UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CLEAR-VU LIGHTING LLC,
Petitioner,

v.

UNIVERSITY OF STRATHCLYDE,
Patent Owner.

Case IPR2019-00431
Patent 9,839,706 B2

PATENT OWNER UNIVERSITY OF STRATHCLYDE'S NOTICE OF APPEAL

Director of the United States Patent and Trademark Office
c/o Office of the General Counsel
Madison Building East, Room 10B20
600 Dulany Street
Alexandria, VA 22314-5793

Pursuant to 35 U.S.C. §§ 141(c) and 142 and 37 C.F.R. §§ 90.2(a) and 90.3, Patent Owner University of Strathclyde hereby appeals to the United States Court of Appeals for the Federal Circuit from the Patent Trial and Appeal Board's Final Written Decision in IPR2019-00431, entered on July 8, 2020 (Paper 38) (a copy of which is attached), and from all underlying and related findings, orders, decisions, rulings, and opinions that are adverse to University of Strathclyde. This Notice of Appeal is timely filed within 63 days of the Board's Final Written Decision. 37 C.F.R. § 90.3.

For the limited purpose of providing the Director with the information requested in 37 C.F.R. § 90.2(a)(3)(ii), University of Strathclyde further indicates that the issues on appeal include at least: (i) whether the Board erred in finding that claims 1 and 3 of U.S. Patent No. 9,839,706 ("'706 Patent") are unpatentable as obvious in view of the combination of "Eradication of *Propionibacterium acnes* by its endogenic porphyrins after illumination with high intensity blue light" by Ashkenazi *et al.* ("Ashkenazi") and "ALA induced photodynamic effects on Gram positive and negative bacteria" by Nitzan *et al.* ("Nitzan"); and (ii) whether the Board erred in finding that claims 2 and 4 of the '706 Patent are

unpatentable as obvious in view of the combination of Ashkenazi, Nitzan, and U.S. Patent Application Publication No. 2005/0055070 to Jones *et al.* ("Jones"). University of Strathclyde further reserves the right to challenge any finding or determination supporting or relating to the issues above, and to challenge other issues decided adversely to University of Strathclyde.

Pursuant to 35 U.S.C. § 142 and 37 C.F.R. § 90.2(a), University of Strathclyde is (1) filing this Notice of Appeal with the Director of the United States Patent and Trademark Office; (2) filing a copy of this Notice of Appeal with the Patent Trial and Appeal Board in accordance with 37 C.F.R. § 42.6(b); and (3) electronically filing a copy of this Notice of Appeal with the Federal Circuit on the CM/ECF Document Filing System, along with the required docketing fee.

DATED: September 8, 2020

Respectfully submitted,

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By /s/ *Christopher B. Kelly*

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CERTIFICATE OF FILING AND SERVICE

Pursuant to 37 C.F.R. §§ 90.2(a)(1) and 104.2, the undersigned hereby certifies that the foregoing Notice of Appeal was filed by hand delivery on September 8, 2020 with the Director of the United States Patent and Trademark Office at the following address:

Director of the United States Patent and Trademark Office
c/o Office of the General Counsel
Madison Building East, Room 10B20
600 Dulany Street
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Pursuant to 37 C.F.R. §§ 90.2(a)(1) and 42.6(b)(1), the undersigned hereby certifies that, on September 8, 2020, the foregoing Notice of Appeal was filed electronically via PTAB E2E with the Board.

Pursuant to 37 C.F.R. § 90.2(a)(2), Fed. R. App. P. 15, and Fed. Cir. R. 15, 25, and 52, the undersigned hereby certifies that, on September 8, 2020, the foregoing Notice of Appeal was electronically filed with the Court of Appeals for the Federal Circuit via CM/ECF with requisite fees paid via pay.gov.

Pursuant to 37 C.F.R. § 42.6(e) and the parties' agreement to accept electronic service, the undersigned hereby certifies that, on September 8, 2020, the foregoing Notice of Appeal was served via e-mail to counsel of record for Petitioner Clear-Vu Lighting LLC as follows:

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Paper 38
Entered: July 8, 2020

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CLEAR-VU LIGHTING LLC,
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v.

UNIVERSITY OF STRATHCLYDE,
Patent Owner.

Case IPR2019-00431
Patent 9,839,706 B2

Before DONNA M. PRAISS, CHRISTOPHER L. CRUMBLEY, and JEFFREY W. ABRAHAM, *Administrative Patent Judges.*

ABRAHAM, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Claims Unpatentable
Denying Patent Owner's Motion to Exclude
35 U.S.C. § 318(a); 37 C.F.R. § 42.64

I. INTRODUCTION

Clear-Vu Lighting LLC ("Petitioner") filed a Petition (Paper 1, "Pet.") requesting *inter partes* review of claims 1–4 of U.S. Patent No. 9,839,706 B2 (Ex. 1001, "the '706 patent"). University of Strathclyde ("Patent Owner") filed a Preliminary Response to the Petition (Paper 10, "Prelim. Resp.").

On July 10, 2019, we instituted an *inter partes* review of all of the challenged claims based on all of the grounds identified in the Petition. Paper 12 ("Inst. Dec."). Subsequently, Patent Owner filed a Response (Paper 16, "PO Resp."), Petitioner filed a Reply (Paper 21) and Patent Owner filed a Sur-reply (Paper 29). An oral hearing was held on April 21, 2020, and a transcript of the hearing has been entered into the record. Paper 37 ("Tr.").

Patent Owner also filed a Motion to Exclude Evidence. Paper 33 ("Motion"). Petitioner filed an Opposition to Patent Owner's Motion (Paper 34) and Patent Owner filed a Reply to Petitioner's Opposition (Paper 36).

We have jurisdiction under 35 U.S.C. § 6. This Final Written Decision is issued pursuant to 35 U.S.C. § 318(a). For the reasons that follow, we determine that Petitioner has shown by a preponderance of the evidence that claims 1–4 of the '706 patent are unpatentable.

A. Related Proceedings

The parties state that the '706 patent issued from U.S. Application No. 14/657,398 ("the '398 Application"), which is a continuation of U.S. Application No. 11/997,227 ("the '227 Application"). Pet. 1; Paper 9, 2.

The ’227 Application is now issued as U.S. Patent No. 9,039,966 (“the ’966 patent”), which was the subject of IPR2019-00588.[1] Pet. 1; Paper 9, 2.

The parties indicate that the ’706 patent is at issue in *Kenall Mfg. Co. v. Clear-Vu Lighting LLC,* 2:18-cv-01337 (E.D.N.Y). Pet. 1; Paper 9, 2.

The ’706 patent was also at issue in *Kenall Mfg. Co. v. 555 Int’l, Inc.,* No. 1:17-cv-01668 (D. Del.) (voluntarily dismissed on May 14, 2018), and *Kenall Mfg. Co. v. Oldenburg Group Inc.,* No. 2:18-cv-01352 (E.D. Wis.) (voluntarily dismissed on May 12, 2020). Paper 9, 2–3.

B. The ’706 Patent

The ’706 patent, titled “Inactivation of Gram-Positive Bacteria,” issued on December 12, 2017. Ex. 1001, codes (45), (54). The ’706 patent explains that Gram-positive bacteria, including *Staphylococcus aureus* and methicillin (multi)-resistant *Staphylococcus aureus* (MRSA), Coagulase-Negative *Staphylococcus* (CONS), *Streptococcus*, *Enterococcus,* and *Clostridium* species, are known to cause health problems, such as infections, especially in a hospital environment. Ex. 1001, 1:23–58. The ’706 patent explains that MRSA

> is becoming an increasingly problematic micro-organism, with infection rates rising and effective methods of control becoming more and more limited. In addition to the resistance of MRSA to antibiotics, there is a significant problem due to the availability of few effective sterilisation methods for environmental decontamination; for example in air and on contact surfaces. Public and media interest in the transmission and control of MRSA is escalating and it is becoming one of the most significant problems within the healthcare industry.

[1] The Board denied institution of IPR2019-00588 on September 30, 2019. *Clear-Vu Lighting LLC v. University of Strathclyde*, IPR2019-00588, Paper 24 (PTAB Sept. 30, 2019).

Ex. 1001, 1:23–33. The '706 patent discusses prior art techniques for destroying harmful bacteria, including ones that use light energy in combination with photosensitizing agents. Ex. 1001, 1:60–2:19. The '706 patent characterizes these as "useful," but "suffer[ing] from the significant practical disadvantage that photosensitising agents must be applied to the bacteria that are to be inactivated." Ex. 1001, 2:10–15.

Thus, the '706 patent is directed to a "simple and effective" technique for inactivating bacteria comprising exposing bacteria to visible light without using a photosensitizer. Ex. 1001, 2:20–30. According to the '706 patent, the inventors found that exposing certain bacteria to blue light, or white light containing blue light, stimulates an inactivation process. Ex. 1001, 2:50–52. Using light in the visible-wavelength region is advantageous because it has no detrimental effect on human or animal heath, and, therefore, "can be used for an extensive range of applications, such as air disinfection, contact-surface and materials disinfection and, most noteworthy, wound protection and tissue disinfection." Ex. 1001, 2:52–57.

C. Illustrative Claim

Petitioner challenges claims 1–4 of the '706 patent. Independent claim 1 is illustrative of the challenged claims and is reproduced below:

> 1. A method for disinfecting air, contact surfaces or materials by inactivating one or more pathogenic Gram-positive bacteria in the air, on the contact surfaces or on the materials, said method comprising exposing the one or more pathogenic Gram-positive bacteria to visible light without using a photosensitizer, wherein the one or more pathogenic Gram-positive bacteria are selected from the group consisting of Methicillin-resistant *Staphylococcus aureus* (MRSA), Coagulase-Negative *Staphylococcus* (CONS), *Streptococcus*, *Enterococcus*, and *Clostridium* species, and wherein a portion

> of the visible light that inactivates the one or more pathogenic Gram-positive bacteria consists of wavelengths in the range 400-420 nm, and wherein the method is performed outside of the human body and the contact surfaces or the materials are non-living.

Ex. 1001, 7:17–8:5.

D. Reviewed Grounds of Unpatentability

Claims Challenged	35 U.S.C. §	Reference(s)
1, 3	102	Nitzan[2]
2, 4	103	Nitzan, Jones[3]
1, 3	103	Ashkenazi,[4] Nitzan
2, 4	103	Ashkenazi, Nitzan, Jones

E. Level of Ordinary Skill in the Art

Petitioner contends that a person of ordinary skill in the art "would have had at least a bachelor of science degree in one of the areas of molecular biology, biochemistry, microbiology, or infectious diseases, and likely a doctoral degree in one of these subjects, with several to many years of experience with bacterial inactivation techniques." Pet. 18 (citing

[2] Yeshayahu Nitzan et al., *ALA induced photodynamic effects on Gram positive and negative bacteria*, J. PHOTOCHEM. PHOTOBIOL. SCI., 3 (2004), 430–435 (Ex. 1009).

[3] Jones et al., US 2005/00550070 A1, published Mar. 10, 2005 (Ex. 1007).

