

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ZHEJIANG CRYSTAL-OPTECH CO. LTD.,
Petitioner,

v.

VIAVI SOLUTIONS INC.,
Patent Owner.

IPR2022-01184
Patent 9,588,269 B2

Before DEBRA K. STEPHENS, JOHN A. HUDALLA, and
SHARON FENICK, *Administrative Patent Judges*.

STEPHENS, *Administrative Patent Judge*.

DECISION
Denying Institution of *Inter Partes* Review
35 U.S.C. § 314

I. INTRODUCTION

A. Background and Summary

Zhejiang Crystal-Optech Co. Ltd. (“Petitioner”) filed a petition for inter partes review (Paper 1 (“Pet.” or “Petition”)) challenging claims 1–15 and 17–32 of U.S. Patent 9,588,269 B2 (Ex. 1001 (“’269 Patent”)). Viavi Solutions Inc. (“Patent Owner”) timely filed a Preliminary Response (Paper 6 (“Prelim. Resp.”)). Petitioner filed a Petitioner Reply to Patent Owner’s Preliminary Response with our authorization (Paper 7 (“Pet. Reply to POPR”)).

The standard for instituting an *inter partes* review is set forth in 35 U.S.C. § 314(a), which provides as follows:

(a) THRESHOLD.—The Director may not authorize an inter partes review to be instituted unless the Director determines that the information presented in the petition filed under section 311 and any response filed under section 313 shows that there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition (35 U.S.C. § 314(a)).

Petitioner challenges claims 1–15 and 17–32 as unpatentable under 35 U.S.C. § 103 in seven grounds of unpatentability (Pet. 4–5). Generally, Patent Owner contends the Petition should be denied as to all challenged claims (*see* Prelim. Resp.). Based on our review of the record, we conclude that Petitioner is not reasonably likely to prevail in demonstrating at least one of the challenged claims is not patentable.

B. Real Parties-in-Interest

Patent Owner states that Viavi Solutions Inc. is the real party-in-interest (Paper 4, 2).

Petitioner states that Zhejiang Crystal-Optech Co. Ltd. is real party-in-interest (Pet. 65).

C. Related Matters

Petitioner and Patent Owner state the '269 Patent is involved in the following district court proceeding between Petitioner and Patent Owner: *Viavi Solutions Inc. v. Zhejiang Crystal-Optech Co. Ltd.*, No. 2:21-cv-00378-JRG (E.D. Tex.) (Pet. 65; Paper 4, 2).

Petitioner further states that the '269 Patent is also involved in the following district court proceedings that do not include Petitioner: *Viavi Solutions Inc. v. Platinum Optics Technology Inc.*, No. 5:20-cv-05501 (N.D. Cal.) and *Viavi Solutions Inc. v. Platinum Optics Technology Inc.*, No. 5:20-cv-06655 (N.D. Cal.) (Pet. 65).

Petitioner additionally states that the '269 Patent was previously the subject of IPR2021-00424, in which the Board denied institution of *inter partes* review (Pet. 65).

Additionally, Patent Owner states that the '269 Patent is related to U.S. Patents 10,222,526 B2 and 11,131,794 B2 which are, respectively, the subject of petitions in IPR2022-01183 and IPR2022-01281 (Paper 4, 2).

D. The '269 Patent (Ex. 1001)

The '269 Patent, titled "Optical Filter and Sensor System," relates to optical filters useful in sensor systems that detect movements or gestures

based on near-infrared (NIR) light reflected from a user (Ex. 1001, code (54), 1:24–29). Figure 10 is reproduced below.

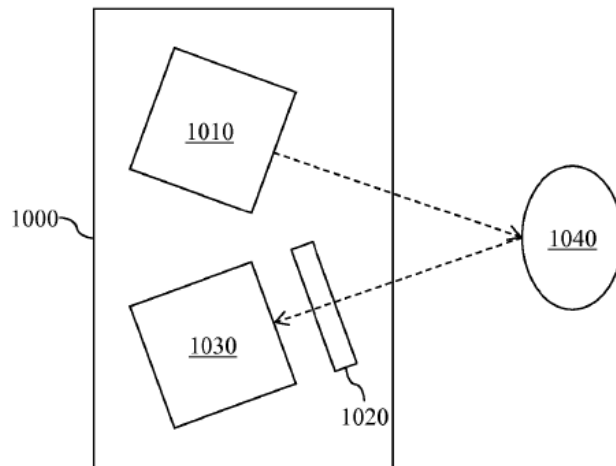


FIG. 10

Figure 10 is a block diagram of a sensor system according to the '269 Patent (Ex. 1001, 4:11–12). Sensor system 1000 includes light source 1010 that emits NIR light toward target 1040, which, in turn, reflects the emitted light toward sensor 1030 (Ex. 1001, 9:53–62). Optical filter 1020 is disposed “to receive the emitted light after reflection by the target 1040” (Ex. 1001, 9:63–64). The '269 Patent describes optical filter 1020 as a “narrow bandpass” filter; it transmits emitted light from light source 1010 “at least partially overlapping with the wavelength range of 800 nm to 1100 nm,” while “substantially blocking ambient light” (Ex. 1001, 1:30–38, 9:64–10:4).

Figure 6 of the '269 Patent is reproduced below.

