

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

METALL ZUG AG, HAAG-STREIT AG,
AND HAAG-STREIT USA, INC.,
Petitioner,

v.

CARL ZEISS MEDITEC AG,
Patent Owner.

IPR2020-00300
Patent 8,690,330

Before GRACE KARAFFA OBERMANN, BRYAN F. MOORE, and
AMBER L. HAGY, *Administrative Patent Judges*.

HAGY, *Administrative Patent Judge*.

JUDGMENT

Final Written Decision

Determining Some Challenged Claims Unpatentable
Granting Patent Owner's Revised Contingent Motion to Amend
35 U.S.C. § 318(a)

I. INTRODUCTION

A. *Background and Summary*

Petitioners Metall Zug AG, Haag-Streit AG, and Haag-Streit USA Inc. (collectively, “Petitioner”) filed a petition, on December 16, 2019, for *inter partes* review (Paper 1 (“Pet.”)) challenging claims 1, 2, 21–27, 40, and 42 of U.S. Patent No. 8,690,330 (Ex. 1001, the “’330 patent”).

See 35 U.S.C. § 311. Carl Zeiss Meditec AG (“Patent Owner”) timely filed a Preliminary Response. Paper 10 (“Prelim. Resp.”). With authorization from the Board, Petitioner filed a Reply to Patent Owner’s Preliminary Response (Paper 13), and Patent Owner filed a Sur-reply to Petitioner’s Reply (Paper 14).

Pursuant to 35 U.S.C. § 314, we instituted an *inter partes* review of all challenged claims on all grounds presented in the Petition. Paper 15 (“Inst. Dec.”). After institution, Patent Owner filed a Patent Owner Response (Paper 17, “PO Resp.”) as well as a Contingent Motion to Amend (Paper 18, “MTA”). Petitioner filed a Reply to Patent Owner’s Response (Paper 19, “Pet. Reply”), and an opposition to Patent Owner’s Motion to Amend (Paper 20, “MTA Opp.”). On January 6, 2021, pursuant to Patent Owner’s request (*see* MTA 2), we issued Preliminary Guidance on Patent Owner’s Motion to Amend. Paper 21 (“PG”). Patent Owner then filed a Revised Contingent Motion to Amend (Paper 22, “RMTA”), along with a Sur-reply (Paper 23, “PO Sur-reply”). Petitioner opposed Patent Owner’s Revised MTA. Paper 25 (“RMTA Opp.”). Patent Owner filed a reply in support of its Revised MTA. Paper 28 (“RMTA Reply”). Petitioner then filed a Sur-reply related to the Revised Contingent Motion to Amend. Paper 30 (“RMTA Sur-reply”).

Petitioner relies on a first Declaration of Dr. James F. Brennan (Ex. 1012) to support its Petition. Patent Owner relies on a Declaration of Dr. Rainer A. Leitgeb (Ex. 2013) to support its Response. Petitioner relies on a second Declaration of Dr. James F. Brennan (Ex. 1027) in support of its Reply.

Patent Owner relies on a Supplemental Declaration of Dr. Rainer A. Leitgeb (Ex. 2019) to support its Revised Contingent Motion to Amend. Petitioner relies on a Supplemental Declaration of Dr. James F. Brennan (Ex. 1043) to support its Opposition to the Revised Contingent Motion to Amend.

On April 28, 2021, we conducted an oral hearing. A copy of the transcript (Paper 33, “Tr.”) is included in the record.

We have jurisdiction under 35 U.S.C. § 6(b), and we issue this Final Written Decision pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. As explained below, we conclude that Petitioner has shown by a preponderance of the evidence that claims 1 and 21–26 of the ’330 patent are unpatentable, but has not shown that claims 2, 27, 40, and 42 of the ’330 patent are unpatentable. We also determine that Petitioner has not met the burden to show, by a preponderance of the evidence on this trial record, that proposed substitute claims 44 and 45, as set forth in Patent Owner’s Revised Contingent Motion to Amend, are unpatentable. Accordingly, for the reasons given below, we conclude that claims 1 and 21–26 are unpatentable and should be canceled. Because we determine that original claims 1 and 21 are unpatentable, and Petitioner has not shown that proposed substitute claims 44–45 are unpatentable, we grant Patent Owner’s Revised Contingent Motion to Amend, and enter proposed substitute claims 44 and 45.

B. Real Parties in Interest

Petitioner identifies the real parties-in-interest as Metall Zug AG, Haag-Streit AG, and Haag-Streit USA Inc. Pet. 4.

Patent Owner identifies the real party-in-interest as Carl Zeiss Meditec AG. Paper 5, 2.

C. Related Matters

Petitioner does not identify any pending district court or *inter partes* review proceedings as related to the present matter. See Pet. 4–5. Patent Owner represents that “[t]here are no judicial or administrative matters that may affect or be affected by a decision in this proceeding.” Paper 5, 2.

Petitioner notes that the ’330 patent was previously subject to an *ex parte* reexamination, which resulted in issuance of an *Ex parte* Reexamination Certificate. Pet. 5; Ex. 1001, 16 (“Re-exam. Cert.”). Claim 1 (amended), and claims 40 and 42 (added) from the reexamination proceeding, are before us, along with claims 2 and 21–27, which were determined to be patentable. Pet. 22–23; Ex. 1001, 17. None of the prior art references addressed in the reexamination proceeding are before us, and Petitioner represents that “none of the references cited in this Petition are cumulative of those references.” Pet. 17 (emphasis omitted); *see also id.* at 7 (stating that “[n]either Huber nor Everett were brought to the attention of the USPTO” during original prosecution or reexamination). Patent Owner does not contest that representation.

Patent Owner identifies as a related matter “[a]n opposition filed by an anonymous party concerning two Japanese patents (Appln. No. JP2017000184(A) and Publ. No. JP6523349(B2), at least the latter of which

is related to the '330 patent),” which Patent Owner states is “pending in the Japanese Patent Office, docket no. jp-P2019-700965_J7.” Paper 5, 2.

D. The '330 Patent (Ex. 1001)

The '330 patent, titled “Device for Swept-Source Optical Coherence Domain Reflectometry,” issued April 8, 2014, and claims priority to PCT Application No. PCT/EP2009/009189, published July 1, 2010, which in turn is based on German Patent Application No. 10 2008 063 225, filed December 23, 2008. Ex. 1001, codes (30), (45), (54), (86), (87).¹

The '330 patent relates to “quickly and accurately” measuring dimensions of a sample, including “intraocular distances in the eye,” particularly given “the occurrence of typical eye movements.” Ex. 1001, 2:51–53. By way of background, the '330 patent explains that measuring certain intraocular distances, including the “distances between the cornea, crystalline lens and retina,” is necessary for corrective eye surgery that requires “optimal matching of an artificial intraocular lens.” *Id.* at 1:21–24. The '330 patent describes various prior-art measurement devices and techniques for such measurements, including use of a “short coherence light source” that provides measurements through “detection of interference of light scattered back by the cornea, lens and retina.” *Id.* at 1:25–41. This technique is generally referred to as “optical coherence domain reflectometry,” or OCDR. *Id.* at 2:57–58. OCDR refers to a one-dimensional measurement along the light axis, called an “A-scan”; multiple

¹ Petitioner states that it “reserves the right to challenge priority” dating to the German application, but, for purposes of the Petition, refers to the “earliest possible priority date of the '330 patent as December 23, 2008.” Pet. 4, n.3.

A-scans may be taken to create a two- or three-dimensional image, in a technique referred to as “optical coherence tomography,” or OCT. Ex. 1001, 2:7–14; Ex. 1012 ¶ 44.

As the '330 patent background notes, OCDR is generally considered to include multiple subcategories, one of which is “swept source” OCDR, or SS OCDR. Ex. 1001, 1:60–2:6; Ex. 1012 ¶ 46. In SS OCDR, the light source is tuned spectrally and the signal received by a detector includes sample depth information after a Fourier transformation. *See* Ex. 1001, 1:66–2:2; Ex. 1012 ¶ 45. The '330 patent acknowledges prior use of SS OCDR to determine intraocular distances as described, for example, in *Lexer*.² Ex. 1001, 2:15–26; *see* Ex. 1006. The '330 patent explains that such techniques did not, however, achieve what the '330 patent describes as the necessary accuracy to limit residual errors. *See id.* at 2:25–29. A stated fundamental object of the '330 patent, therefore, is to improve the SS OCDR procedure so that “[a] measuring accuracy for the eye length . . . [is] smaller than 30 μm .” *Id.* at 2:27–29.

The '330 patent describes and claims the properties of the light source necessary to achieve its objective. In particular, the '330 patent describes a device with a measuring range that corresponds to the sample depth, a laser light source tunable about a centroid wave number k_0 , and at least one receiver for the light backscattered from the sample. *Id.* at 2:60–63. The sample is illuminated via a coupling device on the surface with the aid of a measurement beam of diameter D . *Id.* at 2:63–65. The light source has a narrow spectral linewidth ($\delta k < 168 \text{ m}^{-1}$). *Id.* at 1:42–50, 2:65–67. The light

² *See infra* n.5.

source is tuned quickly over a range of wavelengths ($\tau < 44 \text{ sec} / (D \cdot k_0)$). *Id.* at Abstr. The measurement is designed to be performed so rapidly that it is not significantly affected by, for example, typical eye movements. *Id.* at 3:8–18.

E. Illustrative Claim

Of the challenged claims, claim 1 is the sole independent claim. Challenged claims 2, 21, 25, and 26 depend from claim 1, claims 22–24 depend from claim 21, and claim 27 depends from claim 26. Challenged claims 40 and 42 depend from claim 2. Claim 1 illustrates the claimed subject matter:

1. A device for swept source optical coherence domain reflectometry (SS OCDR) on a movable sample, for the purpose of obtaining A-scans, comprising:

a tunable laser light source;

at least one receiver for light backscattered from the sample, wherein the sample is illuminated on the sample surface with a measurement beam of diameter D ;

wherein the light source has a line width of $\delta k < 168 \text{ m}^{-1}$, wherein $k = 2\pi/\lambda$,

wherein the A scan measuring range corresponds to a depth of the sample, and

further wherein the device is configured such that tuning of the light source is performed in a time $\tau < 44 \text{ sec} / (D \cdot k_0)$ about a centroid wave number k_0 .

Ex. 1001, Re-exam. Cert. at 1:23–2:5 (emphasis omitted).

F. Instituted Grounds of Unpatentability

We instituted *inter partes* review of all challenged claims based on the sole ground of unpatentability asserted in the Petition (Inst. Dec. 40; Pet. 23):

Claims Challenged	35 U.S.C. §	References/Basis
1, 2, 21–27, 40, 42	103(a) ³	Huber, ⁴ Everett, ⁵ Lexer ⁶

II. ANALYSIS

A. Principles of Law

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

³ The Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) (“AIA”), amended several provisions of 35 U.S.C., including § 103. Because the ’330 patent claims priority to an application that has an effective filing date prior to the effective date of the applicable AIA amendments, we refer herein to the pre-AIA version of § 103.

⁴ Huber et al., U.S. Patent No. 7,414,779 B2, issued August 19, 2008 (Ex. 1008, “Huber”).

⁵ Everett et al., U.S. Patent No. 7,365,856 B2, issued April 29, 2008 (Ex. 1009, “Everett”).

⁶ F. Lexer, C.K. Hitzenberger, A.F. Fercher, M. Kulhavy, “Wavelength-tuning interferometry of intraocular distances,” *Appl. Optics*, vol. 36, pp. 6548–6553 (Sept. 1, 1997) (Ex. 1006, “Lexer”).

(2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) when in evidence, objective evidence of nonobviousness.⁷ *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

“In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.” *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (requiring *inter partes* review petitions to identify “with particularity . . . the evidence that supports the grounds for the challenge to each claim”)). This burden of persuasion never shifts to Patent Owner. *See Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (discussing the burden of proof in *inter partes* review).

B. Level of Ordinary Skill in the Art

The level of skill in the art is a factual determination that provides a primary guarantee of objectivity in an obviousness analysis. *Al-Site Corp. v. VSI Int’l Inc.*, 174 F.3d 1308, 1324 (Fed. Cir. 1999) (citing *Graham*, 383 U.S. at 17–18; *Ryko Mfg. Co. v. Nu-Star, Inc.*, 950 F.2d 714, 718 (Fed. Cir. 1991)).

Relying on the declaration testimony of Dr. Brennan, Petitioner asserts “a person having ordinary skill in the art (POSITA) at the time of the alleged invention for the ’330 patent (in 2008 up to and including the December 23, 2008 filing date of the [German priority application])” would

⁷ The parties do not direct our attention to any evidence of objective indicia of nonobviousness.

have held “a Masters or Ph.D. degree in Physics or Electrical Engineering, or the equivalent years of experience or research, in optics, interferometry, optical fibers and devices, biomedical optics, signal processing, and optical signal processing, especially pertaining to the various forms of optical coherence tomography or optical coherence domain reflectometry.” Pet. 24–25 (citing Ex. 1012 ¶¶ 35–38). Patent Owner does not propose an alternative assessment. *See generally* PO Resp.

To the extent necessary, and as we did in the Institution Decision, we apply the assessment offered by Petitioner as it is consistent with the ’330 patent and the asserted prior art.

C. Claim Construction

In interpreting the claims of the ’330 patent, we “us[e] the same claim construction standard that would be used to construe the claim[s] in a civil action under 35 U.S.C. [§] 282(b).” *See* 37 C.F.R. § 42.100(b) (2019). The claim construction standard includes construing claims in accordance with the ordinary and customary meaning of such claims as would have been understood by one of ordinary skill in the art in light of the written description and the prosecution history pertaining to the patent. *See id.*; *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–14 (Fed. Cir. 2005) (en banc).

1. Petitioner’s Proposed Constructions

Petitioner proposes constructions of several terms: “A-scan,” “wave number k ,” “line width δk ,” and “spectral tuning range Δk .” Pet. 25–36. Petitioner provides supporting analysis for the construction of each term by reference to the Specification and the prosecution history for the ’330 patent. *Id.* Patent Owner does not challenge Petitioner’s proposed constructions of these terms. We determine, as we did in the Institution Decision, that no

explicit construction of these terms is needed to resolve the issues presented by the arguments and evidence of record. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (per curiam) (claim terms need to be construed “only to the extent necessary to resolve the controversy” (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

2. Patent Owner’s Proposed Construction

In pre-institution briefing, the parties disputed the construction of the term “movable sample,” which is recited in the preamble of claim 1. Patent Owner proposed that this term “should be construed to require a sample that is subject to involuntary movement including, but not limited to, a human eye.” Prelim. Resp. 8. Petitioner did not directly take issue with treating the preamble’s recitation of “movable sample” as limiting, but presented arguments and evidence mapping the preamble to the prior art “[t]o the extent the preamble is considered limiting.” Pet. 46. Petitioner also asserted that Patent Owner’s proposed construction was unduly narrow, and noted that the ’330 patent’s disclosure of a human eye was merely an example of a sample. Paper 13, 2.

In our Institution Decision, we first addressed whether this term is entitled to patentable weight. Inst. Dec. 11. We determined that

[a]nalysis of the relevant considerations does not, on this record, support affording the term “movable sample” patentable weight. The body of apparatus claim 1 affirmatively refers to a “sample” that is subject to being measured by the claimed apparatus, but does not refer to or rely on particular characteristics of the sample, such as whether it is “movable.”

Id. at 13. Nevertheless, at that preliminary stage, we declined to resolve whether “movable sample” is entitled to patentable weight, and we then

evaluated the parties' contentions on the assumption that the term would be afforded patentable weight. *Id.* at 14. After considering the parties' contentions in light of the intrinsic record, we determined that Patent Owner's proposal limiting "movable sample" to a sample subject to involuntary movement was not consistent with the intrinsic record. *Id.* at 15–17. Rather, we determined that

affording the term "movable sample" its ordinary and customary meaning, consistent with the Specification, we construe "movable sample" for purposes of this Decision to encompass a sample that is subject to movement relative to the SS OCDR measurement device. This construction thus encompasses, but is not limited to, a living sample, such as an eye, that is subject to voluntary or involuntary movements by the body in which the sample is located.

