

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

PLATINUM OPTICS TECHNOLOGY INC.,
Petitioner,

v.

VIAVI SOLUTIONS INC.,
Patent Owner.

IPR2021-00631
Patent 9,354,369 B2

Before DEBRA K. STEPHENS, PATRICK M. BOUCHER, and
SHARON FENICK, *Administrative Patent Judges*.

BOUCHER, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining No Challenged Claims Unpatentable
35 U.S.C. § 318(a)

In response to a Petition (Paper 1, “Pet.”) filed by Platinum Optics Technology Inc. (“Petitioner”), we instituted an *inter partes* review of claims 1–3, 5–8, 10–12, 14, 16–21, and 23 of U.S. Patent No. 9,354,369 B2 (Ex. 1001, “the ’369 patent”). Paper 7 (“Dec.”). During the trial, Viavi Solutions Inc. (“Patent Owner”) filed a Response (Paper 12, “PO Resp.”), to which Petitioner filed a Reply (Paper 17, “Reply”) and Patent Owner filed a Sur-reply (Paper 19, “Sur-reply”). An oral hearing was held with the parties, and a copy of the transcript was entered into the record. Paper 27 (“Tr.”).

We have jurisdiction under 35 U.S.C. § 6. This Decision is a Final Written Decision under 35 U.S.C. § 318(a) as to the patentability of the claims on which we instituted trial. Based on the record before us, Petitioner has not shown, by a preponderance of the evidence, that claims 1–3, 5–8, 10–12, 14, 16–21, and 23 are unpatentable.

I. BACKGROUND

A. The '369 Patent

1. Overview

The '369 patent “relates to optical filters including hydrogenated silicon layers and to sensor systems comprising such optical filters.”

Ex. 1001, 1:12–16. Figure 6 of the '369 patent is reproduced below.

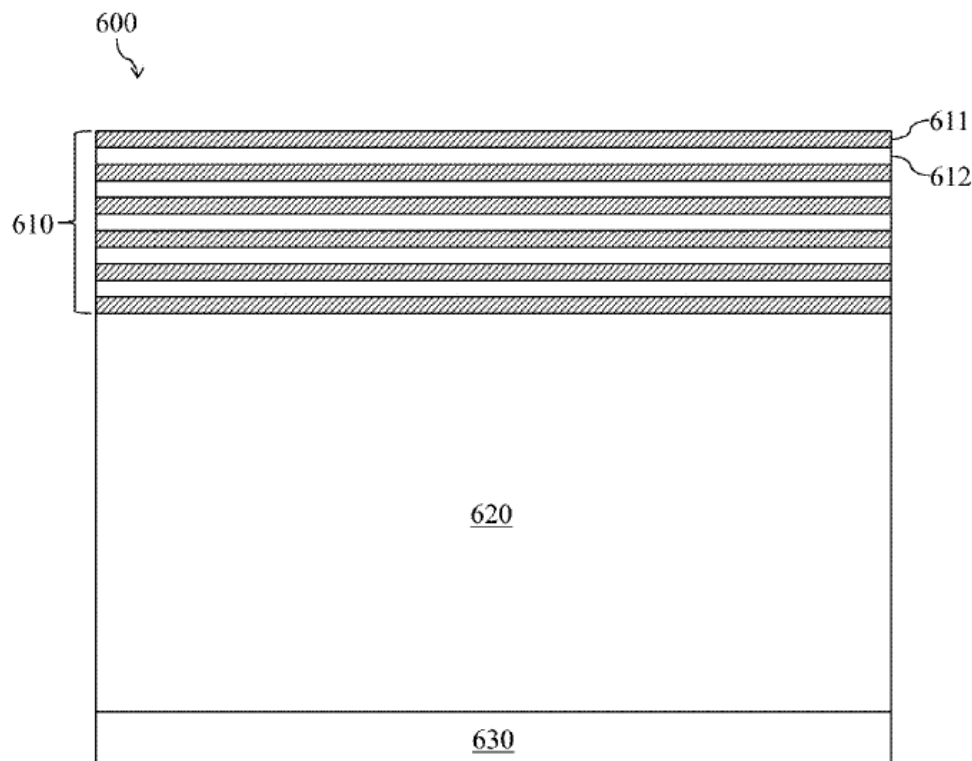


Figure 6 is a schematic illustration of a cross-section of an optical filter. *Id.* at 3:37–38. Optical filter 600 includes filter stack 610 disposed on first substrate 620, and may include antireflective coating 630 when substrate 620 is a free-standing substrate such as glass. *Id.* at 5:53–55. Filter stack 610 “includes a plurality of hydrogenated silicon [Si:H] layers 611, which serve as higher-refractive-index layers, and a plurality of lower-refractive-index layers 612, stacked in alternation.” *Id.* at 5:65–6:1. “In most instances, the

lower-refractive-index material is a dielectric material, typically an oxide” like “silicon dioxide (SiO_2), aluminum oxide (Al_2O_3), titanium dioxide (TiO_2), niobium pentoxide (Nb_2O_5), tantalum pentoxide (Ta_2O_5), and mixtures thereof.” *Id.* at 6:55–60.

The wavelength range of 800–1100 nm is identified by the ’369 patent as being of particular interest, as it may arise in applications that use the optical filter in a sensor system, such as a proximity sensor system, a 3D imaging system, or a gesture-recognition system. *See id.* at 4:9–13, 9:27–37. In such systems, a light source emits light at an emission wavelength within the 800–1100 nm range, and the optical filter has a passband that “includ[es] the emission wavelength and at least partially overlap[s] with the wavelength range of 800 nm to 1100 nm.” *Id.* at 9:36–37, 9:47–50.

The disclosure of the ’369 patent focuses on specific properties of what the inventors characterize as an “improved hydrogenated silicon material” over this wavelength range. *See id.* at 4:14–18. In particular, the inventors concerned themselves with hydrogenated silicon that simultaneously has a sufficiently high refractive index and sufficiently low extinction coefficient over the 800–1100 nm wavelength range. *See id.* at 4:49–59. The hydrogenated silicon layers have a refractive index greater than 3 over this wavelength range, contrasting with a refractive index lower than 3 for the lower-refractive-index layers over the same wavelength range. *Id.* at 2:51–54. At the same time, the extinction coefficient (which relates to how much light is absorbed by the material) of such hydrogenated silicon

layers is less than 0.0005 over the same wavelength range.¹ *Id.* at 4:49–59. In certain specific embodiments, more stringently defined properties of both the refractive index and extinction coefficient are disclosed. *See, e.g., id.* at 6:17–28 (discussing refractive index greater than 3.5 over the 800–1100 nm wavelength range or “a refractive index of greater than 3.64, i.e., about 3.6, at a wavelength of 830 nm” and discussing extinction coefficients less than 0.004 or less than 0.0003 over the 800–1100 nm wavelength range).

The inventors specifically drew attention to the fact that it was known to use hydrogenated silicon for high-refractive-index layers in optical filters, such as described by B. M. Lairson, *Reduced Angle-Shift Infrared Bandpass Filter Coatings*, in *PROC. SPIE WINDOW AND DOME TECHS. AND MATERIALS*, Vol. 6545:1–5² (Randal W. Tustison ed., 2007) (“Lairson”) and K. Gibbons *et al.*, *Development and Implementation of a Hydrogenated a-Si Reactive Sputter Deposition Process*, in *PROC. ANNUAL TECHNICAL CONFERENCE, SOCIETY OF VACUUM COATERS*, 50:327–330³ (2007) (“Gibbons”). *Id.* at 2:27–35. But the inventors identified the hydrogenated silicon materials described by such references as inadequate for not having “a suitably low extinction coefficient over the wavelength range of 800 nm to 1100 nm.” *Id.* at 2:42–45. For example, the inventors noted that Lairson disclosed “a hydrogenated silicon material having a refractive index of 3.2 at a

¹ Optical properties of a material may generally be described using a complex index of refraction in which the real component is the refractive index n and the imaginary component is the extinction coefficient k . Ex. 1002 ¶ 33. That is, the complex index of refraction is $N = n - ik$. *Id.* Some of the references discussed herein use this formulation.

² When citing to Lairson, we refer to its original pagination, but omit the prefix “65451C-” that is common to all of its pages.

³ When citing to Gibbons, we refer to its original pagination.

wavelength of 1500 nm and an extinction coefficient of less than 0.001 at wavelengths of greater than 1000 nm,” and further noted that Gibbons disclosed a hydrogenated silicon material “having a refractive index of 3.2 at a wavelength of 830 nm and an extinction coefficient of 0.0005 at a wavelength of 830 nm.” *Id.* at 2:35–42.