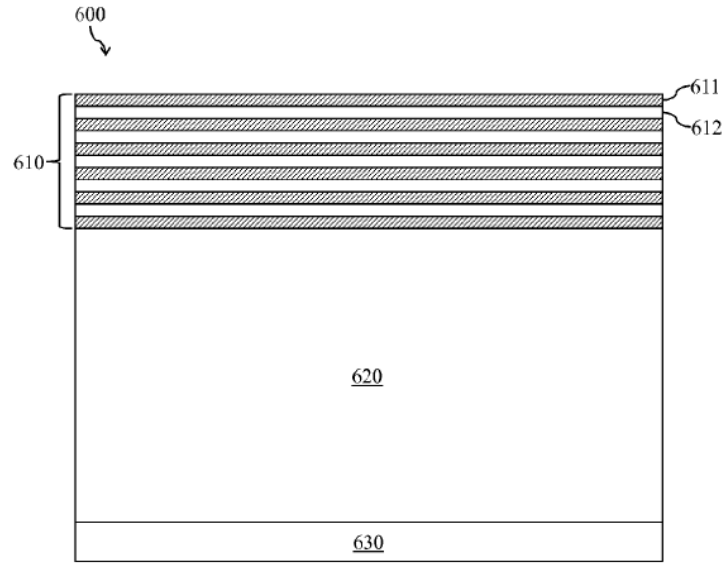


FIG. 6

Figure 6 illustrates a cross-section of the optical filter according to the '269 Patent (Ex. 1001, 3:43–44). Optical filter 600 includes filter stack 610 disposed on substrate 620, such as a glass substrate (Ex. 1001, 5:62–66). 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” (Ex. 1001, 6:7–10). The Si:H layers have a refractive index of greater than 3 over a wavelength range of 800 nm to 1100 nm, while the lower-refractive-index layers have a refractive index of less than 3 over the wavelength range of 800 nm to 1100 nm (Ex. 1001, 2:53–63).

According to the '269 Patent, the disclosed optical filter improves over the prior art by minimizing the “center wavelength shift” in the filter’s optical response as the angle of incident light varies (Ex. 1001, 2:7–13, 20–26). Specifically, the claimed optical filter has a center wavelength shift of less than 20 nm in response to a 0° to 30° change in an incidence angle

(Ex. 1001, 7:54–58). The '269 Patent states that a lower center wavelength shift allows for a “significantly narrower” passband that “improves the signal-to-noise ratio of systems incorporating the” claimed optical filters (Ex. 1001, 8:32–38).

E. Illustrative Claim

Challenged claims, claims 1, 22, and 30 are independent. Claim 1 is reproduced below:

1. An optical filter, comprising:

a filter stack comprising:

a plurality of thin film hydrogenated silicon layers, wherein the plurality of thin film hydrogenated silicon layers have a refractive index of greater than 3 over a wavelength range of 800 nm to 1100 nm; and

a plurality of thin film dielectric lower-refractive-index layers, wherein the plurality of thin film dielectric lower-refractive-index layers have a refractive index of less than 3 over the wavelength range of 800 nm to 1100 nm, and wherein the plurality of thin film dielectric lower-refractive-index layers alternate, in a one-to-one ratio, with the plurality of thin film hydrogenated silicon layers; and

wherein the optical filter has exhibits interference that creates 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°

(Ex. 1001, 10:41–30).

F. References Relied Upon

Petitioner relies upon the following prior art references:

Reference	Exhibit
Pilgrim, US 2012/0224061 A1, published September 6, 2012 (“Pilgrim”)	1004
Yoda et al. <i>α-Si:H/SiO₂ Multilayer Films Fabricated by Radio-Frequency Magnetron Sputtering for Optical Filters</i> , Applied Optics, Vol. 43, No. 17 (June 10, 2004) (“Yoda”)	1005
Gibbons et al., <i>Development and Implementation of a Hydrogenated α-Si Reactive Sputter Deposition Process</i> , PROC. ANNUAL TECHNICAL CONFERENCE, SOCIETY OF VACUUM COATERS, 50th Ann. Tech. Conference Proceedings, 327–330 (2007) (“Gibbons”) ¹	1007
Tsai et al., US 5,398,133, issued March 14, 1995 (“Tsai”)	1008
Wallace et al., <i>Near-Infrared Bandpass Filters for Astronomy</i> , www.photonics.com/Articles/Near-Infrared_Bandpass_Filters_for_Astronomy/a43370 (August 2010) (“Wallace”)	1010
Lairson et al., <i>Reduced Angle-Shift Infrared Bandpass Filter Coatings</i> , Proc. of SPIE Vol. 65451C-1–65451C-5, Window and Dome Technologies and Materials X (2007) (“Lairson”) ²	1019
Gokturk et al., US 7,340,077 B2, issued March 4, 2008 (“Gokturk”)	1025
Domash et al., US 7,049,004 B2, issued May 23, 2006 (“Domash”)	1080

(Pet. 1–3).

Petitioner also relies on the Declaration of Alan E. Willner for support of its contentions in the Petition (Ex. 1002).

¹ When citing to Gibbons, we refer to its original pagination.

² When citing to Lairson, we omit the “65451C-” prefix, referring only to the ending page number.

G. Asserted Grounds

Petitioner challenges claims 1–15 and 17–32 based on the asserted grounds of unpatentability set forth in the table below:

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–7, 9, 10, 12–14, 17, 18, 20–23, 27, 30, 31	103	Pilgrim, Gibbons, Lairson, Yoda
11, 19	103	Pilgrim, Gibbons, Lairson, Yoda, Wallace
8	103	Pilgrim, Gibbons, Lairson, Yoda, Nahum
15, 29, 32	103	Pilgrim, Gibbons, Lairson, Yoda, Tsai
22–27	103	Gokturk, Pilgrim, Gibbons, Lairson, Yoda
28	103	Pilgrim, Gibbons, Lairson, Yoda, Domash
28	103	Gokturk, Pilgrim, Gibbons, Lairson, Yoda, Domash

(Pet. 4–5).

II. ANALYSIS

A. Discretionary Denial – 35 U.S.C. § 314(a)

Patent Owner argues that we should exercise discretion to deny institution under 35 U.S.C. § 314(a) because the factors identified in *Apple, Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (PTAB Mar. 20, 2020) (precedential) (“*Fintiv*”), weigh in favor of denying institution (Prelim. Resp. 49–54). Petitioner argues we should not discretionarily deny institution under *Fintiv* (Pet. 66–67).

Because we determine Petitioner fails to establish a reasonable likelihood of prevailing in showing any of the claims challenged would have been obvious as discussed below, we do not reach this issue.