Id. at 17. We also invited the parties to further develop this issue during trial, including whether "movable sample" is entitled to patentable weight. *Id.* at 14.

In its Response, Patent Owner now proposes an even narrower construction, asserting that the term "should be construed as a live ocular sample, including an eye, but not limited to a human eye, characterized by significant, hard-to-control motion during an A scan measurement of its entire depth." PO Resp. 9. Patent Owner contends this construction is supported by statements in the '330 patent that the object of the invention is to provide SS OCDR "on movable samples, particularly human eyes." *Id.* at 10 (emphasis omitted). Patent Owner notes, in particular, that the Specification "is replete with examples of an ocular sample subject to significant motion when being measured but is devoid of any example of a non-ocular sample." *Id.*

In its Reply, Petitioner first contends that, consistent with our analysis in the Institution Decision, “the record does not support ‘movable sample’ having patentable weight.” Pet. Reply 2. In particular, Petitioner notes that “the body of claim 1 itself refers to the ‘sample’ that is subject to being measured by the claimed apparatus. . . . The claimed apparatus is no different if the sample is movable or immovable.” *Id.* (citing Inst. Dec. 13). Petitioner then contends that Patent Owner’s proposed construction is an improper attempt to constrain the term to preferred embodiments disclosed in the Specification and “adds limitations into the term [that] are unrelated to the ordinary and customary meaning of ‘movable sample.’” *Id.* at 4–5.

In its Sur-reply, Patent Owner argues that “movable sample” should be afforded patentable weight because the recitation of “movable sample” in the preamble (1) provides antecedent basis for the term “sample,” which “appears three times in the body of claim 1” (PO Sur-reply 2); and (2) “also ‘discloses a fundamental characteristic of the claimed invention that is properly construed as a limitation of the claim itself’” (*id.* (citing *Poly-America, L.P. v. GSE Lining Tech. Inc.*, 383 F.3d 1310 (Fed. Cir. 2004))). Patent Owner denies that its construction includes “irrelevant limitations,” as Petitioner contends. *Id.* at 4.

Although we declined in the Institution Decision to resolve, pre-trial, whether the preamble’s recitation of “movable sample” is to be afforded patentable weight, we now conclude, on the full trial record, that “movable sample” is not limiting. As our reviewing court has held, “whether to treat a preamble as a claim limitation is determined on the facts of each case in light of the claim as a whole and the invention described in the patent.” *Bicon, Inc. v. Straumann Co.*, 441 F.3d 945, 952 (Fed. Cir. 2006) (quoting

Storage Tech. Corp. v. Cisco Sys., Inc., 329 F.3d 823, 831 (Fed. Cir. 2003)). If the body of the claim “sets out the complete invention,” the preamble is not ordinarily treated as limiting the scope of the claim. *Schumer v. Lab. Comput. Sys., Inc.*, 308 F.3d 1304, 1310 (Fed. Cir. 2002). But the preamble is limiting if it “recites essential structure or steps, or if it is necessary to give life, meaning, and vitality to the claim.” *Catalina Mktg. Int’l, Inc. v. Coolsavings.com, Inc.*, 289 F.3d 801, 808 (Fed. Cir. 2002). That means if the claim drafter “chooses to use both the preamble and the body to define the subject matter of the claimed invention, the invention so defined, and not some other, is the one the patent protects.” *Bicon*, 441 F.3d at 953 (quoting *Bell Commc’ns Research, Inc. v. Vitalink Commc’ns Corp.*, 55 F.3d 615, 620 (Fed. Cir. 1995) (emphasis omitted)). Thus, a preamble may be limiting if “it recites essential structure or steps”; claims “depend[] on a particular disputed preamble phrase for antecedent basis”; the preamble “is essential to understand limitations or terms in the claim body”; the preamble “recit[es] additional structure or steps underscored as important by the specification”; or there was “clear reliance on the preamble during prosecution to distinguish the claimed invention from the prior art.” See *Georgetown Rail Equip. Co. v. Holland L.P.*, 867 F.3d 1229, 1236 (Fed. Cir. 2017) (quoting *Catalina Mktg.*, 289 F.3d at 808 (citations omitted)).

Analysis of the relevant considerations does not, on this record, support affording the term “movable sample” patentable weight. “Dependence on a particular disputed preamble phrase for antecedent basis may limit claim scope because it indicates a reliance on both the preamble and claim body to define the claimed invention.” *Catalina Mktg.*, 289 F.3d at 808 (citing *Bell Commc’ns*, 55 F.3d at 620). Nevertheless, here, although

the body of claim 1 affirmatively refers back to “the sample” that is subject to being measured by the claimed apparatus, it does not refer to or rely on particular characteristics of the sample, such as whether it is “movable.” Nor does the body of the claim recite structure particular to a *movable* sample. Although Patent Owner is correct that the Specification of the ’330 patent refers to compensating for potential movement of a sample as being significant or important for the purpose of the invention (*see* PO Resp. 12–15 (citing Specification)), the “movable” characteristic of a sample does not appear to be essential for providing context for any of the recited structure in claim 1 or for understanding the limitations or terms in the claim body. Rather, measuring movable samples may have provided, as Patent Owner explains, the motivation for improving the prior art to perform faster measurements. *See id.*; *see also* Sur-reply 2. But Patent Owner does not assert, for example, that the structure of the claimed apparatus would be any different if a stationary sample were to be measured as opposed to a movable one (or that use on a stationary sample would not infringe).

Thus, the “movable” modifier appears to state a purpose or intended use for the invention as being particularly suitable for movable samples. Our reviewing court has explained that a preamble is not limiting “where a patentee defines a structurally complete invention in the claim body and uses the preamble only to state a purpose or intended use for the invention.” *Catalina Mktg.*, 289 F.3d at 808 (quoting *Rowe v. Dror*, 112 F.3d 473, 478 (Fed. Cir. 1997)). Although “statements of intended use or asserted benefits in the preamble may, in rare instances, limit apparatus claims,” that is “only if the applicant clearly and unmistakably relied on those uses or benefits to

distinguish prior art.” *Id.* at 809. Patent Owner does not point to any such statements here, nor do we discern any.

In summary, we determine that the term “movable sample” in the preamble of claim 1 is not afforded patentable weight.

We also do not construe “sample,” which additionally appears in the body of claim 1, as limited to an ocular sample. Although the ’330 patent discusses a human eye as an exemplary sample, it is clear from the generic use of the term “sample” in both the Specification and in claim 1 that the inventors did not intend to limit a “sample” to a human eye. Our reviewing court “has repeatedly ‘cautioned against limiting the claimed invention to preferred embodiments or specific examples in the specification.’”

Williamson v. Citrix Online, LLC, 792 F.3d 1339, 1346–47 (Fed. Cir. 2015).

Significantly, “it is the *claims*, not the written description, which define the scope of the patent right.” *Id.* at 1346. In addition, claim 1 uses the generic term “sample,” whereas claim 2, which depends from claim 1, recites that “the sample comprises a human eye.” The doctrine of claim differentiation creates a presumption that an independent claim does not contain a limitation recited in a claim depending from the independent claim.

Bancorp Servs., L.L.C. v. Sun Life Assur. Co. of Can., 687 F.3d 1266, 1275 (Fed. Cir. 2012); *Phillips*, 415 F.3d at 1315. Although Patent Owner contends that claim differentiation does not come into play because “sample” could still be limited to an eye in claim 1 without being limited to a *human* eye as recited in claim 2 (PO Sur-reply 3–4), nothing in the ’330 patent suggests drawing a distinction between a human and a non-human eye insofar as a “sample” is concerned. Rather, the logical distinction,

consistent with the Specification, is a generic sample, as recited in claim 1, versus a human eye, as recited in claim 2.

We do not need to further construe the term “sample,” or any other terms, to resolve the issues presented herein. *See Nidec Motor Corp.*, 868 F.3d at 1017. To the extent that the scope of this or any other term requires further discussion, however, we provide it in our analysis of the challenges.

D. Asserted Obviousness

Petitioner contends claims 1, 2, 21–27, 40, and 42 are unpatentable under 35 U.S.C. § 103(a) over the combination of Huber, Everett, and Lexer. Pet. 6–80.

1. Overview of Cited References

a. Huber (Ex. 1008)

Huber is a United States patent issued on August 19, 2008, and is based on an application published on August 24, 2006. Ex. 1008, codes (45), (65). Petitioner asserts Huber is prior art “under at least 35 U.S.C. § 102(b).” Pet. 24. Patent Owner does not dispute the prior-art status of Huber. *See generally* PO Resp.

Huber discloses a method and apparatus for generating fast frequency swept waveforms, including for applications in OCT and surgery. Ex. 1008, 1:54–56, 1:61–67, 25:23–26. Huber discloses in particular a swept light source comprising a tunable laser with a narrow instantaneous bandwidth and a coherence length that can range from about 1 cm to about 40 cm. *Id.* at 6:34–38, 8:20–22. Huber discloses a preferred wavelength sweep range “between 1250 nm and 1360 nm,” with an instantaneous coherence length of “about 4 cm.” *Id.* at 10:17–23. Huber discloses that its light source could be applied to a myriad of applications, replacing other swept

sources: “The fundamental improvement in performance of the present invention compared to other swept sources could allow the systems disclosed herein to replace a significant part of these swept sources” *Id.* at 24:50–25:5. Contemporaneous publications authored by the inventors named in Huber illustrate the use of their laser in SS OCT systems to image human skin *in vivo*. See Ex. 1013, 3 (depicting an OCT image of a human finger *in vivo*); Ex. 1014, 5 (same); Pet. 39, n.8.

b. Everett (Ex. 1009)

Everett is a United States patent issued on April 29, 2008, based on an application published on July 27, 2006. Ex. 1009, codes (45) (65).

Petitioner asserts Everett is prior art “under at least 35 U.S.C. § 102(b).”

Pet. 24. Patent Owner does not dispute the prior-art status of Everett.

See generally PO Resp.

Everett discloses an OCT imaging system that can be used to take A-scans of a human eye to create three-dimensional data sets. Ex. 1009, 3:39–60. Figure 1 of Everett depicts this OCT imaging system, and is reproduced below.

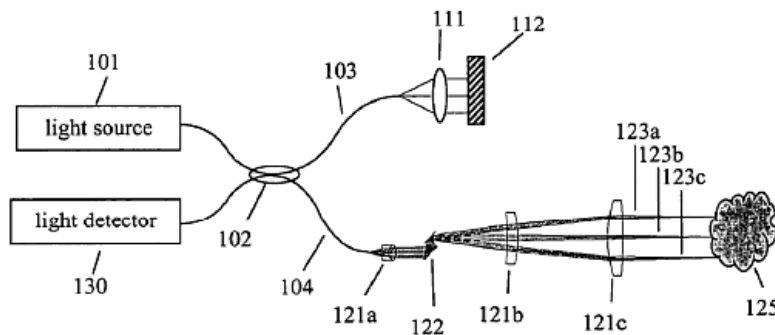


FIG. 1

Figure 1 of Everett, reproduced above, is a schematic illustration of an OCT system. Ex. 1009, 2:63.

c. Lexer (Ex. 1006)

Lexer is an article published on September 1, 1997 (Ex. 1006), and is described in the Background portion of the Specification (Ex. 1001, 2:15–21), indicating the article was publicly available as of the date of the invention described in the '330 patent. Petitioner asserts Lexer is prior art “under at least 35 U.S.C. § 102(b).” Pet. 24. Patent Owner does not dispute the prior-art status of Lexer. *See generally* PO Resp.

Lexer discloses basic principles of wavelength-tuning interferometry and its application in ophthalmology. Ex. 1006, 1. In particular, Lexer discloses use of an OCT system comprising a laser light source that is tunable at different wavelengths to obtain simultaneous measurement of various parts of the eye, such as the anterior segment length, vitreous chamber depth, and axial eye length in human eyes *in vivo*. *Id.* at 3–4.

2. Analysis

Petitioner contends claims 1, 2, 21–27, 40, and 42 are unpatentable under 35 U.S.C. § 103(a) over the combination of Huber, Everett, and Lexer. Pet. 42–67. For the reasons explained herein, we are persuaded that Petitioner has established by a preponderance of the evidence that claims 1 and 21–26 are unpatentable, but has not established by a preponderance of the evidence that claims 2, 27, 40, and 42 are unpatentable.

Patent Owner argues that Petitioner has failed to demonstrate unpatentability, raising several contentions spanning the claims. PO Resp. 2–5, 20–50. In particular, Patent Owner argues that (1) “the Petition fails to demonstrate that the alleged combination meets the line width limitation of the claimed SS OCDR device configured to measure a movable sample (including an eye but not limited to a human eye)” (*id.* at 2, 20–38); (2) “the

Petition fails to demonstrate that the alleged combination meets the measuring range limitation of the claimed SS OCDR device” (*id.* at 3, 38–45); and (3) “Everett teaches away from the claimed invention, which tackles the fast and hard-to-control eye motion *during an individual A-scan* when the movable sample is being measured over its entire length” (*id.* at 4, 46–50). As to claims 40 and 42, Patent Owner argues that Petitioner’s reliance on Huber’s coherence length alone fails to establish the recited line widths, which are narrower in those claims than recited in claim 1. *Id.* at 4, 50–55. Patent Owner also argues Petitioner fails to demonstrate the prior art teaches a bandwidth of “less than 80 Mhz,” as recited in claim 27. *Id.* at 55–56.

We divide the claims at issue into two categories: (1) claims wherein the sample is not limited to an eye (claims 1 and 21–27); and (2) claims wherein the sample is expressly limited to a human eye (claims 2, 40, and 42). We first provide our analysis of the parties’ evidence and arguments for independent claim 1, then for dependent claims 21–27. We then address the parties’ arguments and evidence as to claims 2, 40, and 42.

a. Claim 1

(1) *Preamble: “A device for swept source optical coherence domain reflectometry (SS OCDR) on a movable sample, for the purpose of obtaining A-scans, comprising”*

Petitioner presents evidence that, “[t]o the extent the preamble is considered limiting,” Huber discloses an SS OCDR device for obtaining A-scans on a movable sample. Pet. 46 (citing Ex. 1008, 1:54–62, 4:48–51, 6:34–40, 10:62–11:7, 11:15–26, 23:24–48, 24:50–53, Figs. 6, 36).⁸

⁸ Petitioner’s cite to “Ex. 1001” instead of “Ex. 1008” appears to have been

Petitioner also presents evidence of Huber’s disclosure relevant to imaging a sample, noting “that the tunable laser may be useful in various applications, such as surgery.” *Id.* at 39 (citing Ex. 1008, 25:23–26). Petitioner’s evidence also includes “[c]ontemporaneous publications by . . . some of the same inventors in Huber” that “illustrate the use of their FDML laser in SS OCT systems to image human skin.” *Id.* at 46 (citing Ex. 1013; Ex. 1014; Ex. 1015).

Patent Owner does not present arguments or evidence specifically addressing the preamble of claim 1, other than arguing that the preamble is entitled to patentable weight and that “movable sample” is limited to a “live ocular sample” with additional limitations. *See* PO Resp. 20; *see also supra* Section II.C.2. Based on these premises, Patent Owner contends Huber does not disclose use of its OCT system on movable samples because Huber does not mention ophthalmic imaging, and the wavelengths of Huber’s system as disclosed are not suitable for use on ocular samples. PO Resp. 20–21.

We addressed the foundation of these arguments *supra* Section II.C.2, wherein we conclude that (1) “movable sample” is not entitled to patentable weight; and (2) a “sample,” as recited in the preamble and the body of claim 1, is not limited to an ocular sample. Thus, Patent Owner’s arguments that Huber’s wavelength would have to be modified for use in SS OCDR on an ocular sample are not relevant to claim 1. The same is true for claims 21–27, which depend from claim 1. We note, however, that Patent Owner’s

a typographical error. Petitioner appears to repeat this error in several places in its briefing. *E.g.*, Pet. 46, 48, 52. Where, as here, it is clear that this is a typographical error and Petitioner intended to cite to Huber, we correct those cites when referencing them herein.

arguments regarding the suitability of Huber's system for ophthalmic applications are relevant to dependent claims 2, 40, and 42, which do require the sample to be a human eye. Therefore, we address these arguments *infra* Section II.D.2.c.

