

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

NICHIA CORPORATION and
OSRAM OPTO SEMICONDUCTORS, INC.,
Petitioner,

v.

LIGHTING SCIENCE GROUP CORP.,
Patent Owner.

IPR2019-01259
Patent 7,098,483 B2

Before KEVIN F. TURNER, PATRICK M. BOUCHER, and
JOHN A. HUDALLA, *Administrative Patent Judges*.

BOUCHER, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

In response to a Petition (Paper 1, “Pet.”) filed by Nichia Corporation and OSRAM Opto Semiconductors (collectively, “Petitioner”), we instituted an *inter partes* review of claims 11 and 14–16 of U.S. Patent No. 7,098,483 B2 (“the ’483 patent”). Paper 21 (“Dec.”). During the trial, Lighting Science Group Corp. (“Patent Owner”) filed a Response (Paper 24, “PO Resp.”), to which Petitioner filed a Reply (Paper 30, “Reply”) and Patent Owner filed a Sur-reply (Paper 38, “Sur-reply”). An oral hearing was held with the parties, and a copy of the transcript was entered into the record. Paper 43 (“Tr.”).

We have jurisdiction under 35 U.S.C. § 6. This Decision is a Final Written Decision under 35 U.S.C. § 318(a) as to the patentability of the claims on which we instituted trial. Based on the record before us, Petitioner has shown, by a preponderance of the evidence, that claims 11 and 14–16 are unpatentable.

I. BACKGROUND

A. The ’483 Patent

1. Overview

The ’483 patent “relates to light emitting diodes [(“LEDs”)] and, in particular, to light emitting diodes packaged for high temperature operation.” Ex. 1001, 1:20–22. A version of Figure 1A of the ’483 patent, modified with coloring added by Petitioner, is reproduced below. Pet. 6.

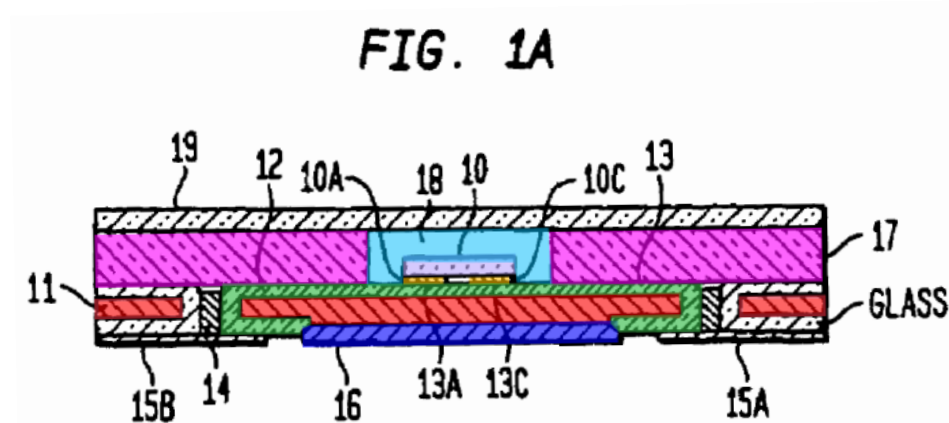


Figure 1A is a schematic cross section of an LED packaged for high-temperature operation. Ex. 1001, 2:45–47. The coloring added to the drawing by Petitioner simplifies identification of the relevant components of the structure.

As illustrated in Figure 1A, the LED package includes LED 10 (purple) with anode 10A and cathode 10C (orange) “mounted overlying and thermally coupled to a metal base 11” (red). *Id.* at 2:45–57. Metal base 11 “includes a patterned low thermal resistance, electrically insulating layer 12 [(green)] to provide electrical insulation from the base 11 and a patterned conductive layer 13 to provide thermal coupling and electrical connection,” though the patent notes that “layers 12 and 13 can be patterned to provide insulation or electrical connection regions as desired.” *Id.* at 2:48–54. “Electrical connections may be made through the metal base 11 to underlying electrical connection pads 15A and 15B using electrically insulated vias 14 or the metal of the base 11.” *Id.* at 2:58–61. Thermal conductor pads 16 (dark blue) may be provided on remaining areas of metal base 11 to carry heat from the LED package to a printed circuit board. *Id.* at 2:64–67. One or more ceramic layers 17 (pink) can be added to the surface of the package, overlying metal base 11, to form cavity 18 (light blue)

around LED 10. *Id.* at 3:5–7. Transparent cover 19 is a transparent clear cover or lens bonded over cavity 18. *Id.* at 3:14–16.

Figures 15 and 16 of the '483 patent are reproduced below.

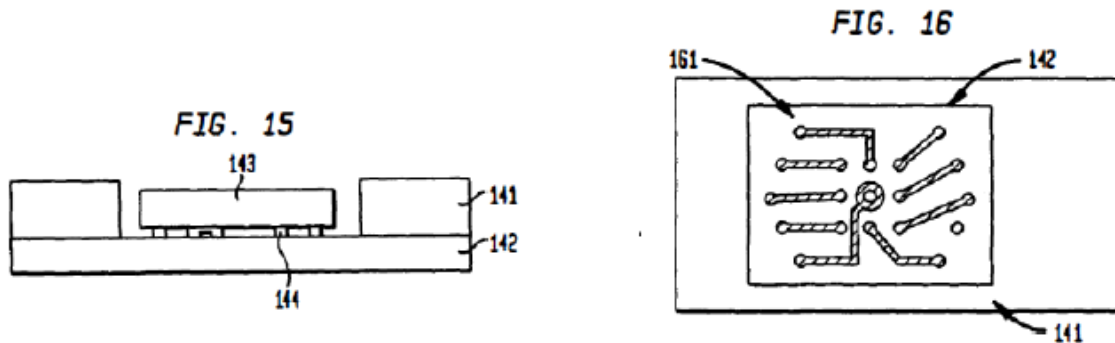


Figure 15 (left) is a side view of a flip-chip die in a low-temperature co-fired ceramic-on-metal (“LTCC-M”) package, and Figure 16 (right) shows a top view of the package before the die is installed. *Id.* at 5:41–45. As the patent explains, LED die 143 may be flip-chip bonded to wiring traces 161 by solder or gold balls 144 on surface 142, with circuitry incorporated using LTCC-M. *Id.* at 2:22–24, 3:36–41, 5:32–44. The LTCC-M techniques may also be used to incorporate “[d]ensely packed microcircuitry, and devices such as decoder/drivers, amplifiers, oscillators and the like, which generate large amounts of heat.” *Id.* at 7:60–63.

Figure 17 of the '483 patent is reproduced below.

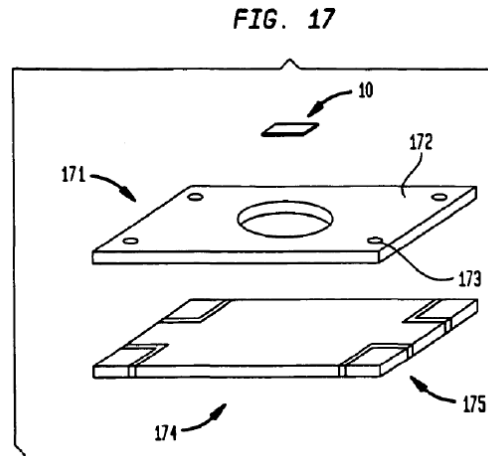


Figure 17 shows a single LED package having “isolated base terminals and vias.” *Id.* at 2:26–27. With this structure, connections to the LED assembly are “made by isolated terminals 175 on base 174.” *Id.* at 5:47–49. Openings in insulating layer 171, which may include ground plane 172, form wells for the LEDs, and metal vias 173 facilitate electrical connections from isolated terminals 175 to the die via conductive traces (not shown). *Id.* at 5:49–53.

2. Illustrative Claim

Independent claim 11 is illustrative of the challenged claims and is reproduced below.

11. A light emitting diode (LED) assembly for high temperature operation comprising:
 - a metal base, the metal base including a thermal connection surface;
 - at least one LED die, the LED die having a pair of electrodes overlying and electrically insulated from the metal base by an insulating layer, the die thermally coupled through the metal base to the thermal connection surface;

a layer of electrically insulating material overlying the metal base, wherein the layer of electrically insulating material includes at least one opening to house the LED die;

a plurality of conductive traces insulated from the metal base, the LED electrodes electrically connected to the conductive traces; and

one or more isolated terminals formed on the metal base, the one or more isolated terminals electrically connected to decoder/driver electronics that control the LED electrodes, wherein the electronics are mounted within the assembly.

Ex. 1001, 10:3–23.