B. Discretionary Denial – 35 U.S.C. §325(d)

Patent Owner contends we should exercise our discretion under 35 U.S.C. § 325(d) because of the Petition’s “reliance upon the secondary references Gibbons, Lairson, and Yoda. Gibbons and Lairson were considered by the Examiner, and Yoda does not contain any meaningful additional disclosure or basis for unpatentability that was not considered by the Examiner” (Prelim. Resp. 21–22).

Because we determine Petitioner fails to establish a reasonable likelihood of prevailing in showing any of the claims challenged in those grounds would have been obvious as discussed below, we do not reach this issue.

C. Legal Standards

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 (*Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966)).

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

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

D. 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 v. John Deere Co.*, 383 U.S. 1, 17–18 (1966); *Ryko Mfg. Co. v. Nu-Star, Inc.*, 950 F.2d 714, 718 (Fed. Cir. 1991))).

The prior art itself demonstrates the level of ordinary skill in the art at the time of the invention (*see Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (explaining that specific findings regarding ordinary skill level are not required “where the prior art itself reflects an appropriate level and a need for testimony is not shown”) (quoting *Litton Indus. Prods., Inc. v. Solid State Sys. Corp.*, 755 F.2d 158, 163 (Fed. Cir. 1985))).

Petitioner asserts a person of ordinary skill in the art (“POSITA”), “in the relevant field would have 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 element design and optical filters” (Pet. 6; *see* Ex. 1002 ¶ 18). Petitioner further asserts “[a]dditional education (e.g., a Master’s degree with exposure to the above[-]mentioned technologies) may substitute for some industrial experience in optical filter design, and more industrial experience can substitute for a different educational background” (Pet. 6).

Patent Owner does not directly oppose Petitioner’s definition of a POSITA (*see generally* Prelim. Resp.). Patent Owner does, however, state that “Petitioner’s expert has proposed a definition of a POS[IT]A that does not include specific experience in the design of optical filters” and “[m]ere general experience in optical elements does not demonstrate that a POS[IT]A would have possessed the specific ability to” achieve the claimed invention (*see* Prelim. Resp. 44–45).

Based on the present record including the disclosure in the ’269 Patent, we apply a slightly modified version of Petitioner’s definition of the level of ordinary skill in the art that removes the qualification of “at least” and clarifies some statements (*see* Pet. 6). More specifically, we determine a POSITA would have had a Bachelor’s degree or equivalent in physics, or in a related science or engineering field, along with five years of experience in optical element design and optical filters although additional education (e.g., a Master’s degree with exposure to optical element design and optical filters) may substitute for some industrial experience in optical element and optical filter design, and more industrial experience can substitute for a different educational background.

We determine this level of skill comports with the qualifications a person would have needed to understand and implement the teachings of the ’269 Patent and the prior art of record (*cf. Okajima*, 261 F.3d at 1355 (the prior art itself may reflect an appropriate level of skill in the art)).

E. Claim Construction

We construe claim terms according to the standard set forth in *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–17 (Fed. Cir. 2005) (en banc), i.e., as construed in a civil action under 35 U.S.C. § 282(b) (37 C.F.R. § 42.100(b)

(2020)). Under *Phillips*, claim terms are afforded “their ordinary and customary meaning” (*Phillips*, 415 F.3d at 1312). “[T]he ordinary and customary meaning of a claim term is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention” (*Phillips*, 415 F.3d at 1313). “Importantly, the person of ordinary skill in the art is deemed to read the claim term not only in the context of the particular claim in which the disputed term appears, but in the context of the entire patent, including the specification” (*Phillips*, 415 F.3d at 1313). An inventor may rebut that presumption by providing a definition of the term in the specification “with reasonable clarity, deliberateness, and precision” (*In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994)). In the absence of such a definition, limitations are not to be read from the specification into the claims (*In re Van Geuns*, 988 F.2d 1181, 1184 (Fed. Cir. 1993)).

Petitioner asserts the term “center wavelength” should be interpreted as “the average of the two half-power wavelengths (i.e., FWHM) in a passband” (Pet. 6 (citing Ex. 1001, 7:48–50, 8:66–9:1, Figs. 7D, 8C, 9B; Ex. 1037, 5)).

Petitioner asserts the term “passband” should be interpreted as “a wavelength range within which a signal can pass through a filter and outside of which the signal is blocked” (Pet. 7 (citing Ex. 1037, 12–15)).

Patent Owner does not directly address Petitioner’s proposed interpretations nor provide its own constructions of any other claim term (*see generally* Prelim. Resp.). Having considered the record, we conclude that no express claim construction is necessary for any claim terms (*see Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (holding that only claim terms in controversy need to be construed, and only to the extent necessary to resolve the controversy

(citing *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)))).

F. Ground I: Asserted Obviousness over Pilgrim, Gibbons, Yoda, and Lairson – Claims 1–7, 9, 10, 12–14, 17, 18, 20–23, 27, 30, and 31

Petitioner contends Pilgrim, Gibbons, Lairson, and Yoda, taken in combination, render claims 1–7, 9, 10, 12–14, 17, 18, 20–23, 27, 30, and 31 obvious (Pet. 7–39). Before turning to Petitioner's asserted grounds of unpatentability, we provide brief summaries of the asserted references.

1. Pilgrim (Ex. 1004)

Pilgrim describes a “method and device for viewing objects situated in fog” (Ex. 1004 ¶ 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 (Ex. 1004 ¶¶ 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” (Ex. 1004 ¶ 16).

Figure 3A of Pilgrim is reproduced below.

