a phosphor 6a is mixed to obtain white light. Ex. 1008 at [0034], [0041].

173. Yatsuda discloses that “A **transparent silicone resin 6**, into which a **phosphor 6a** is mixed to obtain white light, can be injected and held in the recessed section (cavity) 3a to protect the mounted **LED chip 2**.” Ex. 1008 at [0034] (emphasis added; color added); *see also* [0041] (same in context of Figure 4).

174. I note that in paragraph [0034], Yatsuda is describing Figure 3, but in paragraph [0041] Yatsuda explains that Figure 4 is like Figure 3, but with an additional silicone layer added. Yatsuda also discusses and depicts transparent silicone resin 6 with phosphor 6a mixed in, in the context of Figure 4. Ex. 1008 at [0041]. In other words, a POSA would have understood the disclosure at paragraph [0034] to apply to Figure 4.

175. Figure 4, below, shows **transparent silicone resin 6** including phosphor **6a** mixed into the silicone resin (*i.e.*, the claimed “*a phosphor bearing film ... comprising phosphor and a silicone carrier*”) arranged with **LED chips 2**. Ex. 1008 at [0041].

Fig. 4



Ex. 1008, FIG. 4 (coloring added to figure).

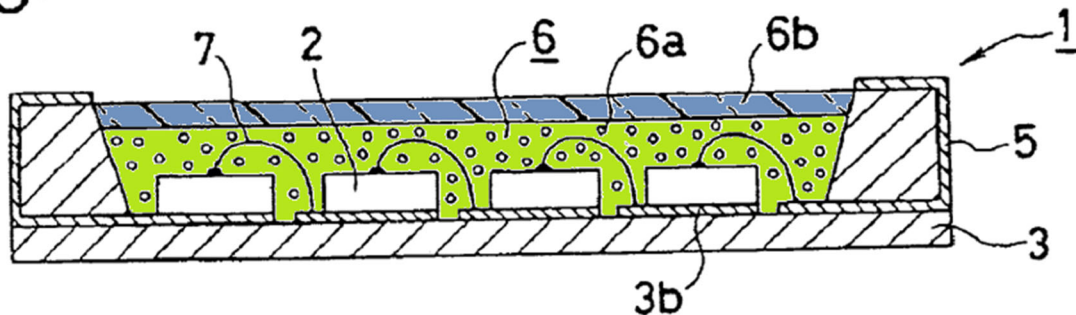
176. I again note that this is consistent with: (i) the position the Patent Owner took in district court (as I explained in Section VIII (regarding Term No. 1)); (ii) the applicant during prosecution describing a “carrier” as “a medium for ‘carrying,’ [] another substance, which in this case is, for example, phosphor”, Ex. 1002 at 53; and (iii) the ’465 Patent which describes “mixing” phosphor and silicone and a “phosphor bearing *layer* 302” and “phosphor bearing *film* 302” comprising phosphor and silicone (*i.e.*, it uses “film” and “layer” interchangeably), Ex. 1001 at 5:50-6:47 (emphases added).

1[c] “a cured silicone film on the phosphor bearing film, the cured silicone film being substantially free of phosphor.”

177. Yatsuda discloses (or it would have been obvious to include as part of its Figure 4 embodiment) the claimed “*a cured silicone film on the phosphor bearing film, the cured silicone film being substantially free of phosphor*”, for example, hard silicone resin film 6b that does not contain phosphor 6a and is on transparent silicone resin 6. Ex. 1008 at [0041].

178. Figure 4, below, depicts “**a film of a hard silicone resin 6b** ... provided over the **transparent silicone resin 6**” (and, as can be seen, on resin 6). Ex. 1008 at [0041] (color added).

Fig. 4



Ex. 1008, FIG. 4 (coloring added to figure).

179. A POSA would have understood that hard silicone resin film 6b is “*substantially free of phosphor*”, as required by the claim. In fact, it is entirely free of phosphor. That is, a POSA would have understood that hard silicone resin film 6b does not contain phosphor 6a based on Yatsuda’s disclosure that phosphor 6a is an **optional** component in hard silicone resin film 6b (and thus need not be included):

“In this case, the phosphor 6a or other wavelength conversion material may be mixed into the hard silicone resin 6b.” Ex. 1008 at [0041]. I note that “may” confirms the optionality.

180. In addition, Yatsuda’s Figure 4 itself provides further confirmation to a POSA that hard silicone resin film 6b does not contain phosphor 6a. As can be seen in Figure 4, above in Paragraph 178, phosphor 6a (the small circles) are found in transparent silicone resin 6 but not in hard silicone resin film 6b.

181. I note that Yatsuda does not expressly state that the disclosed “film of hard silicone resin 6b” in Figure 4 is “cured” (or specifically how it is made “hard”). However, a POSA would have understood that hard silicone resin film 6b would be cured in order to form a cured silicone resin film, and logically have thought to cure silicone resin 6b in order to harden it. I note that curing was a well-known, common technique conventionally used to harden silicone resins within cavities of LED packages such that the hardened silicone resin effectively protects the LED chip and components and prevents adhesion of foreign matter (just like in Yatsuda). Ex. 1008 at [0041], claim 8 of Yatsuda; Ex. 1006 at [0029], [0034], [0043]-[0044], [0046]; Ex. 1005 at [0002], [0012]; Ex. 1009 at [0014]-[0016], [0022]; Ex. 1025 at [0045], [0050]; Ex. 1024 at 526.

182. As further evidence that it would have been understood by a POSA to cure silicone resin 6b in Yatsuda to achieve Yatsuda’s stated objectives, I note that

it is confirmed by the state of the art (including in each of Hussell, Shoji, Thompson, and Miyoshi). For example, Hussell uses “cured” and “hardened” interchangeably when explaining how to create a silicone encapsulant to encapsulate LEDs in LED packages, Ex. 1006 at [0029], [0034], [0043]-[0044], [0046]. Shoji teaches “a conventional method for forming a white LED lamp” includes curing resin to cover and protect the LED chip and further explains the temperature at which to do so for silicone resin, Ex. 1005 at [0002], [0012]. Thompson similarly explains to cure silicone encapsulant over an LED in LED packages, Ex. 1009 at [0014]-[0016], [0022]. And Miyoshi teaches that cured silicone resin, among other things, encapsulates and protects the LED in the package, Ex. 1025 at [0045], [0050].

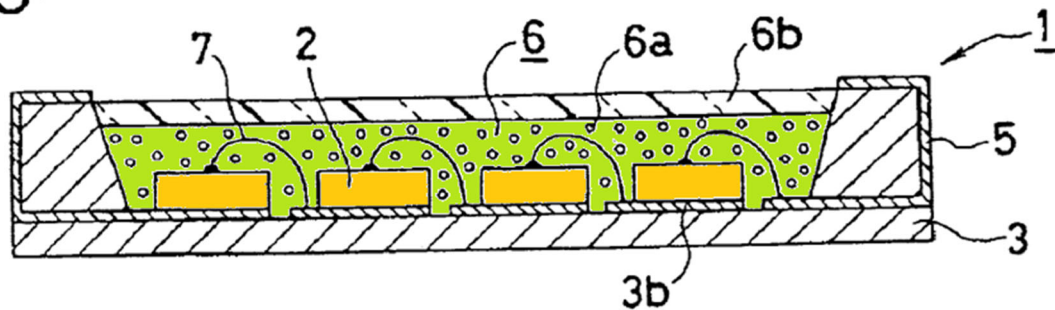
2. Claim 3

“3. The apparatus of claim 1, wherein the phosphor bearing film is at least partially on the light emitting device.”

183. Yatsuda discloses and renders obvious the claimed “*wherein the phosphor bearing film is at least partially on the light emitting device*”, for example, transparent silicone resin 6 being on LED chips 2 in Figure 4. Yatsuda also renders claim 1 obvious, as I explained above.

184. Figure 4, below, depicts that the **transparent silicone resin 6** including phosphor 6a (*i.e.*, the claimed “*phosphor bearing film*”) is at least partially on **LED chips 2** (*i.e.*, the claimed “*the light emitting device*”). Ex. 1008 at [0041].

Fig. 4



Ex. 1008, FIG. 4 (coloring added to figure).

185. I again note the '465 Patent's teaching that "It will be understood that when an element such as a region, layer, section, substrate, or the like, is referred to as being 'on' another element, it can be directly on the other element or intervening elements may also be present." Ex. 1001 at 3:1-4. In other words, Yatsuda's disclosure is consistent with the '465 Patent.

3. Claim 4

"4. The apparatus of claim 3, further comprising a metallic package, wherein the light emitting device is in the metallic package."

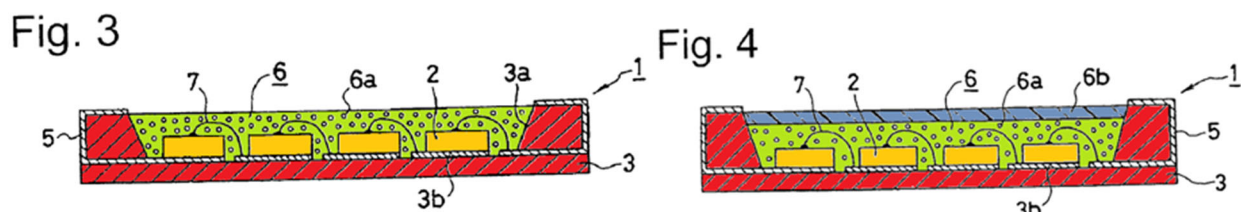
186. Yatsuda discloses and renders obvious the claimed "*a metallic package, wherein the light emitting device is in the metallic package*", relative to each of Figures 2, 3, and 4. Yatsuda also renders claims 1 and 3 obvious, as I explained above. In fact, Yatsuda discloses and renders these claims obvious, in each of Figures 2, 3, and 4. I discuss Figure 4 first, followed by Figures 2 and 3.

like structure with high thermal conductivity”, Ex. 1001 at 3:61-64; and (ii) “a metallic material, that is, any material with metal-like properties including a high thermal conductivity, thus enabling the dissipation of heat from the device to a heat sink 306”, Ex. 1001 at 6:35-39. For example, in the portion I quoted in subpart (i) in the previous sentence at column 3, lines 61-64, the ’465 Patent provides two alternatives for a “metallic package” (either including “a metal”, or alternatively, “any metal-like structure with high thermal conductivity”). Thus, to the extent that the claimed “*metallic package*” encompasses materials with high thermal conductivity (*e.g.*, that enable heat dissipation from the device), a highly thermally conductive ceramic package would qualify as the claimed “*metallic package*”. This is consistent with the base materials disclosed in Yatsuda. Ex. 1015 at 456-57, 493-494; Ex. 1022 at 3.7-3.16; Ex. 1010 at [0019].

190. In addition to paragraph [0033] of Yatsuda explaining what the base materials in its invention “should be made of” and the same-numbering for base 3 in each of Figures 2, 3, and 4, Yatsuda discloses that the difference between its Figure 3 and 4 embodiments is the addition of hard silicone resin film 6*b*. Ex. 1008 at [0041]. A POSA would have understood Yatsuda to be explaining that, except for the addition of the hard silicone resin 6*b* in Figure 4, Figures 3 and 4 are otherwise the same. Ex. 1008 at [0041]. It then follows that the base material in Figure 4 would

be a highly conductive ceramic such as aluminum nitride. Ex. 1008 at [0033]; Ex. 1015 at 493-494; Ex. 1012 at 13:39-42, 14:54-61; Ex. 1022 at 3.7-3.16.

191. The similarities between Figures 3 and 4 can further be seen below; note the same LED package structure and component numbering, except for the addition of **hard silicone resin film 6b** in Figure 4. I note that Figure 3 includes a labeling for the “recessed section (cavity) 3a” which is not labeled—though exists—in Figure 4. Ex. 1008 at [0034], [0047] (explaining that each of Figures 2-7 have “cavity 3a provided in the base 3”).



Ex. 1008, FIGs. 3-4 (coloring added to figures).

192. In addition, a POSA would logically and advantageously have thought to use a metal (such as copper) disclosed in highly similar Figure 2 as the base material in the Figure 4 embodiment, for essentially the same reasons. Ex. 1008 at [0033]-[0034], [0041]. As I discussed in the prior paragraph (Paragraph 191), Yatsuda explains the similarities between Figures 3 and 4 (*i.e.*, they are identical except for the addition of resin 6b). Ex. 1008 at [0033]-[0034], [0041]. Yatsuda also explains that Figures 2 and 3 are essentially the same (including the various

components such as the LED chip 2 in the recess cavity 3a of base 3, terminal boards 5, and silicone resin 6 with phosphor 6a). Ex. 1008 at [0033]-[0034]. Yatsuda then explains that the differences between Figures 2 and 3 are the base material and the adjustments necessary as a result of base 3 being metal in Figure 2. Ex. 1008 at [0033]-[0034]. According to Yatsuda, “When the base 3 is made of a metal, insulating layers 4 can be provided in proper positions on both side faces of the base 3 as shown in FIG. 2, in order to insulate terminal boards 5 for feeding power to the LED chip 2 from the base 3.” Ex. 1008 at [0034]. Thus, modifying Figure 4 - which as I have explained is highly similar to Figures 2 and 3 - to make the Figure 4 “base 3” from metal such as copper would only require simple routine adjustments - as explained in Yatsuda itself - and result in an even higher thermal conductivity package using copper, with insulating layers 4 provided in proper positions on base 3 (e.g., to prevent a short circuit). Ex. 1008 at [0034]; Ex. 1022 at 3.8-3.11.

193. Regarding Yatsuda Figures 2 and 3, below, a POSA would have alternatively sought to take the hard silicone resin film 6b teachings from Figure 4 and apply them to Figures 2 and 3. A POSA would also have advantageously thought to add hard silicone resin film 6b to either Figures 2 or 3, which would create the

claimed structure with the existing bases in each figure.⁵ Ex. 1008 at [0033]-[0041]. That is, each of Figures 2 and 3, as shown below, would include (i) **LED chips 2**, (ii) **transparent silicone resin 6** with phosphor 6a that cover **LED chips 2**, (iii) **base 3** made of a metallic material, and (iv) cured silicone resin film 6b (not pictured) that is free of phosphor 6a. Ex. 1008 at [0033]-[0041]. Adding cured silicone resin film 6b would be a simple addition of silicone 6b over **silicone resin 6** in Figures 2 and 3, using the techniques disclosed in Yatsuda, in otherwise identical Figure 3 and essentially identical Figure 2 (except for the adjustments made to account for metal base 3 such as insulating layer 4). Ex. 1008 at [0033]-[0041]. It would also improve the Figures 2 and 3 embodiments for the same reason as Yatsuda discloses regarding Figure 4 (including to protect the package components and prevent adhesion of foreign matter). Ex. 1008 at [0041].

Fig. 2

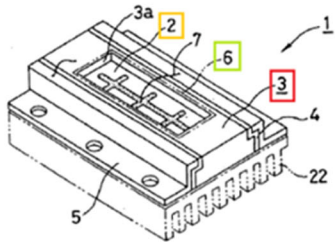
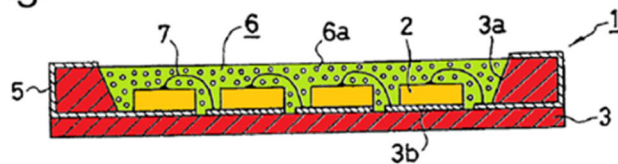


Fig. 3



Ex. 1008, FIGs. 2-3 (coloring added to figures).

⁵ A POSA would also have cured the hard silicone resin film 6b, for the same reasons I explained in Section IX.D.1 (limitation 1[c]).

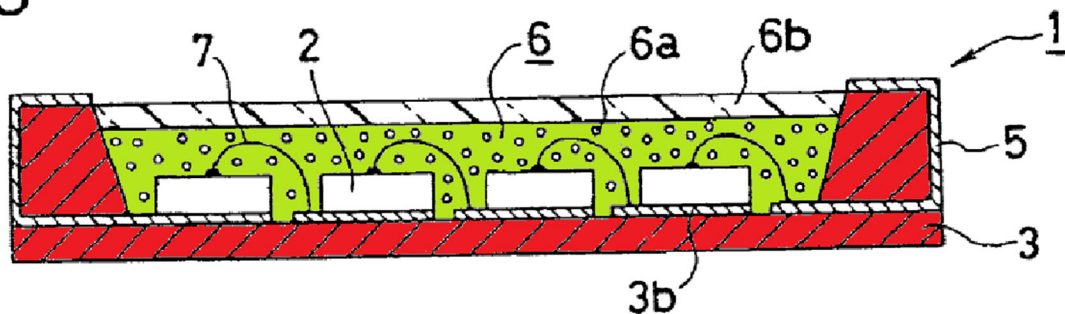
4. Claim 5

“5. The apparatus of claim 4, wherein the phosphor bearing film is at least partially on a surface of the metallic package.”

194. Yatsuda discloses and renders obvious the claimed “*wherein the phosphor bearing film is at least partially on a surface of the metallic package*”, relative to each of Figures 2, 3 and 4. Yatsuda also renders claims 1, 3, and 4 obvious, as I explained above.

195. Regarding Figure 4, below, the **transparent silicone resin 6** (*i.e.*, the claimed “*phosphor bearing film*”) is at least partially on a surface of **base 3** (*i.e.*, the claimed “*metallic package*”, as I explained above regarding claim 4). Ex. 1008 at [0041].

Fig. 4



Ex. 1008, FIG. 4 (coloring added to figure).

196. Regarding Figures 2 and 3, below, similarly, when hard silicone resin film 6b is added to Figures 2 and 3 (as explained regarding claim 4), **transparent silicone resin 6** (*i.e.*, the claimed “*phosphor bearing film*”) is also at least partially

[0034].

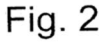


Fig. 3

Ex. 1008, FIGs. 2-3 (coloring added to figures).

5. Claim 6

“6. The apparatus of claim 6, further comprising a heat sink, wherein the package is on the heat sink.”

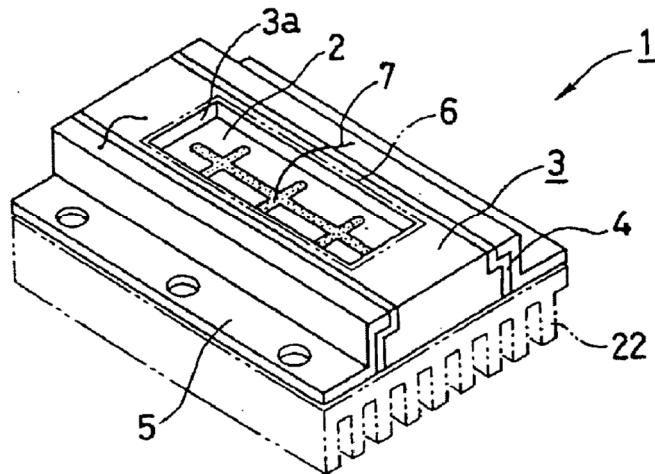
197. Yatsuda discloses and renders obvious the claimed “*a heat sink, wherein the package is on the heat sink*”, relative to each of Figures 2, 3 and 4.

Yatsuda also renders claims 1 and 3-5 obvious, as I explained above.