3. Prosecution History

When the application that matured into the '483 patent was filed, it included the following claim:

11.^[1] A low temperature co-fired on metal (LTCC-M) light emitting diode (LED) assembly for high temperature operation comprising:

a metal base, the metal base including a thermal connection surface;

at least one LED die, the LED die having a pair of electrodes overlying and electrically insulated from the metal base, the die thermally coupled through the metal base to the thermal connection surface;

a layer of ceramic overlying the metal base, the layer of ceramic having at least one opening to house the LED die; and

a plurality of conductive traces insulated from the metal base, the LED electrodes electrically connected to the conductive traces.

¹ Although this claim was filed initially as original claim 11, it corresponds to issued claim 1. Prosecution claim 25, introduced by amendment during prosecution and discussed further below, matured into issued claim 11.

Ex. 1002, 31. Original claim 13 introduced “decoder / driver electronics that control the LED electrodes,” which were further limited by original claim 14 to be “embedded in the LTCC-M package.” *Id.*

Original claim 11 was rejected by the Examiner for obviousness over the combination of U.S. Patent No. 5,847,935 (“Thaler”) and U.S. Pat. Publ. No. 2002/0163006 (“Yoganandan”). *Id.* at 76–77. In the same Office Action, the Examiner indicated that original claim 14 “would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.” *Id.* at 78.

The Applicant subsequently amended original claim 11 to incorporate the limitations of original dependent claims 13 and 14, thereby placing claim 11 in condition for allowance and ultimate issuance as claim 1 of the ’483 patent. *Id.* at 99. At the same time, the Applicant introduced claim 25 by amendment, in the form that ultimately issued as claim 11, reproduced above. *Id.* at 101–02. In allowing the claims, the Examiner provided the following statement of reasons for allowance:

The prior art of record fails to disclose all the limitations recited in the base Claims. Specifically, the combination of a LTCC-M LED structure comprising a metal base including a thermal connection surface; an LED die having a pair of electrodes overlying and electrically insulated from the metal base by an insulating layer; and one or more isolated terminals formed on the metal base and electrically connected decoder/driver electronics which are mounted within the assembly (base claims 11 and 25) or a plurality of edge connector fingers connected to decoder/driver electronics which are embedded in the assembly and control the LED electrodes (base claims 21 and 31).

Id. at 119.

B. Evidence

Petitioner relies on the following references:

Shimizu	US 6,949,772 B2	Sept. 27, 2005	Ex. 1007
Agari	JP 3-61556	Mar. 18, 1991	Ex. 1012 ²
Song	US 6,707,069 B2	Mar. 16, 2004	Ex. 1016

In addition, Petitioner relies on a Declaration by Michael S. Lebby, Ph.D. Ex. 1003. No cross-examination testimony of Dr. Lebby was entered into the record. Patent Owner relies on a Declaration by Martin Kuball, Ph.D. Ex. 2012. Dr. Kuball was cross-examined by Petitioner, and a transcript of his deposition was entered into the record. Ex. 1029.

C. Instituted Grounds of Unpatentability

Petitioner challenges claims 11 and 14–16 on the following grounds.
Pet. 4–5.

Claims Challenged	35 U.S.C. § ³	Reference(s)
11, 14–16	102	Shimizu
11, 14–16	103	Shimizu, Agari
11, 14–16	103	Shimizu, Song
11, 14–16	103	Shimizu, Agari, Song

² Exhibit 1012 includes a copy of the original Japanese reference and an English translation, with an affidavit by the translator attesting to the accuracy of the translation. We make our citations to the English translation.

³ The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112-29, 125 Stat. 284, 287–88 (2011), amended 35 U.S.C. §§ 102 and 103. Because the ’483 patent was filed before March 16, 2013 (the effective date of the relevant amendment), the pre-AIA versions of §§ 102 and 103 apply.

D. Real Parties in Interest

Petitioner identifies Nichia Corporation, Nichia America Corporation, OSRAM GmbH, OSRAM Licht AG, OSRAM Opto Semiconductors GmbH, and OSRAM Opto Semiconductors, Inc. as real parties in interest. Pet. 1. Patent Owner identifies only itself as a real party in interest. Paper 5, 1.

E. Related Matters

Both parties identify the following matters as involving the '483 patent: (1) *Lighting Science Group Corp. v. Nichia Corp.*, No. 1:19-cv-01948 (N.D. Ga.); (2) *Lighting Science Group Corp. v. OSRAM GmbH*, No. 1:19-cv-00797 (D. Del.); (3) *Lighting Science Group Corp. v. Cree, Inc.*, No. 1:19-cv-00632 (E.D. Wis.); (4) *Lighting Science Group Corp. v. Acuity Brands, Inc.*, No. 1:19-cv-00805 (D. Del.); (5) *Lighting Science Group Corp. v. Eaton Corp. plc*, No. 1:19-cv-00808 (D. Del.); (6) *Lighting Science Group Corp. v. Gen. Elec. Co.*, 1:19-cv-00806 (D. Del.); (7) *Lighting Science Group Corp. v. Lumileds Holdings B.V.*, No. 1:19-cv-00809 (D. Del.); (8) *Lighting Science Group Corp. v. MLS Co., Ltd.*, No. 1:19-cv-00798 (D. Del.); (9) *Lighting Science Group Corp. v. Signify N.V.*, No. 1:19-cv-00807 (D. Del.); and (10) *Certain Light Emitting Diode Products, Systems, and Components Thereof (I)*, Inv. No. 337-TA-1163 (ITC). Pet. 1–2; Paper 5, 2. In addition, Petitioner identifies *Lighting Science Group Corp. v. Leedarson Lighting Co., Ltd.*, No. 1:19-cv-01949 (N.D. Ga.) as a related matter involving the '483 patent. Pet. 2.

The '483 patent is also the subject of *In re: Certain Light-Emitting Diode Products, Systems, and Components Thereof (III)*, Investigation No. 337-TA-1168 (“the ITC Investigation”).

II. ANALYSIS

A. Legal Principles

To establish anticipation under 35 U.S.C. § 102, each and every element in a claim, arranged as recited in the claim, must be found in a single prior art reference. *Net MoneyIN, Inc. v. VeriSign, Inc.*, 545 F.3d 1359, 1369 (Fed. Cir. 2008); *Karsten Mfg. Corp. v. Cleveland Golf Co.*, 242 F.3d 1376, 1383 (Fed. Cir. 2001). While the elements must be arranged in the same way as is recited in the claim, “the reference need not satisfy an *ipsissimis verbis* test.” *In re Gleave*, 560 F.3d 1331, 1334 (Fed. Cir. 2009); *In re Bond*, 910 F.2d 831, 832–33 (Fed. Cir. 1990). Identity of terminology between the anticipatory prior art reference and the claim is not required. Prior art references must be “considered together with the knowledge of one of ordinary skill in the pertinent art.” *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994).

A claim is unpatentable for obviousness under 35 U.S.C. § 103(a) if the differences between the claimed subject matter and the prior art are “such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the

prior art; (3) the level of skill in the art; and (4) when in evidence, objective indicia of nonobviousness, i.e., secondary considerations.⁴ *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

Additionally, the obviousness inquiry typically requires an analysis of “whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue.” *KSR*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006) (requiring “articulated reasoning with some rational underpinning to support the legal conclusion of obviousness”)); see *In re Warsaw Orthopedic, Inc.*, 832 F.3d 1327, 1333 (Fed. Cir. 2016) (citing *DyStar Textilfarben GmbH & Co. Deutschland KG v. C.H. Patrick Co.*, 464 F.3d 1356, 1360 (Fed. Cir. 2006)).

B. Level of Ordinary Skill in the Art

In determining whether an invention would have been obvious at the time it was made, we consider the level of ordinary skill in the pertinent art at the time of the invention. *Graham*, 383 U.S. at 17. “The importance of resolving the level of ordinary skill in the art lies in the necessity of maintaining objectivity in the obviousness inquiry.” *Ryko Mfg. Co. v. Nu-Star, Inc.*, 950 F.2d 714, 718 (Fed. Cir. 1991). The “person of ordinary skill in the art” is a hypothetical construct, from whose vantage point obviousness is assessed. *In re Rouffet*, 149 F.3d 1350, 1357 (Fed. Cir. 1998). “This legal construct is akin to the ‘reasonable person’ used as a reference in negligence determinations” and “also presumes that all prior art references in the field of the invention are available to this hypothetical

⁴ The parties do not address objective indicia of nonobviousness, which accordingly do not form part of our analysis.

skilled artisan.” *Id.* (citing *In re Carlson*, 983 F.2d 1032, 1038 (Fed. Cir. 1993)).

Petitioner asserts that the level of skill in the art is apparent from the cited art and that such a person “would have had at least a B.S. in mechanical or electrical engineering or a related field, and four years’ experience designing semiconductor—including LED—packages.” Pet. 11 (citing Ex. 1003 ¶¶ 36–38). Patent Owner “does not dispute the Petition’s proposed level of skill for a person of skill in the art.” PO Resp. 7. We accordingly adopt Petitioner’s articulation, which is consistent with the prior art presented. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (the prior art may reflect an appropriate level of skill in the art).