We find Petitioner's arguments persuasive and supported by the cited evidence. Although we conclude above (Section II.C) that the recitation of "movable sample" in the preamble is not entitled to patentable weight, we nevertheless find that Huber's disclosure of a tunable laser in an OCT device used in surgery teaches use on a movable sample (e.g., a part of a human body), which, as we conclude above (*id.*), is not limited to an eye. *See* Ex. 1008, 1:54–62, 4:48–51, 6:34–40, 10:62–11:7, 11:15–26, 23:24–48, 24:50–53, 25:23–26, Figs. 6, 36.

Based on the full trial record, we find Petitioner has demonstrated that Huber teaches "[a] device for swept source optical coherence domain reflectometry (SS OCDR) on a movable sample, for the purpose of obtaining A-scans," as recited in claim 1.

(2) *"a tunable laser light source"*

Petitioner presents evidence that this limitation is taught by Huber, which "discloses a tunable wavelength selective filter element that can include a tunable bandpass filter that is tuned continuously over time to generate a frequency sweep." Pet. 48 (citing Ex. 1008, 1:56–59, 2:62–3:14; Ex. 1012 ¶ 137). Petitioner further presents evidence of Huber's disclosure "that the invention disclosed therein can be used for generation of swept laser sources." *Id.* (citing Ex. 1008, 8:62–9:2, 10:62–64, 24:50–53, Figs. 5, 6; Ex. 1012 ¶¶ 58–66, 137). We agree Petitioner's contentions are supported

by the cited disclosures. Patent Owner does not present arguments or evidence specifically addressing Petitioner's showing as to this limitation.

Based on the full trial record, we find Petitioner has demonstrated that Huber teaches "a tunable laser light source," as recited in claim 1.

- (3) *"at least one receiver for light backscattered from the sample, wherein the sample is illuminated on the sample surface with a measurement beam of diameter D"*

Petitioner maps the specified "at least one receiver" to Huber's disclosure of a pair of photodiodes, which detect "backreflected light from a reference arm and sample arm of an interferometer" that are interfered. Pet. 48 (citing Ex. 1008, 4:48–51, 11:15–26, Fig. 6; Ex. 1012 ¶ 138). Petitioner presents evidence that Huber "discloses that the sample is illuminated on the sample surface." *Id.* (citing Ex. 1008, Fig. 6; Ex. 1012 ¶ 139). Petitioner acknowledges "Huber does not explicitly disclose that the sample surface is illuminated with a beam of diameter D," but presents evidence that Huber's system as illustrated in Figure 6 inherently teaches a beam of diameter D. *Id.* (citing Ex. 1008, 9:45–50, 23:24–38, Figs. 6, 36; Ex. 1012 ¶ 139).

Petitioner also presents evidence that Everett discloses use of OCT to obtain A-scans, which discussion includes reference to a "beam diameter." *Id.* at 49 (citing Ex. 1009, 3:8–21, 3:46–60, 6:30–34, 7:22–26; Ex. 1012 ¶ 140). Relying in part on the testimony of Dr. Brennan, Petitioner presents evidence that the ordinarily skilled artisan "would understand that Everett discloses a measurement beam that has a diameter D that illuminates a sample surface." *Id.* (citing Ex. 1012 ¶ 141). Petitioner also presents evidence, including the testimony of Dr. Brennan, that "[g]enerating a cylindrical measurement beam with a diameter D was a basic function of

interferometry that involved standard off the shelf components such as lenses and filters.” *Id.* at 49–50 (citing Ex. 1012 ¶ 141).

Patent Owner’s arguments regarding this limitation focus on differences between Everett’s system and the claimed invention, which Patent Owner contends teach away from the claimed combination. PO Resp. 46–50. In a nutshell, Patent Owner argues Everett discloses comparing successive A-scans to estimate and correct for motion of the sample (PO Resp. 48), whereas the claimed invention seeks to avoid comparing A-scan pairs by making measurements “at sufficient speed and with sufficient illumination” so as to avoid problems based on movement of the sample in a single A-scan (*id.* at 49). Patent Owner’s arguments do not, however, squarely address Petitioner’s contentions. Petitioner does not rely on Everett for the details of the SS OCDR; rather, for this limitation, Petitioner relies on Everett only for express acknowledgement that the light source in an SS OCDR system has a beam of a particular diameter. Pet. 49. Petitioner otherwise relies on Huber for teaching a measurement beam, noting also that it is implicit in Huber’s disclosure that the measurement beam has a diameter. *Id.* at 48–49.

Based on the full trial record, we are persuaded by Petitioner’s evidence, including the unrebutted testimony of Dr. Brennan (which we credit), and find Petitioner has demonstrated that Huber, alone or in light of Everett, teaches “at least one receiver for light backscattered from the sample, wherein the sample is illuminated on the sample surface with a measurement beam of diameter D,” as recited in claim 1.

- (4) “wherein the light source has a line width of $\delta k < 168 \text{ m}^{-1}$, wherein $k = 2\pi/\lambda$ ”

Petitioner presents evidence that Huber teaches this limitation by disclosing a “semiconductor amplifier chip for wavelength operation between 1250 nm and 1350 nm,” in which the light source has a “coherence length of greater than 4 cm, which corresponds to a linewidth of less than 0.03 nm.” Pet. 50 (citing Ex. 1008, 10:15–29, 24:5–8, Fig. 5a; Ex. 1012 ¶ 143). Petitioner notes, however, that Huber uses units different than those claimed in the ’330 patent, and asserts that “the units of Huber should be converted to inverse meters.” *Id.* Relying on testimony of Dr. Brennan, Petitioner provides the conversion calculations, using the “wavelength sweep range” of 1250–1360 nm disclosed in Huber, in which the “center of the wavelength sweep range λ_0 disclosed in Huber is 1305 nm,” and also based on a laser linewidth at the “highest range of the linewidth” disclosed in Huber of $\delta\lambda = 0.03 \text{ nm}$:

$$(1) k = 2\pi/\lambda$$

$$(2) \delta k = 2\pi/\lambda^2 \delta\lambda$$

$$(3) \delta k = (2\pi/(1.305\text{E-}6 \text{ m})^2) * (3\text{E-}11 \text{ m}) = 110.7 \text{ m}^{-1}.$$

Id. at 50–51 (citing Ex. 1012 ¶ 144). Petitioner then contends “[t]herefore, at a minimum, Huber discloses that $\delta k = 110.7 \text{ m}^{-1}$,” which is less than the 168 m^{-1} recited in claim 1 as the maximum line width δk for the light source. *Id.* at 51.

Patent Owner does not dispute Petitioner’s calculations, but argues that Petitioner’s alleged combination of applying the laser source of Huber to ophthalmic imaging as disclosed in Everett and Lexer would require modifications to Huber’s laser source that would prevent Huber’s source from satisfying the claimed line width. PO Resp. 20–38. As noted above,

these arguments are not relevant to claim 1, in which the sample is not limited to an ocular sample. These arguments are addressed *infra* Section II.D.2.c in connection with our analysis of the parties' arguments and evidence as to claims 2, 40, and 42.

Based on the full trial record, including the testimony of Dr. Brennan (which we credit), we are persuaded by Petitioner's evidence and find Petitioner has demonstrated that Huber teaches "wherein the light source has a line width of $\delta k < 168 \text{ m}^{-1}$, wherein $k = 2\pi/\lambda$," as recited in claim 1.

(5) *"wherein the A scan measuring range corresponds to a depth of the sample"*

Petitioner notes, first, that claim 1 does not specify the meaning of "measuring range" or "depth of the sample." Pet. 51. Petitioner nevertheless presents evidence that Huber discloses a sufficient A-scan measuring range based on Huber's disclosure of coherence lengths of up to 40 cm. *Id.* at 52 (citing Ex. 1008, 10:15–23, 24:5–9). Relying on the testimony of Dr. Brennan, Petitioner presents evidence that the ordinarily skilled artisan would have understood that "the coherence length is twice the measurement range of the SS OCT system (assuming 6 dB optical signal falloff)" and therefore would also have understood that "Huber's disclosure of a coherence length of 40 cm would result in a depth measurement of at least 20 cm (or 200 mm)." *Id.* at 53 (citing Ex. 1012 ¶¶ 67–74, 148). Also relying on the testimony of Dr. Brennan, Petitioner further presents evidence that if the sample were a human eye, for example, an ordinarily skilled artisan would have understood that the required measuring range would "correspond[] to the optical path length of a human eye, *i.e.*, between 19 mm and 54 mm (accounting for the 1.36 index of refraction within the eye)." *Id.*

at 51–52 (citing Ex. 1012 ¶ 145). Petitioner asserts that Huber, therefore, teaches a sufficient A-scan measuring range to encompass the depth of, e.g., a human eye. *Id.* at 53.

Patent Owner’s challenge to Petitioner’s showing as to this limitation is two-fold. First, Patent Owner reiterates its argument that Petitioner’s calculations are based on Huber’s device operating at a wavelength that would not be suitable for imaging an eye. PO Resp. 39–41. As noted above, we disagree that claim 1 is limited to a device for use on ocular samples. *See* Section II.C.2. We address Patent Owner’s arguments in this regard below in connection with claims 2, 40, and 42.

Second, Patent Owner argues that Petitioner’s showing is still deficient even if “movable sample” is construed broadly enough to encompass human skin, as in the examples taught by Huber. PO Resp. 41–42. In particular, Patent Owner argues “Petitioner still fails to show that Huber’s laser source can meet a measuring range on par with its purported coherence length.” *Id.* Patent Owner elaborates by asserting that

the Petition has never addressed the significant absorption and scattering of light inside a sample when inferring a measurement range solely based on a purported coherence length of Huber’s laser. . . . In other words, Petitioner’s sole reliance on the coherence length ignores the physical changes of light propagating inside a sample, which operate to significantly reduce the inferred measurement range.

Id. at 42 (citing Ex. 2013 ¶ 164). Patent Owner also argues that Petitioner’s reliance on Huber’s coherence length “is driven by nothing but hindsight conjecture to read on the measuring range limitation.” *Id.* at 45.

Petitioner responds with several contentions. First, Petitioner contends Patent Owner’s criticism of Petitioner’s alleged failure to account

for absorption is confusing distinct issues—power reduction due to water absorption and decrease in sensitivity due to low coherence. Pet. Reply 14. Petitioner presents testimony from Dr. Brennan that, if the coherence length is long enough, the ordinarily skilled artisan “can increase the optical power of a source to overcome power lost to water absorption.” *Id.* (citing Ex. 1027 ¶¶ 46–47). Petitioner further notes that the ’330 patent itself does not define “measuring range” nor does it address water absorption when discussing measuring range, but explains measuring range as depending only on linewidth. *Id.* at 14–15 (citing Ex. 1027 ¶¶ 45–52). Petitioner further presents testimony from Dr. Brennan that Petitioner’s calculation of a potential measuring range of Huber’s system uses the same parameters as described in the ’330 patent. *Id.* at 14 (citing Ex. 1027 ¶¶ 48–54; Ex. 1012 ¶ 67). In particular, Petitioner presents evidence that Huber explicitly discloses a coherence length of between 1 cm and 40 cm, which “far exceeds” the depth of the kind of sample Patent Owner references (a human eye). *Id.* at 16 (citing Ex. 1027 ¶¶ 48–54).

Patent Owner’s arguments in response focus on issues that would arise particularly when imaging ocular samples, including issues regarding increasing power to offset attenuation in ophthalmology applications. *See* PO Sur-reply 15–16. Patent Owner also disputes that the ’330 patent does not describe a measuring range, noting that Petitioner itself relies on the optical path length of a human eye when addressing the claimed measuring range. *Id.* at 16. With regard to Huber’s teaching of a sufficient measuring range, Patent Owner again emphasizes absorption issues that would arise when using Huber’s center wavelength of 1305 nm to measure an eye. *Id.* at 18–20.

We agree with Petitioner that the '330 patent does not explicitly define the “measuring range” of the device, other than providing that it should be according to the sample length—that is, sufficient to reach the depth of the sample. *See* Ex. 1001, Abstract, 2:60–61, 12:31–31 (claim 1). Although the Specification describes the operation of the claimed invention in connection with an ocular sample (which the Specification describes as having depth extremes ranging from 14–40 mm), we have determined herein that claim 1 is not limited to the sample being an eye. *See* Section II.C.2. Petitioner has presented persuasive evidence, including the testimony of Dr. Brennan (which we credit), establishing that Huber discloses an A-scan measuring range of at least 20 cm, which would include the depth of many types of samples. *See* Pet. 52–53 (citing Ex. 1012 ¶¶ 67–74, 148). Patent Owner, on the other hand, has not presented arguments or evidence responding to Petitioner’s evidence. At most, Patent Owner has cast doubt on whether, *if the sample is an eye*, Huber’s system would have the requisite measuring range while satisfying the other claim limitations—arguments that we address *infra* in connection with the claims that are limited to a system suitable for use in measuring an eye. *See* Section II.D.2.c. But such arguments do not undermine Petitioner’s showing as to non-ocular samples.

Based on the full trial record, we are persuaded by Petitioner’s evidence and find that Petitioner has demonstrated that Huber teaches “wherein the A scan measuring range corresponds to a depth of the sample,” as recited in claim 1.

(6) “wherein the device is configured such that tuning of the light source is performed in a time $\tau < 44 \text{ sec}/(D \cdot k_0)$ about a centroid wave number k_0 ”

Petitioner presents evidence that Huber discloses tuning times of less than the recited maximum. Pet. 54–55. In so doing, Petitioner notes that claim 1 does not specify a measurement beam diameter D or a centroid wave number k_0 , but Petitioner makes certain assumptions. *Id.* at 54. In particular, Petitioner assumes a centroid wavelength of 1305 nm (based on Huber’s disclosed wavelength sweep range of between 1250 nm and 1360 nm), and assumes a beam diameter of 3 mm, based on the ’330 patent’s disclosure that it is “particularly advantageous” when the “measurement beam diameter D is smaller than 3 mm in the region of the sample entrance.” *Id.* (citing Ex. 1001, 4:8–10; Ex. 1012 ¶ 149). Relying on the testimony of Dr. Brennan, Petitioner calculates the claimed maximum tuning time τ for a light source with these parameters as 3 milliseconds. *Id.* (citing Ex. 1012 ¶ 149). Petitioner presents evidence that the tuning rate disclosed by Huber is “between 29 kHz and 116 kHz,” which Petitioner, again relying on the testimony of Dr. Brennan, calculates as corresponding to tuning times between 34 and 8.6 microseconds. *Id.* (citing Ex. 1008, 10:15–23, 10:38–46; Ex. 1012 ¶ 150). Because the range of tuning times disclosed by Huber is less than Petitioner’s calculated maximum tuning time of 3 milliseconds for the assumed wavelength and maximum beam diameter, Petitioner contends Huber’s system meets this limitation. *Id.* at 55 (citing Ex. 1012 ¶ 150). Patent Owner does not present arguments directed particularly to Petitioner’s showing as to this limitation. *See generally* PO Resp.

Based on the full trial record, we are persuaded by Petitioner’s evidence, including the testimony of Dr. Brennan (which we credit), and

find Petitioner has demonstrated that Huber teaches “wherein the device is configured such that tuning of the light source is performed in a time $\tau < 44 \text{ sec}/(D \cdot k_0)$ about a centroid wave number k_0 ,” as recited in claim 1.

(7) *Claim 1 Conclusion*

After having analyzed the entirety of the trial record and assigning appropriate weight to the cited supporting evidence, we determine Petitioner has shown by a preponderance of the evidence that independent claim 1 is unpatentable over the teachings of Huber in view of Everett and Lexer.

b. *Claims 21–27*

Petitioner contends that claims 21–27, which depend, directly or indirectly, from claim 1, would have been obvious over the combination of Huber, Everett, and Lexer. Pet. 56–65. Claims 21–27 recite additional properties of the claimed apparatus, including the tuning range of the claimed light source (claims 21–23), the digitization rate of the received backscattered light (claim 24), the line width of the light source (claim 25), and the bandwidth of the receiver (claims 26–27). We have reviewed Petitioner’s contentions and supporting evidence regarding claims 21–24 and 26, including the calculations provided by Dr. Brennan, and find them sufficient to demonstrate unpatentability by a preponderance of the evidence based on the full trial record. *See id.* at 56–57 (claim 21) (citing Ex. 1008, 10:15–23; Ex. 1012 ¶¶ 112–114, 159–160); *id.* at 57–59 (claim 22) (citing Ex. 1008, 10:15–23, 24:5–8; Ex. 1012 ¶¶ 162, 164); *id.* at 59–60 (claim 23) (citing Ex. 1008, 10:15–23; Ex. 1012 ¶¶ 165–167); *id.* at 60–61 (claim 24) (citing Ex. 1008, 10:15–23; Ex. 1012 ¶¶ 168–170); *id.* at 63–65 (claim 26) (citing Ex. 1008, 23:24–38; Ex. 1009, 3:17–21; Ex. 1012 ¶¶ 176–183).