The ’369 patent describes a method for fabricating the “improved hydrogenated silicon material,” stating that it is “preferably[] produced by pulsed direct current (DC) sputtering.” *Id.* at 4:19–20. In such a method, a cathode that includes a silicon target is sputtered in the presence of hydrogen and an inert gas like argon to deposit the hydrogenated silicon material as a layer on a substrate. *Id.* at 4:34–41. The hydrogen is activated with a plasma activation source and, because the activated hydrogen is more chemically reactive, is more likely to create Si–H bonds, “which are thought to be responsible for the optical properties of the hydrogenated silicon material.” *Id.* at 4:42–47. The use of a plasma activation source in such a method also “allows the hydrogenated silicon layer to be deposited at a relatively high deposition rate with a relatively low hydrogen content.” *Id.* at 4:51–53. According to the inventors, “[t]he optical properties of the hydrogenated silicon material depend primarily . . . on the hydrogen flow rate,” but they are also “influenced” by other parameters that include the flow rate of the inert gas, the power level of the plasma activation source, the cathode power level, and the deposition rate. *Id.* at 4:58–63. In addition, an annealing step may be used, such that “the refractive index and the [extinction] coefficient of the hydrogenated silicon material can . . . be tuned by adjusting the hydrogen flow rate and, optionally, by annealing.” *Id.* at 5:22–25.

The '369 patent describes a further improvement of the optical filter by minimizing the “center wavelength shift” in the filter’s optical response as the angle of incident light varies. *Id.* at 2:4–10, 2:16–22. Specifically, the optical filter has a center wavelength shift less than 20 nm in response to a 0–30° change in incidence angle. *Id.* at 7:41–46. A lower center wavelength shift allows for a “significantly narrower” passband that “improv[es] the signal-to-noise ratio of systems incorporating the” optical filter. *Id.* at 8:17–23.

2. Illustrative Claim

Independent claim 1 is illustrative of the challenged claims and is reproduced below.

1. An optical filter comprising:
 - a filter stack comprising:
 - a plurality of hydrogenated silicon layers, wherein the plurality of hydrogenated silicon layers have a refractive index of greater than 3 over a wavelength range of 800 nm to 1100 nm and an extinction coefficient of less than 0.0005 over the wavelength range of 800 nm to 1100 nm; and
 - a plurality of lower-refractive-index layers, wherein the plurality of lower-refractive-index layers each have a refractive index of less than 3 over the wavelength range of 800 nm to 1100 nm, and wherein the plurality of lower-refractive-index layers are stacked in alternation with the plurality of hydrogenated silicon layers;
 - wherein the optical filter has a passband at least partially overlapping with the wavelength range of 800 nm to 1100 nm,
 - wherein the passband has a center wavelength that shifts by less than 20 nm in magnitude with a change in an incidence angle between 0° to 30°, thereby providing the optical filter with a wide incidence-angle acceptance range.

Ex. 1001, 10:20–42.

B. Evidence

Petitioner relies on the following references:

Tsai-133	US 5,398,133	Mar. 14, 1995	Ex. 1008
Pilgrim	US 2012/0224061 A1	Sept. 6, 2012	Ex. 1018
Bamji	US 6,323,942 B1	Nov. 27, 2001	Ex. 1024
Gokturk ⁴	US 7,340,077 B2	Mar. 4, 2008	Ex. 1025

B. M. Lairson, *Reduced Angle-Shift Infrared Bandpass Filter Coatings*, in Proc. SPIE Window and Dome Techs. and Materials, Vol. 6545:1–5 (Randal W. Tustison ed., 2007) (“Lairson”) (Ex. 1019)

K. Gibbons *et al.*, *Development and Implementation of a Hydrogenated a-Si Reactive Sputter Deposition Process*, in Proc. Annual Technical Conference, Society of Vacuum Coaters, 50:327–330 (2007) (“Gibbons”) (Ex. 1016)

R.-Y. Tsai, L.-C. Kuo, and F. C. Ho, *Amorphous silicon and amorphous silicon nitride films prepared by a plasma-enhanced chemical vapor deposition process as optical coating materials*, APPLIED OPTICS 32:5561–66 (1993) (“Tsai paper”) (Ex. 1009)

H. Yoda, K. Shiraishi, Y. Hiratani, and O. Hanaizumi, *a-Si:H/SiO₂ multilayer films fabricated by radio-frequency magnetron sputtering for optical filters*, APPLIED OPTICS 43:3548–54 (2004) (“Yoda”) (Ex. 1034)

In addition, Petitioner relies on a Declaration by Ronald R. Willey. Ex. 1002. Mr. Willey was cross-examined by Patent Owner, and a transcript of his deposition was entered into the record. Ex. 2004. Patent Owner relies on a Declaration by Bruce Clemens, Ph.D. Ex. 2001. Dr. Clemens was

⁴ Gokturk states that Bamji is “hereby incorporated by reference in its entirety for all purposes.” Ex. 1025, 5:41–44. Patent Owner does not contest the effectiveness of Gokturk’s incorporation of Bamji, and we treat Gokturk and Bamji as a single reference that we refer to as “Gokturk.”

cross-examined by Petitioner, and a transcript of his deposition was also entered into the record. Ex. 1079.

C. Instituted Grounds of Unpatentability

Petitioner challenges, and we instituted review of, claims 1–3, 5–8, 10–12, 14, 16–21, and 23 on the following grounds. Pet. 15; Dec. 8.

Claim(s) Challenged	35 U.S.C. §⁵	References
1–3, 5–7, 10, 11, 14, 16, 17, 21	103	Pilgrim, Gibbons, Lairson, Yoda
8	103	Pilgrim, Gibbons, Lairson, Yoda, Tsai-133, Tsai paper
12, 23	103	Pilgrim, Gibbons, Lairson, Yoda, Tsai-133
16, 18–21	103	Gokturk (incorporating Bamji), Gibbons, Lairson, Yoda, Pilgrim

D. Real Parties in Interest

The parties identify only themselves as real parties in interest. Pet. 68; *see* Paper 18, 2 (Petitioner confirming no changes); Paper 4, 2.

⁵ The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112-29, 125 Stat. 284, 287–88 (2011), amended various provisions of 35 U.S.C. Petitioner “assumes that the claims of the ’369 patent are entitled to the benefit of the filing date of [an earlier-filed] provisional application,” such that the pre-AIA version of § 103 applies. Pet. 15 n.4. Patent Owner does not dispute this assumption, and our ultimate decision would be the same regardless of which version of § 103 we apply. Consistent with Petitioner’s assumption, we apply the pre-AIA version of § 103.

E. Related Matters

Both parties identify *Viavi Solutions Inc. v. Platinum Optics Technology Inc.*, No. 5:20-cv-05501 (N.D. Cal.) as involving the '369 patent. Pet. 68; Paper 4, 2. The parties also identify IPR2021-00424 and IPR2021-00432 as involving patents related to the '369 patent; in both those proceedings, institution of an *inter partes* review was denied. Pet. 68; Paper 4, 2.

II. ANALYSIS

A. Legal Principles

A claim is unpatentable for obviousness under 35 U.S.C. § 103 if the differences between the claimed subject matter and the prior art are “such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) when in evidence, objective indicia of nonobviousness, i.e., secondary considerations.⁶ *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

Additionally, the obviousness inquiry typically requires an analysis of “whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue.” *KSR*, 550 U.S. at 418 (citing

⁶ The parties do not address objective indicia of nonobviousness, which accordingly do not form part of our analysis.

In re Kahn, 441 F.3d 977, 988 (Fed. Cir. 2006) (requiring “articulated reasoning with some rational underpinning to support the legal conclusion of obviousness”)); *see In re Warsaw Orthopedic, Inc.*, 832 F.3d 1327, 1333 (Fed. Cir. 2016) (citing *DyStar Textilfarben GmbH & Co. Deutschland KG v. C.H. Patrick Co.*, 464 F.3d 1356, 1360 (Fed. Cir. 2006)).

B. Level of Ordinary Skill in the Art

In determining whether an invention would have been obvious at the time it was made, we consider the level of ordinary skill in the pertinent art at the time of the invention. *Graham*, 383 U.S. at 17. “The importance of resolving the level of ordinary skill in the art lies in the necessity of maintaining objectivity in the obviousness inquiry.” *Ryko Mfg. Co. v. Nu-Star, Inc.*, 950 F.2d 714, 718 (Fed. Cir. 1991). The “person of ordinary skill in the art” is a hypothetical construct, from whose vantage point obviousness is assessed. *In re Rouffet*, 149 F.3d 1350, 1357 (Fed. Cir. 1998). “This legal construct is akin to the ‘reasonable person’ used as a reference in negligence determinations” and “also presumes that all prior art references in the field of the invention are available to this hypothetical skilled artisan.” *Id.* (citing *In re Carlson*, 983 F.2d 1032, 1038 (Fed. Cir. 1993)).

Supported by Mr. Willey’s testimony, Petitioner proposes that a person of ordinary skill in the art would have had “a Bachelor’s degree or equivalent in physics, or in a related science or engineering field, along with at least 5 years of experience in optical coating design and the manufacturing of optical filters, including various deposition techniques.” Pet. 13 (citing Ex. 1002 ¶¶ 66–68). According to Petitioner, “[a]dditional

education (e.g., a Master’s degree with exposure to coating design and manufacturing) may substitute for some industrial experience in optical thin film design, and more industrial experience can substitute for a different educational background. *Id.* (citing Ex. 1002 ¶ 66). Patent Owner neither directly addresses Petitioner’s proposal nor provides its own proposal. *See* Tr. 35:15–18 (Patent Owner confirming for the record that it has not proposed a different level of ordinary skill than Petitioner’s proposal).

