

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

HONEYWELL INTERNATIONAL INC.
Petitioner,

v.

CREE, INC.,
Patent Owner

Case IPR2015-_____
U.S. Patent No. 8,860,058

**PETITION FOR *INTER PARTES* REVIEW OF
U.S. PATENT NO. 8,860,058 Claims 27-48
UNDER 35 U.S.C. §§ 311–319 AND 37 C.F.R. § 42.100 *et seq.***

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EXHIBIT LIST

Ex. 1001	U.S. Patent No. 8,860,058 (“the ’058 patent”).
Ex. 1002	Declaration of Dr. E. Fred Schubert with attached Curriculum Vitae (“the Schubert Decl.”).
Ex. 1003	USPTO Decision on Appeal 2014-007890; Reexamination Control No. 90/010; 940, Patent No. 6,600,175 B1.
Ex. 1004	USPTO Final Rejection of Patent No. 7,615,795. 2/23/2015.
Ex. 1005	USPTO Final Rejection of Patent No. 7,943,945. 3/3/2015.
Ex. 1006	Nakamura, S. <i>et al.</i> , “Candela-class High-brightness InGaN/AlGaIn Double-heterostructure Blue-light-emitting Diodes.” American Institute of Physics. 1994.
Ex. 1007	Tadatsu, Y., <i>et al.</i> , Laid Open Application Publication (A). Japanese Patent Office H05-152609 - English translation.
Ex. 1008	Tabuchi, S., Utility Model Patent Application Publication No. S50-79379. Japanese Patent Office - English translation.
Ex. 1009	Pinnow, D.A , <i>et al.</i> , Patent Specification (11)1305111. London Patent Office.
Ex. 1010	Werner, K., “Higher Visibility for LEDs.” IEEE Spectrum. 1994.
Ex. 1011	Webster’s New 20th Century Dictionary Second Edition, 1983.
Ex. 1012	Ouyang, J. <i>et al.</i> , “Gradiently Alloyed Zn _x Cd _{1-x} S Colloidal Photoluminescent Quantum Dots Synthesized via a Noninjection One-Pot Approach.” J. Phys. Chem. 112, 4908-4919. 2008.
Ex. 1013	Stenzenberger, H.D., “Recent Developments of Thermosetting Polymers for Advanced Composites.” Composite Structures 24; 219-231. 1993.
Ex. 1014	U.S. Patent No. 3,921,026 (“the ’026 patent”).

I. INTRODUCTION

Petitioner Honeywell International Inc. (“Honeywell” or “Petitioner”) respectfully requests *inter partes* review of Claims 27-48 of U.S. Patent No. 8,860,058 (the “’058 Patent,” Ex. 1001) in accordance with 35 U.S.C. §§ 311–319 and 37 C.F.R. § 42.100 *et seq.*

II. MANDATORY NOTICES (37 C.F.R. § 42.8(A)(1))

A. Real Party-In-Interest (37 C.F.R. § 42.8(b)(1))

Honeywell International Inc. is the real party-in-interest for Petitioner.

B. Related Matters (37 C.F.R. § 42.8(b)(2))

The ’058 Patent is currently the subject of *Cree, Inc. v. Honeywell International Inc.*, Civil Action No. 14-CV-737 (W.D. Wis. 2014). In addition to instant petition, Honeywell is concurrently filing a separate *inter partes* review petition for ’058 Patent on a different set of claims, namely Claims 1-26.

C. Lead And Back-Up Counsel (37 C.F.R. § 42.8(b)(3))

Petitioner designates the following counsel:

LEAD COUNSEL for Honeywell International Inc.	Jennifer A. Sklenar Arnold & Porter, LLP 777 S. Figueroa Street, 44th Floor Los Angeles, CA 90017-5844 Tel: +1 213.243.4000 Fax: +1 213.243.4199 jennifer.sklenar@aporter.com Reg. No 40,205
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D. Service Information (37 C.F.R. § 42.8(b)(4))

Service information for lead and back-up counsel is provided in the above designation of lead and back-up counsel. Honeywell International Inc. consents to service by email, where such service is to be made at each of the following email addresses: (a) jennifer.sklenar@aporter.com; (b) wallace.wu@aporter.com; (c) ryan.casamiquela@aporter.com; (d) ed.han@aporter.com; and (e) marc.cohn@aporter.com

III. PAYMENT OF FEES

The undersigned authorizes the Office to charge \$26,200 to Deposit Account No. 50-2387 as the fee required by 37 C.F.R. § 42.15(a) for this Petition for *inter partes* review. The undersigned further authorizes payment for any additional fees that might be due in connection with this Petition to be charged to the same Deposit Account.

IV. GROUNDS FOR STANDING (37 C.F.R. § 42.104(A))

Petitioner certifies that the '058 Patent is available for *inter partes* review and that the Petitioner is not barred or estopped from requesting *inter partes* review challenging the claims of the '058 Patent on the grounds

identified herein.

V. FACTUAL BACKGROUND AND SUMMARY OF THE PRIOR ART

A. The '058 Patent

The '058 Patent issued on October 14, 2014. The claims are directed to a display containing a LED that produces white light. The claims recite a LED that emits blue light, along with luminophoric medium arranged for exposure to blue light so that white light can be produced. As recited in the claimed invention, the blue LED emits blue light, which has a relatively shorter wavelength. Ex. 1001, '058 Patent at Abstract, Claims 27 and 40. That blue light excites a luminophoric medium, which, in response, re-emits the light with a relatively longer wavelength. *Id.* The '058 Patent refers to this as the down-conversion of light. *Id.* at 4:4-7 (“‘down-converting’ (i.e., transforming a higher frequency, shorter wavelength form of energy to a lower frequency, longer wavelength form of energy)”). The down-converted, longer wavelength(s) of light appear white in color. *Id.* at 7:44-48 (“The monochromatic blue or UV radiation output of the LED is absorbed and then down converted by the fluorophore or phosphor to yield longer wavelengths to include a broad spectrum of frequencies which appear as white light”). Claim 40 recites:

40. A display, comprising a multiplicity of light-emitting devices,
each light-emitting device comprising: at least one single-die

semiconductor light-emitting diode (LED) coupleable with a power supply to emit blue light, and a down-converting luminophoric medium arranged for exposure to said blue light, and which in exposure to said blue light responsively emits a longer wavelength, polychromatic radiation, so that each light-emitting device produces a white light output, wherein said white light output comprises blue light from said blue light emitted by the LED and said longer wavelength, polychromatic radiation emitted by the down-converting luminophoric medium.

Id. at 16:14-26.

The '058 Patent issued from a continuation application claiming priority to a parent application that issued as U.S. Patent No. 6,600,175 ("the '175 Patent"). These two patents share the same specification and the claims of the '175 Patent also recite a light emitting device having a blue LED and a luminophoric medium, where the luminophoric medium receives blue LED radiation and then responsively re-emits a secondary radiation that produces white light. Claim 134, a representative claim of the '175 Patent, recites:

134. A light-emitting device, comprising:

at least one single-die gallium nitride based semiconductor blue

light-emitting diode (LED) coupleable with a power supply to emit

a primary radiation which is the same for each single-die LED present in the device, said primary radiation being a relatively shorter wavelength radiation; and

a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation, is excited to responsively emit a secondary, relatively longer wavelength, polychromatic radiation, with separate wavelengths of said polychromatic radiation mixing to produce a white light output,

wherein each of the at least one single-die gallium nitride based semiconductor blue light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output, and

wherein the luminophoric medium is dispersed in a polymer that is on or about the single-die gallium nitride based semiconductor blue light-emitting diode.

Ex. 1003, Decision on Appeal at 5-6.

B. The Patent Trial And Appeal Board (PTAB) Has Rejected All Claims Of The '175 Parent Patent As Obvious

On November 21, 2014, the PTAB issued a Decision on Appeal affirming an Examiner's Final Rejection in an *ex parte* reexamination of the

'175 Patent. Ex. 1003, Decision on Appeal at 51-52 (Dkt. No. 2014-007890). In its Decision on Appeal, the PTAB found that “an artisan of ordinary skill would have found it obvious to use a blue LED to create white light via down-conversion, and that the relied upon rebuttal evidence is insufficient to outweigh the evidence in support of obviousness.” Ex. 1003, Decision on Appeal at 51.

The PTAB found claims of the '175 Patent invalid over the prior art, relying on six prior art references, including prior art Petitioner relies upon to support the instant request for *inter partes* review of the '058 Patent-at issue. Specifically, the PTAB found that the prior art disclosed the claimed blue LED as well as the down-conversion of light via a luminophoric medium. The PTAB summarized the question for the Decision on Appeal, which it characterized as “simple and straightforward”, stating: “was it obvious at the time of the invention to use an LED, in particular a blue LED, to create white light via down-conversion as recited in the claims?” Ex. 1003, Decision on Appeal at 27-28. And the PTAB held, “the answer to that question is a simple resounding ‘yes’ particularly, in light of high-power, high-brightness blue LEDs developed by Dr. Shuji Nakamura in late 1993.” *Id.*

The '058 Patent issued on October 14, 2014, one month before the PTAB issued its Decision on Appeal rendering obvious the claims of the '175

parent. The '058 Patent generally claims the same white LED as claimed in the '175 Patent, but has additional limitations claiming the use of the LED in a display, as well as specifying that the luminophoric medium is contiguous to the LED or alternatively in a laterally spaced relationship to the LED, among other configurations. As discussed more fully below, these additional elements of the '058 Patent do not create any patentable distinction over the finally cancelled claims of the '175 Patent. Rather, like the claims of the '175 Patent, the claims of the '058 Patent are obvious over the prior art.

C. The Prior Art Relied Upon In This Petition

Petitioner relies primarily upon prior art that the PTAB and/or Patent Office¹ has relied upon in its recent decisions rendering obvious the inventions of family members of the '058 Patent, namely the '175 Patent (the parent), the '795 Patent (first continuation in the priority chain), and the '945 Patent (second continuation in the priority chain). Specifically, in this Petition for *inter partes* review, Petitioner relies upon:

¹ In recent weeks, during *ex parte* reexaminations, the Patent Office issued Final Rejections on two other patents in same the priority chain as the '058 Patent, namely U.S. Patent No. 7,615,795 (the "'795 Patent") and U.S. Patent No. 7,943,945 (the "'945 Patent"). Exs. 1004 and 1005.

(1) Nakamura, S., et al., “Candela-class high-brightness InGaN/AlGaN double-heterostructure blue-light-emitting diodes”, “Appl. Phys. Lett.”, published Mar. 28, 1994, pp. 1687-1689 (hereinafter, “Nakamura”) (Ex. 1006).

- Disclosing the high-brightness blue LED. Ex. 1006, Nakamura at p. 1 (“high-brightness InGaN/AlGaN double-heterostructure blue-light-emitting diodes with a luminous intensity over 1 cd were fabricated”).

(2) JP 5-152609 A to Tadatsu, et al. (hereinafter, “Tadatsu”) (Ex. 1007), published June 18, 1993.

- Disclosing down-conversion of blue light via fluorescent material. Ex. 1007, Tadatsu at [0009] (“Therefore, different types of a fluorescent dye or pigment can not only correct color of blue LED’s but also convert light into a variety of wavelengths”).²
- Disclosing down-conversion to white light. *Id.* at [0003] (“For instance, when a red pigment is added to a resin mold around a

² Recently, the Patent Office relied upon Tadatsu in Final Rejections during *ex parte* reexaminations of the ’795 and ’945 Patents. *See, e.g.*, Ex. 1004, ’795 Rejection at 6, 26-27 (“follow the teachings of Tadatsu and down-convert the blue light of the high-brightness blue LED in the Nakamura reference to obtain ‘a variety of wavelengths’ as taught by Tadatsu”); Ex. 1005, ’945 Rejection at 33.

green light emitting device having GaP semiconductor materials, its emission color turns into white.”).

(3) JP 50-79379 U to Tabuchi (hereinafter, “Tabuchi”) (Ex. 1008), published on November 24, 1973.

- Disclosing a LED with phosphor to down convert light. Ex. 1008, Tabuchi at 3 (“phosphor layer 7 converts infrared or UV emitted from light emitting semiconductor device 4 to visible light”).³

(4) GB 1305111 to Pinnow, et al. (hereinafter, “Pinnow”) (Ex. 1009), published on January 31, 1973.