[4] Helena Ashkenazi et al., *Eradication of Propionibacterium acnes by its endogenic porphyrins after illumination with high intensity blue light*, J. FEMS IMMUNOLOGY AND MEDICAL MICROBIOLOGY, 35 (2003), 17–24 (Ex. 1010).

Ex. 1023[5] ¶¶ 68–76). Patent Owner does not address the definition of a person of ordinary skill in the art in its Response or Sur-reply, but Patent Owner's declarant, Raymond Goodrich, Ph.D., testified that a person of ordinary skill in the art "would have had a combination of experience and education in chemistry, photochemistry, biochemistry, bacteriology, microbiology and/or infectious disease" including "at least a bachelor degree of science degree in one or more of these areas and at least two years of work experience in at least one of these fields." Ex. 2001[6] ¶ 23. Dr. Goodrich also indicated that all of his opinions would apply equally under Petitioner's definition of a person of ordinary skill in the art. Ex. 2001 ¶ 24.

In view of the large degree of overlap between the parties' definitions, and Dr. Goodrich's statement that his opinions would apply under either definition, we adopt Petitioner's proposed definition, such that a person of ordinary skill in the art would have had "at least a bachelor of science degree in one of the areas of molecular biology, biochemistry, microbiology, or infectious diseases, and likely a doctoral degree in one of these subjects, with several to many years of experience with bacterial inactivation techniques." Pet. 18. This level of skill is consistent with the field of endeavor of the '706 patent and the disclosures of the asserted prior art. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001); *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995); *see also* PO Resp. 36 (noting that Dr. Sulzinski based his definition of the level of ordinary skill on the

[5] Declaration of Michael A. Sulzinski, Ph.D. in Support of Petitioner Clear-Vu Lighting LLC's Petition for *Inter Partes* Review of U.S. Patent 9,839,706 ("Sulzinski Declaration").

[6] Declaration of Dr. Raymond P Goodrich ("Goodrich Declaration).

experience level of the authors of Nitzan); Ex. 1023 ¶¶ 71–72 (discussing the experience level of the authors of Nitzan and Ashkenazi in assessing the level of ordinary skill in the art).

II. ANALYSIS

A. Claim Construction

In an *inter partes* review we construe claim terms according to the standard set forth in *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–17 (Fed. Cir. 2005) (en banc). 37 C.F.R. § 42.100(b) (2019). Under *Phillips*, claim terms are afforded "their ordinary and customary meaning." *Phillips*, 415 F.3d at 1312. "[T]he ordinary and customary meaning of a claim term is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention." *Id.* at 1313. "Importantly, the person of ordinary skill in the art is deemed to read the claim term not only in the context of the particular claim in which the disputed term appears, but in the context of the entire patent, including the specification." *Id.* It is also important to consider the prosecution history, as it "can often inform the meaning of the claim language by demonstrating how the inventor understood the invention." *Id.* at 1317. Additionally, extrinsic evidence, particularly dictionaries and treatises, can be useful for purposes of claim construction, but is "less significant" than intrinsic evidence. *Id.* at 1317–1318 (quoting *C.R. Bard, Inc. v. U.S. Surgical Corp.,* 388 F.3d 858, 862 (Fed. Cir. 2004)).

Petitioner proposes constructions for three terms, "inactivating," "photosensitizer," and "without using a photosensitizer." Pet. 9–16. Petitioner also addresses the preamble of independent claims 1 and 3, as well as means-plus-function language in claim 3. Pet. 16–18. In its Preliminary

Response, Patent Owner proposed its own construction of the terms "photosensitizer" and "without using a photosensitizer." Prelim. Resp. 10–28. In our Institution Decision, we construed the term "photosensitizer" to mean "a substance that, when applied to a target substance, makes the target substance more sensitive to light," as proposed by Patent Owner. Inst. Dec. 6–13. In its Response, Patent Owner provides the same arguments it presented in its Preliminary Response and argues that we should reaffirm our construction of "photosensitizer." PO Resp. 9–25. Petitioner asserts that we should reconsider our provisional adoption of Patent Owner's proposed construction of this term. Reply 21–24.

After reviewing the parties' arguments and evidence developed during the entire course of this proceeding, we determine that only one term of the '706 patent, "photosensitizer," requires express construction for purposes of this Final Written Decision. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (citing *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) ("[O]nly those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy.")). We address the parties' construction of "photosensitizer" below.

"photosensitizer"

Independent claims 1 and 3 require exposing bacteria to visible light "without using a photosensitizer." Ex. 1001 7:20–22, 8:12–13. Petitioner contends a photosensitizer is "a light-reactive substance that, when exposed to light, initiates a change in another substance." Pet. 10 (citing Ex. 1023 ¶¶ 79, 84–85). Petitioner contends that "[t]his construction is consistent with the '706 Patent's statements about the use of photosensitizers in the

prior art methods of bacterial inactivation." Pet. 10 (citing Ex. 1001, 1:59–2:19; Ex. 1023 ¶ 89). In particular, Petitioner notes that the '706 patent discusses two prior art documents, Biel[7] and Albrecht[8], that use light-sensitive dyes to inactivate bacteria. Pet. 10. According to Petitioner, the dyes in Biel and Albrecht are activated by exposing them to visible light, causing them to produce reactive oxygen species and free radicals that lead to the destruction of bacteria. Pet. 10–11 (citing Ex. 1001, 1:67–2:6, 2:15–17; Ex. 1011, Abstract, 1:14–24, 4:47–53; Ex. 1012 ¶¶ 10, 16, 24).

Petitioner argues that other language in the '706 patent specification supports its construction of photosensitizer as a light reactive substance, specifically the patent's discussion of the "***combined*** use of light and photosensitizers to inactivate bacteria." Reply 22 (citing Ex. 1001, 1:64, 2:1–2, 2:16–17; Ex. 1033[9] ¶ 80). Petitioner contends that the use of this language "shows that the key feature of the substance used for photodynamic treatment is its reaction when exposed to light." Reply 22 (citing Ex. 1001, 1:59–2:19; Ex. 1033, ¶ 80).

Petitioner also argues that its construction is consistent with statements about photosensitizers Patent Owner made during prosecution of the application leading to the '966 patent, which is the parent of the '706 patent. Pet. 11 (citing Ex. 1006, 269); Reply 22 (citing Ex. 1006, 67, 104–105, 269). In particular, Petitioner directs us to a statement in which Patent Owner identified fullerene compounds, which generate singlet oxygen that

[7] US 6,251,127 B1, issued June 26, 2001 (Ex. 1011).

[8] US 2005/0049228 A1, published March 3, 2005 (Ex. 1012).

[9] Declaration of Michael A. Sulzinski, Ph.D. in Support of Petitioner's Reply to Patent Owner's Response ("Sulzinski Reply Declaration").

induces bacterial cell death when irradiated with visible light, as photosensitizers. Pet. 11 (citing Ex. 1006, 269); Pet. 22 (citing Ex. 1006, 269).

Additionally, Petitioner presents extrinsic evidence to support its construction, including a technical dictionary that defines photosensitizer as "[a] light-absorbing substance that initiates a photochemical or photophysical reaction in another substance (molecule), and is not consumed in the reaction." Pet. 12 (quoting Ex. 1014, 3); *see also* Reply 23 (noting that one technical definition of photosensitizer refers to the combined use of light and a photosensitizer (quoting Ex. 1037, 4)). Additionally, Petitioner argues that "[c]ontemporaneous scientific and technical literature also show that the physics and chemistry behind the activation of photosensitizers was well-understood" and includes the absorption of light and transfer of energy. Pet. 12 (citing Ex. 1016, 2, 5–7). Petitioner also directs us to an instance wherein Patent Owner's own declarant identified a photosensitizer as a light-reactive substance. Reply 23 (citing Ex. 1039, 1:29–32; Ex. 2004, 6 n.3).

Patent Owner contends "photosensitizer" should be given its plain and ordinary meaning, which is "a substance that, when applied to a target substance, makes the target substance more sensitive to light." PO Resp. 12–13 (emphasis omitted). Patent Owner asserts Petitioner's proposed construction improperly excludes well-known photosensitizers such as ALA,[10] arguing that the claims do not qualify the word photosensitizer in

[10] ALA is δ-aminolevulinic acid. Ex. 1023 ¶ 30. It is undisputed that ALA is not light reactive. Rather, ALA stimulates production of endogenous porphyrins, which themselves react with light. Pet. 26; Ex. 1023 ¶ 137; PO Resp. 11; Ex. 2024 ¶ 34.

any way, and the Specification does not limit the definition of photosensitizer to any particular type or group, or based on how it operates on a molecular level. PO Resp. 11, 14. Instead, Patent Owner contends that the inventors of the '706 patent were "focused on solving the *practical* disadvantages of using photosensitizers to inactivate bacteria outside of the human body—disadvantages common to both ALA and other photosensitizers." PO Resp. 11 (citing Ex. 1001, 2:10–24; Ex. 2024 ¶¶ 35–36). Patent Owner further argues that statements made by the Examiner during prosecution of the application leading to the '706 patent support its interpretation of photosensitizer. PO Resp. 15–19.

Patent Owner also presents its own dictionary definition of photosensitizer from Merriam-Webster's Collegiate Dictionary, which is a "substance that makes another substance 'sensitive to the influence of radiant energy and especially light.'" PO Resp. 22–23 (citing Ex. 2005, 3). Patent Owner cites to several technical references that refer to certain materials (such as ALA) as photosensitizers, consistent with this definition and Patent Owner's proposed construction of the term. PO Resp. 19–22 (citing Exs. 2006–2016).

Based on our review of the totality of the record after trial, we adopt Patent Owner's proposed construction, and construe "photosensitizer" to mean "a substance that, when applied a target substance, makes the target substance more sensitive to light." [11] PO Resp. 12. Patent Owner's

[11] Petitioner argues that it is not necessary to require that a photosensitizer be "applied" as stated in Patent Owner's construction. Reply 21. This distinction is not relevant to the primary dispute between the parties on this issue, namely whether photosensitizer is limited to only light-reactive substances. The use of the term "applied" reflects the parties' agreement

proposed construction of a photosensitizer as a substance that makes a target substance more sensitive to light accords with the plain and ordinary meaning of the term in the context of the claims and specification of the '706 patent, whereas Petitioner's proposed construction is unduly narrow. Although a photosensitizer may be "a light-reactive substance that, when exposed to light, initiates a change in another substance," as Petitioner proposes, we are not persuaded that the claim term should be limited to only this specific type of photosensitizer.