Petitioner’s proposal is reasonable and consistent with the prior art presented. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (the prior art may reflect an appropriate level of skill in the art). We accordingly adopt Petitioner’s proposal.

C. Testimony by Dr. Clemens

Petitioner asks that we give Dr. Clemens’s testimony “little to no weight.” Reply 8–10 (capitalization and bold face omitted). According to Petitioner, Dr. Clemens does not qualify as a person of ordinary skill in the art, “did not review all the evidence in rendering his opinions, did not select the materials he reviewed, and did no independent research on the question of enablement.” *Id.*

Petitioner faults Dr. Clemens’s qualifications as a person of ordinary skill because “his CV shows no apparent work on optical filters and he admitted his ‘main expertise’ was not in filters.” Reply 8–9 (citing Ex. 1079, 20:23–21:3). In doing so, Petitioner emphasizes that, as we adopt, a person of ordinary skill in the art would have had “at least 5 years of experience in optical coating design and the *manufacturing of optical filters*” *Id.* at 8 (citing Ex. 1002 ¶ 66) (emphasis by Petitioner). The

following cross-examination testimony is relevant to our evaluation of Dr. Clemens's qualifications.

Q. Okay. Sir, are you an expert in the field of multilayer thin films?

A. Yes.

Q. And are you an expert in the field of the design of multilayer thin films?

A. I guess if you could clarify it, I would appreciate it.

Q. Okay. I'll ask a slightly different question.

Are you an expert in the field of the design of multilayer thin film interference filters?

A. I would say that that is not my main expertise.

Q. You are an expert in depositing multilayer thin films and multilayer thin film processes, correct?

A. Yes.

Q. You are an expert in characterizing multilayer thin films, correct?

A. Yes.

Q. Have you manufactured any thin film interference filters?

A. We have made filters or mirrors for optical use, but not commercially.

Ex. 1079, 20:14–21:14.

Although Petitioner characterizes Dr. Clemens as having testified on cross-examination that “his ‘main expertise’ was not in filters,” Dr. Clemens was actually responding to a narrower question that focused on “the design of multilayer thin film interference filters.” *See id.* at 20:21–21:3. As Patent

Owner points out, “the stated qualifications of a [person of ordinary skill in the art] is not directed to thin film interference filters, but to ‘optical filters.’”

Sur-reply 26. Patent Owner also points out that “Dr. Clemens was never asked about his manufacturing experience with optical filters in general.”

Id. We nevertheless note that, in responding to a question whether he had “manufactured any thin film interference filters,” Dr. Clemens responded that “We have *made filters* or mirrors *for optical use*, but not commercially.” Ex. 1079, 21:11–14 (emphases added).

Dr. Clemens specifically testifies in his Declaration that he had been asked to apply our adopted definition of a person of ordinary skill in forming his opinions and that he “meet[s] (and even exceed[s])” that definition.

Ex. 2001 ¶ 22. Dr. Clemens elaborates that he is “familiar with the level of ordinary skill based on both [his] own experience working with multilayer thin film stacks for optical filter applications and [his] experience teaching and supervising others doing the same work.” *Id.* It is also of some relevance that, as Patent Owner points out, “Dr. Clemens has an immediate academic and scientific connection to two of three references in Petitioner’s combination of Gibbons, Lairson, and Yoda.” Sur-reply 24. In particular, “Dr. Lairson, the lead author of the Lairson reference and one of the authors of the Gibbons reference, took classes from Dr. Clemens as a student at Stanford and was hired by and worked with Dr. Clemens as a post-doctoral researcher in his group.” *Id.* at 24–25 (citing Ex. 1079, 12:20–13:11).

Petitioner’s complaint that Dr. Clemens’s “CV shows no apparent work on optical filters” is both broad and vague, particularly given the length of Dr. Clemens’s CV and the timespan it covers. *See* Reply 9; Ex. 2006. Petitioner had an opportunity during cross-examination to

question Dr. Clemens more particularly about his CV, rather than apparently relying on inferences drawn from the titles of various presentations and publications identified in that CV. But as Patent Owner states, “Dr. Clemens was not asked [about] the optical filter experience he had over his lengthy research and academic career.” Sur-reply 26.

Based on the statements Dr. Clemens made under oath in his Declaration, we find that he qualifies as a person having at least ordinary skill in the art according to our adopted definition. The questions Petitioner raises about Dr. Clemens’s qualifications were insufficiently explored on cross-examination to impeach that testimony.

With respect to Petitioner’s further complaint that Dr. Clemens “did not review all the evidence in rendering his opinions, did not select the materials he reviewed, and did no independent research on the question of enablement,” we agree with Patent Owner that Petitioner cites no authority for the propositions that expert witnesses must review all exhibits or perform independent research. Sur-reply 27. Indeed, we do not find it particularly unusual for an expert witness to focus his analysis and opinions on specific issues identified by counsel, and Dr. Clemens properly discloses the underlying facts and data upon which his opinions are based. *See* 37 C.F.R. § 42.65(a).

We thus accord due weight to Dr. Clemens’s testimony.

D. Claim Construction

The Board uses “the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. 282(b), including construing the claim in accordance with the ordinary and customary

meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.” 37 C.F.R. § 42.100(b) (2019); *see Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc). The specification may reveal a special definition given to a claim term by the patentee. *Phillips*, 415 F.3d at 1316. If an inventor acts as his or her own lexicographer, the definition must be set forth in the specification with reasonable clarity, deliberateness, and precision. *Renishaw PLC v. Marposs Societa’ per Azioni*, 158 F.3d 1243, 1249 (Fed. Cir. 1998).

Petitioner contends that “the claims do not need an express construction to resolve the issues presented in this proceeding” but nevertheless “provides its proposed interpretations of two terms [namely, ‘center wavelength’ and ‘passband’] to clarify how Petitioner is applying the prior art to the claims.” Pet. 13. Patent Owner does not directly address Petitioner’s proposed constructions for these terms, and appears generally to treat the terms in a manner consistent with Petitioner’s proposals.

We conclude that no express claim construction is necessary for any claim term. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (“[W]e need only construe terms ‘that are in controversy, and only to the extent necessary to resolve the controversy.’” (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

E. Scope and Content of the Prior Art

1. Tsai-133

Tsai-133 describes a near-infrared optical filter having alternating layers of “low refractive index amorphous silicon nitride and high refractive

index amorphous silicon,” with the layers deposited by plasma-enhanced chemical vapor deposition (“PECVD”). Ex. 1008, Abstr. Figure 10 of Tsai-133 is reproduced below.

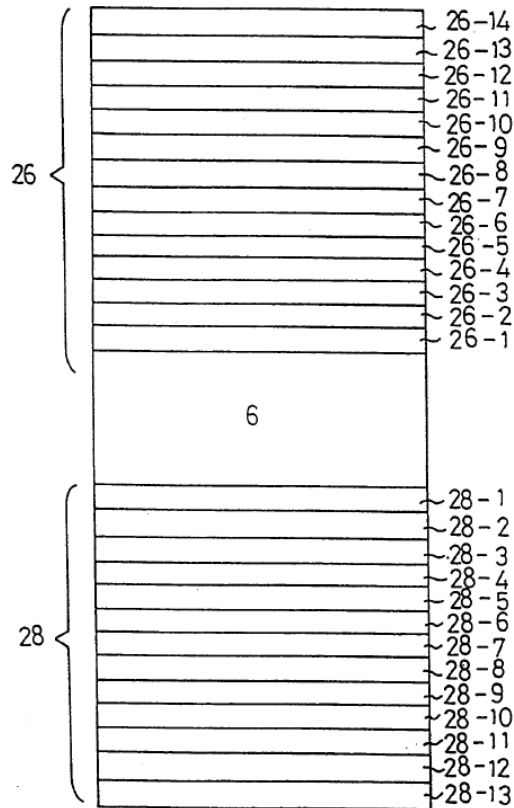


FIG.10

Figure 10 shows a cross-section of a near-infrared narrow-passband filter. *Id.* at 2:47–48. The filter includes high-pass filter 26 and low-pass filter 28 deposited on opposite sides of glass substrate 6. *Id.* at 5:30–39. The narrow-passband filter is achieved by “deposit[ing] alternate layers of amorphous silicon (a-Si:H) and amorphous silicon nitride (a-SiNx:H) on a Corning 7059 glass plate or a quartz plate.” *Id.* at 1:63–66, 4:7–25, 5:36–60.

Figure 12 of Tsai-133 is reproduced below.

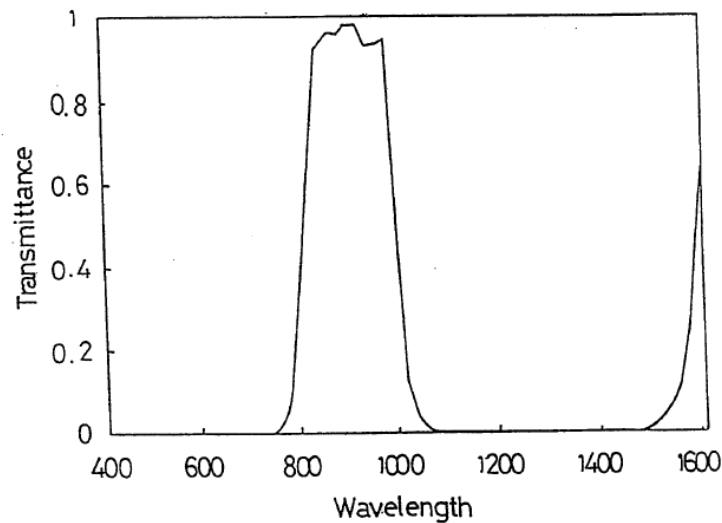


FIG.12

Figure 12 shows the transmittance curve of the narrow-bandpass filter, notably for which “[t]he transmittance in the 800–1000 nm range is peaked at 99.23% and has a bandwidth of 185 nm with a nearly rectangular shape.” *Id.* at 6:2–5.