- Disclosing down-conversion via a blend of phosphors to produce white light. Ex. 1009, Pinnow at 4:29-46 (“The broken line represents a particulate 50-50 mixture of these two phosphors ... the overall

³ Recently, the Patent Office relied upon Tabuchi in a Final Rejection during an *ex parte* reexamination of the related ’945 Patent. *See, e.g.*, Ex. 1005, ’945 Rejection at 8-9 (“It would have been obvious to one of ordinary skill in the art at the time the invention was made to have prepared Tabuchi’s LED apparatus such that Nakamura’s high-brightness InGaN/AlGaN double-heterostructure blue-light emitting diode is used for Tabuchi’s semiconductor LED with an appropriate phosphor” so that white light is produced).

effect is to produce a white appearance to the eye.”).⁴

In addition, for claim elements related to the use of the claimed invention in a liquid crystal display and a back-lighting array, Petitioner relies upon:

(5) Werner, K. , “Higher Visibility for LEDs”, IEEE Spectrum, July 1994 (hereinafter, “Werner”) (Ex. 1010).

- Disclosing that the discovery of the bright blue LED from Nakamura opens the path to a white LED source for backlighting. Ex. 1010, Werner at pp. 1, 6 (“long-sought Holy Grail of LED technology -- a blue LED with luminous efficiency high enough” . . . may “open the way for white LED light sources that could be used as, for example, backlights for laptop computer screens”).

D. A Person Of Ordinary Skill In The Art (“POSITA”)

Petitioner submits that a POSITA in the subject matter of the ’058 Patent would have been someone prior to the time of the invention, particularly in 1994 or earlier, having at least a bachelor’s degree in electrical engineering or physics (or

⁴ Recently, the PTAB relied on similar disclosure in its Decision on Appeal rendering obvious the ’175 parent patent. *See, e.g.*, Ex. 1003, Decision on Appeal at 17 (“Examiner relies on [] Pinnow for explicitly disclosing the ‘down-conversion’ of the primary radiation using a mixture of phosphors to produce white light”).

equivalent) and at least five years experience working on LED technology; or someone with a Master's Degree in electrical engineering or physics (or equivalent) and at least three years of experience working on LED technology. Ex. 1002, Declaration of Dr. E. Fred Schubert ("Schubert Decl."), filed concurrently herewith, at ¶ 13.

VI. IDENTIFICATION OF CHALLENGE (37 C.F.R. § 42.104(B))

A. Statement Of Each Claim Challenged (§ 42.104(b)(1))

Petitioner requests *inter partes* review of Claims 27-48 of the '058 Patent, and that the PTAB invalidate the same.

B. The Specific Art And Statutory Ground(s) On Which The Challenge Is Based (§ 42.104(b)(2))

Petitioner requests that Claims 27-48 of the '058 Patent be found obvious pursuant pre-AIA 35 U.S.C. § 103(a) under the following grounds:

Ground 1	Claims 27-30, 33-48 are invalid under pre-AIA 35 U.S.C. § 103(a) as obvious over Tadatsu (Ex. 1007) in view of Nakamura (Ex. 1006) and Werner (Ex. 1010)
Ground 2	Claims 27-30, 33-48 are invalid under pre-AIA 35 U.S.C. § 103(a) as obvious over Tadatsu (Ex. 1007) in view of Nakamura (Ex. 1006) and Werner (Ex. 1010), and in further view of Pinnow (Ex. 1009)
Ground 3	Claims 27, 30-33, 35, 37-48 are invalid under pre-AIA 35 U.S.C. § 103(a) as obvious over Tabuchi (Ex. 1008) in view of Nakamura (Ex. 1006) and Werner (Ex. 1010), and in further view of Pinnow (Ex. 1009)

Petitioner submits that the above grounds are not horizontally or vertically

redundant. The difference between Ground 1 and Ground 2 is that Ground 2 adds Pinnow to the § 103 combination in Ground 1. Pinnow adds a specific blend of two phosphors that act as the luminophoric medium to interact with blue light to produce white light. This provides further support that the claims are invalid.

Ground 3 differs from Ground 1 and Ground 2 in that Ground 3 relies on Tabuchi instead of Tadatsu as the base reference. Tabuchi discloses a configuration where the LED and the luminophoric medium are in a spaced relationship. Tadatsu discloses a configuration where the LED and the luminophoric medium are contiguous with one another. Dependent claims 31-32 recite a spaced relationship, whereas dependent claims 28-29, 34, and 36 recite a contiguous relationship. Further, for Ground 1 and Ground 2, Tadatsu and Nakamura represent part of a § 103(a) combination born from the same Japanese company, namely Nichia Corporation. For Ground 3, Tabuchi and Nakamura represent part of a §103(a) combination in light by Tabuchi's disclosure of high-brightness LEDs and displays, and Nakamura's discovery of "high-brightness" blue LEDs, including for displays.

**C. How The Challenged Claims Are To Be Construed
(§ 42.104(b)(3))**

The claims subject to *inter partes* review shall receive the "broadest reasonable construction in light of the specification of the patent in which [they] appear[]." 37 C.F.R. § 42.100(b); *In re Morris*, 127 F.3d 1048, 1054-55

(Fed. Cir. 1997).⁵ For each claim term not specifically addressed below, Petitioner submits it is construed to have its broadest reasonable interpretation in light of the patent specification, including its plain and ordinary meaning to the extent such a meaning could be determined by a POSITA.

1. “down-converting”

The '058 Patent refers to down-conversion throughout its specification. *See, e.g.,* Ex. 1001, '058 Patent at Abstract, 4:3-9; 7:40-52. The specification indicates that down-converting is the process of transforming a shorter wavelength form of light into a longer wavelength form of light. *Id.* As such, “down-converting” should be construed as “transforming light from a shorter wavelength form to a longer wavelength form”.

2. “luminophoric medium”

The '058 Patent refers to “luminophoric medium” throughout its disclosure. *See, e.g.,* Ex. 1001, '058 Patent at Abstract, 8:9-12. The specification provides that fluorescers and/or phosphors are materials for the “luminophoric medium”, which absorbs light and then in response emits light. *Id.* at Abstract, 7:40-52, 8:9-12. As such, “luminophoric medium” should be construed as “a material, which in

⁵ Petitioner expressly reserves the right to assert a different claim construction in the district court litigation between Honeywell and Cree for any '058 Patent term.

response to radiation emitted by a device, emits light by fluorescence and/or phosphorescence.”

D. How The Construed Claims Are Unpatentable And Supporting Evidence Relied Upon To Support The Challenge

Pursuant to 37 C.F.R. § 42.104(b)(4), a detailed explanation of how Claims 27-48 of the '058 Patent are unpatentable, including the identification of how each claim element is found in the prior art, is set forth below in Section VII. Pursuant to 37 C.F.R. § 42.104(b)(5), Petitioner provides an Appendix of Exhibits supporting this petition, which includes the Declaration of Dr. E. Fred Schubert under 37 C.F.R. § 1.68. In addition, the relevance of the evidence to the challenged claims, including the specific portions of the evidence supporting the challenge, is included in Section VII.

VII. GROUNDS OF UNPATENTABILITY AND SHOWING THAT PETITIONER IS LIKELY TO PREVAIL

As evidenced by the presented prior art references and the Declaration of Dr. E. Fred Schubert, the limitations of Claims 27-48 were well known to a POSITA, where that POSITA would have been motivated to combine the elements of the presented references. *See* 35 U.S.C. § 103(a); *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 420 (2007). Accordingly, there is a reasonable likelihood that the Petitioner will prevail in establishing obviousness of each of the claims challenged. For the reasons presented herein, Petitioner respectfully request that

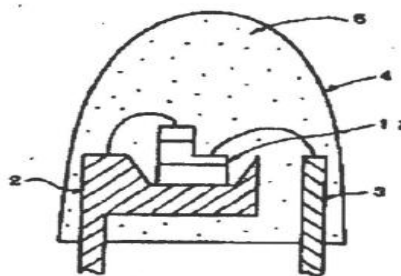
the PTAB institute *inter partes* review of Claims 27-48 of the '058 Patent.

A. Ground 1: Claims 27-30, 33-48 Are Invalid As Obvious Over Tadatsu In View Of Nakamura And Werner

1. Tadatsu Discloses A Blue Light Emitting Device With Down-Converting Fluorescent Material

Tadatsu discloses a blue light emitting device packaged with fluorescent material. As illustrated, Figure 2 designates the “blue light emitting device” at 11. Ex. 1007, Tadatsu at [0008]. The fluorescent material at 5 surrounds the light emitting device. Ex. 1007, Tadatsu at [0009] (“fluorescent dye or pigment is added to a resin mold surrounding the light emitting device”). The fluorescent material 5 is dispersed within a resin, which is a type of polymer. *Id.*; Ex. 1002, Schubert Decl. at ¶ 26. The dots in Figure 2 also show the dispersal of the fluorescent material 5. Ex. 1002, Schubert Decl. at ¶ 25.

[Figure 2]



The “blue light emitting device” is a gallium nitride based semiconductor emitting blue light, which has a relatively short wavelength. Ex. 1007, Tadatsu at [Abstract]; Ex. 1002, Schubert Decl. at ¶ 27. Blue light has a wavelength generally

in the range of 420 nanometers (nm) to 490 nm. Ex. 1002, Schubert Decl. at ¶ 14. Blue and violet light have the shortest wavelengths in the visible light spectrum. *Id.* at ¶ 14. In Tadatsu, the blue light emitting device will emit light exciting the fluorescent material, which in response, re-emits the light in a longer wavelength. Ex. 1007, Tadatsu at [0009] (“A fluorescent dye or pigment is generally excited with a short-wavelength light and emits light with a longer wavelength than that of the excitation light.”). As explained in the Declaration of Dr. Schubert, “Tadatsu discloses down-converting light”, transforming a relatively shorter wavelength of light into a longer wavelength. Ex. 1002, Schubert Decl. at ¶ 27. As such, Tadatsu discloses the construed “down-converting” element, where the fluorescent material acts as the construed “luminophoric medium”. *Id.*

Tadatsu teaches using down-converting fluorescent material to produce white light. In an example, Tadatsu discloses that “when a red pigment is added to a resin mold around a green light emitting device having GaP semiconductor materials, its emission color turns into white.” Ex. 1007, Tadatsu at [0003]. In his declaration, Dr. Schubert explains that “in this example, Tadatsu mixes the colors from the light emitting device and the fluorescent material to yield a white light output.” Ex. 1002, Schubert Decl. at ¶ 28. Similarly, Tadatsu teaches that a blue light emitting device could be arranged with “different types of fluorescent” material. Ex. 1007, Tadatsu at [0009]. To a POSITA, it would have been obvious

to use a blue light emitting device so that the blue light mixes with light from the fluorescent material that together ‘turns into white’” *Id.* at [0003], [0009]; Ex. 1002, Schubert Decl. at ¶ 28. Further, Tadatsu discloses that the blue light emitting device is arranged with “different types of a fluorescent” material to produce a “variety of wavelengths” . Ex. 1007, Tadatsu at [0009] (“Therefore, different types of a fluorescent dye or pigment can not only correct color of blue LED’s but also convert light into a variety of wavelengths.”). Dr. Schubert in his declaration explains that “a POSITA would understand the disclosed ‘variety of wavelengths’ to mean a variety of colors, where the light is polychromatic, having multiple colors.” Ex. 1002, Schubert Decl. at ¶ 28. And it was well-known to a POSITA that a broad spectrum of colors will mix to appear white. *Id.* Such a broad spectrum of colors would have been an obvious “variety of wavelengths” because Tadatsu disclosed an example where the “emission color turns into white”. Ex. 1007, Tadatsu at [0003], [0009]; Ex. 1002, Schubert Decl. at ¶ 28.⁶

⁶ In its Final Rejections of related ’795 Patent and related ’945 Patent, the Patent Office relied on Tadatsu to find obvious the down-conversion of blue light to white light via fluorescent material to obtain a “‘variety of wavelengths’ as taught by Tadatsu.” Ex. 1004, ’795 Rejection at 26-27; Ex. 1005 ’945 Rejection at 36-37.

2. Nakamura Introduces The Bright Blue LED

On March 28, 1994, Nakamura discloses a gallium nitride based bright blue LED, including indium or aluminum in the alloy. Ex. 1006, Nakamura at p. 1; Ex. 1002, Schubert Decl. at ¶ 29. The bright blue LED from Nakamura measured a luminous intensity of 1000 millicandelas (or 1 candela). *Id.* Nakamura also discloses that “using these high-brightness blue LEDs, high-brightness full color indicators and flat panel displays will be developed in the near future.” Ex. 1006, Nakamura at p. 3.

3. Werner Teaches A Liquid Crystal Display And A Backlighting Array

Werner teaches that the bright blue LED from Nakamura is a long-sought LED technological breakthrough that “unveils bright vistas of new applications” including “full-color outdoor video displays,” “backlights for small liquid-crystal displays,” and “backlights for laptop computer screens.” Ex. 1010, Werner at pp. 1, 6. Werner also discloses an array of LEDs, which can be used to backlight a display, including a liquid crystal display. *Id.* at p. 6 (“Rectangular LED light bars put two or more LED chips in an epoxy package ... Long, thin, flexible packages containing dozens of LED chips are used as backlights for small liquid-crystal displays.”). As confirmed by Dr. Schubert, “a POSITA would have the ability to implement LEDs in an array for purposes of backlighting a liquid crystal display.” *Id.*; Ex. 1002, Schubert Decl. at ¶ 41.