Patent Owner does not present separate, substantive arguments for claims 21–24 or 26, but instead relies on arguments that are discussed with reference to claim 1. *See* PO Resp. 20–50. These arguments are premised on the claims being limited to an apparatus for use on an ocular sample. *See id.* As discussed above, we do not find that these arguments rebut Petitioner’s persuasive showing on this record.

Claim 25 depends from claim 1 and recites “wherein the line width δk of the light source lies between 22 and 50 m^{-1} .” Ex. 1001, 13:44–46. Petitioner presents evidence that Huber discloses embodiments having coherence lengths from 1 cm to about 40 cm (Pet. 62 (citing Ex. 1008, 8:20–22; Ex. 1012 ¶ 173)), and further presents testimony from Dr. Brennan that such coherence lengths correlate (via a known mathematical formula) to line widths between 22 and 50 m^{-1} (*id.* (citing Ex. 1012 ¶¶ 174–175)).

Patent Owner argues claim 25 collectively with claims 40 and 42, which are limited to the sample being an eye, and premises its response to Petitioner’s showing on Huber’s apparatus being unsuitable for use in measuring an eye. PO Resp. 52–55. Claim 25, however, is not so limited. Patent Owner has not, with respect to claim 25, otherwise responded to Petitioner’s arguments and evidence. As noted below in connection with claims 2, 40, and 42, however, Patent Owner has presented compelling arguments and evidence that do undermine Petitioner’s showing as to the suitability of Huber’s system for use on eyes, in which the wavelength of the laser source is critical (which in turn would affect the line width). *See* Section II.D.2.c. As for non-ocular samples, however, we find Petitioner has presented persuasive arguments and evidence, including the

testimony of Dr. Brennan (which we credit), that Huber discloses a system that can achieve a line width encompassing the value recited in claim 25.

Claim 27 depends from claim 26, and recites “wherein the bandwidth of the at least one receiver is less than 80 Mhz.” Ex. 1001, 14:1–3. Arguing claim 27 collectively with claim 26, Petitioner presents evidence that the bandwidth calculated from the values disclosed by Huber is 425 MHz. Pet. 63 (citing Ex. 1012 ¶ 178). Petitioner then presents evidence that the ordinarily skilled artisan “would have found it obvious to optimize the bandwidth of the receiver (detector) *to be more than 425 MHz*, as recited by claim 26,” because doing so would have been a known “design consideration” and “it would be a matter of routine optimization to allow the signals backscattered from various parts of the eye to be received by the detector.” *Id.* at 64 (citing Ex. 1012 ¶ 179). As Patent Owner points out, however, claim 27 recites that the bandwidth is *less than* 80 MHz, and thus Huber’s disclosure of a bandwidth of “more than” 425 MHz does not overlap with the value recited in claim 27. PO Resp. 55–56.

Petitioner responds that the Petition stated it “would have been obvious to choose the bandwidth of a receiver so that desired signals are collected and yet the effect of faster interference signals is minimized.” Pet. Reply 25. Petitioner then notes that Dr. Brennan’s declaration, cited in the Petition, described photodetectors sold by Analog Modules, Inc. at the time of the ’330 patent as having a maximum bandwidth of 80 MHz. *Id.* (citing Ex. 1012 ¶¶ 180–181).

We are not persuaded by Petitioner’s showing as to claim 27. Arguing claims 26 and 27 collectively, the Petition presents evidence that the ordinarily skilled artisan would have understood that Huber’s system

would achieve a bandwidth of “*more than 425 MHz*,” thus rendering claim 26 unpatentable (Pet. 64 (emphasis added)), but is silent as to whether Huber’s system would also achieve a bandwidth of “*less than 80 Mhz*,” as recited in claim 27 (emphasis added).

Petitioner’s attempt in its Reply to reference statements from Dr. Brennan’s declaration is unavailing to satisfy Petitioner’s burden to make its case for unpatentability of claim 27 in the Petition. Nothing in the Petition itself expressly states, much less demonstrates, that Huber’s system would achieve a bandwidth of less than 80 MHz. A petition for *inter partes* review must “identif[y], in writing and with particularity, each claim challenged, the grounds on which the challenge to each claim is based, and the evidence that supports the grounds for the challenge to each claim.” 35 U.S.C. § 312(a)(3). To avoid self-help attempts to increase the length of the petition, *see DeSilva v. DiLeonardi*, 181 F.3d 865, 866 (7th Cir. 1999) (“[A]doption by reference amounts to a self-help increase in the length of the appellate brief.”), our rules prohibit incorporation by reference of arguments in one document into another, 37 C.F.R. § 42.6(a)(3). As the Board has explained previously, “[the] practice of citing the Declaration to support conclusory statements that are not otherwise supported in the Petition also amounts to incorporation by reference.” *Cisco Sys., Inc. v. C-Cation Techs., LLC*, Case IPR2014-00454, slip. op. at 9 (PTAB Aug. 29, 2014) (Paper 12) (informative). In such situations, Board practice has been to consider only arguments that are expressly set forth in the Petition. *Id.* at 10 (“[W]e will not consider arguments that are not made in the Petition, but are instead incorporated by reference to the cited paragraphs and claims charts of [the] Declaration.”).

Even considering the cited paragraph of Dr. Brennan’s testimony (Ex. 1012 ¶ 181), we note that it fails to offer evidence supporting the Petition’s reliance on Huber. Rather, the cited testimony describes a photodetector having a bandwidth of less than 80 MHz, which was, according to Dr. Brennan, sold at the time of the ’330 patent by a company with no apparent relation to Huber (Analog Modules). *See* Ex. 1012 ¶ 181. Dr. Brennan’s testimony, even if considered as part of Petitioner’s showing, fails to demonstrate how *the cited art (Huber)* would have been understood by the ordinarily skilled artisan as teaching or suggesting a device with a bandwidth of less than 80 MHz, as recited in claim 27.

Thus, having considered Petitioner’s arguments and Patent Owner’s response on the full record, we are not persuaded that Petitioner has established, by a preponderance of the evidence, unpatentability of claim 27.

c. Claims 2, 40, and 42

Unlike claims 1 and 21–27, claim 2 (which depends from claim 1) and claims 40 and 42 (which depend from claim 2) do require the sample to be a human eye. Ex. 1001, 12:35–36; Ex. 1001 (Re-exam. Cert.) 2:8. For the reasons expressed below, having evaluated the full trial record, we determine that Petitioner has not persuaded us, by a preponderance of the evidence, that the prior art teaches or suggests the subject matter of claims 2, 40, and 42.

As noted above, Petitioner relies primarily on Huber as disclosing the details of the claimed apparatus; with regard to applications in which the sample is a human eye, Petitioner additionally relies on the teachings of Everett and/or Lexer in combination with Huber. *See* Pet. 42–46, 55–56. In particular, Petitioner contends that “Huber discloses a laser light source with

all of the limitations of the [challenged claims] except for an explicit reference to performing OCT on the eye and taking measurements of various parts of the eye during the acquisition of A-scans.” *Id.* at 42. Petitioner presents evidence that “Huber discloses a frequency swept laser source that changes its frequency or wavelength over time.” *Id.* (citing Ex. 1008, 6:12–21). Petitioner also presents evidence that Huber’s “laser source is disclosed as being applicable to OCT, Fourier domain reflectometry, swept source OCT, and optical Fourier domain reflectometers.” *Id.* (citing Ex. 1008, 1:59–67, 13:65–67, 24:50–25:11, Fig. 6).

Further, relying in part on the testimony of Dr. Brennan, Petitioner presents evidence that Huber’s swept source laser would have been understood by the ordinarily skilled artisan to be applicable to a myriad of applications, based on Huber’s disclosure that “[t]he fundamental improvement in performance of the present invention compared to other swept sources could allow the systems disclosed herein to replace a significant part of these swept sources by devices based on the presented FDML concept.” *Id.* at 43 (citing Ex. 1008, 24:50–25:5; Ex. 1012 ¶ 124) (emphasis omitted). Included within those applications, Petitioner states, are “various medical applications, such as surgery,” and Petitioner also asserts “contemporaneous publications by the same authors illustrated their use of FDML laser in SS OCT systems to image human skin.” *Id.* (citing Ex. 1008, 25:23–26, Fig. 6; Exs. 1013, 1014, 1015; Ex. 1021 ¶¶ 94–112); *see also id.* at 55.⁹

⁹ Petitioner’s citation includes a typographical error referring to Ex. 2021. It is apparent from review of the record that Petitioner intends to cite to Ex. 1021.

Petitioner acknowledges that Huber does not explicitly disclose that the apparatus is for use in measuring ocular samples, and presents evidence that Everett and Lexer teach use of OCT for measuring various parts of an eye. Pet. 43, 55. In particular, Petitioner presents evidence that “Everett discloses an OCT system that allows for correction of effects caused by movement of the eye.” *Id.* at 43 (citing Ex. 1009, Abstract), 55. Petitioner also presents evidence that “Everett specifically discloses [applying] its method and apparatus . . . to Fourier-domain methods of OCT,” and “incorporates by reference Exhibit 1005, an article published in the journal Optics Express (‘Optics Express’), that discloses swept source OCT.” *Id.* at 43 (citing Ex. 1009, 6:58–8:32, 8:59–60, 9:28–29). Petitioner also presents evidence that “Lexer also discloses the application of [wavelength-tuning interferometry (“WTI”)] to ophthalmology and specifically the use of WTI to perform depth imaging of various structures of the eye.” *Id.* at 44 (citing Ex. 1006, 1); *see also id.* at 53, 56 (same).

Relying in part on the testimony of Dr. Brennan, Petitioner presents evidence that it would have been obvious to the ordinarily skilled artisan

to use the swept laser source and OCT system disclosed by Huber, the OCT method for correcting for eye movement disclosed by Everett, and the WTI system disclosed by Lexer to simultaneously take advantage of the narrow instantaneous linewidths and fast tuning time of Huber’s swept laser source while also correcting for movements of the eye in an OCT system.

Id. at 44 (citing Ex. 1012 ¶¶ 123–128). Petitioner asserts as motivation that the ordinarily skilled artisan would have understood that “[d]oing so would allow the effect of eye movement on the accurate acquisition of A-scans of the eye to be minimized.” *Id.* at 44–45 (citing Ex. 1012 ¶¶ 123–128).

Petitioner also presents evidence that “[b]ecause all three references deal with OCT and attempt to solve the problem of movement of an eye during acquisition of A-scans, a POSITA would have been motivated to combine these references with a reasonable expectation of success.” *Id.* at 45 (citing Ex. 1012 ¶¶ 123–128). In particular, Petitioner presents evidence, including the testimony of Dr. Brennan, that an ordinarily skilled artisan “would have understood that Everett intended the OCT system disclosed therein to be used with swept source OCT.” *Id.* (Ex. 1012 ¶¶ 123–128). Also relying in part on the testimony of Dr. Brennan, Petitioner presents evidence that “[u]sing the swept laser source with a fast tuning time disclosed by Huber with the OCT system disclosed by Everett and the WTI system disclosed by Lexer would further this goal by improving the speed with which A-scans were acquired while allowing the entirety of the depth of the eye to be imaged.” *Id.* (citing Ex. 1012 ¶ 127).

Arguing the claims collectively, Patent Owner asserts several deficiencies in the Petition with regard to apparatus suitable for measuring ocular samples: (1) the Petition fails to demonstrate a light source meeting the claimed line width, which depends on a specific wavelength, because the wavelength in Huber relied upon by the Petition for calculating line width (1305 nm) is not suitable for use in measuring ocular samples (PO Resp. 20–29); (2) the Petition fails to demonstrate a light source meeting the measuring range limitation when measuring an ocular sample (*id.* at 38–45); and (3) the Petition’s reliance on Huber combined with Everett is deficient because Everett addresses sample motion between multiple A-scans, which teaches away from the claimed invention directed to addressing motion during a single, individual A-scan (*id.* at 46–50).

Patent Owner points out that the Petition relies on Huber for the claimed line width (δk , measured in inverse meters), but notes that Huber does not disclose values of line width but rather a “linewidth” of $\delta\lambda$, measured in nanometers, which “characterizes the frequency distribution of the source at a certain time.” PO Resp. 21 (citing Ex. 1008, 6:34–37, 6:14–19, 6:53–67). In comparison, the ’330 patent uses a line width of δk to denote a spatial frequency in units of number of cycles per meter (m^{-1}). Ex. 1001, Abs. (“The light source has a *spectral line width of* $\delta k < 168 \text{ m}^{-1} \dots$ ”) (emphasis added). Patent Owner further notes that “[a] linewidth of $\delta\lambda$ can be converted to a corresponding line width of δk ” according to the following formula:

$$\delta k = \frac{2\pi}{\lambda^2} \delta\lambda$$

PO Resp. 21. In so doing, Patent Owner is applying the same formula stated in the Petition. *See* Pet. 51. As Patent Owner notes, “[a] significance of this conversion from $\delta\lambda$ (in units of nm) to δk (the spatial frequency in units of m^{-1}) is that it *depends on a specific wavelength* and more specifically, the dependency manifests itself as an *inverse square of wavelength* λ .”

PO Resp. 21 (citing Ex. 2013 ¶ 132).

Patent Owner then presents persuasive evidence that the wavelength of Huber used in Petitioner’s calculations (1305 nm) is not suitable for measuring a human eye, and further that the use of SS OCDR on an eye would require wavelengths well *below* Huber’s wavelength sweep range of 1250–1360 nm. PO Resp. 2–3, 20–38, 53–55. For example, Patent Owner points to the testimony of Dr. Leitgeb, as well as to articles discussing “increased absorption” of light in samples containing water at wavelengths

of around 1300 nm, noting that “water absorption increases dramatically between 1100nm and 1200nm and upward.” *See id.* at 21–23 (citing Ex. 2013 ¶¶ 106, 117–120, § V-A-(ii); Ex. 2017, Table 1; Ex. 2002 ¶ 12; Ex. 2003, 502). Patent Owner also presents evidence, including paragraph 12 of Exhibit 2002, demonstrating that although known SS OCT solutions around the time of the ’330 patent used wavelengths of around 1300 nm, they were described as “caus[ing] a serious limitation to this method, especially *when applied for ophthalmic imaging*, because in an eye (and especially in measurements near the eye fundus), absorption of light at wavelengths around 1300 nm is much higher than for light at a wavelength range around 800 nm.” Ex. 2002 ¶ 12 (emphasis added); PO Resp. 37.

Patent Owner then posits that, if Huber’s system were to be used in ophthalmic imaging as disclosed in Everett or Lexer, Huber’s light source would have to be modified to operate on shorter wavelengths, noting that “[b]ecause of water absorption, a wavelength around 800nm was the preferred central wavelength for retinal OCT around the time of the claimed invention.” PO Resp. 21–22 (citing Ex. 2013 ¶¶ 120–121). As support, Patent Owner notes that Lexer, which applies OCT in ophthalmic imaging, “used a center wavelength of 780nm to reach behind the lens structures.” *Id.* at 22 (citing Ex. 1006, 6550). Patent Owner also cites two articles as supporting a finding that the ordinarily skilled artisan would have understood that light at a shorter wavelength of around 800 nm is needed for ophthalmic imaging to avoid “absorption” in the ocular media, which is substantially greater at longer wavelengths (such as around 1300 nm) than for shorter wavelengths. *Id.* (citing Ex. 2002 ¶ 12; Ex. 2003, 502).