2. The Tsai Paper

The Tsai paper describes the design and fabrication of optical filters in the near-infrared region using PECVD to deposit amorphous silicon and amorphous silicon nitride thin films. Ex. 1009, 5561.⁷ The Tsai paper provides evaluations of the “physical properties and the environmental durability” of the filters, reporting that “plasma-deposited a-Si:H and a-SiN_x:H thin films provide excellent characteristics for the design and the fabrication of optical coatings in various applications.” *Id.* at 5562.

⁷ When citing to the Tsai paper, we refer to its original pagination.

Table 2 of the Tsai paper is reproduced below.

Table 2. Averaged Dispersive Refractive Indices of a-Si:H and a-SiN _x :H Thin Films		
Wavelength (nm)	$n-ik$	
	(a-Si:H)	(a-SiN _x :H)
400	3.650- <i>i</i> 0.500	1.830- <i>i</i> 0.002
500	3.620- <i>i</i> 0.300	1.820
600	3.600- <i>i</i> 0.100	1.800
700	3.570- <i>i</i> 0.040	1.790
800	3.530- <i>i</i> 0.004	1.785
900	3.470	1.780
1000	3.400	1.776
1200	3.350	1.770
1500	3.340	1.765

Table 2 presents dispersions of refractive indexes and extinction coefficients (expressed in the form of complex indexes of refraction) for a-Si:H and a-SiN_x:H films. *Id.* at 5562–5563. The Tsai paper characterizes the results presented in Table 2 as showing that “[t]he a-Si:H thin film has a high refractive index and a medium absorption in the visible spectral region, while the a-SiN_x:H thin film has a low refractive index and no absorption in the visible and [near-infrared] spectral regions.” *Id.* at 5563. “These results,” the Tsai paper states, “make them suitable for the design and fabrication of [near-infrared] interference filters.” *Id.*

3. Gibbons

Gibbons describes “the results of a developmental program to commercialize a high index optical coating consisting of hydrogenated amorphous silicon.” Ex. 1016, 327. Gibbons presents its results in the context of a general “effort to develop commercially viable high index amorphous silicon thin films.” *Id.* Such industry efforts were motivated because “[t]he high index of refraction of this thin film material can be exploited in optical interference designs to reduce the number of layers

required to produce a bandpass filter.” *Id.* To deposit a-Si:H thin films, Gibbons used energetic magnetron sputtering, which was known to be capable of producing “high quality amorphous silicon” because that process can “add energy to the growing thin film, but not enough energy to induce damage.” *Id.*

Figure 2 of Gibbons is reproduced below.

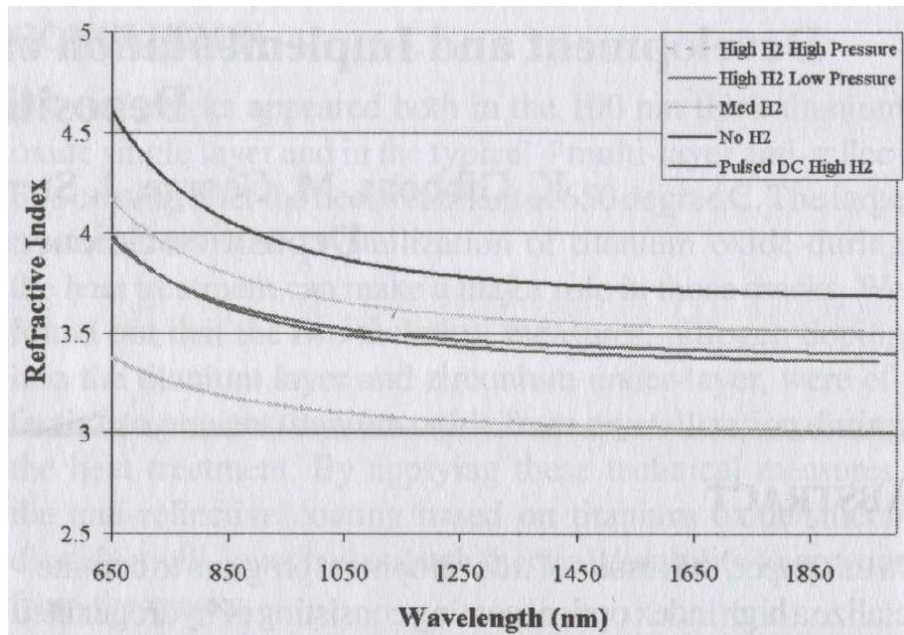


Figure 2 plots the refractive index as a function of wavelength for amorphous silicon samples produced under different hydrogen

concentrations and total system pressure. *Id.* at 328. Figure 3 of Gibbons is reproduced below.

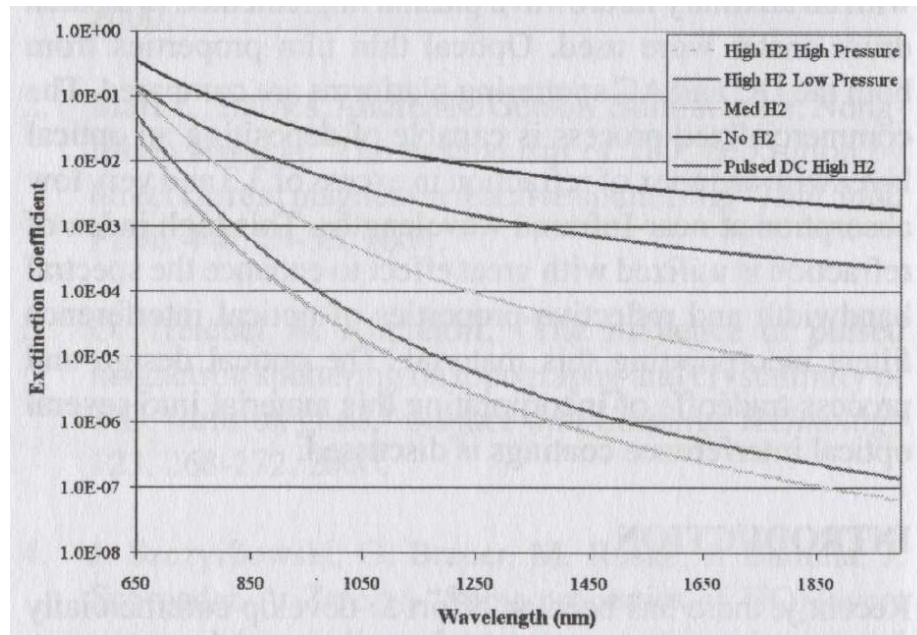


Figure 3 plots the extinction coefficient as a function of wavelength for the same samples used to generate Figure 2, namely amorphous silicon samples produced under different hydrogen concentrations and total system pressure. *Id.* Figures 2 and 3 show that both the refractive index and extinction coefficient of amorphous silicon decreases as the hydrogen concentration or total system pressure increases. *Id.* Gibbons teaches that “[t]he least amount of hydrogen necessary should be [used] to maintain the highest refractive index possible.” *Id.* at 329.

Gibbons notes that “[a]morphous silicon is an ideal selection for one of the materials in the design” of films used for high near-infrared optical transmission “due to its high absorptance in the visual region.” *Id.* at 329. According to Gibbons, “[t]raditionally deposited amorphous silicon thin films have an absorption band edge near 1200 nm,” but its energetic magnetron sputtering process for sputtering a-Si:H can shift that band edge

“to below 800 nm.” *Id.* Gibbons thus concludes that its process can produce a “high index, low absorption thin film amorphous silicon suitable for many near-infrared optical applications.” *Id.* at 330. In particular, Gibbons explains that, “[b]y controlling the amount of hydrogen incorporated in the film, we demonstrated that it is possible to move the absorption edge to tailor the transmission and blocking capabilities of the material to an individual application.” *Id.*

4. Pilgrim

Pilgrim describes a “method and device for viewing objects situated in fog.” Ex. 1018 ¶ 13. The method and device make use of an optical system with filters that “block all wavelengths of light except for those corresponding to the absorption bands of water,” and such filters may be made of multilayer coatings applied to flat optical surfaces. *Id.* ¶¶ 15–16. When multilayer bandpass filters are used, the “band limits are chosen to ensure the shift in the pass band due to changes in the angle of incidence (AOI) does not result in the pass band being shifted out of the absorption band for which it is designed.” *Id.* ¶ 16.

Figure 3A of Pilgrim is reproduced below.