198. Regarding Figure 2, below, when hard silicone resin film 6*b* is added to Figure 2 (as I explained above regarding claims 4 and 5), base 3 is on heat sink

22. Ex. 1008 at [0033].

Fig. 2



Ex. 1008, FIG. 2.

199. Regarding Figure 4, although Yatsuda discloses heat sink 22 in the context of Figure 2, a POSA would have understood that heat sink 22 would be included (or at least that it advantageously should be included in Figure 4) because it was common and well-known to mount a package (here, base 3) to a heat sink in order to further improve heat dissipation using conventional techniques. For example, for the same reasons I discussed above in Sections IX.C.1 and IX.C.4, a POSA would have advantageously thought to apply - and had no technical difficulty in applying using conventional techniques known to a POSA - the heat sink of Yatsuda to base 3 in Figure 4, which would predictably improve heat dissipation.

200. Regarding Figure 3, when hard silicone resin film 6b is added to Figure 3 (as I explained above regarding claims 4 and 5), a POSA would have understood that heat sink 22 would be included (or at least that it advantageously should be

included in Figure 3) for the same reasons I discussed in the prior paragraph 199 regarding Figure 4.

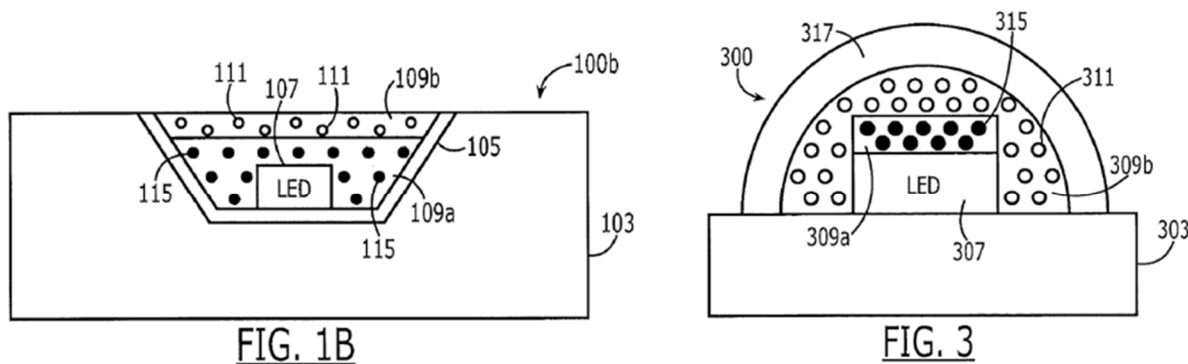
E. Ground 4: Hussell Anticipates Claims 1 and 3-5

201. In my opinion, Hussell discloses all of the limitations of claims 1 and 3-5, arranged as in the claims, for example, in its Figure 1C and/or Figure 3 embodiments. Thus, it is my opinion that Hussell anticipates these claims.

1. Claim 1

1[pre] “An apparatus comprising:”

202. Regardless of whether the preamble of claim 1 is found to be a limitation, Hussell discloses “*An apparatus*”, such as lighting structures 100b and 300 in Figures 1B and 3, shown below, respectively. Ex. 1006 at [0033]-[0034], [0044], [0049].

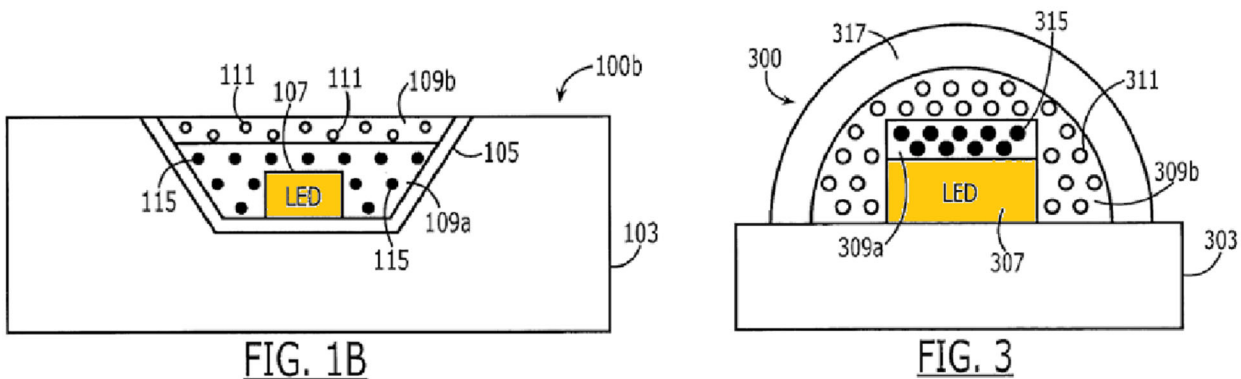


Ex. 1006, FIGs. 1B, 3.

1[a] “a light emitting device;”

203. Hussell discloses the claimed “*a light emitting device*”, in particular, “semiconductor light emitting device[s]” (light emitting diodes (LEDs) 107 and 307) in Figures 1B and 3, respectively. Ex. 1006 at [0025], [0034]-[0035], [0044]-[0045].

204. As shown in Figures 1B and 3, below, Hussell discloses **LEDs 107 and 307**. Ex. 1006 at [0025], [0034]-[0035], [0044]-[0045].



Ex. 1006, FIGs. 1B, 3 (coloring added to figures).

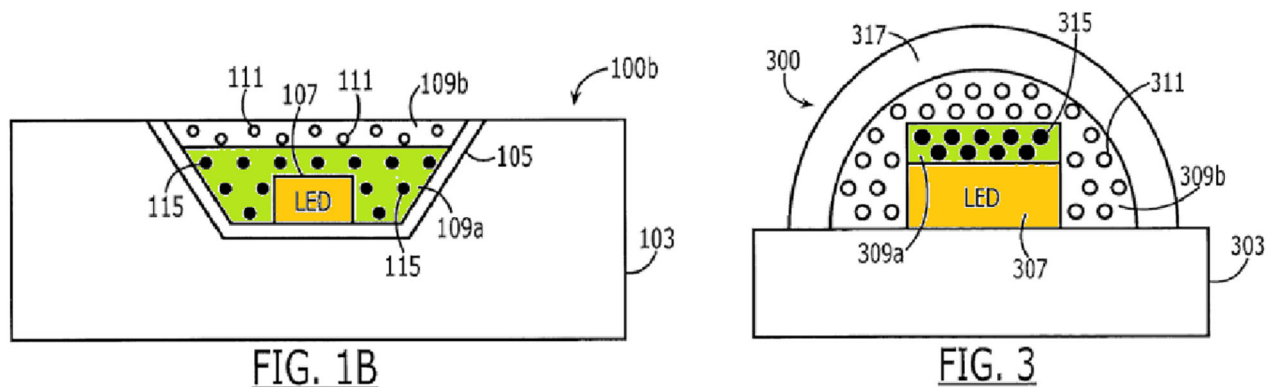
205. As I explained above in Section IX.B.1, a POSA would have understood that the claimed “*light emitting device*” in the context of the ’465 Patent corresponds to at least a light emitting diode (LED).

1[b] “a phosphor bearing film arranged with the light emitting device, the phosphor bearing film comprising phosphor and a silicone carrier; and”

206. Hussell discloses the claimed “*a phosphor bearing film arranged with the light emitting device, the phosphor bearing film comprising phosphor and a*

silicone carrier”, for example, silicone encapsulant layers 109a and 309a containing YAG phosphor particles 115 and 315, respectively, that cover LEDs 107 and 307, in Figures 1B and 3. Ex. 1006 at [0029], [0032]-[0034], [0044]-[0045].

207. In Figure 1B, below left, Hussell discloses a “**layer of encapsulating material 109a**” that includes “cerium doped YAG phosphor particles 115” and covers **LED 107**. Ex. 1006 at [0032]-[0034] (color added). In Figure 3, below right, Hussell discloses a “**layer of encapsulating material 309a**” that also includes cerium doped YAG phosphor particles 315 and is on top of **LED 307**. Ex. 1006 at [0044]-[0045] (color added).



Ex. 1006, FIGs. 1B, 3 (coloring added to figures).

208. Hussell explains that “The phosphor particles may be luminescent doped yttrium aluminum garnet (YAG) phosphor particles such as luminescent cerium doped yttrium aluminum garnet (YAG:Ce) phosphor particles.” Ex. 1006 at [0008]. For example, Hussell discloses that phosphor particles 115 (shown in Figure 1B) and phosphor particles 315 (shown in Figure 3) may be such luminescent doped

YAG phosphor particles. Ex. 1006 at [0026], [0033]-[0034], [0045]. Hussell also explains that “the term luminescent refers to the property of a material that emits one wavelength of electromagnetic radiation (e.g., one color of light) responsive to absorbing another (different) wavelength of electromagnetic radiation (e.g., a different color of light),” which may be “For example, cerium doped YAG [that] emits yellow light responsive to absorbing blue light.” Ex. 1006 at [0027].

209. Hussell also explains that the encapsulant layers 109a and 309a may be silicone. Ex. 1006 at [0029], [0033], [0046]; *see also* [0014]. As I explained above in Section IX.A.2.c, I again note that Hussell explains that (i) Figures 1A and 1B are the same “with the exception that phosphor particles 115 and non-luminescent phosphor host diffuser particles 111 are provided in separate layers of encapsulating material 109a and 109b”; (ii) “Further discussion of elements of FIG. 1B that have already been discussed with respect to FIG. 1A will [sic: be] omitted for the sake of conciseness”; and (iii) “Instead, discussion relating to FIG. 1B will focus on elements thereof that are different than FIG. 1B [sic: FIG. 1A].” Ex. 1006 at [0033]. As evident from Hussell, this means that the disclosure regarding layer 109 in Figure 1A applies to layer 109a in Figure 1B (including the phosphor particles 115 and the encapsulating material, for example, as discussed in paragraph [0029] of Hussell and further confirmed by the “Summary” section in Hussell, for example, in paragraph [0014]).

210. Accordingly, a POSA would have understood that silicone layers 109a and 309a correspond to the “*phosphor bearing film... comprising phosphor and a silicone carrier*” and are “*arranged with*” LEDs 107 and 307.

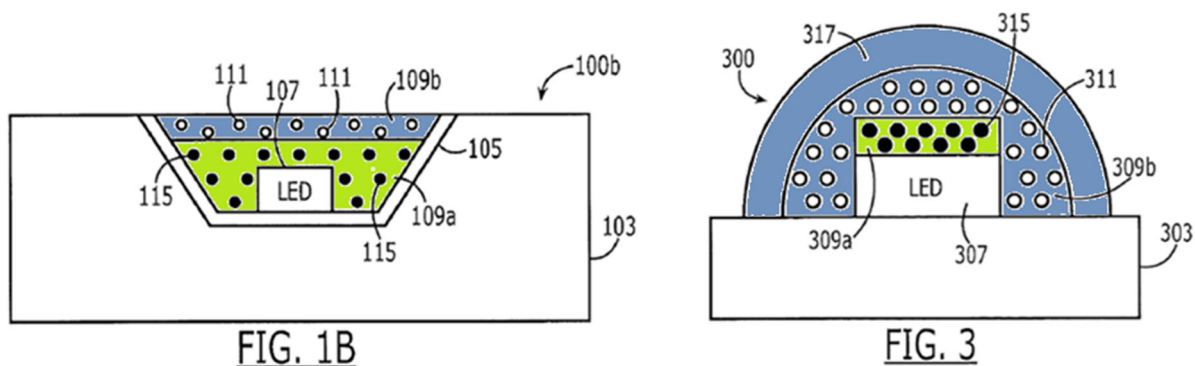
211. I again note that this is consistent with: (i) the position the Patent Owner took in district court (as I explained in Section VIII (regarding Term No. 1)); (ii) the applicant during prosecution describing a “carrier” as “a medium for ‘carrying,’ [] another substance, which in this case is, for example, phosphor”, Ex. 1002 at 53; and (iii) the ’465 Patent which describes “mixing” phosphor and silicone and a “phosphor bearing *layer* 302” and “phosphor bearing *film* 302” comprising phosphor and silicone (*i.e.*, it uses “film” and “layer” interchangeably), Ex. 1001 at 5:50-6:47 (emphases added).

1[c] “a cured silicone film on the phosphor bearing film, the cured silicone film being substantially free of phosphor.”

212. Hussell discloses the claimed “*a cured silicone film on the phosphor bearing film, the cured silicone film being substantially free of phosphor*”, for example, (i) cured silicone encapsulating layer 109b in Figure 1B and (ii) one or both of cured silicone encapsulating layers 309b and 317 in Figure 3. Ex. 1006 at [0006], [0010], [0014], [0029], [0034], [0044], [0046], claim 25 of Hussell.

213. Figure 1B, below left, discloses **encapsulating material layer 109b**, which “may be substantially free of phosphor particles 115” and on **layer 109a** (*i.e.*,

the claimed “*phosphor bearing film*”). Ex. 1006 at [0034]. Figure 3, below right, discloses **encapsulating material layer 309b** and **encapsulating material layer 317**, both of which are “substantially free” of phosphor particles 315 and on **layer 309a** (*i.e.*, the claimed “*phosphor bearing film*”). Ex. 1006 at [0044]. I note that both **encapsulating material layer 309b** and **encapsulating material layer 317** are “on” **layer 309a**, per the ’465 Patent, which explains that “It will be understood that when an element such as a region, layer, section, substrate, or the like, is referred to as being ‘on’ another element, it can be directly on the other element or intervening elements may also be present.” Ex. 1001 at 3:1-4. In other words, intervening **layer 309b** between **layer 317** and **layer 309a** does not impact **layer 317** being “on” **layer 309a** in Figure 3.



Ex. 1006, FIGs. 1B, 3 (coloring added to figures).

214. Hussell further discloses that encapsulant layer 109b in Figure 1B and encapsulant layers 309b and 317 in Figure 3 are “cured/hardened.” Ex. 1006 at [0034], [0044]. For example, Hussell discloses that “Accordingly, liquid

encapsulating material with phosphor particles 115 mixed therein may be dispensed on LED 107 and then at least partially cured/hardened to provide layer of encapsulating material 109a. Then, liquid encapsulating material with non-luminescent phosphor host diffuser particles 111 mixed therein may be dispensed on layer 109a and **then cured/hardened to provide layer of encapsulating material 109b.**” Ex. 1006 at [0034] (emphasis added). Hussell also discloses that “Glob top encapsulating material 309b (with non-luminescent phosphor host diffuser particles 311 dispersed therein) may then be dispensed on LED 307 (including encapsulating material 309a thereon) and on substrate 303 in a liquid form and then **cured/hardened**.... An additional glob top layer of encapsulating material 317 may be dispensed in a liquid state and then **cured/hardened**, and glob top layer of encapsulating material 317 may be substantially free of both YAG diffuser particles and phosphor particles.” Ex. 1006 at [0044] (emphases added). Hussell also discloses that the encapsulant materials (such as layers 109b, 309b, and 317) may be transparent. Ex. 1006 at [0010], [0014], [0029], [0046].

215. Hussell also discloses that each of the cured silicone encapsulant layers layer 109b, 309b and 317 are substantially free of luminescent cerium doped YAG phosphor particles 115 and 315, respectively. A POSA would have understood that the substantial lack of particles 115 and 315 in these layers means that they meet the

claim requirement “*the cured silicone film being substantially free of phosphor*”. Thus, a POSA would have understood that layer 109*b* corresponds to the claimed “*the cured silicone film being substantially free of phosphor*” in Figure 1B of Hussell and that one or both of layers 309*b* and 317 correspond to the claimed “*the cured silicone film being substantially free of phosphor*” in Figure 3 of Hussell.

216. This is true, even though layers 109*b* and 309*b* include “non-luminescent phosphor host diffuser particles” 111 and 311, respectively. Ex. 1006 at [0034], [0044]. Hussell explains these particles 111 and 311 are non-luminescent and have different compositions than luminescent cerium doped YAG phosphor particles 115 and 315. Ex. 1006 at [0026], [0045]. Hussell further explains the difference between luminescent and non-luminescent relevant to these particles:

As used herein, the term luminescent refers to the property of a material that emits one wavelength of electromagnetic radiation (e.g., one color of light) responsive to absorbing another (different) wavelength of electromagnetic radiation (e.g., a different color of light). For example, cerium doped YAG emits yellow light responsive to absorbing blue light. The term non-luminescent refers to the property of a material that does not emit significant electromagnetic radiation of a wavelength different than a wavelength of electromagnetic radiation absorbed by the non-luminescent material. For example, undoped YAG is substantially non-luminescent with respect to blue light. Moreover, the terms luminescent and non-luminescent may be taken with respect to a wavelength(s) of light emitted by a light emitting device(s) in a lighting structure including the luminescent or non-luminescent material. In a structure with a blue light emitting diode generating only blue light, for example, a material may be considered non-luminescent if the material is not luminescent with respect to the blue light of the light emitting

diode even if the material may be luminescent with respect to another wavelength(s) not generated by the lighting structure.

Ex. 1006 at [0027].

217. As is apparent from Hussell and understood by a POSA, the relevant “*phosphor*” particles are luminescent phosphor particles 115 and 315 in Hussell that are used to absorb and convert light. Ex. 1006 at [0026]-[0029], [0034], [0045]; Ex. 1014 at 349-351. This is also consistent with the ’465 Patent, which describes that “The phosphor material converts monochromatic light emitted from the blue or UV LEDs to white light.” Ex. 1001 at 1:34-36.

218. And even if those particles 111 and 311 were considered the claimed “*phosphor*” (they are not), Hussell would **still** disclose limitation 1[c] for Figure 3, because cured silicone encapsulant layer 317 “may be **substantially free of both** YAG diffuser particles and phosphor particles.” Ex. 1006 at [0044] (emphasis added).

2. Claim 3

“3. The apparatus of claim 1, wherein the phosphor bearing film is at least partially on the light emitting device.”

219. Hussell discloses the claimed “*wherein the phosphor bearing film is at least partially on the light emitting device*”, for example, layers 109a and 309a (*i.e.*, the claimed “*the phosphor bearing film*”) are on LEDs 107 and 307, respectively

(i.e., the claimed “*the light emitting device*”) in each of Figures 1B and 3. Hussell also discloses claim 1, from which claim 3 depends, as I explained above.

220. Figures 1B and 3, below, show **encapsulating materials 109a and 309a** (i.e., the claimed “*phosphor bearing film*”) are at least partially on **LEDs 107 and 307**. Ex. 1006 at [0034], [0044].