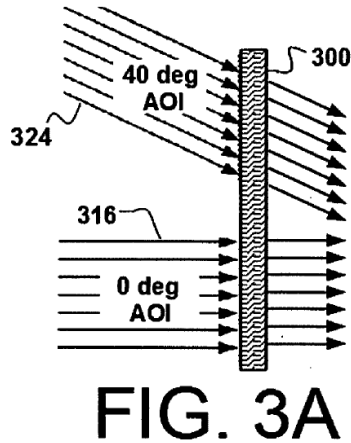


Figure 3A illustrates a multilayer bandpass filter with light passing through it at different incidence angles (Ex. 1004 ¶ 25). “Multilayer bandpass filters are comprised of alternating layers of high and low refractive index materials” and the “number and thickness of these layers are selected to determine the wavelength of the pass band and the bandwidth” (Ex. 1004 ¶ 26). “When incident light has an angle of incidence (AOI) of 0 (zero) degrees 316[,], the pass band is at its longest wavelength” (Ex. 1004 ¶ 25). An incidence angle of “40 degrees 324[] is at the limit of the field-of-view” in a certain embodiment (Ex. 1004 ¶ 25).

Figure 3B of Pilgrim is reproduced below.

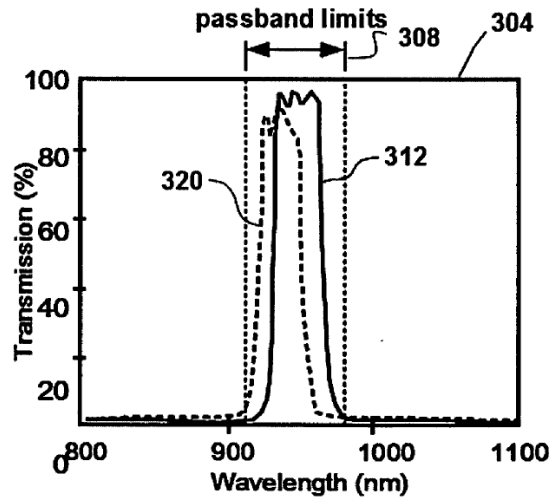


FIG. 3B

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 (Ex. 1004 ¶ 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” (Ex. 1004 ¶ 26). 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” (Ex. 1004 ¶ 26).

2. Gibbons (Ex. 1007)

Gibbons describes “the results of a developmental program to commercialize a high index optical coating consisting of hydrogenated amorphous silicon” (α -Si:H) (Ex. 1007, 327). Gibbons presents its results in the context of a general “effort to develop commercially viable high index amorphous silicon thin films” (Ex. 1007, 327). 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” (Ex. 1007, 327). To deposit α -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” (Ex. 1007, 327).

Figure 2 of Gibbons is reproduced below.

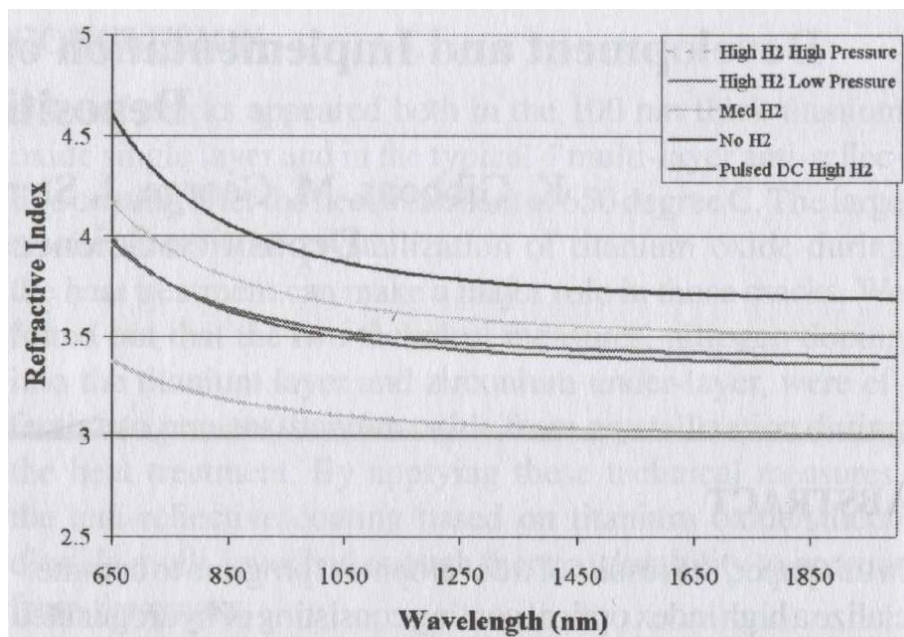


Figure 2 plots the refractive index as a function of wavelength for amorphous silicon samples produced under different hydrogen concentrations and total system pressure (Ex. 1007, 328). Figure 2 shows the refractive index of amorphous silicon decreases as the hydrogen concentration or total system pressure increases (Ex. 1007). Gibbons teaches that “[t]he least amount of hydrogen necessary should be [used] to maintain the highest refractive index possible” (Ex. 1007, 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” (Ex. 1007, 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 α -Si:H can shift that band edge “to below 800 nm” (Ex. 1007, 329). Gibbons thus concludes that its process can produce a “high index, low absorption thin film amorphous silicon suitable for many near-infrared optical applications” (Ex. 1007, 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” (Ex. 1007, 330).

3. *Yoda (Ex. 1005)*

Yoda describes “optical properties of α -Si:H/ SiO₂ multilayer films . . . for optical bandpass filters (BPFs)” (Ex. 1005, 3548). Yoda explains “optical bandpass filters (BPFs)” are “formed from alternating multilayer films of two dielectric materials . . . with high-low refractive indices” (Ex. 1005, 3548). Figure 7 of Yoda, reproduced below, shows an

optical BPF having hydrogenated amorphous silicon (α -Si:H)/silicon dioxide (SiO_2) alternating multilayers (Ex. 1005, 3548, 3551).