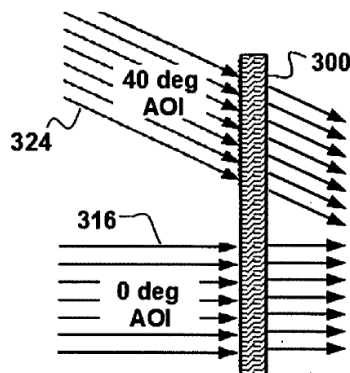


FIG. 3A

Figure 3A illustrates a multilayer bandpass filter with light passing through it at different incidence angles. *Id.* ¶ 25. “When incident light has an angle of incidence (AOI) of 0 (zero) degrees 316[,] the pass band is at its longest wavelength.” *Id.* An incidence angle of “40 degrees 324[] is at the limit of the field-of-view” in a certain embodiment. *Id.*

Figure 3B of Pilgrim is reproduced below.

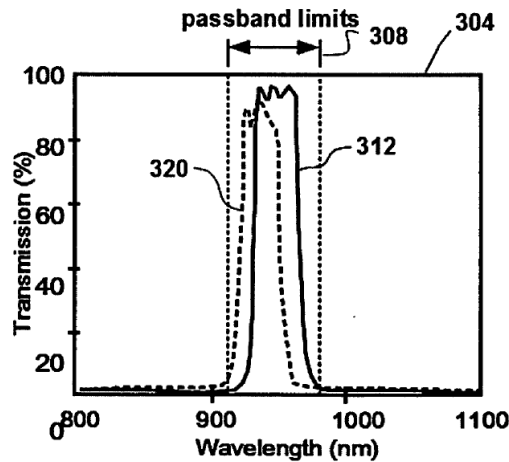


FIG. 3B

Figure 3B is a spectrogram showing spectral effects of changes in the light’s incidence angle for an example in which the passband is centered on 950 nm with a full bandwidth of about ± 25 nm. *Id.* ¶ 26. “The pass band for 0 degree AOI light 312 is designed to be far enough from the edges of the absorption pass band limits 308 that the shift in pass band at the widest AOI for the application (such as 40 degrees) 320 remains inside the pass band limits.” *Id.* Here, Pilgrim states, “[t]he shift in pass band center between an AOI of 0 degrees and an AOI [of] 40 degrees is approximately 15 nm.” *Id.*

5. *Lairson*

Lairson describes bandpass optical filters, including “several designs that have been achieved via hydrogenated silicon in multilayers, with improved performance at oblique angles of incidence.” Ex. 1009, 1. In particular, Lairson studied films that include hydrogenated silicon deposited by magnetron sputtering and having a refractive index of 3.2 at a wavelength of 1500 nm. *Id.* at 1–2. According to Lairson, “[b]andpass filters which perform acceptably over a wide angular range typically require extinction coefficients of less than about 1×10^{-03} in the bandpass wavelength range,” and through “proper optimization” of the sputtering process, “acceptable extinction coefficients were obtained for wavelengths above 1000 nm.” *Id.* at 2.

Lairson constructed a shortwave-pass edge filter from Si:H and silicon nitride (Si:H-Si₃N₄), and reports that the performance of this filter was “considerably better than the performance achievable with lower index materials,” such as a filter fabricated with niobia and silica (Nb₂O₅-Si₃H₄). *Id.* at 3. “Not surprisingly,” Lairson reports, “the filter composed of high index materials has reduced angle shift and reduced s-p splitting” compared to the Nb₂O₅-Si₃N₄ filter. *Id.* “Perhaps more surprising,” Lairson adds, “is the reduced thickness and sharper edge of the SiH/Si₃N₄ filter.” *Id.*

Figure 4 of Lairson is reproduced below.

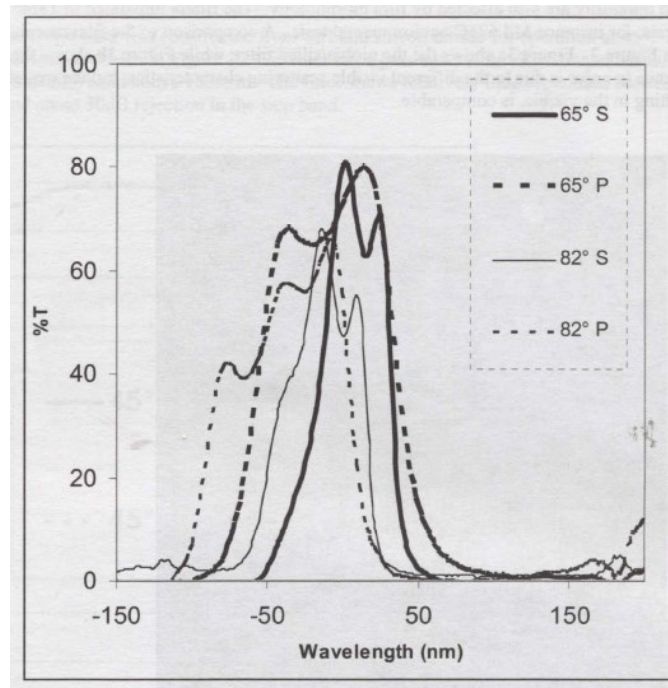


Figure shows transmission spectra for a Si:H-SiO₂ filter at a bandpass of 65° and 82°. *Id.* at 4–5. From these spectra, Lairson observes that “[t]his filter achieves greater than 50% transmission at the wavelength of interest over this angular range, with a bandpass width of approximately 50nm.” *Id.* at 4. Lairson concludes that the use of Si:H as a high-index material in the filter structure “dramatically improved” the filter capability when compared with a comparable design made from niobia and silica. *Id.* More generally, “[t]he availability of higher index materials enables the fabrication of designs with improved performance and reduced thickness,” and “[t]he advantage of higher refractive index is particularly compelling for filters which must operate over a range of angles with both s and p polarizations.” *Id.* at 5.

6. *Gokturk (incorporating Bamji)*

Gokturk relates to a three-dimensional gesture-recognition system that uses depth-perceptive sensors, and refers to “[o]ne suitable three-dimensional sensor system [] described in [Bamji].” Ex. 1025, 1:27–29, 5:41–44. Gokturk “describes a system that sends out a pulse of light to a targeted region, and measures the time that the pulse takes to travel.” *Id.* at 5:44–46. Bamji discloses a lens with an associated filter to ensure that “only incoming light hav[ing] the wavelength emitted by [a] light source [] falls upon the detector array unattenuated.” Ex. 1024, 5:60–64.

7. *Yoda*

Yoda describes optical properties of bandpass filters that include “*a*-Si:H/SiO₂ multilayer films fabricated by radio-frequency magnetron sputtering.” Ex. 1034, 3458.⁸ According to Yoda, a bandpass filter pairing materials having a “high refractive-index contrast, which is defined as the high index of one material divided by the low index of another,” allows for a reduction in the total number of layers of a multilayer optical filter. *Id.* Yoda teaches that “[t]wo such pairs of materials are hydrogenated amorphous silicon (*a*-Si:H) and silicon dioxide (SiO₂),” and that “*a*-Si:H/SiO₂ multilayer films have the major advantage that the total number of layers of the multilayer is almost half of that of Ta₂O₅/SiO₂ multilayer films.” *Id.*

⁸ When citing to Yoda, we refer to its original pagination.

Figure 4 of Yoda is reproduced below.

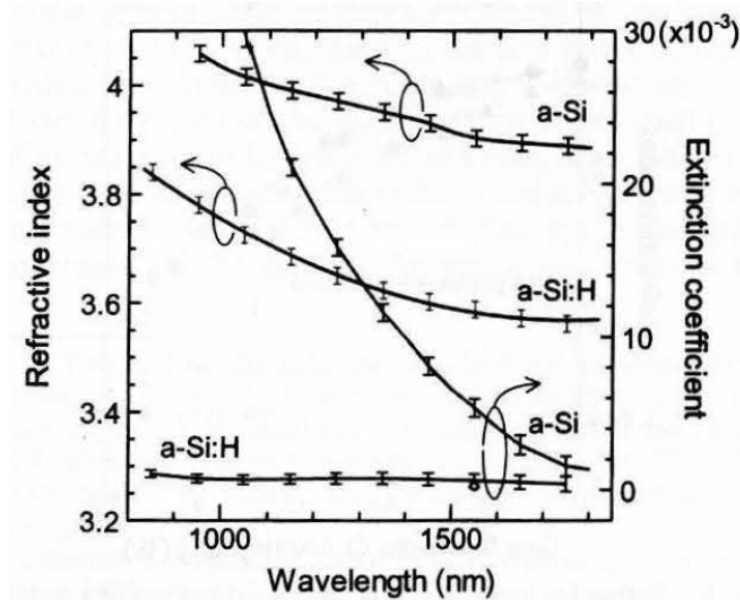


Figure 4 shows “[r]efractive index and extinction coefficient of *a*-Si:H and Si:H as functions of wavelength.” *Id.* at 3550. As shown, the refractive index of *a*-Si:H at a wavelength of 1550 nm “is estimated to be $n = 3.59 \pm 0.015$,” and the extinction coefficient “is estimated to be approximately $k < 1 \times 10^{-4}$.” *Id.*

F. Independent Claim 1

Petitioner challenges claim 1 as unpatentable under 35 U.S.C. § 103(a) over Pilgrim, Gibbons, Lairson, and Yoda. Pet. 18–38.