Neither the claims nor the specification expressly qualify or otherwise limit the word "photosensitizer" in any way. The Specification includes a discussion of two prior art references (Biel and Albrecht) that apply light-reactive dyes as photosensitizers, and states that the methodologies used in these references "suffer[] from the significant practical disadvantage that photosensitising agents must be applied to the bacteria that are to be inactivated." Ex. 1001, 2:10–15. According to the '706 patent, "[t]he need for photosensitising agents is a significant limitation of these techniques." Ex. 1001, 2:17–19. We agree with Patent Owner that these statements in the '706 patent specification refer to the "practical disadvantage" of applying photosensitizers in general, which is an inherent disadvantage in *any* photosensitizer applied before inactivation. *See* PO Resp. 11, 14–15. We are not persuaded by Petitioner's argument that the '706 patent was referring

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that the scope of the entire claim, based on the term "without a photosensitizer," means without using exogenous photosensitizers, i.e., photosensitizers that do not naturally originate within an organism. Pet. 10, 12–13; Ex. 1033 ¶ 86. This is consistent with the discussion of "practical disadvantage[s]" of photosensitizers that "must be applied to the bacteria that are to be inactivated." Ex. 1001, 2:10–15.

only to the "practical disadvantage" associated with applying light-reactive substances because the dyes used in Biel and Albrecht are light-reactive. Pet. 10–11. The '706 patent specification clearly indicates that Biel and Albrecht describe examples of the "[m]any techniques [that] have been proposed for destroying harmful bacteria, such as MRSA." Ex. 1001, 1:59–60.

Consistent with the lack of any limitations on photosensitizers in the '706 patent specification, other evidence in the record demonstrates that a person of ordinary skill in the art would have understood these "many techniques" to include not only the use of light-reactive substances as disclosed in Biel and Albrecht, but also the use of non-light-reactive substances to destroy harmful bacteria. For example, Patent Owner directs us to several references characterizing ALA as a photosensitizer. PO Resp. 20–21 (citing Exs. 2006–2016). As noted above, ALA is not light-reactive. Pet. 26; Ex. 1023 ¶ 137; PO Resp. 11; Ex. 2024 ¶ 34. Thus, the characterization of ALA as a photosensitizer in the extrinsic references provided by Patent Owner is informative as to what the ordinary and customary meaning of photosensitizer would have been to a person of ordinary skill in the art, and weighs against Petitioner's assertion that a person of ordinary skill in the art would understand "photosensitizer" as used in the '706 patent to include only light-reactive substances.

We are not persuaded by Petitioner's argument that the exhibits that refer to ALA as a "photosensitizer" use the term "in a loose manner for the expedience of summarizing the studies they describe," and "go on to explain that the photodynamic effect is due to the *combination* of light and a light-reactive substance." Reply 24. Even if Petitioner had provided sufficient

evidence demonstrating that the authors did indeed use the term photosensitizer in a "loose manner," which Petitioner has not done, these articles would nevertheless demonstrate that persons of ordinary skill in the used the term photosensitizer to encompass both light-reactive and non-light reactive substances. Not only does this undermine Petitioner's arguments, but it further supports Patent Owner's construction of the term photosensitizer.

With regard to Petitioner's argument that the '706 patent "emphasizes the *combined* use of light and photosensitizers to inactivate bacteria" (Reply 22), we note that the language referring to the combination of light and a photosensitizer in the '706 patent specification applies equally to light-reactive substances and non-light-reactive substances, since both types of photosensitizers require light in combination with the photosensitizer itself in order to inactivate bacteria. *See, e.g.*, Ex. 1033 ¶ 88 (explaining that exposing light reactive dyes causes the dye to produce reactive oxygen species and free radicals which destroy bacteria); Ex. 2024 ¶ 34 (explaining that ALA functions by being absorbed by bacteria causing production of excess porphyrins which react with light in order to kill the bacteria). Further, Petitioner has not directed us to evidence in the '706 patent specification suggesting the "combined" language applies only to light-reactive substances. As a result, we are not persuaded by Petitioner's argument that the language discussing combining light with a photosensitizer is evidence that the discussion of the "practical disadvantages" in the '706 patent refers only to light-reactive substances.

Nor are we persuaded by Petitioner's argument that Patent Owner's statements during prosecution of the '966 patent support its narrow

construction. Pet. 11–12. Petitioner's evidence consists of Patent Owner identifying fullerene as a photosensitizer, and explaining that when fullerene is irradiated with light it generates singlet oxygen that induces bacterial cell death, i.e., that it is light-sensitive. Pet. 11–12; Ex. 1006, 269. Patent Owner's arguments here, however, are entirely consistent with its proposed construction, which includes both light-reactive substances and non-light reactive substances. The fact that Patent Owner argued during prosecution that "photosensitizer" includes light reactive substances does not mean it excludes non-light-reactive substances, and Petitioner has not provided adequate evidence to support such a conclusion.

As to the dictionary definitions presented by the parties, each party presents a dictionary definition that supports its own proposed construction, something that is not uncommon. In *Phillips*, the Federal Circuit recognized that "different dictionaries may contain somewhat different sets of definitions for the same words," and cautioned that "[a] claim should not rise or fall based upon the preferences of a particular dictionary editor, or the court's independent decision, uninformed by the specification, to rely on one dictionary rather than another." *Phillips*, 415 F.3d at 1322. Rather, dictionary definitions should be considered in the context of the specification, claims, and prosecution history, and reliance on dictionary definitions is proper "so long as the dictionary definition does not contradict any definition found in or ascertained by a reading of the patent documents." *Id.* at 1322–23 (quoting *Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1584 n.6 (Fed. Cir. 1996)).

Petitioner's dictionary definition, "[a] light-absorbing substance that initiates a photochemical or photophysical reaction in another substance

(molecule), and is not consumed in the reaction," restricts photosensitizers to light absorbing substances. Pet. 12; Ex. 1014, 3. As discussed above, based on our review of the '706 patent's claims, specification, and prosecution history, we discern no basis for restricting the meaning of photosensitizer as proposed by Petitioner. To the contrary, Patent Owner's dictionary definition of photosensitizer, a "substance that makes another substance 'sensitive to the influence of radiant energy and especially light'" (PO Resp. 22–23; Ex. 2005, 3), is more inclusive, and thus most naturally aligns with the patent's description of the invention.

Petitioner argues that Patent Owner's "only definition from a non-technical dictionary cannot outweigh those in the technical dictionaries and references that align with the patent's discussion of photosensitizers in the context of combing light and light-reactive substances." Reply 23–24. As discussed above, however, the definitions in Petitioner's technical dictionaries do not align with the discussion of photosensitizers in the '706 patent specification. Petitioner also contends that Dr. Goodrich, Patent Owner's declarant, has defined photosensitizer as "*compounds which absorb light* of a defined wavelength and *transfer the absorbed energy* to an energy acceptor," i.e., light-reactive substances. Reply 23 (citing Ex. 1039,[12] 1:29–32). The fact that Dr. Sulzinski defines a photosensitizer as a light-reactive substance in a different patent, in which he is entitled to act as his own lexicographer, is not highly relevant to how the inventors of an entirely different patent used that term, nor is it entirely inconsistent with Patent Owner's proposed construction, which includes both light-reactive and non-

[12] US Patent No. 6,258,577 B1, issued July 10, 2001.

light reactive substances. *See Phillips*, 415 F.3d at 1315 (holding that a patent's specification is "the single best guide to the meaning of a disputed term.")

In view of the foregoing reasons, we construe "photosensitizer" to mean "a substance that, when applied to a target substance, makes the target substance more sensitive to light."

B. Legal Principles

1. Burden of Proving Unpatentability

In an *inter partes* review, the petitioner bears the burden of proving unpatentability of the challenged claims, and the burden of persuasion never shifts to the patent owner. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). To prevail in this proceeding, Petitioner must support its challenges by a preponderance of the evidence. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d). Accordingly, all of our findings and conclusions are based on a preponderance of the evidence.

2. Anticipation

"A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. Inc., v. Union Oil Co.*, 814 F.2d 628, 631 (Fed. Cir. 1987). Moreover, "[b]ecause the hallmark of anticipation is prior invention, the prior art reference—in order to anticipate under 35 U.S.C. § 102—must not only disclose all elements of the claim within the four corners of the document, but must also disclose those elements 'arranged as in the claim.'" *Net MoneyIN, Inc. v. VeriSign, Inc.*, 545 F.3d 1359, 1369 (Fed. Cir. 2008). Whether a reference anticipates is assessed from the perspective of an ordinarily skilled artisan. *See Dayco Prods., Inc. v. Total*

Containment, Inc., 329 F.3d 1358, 1368 (Fed. Cir. 2003) ("[T]he dispositive question regarding anticipation [i]s whether *one skilled in the art* would reasonably understand or infer from the [prior art reference's] teaching that every claim element was disclosed in that single reference."). In that regard, in an anticipation analysis, "it is proper to take into account not only specific teachings of the reference but also the inferences which one skilled in the art would reasonably be expected to draw therefrom." *In re Preda*, 401 F.2d 825, 826–27 (CCPA 1968). Furthermore, "[i]t is well settled that the recitation of a new intended use for an old product does not make a claim to that old product patentable." *In re Schreiber*, 128 F.3d 1473, 1477 (Fed. Cir. 1997).

3. Obviousness

In *Graham v. John Deere Co. of Kansas City*, 383 U.S. 1 (1966), the Supreme Court set out a framework for assessing obviousness under § 103 that requires consideration of four factors: (1) the "level of ordinary skill in the pertinent art," (2) the "scope and content of the prior art," (3) the "differences between the prior art and the claims at issue," and (4) "secondary considerations" of non-obviousness such as "commercial success, long-felt but unsolved needs, failure of others, etc." *Id.* at 17–18. "While the sequence of these questions might be reordered in any particular case," *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 407 (2007), the Federal Circuit has "repeatedly emphasized that an obviousness inquiry requires examination of all four *Graham* factors and that an obviousness

determination can be made only after consideration of each factor." *Nike, Inc. v. Adidas AG*, 812 F.3d 1326, 1335 (Fed. Cir. 2016).

"[A] a patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art." *KSR*, 550 U.S. at 418. Rather, "it can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does." *Id.* Furthermore, a party seeking to demonstrate that a patent would have been obvious must show that "a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention, and that the skilled artisan would have had a reasonable expectation of success in doing so." *Kinetic Concepts, Inc. v. Smith & Nephew, Inc.*, 688 F.3d 1342, 1360 (Fed. Cir. 2012) (quoting *Procter & Gamble Co. v. Teva Pharm. USA, Inc.*, 566 F.3d 989, 994 (Fed. Cir. 2009)). Ultimately, "there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness." *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006) (cited with approval in *KSR*, 550 U.S. at 418).

C. Overview of Asserted References

1. Nitzan (Ex. 1009)

Nitzan is directed to the photodynamic inactivation of bacteria by endogenously produced porphyrins after incubation with ALA. Ex. 1009, 430. Nitzan discloses experiments involving growing bacterial strains (including MRSA), incubating the bacteria with ALA, exposing the bacteria to blue light between 407 and 420 nm, and monitoring the survival of bacterial cells following photosensitization. Ex. 1009, 430–431. Nitzan

explains that bacterial cultures grown under the same conditions and light exposure, but without ALA, served as controls. Ex. 1009, 431. The survival fraction of bacterial cells after exposure to light was calculated according to the equation N/N_0, where N_0 is the number of colony forming units ("CFUs") at zero time, and N is the number of colony forming units after illumination. Ex. 1009, 431.