Patent Owner further contends that, if Huber were modified to operate at a wavelength suitable for measuring an ocular sample, Petitioner has failed to demonstrate that Huber would still meet the claimed line width limitation. PO Resp. 28. In particular, using the wavelength disclosed in Lexer of 780 nm, and assuming a linewidth $\delta\lambda$ of 0.03 nm (an assumption Patent Owner separately challenges, as discussed below), Patent Owner calculates Huber's line width δk using the conversion formula applied by Petitioner (Pet. 51) as 309.82 m^{-1} , which exceeds the maximum line width recited in all of the claims. PO Resp. 28 (citing Ex. 2013 ¶¶ 130–133).

Petitioner counters that the ordinarily skilled artisan would have understood that Huber's wavelength would not need to be decreased for use on ocular samples because it was known at the time of the '330 patent that ophthalmic imaging could be done with a light source having a 1300 nm wavelength. Pet. Reply 6 (citing Ex. 1027 ¶¶ 24–25). Patent Owner responds by providing testimony of Dr. Leitgeb stating that use of 1300 nm in ophthalmic applications was not known for measuring the *entire depth of the eye* (as required by the claims), but only for measuring the anterior chamber (front) of the eye, which was of such shallow depth that water absorption was not critical. PO Sur-reply 6–7 (citing Ex. 2013 § V-A-(ii), ¶¶ 118–121). Patent Owner maintains, again citing Dr. Leitgeb's testimony, that use of a 1300 nm wavelength for measuring the entire depth of the eye was deemed unsuitable due to water absorption. *Id.* at 7 (citing Ex. 2013 § V-A-(ii), ¶¶ 116–121).

Petitioner further contends that attenuation due to absorption at 1300 nm could be compensated by increasing the power of the laser. Pet. Reply 7. Patent Owner responds by pointing out that Petitioner does not provide

evidentiary basis for a particular increase of power, “let alone any explanation how this alleged power increase could offset a signal loss at 1300nm, which is about 700 times greater than at the wavelength of 833nm.” PO Sur-reply 7 (citing Ex. 2013 ¶ 124). Patent Owner additionally provides evidence, through Dr. Leitgeb’s testimony, that increasing power sufficiently to compensate for attenuation at 1300 nm would exceed the safety limit for ophthalmic applications. PO Resp. 23 (citing Ex. 2013 ¶ 124); PO Sur-reply 8 (same).

We find that Patent Owner’s arguments and evidence, summarized above, undermine Petitioner’s contention that Huber’s disclosed preferred center wavelength of 1305 nm would have been understood by the ordinarily skilled artisan to be suitable for imaging ocular samples. We do not, however, agree with Patent Owner’s contention that the ordinarily skilled artisan would have understood that wavelengths as short as around 800 nm were required for ophthalmic imaging. *See* PO Resp. 21–22. That contention is undermined by the Specification, which describes wavelengths of the measurement beam of “between 600 and 1150 nm,” with “wavelengths of 700 nm, 800 nm, and 1060 nm being particularly preferred.” Ex. 1001, 5:13–15. Thus, the ’330 patent itself recognizes that wavelengths as long as 1150 nm are suitable for measurement of eyes, which is far in excess of the 800 nm that Patent Owner asserts Huber’s system would have to use for measurement of eyes.

In its Reply submitted prior to our Institution Decision, Petitioner alternatively argues that Huber also teaches operating at shorter wavelengths that are within the range recognized in the ’330 patent as suitable for ophthalmic imaging. In particular, Petitioner argues that: (1) the ’330

patent recognizes that wavelengths of up to 1150 nm are suitable for ophthalmic imaging (Paper 13, 4 (citing Ex. 1001, 5:13–15, 9:64–10:3, 14:15–17)); and (2) Huber discloses wavelengths of between 600 nm and 2000 nm (*id.* at 6 (citing Ex. 1008, 2:17–20, 9:48–52, 24:61–25:11)). Assuming an operating wavelength of 1150 nm in Huber, Petitioner calculates a line width of 142.52 m^{-1} , which meets the line width limitation of claims 2 and 42. *See id.* at 5.

In its Response, Patent Owner first challenges this shorter-wavelength argument procedurally, contending it is a new combination of Huber and Lexer raised for the first time in Petitioner’s pre-institution Reply, relying on previously uncited portions of Huber (PO Resp. 26). Patent Owner also challenges this argument as premised entirely on hindsight, asserting that Petitioner “fails to explain *why* and *how* a POSITA would have had a reason to choose the specific wavelength of 1150nm from Huber’s broad range of 600nm to 2000nm” (*id.* at 27). Because, as discussed below, we agree with Patent Owner’s arguments and evidence directed to the merits of Petitioner’s shorter-wavelength argument, we do not address these first two arguments herein.

Patent Owner addresses the merits of Petitioner’s shorter-wavelength argument by arguing that the Petition fails to demonstrate how Huber could maintain its linewidth $\delta\lambda$ of 0.03 nm when tuning at a shorter wavelength suitable for measuring an ocular sample. PO Resp. 29–33. In particular, Patent Owner presents evidence, including the testimony of Dr. Leitgeb, that Huber’s optical components are “subject to dispersion that is wavelength dependent because the propagating speed of light in these components depends on the specific wavelength of the light.” *Id.* at 29 (citing Ex. 2013

¶¶ 135–136). Patent Owner also points to Huber’s disclosure as indicating that Huber’s laser source is “predicated on sufficient dispersion compensation that is wavelength specific.” *Id.* at 29–30 (citing Ex. 1008, 10:12–23, Fig. 6). Patent Owner contends Huber’s disclosed center wavelength of 1305 nm is important, because it is near the zero dispersion point of the used fiber, at 1313 nm. *Id.* at 29–30 (citing Ex. 1008, 10:12–23). On the other hand, if Huber’s system were modified to operate at a shorter wavelength, Patent Owner contends (relying on the testimony of Dr. Leitgeb) that the decreased wavelength would create significant dispersion issues that would “induce[] a ***spread*** of the waveform after ***each*** round trip through the laser cavity, further ***exacerbating the mismatch*** of round trip time.” *Id.* at 32 (citing Ex. 2013 ¶ 142); *see also id.* at 30–32 (citing Ex. 2013 ¶¶ 140–144).

Patent Owner also notes that the Petition does not account for, e.g., increased dispersion that would accompany a wavelength in Huber shorter than the disclosed preferred center wavelength of 1305 nm. *Id.* at 32. In particular, as Patent Owner notes, the Petition has failed to provide evidence to support the assumption that Huber’s system could maintain an instantaneous linewidth $\delta\lambda$ of 0.03 nm, which is used in Petitioner’s calculations of the claimed parameters. *Id.* at 32–33.

In response, Petitioner points to Exhibit 2016, originally introduced by Patent Owner, as evidencing wavelengths as short as 1050 nm for *in vivo* ophthalmic imaging. Pet. Reply 10 (citing Ex. 2016, 2014). Petitioner emphasizes that Exhibit 2016 is an article authored by Huber, which indicates that “Huber himself disclosed using such lower wavelengths for measurements of the eye.” *Id.* With regard to dispersion issues allegedly

correlating with Huber operating at shorter wavelengths, Petitioner notes that Exhibit 2016 discloses an FDML laser operating “at 1050 nm without additional dispersion compensating elements.” *Id.* at 11 (emphasis omitted). Petitioner further attempts to discount Patent Owner’s dispersion argument, pointing to evidence that “dispersion management and dispersion compensation were well-known before 2006,” and also noting that the ’330 patent “does not discuss the important aspect of fiber dispersion.” *Id.* at 12–13.

We find Petitioner has not demonstrated that Huber teaches a maximum line width of $\delta k < 168 \text{ m}^{-1}$ as recited in claim 2, much less a maximum line width in the shorter ranges of $\delta k < 162 \text{ m}^{-1}$ as recited in claim 42, or $\delta k < 93 \text{ m}^{-1}$ as recited in claim 40, when operating at a wavelength suitable for imaging ocular samples. First, Petitioner asserts that 1305 nm is the center of Huber’s wavelength sweep range of 1250–1360 nm, and relies on that 1305 nm wavelength to calculate the line width δk . *See* Pet. 50–51. As noted above, however, Petitioner does not persuasively demonstrate that a wavelength of 1305 nm is suitable for use in measuring an eye (as claims 2, 40, and 42 require).

Second, Petitioner also does not persuasively demonstrate that the claimed line width δk of claims 2, 40, and 42 would be satisfied if a shorter wavelength within a range recognized in the art as suitable for use in measuring an eye were used. At pages 50–51 of the Petition, Petitioner bases its calculations of claimed line width δk on a particular linewidth $\delta \lambda$ disclosed by Huber—namely, 0.03 nm. But, after reviewing the parties’ arguments and evidence, we agree with Patent Owner, on the full trial

record, that Petitioner has not demonstrated that, if Huber were operated at shorter wavelengths (wavelengths suitable for measuring a human eye), Huber could still achieve an instantaneous linewidth $\delta\lambda$ of 0.03 nm. *See* PO Resp. 29–32; Ex. 2013 ¶¶ 134–154.

In particular, Petitioner does not point us to any evidence supporting a teaching in Huber or otherwise in the trial record that Huber’s instantaneous linewidth $\delta\lambda$ of 0.03 nm applies *regardless* of the operating wavelength. In describing its system, Huber discloses a coherence length of “about 4 cm” operating with “a wavelength sweep range between 1250 nm and 1360 nm.” Ex. 1008, 10:15–29. Huber further discloses that a coherence length greater than 4 cm corresponds to a linewidth of less than 0.03 nm. *Id.* at 24:5–8. Although Huber also generally states that “in the case of a swept light source, the coherence length can range from about 1 cm to about 40 cm” (*id.* at 8:21–22), Huber does not state what parameters of the system would correlate with different coherence lengths.

At oral argument, counsel for Petitioner asserted (by affirming when asked) that Huber’s system could achieve a coherence length of up to 40 cm at any of the wavelengths disclosed (between 600 to 2000 nm) (Tr. 19:4–12), but the evidence of record does not support that assertion. To the contrary, the formula applied by Petitioner to calculate line width reveals a relationship among linewidth $\delta\lambda$, wavelength λ_0 , and line width δk :

$$\delta k = \frac{2\pi}{\lambda_0^2} \delta\lambda$$

See Pet. 51; Ex. 1012 ¶ 116.

Petitioner has also provided a formula for coherence length that reveals a relationship between coherence length (l_c), instantaneous line width ($\delta\lambda'$), and wavelength (λ) (Pet 65; Ex. 1012 ¶ 185):

$$l_c = \frac{2 \ln 2 \lambda^2}{\pi \delta\lambda'}$$

This formula confirms that coherence length l_c is not independent of wavelength, which undermines Petitioner's unsupported contention that Huber's general statement a range of coherence length from 1 cm to 40 cm would apply for any operating wavelength.

Simply put, Petitioner does not present sufficient evidence to support finding that a given linewidth, such as 0.03 nm disclosed by Huber in correspondence with a coherence length of 4 cm at an operating wavelength range of between 1250 nm and 1360 nm, will also apply to a laser operated at a shorter wavelength, such as for a laser operated at a wavelength suitable for use in measuring the human eye (e.g., 1150 or below, according to the '330 patent's Specification). Therefore, Petitioner's calculations of linewidth $\delta\lambda$ based on a shorter wavelength (e.g., 1050 nm) than the wavelengths in Huber's disclosed preferred operating wavelength range, *while assuming and applying the same linewidth $\delta\lambda$ of 0.03 nm*, are not supported on this evidentiary record and hence are not persuasive.

For claim 40, which recites a line width of less than 93 m^{-1} (much less than the value of 110.7 m^{-1} Petitioner calculates for claim 1 (*see* Pet. 51)), Petitioner presents an alternative computation for $\delta\lambda$ using the upper end coherence length value disclosed in Huber of 40 cm. *See* Pet. 65–66. In particular, using a conversion formula described by Dr. Brennan (Ex. 1012 ¶ 116), Petitioner asserts that the line width $\delta\lambda$ may be calculated based

solely on a disclosed coherence length:

$$\delta k = \frac{4 \ln(2)}{l_c}$$

Pet. 66 (citing Ex. 1012 ¶ 186). Assuming a coherence length of 40 cm at the upper end of the theoretical range stated in Huber, Petitioner calculates a line width δk of 6.9 m^{-1} . *Id.* (citing Ex. 1012 ¶ 187).

Thus, Petitioner relies on a wavelength-based equation for some claims (claims 2 and 42), but a “coherence length”-based equation for another claim (claim 40). Petitioner’s shifting analysis appears to be driven by the fact that claim 40 recites that the light source has an upper boundary line width ($\delta k < 93 \text{ m}^{-1}$) that is considerably narrower than the upper boundary line width recited in claim 2 ($\delta k < 168 \text{ m}^{-1}$). However, Petitioner’s analysis based on the coherence length fails to apply Petitioner’s own definition for “line width δk .” *Compare* Pet. 51 (defining “line width δk ” using a wavelength-dependent equation), *with id.* at 65–66 (relying on a wavelength-independent calculation of line width δk in Huber).

Petitioner does not attempt to explain or justify departing from its own definition of “line width δk ” for claim 40. Nor does Petitioner otherwise attempt to explain or justify choosing different equations for calculating the same parameter of line width δk , with the different equations also producing different results. For example, as noted above, Petitioner’s application of the wavelength-based equation to Huber for a wavelength of 1305 nm yields a line width value of 110.7 m^{-1} , while Petitioner’s application of the “coherence length”-based equation to Huber yields a line width value of 6.9 m^{-1} . *See* Pet 50–51, 65–66. In addition, we observe that, even if the product of δk and l_c is a constant (e.g., $4 \ln(2)$) as in Petitioner’s equation at

Pet. 66), it does not follow that any choice of l_c (e.g., 40 cm, as chosen by Petitioner at Pet. 66) would or could correspond to *any choice of a wavelength λ* . In other words, even if Petitioner correctly contends that the product of δk and l_c is a constant (e.g., $4 \ln(2)$), that contention does not acknowledge that *different such pairs* of $(\delta k, l_c)$ values (i.e., pairs whose product amounts to $4 \ln(2)$) correspond to *different wavelengths λ* . Petitioner's argument (and formula) at page 66 of the Petition does not explain why the pair of $\delta k=6.9 \text{ m}^{-1}$ and $l_c=40\text{cm}$ could or would correspond to a *wavelength suitable for ocular measurements*.

We further note that, as we observe above, coherence length is not, in fact, independent of wavelength, and Petitioner does not direct us to any disclosure in Huber of a linewidth or wavelength sweep range corresponding to a coherence length of 40 cm, much less apply Petitioner's wavelength-based equation to Huber's disclosure of a coherence length of 40 cm.

Thus, Petitioner's purported calculations of line width δk using the "coherence length"-based equation are not persuasive because they fail to apply the wavelength-based equation Petitioner adopts as the definition for "line width δk " and applies for claim 2. *See* Pet. 50–51. Petitioner provides no justification for this difference.

We are not persuaded that Petitioner has established, by a preponderance of the evidence, that the prior art teaches or suggests the subject matter of claims 2, 40, and 42. In particular, Petitioner has not presented persuasive evidence of a teaching in the prior art of a light source that, when operating at a wavelength suitable for measuring a sample

comprising a human eye, as required by claims 2, 40, and 42, meets the claimed line width limitations of these claims.

3. Conclusion

After having analyzed the entirety of the trial record and assigning appropriate weight to the cited supporting evidence, we determine Petitioner has shown by a preponderance of the evidence that independent claim 1 and dependent claims 21–26 are unpatentable over the teachings of Huber in view of Everett and Lexer. We are not, however, persuaded by a preponderance of the evidence that dependent claims 2, 27, 40, and 42 are unpatentable over the cited prior art.

III. PATENT OWNER’S REVISED CONTINGENT MOTION TO AMEND

A. Introduction

Under 35 U.S.C. § 316(d)(1) and 37 C.F.R. § 42.121(a), Patent Owner moves to replace claims 1 and 21 of the ’330 patent with proposed substitute claims 44 and 45. RMTA 2. The motion is contingent on our determination that claims 1 and 21 are unpatentable. *Id.* Because we determine that claims 1 and 21 have been shown to be unpatentable for the reasons explained above (*see* Sections II.D.2.a, b), we address Patent Owner’s Revised Motion to Amend.