C. Claim Construction

For petitions filed after November 13, 2018, as here, the Board uses “the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. 282(b), including construing the claim in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.” *See Changes to the Claim Construction Standard for Interpreting Claims in Trial Proceedings Before the Patent Trial and Appeal Board*, 83 Fed. Reg. 51,340, 51,340, 51,358 (Oct. 11, 2018) (amending 37 C.F.R. § 42.100(b) effective November 13, 2018) (now codified at 37 C.F.R. § 42.100(b) (2019)); *see Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc). The specification may reveal a special definition given to a claim term by the patentee. *Phillips* at 1316. If an inventor acts as his or her own lexicographer, the definition

must be set forth in the specification with reasonable clarity, deliberateness, and precision. *Renishaw PLC v. Marposs Societa' per Azioni*, 158 F.3d 1243, 1249 (Fed. Cir. 1998).

Petitioner proposes a construction for “base,” but we find it unnecessary to construe that term to resolve the issues as developed during the trial. *See* Pet. 13–15 (Petitioner proposing that “base” be construed as “support or foundation”); *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (“[W]e need only construe terms ‘that are in controversy, and only to the extent necessary to resolve the controversy.’” (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))). Patent Owner does not explicitly propose a construction for any term, but instead implicitly takes certain positions in its substantive arguments.

In the Institution Decision, we identified two terms that bear on the issues raised in this proceeding, and whose construction we felt would benefit from further development by the parties. *See* Dec. 16–17 (discussing construction of “formed on”), 19 (noting Patent Owner had not proposed any specific construction of “assembly,” and advising the parties that “Patent Owner will have an opportunity to develop the record on this point” during the trial). We address construction of those terms below.

1. “formed on”

Independent claim 11 recites “one or more isolated terminals *formed on* the metal base.” Ex. 1001, 10:19 (emphasis added). During the oral hearing, Patent Owner confirmed that “the only embodiment in [the ’483] patent that is covered by this limitation is . . . one in which the terminals are

formed within the metal base and separated from the remainder of the metal base by some insulating material.” Tr. 49:13–22 (Patent Owner addressing characterization by responding, “That is a correct understanding of the disclosure of the patent in respect to this limitation.”). That sole embodiment is illustrated in Figure 17 of the ’483 patent, reproduced above, which shows terminals 175 formed at the corners of metal base 174 and isolated from the remainder of metal base 174 with electrically insulating material. *See* Ex. 1001, 5:47–55 (describing Figure 17).⁵

In its Response, Patent Owner attempts to distinguish the prior art with respect to this limitation by arguing that terminals separated from the metal base “are *not* ‘on’ [the] metal base in the sense of *directly* ‘on.’” PO Resp. 22; *see* Tr. 50:14–20 (Patent Owner agreeing that its papers take

⁵ Even though Patent Owner concedes that this is the only embodiment of the ’483 patent that informs construction of the limitation at issue, Patent Owner contends that “the Board cannot rely on . . . the Institution Decision’s reference to Figure 17 of the ’483 patent . . . , which Petitioners did not advance in their Petition or Reply.” Sur-reply 14 n.3. Although the Board may not “change theories midstream by adopting a construction in its final written decision that neither party requested or anticipated,” the parties were duly notified of our concern with the construction of “formed on” in the Institution Decision and provided with ample opportunity to respond. *See TQ Delta, LLC v. DISH Network LLC*, 929 F.3d 1350 (Fed. Cir. 2019); Dec. 16–17 (discussing limitation); *Intellectual Ventures II LLC v. Ericsson Inc.*, 686 Fed. App’x. 900, 906 (Fed. Cir. 2017) (explaining that the patent owner’s Administrative Procedure Act and due process arguments were meritless because it was on notice of the at-issue construction before the final written decision issued because there was a “continuous focus on [the claim term] before and during oral arguments”).

the “position that on means directly on”).⁶ But a narrow construction of “formed on,” that would require the isolated terminals to be formed *directly* on the metal base, is plainly untenable. As Petitioner observes, “if the recited ‘isolated terminals’ were *directly* on the metal base, they would not be isolated. Rather, they would be short-circuited to each other.” Reply 15–16. This observation is supported by the testimony of Dr. Lebby, who explains that a person of ordinary skill in the art “would have understood that ‘isolated’ requires electrical separation from the metal base.” Ex. 1003 ¶ 145. Indeed, as we noted in our Institution Decision, Patent Owner itself conceded it its Preliminary Response that “the ’483 patent permits isolated terminals to be formed on a metal base notwithstanding some intervening insulating material.” Paper 17, 14; *see Cook Group Inc. v. Boston Scientific Scimed, Inc.*, 809 Fed. App’x 990, 999–1000 (Fed. Cir. 2020) (“an admission in a preliminary patent owner response is evidence appropriately considered by a factfinder”). We also note that Petitioner’s technical expert, Dr. Kuball, does not address this issue in his Declaration. *See* Ex. 2012, *passim*.

Considering the full record developed during the trial, which includes taking account of the sole applicable embodiment disclosed in the specification of the ’483 patent, the testimony of Dr. Lebby, and Patent Owner’s prior admission, we construe “formed on” consistent with our statements in the Institution Decision. That is, we construe “formed on” to

⁶ Notwithstanding these arguments, we recognize that Patent Owner also asserts that it “is not proposing any construction of ‘formed on’ in this proceeding at all.” PO Resp. 25.

encompass arrangements in which the isolated terminals are separated from the metal base by electrically insulating material.

2. “assembly”

Independent claim 11 recites that one or more isolated terminals are electrically connected to decoder/driver electronics that “are mounted within the *assembly*.” Ex. 1001, 10:20–23 (emphasis added). Neither party proposes an explicit construction of “assembly.”

The recited “assembly” finds its antecedent in claim 11’s preamble, which recites “[a] light emitting diode (LED) assembly.” *Id.* at 10:3. In our Institution Decision, we noted that Patent Owner’s preliminary arguments as applied to the asserted prior art implicitly took a narrow view of the meaning of “LED assembly.” Dec. 18. We found those preliminary arguments wanting because “Patent Owner has not, at this time, proposed any specific construction of ‘assembly’ that would exclude a ‘broader apparatus’ from meeting the recitation of ‘[a] light emitting diode (LED) assembly.’” *Id.* at 18–19. Despite our comments, Patent Owner declines to proffer an explicit construction of “assembly” or “LED assembly,” but instead advances an argument of exclusion that “*the assembly* is necessarily less than an entire LED lamp or luminaire.” PO Resp. 19–20 (citing Ex. 2012 ¶¶ 39–41).

Patent Owner’s position is grounded principally in the prosecution history for the ’483 patent, summarized above, in which the Examiner indicated in his first Office Action that original claim 14 recited allowable subject matter. According to Patent Owner, because that original claim recited that the “decoder / driver electronics that control the LED electrodes is embedded in the LTCC-M package,” “[t]he Examined identified

‘decoder/driver electronics . . . mounted *within the assembly*’ as a point of novelty over the prior art.” *Id.* at 19 (citing Ex. 1002, 49–50, 78; Ex. 2012 ¶ 40) (emphasis by Patent Owner); *see also* Sur-reply 12. Patent Owner reinforces its contention that mounting decoder/driver electronics within the “assembly” is a “point of novelty over the prior art” with testimony by Dr. Kuball that “[i]ncorporating drivers into LED illumination devices in order to regulate the power to the LED die is a basic and ubiquitous concept in LED lighting, and any [person of ordinary skill in the art] at the time of the invention would have known that to be basic knowledge.” Ex. 2012 ¶ 39.

Although we have considered Patent Owner’s position and arguments, we find them insufficient to support a construction of “assembly” that is merely something “less than an entire LED lamp or luminaire.” First, as Petitioner suggests, the prosecution history is of limited value on this point because original claim 14 referred not to a broad “LED assembly,” but to a more limited “LTCC-M package,” with the preamble of the underlying independent claim reciting “[a] low temperature co-fired on metal (LTCC-M) light emitting diode (LED) assembly.” Ex. 1002, 49. As Petitioner points out, “none of the presently challenged claims recite an ‘LTCC-M package.’” Reply 13. The Examiner’s reasons for allowance are similarly not illuminating and, at best, ambiguous. Although those reasons do make reference to prosecution claim 25 (which issued as claim 11) in identifying “decoder/driver electronics which are mounted within the assembly,” they do so only within the context of a “combination” of limitations that also include “a LTCC-M LED structure.” Ex. 1002, 119.