Table 2 of Nitzan shows the survival fractions of "photosensitized bacterial cultures" after illumination with blue light at a light dose of 50 J/cm^2 and 100 J/cm^2. Ex. 1009, 432. The results show a decrease of five orders of magnitude upon illumination of ALA-induced *S. aureus* with a light dose of 50 J/cm^2 and "almost total eradication" with a 100 J/cm^2 dose. Ex. 1009, 430, 432.

Table 5 of Nitzan compares survival fractions of bacterial cultures incubated with and without ALA. Ex. 1009, 433. Nitzan reports that for bacterial strains that were not incubated with ALA, no decrease in viability was observed after illumination with a dose of 50 J/cm^2. Ex. 1009, 433.

2. Ashkenazi (Ex. 1010)

Ashkenazi investigated the eradication of *Propionibacterium acnes* (*P. acnes*) after illumination with intense blue light at 407–420 nm. Ex. 1010, 17 (Abstract). Ashkenazi tested the viability of *P. acnes* both with and without the addition of ALA, and reported the following:

> The viability of 24 h cultures grown anaerobically in liquid medium was reduced by less than two orders of magnitude when illuminated once with a light dose of 75 J cm^{-2}. Better photodynamic effects were obtained when cultures were illuminated twice or three times consecutively with a light dose of 75 J cm^{-2} and an interval of 24 h between illuminations. The viability of the culture under these conditions decreased by four

> orders of magnitude after two illuminations and by five orders of magnitude after three illuminations. When ALA-triggered cultures were illuminated with intense blue light at a light dose of 75 J cm^{-2} the viability of the treated cultures decreased by seven orders of magnitude.

Ex. 1010, 17. Based on these results, Ashkenazi concluded that "[a] treatment protocol with a series of several illuminations or illumination after application of ALA may be suitable for curing acne." Ex. 1010, 17.

3. Jones (Ex. 1007)

Jones relates to a method and apparatus for the treatment of a skin condition, in particular Acne Vulgaris, involving directing light radiation onto a region of skin affected by Acne Vulgaris. Ex. 1007 ¶¶ 2, 12. Jones explains that upon exposure to light, "a photo-chemical reaction is caused that disables or destroys, wholly or partially, the bacteria Propionibacterium acnes, which, as described above, is one of the causes of Acne Vulgaris." Ex. 1007 ¶ 23. According to Jones, the photo-chemical reaction is a result of a substance within the skin absorbing radiation within a range of particular wavelengths and producing free radicals which may destroy the bacteria. Ex. 1007 ¶ 24. Jones explains that for its invention, porphyrin, a naturally occurring substance produced by *P. acnes*, is the targeted substance, and produces free radicals (in the form of oxygen singlets) "when excited by light of a wavelength of around 405 nm." Ex. 1007 ¶ 24; *see also* Ex. 1007 ¶ 29 ("The illuminating radiation may include radiation substantially concentrated around the wavelength of violet/near ultra-violet light (405 nm).").

D. Claims 1 and 3 – Alleged Anticipation by Nitzan

Petitioner contends claims 1 and 3 are unpatentable as anticipated by Nitzan. Pet. 24–39.

Claims 1 and 3 each require exposing bacteria to visible light "without using a photosensitizer." Ex. 1001, 7:20–22, 8:12–13. As discussed above, Nitzan studied the photodynamic inactivation of bacteria after incubation with ALA. Ex. 1009, 430. In the Petition, Petitioner contends that Nitzan discloses the "without using a photosensitizer" limitation because ALA is not a photosensitizer under Petitioner's proposed construction of the term. Pet. 26 (arguing that "ALA is not a light-reactive substance that initiates a change in another substance when it is exposed to visible light"), 38–39. For the reasons discussed above, however, we do not adopt Petitioner's construction of the term photosensitizer.

Instead, the proper construction of photosensitizer is "a substance that, when applied to or present within a target substance, makes the target substance more sensitive to light." Patent Owner argues that "ALA has been used for many years to make bacteria and other substances more sensitive to light," and "was widely regarded in the art as a photosensitizer at the time of the invention." PO Resp. 19–21 (citing Ex. 2024 ¶¶ 46–58; Exs. 2006–2016).

We agree that ALA is a photosensitizer under the proper construction of that term. It is undisputed that upon exposure to bacteria, ALA causes the production of excess porphyrins within the bacteria, which react with light in order to kill the bacteria. Pet. 26; Ex. 1023 ¶ 137; PO Resp. 11; Ex. 2024 ¶ 34. Accordingly, ALA is a substance that, when applied to bacteria, makes the bacteria more sensitive to light. Additionally, based on evidence

presented by Patent Owner, we agree that ALA was regarded in the art as a photosensitizer. *See, e.g.*, Ex. 2006, 158 ("This review focuses on **the development of ALA as a photosensitizer in photodynamic therapy and photodiagnosis**, and the wide range of clinical applications in which ALA is now being used as a therapeutic modality.") (emphasis added).

Petitioner relies on the data presented in Table 2 of Nitzan to demonstrate Nitzan found that MRSA could be inactivated when illuminated with 407–420 nm light. Pet. 24 (citing Ex. 1009, 432, Table 2). It is undisputed that Nitzan introduced ALA to the bacteria studied in Table 2 prior to exposing the bacteria to visible light. Pet. 24, 31; Ex. 1009, 431–32. Other than arguing ALA is not a photosensitizer, Petitioner does not present any arguments or evidence in the Petition demonstrating how or why Nitzan satisfies the "without a photosensitizer" limitation. Pet. 26, 31, 33–35.

In its Reply, Petitioner argues that Nitzan anticipates the independent claims under a construction of photosensitizer that includes ALA. Reply 25. First, Petitioner argues that Nitzan washed the ALA-induced MRSA sample with PBS and transferred the sample to a sterile dish prior to exposing it to blue light. Reply 25 (citing Ex. 1009, 431). According to Petitioner, "[t]he ALA-incubated MRSA thus would have been rinsed of any ALA present in its incubation media," and, therefore Nitzan meets the "exposing . . . without using a photosensitizer" limitation "[b]ecause no ALA would have been present during the PBS-washed MRSA's exposure to blue light." Reply 25 (citing Ex. 1033 ¶ 77).

We are not persuaded by Petitioner's argument. Although Petitioner cites to a paragraph in the Sulzinski Reply Declaration to support the argument that the MRSA would have been rinsed of any ALA, Dr. Sulzinski

merely states that this is his opinion, and offers no evidence to support that statement. Ex. 1033 ¶ 77. Without disclosing the underlying facts or data forming the basis for this opinion, this testimony is entitled to little or no weight. 37 C.F.R. § 42.65(a). Additionally, even if we were to agree that all of the MRSA would have been rinsed of any ALA prior to exposing it to light, the outcome here would not change because Nitzan used a photosensitizer when it incubated the MRSA in ALA. The fact that Nitzan later rinsed the MRSA does not change the fact that Nitzan used a photosensitizer as part of its method, as precluded by claims 1 and 3.

Petitioner also argues that the MRSA exposed to blue light in the absence of ALA and extracellular porphyrins in Nitzan showed a 1.0 survival fraction, which meant that the number of colony forming units before and after light exposure was the same. Reply 25–26. According to Petitioner, this demonstrates inactivation, as that term is defined in the '706 patent. Pet. 26. Dr. Sulzinski testifies that a person of ordinary skill in the art would have expected the bacterial population in Nitzan's non-ALA-treated sample to increase during the four-hour incubation period used in Nitzan's method, leading to the conclusion that the 1.0 survival fraction indicates that the light exposure inhibited the growth of the bacterial population. Ex. 1033 ¶¶ 62–63.

Petitioner's argument is not persuasive because it is based on the assumption that the bacterial population of Nitzan's non-ALA-treated MRSA would have increased between the two CFU measurements taken to determine the survival fraction. Petitioner, however, does not present evidence indicating how much time elapsed between the two CFU measurements or the growth rate of the sample tested, which undermines

Petitioner's argument that a person of ordinary skill in the art would have expected the bacterial population to increase between the two CFU measurements. As a result, Petitioner has not demonstrated by a preponderance of evidence that a 1.0 survival fraction measured for Nitzan's non-ALA induced MRSA demonstrates "inactivation," as claims 1 and 3 require.

For all of the foregoing reasons, we find that Petitioner has failed to demonstrate by a preponderance of evidence that Nitzan discloses all elements of independent claims 1 and 3. Accordingly, based on the present record, we find Petitioner has failed to establish by a preponderance of evidence that claims 1 and 3 are unpatentable as anticipated by Nitzan.

E. Claims 2 and 4 – Alleged Obviousness in view of Nitzan and Jones

Claims 2 and 4 depend from claims 1 and 3, respectively. Petitioner does not rely on Jones to cure the aforementioned deficiencies in its argument that Nitzan anticipates independent claims 1 and 3. *See* Pet. 40–44. As a result, for the reasons discussed above, we reach the same conclusion here as we did for Petitioner's challenge that claims 1 and 3 are anticipated by Nitzan, and find that Petitioner has failed to establish by a preponderance of evidence that claims 2 and 4 are unpatentable as obvious over Nitzan and Jones.

F. Claims 1 and 3 – Alleged Obviousness in view of Ashkenazi and Nitzan

Petitioner argues the subject matter of claims 1 and 3 would have been obvious in view of the combined disclosures of Ashkenazi and Nitzan. Pet. 44–65. Petitioner directs us to portions of Ashkenazi and Nitzan that purportedly teach or suggest all the limitations in claims 1 and 3, arguing

that a person of ordinary skill in the art would have found it obvious to combine the teachings of Ashkenazi and Nitzan to arrive at the claimed invention, and would have had a reasonable expectation of successfully doing so. Pet. 44–65.

In its Response, Patent Owner argues that the combined disclosures of Ashkenazi and Nitzan fail to teach or suggest inactivating MRSA "without using a photosensitizer." PO Resp. 58–61. Patent Owner also contends that Petitioner failed to establish: (1) that a person of ordinary skill in the art would have been motivated to combine the teachings of Ashkenazi and Nitzan; and (2) that the skilled artisan would have had a reasonable expectation of success. PO Resp. 30–58. We address these arguments in turn, below.

1. *Whether Ashkenazi and Nitzan Teach or Suggest All Limitations of Claims 1 and 3*

Claim 1 recites "[a] method for disinfecting air, contact surfaces or materials by inactivating one or more pathogenic Gram-positive bacteria in the air, on the contact surfaces or on the materials," wherein "the one or more pathogenic Gram-positive bacteria are selected from the group consisting of Methicillin-resistant *Staphylococcus aureus* (MRSA), Coagulase-Negative *Staphylococcus* (CONS), *Streptococcus*, *Enterococcus*, and *Clostridium* species." Ex. 1001, 7:17–26.