Pilot Program Participation

A pilot program for motion to amend practice and procedures became available to all proceedings instituted on or after March 15, 2019. *See* Notice Regarding a New Pilot Program Concerning Motion to Amend Practice and Procedures in Trial Proceedings in Under the America Invents Act Before the Patent Trial and Appeal Board, 81 Fed. Reg. 9497 (March

15, 2019). Pursuant to the Pilot Program, a patent owner may request, in its motion to amend, that the Board issue preliminary guidance after the petitioner files its opposition. *See id.* at 9499, 9500. Preliminary guidance on a motion to amend is not binding on the Board. *See id.* at 9500. After receiving preliminary guidance from the Board, a patent owner may elect to file a revised motion to amend, file a reply to petitioner’s opposition and/or the preliminary guidance, or take no action. *See id.*

In the proceeding before us, Patent Owner requested preliminary guidance from the Board in its Motion to Amend. *See* MTA 2. After Petitioner filed its Opposition to the Motion to Amend (Paper 20, “MTA Opp.”), the Board issued Preliminary Guidance. *See* Paper 21. Patent Owner then elected to file a Revised Motion to Amend (Paper 22, “RMTA”), which we address herein.

B. Proposed Substitute Claims

Patent Owner submits the following proposed substitute claims 44 and 45 (with added material underlined, and deleted material bracketed):

44. [44.pre]¹⁰ A device for swept source optical coherence domain reflectometry (SS OCDR) on a movable sample, for the purpose of obtaining A-scans, comprising:

[44.a] a tunable laser light source for illuminating a movable sample, wherein the movable sample is a movable human eye having a cornea and a retina, the cornea having a front surface;

[44.b] at least one receiver for receiving light signals backscattered from the human eye including both the cornea and

¹⁰ We use Patent Owner’s designations to refer to the claim elements of the proposed substitute claims. RMTA, APPENDIX A (Listing of Proposed Substitute Claims).

the retina [[sample]], wherein the [[sample]] human eye is illuminated on the [[sample]] the front surface of the cornea by [[with]] a measurement beam of diameter D[[;]],

[44.c] wherein the tunable laser light source has a line width of $\delta k < 168 \text{ m}^{-1}$, wherein $k = 2\pi/\lambda$,

[44.d] wherein [[the]] an A scan measuring range corresponds to a depth of the [[sample]] human eye from the cornea to the retina, and

[44.e] further wherein the device is configured such that the tuning of the tunable laser light source is performed in a time $\tau < 44 \text{ sec}/(D * k_0)$ about a centroid wave number k_0 , and wherein, during the tuning, the light signals are received from throughout the depth of the human eye from the cornea to the retina.

45. [45.pre] [[The device for SS OCDR as claimed in claim 1,]] A device for swept source optical coherence domain reflectometry (SS OCDR) on a movable sample, for the purpose of obtaining A-scans, comprising:

[45.a] a tunable laser light source for illuminating a movable sample, wherein the movable sample is a movable human eye having a cornea and a retina, the cornea having a front surface;

[45.b] at least one receiver for receiving light signals backscattered from the human eye including both the cornea and the retina, wherein the human eye illuminated on the front surface of the cornea by a measurement beam of diameter D,

[45.c] wherein the tunable light source has a center wavelength between 900nm and 1060nm, a line width of $\delta k < 93 \text{ m}^{-1}$, and wherein $k = 2\pi/\lambda$,

[45.d] wherein an A scan measuring range corresponds to a depth of the human eye from the cornea to the retina,

[45.e] wherein the device is configured such that the tuning of the tunable laser light source is performed in a time $\tau < 44 \text{ sec}/(D * k_0)$ about a centroid wave number k_0 , and wherein

the tunable laser light source has a spectral tuning range Δk about
[[a]] the centroid wave number k_0 of at least $\Delta k > 18\,000\text{ m}^{-1}$.

RMTA, APPENDIX A (indentation added/modified for clarity).

C. Procedural Requirements

“Before considering the patentability of any substitute claims, . . . the Board first must determine whether the motion to amend meets the statutory and regulatory requirements set forth in 35 U.S.C. § 316(d) and 37 C.F.R. § 42.121.” *Lectrosonics, Inc. v. Zaxcom, Inc.*, IPR2018-01129, Paper 15, 4 (PTAB Feb. 25, 2019) (precedential) (“*Lectrosonics*”).¹¹

First, we consider whether the Revised Motion to Amend proposes a reasonable number of substitute claims. 35 U.S.C. § 316(d)(1)(B). We apply “a rebuttable presumption that a reasonable number of substitute claims per challenged claim is one (1) substitute claim.” *Lectrosonics* at 4–5 (citing 37 C.F.R. § 42.121(a)(3)). Patent Owner proposes two substitute claims for two challenged claims. RMTA 2. Thus, Patent Owner has proposed a reasonable number of substitute claims.

Second, we consider whether the proposed substitute claims respond to a ground of unpatentability involved in this trial. *Lectrosonics* at 5–6. Proposed substitute claims 44 and 45 amend the language of claims 1 and 21, respectively, to recite a number of additional features of the device for swept source optical coherence domain reflectometry, and Patent Owner

¹¹ Petitioner challenges the proposed substitute claims on the basis of enablement, indefiniteness, and obviousness, but does not challenge Patent Owner’s assertions that its motion and proposed substitute claims meet the statutory and regulatory requirements set forth in § 316(d) and Rule 42.121. *See generally* RMTA Opp.

asserts that the proposed substitute claims are patentable over the instituted grounds and references at issue in this proceeding. RMTA 13–24. We conclude that the language of the proposed substitute claims is responsive to grounds of unpatentability involved in this trial because Patent Owner adds limitations in a manner intended to address the prior art cited by Petitioner in relation to originally challenged claims.

Third, we consider the breadth of the substitute claims because “[a] motion to amend may not present proposed substitute claims that enlarge the scope of the claims of the challenged patent or introduce new subject matter.” *Lectrosonics* at 6–8; 35 U.S.C. § 316(d)(3); 37 C.F.R. § 42.121(a)(2)(ii). The amendment limits independent proposed substitute claim 44, in particular, as to the features or properties of a device configured to measure an eye. Indeed, the amendment adds claim language that we declined to read into claim 1 (as discussed *supra*, Section II.C.2) and therefore, proposed substitute claim 44 is narrower than its corresponding original claim 1. The amendment also limits independent substitute claim 45, in particular, as to the features or properties of a device with a particular spectral tuning range and configured to measure an eye. Indeed, the amendment adds claim language that we declined to read into claim 21 (as discussed *supra*, Section II.C.2), and therefore, proposed substitute claim 45 is narrower than its corresponding original claim 21.

Patent Owner asserts that the proposed substitute claims are described and supported by the ’330 patent’s application (U.S. Application 13/140,752) and priority application. RMTA 4 (citing Ex. 2014 (“the ’752 App.”) and Ex. 2015 (“DE ’225 App.”)). Patent Owner identifies where, in those applications, the amended claim language derives support. *Id.* at 4–12.

Patent Owner cites the testimony of Dr. Leitgeb to further buttress its analysis. *See id.* (citing Ex. 2013 ¶ 207; Ex. 2019 ¶¶ 49–65). Considering Patent Owner’s assertions and evidence on these points (unopposed by Petitioner), we find on this record that the proposed substitute claims are adequately supported and introduce no new matter.

Finally, the Revised Motion to Amend includes the required claim listing. RMTA, APPENDIX A; 37 C.F.R. § 42.121(b); *Lectrosonics* at 8.

Based on the above, we find that Patent Owner’s Revised Motion to Amend meets the requirements of 35 U.S.C. § 316(d) and 37 C.F.R. § 42.121. Therefore, we analyze whether Petitioner has met its burden of persuasion on the alleged unpatentability of the proposed substitute claims. *See Lectrosonics* at 4 (stating that “the burden of persuasion ordinarily will lie with the petitioner to show that any proposed substitute claims are unpatentable by a preponderance of the evidence”); *see also Aqua Prods., Inc. v. Matal*, 872 F.3d 1290, 1328 (Fed. Cir. 2017) (en banc) (holding the Board must assess the patentability of proposed substitute claims “without placing the burden of persuasion on the patent owner”). In the analysis below, we assess whether the proposed substitute claims “are unpatentable by a preponderance of the evidence based on the entirety of the record” before us. *Lectrosonics* at 4.

D. Claim Construction

Patent Owner “asserts that no express constructions are required to find proposed substitute claims 44–45 patentable because the proposed substitute claims expressly recite that the movable sample is a human eye” and “[a]ll terms should therefore be given their plain and ordinary meanings consistent with the ’330 patent’s specification as understood by a POSITA.”

RMTA 13. Petitioner does not provide its own proposed construction for any terms in the proposed substitute claims. *See generally* RMTA Opp. We determine that no claim terms require construction to address the issues posed by Patent Owner’s Revised Motion to Amend. *See Nidec Motor Corp.*, 868 F.3d at 1017.

As we explain above (*see* Section II.C.2), the term “movable sample” in the preamble of claim 1 is not entitled to patentable weight. As also explained above (Section II.D.2.a, b), we find no basis for limiting claims 1 and 21 to an apparatus suitable for measuring an eye. Patent Owner’s proposed substitute claims 44 and 45 do not, however, rely on recitations in the preamble, but explicitly recite several limitations (e.g., “the movable sample is a movable human eye having a cornea and a retina”) that further define the characteristics of the sample being measured by the device for swept source optical coherence domain reflectometry—limitations that we declined to import into the phrase “movable sample,” as recited in claim 1.

E. Whether the Proposed Substitute Claims are Non-enabled or Indefinite

Petitioner argues, in Section I(A) of its Opposition, that the substitute claims are indefinite for failing to “inform those skilled in the art about the scope of the invention with reasonable certainty.” RMTA Opp. 1 (citing *Nautilus, Inc. v. Biosig Instruments, Inc.*, 572 U.S. 898, 910 (2014)). In Section I(B) of the Opposition, Petitioner argues that those claims are “not enabled.” *Id.* at 5–7.

1. Enablement

Petitioner argues that proposed substitute claims 44 and 45 are non-enabled because they recite a “tunable laser light source” but “the specification does not disclose how a POSITA could achieve the claimed

‘tunable light source’ with the claimed characteristics, in particular a tunable light source with the claimed linewidth, A-scan measuring range, tuning time, and centroid wave number.” RMTA Opp. 5 (citing Ex. 1043 ¶¶ 26–27). Dr. Brennan’s testimony (Ex. 1043 ¶¶ 26–27), relied upon by Petitioner, urges that “*undue experimentation would be required* of a POSITA to make the alleged invention, in particular, to make the claimed tunable source having the claimed parameters” because “the only disclosure in the specification of the ‘330 Patent that identifies an actual type of available ‘tunable light source’ is a single suggestion that ‘tunable fiber ring lasers’ can achieve the desired linewidths and ‘acceptable drops in sensitivity over the measurement depth’” and “the ‘330 Patent does not provide any description of the components, gain medium, tuning mechanism, or cavity design, that a POSITA would need to know in order to make the claimed laser.” *See* Ex. 1043 ¶¶ 26–27 (citing Ex. 1001, 3:55–58) (emphasis added).

Patent Owner counters that the claims are enabled and Petitioner’s arguments should be rejected because “[they] are unsupported.” RMTA Reply 7. According to Patent Owner, the ’330 patent provides guidance in the form of examples of a tunable laser light source and examples that explain, for instance, how to select and adjust suitable centroid wave numbers, measurement beam profiles, photon flux, and wavelengths for a tunable laser light source of the SS OCDR device, how to select reference plane placement, and how to configure the device’s receiver of backscattered light, to obtain the claimed line widths, tuning time, spectral tuning range, and A-scan measuring range that corresponds to a depth of the human eye from cornea to retina. RMTA Reply 7–9 (citing Ex. 1001, 3:9–17, 3:34–58,

4:47–54, 5:12–15, 9:64–10:17; Ex. 2019 ¶¶ 59–61; Ex. 2020 ¶¶ 33–42, 44); *see also* Ex. 2020 ¶¶ 35–42, 44 (discussing disclosure at Ex. 1001, 3:9–17, 3:34–53, 3:55–58, 4:47–54, 5:12–15, 9:64–10:19, 10:23–24, 10:27–37, 11:16–29); Ex. 2019 ¶¶ 59–61 (discussing disclosure of U.S. Application 13/140,752).

Petitioner fails, on this record, to provide persuasive evidence sufficient to meet its burden to demonstrate that claims 44 and 45 are non-enabled. The factors relevant to whether undue experimentation is required include, *inter alia*, “the quantity of experimentation necessary,” “the presence or absence of working examples,” the “predictability or unpredictability of the art,” and the “breadth of the claims.” *In re Wands*, 858 F.2d 731, 737 (Fed. Cir. 1988). Quoting Dr. Brennan’s conclusory statement that “undue experimentation would be required of a POSITA to make the alleged invention, in particular, to make the claimed tunable source having the claimed parameters” (Ex. 1043 ¶ 27), Petitioner references a need for “undue experimentation” to practice the claims. *See* RMTA Opp. 5–6 (citing Ex. 1043 ¶¶ 26–27). Critically lacking, however, is evidence from Petitioner that demonstrates, from the skilled artisan’s perspective, *why* the quantity of experimentation needed would be undue, especially in view of the guidance provided in the patent itself. *Ajinomoto Co. v. Archer-Daniels-Midland Co.*, 228 F.3d 1338, 1345 (Fed. Cir. 2000) (explaining that “[e]nablement is determined from the viewpoint of persons of skill in the field” at the time of the invention). Instead of providing such evidence, Petitioner urges that the ’330 patent merely discloses “*properties* of the tunable laser” and asserts that “[t]here is a difference between *describing desired properties* of a laser (or related equipment) and enabling a POSITA

to make or use the invention without undue experimentation.” RMTA Sur-reply 5 (emphases added). Petitioner’s Opposition similarly states, “[t]he ‘330 patent fails to provide an enabling disclosure of how to build a laser that would achieve the desired properties.” *See id.*

Petitioner’s arguments have not addressed the specific disclosure of the ‘330 patent pointed to by Patent Owner and Patent Owner’s declarant. *See* RMTA Reply 7–9 (citing Ex. 1001, 3:9–17, 3:34–58, 4:47–54, 5:12–15, 9:64–10:17; Ex. 2019 ¶¶ 59–61; Ex. 2020 ¶¶ 33–42, 44); *see also* Ex. 2020 ¶¶ 35–42, 44 (discussing disclosure at Ex. 1001, 3:9–17, 3:34–53, 3:55–58, 4:47–54, 5:12–15, 9:64–10:19, 10:23–24, 10:27–37, 11:16–29); Ex. 2019 ¶¶ 59–61 (discussing disclosure of U.S. Application 13/140,752). In addition, Petitioner has not explained why knowledge of characteristics/properties of a tunable laser and of other components of the SS OCDR device (such as the properties disclosed in the ‘330 patent) would be irrelevant to making and using the claimed SS OCDR device, and why such properties could not be used or relied upon for making and using the claimed SS OCDR device.