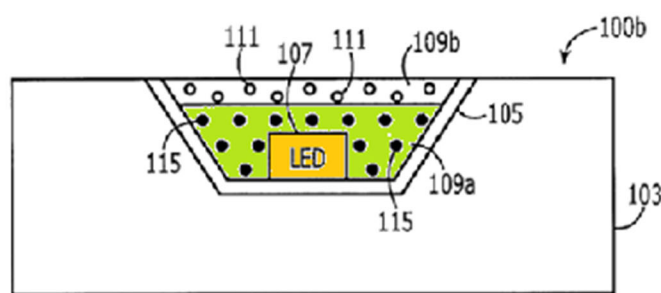


FIG. 1B

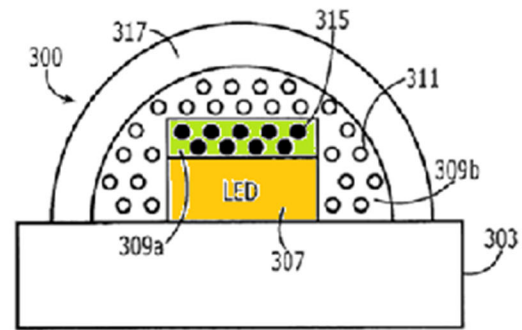


FIG. 3

Ex. 1006, FIGs. 1B, 3 (coloring added to figures).

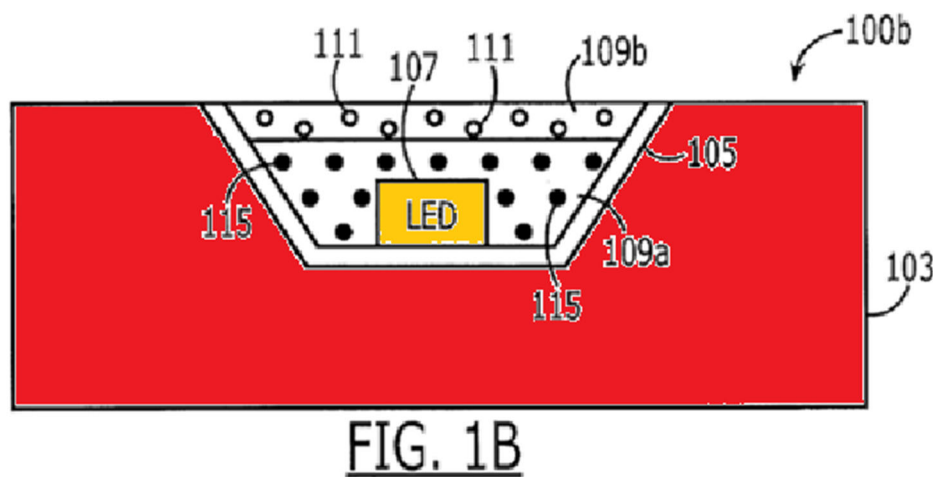
221. I again note the '465 Patent's teaching that “It will be understood that when an element such as a region, layer, section, substrate, or the like, is referred to as being ‘on’ another element, it can be directly on the other element or intervening elements may also be present.” Ex. 1001 at 3:1-4. In other words, Hussell's disclosure is consistent with the '465 Patent.

3. Claim 4

“4. The apparatus of claim 3, further comprising a metallic package, wherein the light emitting device is in the metallic package.”

222. Hussell discloses the claimed “*a metallic package, wherein the light emitting device is in the metallic package*”, for example, substrate 103 in Figure 1B. Ex. 1006 at [0025], [0033]. Hussell also discloses claims 1 and 3, from which claim 4 depends, as I explained above.

223. Figure 1B, below, shows “**substrate 103** defining a cup or depression therein” that includes **LED 107** in the substrate cup/depression. Ex. 1006 at [0025] (color added). According to Hussell, substrate 103 may be a ceramic substrate with a metal-reflective layer or may include a “metal base” with a cup thereon. Ex. 1006 at [0031]. As I explained above in Sections IX.A.2.c and IX.E.1, the Figure 1A disclosure in Hussell applies to Figure 3. Ex. 1006 at [0033]. Accordingly, a POSA would have understood that substrate 103 corresponds to the claimed “*the metallic package*”, consistent with the disclosure in the ’465 Patent (as I explained above, for example, in Section IX.B.4) with LED 107 (*i.e.*, the claimed “*light emitting device*”) therein.



Ex. 1006, FIG. 1B (coloring added to figure).

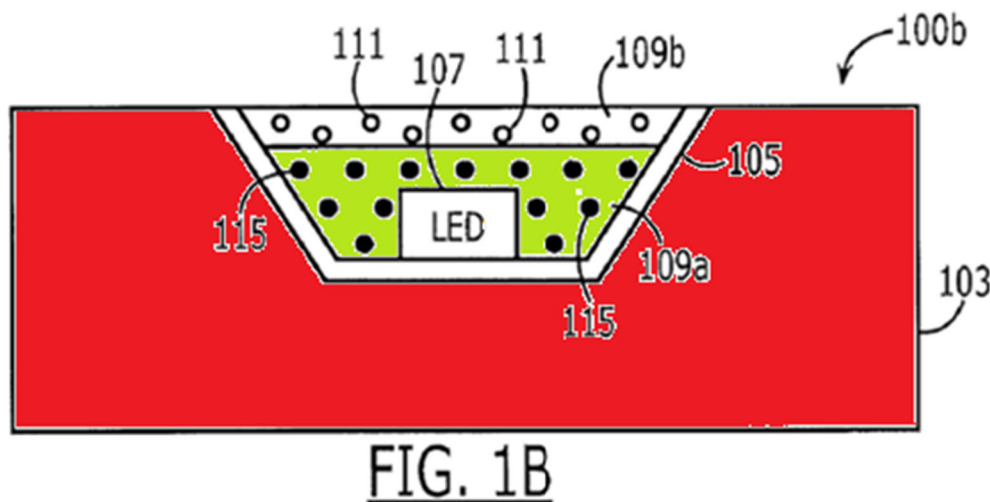
4. Claim 5

“5. The apparatus of claim 4, wherein the phosphor bearing film is at least partially on a surface of the metallic package.”

224. Hussell discloses the claimed “*wherein the phosphor bearing film is at least partially on a surface of the metallic package*”, for example, encapsulating material layer 109a is at least partially on the surface of substrate 103 in Figure 1B. Ex. 1006 at [0033]-[0034]. Hussell also discloses claims 1, 3, and 4, from which claim 5 depends, as I explained above.

225. Figure 1B, below, shows that **encapsulating material layer 109a** is at least partially on the surface of **substrate 103**. Ex. 1006 at [0031], [0033]-[0034]. I again note the '465 Patent's teaching that “It will be understood that when an element such as a region, layer, section, substrate, or the like, is referred to as being

‘on’ another element, it can be directly on the other element or intervening elements may also be present.” Ex. 1001 at 3:1-4. In other words, **encapsulating material layer 109a** is still on a surface of **substrate 103**, even though there is an intervening element shown (reflective layer 105). Ex. 1006 at [0025].



Ex. 1006, FIG. 1B (coloring added to figure).

F. Ground 5: Hussell Renders Claims 2 and 6-12 Obvious

226. In my opinion, Hussell renders claims 2 and 6-12 obvious.

1. Claim 2

“2. The apparatus of claim 1, wherein the phosphor bearing film is 60%-80% phosphor.”

227. It would have been obvious to include as part of Figures 1B and 3 in Hussell that “*the phosphor bearing film is 60%-80% phosphor*”, and Hussell discloses this limitation when Chitnis (incorporated by reference into Hussell) is

considered. Hussell also discloses claim 1, from which claim 2 depends, as I explained above.

228. I note that Hussell itself does not state what percentage of phosphor is in its layers 109a or 309a (*i.e.*, the claimed “*the phosphor bearing film*”) in the context of its Figures 1B and 3 disclosures. However, Hussell incorporates into its disclosure several references, including Chitnis (Ex. 1007). Ex. 1006 at [0051]-[0052]. For example, Hussell explains in its paragraph [0052]:

Moreover, light emitting devices 107, 207, and/or 307 may be represented by a commercially available LED, such as a Cree® EZ1000™ LED, manufactured by the assignee of the present invention, and described in the Data Sheet CPR3CR, Rev. A, entitled “Cree® EZ1000™ LEDs Data Sheet CxxxEZ1000-Sxx000”, copyright 2006, Cree, Inc., available on the Web at cree.com. As indicated in this data sheet, these LEDs may use a single semiconductor die of size 980/980 μm^2 or about 1 mm^2 . These LEDs may operate at a voltage of about 3 V (more typically about 3.3 V), and a current of about 350 mA (current density of about 35 A/ cm^2) for an input power of about 1 watt. The Cree EZ1000 LED may be manufactured under one or more of the following U.S. patents/applications, the disclosures of which are hereby incorporated herein in their entirety as if set forth fully herein: U.S. Pat. No. D566,057, issued Apr. 8, 2008, entitled “LED Chip”; U.S. Application Publication No. 2008/0173884, published Jul. 24, 2008, entitled “Wafer Level Phosphor Coating Method and Devices Fabricated Utilizing Same”; **U.S. Application Publication No. 2008/0179611, published Jul. 31, 2008, entitled “Wafer Level Phosphor Coating Method and Devices Fabricated Utilizing Same”;** and/or U.S. application Ser. No. 29/284,431, filed Sep. 7, 2007, entitled “LED Chip”. **The disclosures of each of the above referenced documents is hereby incorporated herein in its entirety by reference.** However, other commercially available packaged LEDs or bare LED die may be used.

Ex. 1006 at [0052] (emphases added).

229. U.S. Application Publication No. 2008/0179611, emphasized in the above paragraph, is the Chitnis reference (Ex. 1007), which like Hussell and the '465 Patent, is directed to LEDs and LED packages, and further to adding a phosphor coating or layer in a silicone carrier for light conversion. Ex. 1007 at [0007] (light conversion in conventional LEDs), [0072]-[0076] (discussing the binder, including that it may be silicone), [0103]-[0107] (coating LED with phosphor in binder), and [0187] (mounting LEDs in various packages such as in Figures 32 and 33).

230. A POSA reviewing Hussell would have noted the various references that are expressly incorporated into Hussell and would have reviewed those references when reviewing the disclosure of Hussell. For example, a POSA would have looked at Chitnis, which likewise discloses coating an LED with phosphor loaded in, *e.g.*, a silicone binder. Ex. 1007 at [0072]-[0076], [0103]-[0106]. And given the lack of specific percentages disclosed in Hussell itself for the phosphor concentration in Figures 1B and 3, a POSA naturally would have sought out specific disclosures to determine and optimize the appropriate phosphor concentration in layers 109a and 309a in Figures 1B and 3 of Hussell.

231. And when reviewing Chitnis, a POSA would have noted that Chitnis expressly discloses to vary the percentage of phosphor in the binder across a range

(30-70% phosphor by weight) and further to include it at a particular point (65% phosphor by weight) at which the binder coating is applied over an LED:

The coating 32 can also have different concentrations or loading of phosphor materials in the binder, with a typical concentration being in range of 30-70% by weight. In one embodiment, the phosphor concentration is approximately 65% by weight, and is preferably uniformly dispersed throughout the binder. Still in other embodiments the coating can comprise multiple layers of different concentrations or types of phosphors, and the multiple layers can comprise different binder materials. In other embodiments one or more of the layers can be provided without phosphors with our [sic: one or more] more being substantially transparent to the LED light.

Ex. 1007 at [0103] (emphasis added).

232. A POSA logically would have thought to apply both the “range of 30-70% by weight” and the “approximately 65% by weight” disclosed in Chitnis when determining the appropriate concentration in Hussell’s packages (such as Figures 1B and 3). I again note, as I explained above in Section IX.B.2, that there was nothing important or critical about the claimed range, which is further confirmed by the ’465 Patent itself.

233. As I explained in Section IX.C.2 above, consistent with the knowledge of a POSA, a POSA would have readily understood how to adjust the phosphor concentration in order to optimize it for the particular application and LED package (for example, by adjusting the concentration in the first phosphor-containing layer). As I also explained in Section IX.C.2 above, a POSA would have understood the

need and desire to do so, for example, based on film thickness, desired color temperature, and/or desired color of light to be emitted. Ex. 1007 at [0103], [0145]; Ex. 1011 at 7:47-8:3; Ex. 1009 at [0008], [0054], [0061]; Ex. 1005 at [0006]-[0007]; Ex. 1031 at 7:48-52, 10:36-44, 15:2-10, FIG. 17, Table 1. For example, Chitnis teaches to adjust the phosphor concentration in a silicone binder coating an LED in the “range of 30-70% by weight” and at “approximately 65% by weight,” and to use concentration depending on, *e.g.*, “the desired LED chip emission color point.” Ex. 1007 at [0103], [0145]. Chitnis also teaches the “use of different layer thicknesses and composition for different desired emission characteristics for the LED chips”. Ex. 1007 at [0145]. Hussell¹⁷² (which is also incorporated into Hussell)⁶ teaches “various concentrations of phosphors may be used to obtain the desired color temperature”. Ex. 1011 at 7:47-8:3. Thompson teaches to adjust - also in a two-layer LED package - the amount of phosphor (up to 85% by weight) “according to the thickness of the siloxane layer containing the phosphor and the desired color of the emitted light.” Ex. 1009 at [0054]. And Shimizu⁹²⁵ discloses that the color tone changes based on the change in phosphor concentration, and shows the

⁶ As I explained in Section IX.A.2.c, U.S. Patent App. No. 12/273,216, which led to Hussell¹⁷² (Ex. 1011) is incorporated by reference into Hussell. Ex. 1006 at [0051].

concentrations and resulting color tones (*e.g.*, at 30%, 60% and 70% by weight). Ex. 1031 at 7:48-52, 10:36-44, 15:2-10, FIG. 17, Table 1.

234. In making these concentration adjustments, a POSA would have thought to vary the concentrations in layers 109*a* and 309*a* in Figures 1B and 3 of Hussell, using the techniques taught in Hussell explaining how to construct the layers and overall in Hussell's Figures 1B and 3 (as I discussed above).

235. In addition and alternatively, a POSA would also have thought to use Chitnis' teaching directly, *i.e.*, applying a silicone layer containing phosphor to the LED to create an LED coated chip and implement that coated chip as, *e.g.*, LED chip 107 or 307 in Figures 1B and 3, respectively. That is, Chitnis discloses applying the coating 32 to the LED, such as LED 12, which results in an LED coated chip, such as LED chip 10, so that it "can be mounted in a package, or to a submount or printed circuit board (PCB) without the need for further processing to add phosphor" and sealed with an encapsulant. Ex. 1007 at [0103]-[0110], [0060]-[0061] (LED chip 10 comprises LED 12).

236. I note that Hussell expressly states to use various LED chips, including as disclosed in Chitnis. Ex. 1006 at [0052]. For example, Hussell discloses that (i) "light emitting devices 107, 207, and/or 307 may be represented by a commercially available LED such as a Cree® EZ1000™ LED," and (ii) "The Cree EZ1000 LED may be manufactured under one or more of the following U.S. patents/applications,"

which disclosed patents/applications include, among others, Chitnis (*i.e.*, “U.S. Application Publication No. 2008/0179611, published Jul. 1, 2008, entitled ‘Wafer Level Phosphor Coating Method and Devices Fabricated Utilizing Same’”. Ex. 1006 at [0052]. A POSA would logically have followed the express instructions in Hussell, and applied the Chitnis LED chips in the various Hussell figures, for example, Figures 1B and 3. This would result in Chitnis LED 12 (such as in the Chitnis FIG. 1 embodiment, *i.e.*, the embodiment depicted in Figures 1a to 1e of Chitnis, Ex. 1007 at [0018]) with a silicone layer containing phosphor from Chitnis - for example, LED chip 10 in Chitnis FIG. 1 - used as LED 107 in Hussell’s Figure 1B or LED 307 in Hussell’s Figure 3. In this alternative, the claimed “*phosphor bearing film*” would be coating 32 (alone or within layers 109a and 309a of Hussell Figure 1B and Figure 3, respectively).

237. Given that Chitnis LED chip 10 contains LED 12 and phosphor coating 32, it replaces LED 107 and LED 307 in Hussell Figures 1B and 3, respectively. This alternative could also result in simplifying the construction of the LED packages in Hussell Figures 1B and 3, eliminating the need for the application of layer 109a in Figure 1B and layer 309a in Figure 3 and thus simplifying the manufacturing process, for example, as explained in Chitnis:

The present invention eliminates complex wafer fabrication processes to access wire bond pads after blanket coating. Instead a simple and cost effective approach is utilized. It allows for wafer level coating of semiconductor devices without the need

for alignment. A wide variety of coating technologies can be used such as spin-coating of phosphor loaded silicone mixture, or electrophoretic deposition of phosphor followed by blanket coating of silicone or other binding material. Mechanical planarization allows thickness uniformity over the wafer and thickness uniformity of the coat can be achieved over a wide thickness range (e.g. 1 to 100 μm). White LED chip color point may be fine tuned by controlling the final coat thickness, including using an iterative approach (e.g. grind, test, grind, etc.) which will result in tightly binned white LEDs. This approach is also scalable to large wafer sizes.

Ex. 1007 at [0054]. For example, LED 10 with coating 32 in Chitnis (which comprises LED chip 12 in Chitnis) could replace LED 307 with layer 309a in Figure 3 of Hussell.

2. Claim 6

“6. The apparatus of claim 5, further comprising a heat sink, wherein the package is on the heat sink.”

238. It would have been obvious to include as part of Figures 1B and 3 in Hussell “a heat sink, wherein the package is on the heat sink”. Hussell also discloses claims 1 and 3-5, from which claim 6 depends, as I explained above.

239. I note that Hussell itself does not state to include a heat sink in the context of its Figures 1B and 3 disclosures. However, Hussell incorporates into its disclosure several references, including Hussell172 (Ex. 1011). Ex. 1006 at [0051]-[0052]. For example, Hussell explains in its paragraph [0051]:

Lighting structures of FIGS. 1A-1C, 2A-2B, and 3 according to embodiments of the present invention are discussed above by way of example without limiting the scope of the present

invention. Undoped YAG diffuser particles according to embodiments of the present invention, for example, may be used with phosphor materials other than cerium doped YAG phosphor materials, with light emitting devices (e.g., light emitting diodes and/or laser diodes) providing a light color(s) other than blue, with phosphor materials providing color conversions other than blue to yellow, and/or with lighting structures omitting phosphor materials. YAG diffuser particles, for example, may be provided with any of the lighting structures of U.S. Patent Publication No. 2007/0262339 published Nov. 15, 2007, entitled "Side-View Surface Mount White LED; U.S. Publication No. 2008/0054279 published Mar. 6, 2008, entitled "Phosphor Position In Light Emitting Diodes"; U.S. Publication No. 2008/0054284 published Mar. 6, 2008, entitled "Encapsulant Profile For Light Emitting Diodes"; U.S. Publication No. 2008/0173883 published Jul. 24, 2008, entitled "High Performance LED Package"; and/or U.S. application Ser. No. 12/273,216, filed Nov. 18, 2008, entitled **"Semiconductor Light Emitting Apparatus Including Elongated Hollow Wavelength Conversion Tubes And Methods Of Assembling Same"**. The disclosures of each of the above reference patent publications/applications are hereby incorporated herein in their entirety by reference. By way of example, undoped non-luminescent YAG diffuser particles may be included in an encapsulating material defined by an elongated wavelength conversion tube as discussed in U.S. application Ser. No. 12/273,216, the disclosure of which is incorporated above. Accordingly, an air gap or vacuum may be provided between the semiconductor light emitting device and the undoped non-luminescent YAG diffuser particles dispersed in such a wavelength conversion tube.