Petitioner argues that Ashkenazi discloses a study using visible light to inactivate *P. acnes*, a Gram-positive bacteria, distributed into test tubes. Pet. 44, 55 (citing Ex. 1010, 18). Petitioner contends that the test tubes in Ashkenazi correspond to the "materials" or "contact surfaces" recited in claim 1. Pet. 44, 55. Petitioner acknowledges that Ashkenazi does not

explicitly recite inactivating one of the claimed species of Gram-positive bacteria, but argues that Nitzan does, because Nitzan inactivated MRSA by exposing it to blue light, and MRSA is one of the claimed species of Gram-positive bacteria. Pet. 60. Petitioner thus contends that Ashkenazi and Nitzan disclose the claimed step of "disinfecting air, contact surfaces or materials by inactivating one or more pathogenic Gram-positive bacteria in the air, on the contact surfaces or on the materials" as well as the requirement in claim 1 that "the one or more pathogenic Gram-positive bacteria are selected from the group consisting of Methicillin-resistant *Staphylococcus aureus* (MRSA), Coagulase-Negative *Staphylococcus* (CONS), *Streptococcus*, *Enterococcus*, and *Clostridium* species." Pet. 55–58, 60–62.

Claim 1 further requires "exposing the one or more pathogenic Gram-positive bacteria to visible light without using a photosensitizer." Ex. 1001, 7:20–22. Petitioner asserts that Ashkenazi teaches exposing *P. acnes* to blue light, which is within the visible spectrum, without applying ALA to the bacteria. Pet. 59. According to Petitioner, "[a]pplying Ashkenazi's techniques to MRSA would have yielded MRSA grown in the absence of exogenous ALA. (Ex. 1023, ¶ 190.) And that MRSA would have been exposed to visible blue light." Pet. 59. Petitioner thus argues that Ashkenazi in view of Nitzan discloses this limitation.

Petitioner also directs us to Ashkenazi's disclosure of using blue light having a wavelength of 407–420 nm to inactivate bacteria. Pet. 62 (citing Ex. 1010, 18). In view of this, Petitioner argues that Ashkenazi in view of Nitzan teaches that "a portion of the visible light that inactivates the one or

more pathogenic Gram-positive bacteria consists of wavelengths in the range 400-420 nm," as claim 1 requires.

Lastly, claim 1 requires that "the method is performed outside of the human body and the contact surfaces or the materials are non-living." Ex. 1001, 8:3–5. For this limitation, Petitioner argues that the test tubes used in Ashkenazi are located outside the human body, and constitute non-living contact surfaces. Pet. 63 (citing Ex. 1010, 18; Ex. 1023 ¶ 196).

Petitioner presents a nearly identical analysis for claim 3, arguing that claim 3 is substantially similar to claim 1, and that "there is no meaningful difference between the language of these claims." Pet. 64–66.

With the exception of the requirement in claims 1 and 3 of exposing the bacteria to light "without using a photosensitizer," Patent Owner does not challenge Petitioner's arguments that the combined disclosures of Ashkenazi and Nitzan teach or suggest the limitations of claims 1 and 3. As to what Ashkenazi and Nitzan disclose regarding the use of a photosensitizer, Patent Owner first contends that Nitzan achieved inactivation of MRSA only by using a photosensitizer, ALA. PO Resp. 58. Patent Owner acknowledges that Ashkenazi discloses inactivating *P. acnes* grown in the absence of ALA, but argues that Ashkenazi's non-ALA-treated samples were grown in the presence of other photosensitizers, such as riboflavin. PO Resp. 58–59 (citing Ex. 2024 ¶¶ 118–123).

In particular, Patent Owner contends that at every stage of Ashkenazi's experiment, the tested *P. acnes* were present in reinforced clostridial agar (RCA) or a reinforced clostridial broth (RCB), and that both the RCA and RCB contained riboflavin. PO Resp. 59–60. According to Patent Owner, "riboflavin was known to produce reactive oxygen species

("ROS"), such as singlet oxygen, when exposed to visible light," and, therefore, a person of ordinary skill in the art "would have expected that that the riboflavin present in Ashkenazi's RCB (in which the non-ALA *P. acnes* were suspended when exposed to light) would have reacted with the light, generated reactive oxygen species, and thereby enhanced inactivation of even the non-ALA *P. acnes*." PO Resp. 60–61. As a result, Patent Owner contends that a person of ordinary skill in the art would have understood that even Ashkenazi's non-ALA-treated *P. acnes* samples still made use of a photosensitizer, and concludes that Ashkenazi fails to disclose exposing bacteria to light "without using a photosensitizer." PO Resp. 61.

In its Reply, Petitioner does not dispute that riboflavin is a photosensitizer or that it would be present in the RCA/RCB used in Ashkenazi. Instead, Petitioner argues that Patent Owner attacks Ashkenazi individually, instead of addressing the combined teachings of Ashkenazi and Nitzan. Reply 18–19. In this regard, Petitioner asserts that a person of ordinary skill in the art would not have necessarily used Ashkenazi's RCA/RCB to grow the MRSA used in Nitzan because clostridial broth/agar are used to cultivate anaerobic bacteria, whereas MRSA is an aerobic bacteria. Reply 19 (citing Ex. 1033 ¶¶ 74–77). According to Petitioner, a person of ordinary skill in the art would have prepared MRSA as taught by Nitzan, "aerobically, washed with PBS, and placed into sterile dishes." Reply 19. Petitioner contends that no riboflavin would have been present in Nitzan's PBS-washed MRSA, and thus the combined teachings of Ashkenazi and Nitzan do disclose exposing bacteria to light without using a photosensitizer. Reply 19 (citing Ex. 1033 ¶ 77).

We are persuaded by Petitioner's arguments. Petitioner has presented evidence, including testimony from both Dr. Sulzinski and Dr. Goodrich, demonstrating that a person of ordinary skill in the art would have understood that MRSA is aerobic, and needs to be cultivated in aerobic conditions. Ex. 1033 ¶ 77; Ex. 1034, 57:11–58:5 (Dr. Goodrich acknowledging that MRSA is aerobic and would not "grow effectively" in "an environment absent of oxygen"). This evidence supports Petitioner's argument that a person of ordinary skill in the art would not use Ashkenazi's anaerobic conditions to grow MRSA, but instead would have prepared the MRSA as disclosed by Nitzan, and then exposed the MRSA to Ashkenazi's light dose. Reply 19–20. Petitioner has also presented undisputed evidence that the aerobic growth conditions used in Nitzan would not include riboflavin. Ex. 1033 ¶ 77.

Patent Owner did not address Petitioner's aerobic growth conditions arguments in its Sur-reply. And Patent Owner's arguments and evidence regarding the presence of riboflavin in RCA/RCB used to grow P. acnes in Ashkenazi are misplaced as they focus on Ashkenazi individually, whereas Petitioner relies on the combined teachings of Ashkenazi and Nitzan.

In view of this, the preponderance of evidence supports a finding that the combined teachings of Nitzan and Ashkenazi disclose exposing bacteria to light without using a photosensitizer.

Based on our review of the totality of the record after trial, we agree with Petitioner's arguments and evidence presented in the Petition demonstrating that Ashkenazi and Nitzan disclose or suggest the limitations of claims 1 and 3. Thus, we determine that the preponderance of the evidence supports a finding that Petitioner has demonstrated that the

combined disclosures of Ashkenazi and Nitzan teach or suggest all of the limitations in claims 1 and 3.

2. Motivation to Combine Ashkenazi and Nitzan

Petitioner argues that a person of ordinary skill in the art would have found it obvious to employ Ashkenazi's techniques, using blue light to inactivate *P. acnes* grown in the absence of exogenous ALA, to inactivate MRSA grown in the absence of exogenous ALA, as disclosed in Nitzan. Pet. 45. According to Petitioner, "[t]his would have simply been a predictable variation on a known technique in the same field of endeavor prompted by design incentives in that field." Pet. 45. Petitioner argues that the desire to find alternative approaches to treating bacteria such as MRSA that have become resistant to antibiotics, as recognized by Nitzan, constitutes the design incentive that would have prompted a person of ordinary skill in the art to adapt Ashkenazi's technique for the purpose of inactivating MRSA. Pet. 45–46 (citing Ex. 1009, 430; Ex. 1023 ¶ 163). Petitioner contends that employing Ashkenazi's techniques using MRSA instead of *P. acnes* would have been a simple substitution of one known element for another to obtain predictable results, namely, the photoinactivation of MRSA in the absence of ALA. Pet. 46.

Patent Owner does not dispute that Nitzan itself provided motivation for finding methods for photoinactivating MRSA. PO Resp. 35 (citing Ex. 1009, 430–431). Accordingly, it is undisputed on this record that a person of ordinary skill in the art would have understood that "[b]acterial resistance to antibiotics ha[d] become a worldwide problem" and that "[r]esearch has therefore been directed towards bacterial photodynamic inactivation as an alternative approach to antimicrobial drug treatment." Ex. 1009, 431

(internal citations omitted). It is also undisputed that Nitzan tested the photoinactivation of MRSA with and without the addition of ALA, and that MRSA, like the *P. acnes* tested in Ashkenazi, is a Gram-positive bacteria. Ex. 1009, 431; Ex. 1010, 17; PO Resp. 35; Pet. 45–46. Further, as Petitioner points out, Nitzan identified studies showing the successful inactivation of *P. acnes* when discussing "approach[es] for photoinactivation of bacteria." Ex. 1009, 430; Reply 2. This evidence supports Petitioner's argument that a person of ordinary skill in the art would have been prompted to employ and adapt "Ashkenazi's known technique of inactivating *P. acnes* in the absence of exogenous ALA for the purpose and benefit of inactivating MRSA in the absence of exogenous ALA." Pet. 45–46; Ex. 1023 ¶ 163.

The evidence also supports Petitioner's arguments that it would have been obvious to try to inactivate MRSA in the absence of exogenous ALA using Ashkenazi's techniques. Pet. 47; *KSR*, 550 U.S. at 421. Ashkenazi showed one type of Gram-positive bacteria could be inactivated with 407–420 nm light in the absence or presence of ALA. Nitzan showed another type of Gram-positive bacteria (MRSA) could be inactivated with the same visible light in the presence of exogenous ALA. These facts support Petitioner's assertion that "the next logical step" would be to try inactivating MRSA in the absence of exogenous ALA using the same visible light used in Ashkenazi. Pet. 47.

In its Sur-reply, Patent Owner argues that Petitioner's motivation to combine Ashkenazi and Nitzan derives from "Ashkenazi's inactivation of *P. acnes* without using a photosensitizer," which "would have motivated [a person of ordinary skill in the art] to apply Ashkenazi's techniques to Nitzan's MRSA." Sur-reply 15. Patent Owner contends that Petitioner's

argument relies on an entirely false premise because Ashkenazi's non-ALA treated samples made use of riboflavin, which is a photosensitizer. Sur-reply 15–16. Thus, according to Patent Owner, Ashkenazi would not have motivated a person of ordinary skill in the art to attempt to inactivate MRSA "without using a photosensitizer." Sur-reply 15–16.