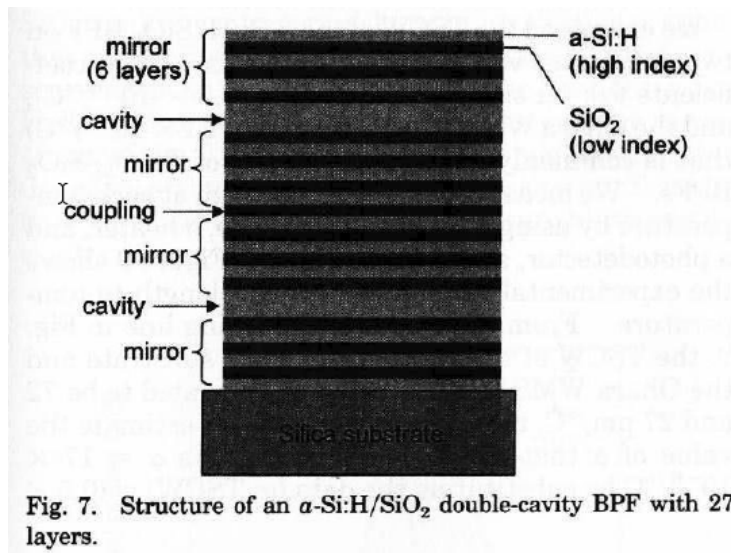


Figure 7 shows an optical BPF having hydrogenated amorphous silicon (α -Si:H)/silicon dioxide (SiO_2) alternating multilayers (Ex. 1005, 3548, 3551).

Figure 8 of Yoda is reproduced below.

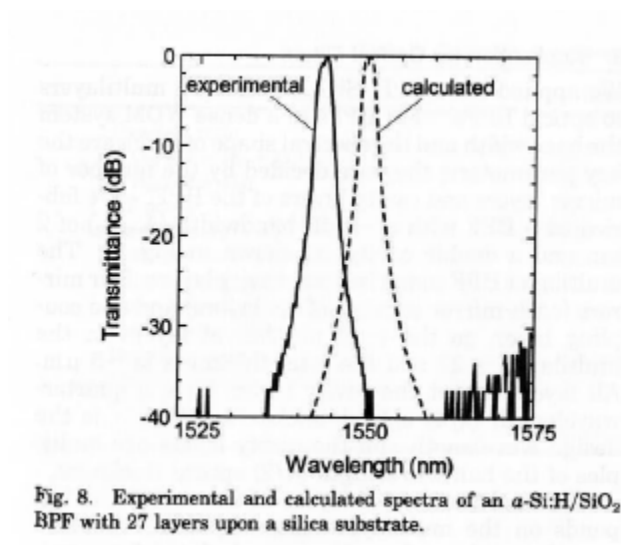


Figure 8 illustrates “experimental and calculated transmission spectra of the α -Si-H/SiO₂ [BandPass Filter] fabricated by use of the optical monitoring system” (Ex. 1005, 3552).

Figure 4 of Yoda is reproduced below.

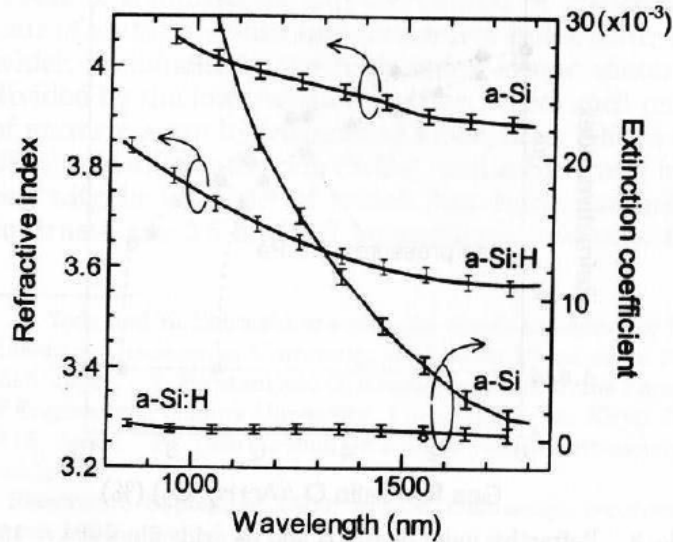


Fig. 4. Refractive index and extinction coefficient of α -Si:H and Si:H as functions of wavelength.

Figure 4 shows “the α -Si:H refractive index (n) with error bars as a function of wavelength” (Ex. 1005, 3550). For example, as shown in Figure 4, “the α -Si:H refractive index at $\lambda = 1550$ nm is estimated to be $n = 3.59 \pm 0.015$ ” (Ex. 1005, 3550).

4. Lairson (Ex. 1019)

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. 1019, 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 (Ex. 1019, 1–2).

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) (Ex. 1019, 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 (Ex. 1019, 3). “Perhaps more surprising,” Lairson adds, “is the reduced thickness and sharper edge of the SiH/Si₃N₄ filter” (Ex. 1019, 3).

Figure 4 of Lairson is reproduced below.

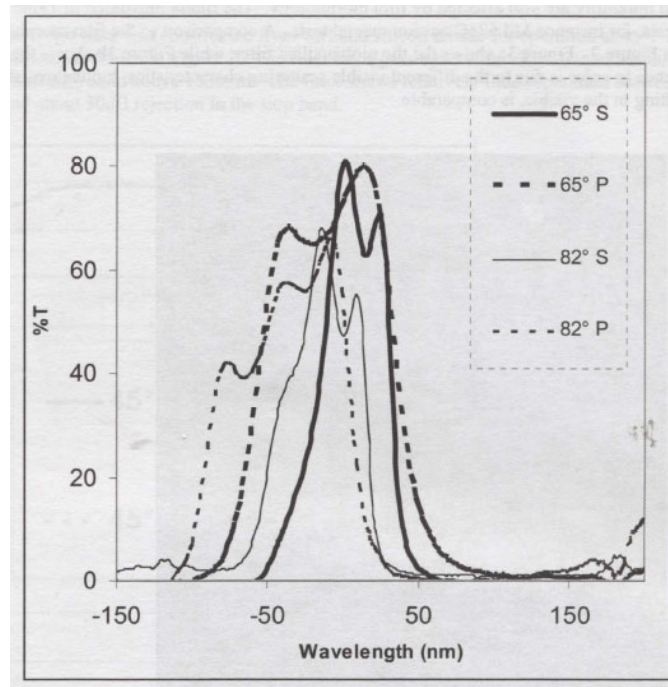


Figure 4 shows transmission spectra for a Si:H-SiO₂ filter at a bandpass of 65° and 82° (Ex. 1019, 4–5). Regarding these spectra, Lairson observes that “[t]his filter achieves greater than 50% transmission at the wavelength of interest over this angular range, with a bandpass width of approximately 50nm” (Ex. 1019, 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 (Ex. 1019, 4). 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” (Ex. 1019, 5).