1. Overview of Combination

Independent claim 1 recites an optical filter that “has a passband at least partially overlapping with the wavelength range of 800 nm to 1100 nm, wherein the passband has a center wavelength that shifts by less than 20 nm

in magnitude with a change in an incidence angle between 0° and 30°, thereby providing the optical filter with a wide incidence-angle acceptance range.” Ex. 1001, 10:35–42. Petitioner relies on Pilgrim for these aspects, noting that Pilgrim discloses an optical “multi-layer interference filter ‘comprised of alternating layers of high and low refractive index materials,’” whose passband of 925–975 nm overlaps the 800–1100 nm wavelength range recited in the claim. Pet. 19. In addition, Petitioner observes that Pilgrim’s filter has a shift in passband center between an incidence angle of 0° and 40° of about 15 nm, consistent with the claim’s requirement of a shift less than 20 nm with a change in incidence angle between 0° and 30°. *Id.* at 19–20.

The “filter stack” recited in the claim comprises “a plurality of hydrogenated silicon layers” and “a plurality of lower-refractive-index layers, . . . wherein the plurality of lower-refractive-index layers are stacked in alternation with the plurality of hydrogenated silicon layers.” Ex. 1001, 10:21–34. Petitioner concedes that “Pilgrim does not describe the specific design or materials for the filter,” but contends that a person of ordinary skill in the art “would have found it obvious to choose Si:H for the high-refractive-index layers.” Pet. 21. This is so, Petitioner says, because such a skilled artisan “would have found Si:H an obvious choice for a high-refractive-index layer for Pilgrim’s filter because it has good blocking properties at lower wavelengths and a high refractive index.” *Id.* at 22 (citing Ex. 1008, 1:57–60, 5:68; Ex. 1016, 330; Ex. 1002 ¶¶ 35–37, 41, 227).

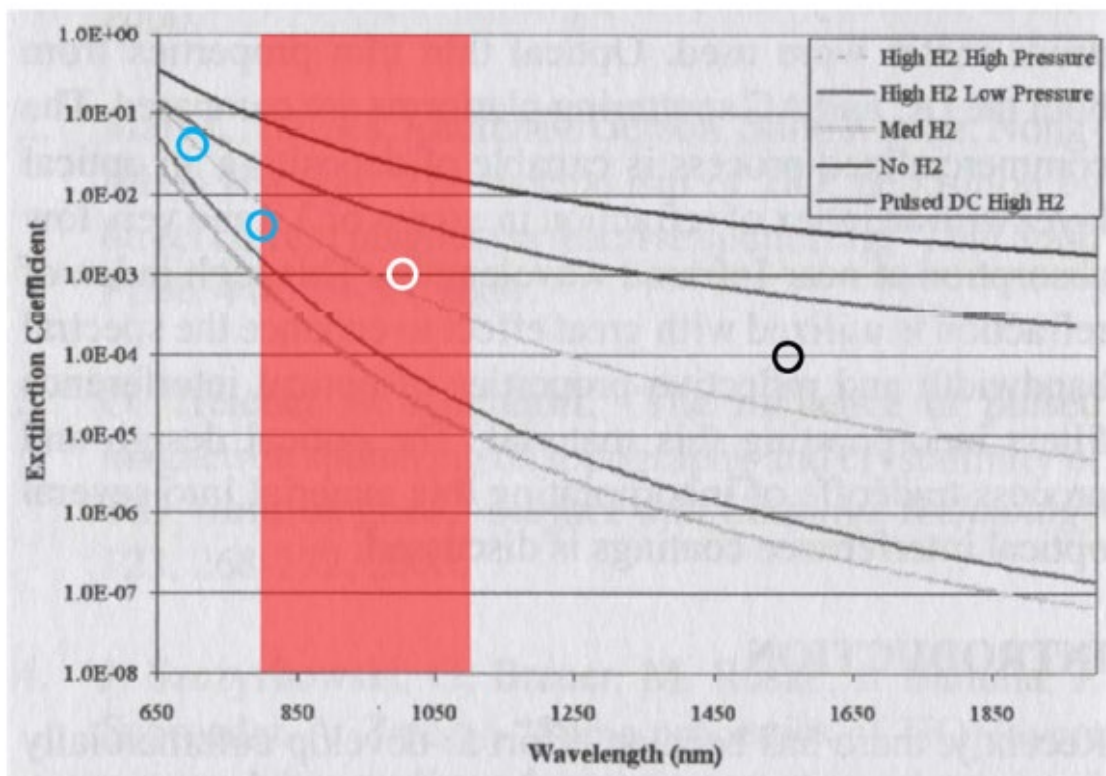
The claim requires that the plurality of hydrogenated silicon layers “have a refractive index of greater than 3 over a wavelength range of 800 nm to 1100 nm and an extinction coefficient of less than 0.0005 over the

wavelength range of 800 nm to 1100 nm.” Ex. 1001, 10:22–27. According to Petitioner, “[t]he claimed Si:H properties and lower-refractive index material properties were nothing more than a matter of routine optimization of known optical properties (e.g., refractive index and extinction coefficient) with known, predictable effects on the[ir] resulting filter designs.” Pet. 21 (citing Ex 1002 ¶¶ 38–39, 224, 227–237). Petitioner supports this contention with the disclosure of Gibbons, Lairson, and Yoda, each of which Petitioner contends “teach[es] Si:H with an index of refraction of greater than 3 over the wavelength range of 800 nm to 1100 nm.” *Id.* at 22–23. In addition, Petitioner observes that “[e]ach of Gibbons, Lairson, and Yoda encourage[s] the [person of ordinary skill in the art] to have a low extinction coefficient and recite[s] an upper limit on the extinction coefficient.” *Id.* at 24.

The claim also requires that the plurality of lower-refractive-index layers “each have a refractive index of less than 3 over the wavelength range of 800 nm to 1100 nm.” Ex. 1001, 10:28–31. Petitioner contends that a skilled artisan would have found it obvious to use layers with such a property “because materials commonly used with Si:H—namely silicon dioxide and silicon nitride—were well known to have a refractive index of less than 3 over the wavelength range of 800 nm to 1100 nm.” Pet. 22 (citing Ex. 1002 ¶¶ 233–235). In particular, Petitioner observes that “Lairson and Yoda disclose that SiO₂ and Si₃N₄ are used with Si: to form interference filters.” *Id.* at 26–27 (citing Ex. 1019, 1; Ex. 1034, 3548).

2. Analysis

Patent Owner primarily disputes Petitioner’s analysis based on the properties of the recited hydrogenated silicon layers, correctly noting that none of the asserted references discloses any hydrogenated silicon layers with an extinction coefficient less than 0.0005 over the wavelength range of 800–1100 nm. PO Resp. 39. In considering Petitioner’s position that layers with such a property would nonetheless have been obvious to include in the recited filter stack, it is instructive to consider the specific disclosures of Gibbons, Lairson, and Yoda in some detail. Those disclosures are usefully summarized by a version of Figure 3 of Gibbons modified by Patent Owner and reproduced below (“modified Figure 3”).



Id. at 48. Modified Figure 3 includes a red band marking the 800–1100 nm wavelength range of interest; the circles relate to disclosures of other references that we discuss further below. *See id.* at 41, 48.

First, Gibbons. As Patent Owner correctly observes, Gibbons is the only one of the asserted references that discloses extinction coefficients for hydrogenated silicon films over the entire 800–1100 nm range. *See id.* at 40. And none of Gibbons’s films achieved an extinction coefficient less than 0.0005 over this entire range. This is noted explicitly in the specification of the ’369 patent. *See* Ex. 1001, 2:27–45 (“Unfortunately, these hydrogenated silicon materials do not have a suitably low extinction coefficient over the wavelength range of 800 nm to 1100 nm.”). It is plainly evident from a visual inspection of Gibbons’s Figure 3 that Patent Owner is accurate in stating that “*all* of the thin films sputtered by Gibbons had $k > 0.0005$ (5.0E-04 in Gibbons’ notation) at least somewhere within that range, with some films having $k > 0.0005$ over the entire range.” PO Resp. 40 (citing Ex. 2001 ¶ 89).