We disagree. Regardless of the presence of riboflavin in the materials used to grow Ashkenazi's *P. acnes*, Ashkenazi still discloses the photoinactivation of *P. acnes* in the absence of exogenous ALA. Ex. 1010, 19. It is this aspect of Ashkenazi, namely the photoinactivation of Gram-positive bacteria in the absence of ALA, that Petitioner focuses on in arguing a person of ordinary skill in the art would have had a reason to combine the teachings of Ashkenazi and Nitzan. Pet. 45–47. Petitioner's reason to combine the teachings of Ashkenazi and Nitzan is not based on Ashkenazi's inactivation of *P. acnes* "without using a photosensitizer," as Patent Owner contends.[13] Patent Owner's argument here improperly focuses on "the problem the patentee was trying to solve," whereas "[u]nder the correct analysis, any need or problem known in the field and addressed by the patent can provide a reason for combining the elements in the manner claimed." *KSR*, 550 U.S. at 402.

In view of the foregoing, we find Petitioner has shown by a preponderance of evidence that a person of ordinary skill in the art would have had reason to combine the teachings of Nitzan and Ashkenazi.

[13] Although not the reason for the combination, photoinactivation of MRSA in the absence of a photosensitizer would follow from the combined teachings of Ashkenazi and Nitzan, based on Nitzan's growth of MRSA in aerobic conditions, as discussed above.

3. Reasonable Expectation of Success

Petitioner argues that "[t]he background knowledge of a [person of ordinary skill in the art] and the teachings of Ashkenazi would have led the [person of ordinary skill in the art] to reasonably expect success in inactivating MRSA, a pathogenic Gram-positive bacteria, using 407-420 nm light without applying exogenous ALA." Pet. 48. In particular, Petitioner argues that it was known in the art that *S. aureus* and *P. acnes* both naturally produce and accumulate the same light reactive porphyrin: coproporphyrin, and that *S. aureus* produces coproporphyrin in the absence of ALA. Pet. 48–49 (citing Ex. 1023 ¶ 166; Ex. 1020, 58, 63); Reply 13–15 (citing Ex. 1021,[14] 270). Petitioner also argues that Ashkenazi and Nitzan identify the same mechanism of bacterial inactivation—damage to the cell membrane caused by free oxygen radicals released upon illumination of coproporphyrin—for both *P. acnes* and *S. aureus*. Pet. 49–50 (citing Ex. 1023 ¶ 168; Ex. 1010, 22–23; Ex. 1009, 434); Reply 17. In view of this, Petitioner asserts that a person of ordinary skill in the art would have known that MRSA, like *P. acnes*, would have produced and accumulated coproporphyrin, and that the coproporphyrin in MRSA would have released free oxygen radicals upon exposure to a sufficient dose of 407–420 nm light, for example the 75 J/cm^2 used in Ashkenazi, which would have led to the inactivation of the MRSA. Pet. 50.

[14] Y. Nitzan et al., *Endogenous Porphyrin Production in Bacteria by δ-Aminolevulinic Acid and Subsequent Bacterial Photoeradication*, LASERS MED. SCI., 14 (1999), 269–277 (Ex. 1021). Patent Owner refers to this as "Nitzan 1999."

Petitioner acknowledges one aspect of Nitzan's study in which non-ALA-treated MRSA exposed to 407–420 nm light at a dosage of 50 J/cm^2 showed "no decrease in viability." Pet. 51. Petitioner contends, however, that this result does not undermine its assertions regarding a reasonable expectation of success in applying Ashkenazi's techniques to inactivate MRSA without using ALA because the parameters used in Nitzan's study were significantly different from those used in Ashkenazi's study. Pet. 51–53; *see also* Pet. 54 (citing *Soft Gel Techs., Inc. v. Jarrow Formulas, Inc.*, 864 F.3d 1334, 1342 (Fed. Cir. 2017) and stating that "the standard for obviousness is not absolute predictability but rather just a reasonable expectation of success").

Specifically, Petitioner points to differences in the intensity and number of doses used in Ashkenazi (using multiple doses of 75 J/cm^2 light) and Nitzan (using a single dose of 50 J/cm^2 light), and contends that increased dosage intensity and number of exposures can result in increased photoinactivation. Pet. 51–53; Reply 15–16. Petitioner also notes that Ashkenazi allowed its samples to grow for 24 or 48 hours prior to testing, and showed that a longer growth period enhanced the photoinactivation effect of a 75 J/cm^2 dose of 407–420 nm light on the non-ALA-treated *P. acnes*. Pet. 53–54. According to Petitioner, "Nitzan's result showing no decrease in the viability of non-ALA-induced *S. aureus* after a short 4-hour growth period does not support a conclusion that a POSA would have had no reasonable expectation of success in inactivating non-ALA-induced MRSA after a 24-hour or 48-hour growth period as taught by Ashkenazi." Pet. 54 (citing Ex. 1023 ¶ 176).

Patent Owner argues Petitioner fails to show that a person of ordinary skill in the art would have been motivated to combine Ashkenazi and Nitzan and would have had a reasonable expectation of success in doing so. PO Resp. 31. Patent Owner emphasizes that Nitzan showed "no decrease in viability" when MRSA incubated without ALA was treated with a dose of 50 J/cm^2 of 407–420 nm light, whereas MRSA incubated with ALA was "almost entirely eradicated" by the same dose of blue light. PO Resp. 46 (citing Ex. 1009, Table 5). According to Patent Owner, Nitzan concluded that the photoinactivation exhibited by the ALA-induced MRSA was caused by the presence of large amounts of coproporphyrin, and that "[t]he degree of photoinactivation *depends solely on the endogenous porphyrins*," not the intensity of blue light applied or the number of light doses. PO Resp. 47 (quoting Ex. 1009, p. 433). Patent Owner argues that the authors in Nitzan concluded that ALA must be used to produce sufficient amounts of coproporphyrin in MRSA to enable photoinactivation by blue light, because MRSA does not naturally produce and accumulate sufficient amounts of coproporphyrin to enable photoinactivation by blue light. PO Resp. 35 (citing Ex. 1009, 433–434; Ex. 2024 ¶¶ 115–117 (stating "Nitzan therefore concluded that ALA induction was required to photoinactivate MRSA."), 47 (citing Ex. 2024 ¶¶ 101–103 (regarding MRSA's ability to naturally produce and accumulate sufficient coproporphyrin).

Patent Owner argues that the *P. acnes* bacteria studied in Ashkenazi and Nitzan's non-ALA-treated MRSA are "fundamentally different bacteria." PO Resp. 46. In particular, Patent Owner contends that Ashkenazi discloses *P. acnes* naturally produces and accumulates large amounts of porphyrins over time, whereas Petitioner fails to provide

sufficient evidence demonstrating that MRSA produces and accumulates coproporphyrin in the absence of a photosensitizer in an amount sufficient for inactivation. PO Resp. 43 (citing Ex. 1010, 17; Ex. 2024 ¶¶ 92–94), 45 (citing Ex. 1009, 430 ("Since *most bacterial species do not produce or accumulate porphyrins* . . . .")), 47. According to Patent Owner, Ashkenazi demonstrates that "the *amount* of endogenous coproporphyrin in bacteria is the critical variable that determines how the bacteria responds to blue light." PO Resp. 38–39. In the absence of evidence demonstrating Nitzan's non-ALA-treated MRSA contained an sufficient amount of endogenous porphyrin to enable photoinactivation, Patent Owner argues that nothing in Ashkenazi would have led a person of ordinary skill in the art to believe that using a higher dosage of light, repeated light dosages, or a longer incubation period "would *trigger* inactivation in bacteria that (in the absence of a photosensitizer) are entirely non-responsive to blue light at a lower intensity." PO Resp. 41–42, 50–56.

Patent Owner further argues that a person of ordinary skill in the art would have been aware of Nitzan 1999, which undermines Petitioner's arguments regarding the use of higher dosages to inactivate MRSA. PO Resp. 48–51. Patent Owner notes that in Nitzan 1999, MRSA incubated with ALA showed increased inactivation as the intensity of blue light increased, but MRSA incubated without ALA was entirely non-responsive as the intensity levels increased. PO Resp. 49 (citing Ex. 1021, 270). In view of this, Patent Owner concludes that "if bacteria exposed to 50 J/cm^2 of blue light showed no degree of inactivation at all (as in Nitzan), a [person of ordinary skill in the art] would have concluded from Ashkenazi that the bacteria needed more coproporphyrin to be inactivated—not that it needed a

higher light intensity or more light doses." PO Resp. 44 (citing Ex. 2024, ¶¶ 93–94).

After reviewing the parties' arguments and evidence developed during trial, we determine, for the reasons discussed below, the preponderance of evidence supports a finding that a person of ordinary skill in the art would have had a reasonable expectation of success in inactivating MRSA using 407–420 nm light without applying a photosensitizer based on the combined teachings of Ashkenazi and Nitzan.

"The reasonable expectation of success requirement refers to the likelihood of success in combining references to meet the limitations of the claimed invention." *Intelligent Bio-Systems v. Illumina Cambridge*, 821 F.3d 1359, 1367 (Fed. Cir. 2016). The '706 patent claims require inactivation of one or more pathogenic Gram-positive bacteria, including MRSA, by exposing the bacteria to visible light without using a photosensitizer. Ex. 1001, 7:17–24. The parties agree that in the context of the '706 patent, inactivation means "bacteria are killed, or damaged so as to reduce or inhibit bacterial replication." Ex. 1001, 2:44–46; Pet. 9; Sur-reply 1–2. Thus, here the relevant inquiry is whether a person of ordinary skill in the art would have had a reasonable expectation of success in combining the teachings of Ashkenazi and Nitzan such that one or more pathogenic Gram-positive bacteria, including MRSA are killed, or damaged so as to reduce or inhibit bacterial replication, by exposing the bacteria to visible light without using a photosensitizer. Notably, the claims do not require any specific amount of inactivation, nor do they require measuring inactivation in a certain way.

It is undisputed that Ashkenazi discloses the photoinactivation of non-ALA-treated *P. acnes*, a Gram-positive bacteria, and that the photoinactivation occurs due to the reaction of blue light with endogenous coproporphyrin in the bacteria. Pet. 50; PO Resp. 37–39; Ex. 1010, 19–20. Ashkenazi teaches that the *P. acnes* inactivation is the result of bacterial membrane damage by free radicals released from light-activated porphyrins. Ex. 1010, 22–23. Additionally, Ashkenazi teaches that "[i]n the case of *P. acnes* or *other bacterial cells that produce porphyrins*, the blue light may photoinactivate the intact bacterial cells as a consequence of the photosensitizer molecules produced and stored within the bacterial cells." Ex. 1010, 21 (second emphasis added).