5. *Claim 1*

Petitioner contends the combination of Pilgrim, Gibbons, Lairson, and Yoda teaches the limitations of independent claim 1 (Pet. 7–22).

Petitioner relies on Pilgrim to teach “[a]n optical filter” (Pet. 7 (citing Ex. 1004, code (57, ¶¶ 15, 21)). Petitioner also asserts a combination of Gibbons, Lairson, and Yoda teaches this limitation (Pet. 7 (citing Ex. 1007, 327; Ex. 1019, 2–5; Ex. 1005, 3548; Ex. 1002 ¶¶ 136–140)).

Petitioner relies on Pilgrim to teach “a filter stack” (Pet. 7–8 (citing Ex. 1004 ¶ 26; Ex. 1002 ¶ 141)).

Petitioner relies on Gibbons, Lairson, and Yoda to teach “a plurality of thin film hydrogenated silicon layers, wherein the plurality of thin film hydrogenated silicon layers have a refractive index of greater than 3 over a wavelength range of 800 nm to 1100 nm” (Pet. 8–11 (citing Ex. 1007, 327–28, Fig. 2; Ex. 1019, 1, Table 1; Ex. 1005, 3550–51, Figs. 4, 7; Ex. 1002 ¶¶ 142–148)).

Petitioner relies on Pilgrim, Lairson, and Yoda to teach “a plurality of thin film dielectric lower-refractive-index layers, wherein the plurality of thin film dielectric lower-refractive-index layers have a refractive index of less than 3 over the wavelength range of 800 nm to 1100 nm” (Pet. 11–12

(citing Ex. 1004 ¶ 26; Ex. 1005, 3548, 3551; Ex. 1009, 1; Ex. 1076, 10:6–8, 12:28–35; Ex. 1077, 774; Ex. 1002 ¶¶ 149–151)).

Petitioner relies on Pilgrim, Lairson, and Yoda to teach “wherein the plurality of thin film dielectric lower-refractive-index layers alternate, in a one-to-one ratio, with the plurality of thin film hydrogenated silicon layers” (Pet. 12–16 (citing Ex. 1004 ¶ 26; Ex. 1019, 1, Table 1; Ex. 1005, 3551, Figs. 6–7; Ex. 1002 ¶¶ 152–155)).

Petitioner relies on Pilgrim to teach “wherein the optical filter has exhibits interference that creates a passband at least partially overlapping with the wavelength range of 800 nm to 1100 nm” (Pet. 13–14 (citing Ex. 404 ¶ 26, Fig. 3B; Ex. 1002 ¶ 156–157)).

Petitioner relies on Pilgrim to teach “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°” (Pet. 14–15 (citing Ex. 1004 ¶¶ 25–26; Ex. 1002 ¶¶ 158–160)).

In its Preliminary Response, Patent Owner does not appear argue that Pilgrim, Gibbons, Lairson, and Yoda fail to teach the respective limitations each reference is relied upon for (*see* Prelim. Resp.). Instead, as discussed below, Patent Owner asserts that Pilgrim, Gibbons, Lairson, and Yoda would not and could not have been combined to render the claim, as a whole, obvious (*see* Prelim. Resp. 24–47).

6. Claims 2–7, 9, 10, 12–14, 17, 18, 20–23, 27, 30, and 31

Petitioner contends the combination of Pilgrim, Gibbons, Lairson, and Yoda teaches the limitations of claims 2–7, 9, 10, 12–14, 17, 18, 20–23, 27, 30, and 31 (Pet. 22–39).

In its Preliminary Response, Patent Owner did not offer any arguments that Pilgrim, Gibbons, Lairson, and Yoda fail to teach the limitations recited in these claims (*see* Prelim. Resp.). As discussed below, Patent Owner asserts that Pilgrim, Gibbons, Lairson, and Yoda would not and could not have been combined to render the claim, as a whole, obvious (*see* Prelim. Resp. 24–47).

7. *Obviousness*

In regard to claim 1, as discussed above, Petitioner asserts Pilgrim teaches an optical filter stack of alternating layers of higher and lower refractive index materials and further teaches that its optical filter stack describes “certain design parameters for an interference filter,” i.e., “interference that creates a passband at least partially overlapping with the wavelength range of 800 nm to 1100 nm” and a “passband [having] a center wavelength that shifts by less than 20 nm in magnitude with a change in an incidence angle between 0° to 30°” as required by the claims (Pet. 7–8, 13–15 (citations omitted)). Petitioner acknowledges Pilgrim does not teach its higher refractive layers comprise a “plurality of thin film hydrogenated silicon layers [having] a refractive index of greater than 3 over a wavelength range of 800 nm to 1100 nm” and, further, does not teach its lower refractive layers comprise a “plurality of thin film dielectric lower-refractive-index layers have a refractive index of less than 3 over the wavelength range of 800 nm to 1100 nm” (*see* Pet. 8, 11). Petitioner explains, “Pilgrim provides certain design parameters for an interference filter — e.g., its center wavelength, [passband having a full width at half maximum (FWHM)], and center wavelength shift — but “Pilgrim does not describe the specific design or materials for the filter” (Pet. 18). That is, Pilgrim teaches an optical filter

having certain desirable properties, but does not detail what materials to use or what properties those materials would need to achieve those desirable properties in the resulting optical filter.