In addition, as Petitioner also points out, Patent Owner has neither offered a construction of “assembly” that would justify its proposed exclusion nor identified any disclaimer. *See Thorner v. Sony Computer Entm’t Am. LLC*, 669 F.3d 1362, 1366–67 (Fed. Cir. 2012) (“It is likewise not enough that the only embodiments, or all of the embodiments, contain a particular limitation. We do not read limitations from the specification into claims. . . . [T]here must be a clear and unmistakable disclaimer.”); *Arlington Indus., Inc. v. Bridgeport Fittings, Inc.*, 632 F.3d 1246, 1254 (Fed. Cir. 2011) (“[E]ven where a patent describes only a single embodiment, claims will not be read restrictively unless the patentee has demonstrated a clear intention to limit the claim scope using words of expressions of manifest exclusion or restriction.”) (internal citations and quotation omitted).

Patent Owner’s position also is undercut by the position it advocated in the ITC Investigation. In that Investigation, Dr. Kuball testified that a counterpart to Figure 9 of the ’483 patent would have been understood by a person of ordinary skill in the art as disclosing “an assembly of an assembly,” contrary to the exclusion Patent Owner now advocates. Ex. 1032, 1383:8–11. When asked, “So what is the LED assembly, then,” Dr. Kuball identified a printed circuit board “together with the LEDs.” *Id.* at 1383:24–1384:1. Relying on this testimony, Patent Owner argued before the ITC that an “LED assembly” could include the illumination sources: “LEDs 10 are not ***the only*** ‘LED assemblies’ in Figure 9. LEDs 10 and PC Board 92 together are also an ‘LED assembly.’” Ex. 1030, 7.

In light of these considerations, we construe “assembly” in accordance with its plain and ordinary meaning as a group of parts that are connected

and form one unit. *See* Ex. 3001 (general-purpose dictionary definition of “assembly”).⁷

D. Scope and Content of the Prior Art

1. Shimizu

Shimizu “relates to an LED illumination apparatus that uses a card-type LED illumination source on which multiple LEDs are mounted.”

Ex. 1007, 1:14–19. Patent Owner does not dispute that Shimizu is prior art to the ’483 patent.

Figure 14(a) of Shimizu, modified with coloring added by Petitioner, is reproduced below. Pet. 17.

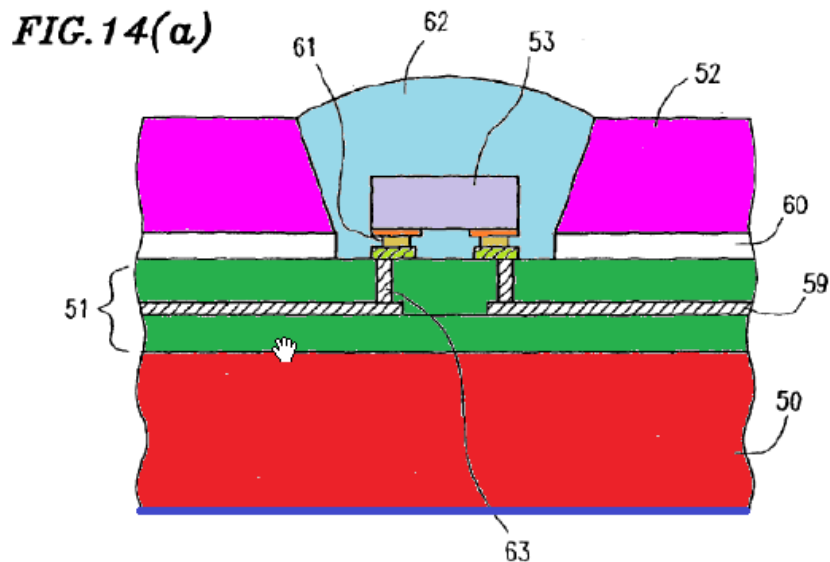


Figure 14(a) provides a cross-sectional view of a portion of a card-type LED illumination source described by the ’483 patent. Ex. 1007, 7:34–36. The

⁷ Judges may rely on dictionary definitions when construing claim terms, so long as the dictionary definition does not contradict any definition found in or ascertained by a reading of the intrinsic evidence. *Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1584 n.6 (Fed. Cir. 1996).

drawing shows flip-chip bonded LED die 53 (purple) with electrodes (orange) that are electrically connected to conductive line patterns 59 (light green) of multilayer circuit board 51 (dark green) via gold bumps 61 (gold), with multilayer circuit board 51 formed over metal plate 50. *Id.* at 22:27–45. Conductive line patterns 59 belonging to different layers are connected by via metals 63. *Id.* at 22:39–41. “The back surface of the metal plate 50 [(dark blue)] is flat and can contact with a flat surface of a member with a good thermal conductivity.” *Id.* at 20:63–65.

The upper surface of multilayer circuit board 51 is “mostly covered” with optical reflector 52 “but is also partially exposed.” *Id.* at 24:12–14. Underfill “(or stress relaxing layer)” 60 is provided between optical reflector 52 and multilayer circuit board 51. *Id.* at 24:20–22. “The underfill 60 not only relaxes the stress to be caused by the difference in thermal expansion coefficient between the optical reflector 52 and the multilayer circuit board 51 but also ensures electrical insulation between the optical reflector 52 and the upper-level conductive lines on the multilayer circuit board 51.” *Id.* at 24:22–27. The openings of optical reflector 52 “are closed with lenses that have been made of a molded resin 62 [(light blue)].” *Id.* at 24:61–62. Shimizu provides the following description of materials for metal plate 50 and optical reflector 52:

The metal plate 50 and the optical reflector 52 may be made of aluminum, copper, stainless steel, iron, or an alloy thereof. The materials of the metal plate 50 and optical reflector 52 may be different from each other. Considering the thermal conductivity, copper, aluminum, iron and stainless steel are preferred in this order. On the other hand, in view of the thermal expansion coefficient, stainless steel, iron, copper and aluminum are preferred in this order. An aluminum-based material is preferred because such a material is easy to handle

in an anticorrosion process, for example. On the other hand, to minimize the decrease in reliability due to the thermal expansion, a stainless steel based material is preferably used.

Id. at 20:50–63.

Figure 12 of Shimizu, modified with coloring added by Petitioner, is reproduced below. Pet. 18.

FIG. 12

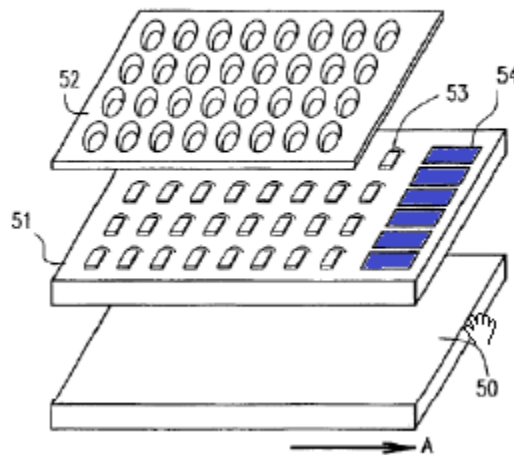


Figure 12 is an exploded perspective view of portions of the structure shown in Figure 14, reproduced above. Ex. 1007, 7:29–31. In addition to showing optical reflector 52, multilayer circuit board 51, and metal plate 50, the drawing shows feeder terminals 54 (dark blue) that are connected to a “lighting drive circuit” that controls LED dies 53. *Id.* at 24:16–19. “By integrating the LEDs and feeder terminals together on one surface, or the principal surface, of the substrate, the other surface (i.e., back surface) thereof, which is opposed to the principal surface, can be fully used as a heat[-]conducting plane for heat dissipation purposes.” *Id.* at 9:9–13.

2. Agari

Agari describes “an optical print head in which a plurality of light emitting diode array chips are disposed on a substrate.” Ex. 1012, 5. Patent Owner does not dispute that Agari is prior art to the ’483 patent. Figure 1 of Agari, modified with coloring added by Petitioner, is reproduced below.

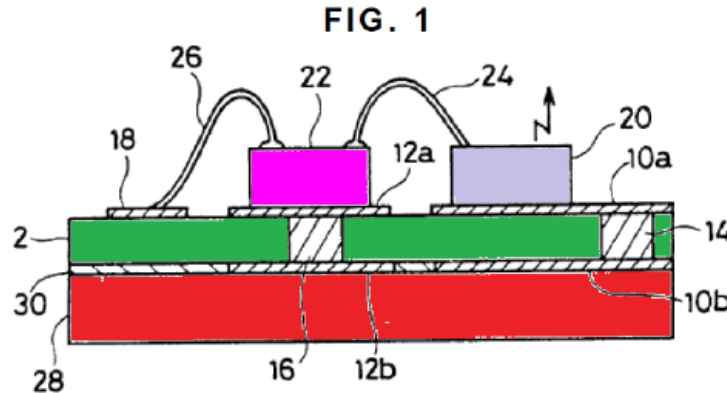


Figure 1 is a cross-sectional view of an optical print head, with LED array chips 20 (purple) disposed over resin-filled porous ceramic substrate 2 (green), which overlies head dissipating plate 28 (red). *Id.* at 6–7. Driving device chip 22 (pink) “for selectively causing the light emitting diodes to emit light” is connected by wire bonding to LED array chips 20 with metallic wire 24. *Id.* at 7.