It is undisputed that MRSA is also a Gram-positive bacteria that naturally produces porphyrins. Tr. 77:14–16 (counsel for Patent Owner stating "[w]e don't dispute . . . that there are some porphyrins in MRSA naturally"), 78:4–9 (counsel for Patent Owner stating "[w]e're not saying that there's no porphyrins at all [in non-ALA-treated MRSA]" and "[c]ertainly there are some tests showing some porphyrins are present"); Pet. 50; Reply 13–15; Ex. 1021, 270–271, Fig. 1(a). And similar to Ashkenazi's discussion of the mechanism of photoinactivation of *P. acnes*, Nitzan teaches that *S. aureus* is inactivated by singlet oxygen radicals released by coproporphyrin photosensitized with blue light. Ex. 1009, 434. This evidence supports a finding that a person of ordinary skill in the art would consider MRSA to be one of the "other bacterial cells" discussed in Ashkenazi that "blue light may photoinactivate . . . as a consequence of the photosensitizer molecules produced and stored within the bacterial cells." Ex. 1010, 21.

The similarities between MRSA and *P. acnes* undermine Patent Owner's argument that a person of ordinary skill in the art would have understood that non-ALA-treated MRSA is "a fundamentally different bacteria from *P. acnes*." PO Resp. 46. Patent Owner's argument appears to be based on Ashkenazi's teachings that *P. acnes* are "known to naturally produce high amounts of intracellular porphyrins," but that other bacteria, such as MRSA "naturally do not produce porphyrins in high amounts." PO Resp. 43–44; Ex. 1010, 21. We disagree that the difference in amount of naturally produced porphyrins constitutes a fundamental difference between MRSA and *P. acnes*. Although *P. acnes* may naturally produce *more* porphyrins than MRSA, this does not change the fact that MRSA, like *P. acnes*, naturally produces at least *some* porphyrins. And those porphyrins, when illuminated with blue light, release radicals that can damage or kill the bacteria. The fact that the claims do not require a particular amount of inactivation diminishes the importance of the amount of porphyrins naturally present in the bacteria. In view of this, Petitioner's evidence that MRSA naturally contains at least some porphyrins that react to blue light to damage or kill bacterial cells, in combination with the teachings in Ashkenazi regarding the successful photoinactivation of *P. acnes* based on the same mechanism under various conditions, provides a reasonable expectation of successfully achieving the claimed invention.

Nitzan's disclosure that non-ALA-treated MRSA showed "no decrease in viability" when exposed to blue light does not preclude a finding of reasonable expectation of success in achieving the claimed invention. Ex. 1009, 433. In conducting its test on non-ALA-treated MRSA, Nitzan exposed the bacteria to a single dose of 50 J/cm^2 of blue light. Ex. 1009,

433. Nitzan's experiments did not include exposing the non-ALA-treated MRSA to more than a single dose of 50 J/cm^2 light or to light at an intensity over 50 J/cm^2. Nor did Nitzan assess the effect of incubation time on photoinactivity. Petitioner, however, has provided evidence demonstrating that increasing the intensity of light, number of exposures, and incubation time can affect inactivation.

For example, with regard to light intensity, Ashkenazi reports a two-order decrease in the viability of cultures grown with ALA when illuminated with a light dose of 75 J/cm^2, and a three-order decrease when the same cultures were illuminated by a light dose of 100 J/cm^2. Ex. 1010, 20. With regard to the number of doses, Ashkenazi reported that two consecutive illuminations of cultures grown without ALA, at an interval of 24 h between the treatments, caused a decrease in the viable count of the cultures by four orders of magnitude, whereas three consecutive illuminations (at 24, 48 and 72 h) resulted in a decrease in viability of five orders of magnitude. Ex. 1010, 19–20. By comparison, Ashkenazi reported a decrease between one to two orders for cultures grown for 24 hours and exposed to a single dose of 75 J/cm^2 light. Ex. 1010, 19. As to incubation time, Ashkenazi reported that cultures grown with ALA for 48 hours showed reduced viability by seven orders of magnitude with a light dose of 75 J/cm^2, whereas cultures grown with ALA for 72 hours showed a decrease in viability by seven orders of magnitude with a light dose of 50 J/cm^2. Ex. 1010, 20.

We note Patent Owner's argument that "even with the benefit of Ashkenazi's prior research, Nitzan concluded the amount of endogenous coproporphyrins in MRSA dictated the degree of photoinactivation—not the

intensity of blue light applied or the number of light doses." PO Resp. 47. Patent Owner asserts that the results in Ashkenazi stem from the ability of *P. acnes* to naturally produce and accumulate large amounts of porphyrins over time, whereas Petitioner has not provided evidence showing MRSA naturally produces and accumulates endogenous coproporphyrin in high amounts. Pet. 37–44. Patent Owner further argues that if MRSA did naturally produce and accumulate sufficient coproporphyrin to enable photoinactivation by blue light, then a person of ordinary skill in the art would have expected some measurable response to Nitzan's 50 J/cm^2 light dose. PO Resp. 47–48. But since Nitzan reported "no decrease in viability" at 50 J/cm^2, Patent Owner argues a person of ordinary skill in the art would have concluded that non-ALA-treated MRSA lacks sufficient amounts of naturally produced coproporphyrin, and could not be inactivated without using a photosensitizer regardless of the dosage intensity, number of doses, or incubation time. PO Resp. 44–46. Given the insufficient amount of endogenous coproporphyrin in Nitzan's MRSA, Patent Owner asserts there is nothing in Ashkenazi that would have led a person of ordinary skill in the art to believe that increasing light intensity or number of doses would have "trigger[ed] inactivation in bacteria that (in the absence of a photosensitizer) are entirely non-responsive to blue light at a lower intensity." PO Resp. 37, 41, 48.

We disagree. The presence of some naturally occurring porphyrins in MRSA, combined with Ashkenazi's disclosure regarding the effects of intensity of light, number of doses, and incubation time provides a reasonable expectation that increasing light intensity or the number of doses could have "triggered" some amount of inactivation, as that term is defined

in the '706 patent. Moreover, Patent Owner's arguments that MRSA lacks "sufficient amounts" of naturally produced coproporphyrin for inactivation with blue light relies on the statement in Nitzan that "[t]he degree of photoinactivation *depends solely on the endogenous porphyrins*." PO Resp. 47. In isolation, the sentence seems to support Patent Owner's arguments, but when read in the full context of Nitzan's study, the sentence has a different meaning. Ex. 1009, 433. Nitzan not only conducted studies regarding naturally produced porphyrins, but also studied the effect of extracellular porphyrins on photoinactivation. Ex. 1009, 433. In reporting the results, Nitzan states "[t]he conclusion that can be drawn from these experiments is that the extracellular porphyrins do not contribute to the photoinactivation. The degree of photoinactivation depends solely on the endogenous porphyrins." Ex. 1009, 433. Thus, the statement Patent Owner relies on does not support the notion that photoinactivation depends only on endogenous porphyrins – to the exclusion of any other factors. Instead, it refers to the fact that Nitzan concluded that extracellular porphyrins do not contribute to photoinactivation. This is consistent with Ashkenazi's conclusion "that the amount of endogenous porphyrin *plays a role* in maintaining a successful phototreatment of *P. acnes*." Ex. 1010, 22.

The totality of the evidence presented thus demonstrates that while the amount of endogenous porphyrins plays a role, it is not the only factor to consider. In view of the knowledge that non-ALA-treated MRSA contains some porphyrins that are activated by exposure to blue light, and Ashkenazi's disclosure regarding increased inactivation based on dosage intensity, number of doses, and incubation time, a person of ordinary skill in the art would have understood that that changing the number of doses, light

intensity, and/or incubation time in Nitzan's experiments could have had an impact on the inactivation of the non-ALA-treated MRSA.

Thus, at best, Nitzan's disclosure of "no decrease in viability" would have led a person of ordinary skill in the art to the limited conclusion that non-ALA-treated MRSA incubated for 4 hours and treated with a single dose of 50 J/cm^2 light showed no decrease in activity. We reach a similar conclusion for the data reported in Nitzan 1999, which only shows data up to a light intensity of 50 J/cm^2, the same intensity used in Nitzan. Ex. 1021, 273–274. In discussing these results in Nitzan 1999, Dr. Goodrich, states that "the response of MRSA without ALA to blue light at 75 J/cm^2 would have been the same as 50 J/cm^2—no bacteria would have been killed." PO Resp. 49–50; Ex. 2024 ¶ 104–107. Dr. Goodrich, however, fails to provide the underlying facts forming the basis for that opinion. As a result, it is entitled to little or no weight. 37 C.F.R. § 42.65(a).

In view of Ashkenazi's teachings regarding the impact of light intensity, number of doses, and incubation time, we agree with Petitioner that the single data point from Nitzan does not demonstrate categorically that non-ALA MRSA could not be inactivated by varying experimental factors including light intensity or number of doses. Tr. 33:1–6; *see also* Tr. 67:20–68:2 (noting that Nitzan did not control for variables such as light dosage, number of exposures, or incubation time); Reply 10–11, 15–17. The same is true with regard to Nitzan 1999's testing, which does not provide data beyond a light intensity of 50 J/cm^2. Ex. 1021, 273–274. The limited data from Nitzan and Nitzan 1999 does not outweigh the evidence Petitioner has provided supporting a finding of reasonable expectation of success of achieving the claimed invention, including the presence of coproporphyrins

in non-ALA-treated MRSA and the mechanism of inactivation with blue light, in addition to the effect of increasing light dosage, number of doses, and incubation time on inactivation. This is especially true considering Petitioner need not show absolute predictability, only a reasonable expectation of success, and the claimed invention does not require any particular amount of inactivation or recite a particular dosage intensity or number of doses. *See Noelle v. Lederman*, 355 F.3d 1343, 1352 (Fed. Cir. 2004) (holding that a reasonable expectation of success "does not necessarily mean an absolute predictability").

Accordingly, we agree with Petitioner that under the proper interpretation of "inactivation," the preponderance of evidence supports a person of ordinary skill in the art's "reasonable expectation that the porphyrins MRSA produces and accumulates (e.g., coproporphyrin) would have been sufficient to reduce or inhibit its replication upon exposure to a sufficient dose of blue light without using a photosensitizer." Reply 9.

4. Objective Indicia of Nonobviousness

Patent Owner argues that objective indicia of non-obviousness weigh in favor of finding the challenged claims patentable. PO Resp. 62. In particular, Patent Owner argues numerous researchers attempted and failed to inactivate MRSA without using a photosensitizer, the ability to inactivate MRSA (as well as the other Gram-positive bacteria recited in the claims) with blue light and without using a photosensitizer was not predictable and was an unexpected result, and there has been a long-felt but unmet need for "efficient, convenient, and effect[ive] methods of inactivating the Gram-positive bacteria recited in the challenged claims." PO Resp. 62.

Petitioner argues that Patent Owner's objective indicia fail to refute the prima facie showing of obviousness because Patent Owner fails to provide evidence showing unexpected results, failure of others, or a long-felt but unresolved need that is commensurate with the scope of the claims. Pet. 20. In particular, Petitioner argues that the scope of the claims extends to "inactivating . . . Gram-positive bacteria in the air," but Patent Owner "provides no evidence of unexpected results from exposing airborne MRSA to blue light or failed attempts to inactivate airborne MRSA," and that Patent Owner's "assertions about the purportedly long-felt need contain only minimal reference to airborne bacteria." Reply 20 (citing Ex. 1001, 4:24-47, 6:9-14).