As Patent Owner points out (RMTA Reply 6–9), the ‘330 patent describes working examples that explain how to select and adjust suitable centroid wave numbers (*see* Ex. 1001, 2:60–62, 3:34–36, 4:50–51, 5:13–15, 8:37–41, 9:64–10:3), measurement beam profiles (*id.* at 2:63–65, 3:9–25, 4:9–45, 6:4–10, 9:36–47, 10:30–36), photon flux (*id.* at 4:47–54), and wavelengths (*id.* at 4:49–54, 5:13–15, 8:37–41, 9:64–10:3) in a tunable laser light source of the SS OCDR device, how to select reference plane placement (*id.* at 5:61–62, 10:10–36, 11:16–29, Figs. 3a–3e), and how to configure the device’s receiver (*id.* at 2:62–64, 3:47–61, 6:4–14, 6:26–28) to

obtain the claimed line widths (*id.* at 2:65–67, 3:37–57, 10:4–8, 10:18–41), tuning time (*id.* at 2:66–67, 3:8–16, 3:43–53, 6:45–7:4, 9:64–67), spectral tuning range (*id.* at 3:34–46, 6:45–50, 9:64–67), and A-scan measuring range that corresponds to a depth of the human eye from cornea to retina (*id.* at 2:7–11, 2:57–62, 4:1–4, 5:43–51, 6:49–64, 7:5–14, 7:34–37, 9:64–10:3). In view of the guidance provided by the '330 patent, we are not persuaded that Petitioner has shown that one skilled in the pertinent art could not implement or use the tunable laser light source of proposed substitute claims 44 and 45. *See PPG Indus., Inc. v. Guardian Indus. Corp.*, 75 F.3d 1558, 1565 (Fed. Cir. 1996) (“Where the specification provides guidance in selecting the operating parameters that would yield the claimed result, it is fair to conclude that the experimentation required to make a particular embodiment is not ‘undue.’”) (internal citation and quotation marks omitted). On balance, the evidence suggests that the use of appropriate laser light source parameters, tuning techniques, and measurement techniques in the SS OCDR device does not require more than ordinary, routine skill over the guidance provided by the '330 patent itself. Some experimentation may be required. But we do not agree with Petitioner’s assertions here that it has shown that the experimentation would be “undue.” Indeed, “[a] claim is sufficiently enabled even if ‘a considerable amount of experimentation’ is necessary, so long as the experimentation ‘is merely routine, or if the specification in question provides a reasonable amount of guidance with respect to the direction in which the experimentation should proceed.’” *Vasudevan Software, Inc. v. MicroStrategy, Inc.*, 782 F.3d 671, 684 (Fed. Cir. 2015) (quoting *Wands*, 858 F.2d at 737).

Petitioner also notes the '330 patent's reference to "tunable fiber ring lasers" (*see* Ex. 1001, 3:55–58, providing that the inventive "line widths can be implemented, for example, with tunable fiber ring lasers"), but asserts the proposed substitute claims are non-enabled because "[t]he '330 Patent does not disclose by which means a tunable fiber ring laser could be implemented to achieve the claims." RMTA Opp. 5. Petitioner further supports its non-enablement argument by asserting that

PO has attacked Huber's disclosure of a coherence length of between 1 cm and 40 cm as being a "one-off sentence" or "one-off instance," yet it provides no explanation for how or why the '330 patent's single mention of a "fiber ring laser" is sufficient to enable the claims of the '330 patent.

RMTA Sur-reply 5 (citing Ex. 1043 ¶¶ 26–31). Petitioner's argument is further illuminated by the testimony of Petitioner's declarant (Dr. Brennan):

To the extent that a POSITA could rely on information known in the art, a POSITA would have concluded from published literature *that FDML lasers were the only configuration of tunable fiber ring lasers capable of achieving the tunable source claimed in claims 44 and 45. . . .*

. . . [A] leading researcher at the time of the '330 patent, Dr. Brett Bouma, *lists only one fiber ring laser* in his chapter encompassing wavelength swept lasers that are suitable for SS-OCT, *and that laser is an FDML fiber ring laser as detailed by Huber*. Yet the Patent Owner contends that the Huber invention of an FDML laser is not capable of meeting the specifications claimed in the '330 patent, although only a 'tunable fiber ring laser' is given as a means for a POSITA to achieve these specifications. *Clearly the '330 patent is enabled and anticipated by Huber, or the '330 patent is not enabled*, as a POSITA would have no means or knowledge to construct this 'tunable fiber ring laser,' which one must conclude was unknown to leading researchers at the time of the filing of the '330 patent.

Ex. 1043 ¶¶ 28–29 (emphases added). Petitioner’s argument appears to be that, if proposed substitute claims 44 and 45 are enabled, then those claims must be using Huber’s FDML fiber ring laser (“[c]learly the ‘330 patent is enabled and anticipated by Huber, or the ‘330 patent is not enabled,” *see* Ex. 1043, reproduced *supra*) because “Dr. Brett Bouma[] lists only one fiber ring laser in his chapter encompassing wavelength swept lasers that are suitable for SS-OCT, and that laser is an FDML fiber ring laser as detailed by Huber.” *See* Ex. 1043 ¶ 29; *see also* RMTA Reply 5.

Petitioner’s argument and evidence of non-enablement are unpersuasive for the following reasons. First, neither claims 44 and 45, nor the relevant disclosure of the ‘330 patent, limit the claimed “tunable laser light source” to *a tunable fiber ring laser*. Second, Petitioner does not provide persuasive evidence sufficient to support Petitioner’s premise that Huber’s FDML fiber ring laser was *the only* swept source tunable laser suitable for SS OCT at the time of the ‘330 patent’s invention. Here, we observe the ‘330 patent casts doubt on Petitioner’s premise by disclosing other (i.e., not Huber’s) prior art lasers suitable for SS OCT and SS OCDR. *See* Ex. 1001, 1:60–2:46; *see also* Ex. 2020 ¶¶ 33–34, 37 (providing testimony disputing Petitioner’s premise).

Petitioner also argues that proposed substitute claims 44 and 45 are non-enabled because the claimed “A scan measuring range correspond[ing] to a depth of the human eye from the cornea to the retina” would allegedly require addressing “the ‘water absorption’ issue,” but “the ‘330 patent itself does not disclose any details about how to build a laser that accounts for such ‘water absorption’ issues . . . [and] also fails to explain whether its disclosed linewidths and tuning range account for such water absorption.”

RMTA Opp. 6–7. Here, again, Petitioner fails to provide persuasive evidence sufficient to meet its burden and demonstrate that proposed substitute claims 44 and 45 are non-enabled—for example, Petitioner has not provided evidence that demonstrates, from the skilled artisan’s perspective, that the quantity of experimentation allegedly needed would be undue because of the “water absorption” issue.

Patent Owner, on the other hand, has explained why no undue experimentation would be required to make and use the claimed SS OCDR device. In particular, Patent Owner explains “the ’330 patent does not need to account for water absorption” because the ’330 patent teaches “wavelengths of 700 nm, 800 nm and 1060 nm being particularly preferred” and “[a]t wavelengths of 700 nm, 800 nm and 1060 nm water absorption is more than 400 times less than at 1300 nm [(Huber’s FDML laser wavelength)].” RMTA Reply 9 (citing Ex. 1001, 5:14–15; Ex. 2013 ¶¶ 31–32, 106, 124; Ex. 2020 ¶¶ 43, 38). Patent Owner’s declarant (Dr. Leitgeb) corroborates this argument, stating that

water absorption at 1300nm was widely known. EX2013, ¶¶31–32, 106, 124. At wavelengths of 700 nm, 800 nm and 1060 nm, as described by the ’330 patent, water absorption is more than 400 times less than at 1300 nm. *Id.* Because the claimed OCDR device of the ’330 patent does not operate around the wavelength of 1300 nm, which Huber relied on for its FDML laser, the ’330 patent does not need to account for water absorption

Ex. 2020 ¶ 43.

In addition, the ’330 patent’s disclosure explains adequately how to implement and use a tunable laser light source having the claimed center wavelengths (*see* proposed substitute claim 45) and line widths

(see proposed substitute claims 44 and 45) to obtain ocular A-scans having the claimed “A scan measuring range [that] corresponds to a depth of the human eye from the cornea to the retina.” See Ex. 1001, 2:7–11, 2:57–62, 4:1–4, 5:43–51, 6:49–64, 7:5–14, 7:34–37, 9:64–10:3.

In view of the guidance provided by the ’330 patent, we are not persuaded that Petitioner has shown that one skilled in the pertinent art could not implement or use the claimed “A scan measuring range correspond[ing] to a depth of the human eye from the cornea to the retina” recited in proposed substitute claims 44 and 45. See *United States v. Telectronics, Inc.*, 857 F.2d 778, 785 (Fed. Cir. 1988) (“The test of enablement is whether one reasonably skilled in the art could make or use the invention from the disclosures in the patent coupled with information known in the art without undue experimentation.”).

For the reasons above, we find Petitioner has not met its burden to show, by a preponderance of the evidence on this record, that proposed substitute claims 44 and 45 are non-enabled.

2. Indefiniteness

Petitioner argues that proposed substitute claims 44 and 45 are indefinite on several bases.

Petitioner first argues the proposed substitute claims are indefinite because they include the language “wherein the human eye is illuminated on the front surface of the cornea by a measurement beam of diameter D.” RMTA Opp. 1–2. According to Petitioner, the phrase “measurement beam of diameter D” renders the claims indefinite because the claims do not recite “where the ‘measurement beam of diameter D’ comes from” so “[i]t is unclear if the ‘measurement beam’ is a property of the ‘tunable laser’ or of

some other light source,” and, in fact, “it appears that the ‘measurement beam’ comes from another source, rather than the ‘tunable laser,’ because it does not have any antecedent basis.” *Id.* at 1.

Petitioner’s argument is unpersuasive. As Patent Owner notes, one having ordinary skill in the art would, in light of the Specification, have understood, with reasonable certainty, the recitation of the “measurement beam of diameter D” by which “the human eye is illuminated on the front surface of the cornea” to refer to a beam from the claimed “tunable laser light source.” RMTA Reply 1–2. This is so because (i) the “tunable laser light source” is the only light source recited in proposed substitute claims 44 and 45, such that “a POSITA would have reasonably understood that the phrase ‘a measurement beam of diameter D’ refers to a beam emitted by that tunable laser light source”; and (ii) the ’330 patent explains that the measurement beam of diameter D that illuminates the cornea is from the tunable laser light source. *See id.* (citing Ex. 1001, 2:63–65, 6:4–9, 6:22–23, Figs. 1–2).

We further note Petitioner’s argument that “it appears that the ‘measurement beam’ comes from another source, rather than the ‘tunable laser,’ because it does not have any antecedent basis” (*see* RMTA Opp. 1) disregards the antecedent basis provided by the claimed “illuminating” operation. In particular, proposed substitute claims 44 and 45 recite that the “tunable laser light source” is used “for *illuminating* . . . a movable human eye having a cornea and a retina, the cornea having a *front surface*” such that “the human eye is *illuminated on the front surface* of the cornea by a measurement beam of diameter D.” *See* claims proposed substitute 44, 45 (emphases added). Thus, language in the proposed substitute claims

indicates the specified illumination of the eye's front surface is performed by the "tunable laser light source" via "a measurement beam of diameter D."

Petitioner next argues that proposed substitute claims 44 and 45 are indefinite because they include the language "wherein an A scan measuring range corresponds to a depth of the human eye from the cornea to the retina." RMTA Opp. 2–3. According to Petitioner, the phrase "an A scan" renders the claims indefinite because the phrase "is not tied in any way to the other limitations of the claims . . . [i]t is not, for example, tied to the 'tunable laser' or the 'measurement beam.'" *Id.* at 2. Petitioner also argues the phrase "measuring range" renders the claims indefinite because (i) "[t]he '330 Patent has no explicit or clear or consistent definition of the term 'measuring range,'" and (ii) "the definition of measuring range used in claim 44 is different than the definition of measuring range used in claim 45" as evidenced by the fact that the different line widths in proposed substitute claims 44 and 45 lead to different sensitivity falloff values for the same eye depth. *Id.* at 2–3.

Petitioner's arguments are unpersuasive. With respect to the claimed "A scan," we note "A scan" is part of the phrase "A scan measuring range," which (as Patent Owner notes) would have been understood by one of ordinary skill in the art with reasonable certainty in light of the Specification. *See* RMTA Reply 3. In particular, Patent Owner directs us to specific disclosures in the Specification that provide guidelines and examples that would have been understood by the ordinarily skilled artisan as explaining that "an A scan measuring range corresponds to a depth of the human eye from the cornea to the retina" as recited in proposed substitute

claims 44 and 45. *Id.* (citing Ex. 1001, 3:1–7, 5:43–47, 7:5–10, 10:11–12; Ex. 2020 ¶¶ 45–46).

We agree with Patent Owner that the Specification shows the language of proposed substitute claims 44 and 45 is sufficiently definite. *See* RMTA Reply 3. In particular, the Specification describes the “A-scan” as indicating “the one-dimensional (axial) measurement in the case of OCDR along the light axis,” and describes an SS OCDR device that “obtain[s] A-scans, having a measuring range corresponding to the sample length” of a human eye to thereby “measure an entire eye with the aid of the OCDR method in an A-scan with an accuracy of better 100 μm , particularly better than 30 μm .” *See* Ex. 1001, 2:7–11, 2:57–61, 4:1–4, 5:43–46, 7:34–37. The Specification further explains that an A-scan includes “the position of retina signals and cornea signals,” and illustrates in Fig. 1c an “A-scan obtained for the example of an eye as sample 3, that is to say the longitudinal profile along the light axis” where “[t]he peaks show from left to right . . . the reflections of the cornea, front side of the lens, rear side lens and retina.” *See id.* at 4:1–4, 7:34–38. We determine that the ordinarily skilled artisan would, in light of the Specification, have understood, with reasonable certainty, the “A scan measuring range” recitation to refer to an axial (i.e., longitudinal, along the light axis) measurement range of the claimed human eye using the claimed tunable laser light source and receiver of the device for swept source optical coherence domain reflectometry.

We also are unpersuaded by Petitioner’s additional argument that the phrase “measuring range” is unclear because the definition of “measuring range” would be different between proposed substitute claims 44 and 45, which recite different claimed line widths that correspond to different

sensitivity falloff values for the same eye depth. *See* RMTA Opp. 3.

Petitioner's argument does not persuasively demonstrate that those skilled in the art would not have understood what is meant by the claimed "A scan measuring range [that] corresponds to a depth of the human eye from the cornea to the retina." As Patent Owner notes, Petitioner has recognized elsewhere that "A scan measuring range" is not unclear to those skilled in the art. RMTA Reply 3–4 (citing Pet. 51–52; Ex. 1012 ¶ 145). And insofar as the proposed substitute claims include different ranges of line widths to enable "an A scan measuring range [that] corresponds to a depth of the human eye from the cornea to the retina" where a "depth of the human eye" may correspond to a range of typical eye lengths (*see* Ex. 1001, 1:42–45, 3:19–25), we note that breadth of a claim is not to be equated with indefiniteness. *See In re Miller*, 441 F.2d 689, 693 (CCPA 1971); *In re Gardner*, 427 F.2d 786, 788 (CCPA 1970).

Petitioner also argues the proposed substitute claims are indefinite because they include the language "at least one receiver for light signals backscattered from both a cornea and retina of . . . a human eye." RMTA Opp. 3 (emphasis omitted). According to Petitioner, the quoted language is indefinite because (1) a "POSITA would understand that '[l]ight signals backscattered from the eye' could refer to the light power $P(t)$ backscattered from the eye, or the electric field amplitudes $E(t)$ " but the '330 patent "does not specify which one to choose"; and (2) "PO has not specified what kind of 'signals' they are referring to, where in the patent they define these 'signals,' and in which sense those signals are backscattered from the eye and detected by the photoreceiver." *Id.* at 3–4.

Petitioner’s argument is unpersuasive. At the outset, we observe that proposed substitute claims 44 and 45 do not recite Petitioner’s quoted phrase (“at least one receiver for light signals backscattered from both a cornea and retina of . . . a human eye”); rather, they recite “at least one receiver for receiving light signals backscattered from the human eye including both the cornea and the retina.” In addition, as Patent Owner notes, Petitioner does not suggest difficulty in applying the meaning of “at least one receiver for receiving light signals backscattered from the human eye including both the cornea and the retina” in Petitioner’s obviousness analysis, but convolutes the same claim language in opposing Patent Owner’s Revised Motion to Amend to declare it indefinite. *See* RMTA Reply 4–5. Petitioner’s arguments also ignore the Specification, which we find, consistent with Patent Owner’s arguments and evidence, sufficiently informs the ordinarily skilled artisan what is claimed when the claim limitation is read in light of the Specification. *See* RMTA Reply 4 (citing Ex. 1001, 2:63–65, 10:11–12; Ex. 2020 ¶ 50). Patent Owner’s declarant (Dr. Leitgeb) provides testimony further supporting a finding that a person of ordinary skill in the art would not have considered the “receiver” claim language unclear:

In my view, a POSITA would have readily understood what is meant by the phrase. Not only is the phrase clear on its own, the specification also describes “*at least one receiver* for the light backscattered from the sample,” Ex. 1001 at 2:63–65, and that “the signals *from the cornea, lens and retina* are detected. . . .”), 10:11–12; 7:36–38 (“The peaks [in Fig. 1c] show from left to right in this case the *reflections of the cornea, front side of the lens, rear side lens and retina.*”) (emphasis added).