3. Song

Song describes “an LED package, which has a ceramic body consisting of laminated ceramic substrates, with a reflective plate made of a thin metal sheet and attached on the vertical inside surface of the ceramic body defining the cavity of a chip mounting area.” Ex. 1016, 3:19–23. Such a configuration “accomplishes an improved heat dissipation effect thereof, in addition to easily controlling its luminance and angular distribution of its

luminance.” *Id.* at 3:24–26. Patent Owner does not dispute that Song is prior art to the ’483 patent.

Figure 3 of Song is reproduced below.

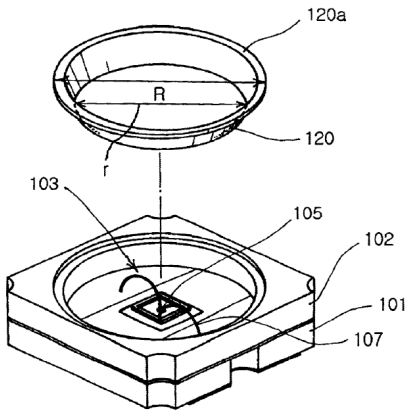


FIG. 3

Figure 3 is an exploded perspective view showing the construction of an LED package having a reflective plate. *Id.* at 4:66–5:2. The LED package has first ceramic substrate 101, which has a chip-mounting area on its top surface for seating LED chip 105. *Id.* at 5:51–55. Electrode 103 is formed on the top surface of first ceramic substrate 101 and is connected to LED chip 105 through wires 107. *Id.* at 5:55–57. Second ceramic substrate 102 is mounted on first ceramic substrate 101, and has a cavity at a position corresponding to the chip-mounting area. *Id.* at 5:58–61. Song discloses that first and second ceramic substrates 101, 102 “may be preferably made of alumina or SiC.” *Id.* at 5:61–62. The vertical surface of the cavity is covered with reflective metal plate 120 to reflect light radiated from the LED chip and thereby increase luminous intensity. *Id.* at 6:1–6.

E. Anticipation by Shimizu

Petitioner challenges independent claim 11 and dependent claims 14–16 as anticipated by Shimizu. Pet. 26–49.

1. Independent Claim 11

Petitioner provides a detailed mapping of the disclosure by Shimizu with the limitations of independent claim 11 to support its anticipation challenge. Pet. 26–44. In that mapping, Petitioner draws the following correspondences between the limitations of claim 11 and Shimizu’s disclosure: (1) the recited “metal base” and Shimizu’s metal plate 50, *id.* at 27–29; (2) the recited “at least one LED die” and Shimizu’s LED die 53, *id.* at 29–33; (3) the recited “layer of electrically insulating material and Shimizu’s optical reflector 52,” *id.* at 34–36; (4) the recited “plurality of conductive traces” and Shimizu’s conductive line patterns 59, *id.* at 36–39; and (5) the recited “one or more isolated terminals” and Shimizu’s feeder terminals 54, *id.* at 39–44. In doing so, Petitioner maps all limitations of claim 11 to elements in Shimizu, and supports that analysis with testimony by Dr. Lebby. *See* Ex. 1003 ¶¶ 101–156.

Three specific issues have been developed by the parties with respect to Petitioner’s anticipation analysis, and we address them in turn below.

a. “a layer of electrically insulating material overlying the metal base”

Independent claim 11 recites “a layer of electrically insulating material overlying the metal base, wherein the layer of electrically insulating material includes at least one opening to house the LED die.” Ex. 1001, 10:12–15. For this limitation, Petitioner identifies Shimizu’s optical

reflector 52. Pet. 34–36. Shimizu’s relevant disclosure, which the parties interpret differently, is reproduced below:

To improve heat dissipation performance, the optical reflector 52 is preferably a metal plate of aluminum, for example. However, a plate made of any other insulating material may also be used. In that case, at least [a] portion (preferably all) of the inner sidewall of the openings is preferably coated with a reflective film that is made of a material having a higher reflectivity than that of the insulating plate, e.g., a metal such as Ni, Al, Pt, Ag or Al or an alloy mainly composed of these metals. Then, the light that has been emitted sideward from the LEDs is appropriately reflected by the reflective film.

Ex. 1007, 24:62–25:5.

According to Petitioner, because Shimizu explains that “a plate of *any other insulating material* may also be used,” a person of ordinary skill in the art “would have understood that layers that form the structure of an optical reflector were typically constructed of electrically insulating materials such as plastic (which would be one example of the ‘any other insulating material’ in Shimizu).” *Id.* at 65–66 (emphasis added); Pet. 35 (citing Ex. 1003 ¶¶ 127–128). Petitioner’s reading of Shimizu is supported by testimony from Dr. Lebby, who also specifically opines that a person of ordinary skill in the art would have understood that “layers that form the structure of an optical reflector were typically constructed of *electrically* insulating materials such as plastic.” Ex. 1003 ¶ 128 (emphasis added). “Even if Shimizu meant that ‘any other insulating material’ was intended to be ‘any other thermally insulating material,’” Dr. Lebby continues, a person of ordinary skill in the art “would still have understood Shimizu to disclose an electrically insulating optical reflector because it was known that ‘One of

the general characteristics of electrical insulating materials is that they are also good thermal insulating materials.” *Id.* ¶ 129 (quoting Ex. 1010, 4).

Patent Owner, as well as Patent Owner’s expert, Dr. Kuball, dispute Petitioner’s reading. First, Patent Owner observes that Shimizu includes pervasive references to its optical reflector as “metallic” (and therefore both electrically and thermally conducting, rather than insulating). PO Resp. 7–11; *see* Ex. 2012 ¶¶ 28–31 (supporting testimony of Dr. Kuball). Other than noting our finding that Patent Owner’s observation is accurate, it is unnecessary for us to list the many references in Shimizu to a “metallic” optical reflector. Specifically, we find that, outside of the isolated disclosure identified by Petitioner, Shimizu otherwise refers repeatedly to a “metallic” optical reflector.

Second, Patent Owner contends that Shimizu’s description of “any other insulating material” (*see* Ex. 1007, 24:62–25:5) as an alternative to aluminum is “nonsensical” because a person of ordinary skill in the art “would have known that aluminum is both electrically and thermally **conductive**, and thus is **neither** electrically insulating nor thermally insulating.” PO Resp. 12; *see* Ex. 2012 ¶ 33 (supporting testimony of Dr. Kuball). Accordingly, Patent Owner argues that the portion of Shimizu relied on by Petitioner is “devoid of any teaching.” PO Resp. 13. In advancing this contention, Patent Owner appears to place significant weight on Shimizu’s use of the word “other” in the phrase “any other insulating material” as indicating a comparison with aluminum.

Although we agree with Patent Owner that a significant majority of Shimizu is devoted to describing embodiments in which the optical reflector is metallic, “[a] reference must be considered for everything that it teaches,

not simply the described invention or a preferred embodiment.” *In re Applied Materials*, 692 F.3d 1289, 1298 (Fed. Cir. 2012). We are not persuaded that the mere presence of the word “other” justifies Patent Owner’s conclusion that the relevant disclosure of Shimizu should simply be disregarded as “devoid of any teaching.” The phrase “any other insulating material” is amenable to being understood as referring to “any other material that is insulating.”

More important, Shimizu evidences a conscious intent to describe embodiments alternative to those in which the optical reflector is “a metal plate of aluminum” because it proceeds to describe additional characteristics of such embodiments. In particular, Shimizu teaches that “[in] that case,” i.e., when “a plate of any other insulating material” is used instead of aluminum, “at least [a] portion (preferably all) of the inner sidewall of the openings is preferably coated with a reflective film that is made of a material having a higher reflectivity than that of the *insulating plate*.” Ex. 1007, 26:66–25:2 (emphasis added). It is notable not only that Shimizu includes particularities for its alternative embodiments, but also that Shimizu expressly refers to the “insulating plate” in doing so. Such repetition of a distinguishing feature of the alternative embodiments from those that use “a metal plate of aluminum” is strong evidence that the description of the alternative embodiments, taken as a whole, is not “devoid of meaning.”