4. A POSITA Would Have Been Motivated To Combine Tadatsu With Nakamura And Werner

Tadatsu discloses a “blue light emitting device” made of “gallium nitride related compound semiconductors.” Ex. 1007, Tadatsu at [0008], [Claim 1]. Tadatsu acknowledged, however, that, at the time of his disclosure in June 1993, blue LEDs had a poor “luminosity factor.” Ex. 1007, Tadatsu at [0005]; Ex. 1002, Schubert Decl. at ¶ 30. Then, nine months later in March 1994, Nakamura disclosed a “high brightness” blue LED, which was also gallium nitride based, adding indium or aluminum. Ex. 1006, Nakamura at p. 1; Ex. 1002, Schubert Decl. at ¶ 29. Accordingly, a POSITA would have been motivated to combine the teachings of Tadatsu and Nakamura because Nakamura solved a problem identified by Tadatsu and the authors of Tadatsu and Nakamura were colleagues at Nichia Corporation, working on the same issues in LED technology. Ex. 1002, Schubert Decl. at ¶ 30.

Also, Werner provides evidence that a “POSITA would have taken notice of this new discovery” of the blue LED from Nakamura and combine it with Tadatsu. Ex. 1002, Schubert Decl. at ¶ 31. Werner, an article from IEEE Spectrum, a flagship publication for the IEEE, referred to Nakamura’s bright blue LED as “the long-sought Holy Grail of LED technology,” namely, “a blue LED with a luminous efficiency high enough to make it adequately bright at reasonable power levels.” *Id.* at ¶ 41; Ex. 1010, Werner at p. 1. IEEE predicted that this discovery

“may open the way for white LED light sources that could be used as, for example, backlights for laptop computer screens.” Ex. 1010, Werner at pp. 1, 6. The breakthrough of the bright blue LED disclosed in Werner and Nakamura would have motivated a POSITA to combine these references with Tadatsu’s teaching of a blue emitting device arranged with fluorescent material in the manner claimed. Ex. 1002, Schubert Decl. at ¶ 31.

Further, in its Decision on Appeal for the ’175 parent, the PTAB found that Nakamura’s discovery provided ample motivation to combine blue LEDs with down conversion, particularly given the industry recognition of the “major breakthrough” represented by the bright blue LED from Nakamura:

-- in view of blue LEDs available from Dr. Nakamura -- the entire industry was adopting the known ‘down-conversion’ process via phosphors to create white light.

Ex. 1003, Decision on Appeal at 43, 27. Tadatsu, which teaches the already known ‘down-conversion’ process to white light, could now use the bright blue LED from Nakamura. Ex. 1002, Schubert Decl. at ¶¶ 30-31.

5. Tadatsu In View Of Nakamura And Werner Render Obvious Claims Claims 27-30, 33-48 Of The ’058 Patent

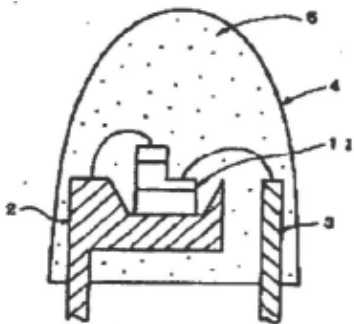
This claim chart shows the obviousness of each element of the claims:

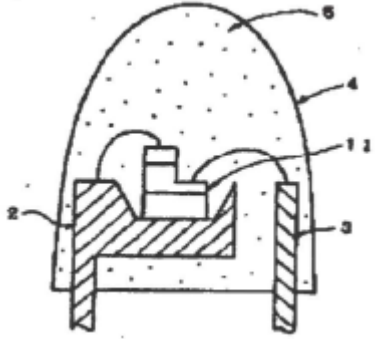
<u>Claim 27</u> : A liquid crystal display, including: a backlight	<p>“A light emitting diode having a light emitting device on a stem...” Ex. 1007, Tadatsu at [Constitution].</p> <p>“Using these high-brightness blue LEDs, high-brightness full-color indicators and flat panel displays will be developed in the</p>
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member including a multiplicity of light-emitting devices, each light-emitting device comprising:	<p>near future.” Ex. 1006, Nakamura at p. 3.</p> <p>“Rectangular LED light bars put two or more LED chips in an epoxy package and are used for backlighting stenciled messages. Long, thin, flexible packages containing dozens of LED chips are used as backlights for small liquid-crystal displays.” Ex. 1010, Werner at p. 6.</p> <p>Ex. 1002, Schubert Decl. at ¶ 41.</p>
(a) at least one single-die gallium nitride based semiconductor blue light-emitting diode (LED) coupleable with a power supply to emit blue light,	<p>“Figure 2 illustrate an example to depict the structure of an LED according to the present invention. The numeral designator 11 represents a blue light emitting device in which n-type and p-type GaAlN layers are stacked on a sapphire substrate, the numeral designators 2 and 3 represent a metal stem and a metal post, respectively, in the same manner as in Figure 1 . . . Therefore, in order to electrically connect an n-electrode on the GaAlN layer to the metal stem 2, a method is employed in which the GaAlN layers are etched to expose the surface of the n-type layer, upon which an ohmic electrode is attached. The ohmic electrode and the metal stem 2 are electrically connected using a gold wire. Moreover, the other electrode is wire-bonded to the surface of the p-type layer using a gold wire coming from the metal post 3 in the same manner as in Figure 1.” Ex. 1007, Tadatsu at [0008], Fig. 2.</p> <p>“Candela-class high-brightness InGaN/AlGaIn double-heterostructure (DH) blue-light-emitting diodes (LEDs)” Ex. 1006, Nakamura at Abstract, p. 1.</p> <p>Ex. 1002, Schubert Decl. at ¶ 26.</p>
(b) and a down-converting luminophoric medium arranged for exposure to said blue light	<p>“Therefore, different types of a fluorescent dye or pigment can not only correct color of blue LED’s but also convert light into a variety of wavelengths.” Ex. 1007, Tadatsu at [0009].</p> <p>“Therefore, when they are employed as materials for a light emitting device and when a fluorescent dye or pigment is added to a resin mold surrounding the light emitting device, the fluorescent material can be most optimally excited.” <i>Id.</i> at [0009].</p>

	<p>“The numeral designator 11 represents a blue light emitting device” “and the numeral designator 4 represents a resin mold surrounding the light emitting device” “Further, a fluorescent dye 5 which is excited with light ... is added to the resin mold 4.” <i>Id.</i> at [0008]; Figure 2.</p> <p>Ex. 1002, Schubert Decl. at ¶¶ 25, 27.</p>
(c) and which in exposure to said blue light responsively emits a longer wavelength, polychromatic radiation,	<p>“Therefore, different types of a fluorescent dye or pigment can not only correct color of blue LED’s but also convert light into a variety of wavelengths.” Ex. 1007, Tadatsu at [0009].</p> <p>“[Advantages of Invention] A fluorescent dye or pigment is generally excited with a short-wavelength light and emits light with a longer wavelength than that of the excitation light.” <i>Id.</i> at [0009].</p> <p>“an inorganic or organic pigment is mixed as a coloring agent in the resin mold 4 in order to convert or correct the emission color of the light emitting device. For instance, when a red pigment is added to a resin mold around a green light emitting device having GaP semiconductor materials, its emission color turns into white.” <i>Id.</i> at [0003].</p> <p>Ex. 1002, Schubert Decl. at ¶ 28.</p>
(d) so that each light-emitting device produces a white light output, wherein said white light output comprises blue light from said blue light emitted by the LED and said longer wavelength, polychromatic radiation emitted by the down-	<p>“Therefore, different types of a fluorescent dye or pigment can not only correct color of blue LED’s but also convert light into a variety of wavelengths.” Ex. 1007, Tadatsu at [0009].</p> <p>“an inorganic or organic pigment is mixed as a coloring agent in the resin mold 4 in order to convert or correct the emission color of the light emitting device. For instance, when a red pigment is added to a resin mold around a green light emitting device having GaP semiconductor materials, its emission color turns into white.” <i>Id.</i> at [0003].</p> <p>“In particular, the present invention relates to a light emitting diode which can emit a variety of light emissions using one type of light emitting device, further which is bright, and which can vary the emission wavelength.” <i>Id.</i> at [0001].</p>

<p>converting luminophoric medium,</p>	<p>“Candela-class high-brightness InGaN/AlGaIn double-heterostructure (DH) blue-light-emitting diodes (LEDs) with the luminous intensity over 1 cd were fabricated.” Ex. 1006, Nakamura at Abstract, p. 1.</p> <p>Ex. 1002, Schubert Decl. at ¶ 28.</p>
<p>(e) and wherein the down-converting luminophoric medium is dispersed in a polymer that is on or about the single-die gallium nitride based semiconductor blue light-emitting diode.</p>	<p>“Figure 2 illustrate an example to depict the structure of an LED according to the present invention. The numeral designator 11 represents a blue light emitting device in which n-type and p-type GaAlN layers are stacked on a sapphire substrate ... and the numeral designator 4 represents a resin mold surrounding the light emitting device. ... Further, a fluorescent dye 5 which is excited with light with a wavelength near 420 to 440nm and which emits light with an emission peak near 480nm is added to the resin mold 4.” Ex. 1007, Tadatsu at [0008].</p> <div data-bbox="782 877 1130 1197" data-label="Image"> </div> <p><i>Id.</i> at Fig. 2.</p> <p>“A light emitting diode having a light emitting device on a stem, the light emitting device being surrounded with a resin mold, ... and further wherein a fluorescent dye or pigment, which is excited with emission light from said gallium nitride related compound semiconductors and which emits fluorescent light, is added to said resin mold.” <i>Id.</i> at [Constitution].</p> <p>“Therefore, when they are employed as materials for a light emitting device and when a fluorescent dye or pigment is added to a resin mold surrounding the light emitting device, the fluorescent material can be most optimally excited.” <i>Id.</i> at [0009].</p>

	Ex. 1002, Schubert Decl. at ¶¶ 25–26.
<p><u>Claim 28</u>: The liquid crystal display of claim 27, comprising the luminophoric medium dispersed in a polymer that is on the single-die gallium nitride based semiconductor blue light-emitting diode.</p>	<p>“Figure 2 illustrate an example to depict the structure of an LED according to the present invention. The numeral designator 11 represents a blue light emitting device in which n-type and p-type GaAlN layers are stacked on a sapphire substrate ... and the numeral designator 4 represents a resin mold surrounding the light emitting device. . . . Further, a fluorescent dye 5 which is excited with light with a wavelength near 420 to 440nm and which emits light with an emission peak near 480nm is added to the resin mold 4.” Ex. 1007, Tadatsu at [0008].</p>  <p><i>Id.</i> at Fig. 2.</p> <p>“A light emitting diode having a light emitting device on a stem, the light emitting device being surrounded with a resin mold, ... and further wherein a fluorescent dye or pigment, which is excited with emission light from said gallium nitride related compound semiconductors and which emits fluorescent light, is added to said resin mold.” <i>Id.</i> at [Constitution].</p> <p>“Therefore, when they are employed as materials for a light emitting device and when a fluorescent dye or pigment is added to a resin mold surrounding the light emitting device, the fluorescent material can be most optimally excited.” <i>Id.</i> at [0009].</p> <p>Ex. 1002, Schubert Decl. at ¶¶ 25–26.</p>
<p><u>Claim 29</u>: The liquid crystal display of claim 27, comprising</p>	<p>“The numeral designator 11 represents a blue light emitting device in which n-type and p-type GaAlN layers are stacked on a sapphire substrate ... and the numeral designator 4 represents a resin mold surrounding the light emitting device ... Further, a</p>