Ex. 1006 at [0051] (emphasis added).

240. U.S. application Ser. No. 12/273,216, emphasized in the above paragraph, is the application that led to the Hussell¹⁷² reference (Ex. 1011), which like Hussell and the '465 Patent, discloses phosphor for light conversion for use in LED packages. Ex. 1011 at 2:4-23, 7:22-8:50.

241. A POSA reviewing Hussell would have noted the various references that are expressly incorporated into Hussell, and reviewed those references when reviewing the disclosure of Hussell. For example, a POSA would have looked at Hussell172, and noted its various teachings, among them, that “any of the embodiments illustrated herein” may “include heat sinks,” Ex. 1011 at 12:9-19.

242. For essentially the same reasons I explained above in Sections IX.C.1 and IX.C.4, a POSA would have both understood the advantages of, and known how to, mount a heat sink to an LED package such as Figures 1B and 3 of Hussell. As I explained in those sections, I again note that a POSA would also have understood the known advantages and ease of implementation in attaching a heat sink to a package to further improve heat dissipation. The advantages and implementation were well known in the LED packaging field, just as they were more generally in electronics packaging fields. This is again evidenced by the state of the art, as I explained in previous sections. Ex. 1008 at [0033]; Ex. 1016 at [0017], [0024], [0027]-[0028]; Ex. 1030 at [0086]-[0087]; Ex. 1013 at [0117], [0127]-[0128], [0137]-[0138]; Ex. 1014 at 192.

3. Claims 7-12

243. As I explained above in Section IX.B.6, claims 7-11 are highly similar to claims 1, 2, 4, and 5 (and are effectively the same relevant to my opinions regarding patentability). As I have discussed above, for example, in Sections IX.C.3-

4, claim 6 includes the same limitation as claim 12. I have repeated the table below, adding claim 12, and again underlined certain terms to highlight the comparison.

Claims 1-2, 4-6	Claims 7-12
1[pre] An apparatus comprising:	7[pre] An apparatus comprising:
1[a] a light emitting device;	7[a] a light emitting device;
1[b] a phosphor bearing film arranged with the light emitting device, the phosphor bearing film comprising phosphor and a <u>silicone</u> carrier; and	7[b] a phosphor bearing film arranged with the light emitting device, the film comprising phosphor and a carrier, 8. The apparatus of claim 7 wherein the carrier comprises <u>silicone</u> .
2. The apparatus of claim 1, wherein the phosphor bearing film is 60%-80% phosphor.	7[c] wherein the phosphor bearing film is 60%-80% phosphor.
1[c] a <u>cured silicone</u> film on the phosphor bearing film, <u>the cured silicone film being substantially free of phosphor</u> .	7[d] a <u>rigid</u> film on the phosphor bearing film. 9. The apparatus of claim 7 wherein the rigid film comprises a <u>transparent cured silicone</u> film.
4. The apparatus of claim 3, further comprising a metallic package, wherein the light emitting device is in the metallic package.	10. The apparatus of claim 7, further comprising a metallic package, wherein the light emitting device is in the metallic package.
5. The apparatus of claim 4, wherein the phosphor bearing film is at least partially on a surface of the metallic package.	11. The apparatus of claim 10, wherein the phosphor bearing film is at least partially on a surface of the package.
6. The apparatus of claim 5, further comprising a heat sink, wherein the package is on the heat sink.	12. The apparatus of claim 10, further comprising a heat sink, wherein the package is on the heat sink.

244. Accordingly, Hussell renders claims 7-12 obvious for essentially the same reasons as claims 1, 2, and 4-6.

245. Regarding claim 9 and the additional requirement that the “*cured silicone film*” be “*transparent*”, I note, as I explained in Section IX.E.1 (limitation 1[c]), that Hussell discloses that cured silicone encapsulating material layer 109*b* (*i.e.*, the claimed “*cured silicone film*”) in Figure 1B and each of cured silicone encapsulating material layer 309*b* and cured silicone encapsulating material layer 317 (alone or together the claimed “*cured silicone film*”) in Figure 3, are all transparent.

246. I additionally note that Hussell would also render obvious claims 7-12 without consideration of the host diffuser particles 111 and 311 in the cured silicone film 109*b* and 309*b*. That is, claims 7-12 are broader in scope than claims 1, 2, and 4-6 in certain respects, *e.g.*, the rigid film / cured transparent silicone film does not need to be substantially phosphor free in claims 7-12, which further demonstrates that Hussell renders these claims obvious.

G. Ground 6: Blonder Renders Claims 1-5 and 7-11 Obvious

247. In my opinion, Blonder renders claims 1-5 and 7-11 obvious.

1. Claim 1

1[pre] “An apparatus comprising:”

248. Regardless of whether the preamble of claim 1 is found to be a limitation, Blonder discloses “*An apparatus*”, such as LED package assembly 200 in Figure 2, shown below. Ex. 1010 at [0018].

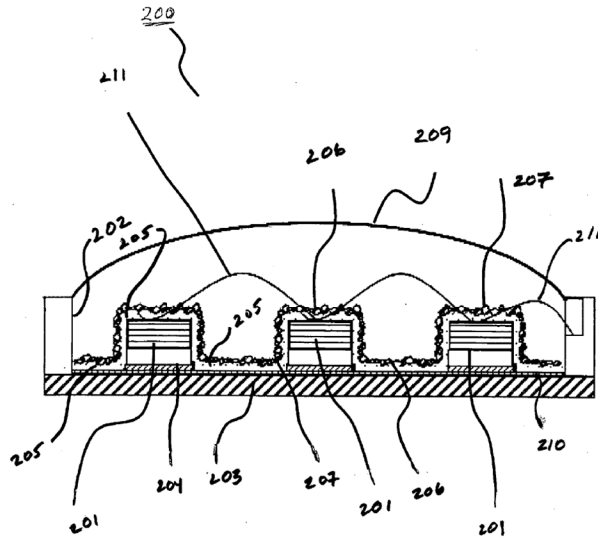


FIG. 2

Ex. 1010, FIG. 2.

1[a] “a light emitting device;”

249. Blonder discloses the claimed “a light emitting device”, in particular, **light emitting diodes (LEDs) 201** in Figure 2, shown below. Ex. 1010 at [0018], [0001], [0008].

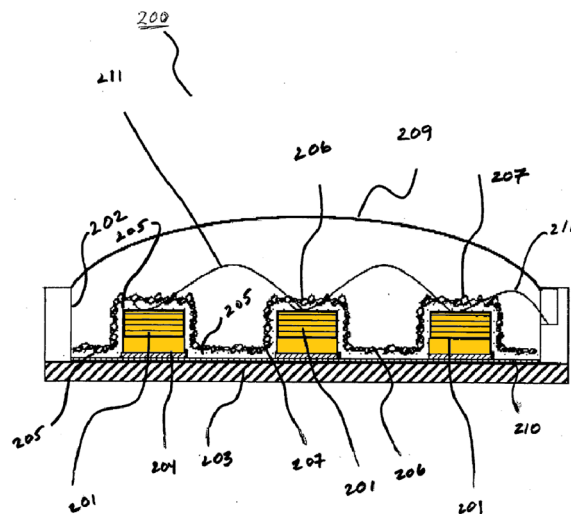


FIG. 2

Ex. 1010, FIG. 2 (coloring added to figure).

250. As I explained above in Section IX.B.1, a POSA would have understood that the claimed “*light emitting device*” in the context of the ’465 Patent corresponds to at least a light emitting diode (LED).

1[b] “a phosphor bearing film arranged with the light emitting device, the phosphor bearing film comprising phosphor and a silicone carrier; and”

251. Blonder discloses the claimed “*a phosphor bearing film arranged with the light emitting device, the phosphor bearing film comprising phosphor and a silicone carrier*”.

252. Blonder discloses “A transparent adhesive monolayer 205 [that] is placed on top of the multiple **LED bodies 201** and a **layer 206** of phosphor particles 207 is adhered overlying and over the sides of the bodies 201.” Ex. 1010 at [0018] (color added). Blonder also describes “monolayer 205” as a “first tacky transparent material 205”, which - according to Blonder - is a resin preferably made of silicone. Ex. 1010 at [0018], [0023]-[0024]. For example, Blonder describes that “first tacky transparent material 205” which “advantageously is a resin” and that “The preferred tacky transparent materials include but are not limited to partially cured silicones”. Ex. 1010 at [0018], [0023]-[0024]. Blonder further discloses that “The particles 207 of the phosphor layer coating can attach to the tacky layer 205 creating **a closed [sic: close] packed dense film layer 206**.” Ex. 1010 at

[0018] (color added). As can be seen in Figure 2, below, **close packed dense film layer 206** is over (and arranged with) **LEDs 201**.

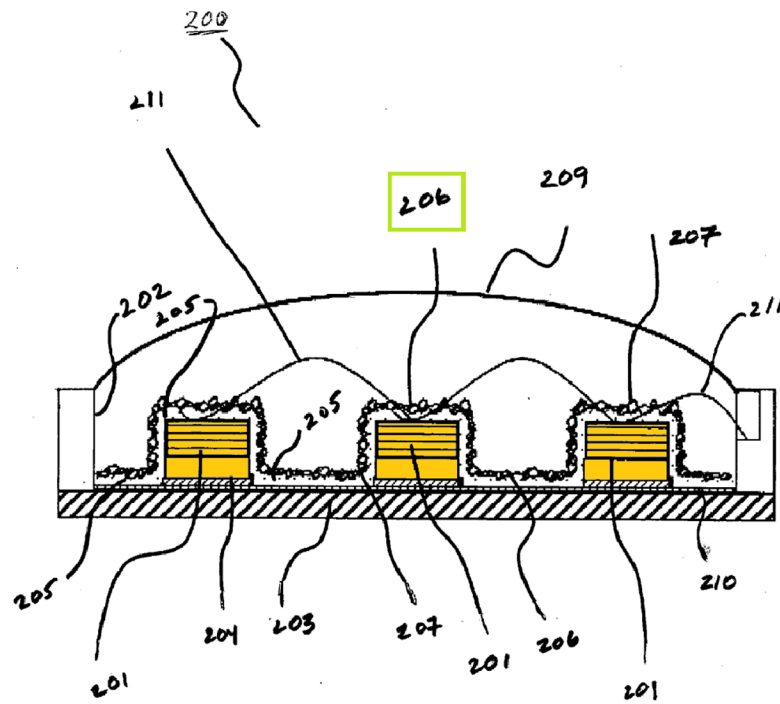


FIG. 2

Ex. 1010, FIG. 2 (coloring added to figure).

253. A POSA would have understood that this close packed dense film layer 206 - which consists of particles 207 and silicone resin in the space between the particles when the particles attach to the tacky silicone - corresponds to the claimed “*phosphor bearing film ... comprising phosphor and a silicone carrier.*” I again note that this is consistent with: (i) the position the Patent Owner took in district court (as I explained in Section VIII (regarding Term No. 1)); (ii) the applicant during prosecution describing a “carrier” as “a medium for ‘carrying,’ [] another substance,

which in this case is, for example, phosphor”, Ex. 1002 at 53; and (iii) the ’465 Patent which describes both a “phosphor bearing *layer* 302” and a “phosphor bearing *film* 302” comprising phosphor and silicone (*i.e.*, it uses “film” and “layer” interchangeably), Ex. 1001 at 5:50-6:47 (emphases added).

1[c] “a cured silicone film on the phosphor bearing film, the cured silicone film being substantially free of phosphor.”

254. It would have been obvious to include as part of Blonder’s Figure 2 the claimed “*a cured silicone film on the phosphor bearing film, the cured silicone film being substantially free of phosphor*”.

255. Blonder discloses to seal assembly 200 “with a **second transparent material 209** that can optionally create a dome or lens” which “minimizes TIR.” Ex. 1010 at [0018] (color added). Blonder explains that “TIR” refers to “total internal reflection”. Ex. 1010 at [0017]. Blonder also discloses that silicone is one of the “Useful materials” for the “transparent encapsulant” of assembly 200. Ex. 1010 at [0026]. That it, Blonder teaches to a POSA to use silicone as the transparent encapsulant for assembly 200 of Figure 2. According to Blonder, the transparent encapsulant “can serve two purposes”: (i) to “seal or encapsulate the cavity containing the coated LEDs,” and (ii) to “create a lens that minimizes TIR.” Ex. 1010 at [0026].

256. I note that Blonder does not specify that the second transparent material 209 would be “*cured*” silicone, but a POSA would have understood that silicone 209

would be cured (or logically thought do so). I again note that curing was a well-known, common technique conventionally used to harden silicone resins within cavities of LED packages such that the hardened silicone resin effectively protects the LED chip and components and prevents adhesion of foreign matter (as in Blonder and known in the field). Ex. 1008 at [0041], claim 8 of Yatsuda; Ex. 1006 at [0029], [0034], [0043]-[0044], [0046]; Ex. 1005 at [0002], [0012]; Ex. 1009 at [0014]-[0016], [0022]; Ex. 1025 at [0038], [0045], [0050]; Ex. 1024 at 526.

257. As further evidence that a POSA would have understood to cure silicone 209 in Blonder to achieve Blonder's objectives, I note that it is confirmed by the state of the art (including in each of Hussell, Shoji, Thompson, and Miyoshi). For example, Hussell uses "cured" and "hardened" interchangeably when explaining how to create a silicone encapsulant to encapsulate LEDs in LED packages, Ex. 1006 at [0029], [0034], [0043]-[0044], [0046]. Shoji teaches "a conventional method for forming a white LED lamp" includes curing resin to cover and protect the LED chip and further explains how to do so for silicone resin, Ex. 1005 at [0002], [0012]. Thompson similarly explains to cure silicone encapsulant over an LED in LED packages, Ex. 1009 at [0014]-[0016], [0022]. And Miyoshi teaches that cured silicone resin, among other things, encapsulates and protects the LED in the package. Ex. 1025 at [0038], [0045], [0050].

258. Consistent with the disclosure in Blonder, Figure 2, below, shows that **film layer 206** (i.e., the claimed “phosphor bearing film”) includes phosphor 207 while **second transparent material 209** on **film layer 206** (i.e., the claimed “a cured silicone film on the phosphor bearing film”) does not contain any phosphor. Ex. 1010 at [0018].

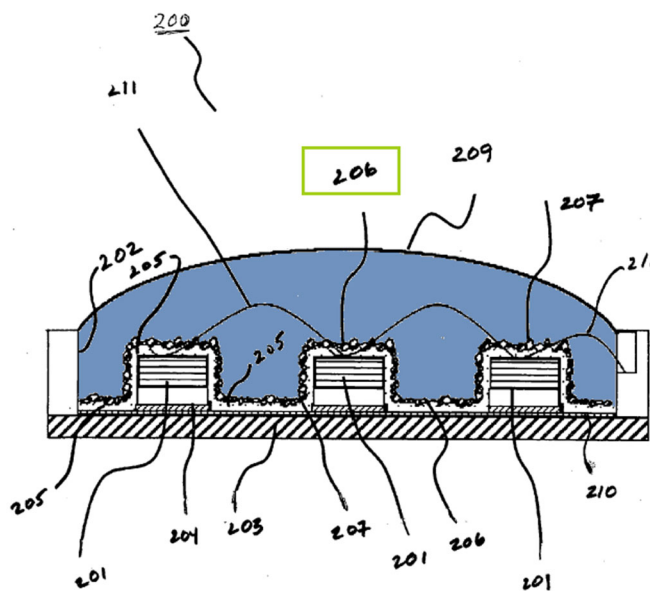


FIG. 2

Ex. 1010, FIG. 2 (coloring added to figure).

2. Claim 2

“2. The apparatus of claim 1, wherein the phosphor bearing film is 60%-80% phosphor.”

259. Blonder discloses and renders obvious the claimed “wherein the phosphor bearing film is 60%-80% phosphor” (under both the weight and volume

interpretations). Blonder also renders claim 1 obvious, from which claim 2 depends, as I explained above.

260. As I discussed regarding claim 1, Blonder discloses that “The particles 207 of the phosphor layer coating can attach to the tacky layer 205 creating a **closed [sic: close] packed dense** film layer 206.” Ex. 1010 at [0018] (emphasis added). Blonder further discloses that “The adhesion mechanism that holds the particle layer can involve many mechanisms of particle-to-particle bonding,” such as “mechanical interlocking, molecular forces, Vanderwaals adhesion forces, capillary, electrostatic, magnetic, and free chemical forces,” and how to increase the packing density of phosphor particles:

The monolayer of frequency converting particles can be a layer of particles or an organic film layer that includes the particles. **The adhesion mechanism that holds the particle layer can involve many mechanisms of particle-to-particle bonding. Among them are mechanical interlocking, molecular forces, Vanderwaals adhesion forces, capillary, electrostatic, magnetic, and free chemical forces. In most cases, the strength of the particle-to-particle particle bond depends on the contact pressure and surface area of contact between particles.** The key is to create a dust or mist comprising the particles over the tacky film.

The control of the powder quality such as the particle size distribution, shape, and composition of the constituents has major influence on the development of the particle monolayer. Increasing the packing density in powders is usually accomplished by filling the interstices between large particles with smaller particle sizes.

Ex. 1010 at [0028]-[0029] (emphasis added).

261. As evidenced by the disclosure in Blonder, Blonder teaches to create a close packed dense film layer 206 consisting of phosphor particles 207 that are included in the organic film that is preferably silicone resin. Ex. 1010 at [0023], [0028].

262. A POSA would have understood that Blonder's close packed dense film layer 206 would result in approximately 74% phosphor by volume if the phosphor particles were spherical, which is inherent to the definition of close packed. Ex. 1027 at 16 (Introduction to Materials Science textbook explaining that the packing factor for a close packed structure is 74% by volume); Ex. 1023 at 31 (similarly explaining that close packed structures result in packing factor of 74% by volume). Qualities such as the particle size distribution and shape have a "major influence on the development of the particle monolayer." Ex. 1010 at [0029]. A POSA would have known that such a size and shape distribution may result in higher or lower percentages by volume, and that 74% by volume, identified by the term "close packed" is a reasonable value. That is, a POSA would have understood that Blonder's disclosure of the term close packed, yielding an approximately 74% packing by volume, is a point within the claim range.

263. I further note that Blonder's teachings—when considered in the context of the knowledge of a POSA—would apply to both the "by-weight" or "by-volume" interpretations of the claimed range, as it would simply be a routine adjustment of

the phosphor concentration in the close packed dense film layer 206 (*e.g.*, by adjusting “particle size distribution, shape, and composition” of the powder, Ex. 1010 at [0029]), consistent with teachings in Blonder to create a thin, close packed dense film. For example, as I explained in Section IX.C.2 above, consistent with the knowledge of a POSA, a POSA would have readily understood how to adjust the phosphor concentration in order to optimize it for the particular application and LED package (using the techniques described in Blonder to create close packed dense film layer 206, consisting of particles 207 included in the silicone resin when the particles attach to the tacky silicone, such as those described in paragraph [0028] of Blonder that I discussed above). As I also explained in Section IX.C.2 above, a POSA would have understood the need and desire to do so, for example, based on film thickness, desired color temperature, and/or desired color of light to be emitted. Ex. 1007 at [0103], [0145]; Ex. 1011 at 7:47-8:3; Ex. 1009 at [0008], [0054], [0061]; Ex. 1005 at [0006]-[0007]; Ex. 1031 at 7:48-52, 10:36-44, 15:2-10, FIG. 17, Table 1. I again note, as I explained above in Section IX.B.2, that there was nothing important or critical about the claimed range, which is further confirmed by the ’465 Patent itself.