Second, Lairson. This reference, which is also discussed in the specification of the ’369 patent, Ex. 1001, 2:27–45, characterizes bandpass filters that “perform acceptably over a wide angular range” as typically requiring “extinction coefficients of less than about 1×10^{-3} in the bandpass wavelength range.” Ex. 1019, 2. In this context, Lairson states that “acceptable extinction coefficients were obtained for wavelengths above 1000nm.” *Id.* Modified Figure 3 identifies this point with a white circle. *See* PO Resp. 43. As Patent Owner asserts, even if Lairson’s disclosure “is taken to mean that Lairson achieved $k < 0.001$ for hydrogenated silicon at 1000 nm, it also must mean that k would have been *greater* than 0.001 (*i.e.*,

unacceptable) at wavelengths below 1000 nm.” *Id.* In addition, it is evident from the drawing that the extinction coefficient of Lairson’s hydrogenated silicon is roughly the same as Gibbons’s “Med H2” film, which exhibited $k > 0.0005$ over most of the 800–1100 nm wavelength range. *See id.*

Third, Yoda. Modified Figure 3 includes a black circle that corresponds to Yoda’s stated extinction coefficient at a wavelength of 1550 nm. *See id.* at 45–46. Extinction-coefficient values at other wavelengths, as low as 850 nm, are shown in Yoda’s Figure 4, reproduced above, but the scale of that plot is such that it is difficult to read values with any precision. Regardless, the clear (and undisputed) trend, as illustrated clearly by Gibbons’s Figure 3, is for the extinction coefficient of hydrogenated silicon to increase at lower wavelengths. *See* Ex. 2004, 107:9–17 (Mr. Willey confirming that “[a]s a result of just physics and chemistry,” the refractive index decreases as the wavelength increases). Patent Owner’s assertion that “Yoda’s hydrogenated silicon would have had an extinction coefficient well above 0.001 at the 800 nm end of the claimed wavelength range” is thus reasonable. *See* PO Resp. 46.

Fourth, Tsai-133 and the Tsai paper. Although these references do not form part of Petitioner’s challenge against independent claim 1, Patent Owner notes that they disclose hydrogenated silicon and that the Tsai paper provides values for the extinction coefficient at 400, 500, 600, 700, and 800 nm. PO Resp. 47. Modified Figure 3 includes blue circles showing the values at 700 and 800 nm (the other values are outside the range shown by Gibbons’s Figure 3). *See id.* at 48. In particular, the value of k at 800 nm, at the low end of the wavelength range of interest, is 0.004. Ex. 1009, 5563.

The collection of data illustrated by modified Figure 3 presents a generally consistent picture of the prior art, against which obviousness of the claims is necessarily evaluated. For example, it is evident that the extinction coefficient increases with decreasing wavelength. Thus, although Yoda discloses an extinction coefficient of about 0.0001, that is at a wavelength of 1550, and the extinction coefficient within the 800–1100 nm range of interest is expected to be higher. *See* PO Resp. 46 (“[B]ecause the extinction coefficient of hydrogenated silicon increases at lower wavelengths, as disclosed by Gibbons, Yoda’s hydrogenated silicon would have had an extinction coefficient well above 0.001 at the 800 nm end of the claimed wavelength range.”); Tr. 45:21–46:2 (Patent Owner arguing that “we can see that the Yoda material would have [an extinction coefficient] around probably the middle material of Gibbons and as you move down the wavelengths, that extinction coefficient is just going to rise.”).

Modified Figure 3 makes apparent that none of the asserted references discloses a hydrogenated silicon film that meets the claim limitation requiring an extinction coefficient of $k < 0.0005$ over the 800–1100 nm wavelength range. *See* Ex. 2001 ¶¶ 112, 114. This is noteworthy because, at the time of the invention, the known method for lowering the extinction coefficient was to increase hydrogen content, which also lowered the refractive index. *Id.* ¶¶ 116–118; Ex. 2004, 25:1–8 (Petitioner’s expert testifying on cross-examination that concurrent decreases in refractive index and extinction coefficient with increased hydrogen are “the nature of the chemistry” and “a scientific fact of life”). This is explicitly acknowledged by Gibbons as “consistent with current understanding of the chemistries required to form low defect amorphous silicon.” Ex. 1016, 328. In

discussing Figure 2 of Gibbons (not reproduced here), Gibbons asserts that “[t]he refractive index of the a-Si shows a decrease in index as the hydrogen concentration and total system pressure increase,” and, in discussing Figure 3, further asserts that “[t]he extinction coefficient of the a-Si decreases as the hydrogen concentration and total system pressure increase.” *Id.* (emphasis omitted).

At the time of the invention, the inventors were thus faced with a situation in which their objectives of relatively high refractive index ($n > 3$) and relatively low extinction coefficient ($k < 0.0001$) were in tension, at least with the known method for adjusting those values in hydrogenated silicon. *See, e.g.*, Ex. 1016, 329 (“The least amount of hydrogen necessary should be [used] to maintain the highest refractive index possible.”); *see also* Ex. 1002 ¶ 209 (Petitioner’s expert stating that Gibbons “encourages the [person having ordinary skill in the art] to achieve the highest possible refractive index while minimizing extinction coefficient for the particular application”). And the state of the art as presented by Petitioner’s references was such that the specific combination of $n > 3$ and $k < 0.0001$ had not been achieved. Petitioner nevertheless contends that “the combination of material characteristics was nothing more than routine optimization of material properties that was explicitly encouraged by the prior art.” Pet. 2.

In particular, Petitioner contends that “[i]t would have been obvious to keep the refractive index of the Si:H layers greater than 3 over the claimed wavelength range” because each of Gibbons, Lairson, and Yoda teaches Si:H with a refractive index greater than 3 over the wavelength range of 800–1100 nm. *Id.* at 22–23. And Petitioner contends that the “extinction coefficient was a known ‘result-effective’ variable and its optimization was

within the grasp of the [person of ordinary skill in the art].” *Id.* at 26 (citing *In re Aller*, 220 F.2d 454, 456 (CCPA 1955). According to Petitioner, “[t]he ranges of extinction coefficients in the prior art (i.e., ‘less than 0.001’ as disclosed by Gibbons and Lairson and ‘less than 0.0001’ disclosed by Yoda) encompass the claimed requirement of an extinction coefficient of ‘less than 0.0005’ over the wavelength range of 800 nm to 1100 nm thus making the claimed range *prima facie* obvious.” *Id.* at 25 (citing *In re Applied Materials, Inc.*, 692 F.3d 1289, 1295 (Fed. Cir. 2012); *In re Peterson*, 315 F.3d 1325, 1329 (Fed. Cir. 2003). In advancing this contention, Petitioner relies on the fact that a person of ordinary skill in the art “knew how to optimize the extinction coefficient using various process parameters and controlling hydrogen content.” *Id.* (citing Ex. 1016, 328–330, Ex. 1019, 2; Ex. 1002 ¶¶ 38–39, 231–232).

One difficulty with Petitioner’s position is that it treats the refractive index and extinction coefficient as independent variables in its argument. But the prior art is clear that the adjusting the hydrogen content of Si:H to achieve a desired extinction coefficient necessarily affects the refractive index—and, as we discuss above, that such adjustments do so in a direction counterproductive to the combination of parameters the inventors sought.

And we agree with Patent Owner that the refractive index and extinction coefficient “are not parameters subject to simple adjustment, but *properties* resulting from the parameters of the fabrication process.” PO Resp. 52 (citing Ex. 2001 ¶¶ 121–122; Ex. 1016, Figs. 2–3). At the Oral Hearing, Petitioner conceded that Patent Owner’s characterization is accurate when considering the hydrogenated silicon material. *See* Tr. 65:7–12. When Petitioner refers to the refractive index and extinction coefficient

as result-effective variables, Petitioner means that those parameters are variables that can affect the properties of the claimed optical filter. *See id.* at 64:6–65:12. As we note above, Petitioner’s argument thus presumes that the refractive index and extinction coefficient can be independently adjusted to achieve desired filter properties—but the asserted prior art teaches against such independence because the known method of adjusting the hydrogen content of Si:H not only affects both the refractive index and extinction coefficient, but does so in a manner counterproductive to the inventors’ objective.

Rather, the inventors teach in the specification of the ’369 patent how that combination can be achieved. To reiterate, this involves using a pulsed DC sputtering process in which the hydrogen flow rate, inert-gas flow rate, power level of the plasma activation source, cathode power level, and deposition rate are optimized, in addition to incorporating an annealing step. *See supra* § I.A.1. (citing Ex. 1001, 4:58–63, 5:22–25). Petitioner classifies this achievement as mere “tinker[ing]” that would have required no more than a reasonable number of experiments with an expectation of success. Reply 15–16. According to Petitioner, a person of ordinary skill in the art would have known that “there are between two and four key parameters for Si:H” and that “optimizing Si:H’s optical properties by optimizing the incorporation of hydrogen into the material would have taken between 11 and about 20 experiments using design of experiments”—a procedure that would have taken some five to seven days. *Id.* at 19 (citing Ex. 2004:153:5–155:11; Ex. 1083, 6703; Ex. 1084, 15; Ex. 1085, 9).

Petitioner appears to understate the effort needed to achieve the combination realized by the ’369 patent. Patent Owner agrees that

“Petitioner’s references might explain why hydrogenated silicon may have been a candidate material for a multilayer filter.” PO Resp. 2. Although Petitioner disputes Patent Owner’s assertions regarding the time the inventors worked to achieve the claimed parameters (Reply 10), Patent Owner’s argument is consistent with the cross-examination testimony of Petitioner’s expert, Mr. Willey, that “Gibbons, Lairson, [and] Yoda basically show processes that would be good candidates.” Ex. 2004, 142:9–13. Notably, in discussing an experimental design to progress from a starting point with such “candidates” to developing a layer with the required properties, Mr. Willey further testified that Petitioner’s proposed 11–20 experiments is a “typical feel.” *Id.* at 153:5–154:16. Mr. Willey elaborated that “quite often in some process like this,” he could envision “really want[ing] to go investigate this area of the parameters . . . and look at it in more detail,” a process that could entail “up to 100 . . . experiments” and “months of process development probably.” *Id.* at 154:16–155:11.