In light of these considerations, and mindful of the application of the preponderance standard, we find that Shimizu teaches “a layer of electrically insulating material overlying the metal base.”

b. “one or more isolated terminals formed on the metal base”

Independent claim 11 recites “one or more isolated terminals formed on the metal base.” Ex. 1001, 10:19. In identifying Shimizu’s feeder terminals 54 as disclosing the recited “isolated terminals,” Petitioner recognizes that Shimizu’s feeder terminals 54 are provided on the upper surface of multilayer circuit board 51, which acts to insulate them from metal plate 50: “A [person of ordinary skill in the art] would have understood that these ‘feeder terminals’ are both ‘isolated’ from and ‘formed on’ the metal base 50 because they are both located on metal base 50 and electrically separated from it by insulating layers 51.” Pet. 40–41. Petitioner’s position is consistent with our adopted construction of “formed on,” which encompasses arrangements in which the isolated terminals are separated from the metal base by electrically insulating material. Indeed, as we noted in our Institution Decision, “[t]here is no dispute that the structure identified by Petitioner in Shimizu as corresponding to the recited ‘metal base’ is separated by an insulating layer from the structure Petitioner identifies as corresponding to the recited ‘isolated terminals.’” Dec. 16.

Patent Owner attacks the sufficiency of the Petition’s evidence and argument, contending that the Petition “relies on a naked conclusory statement” that Petitioner’s expert, Dr. Lebby, “merely parrots.” PO Resp. 22. We do not agree with this contention. In the Institution Decision, we credited Dr. Lebby’s testimony at that stage and specifically noted that, with respect to various points addressed in our Decision, “Patent Owner will have an opportunity to develop the record . . . through cross-examination of Dr. Lebby and with submission of its own evidence.” Dec. 17, 19. Patent Owner nonetheless declined to cross-examine Dr. Lebby. And, although

Patent Owner submitted testimonial evidence of its own expert, Dr. Kuball notably does not opine on the issues raised by this particular limitation. *See* Ex. 2012, *passim*.

Furthermore, we disagree that Dr. Lebby's testimony is mere parroting of a naked conclusory statement. Dr. Lebby identifies specific disclosure in Shimizu of feeder terminals provided on the surface of the metal base substrate, Ex. 1003 ¶ 143; justifies his conclusion that a person of ordinary skill in the art would have understood such feeder terminals to be both "isolated" and "formed on" the metal base, explaining that such a person would understand "isolated" to require electrical separation from the metal base, *id.* ¶ 145; and testifies that the '483 patent specification does not support a restriction on how the isolated terminals are formed, noting that it describes only the terminals' spatial relationship to the metal base, and does not discuss a manufacturing process for the terminals, *id.* ¶ 146. We thus find Dr. Lebby's testimony sufficiently supported and notably uncontroverted by any cross-examination or contrary expert testimony.

We accordingly credit Dr. Lebby's testimony on these points, and find that Shimizu discloses "one or more isolated terminals formed on the metal base."

*c. "decoder/driver electronics that . . .
are mounted within the assembly"*

Independent claim 11 recites that the isolated terminals are "electrically connected to decoder/driver electronics that control the LED electrodes, where the electronics are mounted within the assembly." Ex. 1001, 10:20–24. In addressing this limitation, Petitioner characterizes

Shimizu as disclosing two connected subassemblies: an LED illumination apparatus and an LED illumination source. Pet. 43–44. Petitioner observes that Shimizu discloses that its feeder terminals 54 are connected, via connector electrodes and interconnecting cords, to “a circuit such as a lighting drive circuit,” which is part of the LED illumination apparatus, and which Petitioner identifies as corresponding to the recited “decoder/driver electronics.” *Id.* at 41–42 (citing Ex. 1007, 21:33–22:5, Figs. 12, 14(a), 14(b); Ex. 1003 ¶¶ 147–151), 43. Petitioner thus reasons that a person of ordinary skill in the art would have understood that the connected subassemblies are an “assembly,” with the recited “decoder/driver electronics” mounted within such an “assembly.” *Id.* at 44 (citing Ex. 1003 ¶¶ 152–154). This analysis is consistent with the plain and ordinary meaning of “assembly,” which we adopt above.

Petitioner’s analysis is illustrated, for example, with the embodiment shown in Figure 31 of Shimizu, which is reproduced below.

FIG. 31

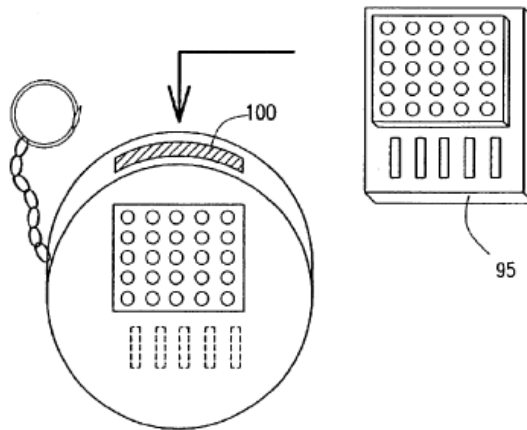


Figure 31 “illustrates a keychain type LED illumination apparatus.”

Ex. 1007, 8:37–38. In this example, card-type LED illumination source 95, which Petitioner identifies as an “optical subassembly (OSA) containing the

metal base, insulating layers, LED dies, and the feeder terminal,” is inserted into the fob of a keychain, which contains the lighting drive circuit, via slot 100. Pet. 43–44; Ex. 1007, 4–8. Petitioner reasons that a person of ordinary skill in the art “would have understood that the LED illumination assembly including the OSA is an ‘assembly’ within the meaning of claim 11 of the ’483 patent,” and supports that reasoning with testimony by Dr. Lebby. Pet. 44 (citing Ex. 1003 ¶¶ 152–164).

Patent Owner does not dispute that Shimizu’s “lighting drive circuit” corresponds to “decoder/driver electronics,” nor that such a circuit is mounted in Shimizu’s various LED illumination-apparatus embodiments. Rather, Patent Owner contends that Petitioner “fails to demonstrate that Shimizu’s LED illumination apparatus is an ‘**LED assembly**’ as recited in the claims.” PO Resp. 15. According to Patent Owner, Petitioner “attempts a subtle word game: it calls Shimizu’s ‘LED illumination *source*’ an ‘optical *sub*assembly’ or ‘OSA,’ in order to create an implicit mental assumption by the reader that Shimizu’s ‘LED illumination *apparatus*’—which houses the ‘LED illumination source’—must therefore be an LED *assembly*.” *Id.* at 18. Although Patent Owner is accurate that “Shimizu *never* refers to its ‘LED illumination source’ as a ‘subassembly’ and likewise never refers to its ‘LED illumination apparatus’ as an ‘LED assembly,’” it is not mere nomenclature that leads us to conclude that Petitioner makes a sufficient showing. *Id.* at 19. We also note that Shimizu expressly refers to its LED illumination apparatus as a composition of “assembled” parts. Ex. 1007, 9:25–29 (“To ensure good electrical insulation between the feeder terminals and to strike an adequate balance between the

electrodes and other units to be *assembled* together, the pitch of the feeder terminals may be defined [according to certain values].” (emphasis added)).

Even when Shimizu’s LED illumination source is integrated with its LED apparatus, such as when card 95 of Figure 31 above is inserted into slot 100 of the fob, the distinction Patent Owner makes relies entirely on its position that the “LED assembly” recited in the claim is something “less than an entire LED lamp or luminaire.” *See* PO Resp. 19–20. That is, Patent Owner argues that Shimizu cannot teach decoder/driver electronics mounted in an LED assembly because “Shimizu’s ‘LED illumination *apparatus*’ is a complete lighting device that is intended to serve as an LED lamp or luminaire.” *Id.* at 20. Although we recognize that Petitioner replies that the keychain and other embodiments disclosed by Shimizu are “LED illumination apparatuses that are *neither lamps nor luminaires*,” we need not resolve that subtlety. Reply 14. Instead, we find Patent Owner’s exclusion of such structures inconsistent with the plain and ordinary meaning of “assembly” that we have adopted. Specifically, the combination of Shimizu’s LED illumination apparatus housing its LED illumination source is a group of parts connected to form one unit, and therefore an “assembly” within which are mounted the decoder/driver electronics as required by the claim.

We accordingly find that Shimizu discloses that the isolated terminals are “electrically connected to decoder/driver electronics that control the LED electrodes, where the electronics are mounted within the assembly.”

d. Summary

For these reasons, we conclude that Petitioner demonstrates, by a preponderance of the evidence, that independent claim 11 is anticipated by Shimizu.

2. Dependent Claims 14–16

Each of challenged claims 14–16 depends from independent claim 11. Ex. 1001, 10:31–38. For dependent claim 14, which recites that “the LED die is a flip-chip,” Petitioner observes that Shimizu expressly describes LED die 53, shown in Figure 3, reproduced above, as “flip-chip bonded with its active layer turned facedown.” Pet. 45 (quoting Ex. 1007, 22:27–36). This identification is sufficient to show that Shimizu discloses the recited limitation.