<p>the single-die gallium nitride based semiconductor blue light-emitting diode comprising die side surface, and wherein the polymer is contiguous to the die side surface.</p>	<p>fluorescent dye 5 which is excited with light...is added to the resin mold 4.” Ex. 1007, Tadatsu at [0008].</p>  <p><i>Id.</i> at Fig. 2.</p> <p>“Therefore, when they are employed as materials for a light emitting device and when a fluorescent dye or pigment is added to a resin mold surrounding the light emitting device, the fluorescent material can be most optimally excited.” Ex. 1007, Tadatsu at [0009].</p> <p>“A light emitting diode having a light emitting device on a stem, the light emitting device being surrounded with a resin mold, ... and further wherein a fluorescent dye or pigment, which is excited with emission light from said gallium nitride related compound semiconductors and which emits fluorescent light, is added to said resin mold.” <i>Id.</i> at [Constitution].</p> <p>Ex. 1002, Schubert Decl. at ¶¶ 25–26.</p>
<p>Claim 30: The liquid crystal display of claim 27, comprising the luminophoric medium dispersed in a polymer that is about the single-die gallium nitride based semiconductor blue light-</p>	<p>“Therefore, when they are employed as materials for a light emitting device and when a fluorescent dye or pigment is added to a resin mold surrounding the light emitting device, the fluorescent material can be most optimally excited.” Ex. 1007, Tadatsu at [0009].</p> <p>“the light emitting device being surrounded with a resin mold, ... and further wherein a fluorescent dye or pigment, which is excited with emission light from said gallium nitride related compound semiconductors and which emits fluorescent light, is added to said resin mold.” <i>Id.</i> at [Constitution].</p>

<p>emitting diode.</p>	<p><i>Id.</i> at Fig. 2.</p> <p>Ex. 1002, Schubert Decl. at ¶¶ 25–26.</p>
<p><u>Claim 33</u>: The liquid crystal display of claim 27, comprising the single-die gallium nitride based semiconductor blue light-emitting diode being arranged to directly impinge blue light on the polymer.</p>	<p>“Therefore, when they are employed as materials for a light emitting device and when a fluorescent dye or pigment is added to a resin mold surrounding the light emitting device, the fluorescent material can be most optimally excited.” Ex. 1007, Tadatsu at [0009].</p> <p>“Therefore, different types of a fluorescent dye or pigment can not only correct color of blue LED’s but also convert light into a variety of wavelengths.” <i>Id.</i> at [0009].</p> <p><i>Id.</i> at Fig. 2.</p> <p>Ex. 1002, Schubert Decl. at ¶¶ 25–26.</p>
<p><u>Claim 34</u>: The liquid crystal display of claim 27, comprising the single-die gallium nitride based semiconductor</p>	<p>“The numeral designator 11 represents a blue light emitting device in which n-type and p-type GaAlN layers are stacked on a sapphire substrate ... and the numeral designator 4 represents a resin mold surrounding the light emitting device ... Further, a fluorescent dye 5 which is excited with light...is added to the resin mold 4.” Ex. 1007, Tadatsu at [0008].</p>

<p>blue light-emitting diode and polymer being arranged without intermediate material therebetween.</p>	<div data-bbox="771 191 1138 527" data-label="Image"> </div> <p><i>Id.</i> at Fig. 2.</p> <p>“Therefore, when they are employed as materials for a light emitting device and when a fluorescent dye or pigment is added to a resin mold surrounding the light emitting device, the fluorescent material can be most optimally excited.” <i>Id.</i> at [0009].</p> <p>Ex. 1002, Schubert Decl. at ¶¶ 25–26.</p>
<p><u>Claim 35</u>: The liquid crystal display of claim 27, comprising the luminophoric medium being in a homogeneous composition.</p>	<p>“[A]n inorganic or organic pigment is mixed as a coloring agent in the resin mold 4 in order to convert or correct the emission color of the light emitting device. For instance, when a red pigment is added to a resin mold” Ex. 1007, Tadatsu at [0003].</p> <p>“a fluorescent dye 5 which is excited with light ... is added to the resin mold 4.” <i>Id.</i> at [0008].</p> <div data-bbox="771 1220 1138 1556" data-label="Image"> </div> <p><i>Id.</i> at Fig. 2.</p> <p>Ex. 1002, Schubert Decl. at ¶ 25.</p>
<p><u>Claim 36</u>: The liquid crystal display of claim 35, wherein the homogeneous</p>	<p>“The numeral designator 11 represents a blue light emitting device ... and the numeral designator 4 represents a resin mold surrounding the light emitting device ... Further, a fluorescent dye 5 which is excited with light...is added to the resin mold 4.” Ex. 1007, Tadatsu at [0008].</p>

<p>composition is contiguous to the single-die light-emitting diode.</p>	<div data-bbox="760 233 1154 594" data-label="Image"> </div> <p><i>Id.</i> at Fig. 2.</p> <p>“[A]n inorganic or organic pigment is mixed as a coloring agent in the resin mold 4 in order to convert or correct the emission color of the light emitting device. For instance, when a red pigment is added to a resin mold around a green light emitting device” <i>Id.</i> at [0003].</p> <p>“Therefore, when they are employed as materials for a light emitting device and when a fluorescent dye or pigment is added to a resin mold surrounding the light emitting device, the fluorescent material can be most optimally excited.” <i>Id.</i> at [0009].</p> <p>Ex. 1002, Schubert Decl. at ¶ 25.</p>
<p><u>Claim 37</u>: The liquid crystal display of claim 27, wherein the luminophoric medium comprises inorganic luminophoric material.</p>	<p>“[A]n inorganic or organic pigment is mixed as a coloring agent in the resin mold 4 in order to convert or correct the emission color of the light emitting device.” Ex. 1007, Tadatsu at [0003].</p> <p>Ex. 1002, Schubert Decl. at ¶ 32.</p>
<p><u>Claim 38</u>: The liquid crystal display of claim 27, wherein the single-die light-</p>	<p>“The present invention . . . having a light emission device which is made of gallium nitride related compound semiconductors” Ex. 1007, Tadatsu at [0006].</p> <p>“The numeral designator 11 represents a blue light emitting</p>

emitting diode comprises gallium nitride and its alloys.	<p>device in which n-type and p-type GaAlN layers are stacked on a sapphire substrate...” <i>Id.</i> at [0008].</p> <p>“Candela-class high-brightness InGaN/AlGaN double-heterostructure (DH) blue-light-emitting diodes (LEDs)” Ex. 1006, Nakamura at Abstract, p. 1.</p> <p>Ex. 1002, Schubert Decl. at ¶ 29.</p>
<p><u>Claim 39</u>: The liquid crystal display of claim 27, wherein the single-die light-emitting diode comprises at least one of gallium nitride, indium gallium nitride, aluminum gallium nitride, and aluminum gallium indium nitride.</p>	<p>“Candela-class high-brightness InGaN/AlGaN double-heterostructure (DH) blue-light-emitting diodes (LEDs) with the luminous intensity over 1 cd were fabricated.” Ex. 1006, Nakamura at Abstract, p. 1.</p> <p>The present invention . . . having a light emission device which is made of gallium nitride related compound semiconductors”. Ex. 1007, Tadatsu at [0006].</p> <p>Ex. 1002, Schubert Decl. at ¶ 29.</p>
<p><u>Claim 40</u>: A display, comprising a multiplicity of light-emitting devices, each light-emitting device comprising:</p>	<p>“Using these high-brightness blue LEDs, high-brightness full-color indicators and flat panel displays will be developed in the near future.” Ex. 1006, Nakamura at p. 3.</p> <p>“A light emitting diode having a light emitting device on a stem...” Ex. 1007, Tadatsu at [Constitution].</p> <p>“Rectangular LED light bars put two or more LED chips in an epoxy package and are used for backlighting stenciled messages. Long, thin, flexible packages containing dozens of LED chips are used as backlights for small liquid-crystal displays.” Ex. 1010, Werner at p. 6.</p> <p>Ex. 1002, Schubert Decl. at ¶ 41.</p>
(a) at least one single-die	<p>“Figure 2 illustrate an example to depict the structure of an LED according to the present invention. The numeral designator 11</p>

<p>semiconductor light-emitting diode (LED) coupleable with a power supply to emit blue light,</p>	<p>represents a blue light emitting device in which n-type and p-type GaAlN layers are stacked on a sapphire substrate, the numeral designators 2 and 3 represent a metal stem and a metal post, respectively, in the same manner as in Figure 1 . . . Therefore, in order to electrically connect an n-electrode on the GaAlN layer to the metal stem 2, a method is employed in which the GaAlN layers are etched to expose the surface of the n-type layer, upon which an ohmic electrode is attached. The ohmic electrode and the metal stem 2 are electrically connected using a gold wire. Moreover, the other electrode is wire-bonded to the surface of the p-type layer using a gold wire coming from the metal post 3 in the same manner as in Figure 1.” Ex. 1007, Tadatsu at [0008], Fig. 2.</p> <p>“In particular, the present invention relates to a light emitting diode which can emit a variety of light emissions using one type of light emitting device, further which is bright, and which can vary the emission wavelength.” <i>Id.</i> at [0001].</p> <p>“Candela-class high-brightness InGaN/AlGaIn double-heterostructure (DH) blue-light-emitting diodes (LEDs)” Ex. 1006, Nakamura at Abstract, p. 1.</p> <p>Ex. 1002, Schubert Decl. at ¶ 26.</p>
<p>(b) and a down-converting luminophoric medium arranged for exposure to said blue light,</p>	<p>“[Advantages of Invention] A fluorescent dye or pigment is generally excited with a short-wavelength light and emits light with a longer wavelength than that of the excitation light. . . . Therefore, different types of a fluorescent dye or pigment can not only correct color of blue LED’s but also convert light into a variety of wavelengths.” Ex. 1007, Tadatsu at [0009].</p> <p>“Therefore, when they are employed as materials for a light emitting device and when a fluorescent dye or pigment is added to a resin mold surrounding the light emitting device, the fluorescent material can be most optimally excited.” <i>Id.</i> at [0009].</p> <p>“The numeral designator 11 represents a blue light emitting device” “and the numeral designator 4 represents a resin mold surrounding the light emitting device” “Further, a fluorescent</p>

	<p>dye 5 which is excited with light ... is added to the resin mold 4.” <i>Id.</i> at [0008]; Figure 2.</p> <p>Ex. 1002, Schubert Decl. at ¶¶ 25, 27.</p>
<p>(c) and which in exposure to said blue light responsively emits a longer wavelength, polychromatic radiation,</p>	<p>“Therefore, different types of a fluorescent dye or pigment can not only correct color of blue LED’s but also convert light into a variety of wavelengths.” Ex. 1007, Tadatsu at [0009].</p> <p>“[Advantages of Invention] A fluorescent dye or pigment is generally excited with a short-wavelength light and emits light with a longer wavelength than that of the excitation light.” <i>Id.</i> at [0009].</p> <p>“an inorganic or organic pigment is mixed as a coloring agent in the resin mold 4 in order to convert or correct the emission color of the light emitting device. For instance, when a red pigment is added to a resin mold around a green light emitting device having GaP semiconductor materials, its emission color turns into white.” <i>Id.</i> at [0003].</p> <p>Ex. 1002, Schubert Decl. at ¶ 28.</p>
<p>(d) so that each light-emitting device produces a white light output, wherein said white light output comprises blue light from said blue light emitted by the LED and said longer wavelength, polychromatic radiation emitted by the down-converting luminophoric medium.</p>	<p>“Therefore, different types of a fluorescent dye or pigment can not only correct color of blue LED’s but also convert light into a variety of wavelengths.” Ex. 1007, Tadatsu at [0009].</p> <p>“an inorganic or organic pigment is mixed as a coloring agent in the resin mold 4 in order to convert or correct the emission color of the light emitting device. For instance, when a red pigment is added to a resin mold around a green light emitting device having GaP semiconductor materials, its emission color turns into white.” Ex. 1007, Tadatsu at [0003].</p> <p>“In particular, the present invention relates to a light emitting diode which can emit a variety of light emissions using one type of light emitting device, further which is bright, and which can vary the emission wavelength.” <i>Id.</i> at [0001].</p> <p>“Candela-class high-brightness InGaN/AlGaN double-heterostructure (DH) blue-light-emitting diodes (LEDs) with the luminous intensity over 1 cd were fabricated.” Ex. 1006,</p>

	<p>Nakamura at Abstract, p. 1.</p> <p>Ex. 1002, Schubert Decl. at ¶¶ 27-28.</p>
<p><u>Claim 41</u>: The display of claim 40, wherein in each light-emitting device the single-die semiconductor light-emitting diode is on a support in an interior volume of a light-transmissive enclosure.</p>	<div data-bbox="771 363 1136 699" data-label="Image"> </div> <p>Ex. 1007, Tadatsu at Fig. 2.</p> <p>“[A]n inorganic or organic pigment is mixed as a coloring agent in the resin mold 4 in order to convert or correct the emission color of the light emitting device ... its emission color turns into white.” <i>Id.</i> at [0003].</p> <p>“Figure 2 illustrate an example to depict the structure of an LED according to the present invention. The numeral designator 11 represents a blue light emitting device in which n-type and p-type GaAlN layers are stacked on a sapphire substrate ... and the numeral designator 4 represents a resin mold surrounding the light emitting device ... Further, a fluorescent dye 5 which is excited with light ... is added to the resin mold 4.” Ex. 1007, Tadatsu at [0008]</p> <p>“Therefore, when they are employed as materials for a light emitting device and when a fluorescent dye or pigment is added to a resin mold surrounding the light emitting device, the fluorescent material can be most optimally excited.” <i>Id.</i> at [0009].</p> <p>Ex. 1002, Schubert Decl. at ¶ 26.</p>
<p><u>Claim 42</u>: The display of claim 40, wherein said multiplicity of light-emitting</p>	<p>“A light emitting diode having a light emitting device on a stem...” Ex. 1007, Tadatsu at [Constitution].</p> <p>“Using these high-brightness blue LEDs, high-brightness full-color indicators and flat panel displays will be developed in the</p>