We find this testimony by Petitioner’s expert consistent with Patent Owner’s characterization of this testimony as “merely offer[ing] that a [person of ordinary skill in the art] could have selected a material as a starting point, but that any advancement after that selection would have involved significant trial-and-error experimentation with no expectation of success.” PO Resp. 3. The record is not entirely clear in establishing the actual length of time taken by the inventors to achieve the combination of refractive index and extinction coefficient recited in the claim. For example, Dr. Clemens relies on documentary evidence to testify that “the process to develop a material with the claimed properties (n and k values over the entire 800-1100 nm wavelength range) lasted over two years.” Ex. 2001 ¶ 29. At

the same time, Petitioner contends that Dr. Clemens's testimony on this point reflects an "invention story . . . fed to its expert by counsel" and is "inconsistent with [Patent Owner's] litigation position." Reply 10–14 (capitalization and bold face omitted). To support this contention, Petitioner cites evidence that "[i]n parallel litigation, Viavi said that the invention was conceived in February 2011 and reduced to practice in September 2011 (7 months). *Id.* at 10 (citing Ex. 1080, 2). But even accepting that the actual time taken to develop a process to achieve the desired parameters took seven months rather than years is consistent with the general testimony of *both* experts, namely that development of a process to produce hydrogenated silicon with the required properties was not so trivial as to be accomplished in the 5–7 days that Petitioner contends was needed.

Emphasizing that the asserted references do not disclose the recited combination of refractive index and extinction coefficient for hydrogenated silicon, Patent Owner asserts that "[a]spirations without achievement are not invalidating disclosures." PO Resp. 3. Petitioner replies to this contention that the combined disclosures of Gibbons, Lairson, and Yoda would not have enabled a person of ordinary skill in the art to achieve the claimed optical filter by arguing that "[p]atents and printed publications are presumed to enable their disclosures." Reply 7–8 (citing *In re Antor Media Corp.*, 689 F.3d 1282, 1288 (Fed. Cir. 2012); *Amgen Inc. v. Hoechst Mario Roussel, Inc.*, 314 F.3d 1313, 1354 (Fed. Cir. 2003). According to Petitioner, Patent Owner "has not overcome this presumption." *Id.* at 8. While Petitioner is correct that patents and printed publications may be presumed to enable *what they disclose*, it does not logically follow that any such presumption extends to an *undisclosed* combination. In addition to

none of the asserted art disclosing the specific combination of a refractive index greater than 3 and an extinction coefficient less than 0.0005 over a wavelength range of 800–1100 nm, the art makes clear that the known method of adjusting such parameters (by adjusting hydrogen content) involves effects on the parameters.

For these reasons, we determine that Petitioner makes an insufficient showing with respect to independent claim 1's requirement that "the plurality of hydrogenated silicon layers have a refractive index of greater than 3 over a wavelength range of 800 nm to 1100 nm and an extinction coefficient of less than 0.0005 over the wavelength range of 800 nm to 1100 nm." We accordingly conclude that Petitioner does not show, by a preponderance of the evidence, that independent claim 1 is unpatentable under 35 U.S.C. § 103(a) over Pilgrim, Gibbons, Lairson, and Yoda.

G. Dependent Claims 2, 3, 5–8, 10–12, and 14

Each of challenged claims 2, 3, 5–12, and 14 depends, directly or indirectly, from independent claim 1. Ex. 1001, 10:43–66, 11:5–15, 11:18–23.

Petitioner challenges claims 2, 3, 5–7, 10, 11, and 14 as unpatentable under 35 U.S.C. § 103(a) over Pilgrim, Gibbons, Lairson, and Yoda. Pet. 38–43. Petitioner's challenges of those claims inherit the deficiencies of Petitioner's challenge to independent claim 1. We accordingly conclude that Petitioner does not show, by a preponderance of the evidence, that claims 2, 3, 5–7, 10, 11, or 14 is unpatentable under 35 U.S.C. § 103(a) over Pilgrim, Gibbons, Lairson, and Yoda.

Petitioner challenges claim 8 as unpatentable under 35 U.S.C. § 103(a) over Pilgrim, Gibbons, Lairson, Yoda, Tsai-133, and the Tsai paper. Pet. 48–54. In doing so, Petitioner relies on Tsai-133 and the Tsai paper claim 8’s recitation that the optical filter have a “blocking level, outside of the passband, of greater than OD2 over a wavelength range of 400 nm to 1100 nm.” *Id.* Petitioner does not present any argument that Tsai-133 and/or the Tsai paper overcomes the deficiencies of Petitioner’s challenge to independent claim 1. We accordingly conclude that Petitioner does not show, by a preponderance of the evidence, that claim 8 is unpatentable under 35 U.S.C. § 103(a) over Pilgrim, Gibbons, Lairson, Yoda, Tsai-133, and the Tsai paper.

Petitioner challenges claim 12 as unpatentable under 35 U.S.C. § 103(a) over Pilgrim, Gibbons, Lairson, Yoda, and Tsai-133. Pet. 54–57. In doing so, Petitioner relies on Tsai-133 to meet claim 12’s recitations of a substrate and an antireflective coating. *Id.* Petitioner does not present any argument that Tsai-133 overcomes the deficiencies of Petitioner’s challenge to independent claim 1. We accordingly conclude that Petitioner does not show, by a preponderance of the evidence, that claim 12 is unpatentable under 35 U.S.C. § 103(a) over Pilgrim, Gibbons, Lairson, Yoda, and Tsai-133.

H. Independent Claim 16

Independent claim 16 recites a sensor system that comprises an optical filter and a sensor. Ex. 1001, 11:27–12:11. Like the optical filter recited in independent claim 1, the optical filter comprised by the sensor system of claim 16 must include a filter stack that includes “a plurality of

hydrogenated silicon layers, wherein the plurality of hydrogenated silicon layers each have a refractive index of greater than 3 over the wavelength range of 800 nm to 1100 nm and an extinction coefficient of less than 0.0005 over the wavelength range of 800 nm to 1100 nm.” *Id.* at 11:35–42.

Petitioner challenges independent claim 16 as unpatentable under 35 U.S.C. § 103(a) over two combinations of art: first, over Pilgrim, Gibbons, Lairson, and Yoda, Pet. 45–48; and, second, over Gokturk (incorporating Bamji), Gibbons, Lairson, Yoda, and Pilgrim, *id.* at 57–64. For both of these challenges, Petitioner relies on the same combination of Gibbons, Lairson, and Yoda for the properties of the hydrogenated silicon layers as it does in its challenge to independent claim 1. *Id.* at 47, 63–64. Because we determine that Petitioner’s showing for that limitation is deficient with respect to the challenge to claim 1, we also determine that it is deficient with respect to both challenges to claim 16.

We accordingly determine that Petitioner does not show, by a preponderance of the evidence, that claim 16 is unpatentable under 35 U.S.C. § 103(a) over either combination, i.e., over Pilgrim, Gibbons, Lairson, and Yoda; nor over Gokturk (incorporating Bamji), Gibbons, Lairson, Yoda, and Pilgrim.

I. Dependent Claims 17–21 and 23

Each of claims 17–21 and 23 depends, directly or indirectly, from independent claim 16. Ex. 1001, 12:11–36, 12:40–45.

Petitioner challenges claims 17 and 21 as unpatentable under 35 U.S.C. § 103(a) over Pilgrim, Gibbons, Lairson, and Yoda, Pet. 47–48; challenges claim 23 as unpatentable under 35 U.S.C. § 103(a) over Pilgrim,

Gibbons, Lairson, Yoda, and Tsai-133, *id.* at 54–57; and challenges claims 18–21 as unpatentable under 35 U.S.C. § 103(a) over Gokturk (incorporating Bamji), Gibbons, Lairson, Yoda, and Pilgrim, *id.* at 64–66. For each of these challenges, Petitioner presents no additional argument that cures the deficiency of its showing for the properties of the hydrogenated silicon layers recited in underlying independent claim 16. *See id.* at 47–48, 54–57, 64–66.

We accordingly conclude that Petitioner does not show, by a preponderance of the evidence, that any of claims 17–21 and 23 is unpatentable on these bases.

III. CONCLUSION

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

Claims	35 U.S.C. §	References	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1–3, 5–7, 10, 11, 14, 16, 17, 21	103	Pilgrim, Gibbons, Lairson, Yoda		1–3, 5–7, 10, 11, 14, 16, 17, 21
8	103	Pilgrim, Gibbons, Lairson, Yoda, Tsai-133, Tsai paper		8
12, 23	103	Pilgrim, Gibbons, Lairson, Yoda, Tsai-133		12, 23
16, 18–21	103	Gokturk (incorporating Bamji), Gibbons, Lairson, Yoda, Pilgrim		16, 18–21
Overall Outcome				1–3, 5–8, 10– 12, 14, 16–21, 23

IV. ORDER

It is

ORDERED that, based on a preponderance of the evidence, claims 1–3, 5–8, 10–12, 14, 16–21, 23 of U.S. Patent No. 9,354,369 B2 have not been shown to be unpatentable;

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

IPR2021-00631
Patent 9,354,369 B2

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