Patent Owner disputes the propriety of the combination and, in particular, contends Pilgrim only teaches design needs for an optical filter; “none of the four references discloses an optical filter that meets the claimed limitations”; and the references could not have been combined “in a manner that meets the claimed limitations” (Prelim. Resp. 24–25).

Patent Owner first contends, “Pilgrim discloses a sensor system that calls for a bandpass optical filter to block light outside of an absorption band of water” but “Pilgrim does not disclose any multilayer bandpass filter that meets the general design requirements” that Pilgrim sets forth, nor does Pilgrim “require any particular type of optical filter for its system” (Prelim. Resp. 25–26). According to Patent Owner, Pilgrim does not provide a starting point for making a filter that conforms to its requirements such as by describing “any optical filter design or any high or low refractive index materials that could be used” (Prelim. Resp. 26).

Pilgrim teaches a device for viewing through fog (Ex. 1004, code (54)). Specifically, Pilgrim describes using multilayer bandpass filters with band limits chosen “to ensure the shift in the pass band due to changes in the angle of incidence (AOI) [that] does not result in the pass band being shifted out of the absorption band for which it is designed” (Ex. 1004 ¶ 16). Pilgrim states the filter should have a center wavelength of 950 nm, a full-width half-maximum (FWHM) (i.e., bandwidth) of 50 nm (i.e., 925–975 nm), and a shift in “pass band center” (i.e., center wavelength shift) of approximately 15 nm over a change in AOI from 0° to 40° (Ex. 1004 ¶ 26; Prelim. Resp. 9–10). As noted by Patent Owner, Pilgrim teaches desired

filter characteristics; however, Pilgrim does not teach the construction of the filter or the characteristics of the specific materials (*see* Prelim. Resp. 24–27; Ex. 1004). Rather, Pilgrim teaches “[m]ultilayer bandpass filters are comprised of alternating layers of high and low refractive index materials”; without specifying the value(s) of the refractive index materials, or other parameters such as number of layers, thickness, etc. (Ex. 1004 ¶ 26).

To address those missing details about the filter layers in Pilgrim’s optical filter, Petitioner asserts that, based on Gibson, Lairson, and Yoda teaching certain filter layer characteristics, a person of ordinary skill in the art (POSITA) “would have found the claimed Si:H high refractive index layers and optical properties of the filter layers as recited in claim 1 to be obvious material characteristics that were routinely optimized parameters disclosed in the prior art as being result-effective in the performance of optical interference filters” (Pet. 22; *see id.* at 19–21). That overall assertion relies on two underlying contentions. First, a “POSITA would have found Si:H an obvious choice for a high-refractive-index layer” and a POSITA “would have [found it] obvious to keep the refractive index of the Si:H layers greater than 3 over the claimed [800 nm to 1100 nm] wavelength range” (Pet. 19). And second, “[u]sing silicon dioxide or silicon nitride with a refractive index of less than 3 over the wavelength range of 800 to 1100 nm as the lower-refractive-index layers of the filter designed for Pilgrim’s system would have been obvious” (Pet. 21).

Patent Owner responds, “even if the POS[ITA] would have been motivated to undertake this task in lieu of using existing material and designs, the secondary references would not have led a POS[ITA] to the claimed invention” (Prelim. Resp. 27). According to Patent Owner, although Gibbons, Lairson, and Yoda describe “degrees of disclosure

concerning optical filters (including bandpass filters), none of the filters disclosed by these references meet the design parameters for the optical filter required by Pilgrim's system" that Petitioner highlights, e.g., Pilgrim's center wavelength, FWHM, and center wavelength shift (Prelim. Resp. 28; Pet. 18)). That is, Patent Owner argues Petitioner has failed to show it would have been obvious to use the filters disclosed by Gibbons, Lairson, and Yoda, in Pilgrim's *optical filter* with the required characteristics (Prelim. Resp. 28; *see* Pet. 18).

In particular, Patent Owner asserts, "Gibbons does not disclose any bandpass filter" and "Gibbons says nothing about the center wavelength shift of any of its filters" (Prelim. Resp. 30). Regarding Lairson, Patent Owner asserts, "Lairson does not identify the center wavelength of its bandpass filter"; "says nothing about the center wavelength shift of its bandpass filter"; and "does not provide any details on the design of this filter" (Prelim Resp. 31–33). And regarding Yoda, Patent Owner asserts "Yoda's bandpass filter operates above 1530 nm"; "Yoda has a relatively narrow bandwidth, not even close to the wavelength range required by Pilgrim"; and "Yoda does not even consider how the center wavelength would shift based on AOI" (Prelim. Resp. 34–35). Still further, Patent Owner argues the Petition "only identifies passages from Gibbons, Lairson, and Yoda that allegedly teach claim limitations missing from Pilgrim" but fails to "explain how a [POSITA] could have combined Gibbons, Lairson, and Yoda to yield a new bandpass interference filter suitable for Pilgrim's system, or how that new filter would meet the claimed limitations" (Prelim. Resp. 39). Additionally, Patent Owner argues the Petition "fails to establish a reasonable expectation of success" because neither the Petition nor its expert "explain how a [POSITA] would have been able to optimize

parameters to recreate (or redesign) the materials from Gibbons, Lairson, and Yoda” and instead “simply assume[s] the [claimed] filter design as a for[e]gone conclusion” (Prelim. Resp. 47, 41).

We agree with Patent Owner that Petitioner fails to show a reasonable likelihood that the claimed invention would have been obvious over the combination of Pilgrim, Gibbons, Lairson, and Yoda. The claim requires an optical filter having properties (i.e., the claimed passband wavelength, shift requirements, and incidence angle) that are exhibited using an optical filter stack comprising layers with their own particular properties (i.e., the claimed type of layer material and refractive indexes) (Ex. 1001, 10:41–60).