<p>devices comprises an array of single-die semiconductor light-emitting diodes.</p>	<p>near future.” Ex. 1006, Nakamura at p. 3.</p> <p>“Rectangular LED light bars put two or more LED chips in an epoxy package and are used for backlighting stenciled messages. Long, thin, flexible packages containing dozens of LED chips are used as backlights for small liquid-crystal displays.” Ex. 1010, Werner at p. 6.</p> <p>“LEDs are packaged as traditional lamps, as chips that are automatically mountable from tape, and as modules for numerical displays” <i>Id.</i></p> <p>Ex. 1002, Schubert Decl. at ¶ 41.</p>
<p><u>Claim 43</u>: The display of claim 42, wherein said array comprises a regular pattern.</p>	<p>“Rectangular LED light bars put two or more LED chips in an epoxy package and are used for backlighting stenciled messages. Long, thin, flexible packages containing dozens of LED chips are used as backlights for small liquid-crystal displays.” Ex. 1010, Werner at p. 6.</p> <p>“LEDs are packaged as traditional lamps, as chips that are automatically mountable from tape, and as modules for numerical displays” <i>Id.</i></p> <p>Ex. 1002, Schubert Decl. at ¶ 41.</p>
<p><u>Claim 44</u>: The display of claim 40, wherein said luminophoric medium comprises inorganic luminophoric material.</p>	<p>“[A]n inorganic or organic pigment is mixed as a coloring agent in the resin mold 4 in order to convert or correct the emission color of the light emitting device.” Ex. 1007, Tadatsu at [0003].</p> <p>Ex. 1002, Schubert Decl. at ¶ 32.</p>
<p><u>Claim 45</u>: The display of claim 44, wherein each single-die semiconductor light-emitting diode comprises a</p>	<p>“Figure 2 illustrate an example to depict the structure of an LED according to the present invention. The numeral designator 11 represents a blue light emitting device in which n-type and p-type GaAlN layers are stacked on a sapphire substrate, the numeral designators 2 and 3 represent a metal stem and a metal post, respectively, in the same manner as in Figure 1 ...” Ex. 1007, Tadatsu at [0008].</p>

single-die gallium nitride based semiconductor blue light- emitting diode.	<p><i>Id.</i> at Fig. 2.</p> <p>“Candela-class high-brightness InGaN/AlGaIn double-heterostructure (DH) blue-light-emitting diodes (LEDs)” Ex. 1006, Nakamura at Abstract, p. 1.</p> <p>Ex. 1002, Schubert Decl. at ¶ 25.</p>
<p><u>Claim 46</u>: The display of claim 45, wherein each single-die gallium nitride based semiconductor blue light-emitting diode comprises gallium nitride and its alloys.</p>	<p>“The present invention . . . having a light emission device which is made of gallium nitride related compound semiconductors”. Ex. 1007, Tadatsu at [0006].</p> <p>“The numeral designator 11 represents a blue light emitting device in which n-type and p-type GaAlN layers are stacked on a sapphire substrate...” <i>Id.</i> at [0008].</p> <p>“Candela-class high-brightness InGaN/AlGaIn double-heterostructure (DH) blue-light-emitting diodes (LEDs)” Ex. 1006, Nakamura at Abstract, p. 1.</p> <p>Ex. 1002, Schubert Decl. at ¶ 29.</p>
<p><u>Claim 47</u>: The display of claim 45, wherein each single-die gallium nitride based semiconductor blue light-emitting diode comprises at least one of gallium nitride, indium gallium nitride, aluminum gallium nitride, and aluminum gallium indium nitride.</p>	<p>“Candela-class high-brightness InGaN/AlGaIn double-heterostructure (DH) blue-light-emitting diodes (LEDs) with the luminous intensity over 1 cd were fabricated.” Ex. 1006, Nakamura at Abstract, p. 1.</p> <p>“The present invention . . . having a light emission device which is made of gallium nitride related compound semiconductors”. Ex. 1007, Tadatsu at [0006].</p> <p>Ex. 1002, Schubert Decl. at ¶ 29.</p>

<p><u>Claim 48</u>: The display of claim 40, comprising a full-color liquid crystal display.</p>	<p>“Using these high-brightness blue LEDs, high-brightness full-color indicators and flat panel displays will be developed in the near future.” Ex. 1006, Nakamura at p. 3.</p> <p>“Even full-color outdoor video displays based on LEDs are now possible . . . discovered the long-sought Holy Grail of LED technology--a blue LED with a luminous efficiency high enough” Ex. 1010, Werner at p. 1.</p> <p>“Rectangular LED light bars put two or more LED chips in an epoxy package and are used for backlighting stenciled messages. Long, thin, flexible packages containing dozens of LED chips are used as backlights for small liquid-crystal displays.” Ex. 1010, Werner at p. 6.</p> <p>Ex. 1002, Schubert Decl. at ¶ 41.</p>
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B. Ground 2: Claims 27-30, 33-48 Are Invalid As Obvious Over Tadatsu In View Of Nakamura And Werner, In Further View Of Pinnow⁷

Petitioner refers back to its discussion of Tadatsu, Nakamura, and Werner from Ground 1, specifically pages 15-35 in Section VII.A. To supplement that combination, Pinnow adds a specific blend of two phosphors that act as the luminophoric medium to interact with blue light to produce white light. This provides even further support that claims are invalid as obvious.

⁷ During the reexamination of the '175 parent, the PTAB affirmed that a POSITA would combine the teachings of Tadatsu, the bright blue LED from Nakamura, and phosphors/fluorescers from Pinnow. Ex. 1003, Decision on Appeal at 48-49.

1. Pinnow Teaches White Light Via Phosphor And Fluorescer

Pinnow teaches many methods of using phosphors and/or fluorescers to generate white light. For example, Pinnow teaches the use of a blue emitting device in combination with a blend of two phosphors, red and green. Ex. 1009, Pinnow at 4:29-45. The blue emitting device emits blue light to excite a “50-50 phosphor blend” of Xenylimide (emitting yellow-green) and Rhodamine (emitting red). *Id.* at 4:29-33. This 50-50 phosphor blend absorbs the primary blue light from a blue emitting device. *Id.* at 4:35. In response, the 50-50 phosphor blend emits a secondary, down-converted emission of red and yellow-green, and that secondary emission mixes with the primary blue emission from the light emitting device to generate “a white appearance to the eye”. *Id.* at 4:35-46; Ex. 1002, Schubert Decl. at ¶ 40. Because Pinnow teaches the use of a blue emitting device for achieving white light, “a POSITA in 1994 could apply this teaching by taking a bright blue LED and a 50-50 phosphor blend of red and yellow-green to generate white light.” Ex. 1002, Schubert Decl. at ¶ 40.

2. A POSITA Would Have Been Motivated To Combine Tadatsu, Nakamura, And Werner With Pinnow

Like Tadatsu, Pinnow discloses the down-conversion of light. Ex. 1009, Pinnow at 4:118-119 (“can be achieved by down-conversion”). Also like Tadatsu, Pinnow seeks a white light output. *Id.* at 4:110--115 (“achieving a true white.”). Further like Tadatsu, Pinnow discloses phosphor as the means to down-convert to

white light. *Id.* at 4:110-5:5; Table I (listing down-converting phosphors).

Knowing Tadatsu's down-converting method, a POSITA would have been motivated to consult Pinnow as a reference summarizing the different types of down-converting phosphors and their characteristics. Ex. 1002, Schubert Decl. at ¶ 33. Pinnow provides a summary Table I of numerous down-converting phosphors, with the name of the phosphor, its absorption characteristics, and its emission color. Ex. 1009, Pinnow at 5:1-5; Table I.

Further, the discovery of the bright blue LED from Nakamura would serve as additional motivation to consult a reference like Pinnow that summarizes phosphors that absorb blue light and down-converts to white light. Ex. 1002, Schubert Decl. at ¶ 33. The bright blue LED was a breakthrough for the industry, and a "POSITA would have taken notice of this new discovery, particularly for potential uses in backlighting displays with white light." *Id.* at ¶ 31. Nakamura discloses a bright blue LED and predicts that "full-color indicators and flat panel displays will be developed in the near future". Ex. 1006, Nakamura at p. 3. Werner teaches that the Nakamura bright blue LED may "open the way for white LED light sources that could be used as, for example, backlights for laptop computer screens." Ex. 1010, Werner at p. 6. Similarly, Pinnow, which is entitled "Improvements In Or Relating To Visual Display Apparatus", and seeks to achieve "a true white" through the use of a blue emitting device.

Ex. 1009, Pinnow at 1:12-13; 4:91; 4:110-121. Given the similar focus on displays, blue emitting devices, and/or seeking white light, a POSITA would have been motivated to combine the teachings of Pinnow with Tadatsu, Nakamura and Werner in advance of the claimed inventions. Ex. 1002, Schubert Decl. at ¶ 41.

3. Claims 27-30, 33-48 Are Invalid As Obvious Over Tadatsu In View Of Nakamura And Werner, In Further View Of Pinnow

Petitioner refers back to its claim chart from Ground 1 found on pages 20-35 in Section VII.A.5. Petitioner’s claim chart herein only provides evidence from Pinnow, which adds to the evidence provided in the claim chart in Ground 1.

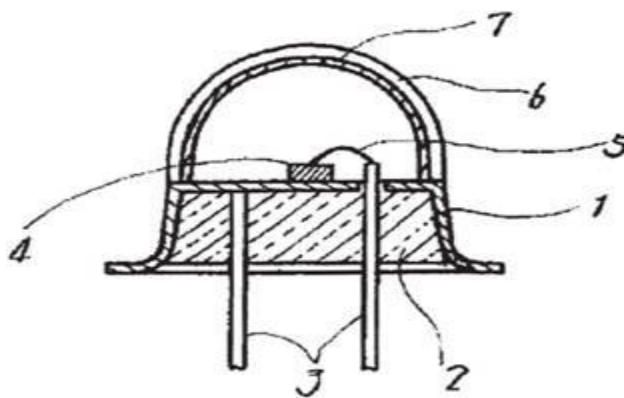
<p><u>Claim 27(d)</u>: so that each light-emitting device produces a white light output, wherein said white light output comprises blue light from said blue light emitted by the LED and said longer wavelength, polychromatic radiation emitted by the down-converting luminophoric medium,</p>	<p>“FIG. 3 presents the emission spectra for two organic phosphors and their 50—50 blend. The phosphors are 4-amino, 1,8-napthal p-xenylimide (peaking at 5300 Å) (curve A) and Rhodamine (peaking at 6050 Å) (curve B). Both fluoresce with high efficiencies (greater than 50%) under 4880 Å excitation. The broken line represents a particulate 50—50 mixture of these two phosphors. The individual phosphors fluoresce yellow-green and red. Their combined output is orange. The blue content of radiation from the screen can also be enhanced by addition of reflective matter to increase the fraction of 4880 Å laser radiation reflected when this argon-ion laser radiation is used, for example. Hence, the overall effect is to produce a white appearance to the eye.” Ex. 1009, Pinnow at 4:29-46.</p> <p>“The invention relates to visual display apparatus.” <i>Id.</i> at 1:12-13.</p> <p>Ex. 1002, Schubert Decl. at ¶ 40.</p>
<p><u>Claim 40(d)</u>: so</p>	<p>“FIG. 3 presents the emission spectra for two organic</p>

<p>that each light-emitting device produces a white light output, wherein said white light output comprises blue light from said blue light emitted by the LED and said longer wavelength, polychromatic radiation emitted by the down-converting luminophoric medium.</p>	<p>phosphors and their 50—50 blend. The phosphors are 4-amino, 1,8-naphthal p-xenylimide (peaking at 5300 Å) (curve A) and Rhodamine (peaking at 6050 Å) (curve B). Both fluoresce with high efficiencies (greater than 50%) under 4880 Å excitation. The broken line represents a particulate 50—50 mixture of these two phosphors. The individual phosphors fluoresce yellow-green and red. Their combined output is orange. The blue content of radiation from the screen can also be enhanced by addition of reflective matter to increase the fraction of 4880 Å laser radiation reflected when this argon-ion laser radiation is used, for example. Hence, the overall effect is to produce a white appearance to the eye.” Ex. 1009, Pinnow at 4:29-46.</p> <p>“The invention relates to visual display apparatus.” <i>Id.</i> at 1:12-13.</p> <p>Ex. 1002, Schubert Decl. at ¶ 40.</p>
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C. Ground 3: Claims 27, 30-33, 35, 37-48 Are Invalid As Obvious Over Tabuchi In View Of Nakamura, Werner, And Pinnow

1. Tabuchi Provides A LED With A Phosphor Layer

Tabuchi discloses a semiconductor device with a light-emitting diode (LED) and a phosphor layer. Ex. 1008, Tabuchi at 2. Figure 1 shows that a phosphor layer 7 dispersed in a hemisphere facing the LED 4.