See Ex. 2020 ¶ 50.

We agree with Patent Owner that the Specification provides sufficient guidelines and examples such that the ordinarily skilled artisan would have understood what is meant by the claimed “receiver for receiving light signals backscattered from the human eye including both the cornea and the retina.” In particular, we find that the ordinarily skilled artisan would, in light of the Specification, have understood, with reasonable certainty, the limitation to refer to a receiving device/detector that receives signals backscattered from the cornea and retina in response to the tunable laser light’s beam illuminating the human eye. *See* Ex. 1001, 2:62–65, 3:47–52, 4:29–35, 6:4–14, 6:26–30, 6:45–48.

Petitioner also argues the claimed “tunable laser light source” having particular line widths (of, e.g., $\delta k < 168 \text{ m}^{-1}$ in proposed substitute claim 44) is indefinite because “[c]laim 44 does not identify a particular wavelength nor range of wavelengths for which this linewidth is applicable,” despite the fact that a given wavelength is necessary to calculate the line width. RMTA Opp. 4.

Petitioner’s argument is unpersuasive. As Patent Owner notes, [t]he absence of “a particular wavelength” has no bearing on whether a POSITA would have reasonably understood what “a tunable laser light source” refers to. Here, a POSITA would have readily understood what is meant by that term and Petitioner has not alleged to the contrary. Further, as explained by Dr. Leitgeb, the ’330 patent and the substitute claims recite a line width in units well understood by a POSITA.

RMTA Reply 5 (citing Ex. 2020 ¶¶ 19–21). We agree with Patent Owner that the scope of the subject matter embraced by the claimed “tunable laser light source [that] has a line width of $\delta k < 168 \text{ m}^{-1}$, wherein $k = 2\pi/\lambda$ ” is not indefinite, because the ordinarily skilled artisan would, in light of the

Specification, have understood, with reasonable certainty, the recitation to refer to a tunable laser light source having a center wavelength and a linewidth around that center wavelength. *See* Ex. 1001, 2:61–63, 3:34–40, 3:43–46, 3:54–55, 5:66–6:3, 8:37–41, 9:64–67, 10:18–39. Insofar as the ’330 patent indicates that various center wavelengths and wavelength linewidths characterize a tunable laser light source having the claimed line width of $\delta k < 168 \text{ m}^{-1}$ (*see id.* at 3:34–40, 3:43–46, 3:54–55, 5:66–6:3, 8:37–41, 9:64–67), we note that claim “[b]readth is not indefiniteness.” *In re Gardner*, 427 F.2d at 788. And, on this record, Petitioner fails to persuade us that the meaning of the phrase “tunable laser light source has a line width of $\delta k < 168 \text{ m}^{-1}$, wherein $k = 2\pi/\lambda$ ” would have been unclear to those with ordinary skill in the art.

Petitioner next argues that proposed substitute claim 44 is indefinite because it includes the language “light signals are received from throughout the depth of the human eye from the cornea to the retina.” RMTA Opp. 4. According to Petitioner, the meaning of the quoted language would be uncertain to the ordinarily skilled artisan because such artisan “would conclude that *any light reflected* from these structures within the eye would meet this new proposed phrase”—including even *light* from backscattered light signals produced by a “handheld visible laser pointer that was directed into one’s eye.” *Id.* at 4–5 (emphases added); *see also* RMTA Reply 4.

Petitioner’s argument is unavailing. Proposed substitute claim 44 expressly recites that “the light signals” received from throughout the depth of the human eye from the cornea to the retina are not just *any reflected light*, but rather are “light signals backscattered from the human eye including both the cornea and the retina” in response to the tunable laser

light source of an SS OCDR device illuminating the eye “on the front surface of the cornea,” “the light signals” being received “during the tuning [of the tunable laser light source].” Thus, we agree with Patent Owner that

because the claims recite a device for swept source optical ***coherence*** domain reflectometry (SS OCDR), the sweeping assertion that “[a]ny light, such as . . . *incoherent* light . . . capable of penetrating the eye to the retina would meet this definition” is unfounded. . . .

Petitioner asserted that “[a] handheld visible laser pointer that was directed into one’s eye would produce backscattered light signals ‘from throughout the depth of the eye from the cornea to the retina.’” However, the claimed feature recites “light signals are received.” Neither the Petitioner nor its [declarant] ever explained *how* light signals from its visible laser pointer are received, as claimed.

RMTA Reply 6. Thus, we determine that Petitioner does not show that the skilled artisan would fail to understand, with a reasonable level of certainty, the meaning of “light signals [that] are received from throughout the depth of the human eye from the cornea to the retina.”

For the above reasons, Petitioner has not met its burden to demonstrate, by a preponderance of the evidence, that the proposed substitute claims are indefinite.

F. Whether the Proposed Substitute Claims Would Have Been Obvious

Petitioner submits that proposed substitute claims 44 and 45 are unpatentable as obvious. RMTA Opp. 7–25. More specifically, Petitioner argues that the proposed substitute claims would have been obvious over Huber in view of Everett, Lexer, and Exhibit 2016. *Id.* at 7.

1. Exhibit 2016

Exhibit 2016 is an article entitled “Fourier domain mode locking at 1050 nm for ultra-high-speed optical coherence tomography of the human retina at 236,000 axial scans per second,” published by the Optical Society of America, in volume 32, no. 14, of *Optics Letters*, with a publication date stated on its face of July 15, 2007. Ex. 2016, 1. The authors of Exhibit 2016 include Robert Huber, who is the first-named inventor of the Huber patent relied upon by Petitioner (Exhibit 1008). Petitioner asserts that Exhibit 2016 is prior art under 35 U.S.C. § 102(b). RMTA Opp. 13. Patent Owner does not dispute the prior-art status of Exhibit 2016. *See generally* RMTA Reply.

Exhibit 2016 discloses that “Optical coherence tomography (OCT) is a high resolution optical imaging technique with many biomedical applications. The largest clinical application of OCT is ophthalmology, where OCT can visualize cross-sectional structure of retinal pathologies.” Ex. 2016, 2049. Exhibit 2016 presents “a detailed analysis of an FDML laser in the 1050 nm wavelength region, demonstrate a sweep repetition rate of 236 kHz, and use this laser for 3D *in vivo* ophthalmic imaging.” *Id.*

2. Analysis

Proposed substitute claims 44 and 45 are both limited to the sample being a “human eye.” RMTA, APPENDIX A at 1–2. Both claims also recite a line width maximum. Proposed substitute claim 44, similarly to claim 1, recites “the tunable laser light source has a line width of $\delta k < 168 \text{ m}^{-1}$, wherein $k = 2\pi/\lambda$.” *Id.* (limitation [44.c]) (emphasis omitted). Proposed substitute claim 45 recites “wherein the tunable light source has a center wavelength between 900nm and 1060nm, a line width of $\delta k < 93 \text{ m}^{-1}$, and wherein $k = 2\pi/\lambda$.” *Id.* at 2 (limitation [45.c]) (emphasis omitted).

Petitioner presents essentially the same analysis of these limitations as it does for claims 2, 40, and 42, arguing (1) Huber discloses a swept laser source, that could be applied to a “myriad of applications” (RMTA Opp. 8–9); (2) Everett specifically discloses how its method and apparatus can be applied to Fourier-domain methods of OCT and that a measurement beam has a diameter D (*id.* at 9 (citing Ex. 1009, 6:58–8:32; Ex. 1012 ¶¶ 125, 141)); (3) “Lexer also discloses WTI, which is the same as the SS OCDR disclosed in the ‘330 patent,” and “discloses the application of SS OCDR to ophthalmology and specifically to perform depth imaging of various structures of the eye” (*id.* (citing Ex. 1006, 1; Ex. 1012 ¶ 125)); and (4) it would have been obvious to the ordinarily skilled artisan “to use the swept laser source and OCT system disclosed by Huber, the beam diameter D disclosed by Everett, and the SS OCDR system of Lexer for performing depth imaging of various parts of the eye to take advantage of the narrow instantaneous linewidths and fast tuning time of Huber” (*id.* (citing Ex. 1012 ¶ 127)). Petitioner also relies on Exhibit 2016 as disclosing an FDML laser in the 1050 nm wavelength region for use in *in vivo* ophthalmic imaging. *Id.* at 15–16, 19.

With regard to the line width recited in limitations [44.c] and [45.c], Petitioner presents the same evidence that it does for claims 2, 40, and 42, including evidence that Huber discloses a “semiconductor amplifier chip for wavelength operation between 1250 nm and 1350 nm,” with a “coherence length of greater than 4 cm, which corresponds to a linewidth of less than 0.03 nm.” RMTA Opp. 16 (citing Ex. 1008, 9:44–50, 10:15–29, 24:5–8, Fig. 5a; Ex. 1012 ¶ 143). For proposed substitute claim 44, Petitioner uses the same equation as it uses for claims 1 and 2 as discussed above (*see*

Sections II.D.2.a.(4), II.D.2.c.), applying the same center wavelength of 1305 nm and linewidth of 0.03 nm, to calculate a line width δk of 110.7 m^{-1} . *Compare* RMTA Opp. 17, *with* Pet. 50–51. For proposed substitute claim 45, which recites a maximum line width of 93 m^{-1} , Petitioner calculates a linewidth of 6.9 m^{-1} using the coherence-length-based equation and coherence length of 40 cm that Petitioner applies for claims 40 and 42. *Compare* RMTA 17, *with* Pet. 65–67.

With regard to Patent Owner’s arguments that Petitioner has failed to show the prior art teaches or suggests the claimed line width at a wavelength suitable for measuring ocular samples, Petitioner asserts the proposed substitute claims “do[] not recite any particular wavelength,” and “[t]here is no requirement in the claim[s] that the linewidth must be used at a wavelength suitable for OCDR of the eye—the only requirement is that the tunable laser ‘illuminate’ a movable sample.” RMTA Opp. 16, 18–19. To the extent Petitioner contends that the ordinarily skilled artisan would not have been concerned with choosing a wavelength suitable for measuring an ocular sample with OCDR A-scans, we disagree. The proposed substitute claims do not recite merely a tunable laser light source for illuminating a surface of a movable sample (human eye), but recite other limitations regarding the apparatus for obtaining A-scans for measuring the eye, including a receiver for receiving light signals backscattered from both the cornea and the retina of the eye, and also that the device has an “A scan measuring range” corresponding to the depth of the eye from the cornea to the retina. RMTA, APPENDIX A, limitations [44.a], [45.a], [44.b], [45.b], [44.d], [45.d]. Thus, for the reasons we discuss above (Section II.D.2.c), we agree with Patent Owner that the ordinarily skilled artisan would not have

combined the prior art to satisfy these limitations using a laser source with a wavelength that is not suitable for measuring a human eye. And, also for the reasons we discuss above (*id.*), we find Petitioner has not satisfied its burden to demonstrate that Huber teaches the required line width when operating at wavelengths suitable for measuring eyes.

In opposing Patent Owner's RMTA, Petitioner additionally cites to Exhibit 2016 as disclosing "an FDML laser in the **1050 nm** wavelength region for use in *in vivo* ophthalmic imaging," which Petitioner notes is within Patent Owner's proposed range. RMTA Opp. 19. Petitioner's reliance on Exhibit 2016 does not remedy the deficiencies in Petitioner's reliance on Huber. Although Exhibit 2016 discloses the use of a laser producing a wavelength suitable for imaging the eye ($\lambda=1050$ nm, *see* Ex. 2016, Title, Abstract), Exhibit 2016 does not teach that its laser light source has a line width of $\delta k < 168 \text{ m}^{-1}$ or $\delta k < 93 \text{ m}^{-1}$. In particular, Exhibit 2016 does not indicate a value or range for δk , where $k = 2\pi/\lambda$. Exhibit 2016 does disclose "[i]n an FDML [(Fourier domain mode-locked)] laser, a narrowband optical bandpass filter is tuned with a period equal to a harmonic of the optical cavity round-trip time" and provides examples of "fiber Fabry–Perot tunable filters (FFP-TFs) with bandwidths of 0.08, ~0.15, and ~0.3 nm" with which the laser is operated. *See* Ex. 2016, 2049–2051. But, applying the same formula as Petitioner applies for its calculations in the Petition (*see* Pet. 51) and for proposed substitute claim 44 (RMTA Opp. 17), we note that δk for the laser of Exhibit 2016 (having $\lambda = 1050$ nm and a

bandwidth¹² of 0.08nm, 0.15nm, or 0.3nm) would have the values $\delta k = (2\pi/(1.050\text{E}-6 \text{ m})^2)*(8\text{E}-11 \text{ m})=455.9 \text{ m}^{-1}$, or $(2\pi/(1.050\text{E}-6 \text{ m})^2)*(15\text{E}-11 \text{ m})=854.8 \text{ m}^{-1}$, or $(2\pi/(1.050\text{E}-6 \text{ m})^2)*(30\text{E}-11 \text{ m})=1709.7 \text{ m}^{-1}$, which do not satisfy $\delta k < 168 \text{ m}^{-1}$ or $\delta k < 93 \text{ m}^{-1}$, as recited, respectively, in limitations [44.c] and [45.c].

Thus, having considered the evidence and arguments presented by the parties, we determine that Petitioner has not met its burden to demonstrate, by a preponderance of the evidence, that the subject matter recited in limitations [44.c] and [45.c] was taught or suggested by the prior art. Because this deficiency fatally undermines Petitioner's patentability challenge to proposed substitute claims 44 and 45, we need not resolve the other challenges presented by Petitioner as to other recited limitations of these claims.

¹² We acknowledge that Exhibit 2016 uses the term *bandwidth* for the values of 0.08 nm, 0.15 nm, or 0.3 nm (*see* Ex. 2016, 2050), not *linewidth* as Huber does for the value of 0.03 nm that was used in Petitioner's calculation (*see* Pet. 50–51 (citing to Huber's "0.03 nm [linewidth]" and "[c]hoosing a conservative value on the highest range of the linewidth, *i.e.*, $\delta\lambda = 0.03 \text{ nm}$ ")). We express no opinion as to whether Exhibit 2016's *bandwidth* designates the same physical parameter as Huber's *linewidth*, and have provided these δk calculations for Exhibit 2016 merely to show that, by Petitioner's own formula, Exhibit 2016 does not meet $\delta k < 168 \text{ m}^{-1}$ or $\delta k < 93 \text{ m}^{-1}$ recited in substitute claims 44 and 45.

IV. CONCLUSION¹³

Based on the information presented, we conclude Petitioner has shown, by a preponderance of the evidence on this record, that claims 1 and 21–26 of the '330 patent are unpatentable, but Petitioner has not shown, by a preponderance of the evidence, that claims 2, 27, 40, and 42 are unpatentable. Because we also determine that Petitioner has not shown by a preponderance of the evidence that proposed substitute claims 44–45 are unpatentable, we grant Patent Owner's Revised Contingent Motion to Amend. Thus, we conclude that it is appropriate to replace claims 1 and 21 with proposed substitute claims 44 and 45.

¹³ Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding. *See* 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

In summary:

Claims	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1, 2, 21– 27, 40, 42	103(a)	Huber, Everett, Lexer	1, 21–26	2, 27, 40, 42

Motion to Amend Outcome	Claims
Original Claims Cancelled by Amendment	
Substitute Claims Proposed in the Amendment	44, 45
Substitute Claims: Revised Motion to Amend Granted	44, 45
Substitute Claims: Revised Motion to Amend Denied	
Substitute Claims: Not Reached	

V. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that, claims 1 and 21–26 of U.S. Patent No. 8,690,330 are held unpatentable;

FURTHER ORDERED that, claims 2, 27, 40, and 42 of U.S. Patent No. 8,690,330 are not held unpatentable;

FURTHER ORDERED that Patent Owner's Revised Contingent Motion to Amend Claims is granted as to proposed substitute claims 44 and 45; and

FURTHER ORDERED that because this is a final written decision, 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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