3. Claim 3

“3. The apparatus of claim 1, wherein the phosphor bearing film is at least partially on the light emitting device.”

264. Blonder discloses and renders obvious the claimed “*wherein the phosphor bearing film is at least partially on the light emitting device*”. Blonder also renders claim 1 obvious, from which claim 3 depends, as I explained above.

265. Figure 2, below, shows **film layer 206** (i.e., the claimed “*phosphor bearing film*”) is at least partially on **LEDs 201**. Ex. 1010 at [0018].

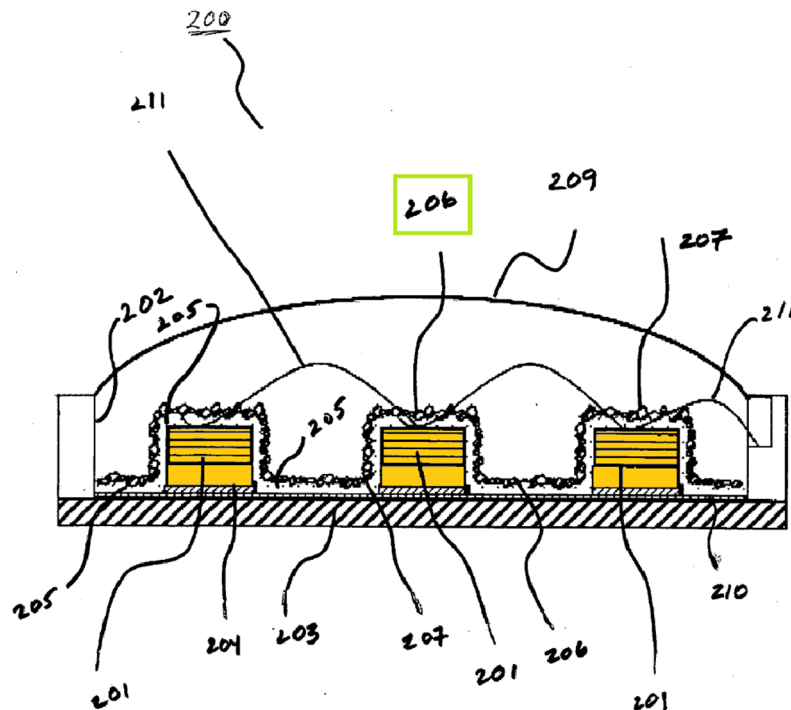


FIG. 2

Ex. 1010, FIG. 2 (coloring added to figure).

266. I again note the '465 Patent's teaching that “It will be understood that when an element such as a region, layer, section, substrate, or the like, is referred to

as being ‘on’ another element, it can be directly on the other element or intervening elements may also be present.” Ex. 1001 at 3:1-4. In other words, Blonder’s disclosure is consistent with the ’465 Patent.

4. Claim 4

“4. The apparatus of claim 3, further comprising a metallic package, wherein the light emitting device is in the metallic package.”

267. Blonder discloses and renders obvious the claimed “*a metallic package, wherein the light emitting device is in the metallic package*”. Blonder also renders claims 1 and 3 obvious, from which claim 4 depends, as I explained above.

268. Blonder discloses that “**Substrate 203** advantageously comprises a highly thermally conductive metal such as copper, tungsten or molybdenum and/or a highly thermally conductive ceramic,” such as aluminum nitride, silicon carbide, or aluminum oxide. Ex. 1010 at [0019] (color added). As I explained above (for example, in Section IX.C.3), such highly thermally conductive ceramic qualifies as “metallic” where the claimed “*metallic*” encompasses highly thermally conductive materials that enable heat dissipation from the device (per the description of “metallic” in the ’465 Patent, Ex. 1001 at 3:61-64, 6:35-39). And regardless, the various metals (such as copper) disclosed in Blonder qualify as well. Ex. 1010 at [0019]. Blonder also discloses “**ceramic cavity 202**,” Ex. 1010 at [0018] (color added). A POSA would have understood that the cavity is also made of highly

thermally conductive material (or at least would have thought to do so) for the reasons the reasons I explained in Sections IX.C.1 and IX.C.3 (for example, among other reasons, for improved heat dissipation). I further note that Blonder treats the cavity as part of the substrate, disclosing, for example, that the “substrate [has] a surface and a cavity in the surface.” Ex. 1010 at [0008], Abstract, claim 1 of Blonder.

269. Based on the above, a POSA would have understood that the **substrate 203**, alone or with **cavity 202**, corresponds to the claimed “*metallic package*” with **LEDs 201** mounted therein, as shown in Figure 2, below.

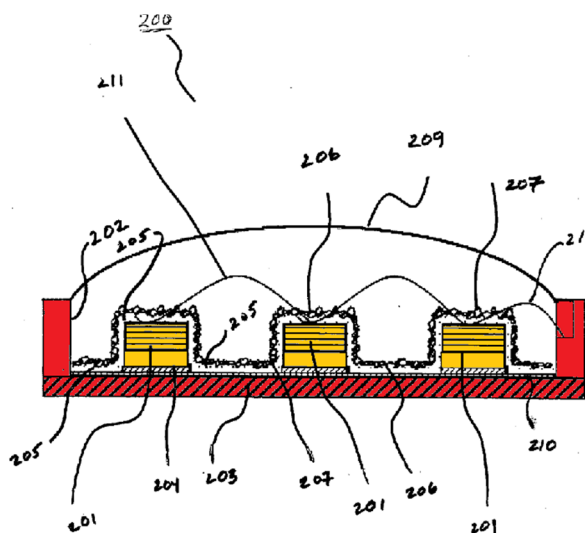


FIG. 2

Ex. 1010, FIG. 2 (coloring added to figure).

5. Claim 5

“5. The apparatus of claim 4, wherein the phosphor bearing film is at least partially on a surface of the metallic package.”

270. Blonder discloses and renders obvious the claimed “*wherein the phosphor bearing film is at least partially on a surface of the metallic package*”.

Blonder also renders claims 1, 3, and 4 obvious, from which claim 5 depends, as I explained above.

271. Figure 2, below, shows **film layer 206** is at least partially on a surface of **substrate 203**. Ex. 1010 at [0018]. I again note the '465 Patent's teaching that “It will be understood that when an element such as a region, layer, section, substrate, or the like, is referred to as being ‘on’ another element, it can be directly on the other element or intervening elements may also be present.” Ex. 1001 at 3:1-4.

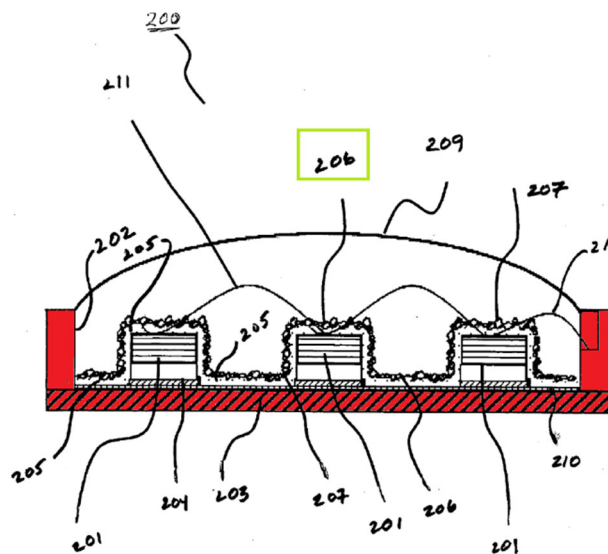


FIG. 2

Ex. 1010, FIG. 2 (coloring added to figure).

6. Claims 7-11

272. As I explained above in Section IX.B.6, claims 7-11 are highly similar to claims 1, 2, 4, and 5 (and are effectively the same relevant to my opinions regarding patentability). I have repeated the table below, again with certain terms underlined.

Claims 1-2, 4-5	Claims 7-11
1[pre] An apparatus comprising:	7[pre] An apparatus comprising:
1[a] a light emitting device;	7[a] a light emitting device;
1[b] a phosphor bearing film arranged with the light emitting device, the phosphor bearing film comprising phosphor and a <u>silicone</u> carrier; and	7[b] a phosphor bearing film arranged with the light emitting device, the film comprising phosphor and a carrier, 8. The apparatus of claim 7 wherein the carrier comprises <u>silicone</u> .
2. The apparatus of claim 1, wherein the phosphor bearing film is 60%-80% phosphor.	7[c] wherein the phosphor bearing film is 60%-80% phosphor.
1[c] a <u>cured silicone</u> film on the phosphor bearing film, <u>the cured silicone film being substantially free of phosphor</u> .	7[d] a <u>rigid</u> film on the phosphor bearing film. 9. The apparatus of claim 7 wherein the rigid film comprises a <u>transparent cured silicone</u> film.
4. The apparatus of claim 3, further comprising a metallic package, wherein the light emitting device is in the metallic package.	10. The apparatus of claim 7, further comprising a metallic package, wherein the light emitting device is in the metallic package.
5. The apparatus of claim 4, wherein the phosphor bearing film is at least partially on a surface of the metallic package.	11. The apparatus of claim 10, wherein the phosphor bearing film is at least partially on a surface of the package.

273. Accordingly, Blonder renders claims 7-11 obvious for essentially the same reasons as claims 1, 2, and 4-5.

274. Regarding claim 9 and the additional requirement that the “*cured silicone film*” be “*transparent*”, I note, as I explained in Section IX.G.1 (limitation 1[c]), Blonder discloses that “second transparent material 209” (*i.e.*, the claimed “*cured silicone film*” after curing) is transparent. Ex. 1010 at [0018].

275. I additionally note that Blonder would still render obvious claims 7-11 regardless of whether the second transparent material 209 is substantially phosphor free (although it is, as I have explained).

H. Ground 7: Blonder Alone or in View of Yatsuda Renders Claims 6 and 12 Obvious

276. In my opinion, Blonder by itself or in view of Yatsuda renders claims 6 and 12 obvious. I explain in this section how Blonder by itself, or when viewed with Yatsuda, renders claims 6 and 12 obvious. I first provide an overview of a POSA’s motivation to combine the references, and why a POSA would have had no technical difficulty in doing so and would have expected it to work. I then explain how Blonder by itself or with Yatsuda renders the claims obvious.

1. Motivation to Combine and Reasonable Expectation of Success

277. A POSA would have been motivated and had a reasonable expectation of success - and in fact, a high expectation - for example, to apply the teachings of Yatsuda regarding its heat sink to Figure 2 of Blonder.

278. As an initial matter, Blonder and Yatsuda are in the same field as each other and the '465 Patent (LED packaging for lighting devices). Ex. 1010 at Abstract, [0001]; Ex. 1008 at Abstract, [0003]-[0009]; Ex. 1001 at 1:15-51.

279. Blonder and Yatsuda are directed to the same problem: improved LED packages for efficient light extraction in, for example, LED packages including phosphors in silicone Ex. 1010 at [0002]-[0009], [0018], [0024]; Ex. 1008 at [0005]-[0015]. The '465 Patent is also directed to the same problem. Ex. 1001 at 1:18-51. And they all solve the problem in the same way: an LED apparatus with a first film comprising phosphor in a silicone carrier and a second film that may be, for example, a rigid or transparent cured silicone film that may be substantially phosphor free. Ex. 1010 at [0018]-[0024]; Ex. 1008 at [0033]-[0041]; Ex. 1001 at 6:12-47.

280. As is evident by my explanation in Section IX.A.2, Blonder and Yatsuda also have highly similar and complementary disclosures. This is evident, for example, by comparing figures and disclosure in the references, such as comparing Blonder's Figure 2, below left, to Yatsuda's Figure 4, below right. Note, for example, the **LED chip** mounted in a **package well**, with a **first film** that

comprises phosphor in a silicone carrier and a **second transparent silicone film** that is free of phosphor.

Blonder

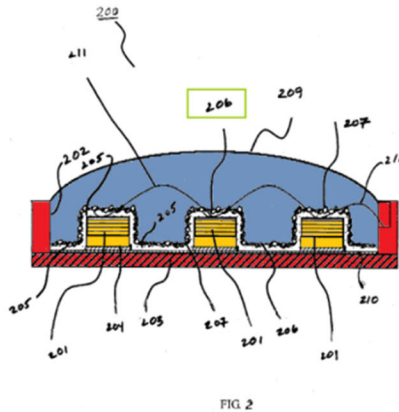
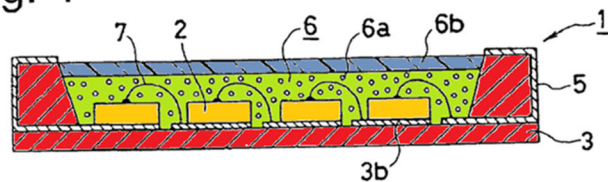


FIG. 2

Yatsuda

Fig. 4



Ex. 1010, FIG. 2 (left, coloring added to figure); Ex. 1008, FIG. 4 (right, coloring added to figure).

281. The similarities are further evident in view of Figures 2 and 3 of Yatsuda, shown below (which are just like Figure 4 of Yatsuda, without the additional second film applied):

Fig. 2

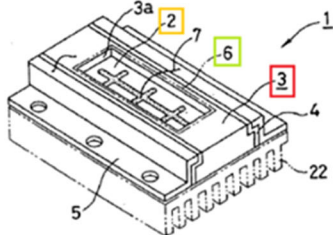
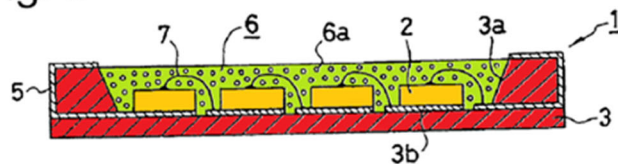


Fig. 3



Ex. 1008, FIGs. 2-3 (coloring added to figures).

282. A POSA would also have had motivation to mount Blonder's highly thermally conductive substrate to a heat sink in order to further improve heat dissipation - this was a known goal and method in the LED packaging field for dissipating heat generated by the LED chip. Ex. 1008 at [0033], FIGs. 2-4; Ex. 1013 at [0117], [0127]-[0128], [0137]-[0138]; Ex. 1014 at 192; Ex. 1016 at [0017], [0019]-[0020], [0024], [0027]-[0028]; Ex. 1030 at [0086]-[0087]. Indeed, Yatsuda teaches the use of a heat sink attached to an already highly thermally conductive package:

In the LED lamp 1, an electric current can be applied to the LED chip 2 (as much as possible), to obtain as much amount of light as possible. Accordingly, in this case, the base 3 on which the LED chip 2 is mounted **should be made of a material being superior in heat conductivity, such as a metal like copper (refer to FIG. 2), a ceramic like AlN (aluminum nitride) (refer to FIG. 3), and the like.** The thickness of the base 3 should be sufficient, if desired, **for thermal diffusion after connecting with a heat sink 22 in its rear surface.**

Ex. 1008 at [0033] (emphases added).

283. A POSA would also have understood that there were known advantages to the additional heat sink, including to improve heat dissipation and package performance, and that it would have been a simple addition to mount that package to a heat sink. Ex. 1008 at [0033], [0036], FIGs. 2-4; Ex. 1016 at [0017], [0019]-[0020], [0024], [0027]-[0028]; Ex. 1030 at [0086]-[0087].

284. I again note that the '465 Patent does not explain how to construct its metallic package or heat sink, but rather states only to include them (consistent with the knowledge of a POSA that such polishing or plating were readily known). *See generally* Ex. 1001.

285. I explain below further reasons why a POSA would have applied the heat sink teachings of Yatsuda to Blonder.

2. Claims 6 and 12

“6. The apparatus of claim 5, further comprising a heat sink, wherein the package is on the heat sink.”

“12. The apparatus of claim 10, further comprising a heat sink, wherein the package is on the heat sink.”

286. Blonder alone or in view of Yatsuda also renders obvious claims 6 and 12. As I explained above, Blonder renders obvious claims 1 and 3-6, and 7 and 10 from which claims 6 and 12 depend, respectively.

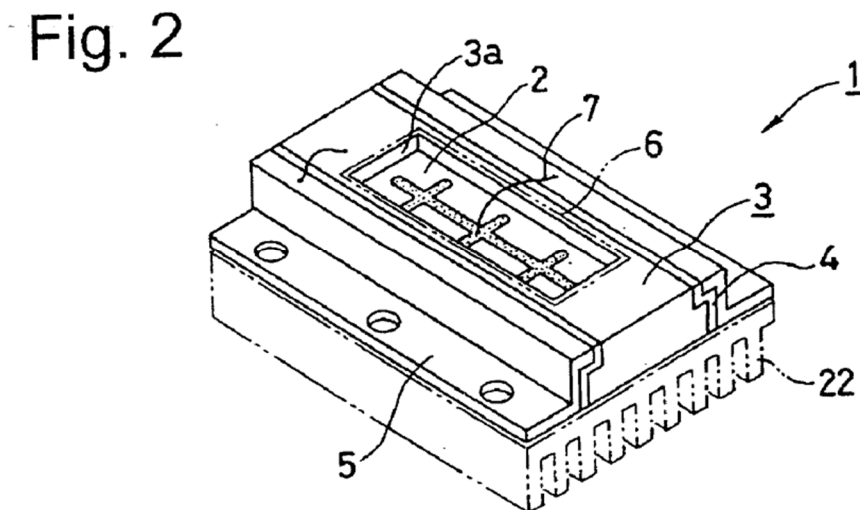
287. Blonder discloses that its substrate 203 may include a heat sink and “Most of the heat generated by the LED during operation can be carried away from the diode through the substrate.” Ex. 1010 at [0019], [0022].

288. Yatsuda teaches that when maximizing light output (and therefore applying as much electrical current as possible to the LED chip), to most effectively dissipate heat, it is advantageous to include (i) a metal or highly thermally conductive base package and (ii) a further heat sink on which that package is mounted:

In the LED lamp 1, an electric current can be applied to the LED chip 2 (as much as possible), to obtain as much amount of light as possible. Accordingly, in this case, the base 3 on which the LED chip 2 is mounted should be made of a material being superior in heat conductivity, such as a metal like copper (refer to FIG. 2), a ceramic like AlN (aluminum nitride) (refer to FIG. 3), and the like. The thickness of the base 3 should be sufficient, if desired, for thermal diffusion after connecting with a heat sink 22 in its rear surface.

Ex. 1008 at [0033] (emphases added).

289. Base 3 on heat sink 22 can be seen in Figure 2 of Yatsuda, below:



Ex. 1008, FIG. 2.