Id. at Figure 1; *see also id.* at 3 (phosphor layer 7 “is dispersed”). Phosphor layer 7 uses a “binding agent”, which would be the disclosed “epoxy resin”, to absorb and hold the powder-like phosphor material. *Id.* at 3; Ex. 1002, Schubert Decl. at ¶ 45. A resin is a type of polymer. *Id.* at ¶ 46.

The LED 4 in Tabuchi can emit “near” ultraviolet (UV) light, which has a shorter wavelength than visible light.⁸ Ex. 1008, Tabuchi at 5. In Tabuchi, the phosphor layer 7 absorbs the shorter wavelength of UV light, and in response, re-emits the light with a longer wavelength of visible light. *Id.* at 5 (“a near UV light emitting devices with GaN can be employed and [] an ordinary UV-visible light conversion phosphor can be utilized.”); *id.* at 3 (“A phosphor layer 7 is provided ... in which a phosphor to convert the radiation from light emitting semiconductor device 4 to visible light”). As explained in the Declaration of Dr. Schubert, “the phosphor layer in Tabuchi is down-converting the UV light to visible light, transforming the relatively shorter wavelength of UV light into the longer wavelength of visible light.” Ex. 1002, Schubert Decl. at ¶ 43. As such, Tabuchi

⁸ A UV LED that emits “near UV light” would have a wavelength in the range of 320nm-380nm, as compared to blue light in the range of 420nm-490nm. Ex. 1002, Schubert Decl. at ¶ 43. Like blue emitting LEDs, UV emitting LEDs are used in the industry with phosphor to produce white light. *Id.*

discloses the construed “down-converting” element, where the phosphor layer acts as the construed “luminophoric medium”.

Petitioner refers back to its discussion of Nakamura on pages 17-18 in Section VII.A.2, entitled “Nakamura Introduces The Bright Blue LED”, and its discussion of Werner on page 18 in Section VII.A.3, entitled “Werner Teaches A Liquid Crystal Display And A Backlighting Array”.

2. A POSITA Would Have Been Motivated To Combine Tabuchi With Nakamura And Werner

Tabuchi discloses a “high brightness” LED to produce visible light. Ex. 1008, Tabuchi at 2. Similarly, Nakamura discloses a “high brightness” blue LED. Ex. 1006, Nakamura at p. 1. Tabuchi teaches LEDs as “display devices with a long life.” Ex. 1008, Tabuchi at 2. Similarly, Nakamura discloses using bright blue LEDs in “high-brightness full color indicators and flat panel displays.” Ex. 1006, Nakamura at p. 3. With Tabuchi and Nakamura’s similar focus on high-brightness LEDs and their use in displays, a POSITA would have been motivated to combine their teachings. Ex. 1002, Schubert Decl. at ¶ 49.

Werner, at Exhibit 1010, shows that a POSITA would have taken notice of the bright blue LED disclosed in Nakamura and Werner and apply such a LED to Tabuchi. Werner discloses that the bright blue LED from Nakamura is the “long-sought Holy Grail of LED technology--a blue LED with a luminous efficiency high enough” that “even full color outdoor video displays based on LEDs are now

possible.” Ex. 1010, Werner at p. 1. Werner is a published article by IEEE Spectrum that would have motivated a POSITA in 1994 to combine it with prior art disclosing “high brightness” LEDs and “display” applications, such Tabuchi and Nakamura. Ex. 1002, Schubert Decl. at ¶¶ 49–50. As such, a POSITA in 1994 would have been motivated apply the “high brightness” blue LED of Nakamura and Werner to the disclosure in Tabuchi in advance of the claimed inventions.⁹ *Id.*

3. A POSITA Would Have Been Motivated To Combine Tabuchi, Nakamura, And Werner With Pinnow¹⁰

Petitioner refers back to its discussion of Pinnow on pages 35-36 in Section VII.B.1, entitled “Pinnow Teaches White Light Via Phosphor And Fluorescer”.

Like Tabuchi, Pinnow discloses the down-conversion of light. Ex. 1009, Pinnow at 4:118-119 (“can be achieved by down-conversion of frequency”), Table I. Also like Tabuchi, Pinnow discloses down-conversion via phosphor. *Id.* at

⁹ During the *ex parte* reexamination of the related ’945 Patent, the Patent Office in substantial part relied on Tabuchi and Nakamura in issuing a Final Rejection of the claims. Ex. 1005, ’945 Rejection at 4-12.

¹⁰ During the reexamination of the parent, the ’175 Patent, the PTAB affirmed that a POSITA would combine the teachings of Tabuchi, the bright blue LED of Nakamura, and the phosphors of Pinnow. Ex. 1003, Decision on Appeal at 50.

4:110-5:5, Table I (listing down-converting phosphors). With the knowledge of Tabuchi's down-converting process via phosphor, a POSITA would have been motivated to consult a reference like Pinnow that summarizes the different types of phosphors and their characteristics. Ex. 1002, Schubert Decl. at ¶ 33. Pinnow provides a summary Table I of numerous down-converting phosphors, with the name of the phosphor, its absorption characteristics, and its emission color. Ex. 1009, Pinnow at 4:110-5:5, Table I.

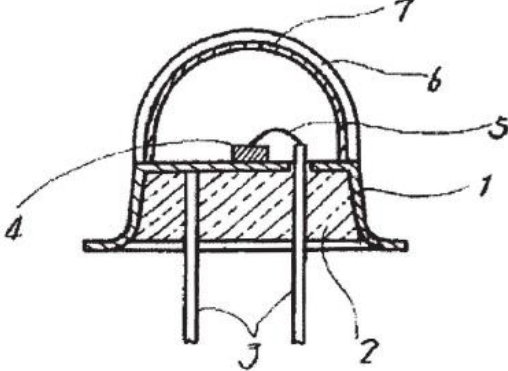
Further, the discovery of the bright blue LED from Nakamura would serve as additional motivation to consult a reference like Pinnow that summarizes phosphors that absorb blue light and down-converts to white light. Ex. 1002, Schubert Decl. at ¶ 33. The bright blue LED was a breakthrough for the industry, and a "POSITA would have taken notice of this new discovery, particularly for potential uses in backlighting displays with white light." *Id.* at ¶ 31. Nakamura introduces the bright blue LED and predicts that "full-color indicators and flat panel displays will be developed in the near future". Ex. 1006, Nakamura at p. 3. Werner teaches that the Nakamura bright blue LED may "open the way for white LED light sources that could be used as, for example, backlights for laptop computer screens." Ex. 1010, Werner at p. 6. And Tabuchi discusses "display devices with a long life." Ex. 1008, Tabuchi at 2. Similarly, Pinnow, which is entitled "Improvements In Or Relating To Visual Display Apparatus", seeks to

achieve “a true white” for a display through the use of a blue emitting device. Ex. 1009, Pinnow at 1:12-13; 4:91; 4:110-121. Given the similar focus on displays, blue emitting devices, and/or seeking white light, a POSITA would have been motivated to combine the teachings of Pinnow with Tabuchi, Nakamura and Werner. Ex. 1002, Schubert Decl. at ¶¶ 41, 50.

4. Claims 27, 30-33, 35, 37-48 Are Invalid As Obvious Over Tabuchi In View Of Nakamura And Werner, In Further View Of Pinnow

This claim chart shows the obviousness of each element of the claims:

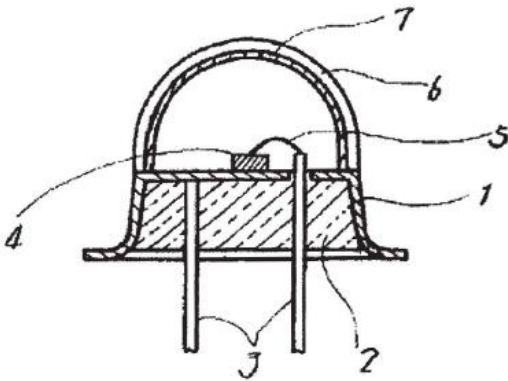
<p><u>Claim 27</u>: A liquid crystal display, including: a backlight member including a multiplicity of light-emitting devices, each light-emitting device comprising:</p>	<p>“The present utility model invention relates to a light emitting semiconductor apparatus which employs a phosphor to produce a visible light emission ... light emitting diodes are frequently utilized as compact display devices with a long life.” Ex. 1008, Tabuchi at 2.</p> <p>“Using these high-brightness blue LEDs, high-brightness full-color indicators and flat panel displays will be developed in the near future.” Ex. 1006, Nakamura at p. 3.</p> <p>“Rectangular LED light bars put two or more LED chips in an epoxy package and are used for backlighting stenciled messages. Long, thin, flexible packages containing dozens of LED chips are used as backlights for small liquid-crystal displays.” Ex. 1010, Werner at p. 6.</p> <p>Ex. 1002, Schubert Decl. at ¶ 41.</p>
<p>(a) at least one single-die gallium nitride based semiconductor blue light-emitting diode</p>	<p>“the present utility model invention is applied to a light emitting semiconductor apparatus which employs a so-called TO-5 stem. Figure 1, glass 2 fixes leads 3 in a TO-5 metal stem 1. A light emitting semiconductor device 4 is conductively connected to stem 1. ... A phosphor layer 7 is provided by applying a binding agent in which a phosphor to convert the radiation from light emitting semiconductor device 4 to visible light is</p>

<p>(LED) coupleable with a power supply to emit blue light,</p>	<p>dispersed on the inner surface of transparent cover 6.” Ex. 1008, Tabuchi at 3.</p>  <p><i>Id.</i> at Fig. 1.</p> <p>“Candela-class high-brightness InGaN/AlGaIn double-heterostructure (DH) blue-light-emitting diodes (LEDs)” Ex. 1006, Nakamura at p. 1.</p> <p>Ex. 1002, Schubert Decl. at ¶ 44.</p>
<p>(b) and a down-converting luminophoric medium arranged for exposure to said blue light</p>	<p>“wherein there is a phosphor layer on a surface of said transparent cover which faces said light emitting semiconductor device”. Ex. 1008, Tabuchi at 2.</p> <p>“In the light emitting apparatus of the present utility model invention, phosphor layer 7 converts infrared or UV emitted from light emitting semiconductor device 4 to visible light” Ex. 1008, Tabuchi at 3-4.</p> <p>“[I]t goes without saying that a near UV light emitting devices with GaN can be employed and that an ordinary UV-visible light conversion phosphor can be utilized.” <i>Id.</i> at 5.</p> <p>“Candela-class high-brightness InGaN/AlGaIn double-heterostructure (DH) blue-light-emitting diodes (LEDs)” Ex. 1006, Nakamura at p. 1.</p> <p>Ex. 1002, Schubert Decl. at ¶ 44.</p>