Patent Owner did not respond to Petitioner's argument in its Sur-reply.

To be relevant, evidence of objective indicia of nonobviousness must be commensurate in scope with the claimed invention. *In re Kao*, 639 F.3d 1057, 1068 (Fed. Cir. 2011). This does not mean Patent Owner is "required to test every embodiment within the scope of his or her claims." *Id.* Rather, if Patent Owner demonstrates objective indicia related to one embodiment, "and provides an adequate basis to support the conclusion that other embodiments falling within the claim will behave in the same manner, this will generally establish that the evidence is commensurate with [the] scope of the claims." *Id.*

Patent Owner's evidence of failure of others is directed to attempts to inactivate MRSA on contact surfaces or materials without using a photosensitizer, as reported in Nitzan and Nitzan 1999. PO Resp. 62 (citing Ex. 1009; Ex. 1021). The claims, however, recite "[a] method for

disinfecting air, contact surfaces or materials by inactivating one or more pathogenic Gram-positive bacteria in the air, on the contact surfaces or on the materials," wherein the Gram-positive bacteria "are selected from the group consisting of Methicillin-resistant *Staphylococcus aureus* (MRSA), Coagulase-Negative *Staphylococcus* (CONS), *Streptococcus*, *Enterococcus*, and *Clostridium* species." Ex. 1001, 7:17–26. Thus, the claims encompass bacteria other than MRSA, and are not limited to inactivation of these bacteria on surfaces or materials. Patent Owner, however, fails to direct us to any portion of Nitzan and Nitzan 1999 that discloses inactivation of MRSA in air. Nor does Patent Owner direct us to evidence regarding the failure of others to inactivate Coagulase-Negative *Staphylococcus* (CONS), *Streptococcus*, *Enterococcus*, and *Clostridium* species without a photosensitizer in air, on a contact surface, or on materials. Further, Patent Owner does not provide an adequate basis to support a conclusion that Coagulase-Negative *Staphylococcus* (CONS), *Streptococcus*, *Enterococcus*, and *Clostridium* species would behave in the same manner as MRSA, such that Patent Owner's evidence regarding MRSA is commensurate in scope with the claims. *Kao*, 639 F.3d at 1068.

Similarly, in support of its argument that "the ability to inactivate MRSA (among other recited Gram-positive [bacteria]) with blue light and without using a photosensitizer was not predictable by a person of ordinary skill and was an unexpected result of the inventors' research," Patent Owner relies on "the reasons discussed with respect to Ground C." PO Resp. 62. Patent Owner's arguments regarding Ground C appear on pages 30–58 of its Patent Owner Response, and primarily address the question of whether a person of ordinary skill in the art would have had a reasonable expectation

of success inactivating MRSA without a photosensitizer in view of the combined disclosures of Ashkenazi and Nitzan. Patent Owner does not direct us to where in this discussion of Ground C it provides evidence regarding the inactivation of Coagulase-Negative *Staphylococcus* (CONS), *Streptococcus*, *Enterococcus*, and *Clostridium* species, or an adequate basis to support a conclusion that Coagulase-Negative *Staphylococcus* (CONS), *Streptococcus*, *Enterococcus*, and *Clostridium* species would behave in the same manner as MRSA, such that Patent Owner's evidence regarding MRSA is commensurate in scope with the claims. Nor does Patent Owner direct us to any portion of its discussion of Ground C addressing inactivation of MRSA in the air.

With regard to its argument of a long-felt but unmet need, Patent Owner cites the need for "efficient, convenient, and effect[ive] methods" of inactivating the bacteria outside the human body, i.e., in air, on non-living contact surfaces, and on non-living materials, and contends that "[t]he invention of the '706 patent solved this problem." PO Resp. 62; *see also* PO Resp. 3 (discussing the aim of the '706 patent).

To the extent there was a need for a "simple and effective" technique for inactivating the claimed bacteria, Patent Owner does not direct us to evidence demonstrating it was "long-felt." The '706 patent describes MRSA as "increasingly problematic," and states that "[p]ublic and media interest in the transmission and control of MRSA is escalating," and that "community-acquired MRSA is also now being recognised as an increasing problem." Ex. 1001, 1:23–35. This language suggests that the '706 patent was intended to address more recent problems arising closer to the filing date of the patent, as opposed to a long-felt need.

For all of the foregoing reasons, we find Patent Owner's evidence of objective indicia does little or nothing to demonstrate the nonobviousness of the claimed subject matter.

5. Conclusion

We have considered the entirety of the evidence, including the evidence of objective indicia of nonobviousness. As discussed above, based on the present record, Petitioner has established sufficiently that Ashkenazi and Nitzan teach or suggest all the limitations of claims 1 and 3, that a person of ordinary skill in the art would have been motivated to combine the references to arrive at the claimed invention, and that a person of ordinary skill in the art would have had a reasonable expectation of successfully doing so. Patent Owner's weak evidence of objective indicia of nonobviousness does not outweigh the strong case for obviousness of claims 1 and 3 as outlined above.

We thus conclude that Petitioner has demonstrated by a preponderance of the evidence that claims 1 and 3 are unpatentable as obvious under 35 U.S.C. § 103(a) over Ashkenazi and Nitzan.

G. Claims 2 and 4 – Alleged Obviousness in view of Ashkenazi, Nitzan, and Jones

Claims 2 and 4 depend from claims 1 and 3 respectively, and further require that the "visible light that inactivates has a wavelength of 405 nm." Ex. 1001, 8:6–7 (claim 2), 8:24–25 (claim 4). Petitioner acknowledges that Ashkenazi does not specifically disclose light having a wavelength of 405 nm, but asserts that Jones teaches that bacterial porphyrins in *P. acnes* optimally produce singlet oxygen when exposed to 405 nm light. Pet. 65. Petitioner contends that a person of ordinary skill in the art "would have

been motivated to use 405 nm for the purpose of achieving optimum activation of the coproporphyrin in the MRSA to be inactivated using Nitzan's techniques," and would have every reason to expect success in employing 405 nm light to inactivate MRSA. Pet. 42, 65–66.

Patent Owner does not substantively address Petitioner's arguments that Jones discloses the additional limitations in claims 2 and 4, or that a person of ordinary skill in the art would have had a reason to combine the teachings of Jones with those of Ashkenazi and Nitzan. PO Resp. 63. Instead, Patent Owner relies on its previously presented arguments that "the combination of Ashkenazi and Nitzan fails to disclose or render obvious the claim elements for which they are relied upon." PO Resp. 63.

Based on our review of the present record, Petitioner has established by a preponderance of evidence that Ashkenazi, Nitzan, and Jones teach or suggest all the limitations of claims 2 and 4, that a person of ordinary skill in the art would have been motivated to combine the teachings of the references to arrive at the claimed invention, and that a person of ordinary skill in the art would have had a reasonable expectation of successfully doing so.

As Petitioner points out, Jones teaches that bacterial porphyrins naturally occurring in *P. acnes* "produce[] singlet oxygen . . . when excited by light of a wavelength of around 405 nm." Ex. 1007 ¶ 24; Pet. 41, 65–66. Jones also teaches that these oxygen singlets may destroy the bacteria. Ex. 1007 ¶ 24. These teachings in Jones, combined with the fact that Nitzan recognized that the same porphyrin–coproporphyrin–is present in both *P. acnes* and *Staphylococcal* strains (Ex. 1009, 434) supports Petitioner's assertion that a person of ordinary skill in the art "would have been

motivated to use 405 nm for the purpose of achieving optimum activation of the coproporphyrin in the MRSA to be inactivated using Nitzan's techniques." Pet. 42 (citing Ex. 1023 ¶ 158), 65–66. It also supports Petitioner's argument that a person of ordinary skill in the art would have a reasonable expectation of success in employing 405 nm light to inactivate MRSA. Pet. 42, 65–66.

For these reasons, in addition to those presented above addressing the combination of Ashkenazi and Nitzan with regard to claims 1 and 3, we find Petitioner has demonstrated by a preponderance of evidence that claims 2 and 4 are unpatentable as obvious in view of Ashkenazi, Nitzan, and Jones.

III. MOTION TO EXCLUDE

Patent Owner filed a Motion to Exclude Evidence, seeking to exclude several paragraphs of Dr. Sulzinski's Reply Declaration. Paper 33 ("Motion"). Petitioner filed an Opposition to the Motion (Paper 34), and Patent Owner subsequently filed a Reply to Petitioner's Opposition (Paper 36).

In its Motion, Patent Owner contends that Dr. Sulzinski's Reply Declaration is more than double the allowable length of Petitioner's Reply and is a "blatant attempt to circumvent the Board's word limit for Petitioner's Reply." Mot. 1. Petitioner also contends that our rules expressly prohibit incorporating arguments by reference, and that "[c]onsideration of arguments included in Dr. Sulzinski's Reply Declaration—but not developed and presented in Petitioner's Reply—would lead to fundamental unfairness in this proceeding and would be prejudicial to Patent Owner." Mot. 2.

The only paragraphs in Dr. Sulzinski's Reply Declaration that we rely upon for purposes of this Final Written Decision are paragraphs 74–77. These paragraphs relate to Patent Owner's argument that riboflavin is a photosensitizer and is present in Ashkenazi's growth and incubation media. Mot. 8. Patent Owner contends that these paragraphs cannot be considered by the Board without allowing Petitioner to circumvent the Reply word count limit. Mot. 8–9.

We disagree. As Patent Owner acknowledges, Petitioner discusses these paragraphs on page 19 of the Reply. Mot. 8. In particular, Petitioner cites these paragraphs to support fully developed arguments in the Reply regarding the growth of MRSA in aerobic conditions. Reply 19. Dr. Sulzinski not only presents his opinions in these paragraphs, but also presents the factual basis supporting his opinions, as required by our rules. *See* 37 C.F.R. § 42.65(a). In view of this, we are not persuaded that these paragraphs of Ex. 1033 are unfairly prejudicial and therefore inadmissible, thus, we deny Patent Owner's motion with regard to paragraphs 74–77.

Because we do not rely on any of the remaining paragraphs addressed in Patent Owner's Motion for purposes of our Final Written Decision, we deny the remainder of Patent Owner's Motion as moot.

IV. CONCLUSION

For the foregoing reasons, Petitioner has demonstrated by a preponderance of evidence that claims 1–4 of the '706 patent are unpatentable as obvious over the prior art of record.

In summary:

Claims	35 U.S.C §	Reference(s)	Claims Shown Unpatentable	Claims Not shown Unpatentable
1, 3	102	Nitzan		1, 3
2, 4	103	Nitzan, Jones		2, 4
1, 3	103	Ashkenazi, Nitzan	1, 3	
2, 4	103	Ashkenazi, Nitzan, Jones	2, 4	
Overall Outcome			1–4	

V. ORDER

It is hereby,

ORDERED that claims 1–4 of the '706 patent are held unpatentable;

FURTHER ORDERED that Patent Owner's Motion to Exclude is *denied*; and

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

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