290. As I explained in Section IX.C.1, a POSA would also have understood the known advantages and ease of implementation to attach such a heat sink to a package to further improve heat dissipation. Indeed, the advantages and known implementation were well known in the LED packaging field (and more generally as well), as I explained in Section IX.C.1. This is further evidenced by the state of

the art: (i) Cao explains that heat sinks in LED packages improve thermal dissipation and can be mounted using various conventional means, Ex. 1016 at [0017], [0024], [0027]-[0028]; (ii) Baek explains to mount a “heat radiating plate”, *i.e.*, a heat sink, to the underside of a base member, *e.g.*, a metal substrate, to “further enhance heat dissipating characteristics of the high power LED package”, Ex. 1030 at [0086]-[0087]; (iii) Baek also explains that the base member may be, *e.g.*, a metal substrate or metal lead frame to dissipate heat, Ex. 1030 at [0065]-[0066]; (iv) Sanpei explains that including a heat sink improves the heat-radiating property of a metal baseboard and “thus is preferable in suppressing increase in temperature of the semiconductor light-emitting devices”, Ex. 1013 at [0117], [0127]-[0128], [0137]-[0138]; and (v) Schubert explains that “Power [LED] packages have a *direct, thermally conductive path* from the LED chip, through the package, to a heat sink, *e.g.* a printed circuit board. The power package shown in the figure has several advanced features. Firstly, the package contains an Al or Cu heatsink slug with low thermal resistivity to which the LED submount is soldered by a metal-based solder.” Ex. 1014 at 192 (emphasis in original).

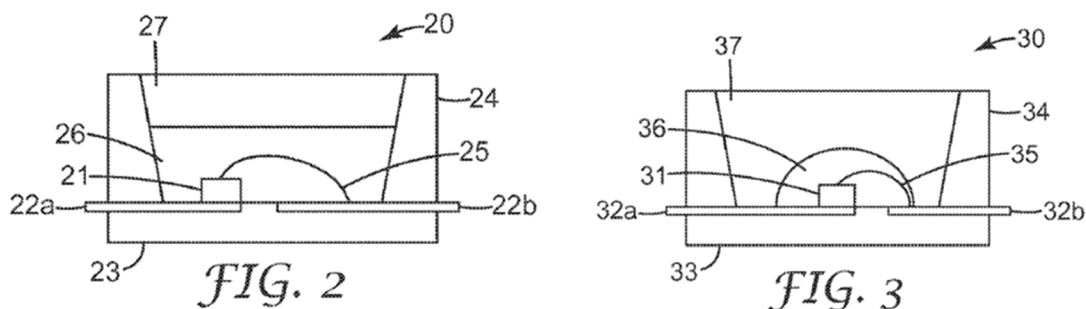
I. Ground 8: Thompson Anticipates Claims 1-3 and 7-9

291. In my opinion, Thompson discloses all of the limitations of claims 1-3 and 7-9, arranged as in the claims, for example, in each of its Figure 2 and Figure 3 embodiments. Thus, it is my opinion that Thompson anticipates these claims.

1. Claim 1

1[pre] “An apparatus comprising:”

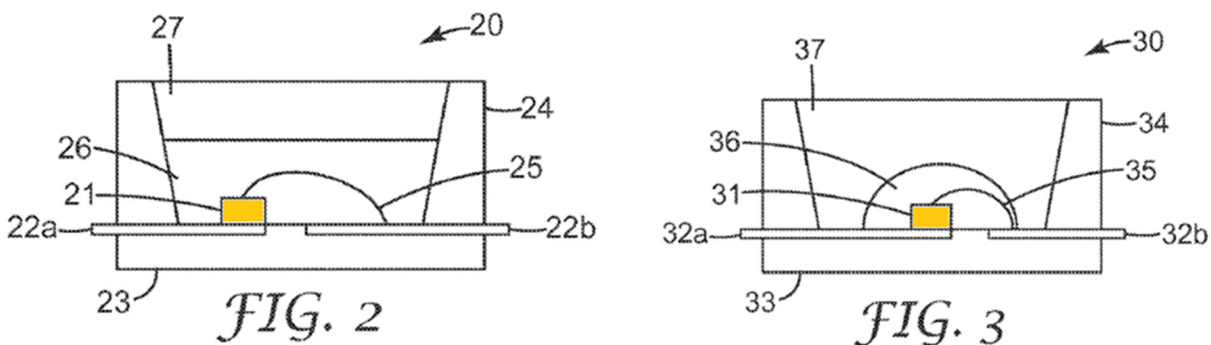
292. Regardless of whether the preamble of claim 1 is found to be a limitation, Thompson discloses “*An apparatus*”, such as “exemplary LED light emitting device[s]” 20 and 30 in Figures 2 and 3, below. Ex. 1009 at [0015], [0058].



Ex. 1009, FIGs. 2-3.

1[a] “a light emitting device;”

293. Thompson discloses the claimed “*a light emitting device*”, in particular, **LED dies 21 and 31** in Figures 2 and 3, respectively, shown below. Ex. 1009 at [0015], [0058].



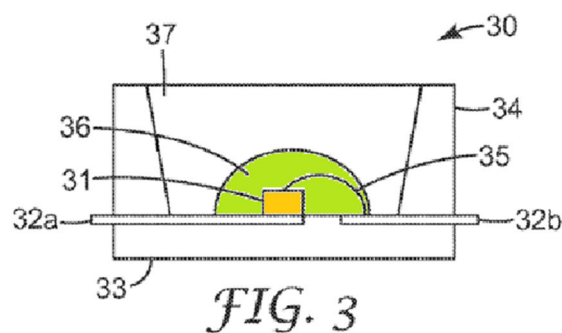
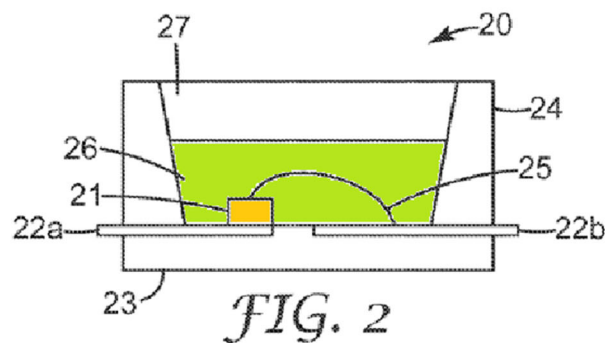
Ex. 1009, FIGs. 2-3 (coloring added to figures).

294. As I explained above in Section IX.B.1, a POSA would have understood that the claimed “*light emitting device*” in the context of the ’465 Patent corresponds to at least a light emitting diode (LED).

1[b] “a phosphor bearing film arranged with the light emitting device, the phosphor bearing film comprising phosphor and a silicone carrier; and”

295. Thompson discloses the claimed “*a phosphor bearing film arranged with the light emitting device, the phosphor bearing film comprising phosphor and a silicone carrier*”, for example, first encapsulant layer 26 and first encapsulant layer 36 in Figures 2 and 3, respectively, that cover LED dies 21 and 31, respectively. Ex. 1009 at [0015], [0058].

296. Figures 2 and 3, below, depict **first encapsulant layers 26 and 36**, respectively. Ex. 1009, at [0015], [0058]. According to Thompson, the first encapsulant may be a silicone encapsulant with phosphors carried therein that “adjust[s] the color emitted from the LED.” Ex. 1009 at [0017], [0019], [0024]-[0025], [0050], [0054]. In Figures 2 and 3, **first encapsulant layers 26 and 36**, respectively, are over and arranged with **LED dies 21 and 31**, respectively.



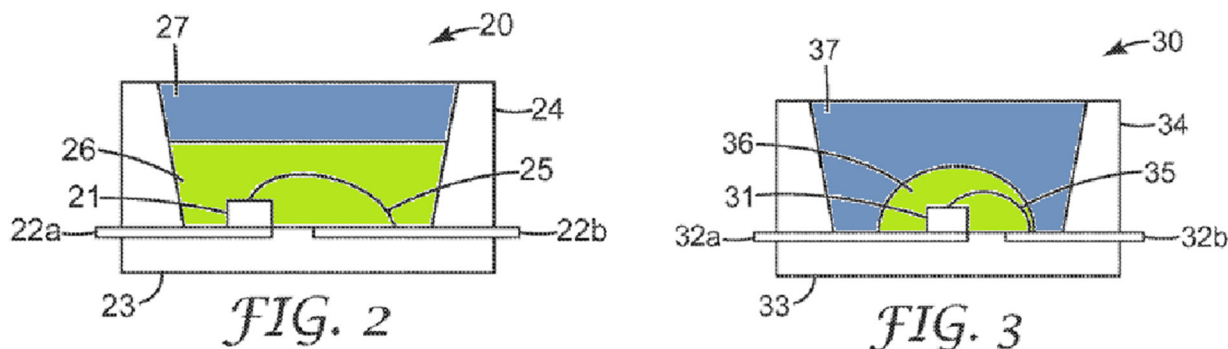
Ex. 1009, FIGs. 2-3 (coloring added to figures).

297. I again note that this is consistent with: (i) the position the Patent Owner took in district court (as I explained in Section VIII (regarding Term No. 1)); (ii) the applicant during prosecution describing a “carrier” as “a medium for ‘carrying,’ [] another substance, which in this case is, for example, phosphor”, Ex. 1002 at 53; and (iii) the ’465 Patent which describes “mixing” phosphor and silicone and a “phosphor bearing *layer* 302” and “phosphor bearing *film* 302” comprising phosphor and silicone (*i.e.*, it uses “film” and “layer” interchangeably), Ex. 1001 at 5:50-6:47 (emphases added).

1[c] “a cured silicone film on the phosphor bearing film, the cured silicone film being substantially free of phosphor.”

298. Thompson discloses the claimed “*a cured silicone film on the phosphor bearing film, the cured silicone film being substantially free of phosphor*”, for example second encapsulant layers 27 and 37 that are on first encapsulant layers 26 and 36, respectively. Ex. 1009 at [0014]-[0016], [0022], [0058], [0062].

299. In Figures 2 and 3, below, Thompson discloses that **second encapsulants 27 and 37** are (i) on **first encapsulant layers 26 and 36**, respectively, and (ii) layers made of silicone that have been cured. Ex. 1009 at [0014]-[0016], [0022], [0058], [0062].



Ex. 1009, FIGs. 2-3 (coloring added to figures).

300. Thompson discloses that these encapsulants form a “hard outer surface” that “resists scratching and other types of physical defects that might otherwise affect the optical characteristics of light emitted by the device.” Ex. 1009 at [0014]-[0016]. Thompson teaches that such encapsulants are transparent organic resins and that its invention is directed to such transparent resins, Ex. 1009 at [0002]-[0004], [0052], and a POSA would have understood from this that the encapsulants are transparent.

301. A POSA would further have understood that second encapsulants 27 and 37 are substantially free of phosphor, given Thompson’s disclosure that the phosphors are optional in each of the first and second encapsulants: (i) “The first **and/or** second encapsulants **can** comprise one or more additives selected from the

group consisting of ... phosphors” (emphasis added), Ex. 1009 at [0050]; and (ii) “Phosphors **can optionally** be included in the encapsulating material”, Ex. 1009 at [0054] (emphasis added).

302. Based on the above, a POSA would have understood that the **second encapsulant layers 27 and 37** are: (i) cured silicone film; (ii) on **first encapsulant layers 26 and 36**, respectively (*i.e.*, the claimed “*phosphor bearing film*”); and (iii) substantially free of phosphor (and, in fact, have no phosphor at all).

2. Claim 2

“The apparatus of claim 1, wherein the phosphor bearing film is 60%-80% phosphor.”

303. Thompson discloses the claimed “*wherein the phosphor bearing film is 60%-80% phosphor*”. Thompson also discloses claim 1, from which claim 2 depends, as I explained above.

304. Thompson discloses that “If used, the phosphor particles are preferably included in the encapsulating material in an amount of no greater than 85 wt-%, and in an amount of at least 1 wt-%, based on the total weight of the encapsulating material.” Ex. 1009 at [0054]. Thompson further discloses that “The amount of phosphor used will be adjusted according to the thickness of the siloxane layer containing the phosphor and the desired color of the emitted light.” Ex. 1009 at [0054]. Thus, Thompson discloses a range that overlaps with the claim range. I again

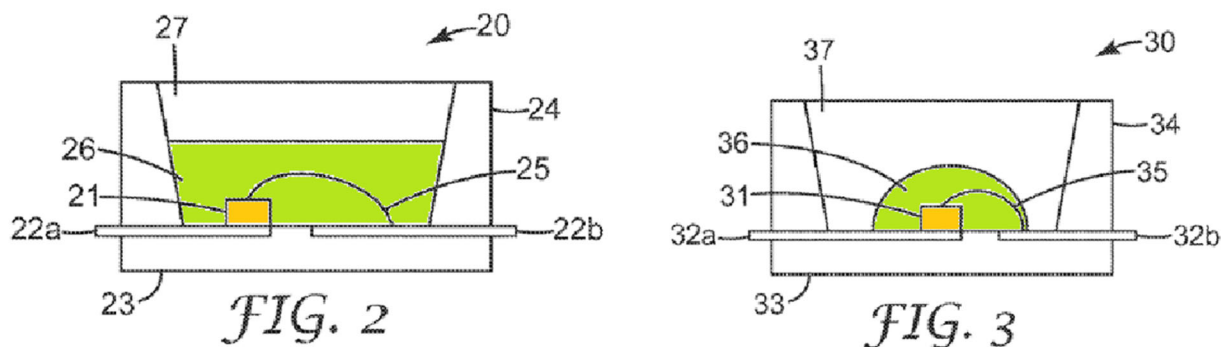
note, as I explained above in Section IX.B.2, that there was nothing important or critical about the claimed range, which is further confirmed by the '465 Patent itself.

3. Claim 3

“The apparatus of claim 1, wherein the phosphor bearing film is at least partially on the light emitting device.”

305. Thompson discloses the claimed “*wherein the phosphor bearing film is at least partially on the light emitting device*”, for example, the first encapsulant layers in Figures 2 and 3 are at least partially on LED dies 21 and 31, respectively. Thompson also discloses claim 1, from which claim 3 depends, as I explained above.

306. Figures 2 and 3, below, show **first encapsulant layers 26 and 36** (i.e., the claimed “*phosphor bearing film*”) are at least partially on with **LED dies 21 and 31**, respectively. Ex. 1009, at [0015], [0058].



Ex. 1009, FIGs. 2-3 (coloring added to figures).

307. I again note the '465 Patent's teaching that “It will be understood that when an element such as a region, layer, section, substrate, or the like, is referred to as being ‘on’ another element, it can be directly on the other element or intervening

elements may also be present.” Ex. 1001 at 3:1-4. In other words, Thompson’s disclosure is consistent with the ’465 Patent.

4. Claims 7-9

308. As I explained above in Section IX.B.6, claims 7-9 are highly similar to claims 1 and 2 (and are effectively the same relevant to my opinions regarding patentability). I have repeated the table below, again with certain terms underlined.

Claims 1, 2	Claims 7-9
1[pre] An apparatus comprising:	7[pre] An apparatus comprising:
1[a] a light emitting device;	7[a] a light emitting device;
1[b] a phosphor bearing film arranged with the light emitting device, the phosphor bearing film comprising phosphor and a <u>silicone</u> carrier; and	7[b] a phosphor bearing film arranged with the light emitting device, the film comprising phosphor and a carrier, 8. The apparatus of claim 7 wherein the carrier comprises <u>silicone</u> .
2. The apparatus of claim 1, wherein the phosphor bearing film is 60%-80% phosphor.	7[c] wherein the phosphor bearing film is 60%-80% phosphor.
1[c] a <u>cured silicone</u> film on the phosphor bearing film, <u>the cured silicone film being substantially free of phosphor</u> .	7[d] a <u>rigid</u> film on the phosphor bearing film. 9. The apparatus of claim 7 wherein the rigid film comprises a <u>transparent cured silicone</u> film.

309. Accordingly, Thompson anticipates claims 7-9 obvious for essentially the same reasons as claims 1 and 2.

310. Regarding claim 9 and the additional requirement that the “*cured silicone film*” be “*transparent*”, I note, as I explained in Section IX.I.1 (limitation

1[c]), a POSA would have understood that Thompson's second encapsulant layers 27 and 37 (*i.e.*, the claimed "*cured silicone film*") are transparent. Ex. 1009 at [0002]-[0004], [0052].

311. I additionally note that Thompson would still render anticipate claims 7-9 without consideration of whether the second encapsulant layers are substantially phosphor free (although they are, as I have explained).

J. Ground 9: Thompson Alone or in View of Yatsuda and/or Nii Renders Claims 1-12 Obvious

312. In my opinion, Thompson by itself or in view of Yatsuda and/or Nii renders claims 1-12 obvious. I explain in this section how Thompson by itself, or when viewed with Yatsuda and/or Nii, renders claims 1-12 obvious. I first provide an overview of a POSA's motivation to combine the references, and why a POSA would have had no technical difficulty and expected it to work. I then explain how Thompson by itself or with Yatsuda renders the claims obvious.

1. Motivation to Combine and Reasonable Expectation of Success

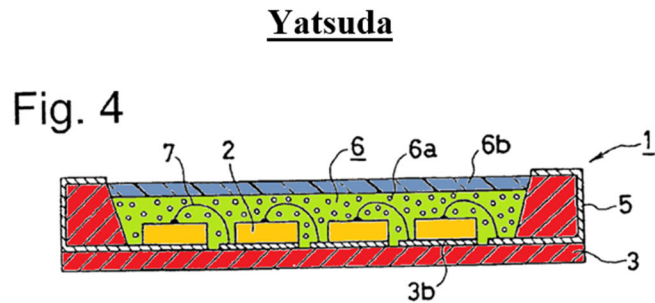
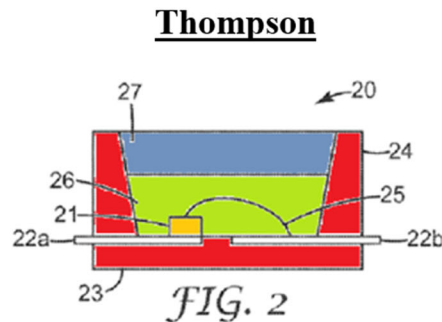
313. A POSA would have been motivated and had a reasonable expectation of success in combining the references - and in fact, a high expectation - for example, to apply the teachings of Yatsuda regarding its metallic package and heat sink to Figures 2 and 3 of Thompson. The same is true for Nii's teachings concerning particular phosphors and silicone.

314. As an initial matter, Thompson, Yatsuda, and Nii are in the same field as each other and the '465 Patent (LED packaging for lighting devices). Ex. 1009 at [0002]-[0004]; Ex. 1008 at Abstract, [0003]-[0009]; Ex. 1026 at Abstract, [0002]; Ex. 1001 at 1:15-51.

315. Thompson, Yatsuda, and Nii are directed to the same problem: improved LED packages for efficient light extraction in, for example, LED packages including phosphors in silicone. Ex. 1009 at [0004]-[0009]; Ex. 1008 at [0005]-[0015]; Ex. 1026 at [0075]-[0082], [0090]-[0091], [0112]-[0113]. The '465 Patent is likewise directed to the same problem. Ex. 1001 at 1:18-51. And they all solve the problem in the same way: an LED apparatus with a first film comprising phosphor in a silicone carrier and a second film that may be, for example, a rigid or transparent cured silicone film that may be substantially phosphor free. Ex. 1009 at [0015], [0058]; Ex. 1008 at [0033]-[0041]; Ex. 1026 at [0075]-[0082], [0090]-[0091], [0112]-[0113]; Ex. 1001 at 6:12-47.