Claim 15 recites that “the flip-chip is bonded to the traces by conductive balls comprising solder or gold.”⁸ Ex. 1001, 10:33–35. For this limitation, Petitioner observes that Shimizu expressly discloses a flip-chip LED bonded to conductive patterns by gold “bumps,” and provides evidence through testimony by Dr. Lebby that a person of ordinary skill in the art would have understood such “bumps” to be equivalent to “balls.” Pet. 46 (citing Ex. 1007, Fig. 19(c), Fig. 14(a); Ex. 1003 ¶¶ 168–169, 46–48). This

⁸ We agree with Petitioner that there appears to be an error in the dependency of the claim, which should apparently depend from claim 14. See Pet. 45 n.9. Patent Owner does not contend otherwise. In accordance with *Fitbit, Inc. v. Valencell, Inc.*, 964 F.3d 1112, 1119–20 (Fed. Cir. 2020), we proceed to resolve the patentability of claim 15 based on its intended dependency.

identification is sufficient to show that Shimizu discloses the recited limitation.

Claim 16 depends from claim 11 and recites that the LED assembly further comprises “vias in the insulating layer, the vias electrically connecting the traces to the isolated terminals.” Ex. 1001, 10:36–38. Petitioner addresses this limitation by pointing to vias 63, shown in Figure 3 of Shimizu, reproduced above, and noting that such vias connect top and bottom conductive line patterns 59 to feeder terminals 54. Pet. 47–49 (citing Ex. 1007, 22:38–41, 24:6–11, Figs. 14(a), 14(b), 17, 18; Ex. 1003 ¶¶ 177–181). This identification is sufficient to show that Shimizu discloses the recited limitation.

For each of dependent claims 14–16, Patent Owner makes no separate argument outside of its arguments directed at underlying independent claim 11, which we address above. We conclude that Petitioner demonstrates, by a preponderance of the evidence, that dependent claims 14–16 are anticipated by Shimizu.

F. Obviousness over Shimizu and Agari

Petitioner challenges claims 11 and 14–16 as unpatentable under 35 U.S.C. § 103(a) over Shimizu and Agari “[t]o the extent that Shimizu does not anticipate . . . because its decoder/driver electronics . . . are not ‘mounted within the assembly.’” Pet. 50. As an alternative for this limitation, Petitioner contends that a person of ordinary skill in the art “would have both been motivated to incorporate, and had a reasonable expectation of success in incorporating, by using general industrial practice, decoder/drive electronics (such as the lighting drive circuit of Shimizu or the

electronic Integrated Circuit (IC) chip of Agari) within the [LED illumination source] of Shimizu.” Pet. 51.

In advancing this contention, Petitioner relies not only on Agari, but also on a “general motivation in the field to move electronic circuits into the LED package both for space-saving purposes and to improve signal integrity.” *Id.* (citing Ex. 1003 ¶¶ 191–216). In particular, Petitioner cites and discusses aspects of U.S. Patent No. 6,885,035 B2 (Ex. 1011, “Bhat”), U.S. Patent No. 6,747,420 B2 (Ex. 1013, “Barth”), WO 01/43167 (Ex. 1017, “Palanisamy ’167”), and Japanese Patent Application Publication No. 2001-168443 (Ex. 1008, “Oike”), and also provides testimony by Dr. Lebby (Ex. 1003 ¶¶ 192–216). *Id.* at 51–60. For example, in discussing a multichip LED assembly, Bhat asserts that “[a] higher density LED architecture is desired for space considerations [because h]igher densities are . . . advantageous to construct high power applications [and] allow the creation of smaller LED assemblies.” Ex. 1011, 1:66–2:8. Barth describes “measures which enable the dimensions of the drive circuit to be kept as compact as possible,” including integration of components with a multilayer circuit implemented by a low-temperature co-fired ceramic structure. Ex. 1013, 2:25–27, 2:40–46. Palanisamy ’167 provides details for achieving incorporation of circuitry into multilayer ceramic boards. Ex. 1017, 2:19–3:8, 6:4–7:3, Fig. 1.

We agree that these references support Petitioner’s contention regarding a “general motivation in the field” to move electronic circuits into the LED package. Furthermore, Dr. Lebby testifies that the fact that “the ’483 patent does not provide any specifics about how the claimed, ‘the one or more isolated terminals [are] electrically connected to the decoder/driver

electronics that control the LED electrodes’ . . . further confirms that it was general industrial practice to do so.” Ex. 2003 ¶ 216.

Patent Owner disputes the sufficiency of Petitioner’s showing by arguing that “the Petition fails to adequately explain how or why a [person of ordinary skill in the art] would have made the proposed modifications.” PO Resp. 27. In particular, Patent Owner argues that it would not have been obvious to incorporate driver circuitry within Shimizu’s card-type LED illumination source because “Shimizu *already* includes a drive circuit within its illumination apparatus, which is coupled to the illumination source.” *Id.* at 31 (citing Ex. 1007, 7:42–45). In its Sur-reply, Patent Owner clarifies this argument: “Shimizu’s decision to keep [driver circuitry and LED packages] separate by disclosing that the driver circuit should be placed outside the illumination source teaches against integrating them.” Sur-reply 17. But the mere disclosure by Shimizu of embodiments that separate the driver circuitry and LED packages does not constitute a teaching away because “such disclosure does not criticize, discredit, or otherwise discourage the solution claimed.” *In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004).

Patent Owner also disputes Petitioner’s rationale that a person of skill in the art would have been motivated to incorporate driver circuitry within the LED illumination source as a space-saving measure. PO Resp. 32–34. According to Patent Owner, “there is no problem of space constraints in Shimizu that would be resolved by the Petition’s proposed modifications” because “Shimizu appears to show a relatively large amount of area in its illumination apparatus (shown, e.g., in the light bulb embodiment of Figure 20) for housing a drive circuit.” *Id.* at 32. And, Patent Owner argues, “in Shimizu’s illumination source as shown in Figs. 4(a) and 4(b)

(and as can be further seen in Figs. 12 and 14(a)), there appears to be no free space to incorporate a drive circuit.” *Id.* at 33. These observations lead Patent Owner to conclude, supported by testimony of Dr. Kuball, that “the proposed modification would create additional space ***constraints and problems***, rather than space-saving benefits.” *Id.* at 34 (citing Ex. 2012 ¶ 53).

But “[i]t is well known that Patent Office drawings are not normally drawn to scale,” *In re Olson*, 212 F.2d 590, 592 (CCPA 1954), and we discern nothing in Shimizu to suggest its drawings are atypical in this respect. Furthermore, as Petitioner points out, even if there is a dispute over the *degree* of space saving, the evidence supports a finding that a person of ordinary skill in the art would have found the potential space saving beneficial. Reply 18. The evidence also supports Petitioner’s contention that “implementing this modification would have been routine to a [person of ordinary skill in the art], and would include sizing the illumination source so as to provide space for the driver electronics.” *Id.* at 19 (citing Pet. 52–60). Notably, as we observed in our Institution Decision, “[t]he test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference.” Dec. 23 (citing *In re Keller*, 642 F.2d 413, 425 (CCPA 1981)).

Patent Owner provides additional arguments that attack the background references cited by Petitioner for the proposition that there was a general motivation in the field to move electronic circuits into the LED package. PO Resp. 34–38. Although we have reviewed and considered Patent Owner’s arguments, they are of limited relevance to the combination of *Shimizu and Agari* that defines the basis for Petitioner’s challenge. That

is, Patent Owner attacks the background references as if they were a much more significant part of the instant ground, when in fact they are only used in limited fashion to support Petitioner's obviousness proposition. *See, e.g.*, Reply 20 (Petitioner addressing Patent Owner's argument that "high power applications" described by Bhat would not have been applicable to Shimizu by noting that "the modification proposed in the Petition is not limited to high power applications").

We also find that Petitioner sufficiently explains *how* to modify Shimizu to include the decoder/driver electronics in Shimizu's card-type illumination source. While noting that "the '483 patent does not provide specific guidance on how to mount driver electronics and LEDs on the same substrate," the Petition describes at some length the fabrication techniques required to do so. *See* Pet. 52–60. Patent Owner nevertheless faults Petitioner for "not address[ing] the size of Agari's IC chip or Shimizu's drive circuit relative to the size of Shimizu's illumination source," characterizing such an omission as "critical" because "Shimizu's illumination source 95 is expressly designed to fit into a space within Shimizu's LED illumination apparatuses, such as those shown in Figures 30 and 31." PO Resp. 40 (citing Ex. 1007, Figs. 30–31; Ex. 2012 ¶ 60). We again do not agree with this argument because it improperly relies upon the bodily incorporation of one reference into another, rather than maintaining focus on the teachings of the references. *See Keller* at 425.