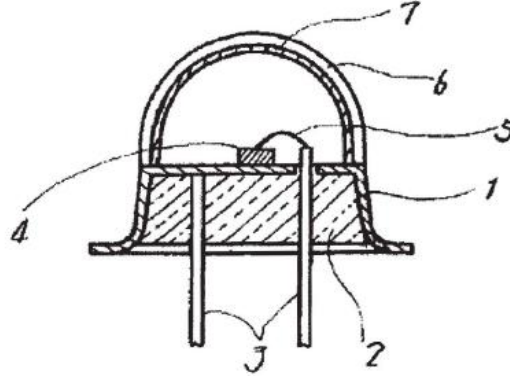
<p>(c) and which in exposure to said blue light responsively emits a longer wavelength, polychromatic radiation,</p>	<p>“In the light emitting apparatus of the present utility model invention, phosphor layer 7 converts infrared or UV emitted from light emitting semiconductor device 4 to visible light” Ex. 1008, Tabuchi at 3.</p> <p>“[I]t goes without saying that a near UV light emitting devices with GaN can be employed and that an ordinary UV-visible light conversion phosphor can be utilized.” <i>Id.</i> at 5.</p> <p>“Candela-class high-brightness InGaN/AlGaIn double-heterostructure (DH) blue-light-emitting diodes (LEDs)” Ex. 1006, Nakamura at p. 1.</p> <p>“FIG. 3 presents the emission spectra for two organic phosphors and their 50—50 blend. The phosphors are 4-amino, 1,8-naphthal p-xenylimide (peaking at 5300 Å) (curve A) and Rhodamine (peaking at 6050 Å) (curve B). Both fluoresce with high efficiencies (greater than 50%) under 4880 Å excitation. The broken line represents a particulate 50—50 mixture of these two phosphors. The individual phosphors fluoresce yellow-green and red. Their combined output is orange. The blue content of radiation from the screen can also be enhanced by addition of reflective matter to increase the fraction of 4880 Å laser radiation reflected when this argon-ion laser radiation is used, for example. Hence, the overall effect is to produce a white appearance to the eye.” Ex. 1009, Pinnow at 4:29-46.</p> <p>Ex. 1002, Schubert Decl. at ¶¶ 40, 43.</p>
<p>(d) so that each light-emitting device produces a white light output, wherein said white light output comprises blue light from said blue light emitted by the LED and said longer</p>	<p>“In the light emitting apparatus of the present utility model invention, phosphor layer 7 converts infrared or UV emitted from light emitting semiconductor device 4 to visible light which is radiated in random directions.” Ex. 1008, Tabuchi at 3.</p> <p>“[I]t goes without saying that a near UV light emitting devices with GaN can be employed and that an ordinary UV-visible light conversion phosphor can be utilized.” Ex. 1008, Tabuchi at 5.</p> <p>“Candela-class high-brightness InGaN/AlGaIn double-heterostructure (DH) blue-light-emitting diodes (LEDs)”</p>

<p>wavelength, polychromatic radiation emitted by the down-converting luminophoric medium,</p>	<p>Ex. 1006, Nakamura at p. 1.</p> <p>“FIG. 3 presents the emission spectra for two organic phosphors and their 50—50 blend. The phosphors are 4-amino, 1,8-naphthal p-xenylimide (peaking at 5300 Å) (curve A) and Rhodamine (peaking at 6050 Å) (curve B). Both fluoresce with high efficiencies (greater than 50%) under 4880 Å excitation. The broken line represents a particulate 50—50 mixture of these two phosphors. The individual phosphors fluoresce yellow-green and red. Their combined output is orange. The blue content of radiation from the screen can also be enhanced by addition of reflective matter to increase the fraction of 4880 Å laser radiation reflected when this argon-ion laser radiation is used, for example. Hence, the overall effect is to produce a white appearance to the eye.” Ex. 1009, Pinnow at 4:29-46.</p> <p>Ex. 1002, Schubert Decl. at ¶¶ 40, 43.</p>
<p>(e) and wherein the down-converting luminophoric medium is dispersed in a polymer that is on or about the single-die gallium nitride based semiconductor blue light-emitting diode.</p>	<p>“Figure 1... A phosphor layer 7 is provided by applying a binding agent in which a phosphor to convert the radiation from light emitting semiconductor device 4 to visible light is dispersed on the inner surface of transparent cover 6. Transparent cover 6 is made of a material such as glass or an epoxy resin...” Ex. 1008, Tabuchi at 3.</p> <p>“phosphor is dispersed is formed into a hemisphere covering a large region including a light emitting device”. <i>Id.</i> at 3.</p> <p>“wherein there is a phosphor layer on a surface of said transparent cover which faces said light emitting semiconductor device”. <i>Id.</i> at 2.</p> <p>“Candela-class high-brightness InGaN/AlGaN double-heterostructure (DH) blue-light-emitting diodes (LEDs)” Ex. 1006, Nakamura at p. 1.</p> <p>Ex. 1002, Schubert Decl. at ¶¶ 44–46.</p>
<p><u>Claim 30</u>: The liquid crystal display of claim 27, comprising</p>	<p>“Figure 1... A phosphor layer 7 is provided by applying a binding agent in which a phosphor to convert the radiation from light emitting semiconductor device 4 to visible light is dispersed on the inner surface of transparent cover 6.</p>

<p>the luminophoric medium dispersed in a polymer that is about the single-die gallium nitride based semiconductor blue light-emitting diode.</p>	<p>Transparent cover 6 is made of a material such as glass or an epoxy resin...” Ex. 1008, Tabuchi at 3.</p> <p>“phosphor is dispersed is formed into a hemisphere covering a large region including a light emitting device”. <i>Id.</i> at 3.</p> <p>“wherein there is a phosphor layer on a surface of said transparent cover which faces said light emitting semiconductor device”. <i>Id.</i> at 2.</p> <p>“Candela-class high-brightness InGaN/AlGaIn double-heterostructure (DH) blue-light-emitting diodes (LEDs)” Ex. 1006, Nakamura at p. 1.</p> <p>Ex. 1002, Schubert Decl. at ¶¶ 44–46.</p>
<p><u>Claim 31</u>: The liquid crystal display of claim 27, comprising the single-die gallium nitride based semiconductor blue light-emitting diode comprising die side surface, and wherein the polymer is in laterally spaced relationship to said side die surface.</p>	<p>“the present utility model invention is applied to a light emitting semiconductor apparatus which employs a so-called TO-5 stem. Figure 1, glass 2 fixes leads 3 in a TO-5 metal stem 1. A light emitting semiconductor device 4 is conductively connected to stem 1... A phosphor layer 7 is provided by applying a binding agent in which a phosphor to convert the radiation from light emitting semiconductor device 4 to visible light is dispersed on the inner surface of transparent cover 6. Transparent cover 6 is made of a material such as glass or an epoxy resin” Ex. 1008, Tabuchi at 3.</p> <p>“Candela-class high-brightness InGaN/AlGaIn double-heterostructure (DH) blue-light-emitting diodes (LEDs)” Ex. 1006, Nakamura at p. 1.</p> <div data-bbox="719 1470 1227 1848" data-label="Image"> </div> <p>Ex. 1008, Tabuchi at Fig. 1.</p>

	Ex. 1002, Schubert Decl. at ¶¶ 44–46.
<p>Claim 32: The liquid crystal display of claim 30, wherein the polymer is in laterally spaced facing relationship to said side die surface.</p>	<p>“the present utility model invention is applied to a light emitting semiconductor apparatus which employs a so-called TO-5 stem. Figure 1, glass 2 fixes leads 3 in a TO-5 metal stem 1. A light emitting semiconductor device 4 is conductively connected to stem 1... A phosphor layer 7 is provided by applying a binding agent in which a phosphor to convert the radiation from light emitting semiconductor device 4 to visible light is dispersed on the inner surface of transparent cover 6. Transparent cover 6 is made of a material such as glass or an epoxy resin”. Ex. 1008, Tabuchi at 3.</p>  <p><i>Id.</i> at Fig. 1.</p> <p>“a transparent cover which covers said light emitting semiconductor device across a gap, wherein there is a phosphor layer on a surface of said transparent cover which faces said light emitting semiconductor device”. <i>Id.</i> at 3.</p> <p>Ex. 1002, Schubert Decl. at ¶¶ 44–46.</p>
<p>Claim 33: The liquid crystal display of claim 27, comprising the single-die gallium nitride based semiconductor blue light-emitting diode</p>	<p>“the present utility model invention is applied to a light emitting semiconductor apparatus which employs a so-called TO-5 stem. Figure 1, glass 2 fixes leads 3 in a TO-5 metal stem 1. A light emitting semiconductor device 4 is conductively connected to stem 1. ... A phosphor layer 7 is provided by applying a binding agent in which a phosphor to convert the radiation from light emitting semiconductor device 4 to visible light is dispersed on the inner surface of transparent cover 6.” Ex. 1008, Tabuchi at 3.</p>

being arranged to directly impinge blue light on the polymer.



Id. at Fig. 1.

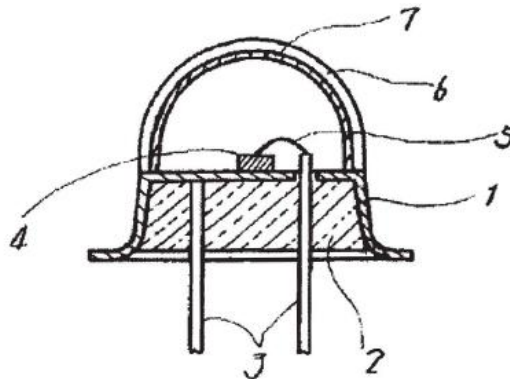
“wherein there is a phosphor layer on a surface of said transparent cover which faces said light emitting semiconductor device”. *Id.* at 2.

“Candela-class high-brightness InGaN/AlGaN double-heterostructure (DH) blue-light-emitting diodes (LEDs)”
Ex. 1006, Nakamura at p. 1.

Ex. 1002, Schubert Decl. at ¶¶ 44-46.

Claim 35: The liquid crystal display of claim 27, comprising the luminophoric medium being in a homogeneous composition.

“Figure 1... A phosphor layer 7 is provided by applying a binding agent in which a phosphor to convert the radiation from light emitting semiconductor device 4 to visible light is dispersed on the inner surface of transparent cover 6.” Ex. 1008, Tabuchi at 3.



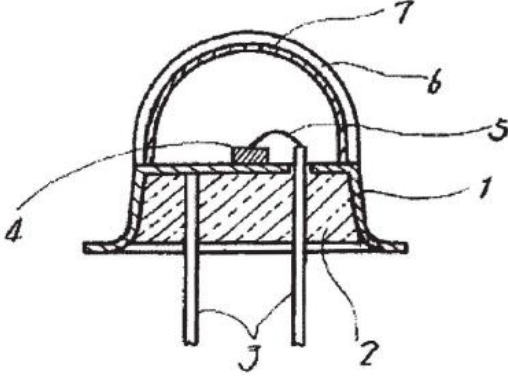
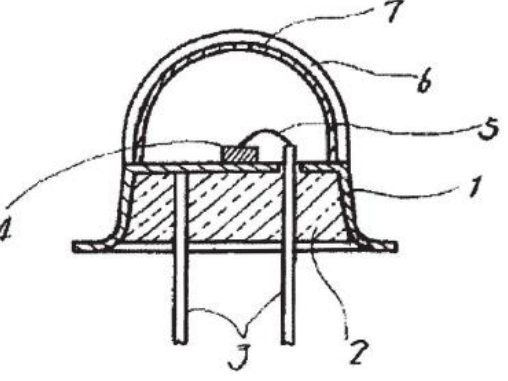
Id. at Fig. 1.

“FIG. 3 presents the emission spectra for two organic phosphors and their 50—50 blend.” Ex. 1009, Pinnow at 4:29-30.

Ex. 1002, Schubert Decl. at ¶ 40.

<p><u>Claim 37:</u> The liquid crystal display of claim 27, wherein the luminophoric medium comprises inorganic luminophoric material.</p>	<p>“When the phosphor composition is at least in part organic due to the large variation of materials which are suitable for use ...” Ex. 1009, Pinnow at 2:30-34.</p> <p>“[A]n ordinary UV-visible light conversion phosphor can be utilized....” Ex. 1008, Tabuchi at 5.</p> <p>“However, as with the garnet phosphors, suitable choices of phosphors can readily be made so that no compensation is needed.” Ex. 1009, Pinnow at 6:58-60.</p> <p>“FIG. 2 presents the emission and related excitation spectra for cerium-doped YAG.” <i>Id.</i> at 2:103-04.</p> <p>Ex. 1002, Schubert Decl. at ¶¶ 47–48.</p>
<p><u>Claim 38:</u> The liquid crystal display of claim 27, wherein the single-die light-emitting diode comprises gallium nitride and its alloys.</p>	<p>“a near UV light emitting devices with GaN can be employed and that an ordinary UV-visible light conversion phosphor can be utilized” Ex. 1008, Tabuchi at 5.</p> <p>“Candela-class high-brightness InGaN/AlGaIn double-heterostructure (DH) blue-light-emitting diodes (LEDs)” Ex. 1006, Nakamura at Abstract, p. 1.</p> <p>Ex. 1002, Schubert Decl. at ¶ 29.</p>