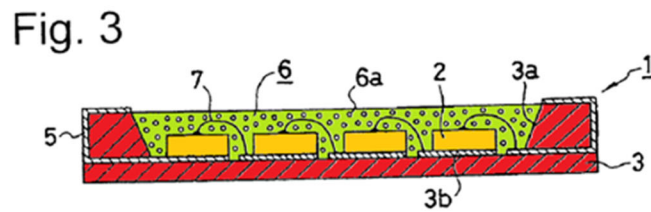
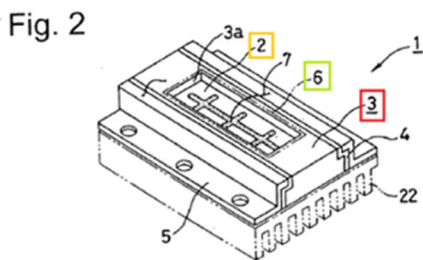
316. As is evident by my explanation in Section IX.A.2, Thompson, Yatsuda, and Nii also have highly similar and complementary disclosures. This is evident, for example, by comparing figures and disclosure in the references, such as comparing Thompson's Figure 2, below left, to Yatsuda's Figure 4, below right. Note, for example, the **LED chip** mounted in a **package well**, with a **first film** that

comprises phosphor in a silicone carrier and a **second transparent silicone film** that is free of phosphor.



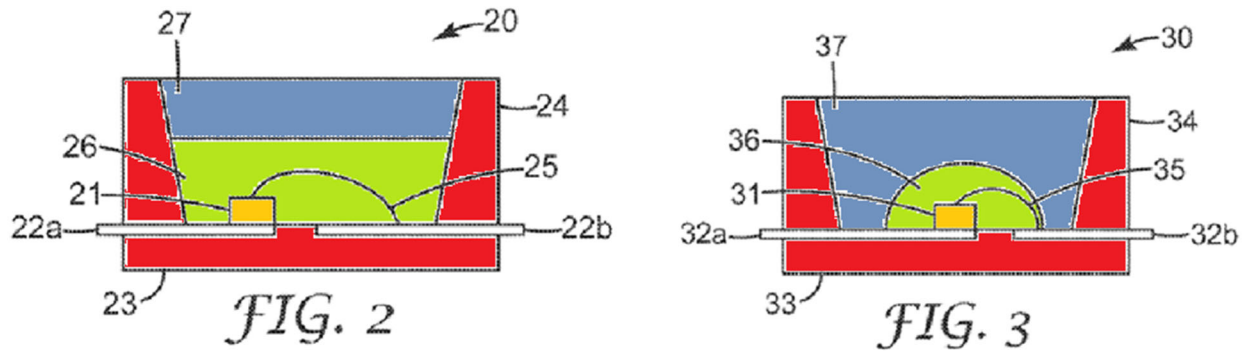
Ex. 1009, FIG. 2 (left, coloring added to figure); Ex. 1008, FIG. 4 (right, coloring added to figure).

317. The similarities are further evident in view of Figures 2 and 3 of Yatsuda, below (which are just like Figure 4 of Yatsuda, without the additional second film applied):



Ex. 1008, FIGs. 2-3 (coloring added to figures).

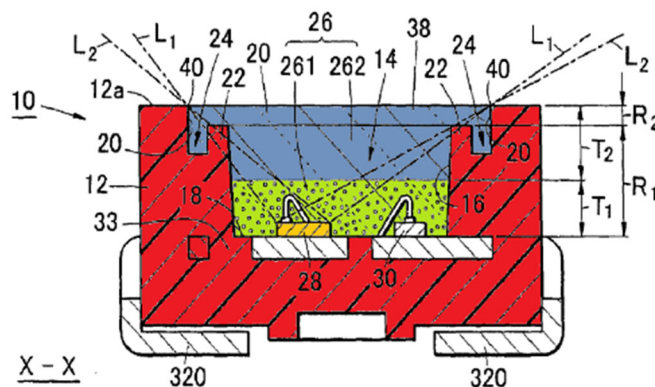
318. The same is true for Thompson's Figure 3, below left (which is highly similar to Thompson's Figure 2, below right):



Ex. 1009, FIGs. 2-3 (coloring added to figures).

319. The similarities to Nii are also apparent, such as in Figure 1C, below. Note that Nii also discloses an LED package with a multi-layer encapsulant, with a **first layer 261** that may be silicone and include fluorescent material such as phosphor, and a **second layer 262** may also be silicone and phosphor free, with **light emitting element 28** mounted in **housing 12**. Ex. 1026 at [0076], [0090]-[0091], [0112]-[0113], [0130], [0164]. This is a similar structure to Figure 2 of Nii as well.

Fig. 1C



Ex. 1026, FIG. 1C (coloring added to figure).

320. A POSA would also have had a motivation to (i) construct Thompson's substrate and reflecting cup package of a high thermal conductivity material (that is, a metallic material per the '465 Patent) and (ii) mount the package to a heat sink in order to further improve heat dissipation – a known goal and method in the LED packaging field to dissipate heat generated by the LED chip. Ex. 1008 at [0033], FIGs. 2-4; Ex. 1005 at [0034]; Ex. 1013 at [0117], [0127]-[0128], [0137]-[0138]; Ex. 1014 at 192; Ex. 1016 at [0017], [0019]-[0020], [0024], [0027]-[0028]; Ex. 1030 at [0083]-[0087]. This is evidenced by various state of the art references, including Yatsuda, which teaches - in such high-powered LED package applications where as much electric current as possible is applied to the LED chip to obtain as much light as possible - to use a metallic package that “should be made of a material being superior in heat conductivity” such as copper or aluminum nitride and attached to an additional heat sink to efficiently dissipate the generated heat:

In the LED lamp 1, an electric current can be applied to the LED chip 2 (as much as possible), to obtain as much amount of light as possible. Accordingly, in this case, the base 3 on which the LED chip 2 is mounted **should be made of a material being superior in heat conductivity, such as a metal like copper (refer to FIG. 2), a ceramic like AlN (aluminum nitride) (refer to FIG. 3), and the like.** The thickness of the base 3 should be sufficient, if desired, **for thermal diffusion after connecting with a heat sink 22 in its rear surface.**

Ex. 1008 at [0033] (emphases added).

321. A POSA would also have understood that there were known advantages to a metallic package and heat sink, including to improve heat dissipation and package performance, and that it would have been a simple modification to select the material of Thompson's substrate (choosing, *e.g.*, highly thermally conductive copper or aluminum nitride) and to mount the resulting package to a heat sink. Ex. 1008 at [0033], [0036], FIGs. 2-4; Ex. 1016 at [0017], [0019]-[0020], [0024], [0027]-[0028]; Ex. 1015 at 493-494; Ex. 1022 at 3.7-3.16; Ex. 1010 at [0019]; Ex. 1030 at [0083]-[0087]. If a metal was used for the metallic package, a POSA would have understood to add an insulating layer to prevent a short circuit, as taught by Yatsuda and generally known to a POSA. Ex. 1008 at [0034], FIG. 2.

322. I note that the '465 Patent does not explain how to construct its metallic package or heat sink, but rather states only to include them (consistent with the knowledge of a POSA that such construction was readily known). *See generally* Ex. 1001.

323. Similarly, a POSA - when considering the appropriate phosphor and silicone to apply to Figures 2 and 3 of Thompson - would have sought out particular silicone and phosphor combinations for the phosphor in the first encapsulant layers 26 and 36, and the silicone used as the encapsulant. A POSA would logically have looked to existing combinations - including specific phosphors for the types described in Thompson, such as (Y,Gd)AG:Ce or YAG type phosphors - especially

for such combinations that had been used in the field in similar multi-layer encapsulant LED packages where a first layer has phosphor in a silicone carrier and a second silicone layer is phosphor free. Ex. 1006 at [0054]; Ex. 1026 at [0076], [0090]-[0091], [0112]-[0113], [0123], [0130], [0164], FIGs. 1C, 2B. I note, for example, that Thompson discloses various phosphor types including doped garnets YAG:Ce and (Y,Gd)AG:Ce that may be in powder form:

Phosphors can optionally be included in the encapsulating material to adjust the color emitted from the LED. As described herein, a phosphor consists of a photoluminescent material. The fluorescent material could be inorganic particles, organic particles, or organic molecules or a combination thereof. **Suitable inorganic particles include doped garnets (such as YAG:Ce and (Y,Gd)AG:Ce).... These materials may be in the form of conventional phosphor powders or nanoparticle phosphor powders.** Another class of suitable inorganic particles is the so-called quantum dot phosphors made of semiconductor nanoparticles including Si, Ge, CdS, CdSe... and combinations thereof. Generally, the surface of each quantum dot will be at least partially coated with an organic molecule to prevent agglomeration and increase compatibility with the binder. In some cases the semiconductor quantum dot may be made up of several layers of different materials in a core-shell construction. Suitable organic molecules include fluorescent dyes such as those listed in U.S. Pat. No. 6,600,175 (Baretz et al.). Preferred fluorescent materials are those that exhibit good durability and stable optical properties. The phosphor layer may consist of a blend of different types of phosphors in a single layer or a series of layers, each containing one or more types of phosphors. The inorganic phosphor particles in the phosphor layer may vary in size (e.g., diameter) and they may be segregated such that the average particle size is not uniform across the cross-section of the siloxane layer in which they are incorporated. If used, the phosphor particles are preferably included in the encapsulating material in an amount of no greater than 85 wt-%, and in an

amount of at least 1 wt-%, based on the total weight of the encapsulating material. The amount of phosphor used will be adjusted according to the thickness of the siloxane layer containing the phosphor and the desired color of the emitted light.

Ex. 1009 at [0054] (emphases added).

324. Armed with this general disclosure, a POSA would have sought out particular phosphors, for example, particular doped garnets (such as YAG:Ce and (Y,Gd)AG:Ce), and, in doing so, examined phosphors used in the field for similar purposes (especially in two-layer encapsulants). Nii, for example, provides specific examples of such phosphor (and correspondingly, silicone) to use when constructing a two-layer LED package much like Thompson that results in a clear borderline between layers. Ex. 1026 at [0090]-[0091], [0112]-[0113], [0123], [0130], [0164]. Like Thompson, Nii discloses that “For the granular additives used in the light emitting device 10 of the present invention, a powdery fluorescent material, a powdery dispersant and/or granular oxide may be used.” Ex. 1026 at [0113]. Nii further discloses that silicone resin is preferably used and the advantages of doing so (which would have led a POSA to select such silicone, including examples expressly disclosed in Nii for this purpose):

The transparent sealing materials preferably used as the sealing material 26 include epoxy resin, silicone resin, urea resin, fluorocarbon resin, a mixture of some of these resins, and an inorganic material such as glass. Silicone resin, which is better in translucency and heat resistance, is particularly suitably used as the sealing material. Bonding between the silicone resin and

the housing 12 can be increased by providing the light blocking section 22 and restricting the density of the granular additives in the second region R_2 as in the light emitting device 10 of the present invention, thereby to suppress the silicone resin from peeling off the inner edge 20 of the opening. Thus, the light emitting device 10 of the present invention achieves higher efficiency of extracting light and longer service life than in the prior art, by using the silicone resin for the sealing material 26.

Ex. 1026 at [0112].

325. Nii provides examples of fluorescent materials including phosphors:

In the light emitting device 10 which emits whitish light, in particular, a fluorescent material which absorbs blue light and emits yellow light may be used in combination with the light emitting element 28 which emits blue light, such as aluminum oxide-based fluorescent material (YAG: Ce) that contains aluminum as ingredient and is activated with a rare earth element such as cerium. Now, a method of forming a yttrium aluminum garnet-based fluorescent material which is a kind of aluminum oxide-based fluorescent material will be described. First, rare earth element such as solution of a mixture of rare earth elements Y, Gd, Ce, La, Al, Sm, Pr, Tb in stoichiometrical proportions dissolved in an acid is coprecipitated with oxalic acid, of which product is fired to obtain a coprecipitated oxide which is mixed with aluminum oxide to obtain a stock material mixture. This mixture, with a fluoride such as ammonium fluoride added thereto as a flux, is put into a crucible and fired at a temperature from $1,400^{\circ}\text{C}$. in air for three hours. The fired mixture is crushed in a ball mill in water, and undergoes the processes of washing, separation, drying and sieving. Thus, a fluorescent material having composition of $\text{Gd}_{0.6}\text{Ce}_{0.03}\text{Y}_{2.4}\text{Al}_5\text{O}_{12}$ is made.

Ex. 1026 at [0130]. “The rare earth metal aluminate-based fluorescent materials activated mainly with lanthanoid element such as Ce include YAG fluorescent

materials having compositions of $\text{Y}_3\text{Al}_5\text{O}_{12}:\text{Ce}$, $(\text{Y}_{0.8}\text{Gd}_{0.2})_3\text{Al}_5\text{O}_{12}:\text{Ce}$ ". Ex. 1026 at [0123].

326. Nii further provides specific examples of the combination of phosphor and silicone, such as "Example 1" that is prepared in accordance with Figures 1A-1C. Ex. 1026 at [0162]-[0164]. I note that Figures 1A-1C are different views of the same embodiment. Ex. 1026 at [0031]-[0033]. In this example:

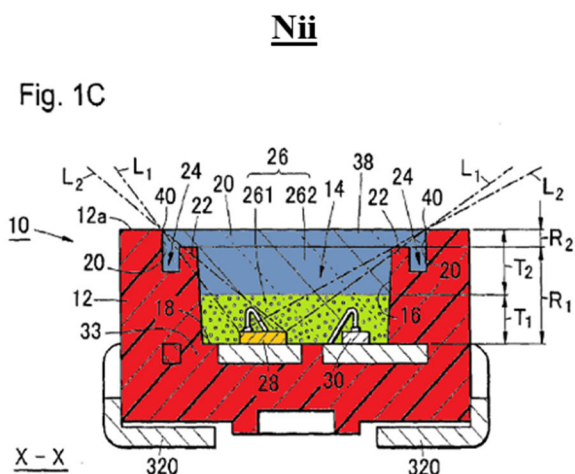
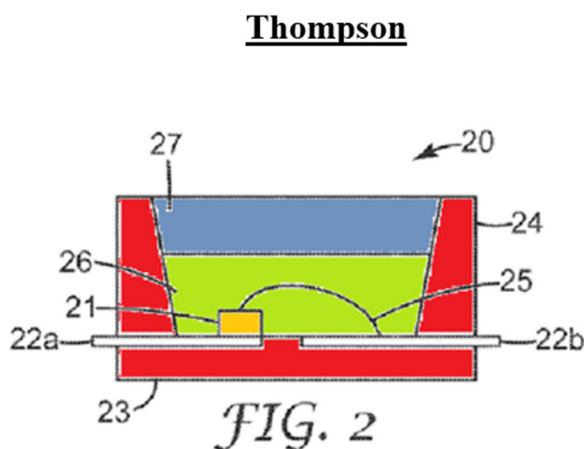
For the sealing resin 26, a silicone resin (specific gravity 1.4, Young's modulus 0.3 to 4 MPa, linear expansion coefficient 200 to 400 ($10^{-6}/^{\circ}\text{C}$.) and viscosity 1,000 to 20,000 ($\text{mPa}\cdot\text{s}$)) was used. For the fluorescent material particles, $(\text{Y}_{0.98}\text{Gd}_{0.02})_{2.85}\text{Ce}_{0.15}\text{Al}_5\text{O}_{12}$ having a mean particle size of $5.0\pm 0.7\ \mu\text{m}$ and specific gravity of 4.6 was used.

Ex. 1026 at [0164].

327. A POSA would have understood that Nii's reference to "fluorescent material particles, $(\text{Y}_{0.98}\text{Gd}_{0.02})_{2.85}\text{Ce}_{0.15}\text{Al}_5\text{O}_{12}$ " in paragraph [0164] of Nii is referring to an exemplary luminescent YAG or (Y,Gd)AG:Ce phosphor, as explained in Nii and as was known in the art. Ex. 1026 at [0123], [0130]; Ex. 1007 at [0077]; Ex. 1006 at [0008]; Ex. 1010 at [0040]-[0041]; Ex. 1011, 2:19-21. Indeed, Thompson specifically lists YAG and (Y,Gd)AG:Ce as suitable materials for the phosphor. Ex. 1009 at [0054].

328. A POSA, especially given the existence of a working example from Nii in a similar two-layer LED package, would have expected that such a combination of silicone and phosphor in Nii's example above could readily be applied to Figures

2 and 3 of Thompson (using the techniques described in Thompson, Nii, and known in the art to create such a two layer structure, as I have discussed). This is further evidenced by comparing, for example, Figure 2 of Thompson, below left, and Figure 1C of Nii, below right. As can be seen, both have a similar two-layer encapsulant resulting in a clear borderline.



Ex. 1009, FIG. 2 (coloring added to figure); Ex. 1026, FIG. 1C (coloring added to figure).

329. I explain below further reasons why a POSA would have applied the teachings of Yatsuda and Nii to Thompson.

2. Claims 1-6

330. I explained above in Section IX.I that Thompson discloses claims 1-3, and I explain below in Section IX.J how Thompson alone or in view of Yatsuda also renders claims 4-6 obvious. However, to the extent that Thompson's second encapsulants 27 and 37 (*i.e.*, the claimed "*cured silicone film*") are not "substantially

free of phosphor,” Thompson alone or in view of Yatsuda renders claims 1-6 obvious.

331. I provided in my overview above in Section IX.A.1 that multi-layer encapsulants - encapsulants with a first layer containing phosphor in a carrier (such as silicone) and a second layer (such as cured silicone without phosphor) - in the LED packaging field were well-known, as were the advantages and routine processes to create multi-layer encapsulants.

332. I note that it was commonly understood that adding a second silicone film that was free of phosphor was well known in the LED packaging art, as were the advantages and ease of implementation. As I explained in Section IX.B.1, Shoji discloses adding an outer molding layer 7 which is (i) made of a cured transparent silicone resin (ii) contains no phosphor 6b, and (iii) covers and is “on” inner molding layer 6 containing phosphor 6b. Ex. 1005 at [0012]. As I explained in Section IX.D.1, Yatsuda discloses adding a second transparent hard silicone encapsulant layer 6b that is free of phosphor over a first silicone encapsulant layer 6 containing phosphor 6a. Ex. 1008 at [0041]. As I explained in Section IX.E.1, Hussell discloses adding cured silicone encapsulating material layers 309b and 317 that are free of phosphor 315 over silicone layer 309a that contains phosphor 315, and cured silicone encapsulating material layer 109b that is free of phosphor 115 over silicone layer 109a that contains phosphor 115. Ex. 1006 at [0005], [0032]-[0034], [0044]-

[0046]. Moreover, Nii, which is similarly in the LED packaging field, discloses to add a second silicone layer 262 that is phosphor free over a first layer 261 containing phosphor. Ex. 1026 at [0090]-[0091], [0112]-[0113]. Maeda, which is likewise in the LED packaging field, discloses a multi-layer resin casing where one layer has phosphor and the overlying layer does not. Ex. 1028 at [0026]-[0027], FIGs. 7, 10. Basin, which is also in the LED packaging field, discloses a multi-layer molding where one layer has phosphor or other layers do not. Ex. 1029 at [0055], FIG. 10.