In light of these considerations, we find that Petitioner both identifies disclosure of all elements of independent claim 11 in the combination of Shimizu and Agari, and articulates a sufficient rationale, supported by rational underpinning, of how to effect the combination. We accordingly

conclude that Petitioner demonstrates, by a preponderance of the evidence, that independent claim 11 is unpatentable under 35 U.S.C. § 103(a) over Shimizu and Agari. With respect to dependent claims 14–16, Petitioner argues that all limitations “are taught in Shimizu” for the reasons previously discussed, and Patent Owner does not separately dispute Petitioner’s showing for these claims. Pet. 50. For the same reasons discussed above with respect to the Shimizu anticipation ground, we also conclude that Petitioner demonstrates, by a preponderance of the evidence, that claims 14–16 are unpatentable under 35 U.S.C. § 103(a) over Shimizu and Agari.

G. Obviousness over Shimizu and Song

Petitioner challenges claims 11 and 14–16 as unpatentable under 35 U.S.C. § 103(a) over Shimizu and Song “[t]o the extent that Shimizu does not anticipate claims 11 and 14–16 because its optical reflector made of an ‘insulating material’ is not ‘a layer of electrically insulating material.’” Pet. 60. As an alternative for this limitation, Petitioner contends that, in view of Song, “it would have been obvious to use an electrically insulating material (such as ceramic or any other number of known electrically insulating materials suitable for LED packaging) for Shimizu’s ‘insulating material’ of its optical reflector.” *Id.* (citing Ex. 1003 ¶¶ 221–234).

Specifically, Petitioner argues that a person of ordinary skill in the art “would have both been motivated to incorporate, and had a reasonable expectation of success in incorporating into Shimizu, a ceramic reflector, as disclosed in Song.” *Id.* at 61 (citing Ex. 1003 ¶¶ 225–233). Supported by the testimony of Dr. Lebby as well as certain additional evidence, Petitioner notes that (1) Song recognizes the benefits of ceramics in LED packages, *id.*

at 61–62 (citing Ex. 1016, 3:2–6, Ex. 1003 ¶ 227); (2) ceramic was well known to be a useful material for high-temperature applications, *id.* at 62 (citing Ex. 1003 ¶ 228; Ex. 1023, 7 (handbook on microelectronics packaging); Ex. 1013, 2:53–56); (3) ceramic was “widely employed in microelectronics” at the time of the invention, *id.* (citing Ex. 1003 ¶ 229; Ex. 1023, 5); and (4) ceramic was a well-known and highly useful electrically insulating material that was commonly used in LED packages, *id.* (citing Ex. 1009, 5, 25; Ex. 1023, 4; Ex. 1013, 2:53–56; Ex. 1003 ¶ 230). Petitioner reasons that, in view of Shimizu’s silence regarding specific insulating materials of its reflector, a person of skill in the art would have been motivated to seek out specific teachings of well-known insulating materials, and, in light of Song, “would have found it obvious to construct Shimizu’s ‘insulating material’ from ceramic.” *Id.* at 62–63.

Patent Owner disputes this reasoning as failing to establish a sufficient motivation to arrive at the specific proposed combination. PO Resp. 47–50. In particular, according to Patent Owner, “[w]hat the Petition does not address . . . is that aluminum (the material that Shimizu teaches its reflector is made of) is *also* a well-known and useful material for semiconductor packaging that has high heat conductivity and results in high heat dissipation.” *Id.* at 48 (citing Ex. 2012 ¶ 38). Patent Owner uses this fact, which is not disputed by Petitioner, to argue that “[t]he fact that ceramic was well-known provides no evidence that [a person of ordinary skill in the art] would have *preferred* ceramic material to the well-known aluminum material that Shimizu teaches should be used for the optical reflector.” *Id.* at 49 (citing Ex. 2012 ¶ 38). At the oral hearing, Patent Owner nevertheless agreed that establishing a *preference* for ceramic material is not the correct

test, and made the more limited argument that “one of skill in the art would not have had a reason or motivation to swap out a metal material that Shimizu discloses [for] its optical reflectors [with] a less effective heat management material, for example ceramic.” Tr. 41:4–7; *see also id.* at 40:25–41:4 (Patent Owner also “100 percent agree[ing]” with the statement that “[t]he test is whether it would have been obvious to use ceramic covered with a metal” and that “though not preferred, it can still be obvious”).

As Petitioner points out, Patent Owner’s argument is faulty because it “hinges on the false assumption that Shimizu teaches that its reflector is only made of aluminum.” Reply 23–24. As we discuss above, Shimizu, in fact, discloses that its reflector may be made of a variety of other materials, including copper, stainless steel, iron, or an “insulating material” coated with a reflective film. *See* Ex. 1007, 20:49–53, 24:65–25:5. In light of this specific teaching, we find that Petitioner articulates a sufficient reason, with rational underpinning, to use an alternative material such as that taught by Song.

Accordingly, we conclude that Petitioner demonstrates, by a preponderance of the evidence, that independent claim 11 is unpatentable under 35 U.S.C. § 103(a) over Shimizu and Song. With respect to dependent claims 14–16, Petitioner argues that all limitations “are taught in Shimizu” for the reasons previously discussed, and Patent Owner does not separately dispute Petitioner’s showing for these claims. Pet. 60. For the same reasons discussed above with respect to the Shimizu anticipation ground, we also conclude that Petitioner demonstrates, by a preponderance of the evidence, that claims 14–16 are unpatentable under 35 U.S.C. § 103(a) over Shimizu and Song.

H. Obviousness over Shimizu, Agari, and Song

Petitioner challenges claims 11 and 14–16 as unpatentable under 35 U.S.C. § 103(a) over Shimizu, Agari, and Song “[t]o the extent that Shimizu does not anticipate claims 11, 14, 15, and 16 because both (i) its decoder/driver electronics (the ‘lighting drive circuit’) are not ‘mounted within the assembly,’ and (ii) its optical reflector made of an ‘insulating material’ is not ‘a layer of electrically insulating material.[’]” Pet. 64. In advancing this challenge, Petitioner relies on the same reasons discussed above for incorporating the respective teachings of Agari and Song into Shimizu. *Id.*

Patent Owner contends that Petitioner provides insufficient motivation to combine the teachings of all three references: “[E]ven assuming the Petition adequately motivated the combination of Shimizu with Song, and Shimizu with Agari, a motivation to combine A with B and A with C is not a motivation to combine A with B and C.” PO Resp. 50 (citing *In re Nuvasive, Inc.*, 842 F.3d 1376, 1381–82 (Fed. Cir. 2016)). Although we agree with Patent Owner’s statement in the abstract, the specific facts before us involve two discrete combinations. That is, mounting the decoder/driver electronics within the assembly according to Agari is distinct from using a metal-coated ceramic reflector according to Song. Under these specific facts, we find Petitioner’s independent articulations addressing the combination of Agari with Shimizu and of Song with Shimizu sufficiently address the combination of the relevant teachings of all three references.

Thus, for the same reasons discussed above with respect to the Shimizu–Song and Shimizu–Agari obviousness grounds, we conclude that Petitioner demonstrates, by a preponderance of the evidence, that claims 11

and 14–16 are unpatentable under 35 U.S.C. § 103(a) over Shimizu, Agari, and Song.

I. Motion for Sanctions

In its Response, Patent Owner contends that, contrary to Petitioner’s implicit certification under 37 C.F.R. § 11.18(b), “there are numerous instances throughout the Petition of statements that Petitioners apparently do *not* believe to be true, because Petitioners asserted a contrary position in the co-pending ITC proceeding.” PO Resp. 51. Patent Owner alleges that Petitioner has thereby violated its duty of candor and requests that we “sanction and strike Petitioners’ inconsistent and subjectively untruthful arguments here, which contradict its stated beliefs before the ITC.” *Id.* at 53.

Patent Owner’s Motion is improper because it fails to comply with the requirements of 37 C.F.R. § 42.11(d)(2), which include making a sanctions motion separately from any other motion, and serving the other party with the proposed sanctions motion at least 21 days before seeking authorization to file the sanctions motion with the Board. Accordingly, we *dismiss* the Motion.

VI. CONCLUSION⁹

The table below summarizes our conclusions as to the challenged claims.

Claims	35 U.S.C. §	References	Claims Shown Unpatentable	Claims Not Shown Unpatentable
11, 14–16	102	Shimizu	11, 14–16	
11, 14–16	103	Shimizu, Agari	11, 14–16	
11, 14–16	103	Shimizu, Song	11, 14–16	
11, 14–16	103	Shimizu, Agari, Song	11, 14–16	
Overall Outcome			11, 14–16	

VI. ORDER

It is

ORDERED that, based on a preponderance of the evidence, claims 11 and 14–16 of U.S. Patent No. 7,098,483 B2 have been shown to be unpatentable;

FURTHER ORDERED that Patent Owner’s Motion for Sanctions is *dismissed*; and

⁹ Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this Decision, we draw Patent Owner’s attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. See 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. See 37 C.F.R. § 42.8(a)(3), (b)(2).

FURTHER ORDERED that, because this is a final written decision, parties to this proceeding seeking judicial review of our decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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