<p><u>Claim 39:</u> The liquid crystal display of claim 27, wherein the single-die light-emitting diode comprises at least one of gallium nitride, indium gallium nitride, aluminum gallium nitride, and aluminum gallium indium nitride.</p>	<p>“a near UV light emitting devices with GaN can be employed and that an ordinary UV-visible light conversion phosphor can be utilized” Ex. 1008, Tabuchi at 5.</p> <p>“Candela-class high-brightness InGaN/AlGaIn double-heterostructure (DH) blue-light-emitting diodes (LEDs)” Ex. 1006, Nakamura at Abstract, p. 1.</p> <p>Ex. 1002, Schubert Decl. at ¶ 29.</p>
<p><u>Claim 40:</u> A display, comprising a multiplicity of light-emitting devices, each light-emitting device comprising:</p>	<p>“The present utility model invention relates to a light emitting semiconductor apparatus which employs a phosphor to produce a visible light emission ... light emitting diodes are frequently utilized as compact display devices with a long life.” Ex. 1008, Tabuchi at 2.</p> <p>“Using these high-brightness blue LEDs, high-brightness full-color indicators and flat panel displays will be developed in the near future.” Ex. 1006, Nakamura at p. 3.</p> <p>“Rectangular LED light bars put two or more LED chips in an epoxy package and are used for backlighting stenciled messages. Long, thin, flexible packages containing dozens of LED chips are used as backlights for small liquid-crystal displays.” Ex. 1010, Werner at p. 6.</p> <p>“LEDs are packaged as traditional lamps, as chips that are automatically mountable from tape, and as modules for numerical displays” <i>Id.</i></p>
<p>(a) at least one single-die semiconductor light-emitting diode (LED)</p>	<p>“the present utility model invention is applied to a light emitting semiconductor apparatus which employs a so-called TO-5 stem. Figure 1, glass 2 fixes leads 3 in a TO-5 metal stem 1. A light emitting semiconductor device 4 is conductively connected to stem 1. ... A phosphor layer 7 is provided by applying a</p>

<p>coupleable with a power supply to emit blue light,</p>	<p>binding agent in which a phosphor to convert the radiation from light emitting semiconductor device 4 to visible light is dispersed on the inner surface of transparent cover 6.” Ex. 1008, Tabuchi at 3.</p>  <p><i>Id.</i> at Fig. 1.</p> <p>“Candela-class high-brightness InGaN/AlGaIn double-heterostructure (DH) blue-light-emitting diodes (LEDs) with the luminous intensity over 1 cd were fabricated.” Ex. 1006, Nakamura at p. 1.</p> <p>Ex. 1002, Schubert Decl. at ¶ 44.</p>
<p>(b) and a down-converting luminophoric medium arranged for exposure to said blue light,</p>	<p>“wherein there is a phosphor layer on a surface of said transparent cover which faces said light emitting semiconductor device” Ex. 1008, Tabuchi at 2.</p>  <p><i>Id.</i> at Fig. 1.</p> <p>“In the light emitting apparatus of the present utility model</p>

	<p>invention, phosphor layer 7 converts infrared or UV emitted from light emitting semiconductor device 4 to visible light” <i>Id.</i> at 3-4.</p> <p>“[I]t goes without saying that a near UV light emitting devices with GaN can be employed and that an ordinary UV-visible light conversion phosphor can be utilized.” <i>Id.</i> at 5.</p> <p>“Candela-class high-brightness InGaN/AlGaIn double-heterostructure (DH) blue-light-emitting diodes (LEDs)” Ex. 1006, Nakamura at p. 1.</p> <p>Ex. 1002, Schubert Decl. at ¶¶ 43–44, 49.</p>
(c) and which in exposure to said blue light responsively emits a longer wavelength, polychromatic radiation,	<p>“In the light emitting apparatus of the present utility model invention, phosphor layer 7 converts infrared or UV emitted from light emitting semiconductor device 4 to visible light which is radiated in random directions.” Ex. 1008, Tabuchi at 3.</p> <p>“[I]t goes without saying that a near UV light emitting devices with GaN can be employed and that an ordinary UV-visible light conversion phosphor can be utilized.” <i>Id.</i> at 5.</p> <p>“Candela-class high-brightness InGaN/AlGaIn double-heterostructure (DH) blue-light-emitting diodes (LEDs)” Ex. 1006, Nakamura at p. 1.</p> <p>“FIG. 3 presents the emission spectra for two organic phosphors and their 50—50 blend. The phosphors are 4-amino, 1,8-naphthal p-xenylimide (peaking at 5300 Å) (curve A) and Rhodamine (peaking at 6050 Å) (curve B). Both fluoresce with high efficiencies (greater than 50%) under 4880 Å excitation. The broken line represents a particulate 50—50 mixture of these two phosphors. The individual phosphors fluoresce yellow-green and red. Their combined output is orange. The blue content of radiation from the screen can also be enhanced by addition of reflective matter to increase the fraction of 4880 Å laser radiation reflected when this argon-ion laser radiation is used, for example. Hence, the overall effect is to produce a white appearance to the eye.” Ex. 1009, Pinnow at 4:29-46.</p>

	Ex. 1002, Schubert Decl. at ¶¶ 40, 43, 49.
(d) so that each light-emitting device produces a white light output, wherein said white light output comprises blue light from said blue light emitted by the LED and said longer wavelength, polychromatic radiation emitted by the down-converting luminophoric medium.	<p>“In the light emitting apparatus of the present utility model invention, phosphor layer 7 converts infrared or UV emitted from light emitting semiconductor device 4 to visible light which is radiated in random directions.” Ex. 1008, Tabuchi at 3.</p> <p>“[I]t goes without saying that a near UV light emitting devices with GaN can be employed and that an ordinary UV-visible light conversion phosphor can be utilized.” Ex. 1008, Tabuchi at 5.</p> <p>“Candela-class high-brightness InGaN/AlGaN double-heterostructure (DH) blue-light-emitting diodes (LEDs)” Ex. 1006, Nakamura at p. 1.</p> <p>“FIG. 3 presents the emission spectra for two organic phosphors and their 50—50 blend. The phosphors are 4-amino, 1,8-naphthal p-xenylimide (peaking at 5300 Å) (curve A) and Rhodamine (peaking at 6050 Å) (curve B). Both fluoresce with high efficiencies (greater than 50%) under 4880 Å excitation. The broken line represents a particulate 50—50 mixture of these two phosphors. The individual phosphors fluoresce yellow-green and red. Their combined output is orange. The blue content of radiation from the screen can also be enhanced by addition of reflective matter to increase the fraction of 4880 Å laser radiation reflected when this argon-ion laser radiation is used, for example. Hence, the overall effect is to produce a white appearance to the eye.” Ex. 1009, Pinnow at 4:29-46.</p> <p>Ex. 1002, Schubert Decl. at ¶¶ 40, 43, 49.</p>
<u>Claim 41</u> : The display of claim 40, wherein in each light-emitting device the single-die semiconductor light-emitting diode is on a support in an	<p>“Figure 1... A transparent cover 6 according to the present utility model invention is fixed on stem 1. ... Transparent cover 6 is made of a material such as glass or an epoxy resin is preferably fixed to stem 2 so that it can also function as a cap for hermetic sealing.” Ex. 1008, Tabuchi at 3.</p>

<p>interior volume of a light-transmissive enclosure.</p>	<div data-bbox="662 191 1177 567" data-label="Image"> </div> <p><i>Id.</i> at Fig. 1.</p> <p><i>Id.</i> at Fig. 2.</p> <p>Ex. 1002, Schubert Decl. at ¶¶ 44, 46.</p>
<p><u>Claim 42</u>: The display of claim 40, wherein said multiplicity of light-emitting devices comprises an array of single-die semiconductor light-emitting diodes.</p>	<p>“Using these high-brightness blue LEDs, high-brightness full-color indicators and flat panel displays will be developed in the near future.” Ex. 1006, Nakamura at p. 3.</p> <p>“Rectangular LED light bars put two or more LED chips in an epoxy package and are used for backlighting stenciled messages. Long, thin, flexible packages containing dozens of LED chips are used as backlights for small liquid-crystal displays.” Ex. 1010, Werner at p. 6.</p> <p>“LEDs are packaged as traditional lamps, as chips that are automatically mountable from tape, and as modules for numerical displays” <i>Id.</i></p> <p>Ex. 1002, Schubert Decl. at ¶ 41.</p>
<p><u>Claim 43</u>: The display of claim 42, wherein said array comprises a regular pattern.</p>	<p>“Using these high-brightness blue LEDs, high-brightness full-color indicators and flat panel displays will be developed in the near future.” Ex. 1006, Nakamura at p. 3.</p> <p>“Rectangular LED light bars put two or more LED chips in an epoxy package and are used for backlighting stenciled messages. Long, thin, flexible packages containing dozens of LED chips are used as backlights for small liquid-crystal displays.” Ex. 1010, Werner at p. 6.</p> <p>“LEDs are packaged as traditional lamps, as chips that are</p>

	<p>automatically mountable from tape, and as modules for numerical displays” <i>Id.</i></p> <p>Ex. 1002, Schubert Decl. at ¶ 41.</p>
<p><u>Claim 44</u>: The display of claim 40, wherein said luminophoric medium comprises inorganic luminophoric material.</p>	<p>“When the phosphor composition is at least in part organic due to the large variation of materials which are suitable for use ...” Ex. 1009, Pinnow at 2:30-34.</p> <p>“[A]n ordinary UV-visible light conversion phosphor can be utilized....” Ex. 1008, Tabuchi at 5.</p> <p>“However, as with the garnet phosphors, suitable choices of phosphors can readily be made so that no compensation is needed.” Ex. 1009, Pinnow at 6:58-60.</p> <p>“FIG. 2 presents the emission and related excitation spectra for cerium-doped YAG.” <i>Id.</i> at 2:103-04.</p> <p>Ex. 1002, Schubert Decl. at ¶¶ 47–48.</p>
<p><u>Claim 45</u>: The display of claim 44, wherein each single-die semiconductor light-emitting diode comprises a single-die gallium nitride based semiconductor blue light-emitting diode.</p>	<p>“the present utility model invention is applied to a light emitting semiconductor apparatus which employs a so-called TO-5 stem. Figure 1, glass 2 fixes leads 3 in a TO-5 metal stem 1. A light emitting semiconductor device 4 is conductively connected to stem 1.” Ex. 1008, Tabuchi at 3.</p> <div data-bbox="717 1213 1222 1591" data-label="Image"> </div> <p><i>Id.</i> at Fig. 1.</p> <p>“Candela-class high-brightness InGaN/AlGaN double-heterostructure (DH) blue-light-emitting diodes (LEDs)” Ex. 1006, Nakamura at p. 1.</p> <p>Ex. 1002, Schubert Decl. at ¶¶ 43, 49.</p>

<p><u>Claim 46:</u> The display of claim 45, wherein each single-die gallium nitride based semiconductor blue light-emitting diode comprises gallium nitride and its alloys.</p>	<p>“[I]t goes without saying that a near UV light emitting devices with GaN can be employed and that an ordinary UV-visible light conversion phosphor can be utilized.” Ex. 1008, Tabuchi at 5.</p> <p>“Candela-class high-brightness InGaN/AlGaIn double-heterostructure (DH) blue-light-emitting diodes (LEDs)” Ex. 1006, Nakamura at Abstract, p. 1.</p> <p>Ex. 1002, Schubert Decl. at ¶ 29.</p>
<p><u>Claim 47:</u> The display of claim 45, wherein each single-die gallium nitride based semiconductor blue light-emitting diode comprises at least one of gallium nitride, indium gallium nitride, aluminum gallium nitride, and aluminum gallium indium nitride.</p>	<p>“[I]t goes without saying that a near UV light emitting devices with GaN can be employed and that an ordinary UV-visible light conversion phosphor can be utilized.” Ex. 1008, Tabuchi at 5.</p> <p>“Candela-class high-brightness InGaN/AlGaIn double-heterostructure (DH) blue-light-emitting diodes (LEDs)” Ex. 1006, Nakamura at Abstract, p. 1.</p> <p>Ex. 1002, Schubert Decl. at ¶ 29.</p>
<p><u>Claim 48:</u> The display of claim 40, comprising a full-color liquid crystal display.</p>	<p>“Using these high-brightness blue LEDs, high-brightness full-color indicators and flat panel displays will be developed in the near future.” Ex. 1006, Nakamura at p. 3.</p> <p>“Even full-color outdoor video displays based on LEDs are now possible . . . discovered the long-sought Holy Grail of LED technology -- a blue LED with a luminous efficiency high enough” Ex. 1010, Werner at p. 1.</p>

	<p>“Rectangular LED light bars put two or more LED chips in an epoxy package and are used for backlighting stenciled messages. Long, thin, flexible packages containing dozens of LED chips are used as backlights for small liquid-crystal displays.” Ex. 1010, Werner at p. 6.</p> <p>Ex. 1002, Schubert Decl. at ¶ 41.</p>
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VIII. CONCLUSION

Petitioner requests that the PTAB institute *inter partes* review of Claims 27-48 of the '058 Patent, and then proceed to cancel these claims as unpatentable.

Dated: June 8, 2015

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CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. § 42.6(e), I certify that I caused to be served on counsel for Patent Owner a true and correct copy of the foregoing Petition for *Inter Partes* Review of U.S. Patent No. 8,860,058, Claims 27-48, including all Exhibits, via EXPRESS MAIL on the USPTO correspondence address of record listed below:

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