333. Not only were such multi-layer silicone encapsulants (where the first layer had phosphor but an overlying second layer did not) well known, the advantages of including such an overlying second encapsulant layer were also well known, as explained by Yatsuda and others as state of the art, with aims including: (i) to protect the LED and components; (ii) to seal and encapsulate the LED and components; (iii) to minimize total internal reflection; (iv) to prevent adhesion of foreign matter or the like; (v) to resist scratching or other types of physical defects; (vi) to provide uniform light output through the phosphor-containing layer with minimal scattering loss; and (vii) improve light output efficiency and longer service life of the LED package. Ex. 1005, [0001], [0003]-[0012]; Ex. 1008 at [0041]; Ex. 1009 at [0016]; Ex. 1010 at [0026], [0035]; Ex. 1026 at [0112].

334. And a POSA would also have understood how to make two-layer LED packages both (i) where the layers may comprise the same or different materials and

(ii) where the layers comprise different materials, how to make the second layer substantially phosphor free using various known two-layer applications described throughout the art (*e.g.*, by not including phosphor when applying in second encapsulant layers 27 and 37 of Thompson over the first encapsulant layers). Ex. 1009 at [0015]-[0016], [0058]; Ex. 1008 at [0041]; Ex. 1005 at [0008]-[0012]; Ex. 1026 at [0090]-[0091], [0112]-[0113], FIGs. 1A-1C.

3. Claims 2 and 7-12

335. Claim 2 depends from independent claim 1 and requires “*wherein the phosphor bearing film is 60%-80% phosphor.*” Thompson discloses claim 1, as I explained above. Independent claim 7 (and by dependency, claims 8-12) similarly requires “*wherein the phosphor bearing film is 60%-80% phosphor.*”

336. I explained above in Section IX.I that Thompson discloses claims 1-2 and 7-9, and I explain in this section (Section IX.J) how Thompson alone or in view of Yatsuda and/or Nii also renders claims 1-2 and 7-12 obvious.

337. Regarding the requirement in the claims, “*wherein the phosphor bearing film is 60%-80% phosphor.*”, to the extent Thompson is found not to disclose this limitation by weight, incorporating the range into the first encapsulant layers 26 and 36 of Thompson’s Figure 2 and 3, respectively, would still have been obvious to a POSA. As explained in Section IX.C.2 above, consistent with the knowledge of a POSA, a POSA would have readily understood how to adjust the phosphor

concentration in order to optimize it for the particular application and LED package (using the techniques described in Thompson to vary the concentration). As I also explained in Section IX.C.2 above, a POSA would have understood the need and desire to do so, for example, based on film thickness, desired color temperature, and/or desired color of light to be emitted. Ex. 1007 at [0103], [0145]; Ex. 1011 at 7:47-8:3; Ex. 1009 at [0008], [0054], [0061]; Ex. 1005 at [0006]-[0007]; Ex. 1031 at 7:48-52, 10:36-44, 15:2-10, FIG. 17, Table 1. I again note, as I explained above in Section IX.B.2, that there was nothing important or critical about the claimed range, which is further confirmed by the '465 Patent itself.

338. To the extent the phosphor percent is interpreted to be by volume, it is disclosed by Thompson alone or in view of Nii (and the claims are obvious).

339. As I discussed in Section IX.J.1 above, Nii provides a specific example of phosphor and silicone to use. Ex. 1026 at [0162]-[0164]. When specific gravities of such silicone (1.4) and phosphor (4.6) are considered and applied to Thompson, Thompson also discloses an overlapping range with the claimed range, when considered by volume. Ex. 1026 at [0164]; *see also* [0090]-[0091], [0112]-[0113]. This is shown by the following formula, which results in 63% phosphor by volume (which I note is also within the claimed range) after converting from 85% phosphor by weight:

$$\text{Vol \% phosphor} = (\text{SG}_{\text{Si}} \times \text{Wt}\%) / [(\text{SG}_{\text{Si}} \times \text{Wt}\%) + (\text{SG}_{\text{Ph}} \times (1 - \text{Wt}\%))]$$

$$\text{So Vol \% phosphor} = (1.4 \times 0.85) / [(1.4 \times 0.85) + (4.6 \times (1 - 0.85))]$$

where SG_{Si} = specific gravity of silicone; SG_{Ph} = specific gravity of phosphor; and Wt% = weight percent of phosphor.

340. As I discussed in Section IX.J.1, a POSA would have been motivated and had a reasonable expectation of success in applying Nii's disclosed phosphor and silicone example to Thompson's Figure 2 and 3. Moreover, when volume is considered, the same optimization rationale I explained in Section IX.C.2 above (and repeated here regarding volume) applies. That is, consistent with the knowledge of a POSA, a POSA would have understood to adjust the phosphor concentration in order to optimize it for the particular application and LED package (using the techniques described in Thompson to vary the concentration). A POSA would have understood the need and desire to do so, for example, based on film thickness, desired color temperature, and/or desired color of light to be emitted. Ex. 1007 at [0103], [0145]; Ex. 1011 at 7:47-8:3; Ex. 1009 at [0008], [0054], [0061]; Ex. 1005 at [0006]-[0007]; Ex. 1031 at 7:48-52, 10:36-44, 15:2-10, FIG. 17, Table 1. I again note, as I explained above in Section IX.B.2, that there was nothing important or critical about the claimed range, which is further confirmed by the '465 Patent itself.

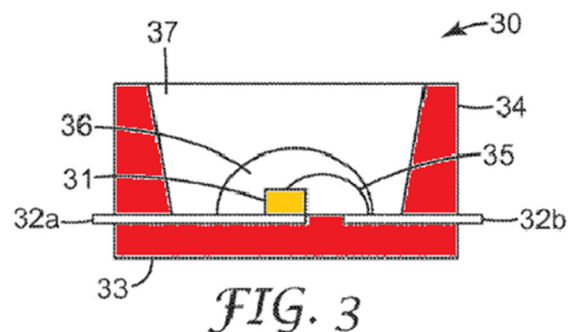
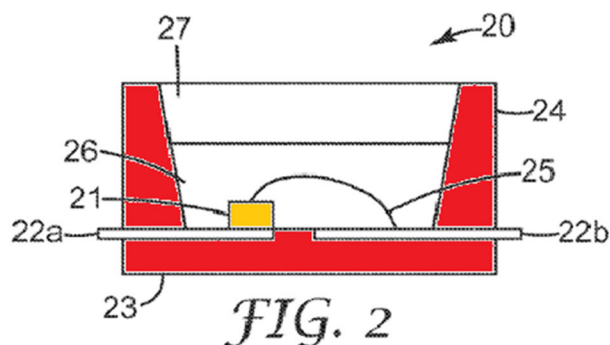
4. Claim 4

“4. The apparatus of claim 3, further comprising a metallic package, wherein the light emitting device is in the metallic package.”

341. Thompson alone or in view of Yatsuda renders obvious the claimed “*a metallic package, wherein the light emitting device is in the metallic package*”.

Thompson also discloses or renders obvious (alone or with Yatsuda) claims 1 and 3, from which claim 4 depends.

342. Thompson discloses “**LED die 21** ... mounted on metallized contact 22a disposed on **substrate 23 in reflecting cup 24**” in Figure 2, below left, and “**LED die 31** ... mounted on metallized contact 32a disposed on **substrate 33 in reflecting cup 34**” in Figure 3, below right. Ex. 1009 at [0015], [0058] (color added).



Ex. 1009, FIGs. 2-3 (coloring added to figures).

343. Thompson does not specify the particular material for the substrate and reflecting cup, but consistent with the knowledge of a POSA - including the known

need and desirability of efficiently dissipating heat generated by the LED out of the package - a POSA would have logically looked to various known ceramics or metals and selected one with high heat conductivity to achieve this goal (such as copper, aluminum nitride or silicon carbide commonly known to be used in LED packages for this purpose). Ex. 1015 at 493-494; Ex. 1022 at 3.7-3.16; Ex. 1008 at [0033], [0036], FIG. 3; Ex. 1012 at 13:39-42, 14:54-61; Ex. 1016 at [0027]. I further discussed material selection for the package in Section IX.C.3. Indeed, given that Thompson does not specify the materials used, a POSA logically would have sought out appropriate materials when constructing the packages.

344. A POSA would also have understood that it was a matter of simple material selection to choose the substrate and reflecting cup. When a metal (*e.g.*, copper) is used, the package would meet the claimed “*metallic package*”. Alternatively, when a highly thermally conductive material (such as a highly thermally conductive ceramic) is used, it would also meet the claimed “*metallic package*”, to the extent that the claimed “*metallic package*” encompasses materials with high thermal conductivity (*e.g.*, that enable heat dissipation from the device). As to the latter alternative (a highly thermally conductive material such as a highly thermally conductive ceramic), I again note the ’465 Patent’s focus regarding “metallic material” and “metallic package”: (i) “a metallic package, which may include a metal or any metal-like structure with high thermal conductivity”, Ex. 1001

at 3:61-64; and (ii) “a metallic material, that is, any material with metal-like properties including a high thermal conductivity, thus enabling the dissipation of heat from the device to a heat sink 306”, Ex. 1001 at 6:35-39. For example, in the portion I quoted in subpart (i) in the previous sentence at column 3, lines 61-64, the ’465 Patent provides two alternatives for a “metallic package” (either including “a metal”, or alternatively, “any metal-like structure with high thermal conductivity”).

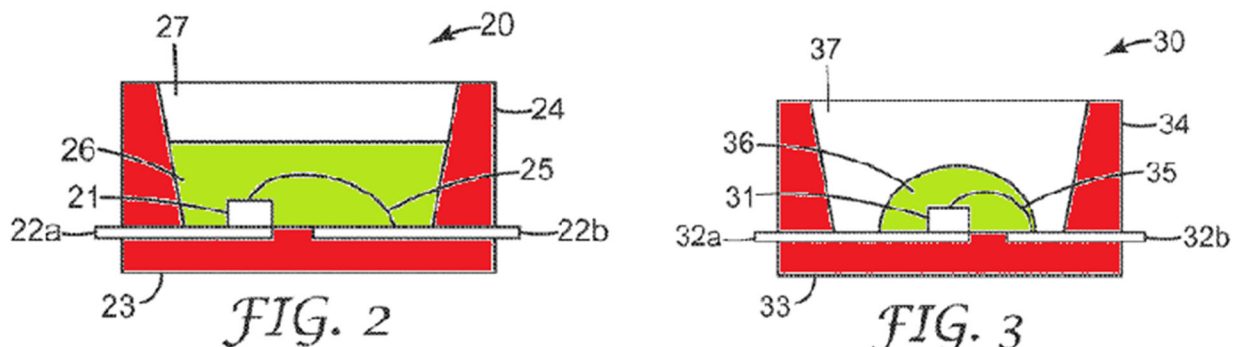
345. For example, as further support for a POSA’s understanding that it would have been obvious to use a “metallic package” in Thompson, Yatsuda discloses to use it as its base - on which an LED chip is mounted in a highly similar package to Thompson’s Figures 2 and 3 as I explained in Section IX.J.1 - “a material being superior in heat conductivity, such as a metal like copper,” “ceramic like (AlN) aluminum nitride” and “the like.” Ex. 1008 at [0033], [0036], FIG. 3. Again, both metal (such as copper) and a highly thermally conductive ceramic would meet the “metallic package” requirement (where highly thermally conductive materials qualify as I discussed in the prior paragraph (Paragraph 344)). Ex. 1001 at 3:61-64, 6:35-39.

5. Claim 5

“5. The apparatus of claim 4, wherein the phosphor bearing film is at least partially on a surface of the metallic package.”

346. Thompson alone or in view of Yatsuda renders obvious the claimed “wherein the phosphor bearing film is at least partially on a surface of the metallic package”. Thompson also discloses or renders obvious (alone or with Yatsuda) claims 1, 3, and 4, from which claim 5 depends.

347. Figures 2 and 3, below, show that **first encapsulants 26 and 36** are at least partially on a surface of the **substrate and reflecting cup** (i.e., the claimed “metallic package” as I explained regarding claim 4). Ex. 1009 at [0015], [0058]. I again note the ’465 Patent’s teaching that “It will be understood that when an element such as a region, layer, section, substrate, or the like, is referred to as being ‘on’ another element, it can be directly on the other element or intervening elements may also be present.” Ex. 1001 at 3:1-4.



Ex. 1009, FIGs. 2-3 (coloring added to figures).

6. Claim 6

“6. The apparatus of claim 5, further comprising a heat sink, wherein the package is on the heat sink.”

348. Thompson alone or in view of Yatsuda renders obvious the claimed “*a heat sink, wherein the package is on the heat sink.*” Thompson also discloses or renders obvious (alone or with Yatsuda) claims 1 and 3-5, from which claim 6 depends.

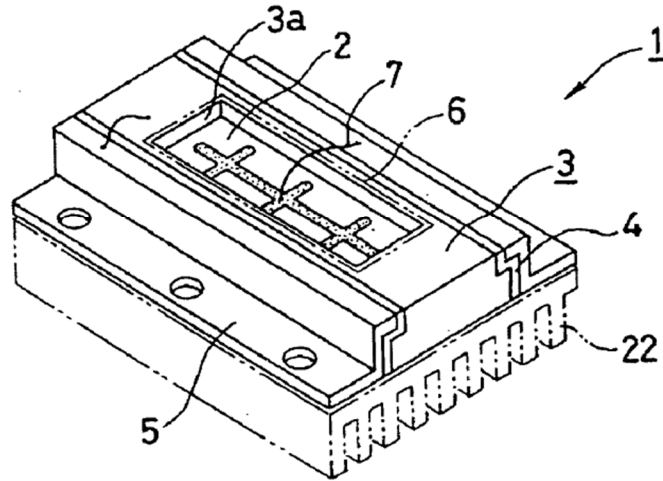
349. Yatsuda teaches that when maximizing light (and therefore as much electrical current as possible), to dissipate heat most effectively, it is advantageous to include (i) a metal or highly thermally conductive base package and (ii) a further heat sink on which the package is mounted:

In the LED lamp 1, **an electric current can be applied to the LED chip 2 (as much as possible), to obtain as much amount of light as possible.** Accordingly, in this case, the base 3 on which the LED chip 2 is mounted **should be made of a material being superior in heat conductivity, such as a metal like copper (refer to FIG. 2), a ceramic like AlN (aluminum nitride) (refer to FIG. 3), and the like.** The thickness of the base 3 should be sufficient, if desired, **for thermal diffusion after connecting with a heat sink 22 in its rear surface.**

Ex. 1008 at [0033] (emphases added).

350. Base 3 on heat sink 22 can be seen in Figure 2 of Yatsuda, below:

Fig. 2



Ex. 1008, FIG. 2.

351. As I explained in Section IX.C.1, a POSA would also have understood the known advantages and ease of implementation to attach such a heat sink to a package to further improve heat dissipation. Indeed, the advantages and known implementation were well known in the LED packaging field (and more generally as well), as I explained in Section IX.C.1. This is further evidenced by the state of the art in the LED packaging field: (i) Cao explains that heat sinks in LED packages improve thermal dissipation and can be mounted using various conventional means, Ex. 1016 at [0017], [0024], [0027]-[0028]; (ii) Baek explains to mount a “heat radiating plate”, *i.e.*, a heat sink, to the underside of a base member, *e.g.*, a metal substrate, to “further enhance heat dissipating characteristics of the high power LED package”, Ex. 1030 at [0086]-[0087]; (iii) Baek also explains that the base member may be, *e.g.*, a metal substrate or metal lead frame to dissipate heat, Ex. 1030 at

[0065]-[0066]; (iv) Sanpei explains that including a heat sink improves the heat-radiating property of a metal baseboard and “thus is preferable in suppressing increase in temperature of the semiconductor light-emitting devices”, Ex. 1013 at [0117], [0127]-[0128], [0137]-[0138]; and (v) Schubert explains that “Power [LED] packages have a *direct, thermally conductive path* from the LED chip, through the package, to a heat sink, e.g. a printed circuit board. The power package shown in the figure has several advanced features. Firstly, the package contains an Al or Cu heatsink slug with low thermal resistivity to which the LED submount is soldered by a metal-based solder.” Ex. 1014 at 192 (emphasis in original).

7. Claim 9

“9. The apparatus of claim 7 wherein the rigid film comprises a transparent cured silicone film.”

352. I explained above in Section IX.I that Thompson discloses claims 7 and 9, and I explained above in Section IX.J how Thompson alone or in view of Yatsuda and/or Nii also renders claims 7-9 obvious (regarding the substantially phosphor free limitation). However, to the extent that Thompson’s second encapsulants 27 and 37 (*i.e.*, the claimed “*cured silicone film*”) are not “*transparent*,” Thompson alone or in view of Yatsuda and/or Nii still renders the claims obvious.

353. A POSA would have understood that silicone encapsulants in LED packages are typically transparent, and understood the need and desire to make them transparent, including so that they can serve a dual purpose of protecting the LED

and components and enabling the LED package to efficiently emit the maximum amount of light. For example, (i) Yatsuda teaches to use both a transparent silicone resin, as well as a hard silicone resin to, among other things, protect the LED chip, Ex. 1008 at [0041]; (ii) Blonder teaches to use a transparent encapsulant such as silicone to seal LEDs and to reduce total internal reflection, Ex. 1010 at [0017]-[0018], [0026]; (iii) Hussell discloses a transparent silicone encapsulant that may be cured, Ex. 1006 at [0010], [0029], [0039]; (iv) Shoji discloses a transparent cured silicone resin encapsulant, Ex. 1005 at [0005]-[0006], [0012], [0015]; (v) Thompson discloses that “LED die are typically encapsulated with a transparent organic resin”, Ex. 1009 at [0003]-[0004]; and (vi) Nii discloses to use a “transparent sealing material, so as to protect the light emitting element, the protective element and the electrically conductive wires from the environment” and that “Silicone resin, which is better in translucency and heat resistance, is particularly suitably used as the sealing material”, Ex. 1026 at [0111]-[0112], claim 1 of Nii.

8. Claims 10-12

354. As I have explained, claims 10-12 include the same limitations as claims 4-6, and thus claims 10-12 are rendered obvious by Thompson alone or in view of Yatsuda and/or Nii⁷ for the same reasons as claims 4-6. Claims 1, 3, and 7,

⁷ Nii would be included here, to the extent that percent phosphor is considered by volume in claims 7-12.

from which these claims depend, are also anticipated or obvious for the reasons I discussed above.

X. CONCLUDING STATEMENTS

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

356. I declare that all statements made herein of my knowledge are true and correct. I also declare that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 35 U.S.C. § 1001.

357. I declare under the penalty of perjury that the foregoing is true and correct.

Executed on March 22, 2024

A handwritten signature in black ink, reading "Nan Marie Jokerst", written over a horizontal line.

Nan Marie Jokerst, PhD