Petitioner has shown that Pilgrim teaches the desirability of an optical filter stack having the claimed optical filter properties and has also shown, in various pieces, that Gibbons, Lairson, and Yoda teach filter layers having the claimed layer properties (*see, e.g.*, Ex. 1004 ¶ 26; Ex. 1005, 3548, 3550–51; Ex. 1007, 327–28; Ex. 1019, 1). However, in this case, Petitioner’s piecemeal citations to four prior art references for teaching the properties of the claimed optical filter and the properties of the claimed layers of the optical filter fail to show that the claimed invention as a whole would have been obvious. Even if it would have been desirable to use filter layers having the claimed filter layer properties, as Petitioner asserts (Pet. 19–21), Petitioner fails to show that Pilgrim’s cited filter properties for an optical filter stack could have been, or would have been, provided when Pilgrim’s optical filter stack incorporates the filter layers taught by Gibbons, Lairson, and Yoda. More specifically, Petitioner argues the filter layer features taught by Gibbons, Lairson, and Yoda are desirable to use in Pilgrim’s optical filter, but has not established sufficiently that Gibbons’s, Lairson’s, and Yoda’s filter layers could have been, or would have been, combined to

obtain an optical filter with the claimed properties (*see* Pet. 18–21). Nor has Petitioner sufficiently explained how the filter layers disclosed by Gibbons, Lairson, and Yoda achieve the optical filter properties required by the claims or the optical filter properties taught by Pilgrim. More specifically, Petitioner relies upon Gibbons, Lairson, and Yoda to teach particular properties of the recited “thin film hydrogenated silicon layers,” without articulating how those particular teachings that each separately have some of the characteristics of Pilgrim’s desired optical filter, would work together to achieve the optical filter having the characteristics of the optical filter.

The optical filter that Pilgrim discloses, and that Petitioner relies on to teach the claimed optical filter properties, has a passband that “is centered on 950 nm with a full bandwidth of approximately +/-25 nm” and a “shift in [passband] center between an [angle of incidence (AOI)] of 0 degrees and an AOI or 40 degrees [which] is approximately 15 nm” (Ex. 1004 ¶ 26). Gibbons, Lairson, and Yoda are all silent with regard to whether their filter layers could be used in an optical filter having a limited shift at a passband center, either as disclosed by Pilgrim or required by the claims. As Patent Owner points out, Gibbons, Lairson, and Yoda do not “consider how the center wavelength would shift based on [incidence angle],” if those references discuss a passband center wavelength or a center wavelength shift at all (Prelim. Resp. 30, 32–33, 35; *see generally* Ex. 1005, 1007, 1019)). For example, Petitioner relies on Pilgrim to teach “the passband has a center wavelength that shifts by less than 20nm in magnitude with a change in an incidence angle between 0° to 30° (Pet. 14–15). Petitioner has not shown Gibbons, Lairson, or Yoda teaches a center wavelength that shifts with a change in an incidence angle (*see* Pet.). Nor has Petitioner explained how combining the teachings of Gibbons, Lairson, and Yoda, relied on to

teach the layers, will achieve the recited feature (*see* Pet.). Gibbons, Lairson, and Yoda are silent regarding their effect on center wavelength shift, and Petitioner fails to establish that an ordinarily skilled artisan would have used the layers taught by Gibbons, Lairson, and Yoda in a filter that has the required center wavelength shift limits. Further, Petitioner's assertion that optical filter properties and the filter layer properties are "routinely optimized parameters" does not adequately explain that the filter layer properties taught by Gibbons, Lairson, and Yoda could be used in an optical filter to obtain the properties disclosed by Pilgrim and or those required by the claims (Pet. 18, 22). Still further, Petitioner's assertion about routine optimization is conclusory and is not supported by evidence.

The declaration of Petitioner's declarant also fails to explain how the types of filter layers disclosed by Gibbons, Lairson, and Yoda would have been incorporated in an optical filter with the required properties. Petitioner's declarant discusses the desirability of filter layers with the claimed properties (*see* Ex. 1002 ¶¶ 163–171) and asserts that it would have been obvious to "combine [Gibbons, Lairson, and Yoda's] layers with optimized parameters to meet the design needs of Pilgrim's bandpass filter" (Ex. 1002 ¶ 172; *see* Ex. 1002 ¶ 162). But Petitioner's declarant does not explain that it would have, or how it would have, been possible to combine the *filter layers* disclosed in Gibbons, Lairson, and Yoda to provide an optical *filter* with the properties described by Pilgrim and recited in the claims. For example, although Petitioner's declarant describes "the deposition processes would have been efficient in creating appropriate [filter layer] materials" and "fabrication techniques" for the filter layer materials, Petitioner's declarant does not explain how an ordinarily skilled artisan would have chosen filter layer materials and a configuration from these

materials that would result in an optical filter with the required properties (see Ex. 1002 ¶¶ 169, 172).

Petitioner's inadequate explanation as to how Gibbons, Lairson, and Yoda's filter layers would have been incorporated into an optical filter with the required properties is typified by Petitioner's generalized reliance on Gibbons, Lairson, and Yoda's separately disclosed filter layers to teach the same filter layer properties. For example, Petitioner asserts that each of Gibbons, Lairson, and Yoda may be relied upon to teach "hydrogenated silicone layers [having] a refractive index of greater than 3," but Petitioner does not explain which of those separately described filter layers should be selected or why any of those separately described filter layers would have been combined to obtain the claimed optical filter. More specifically, Petitioner highlights Gibbon's five types of material (created in several different processes) having refractive indexes which are above 3 (Pet. 8–9 (citing Ex. 1007, Fig. 2)); Lairson's "Si:H material having a refractive index of 3.2 at 1500 nm" (Pet. 9 (citing Ex. 1009, 1)); and "Yoda's Si:H material [that] has a refractive index of greater than 3.7 over the wavelength range of 800 nm to 1100 nm" (Pet. 9 (citing Ex. 1005, 3550, Fig. 4)). But, with all those possible layers — which have different refractive indexes at different wavelengths — Petitioner does not explain (1) how an ordinarily skilled artisan would have chosen among the various layers or (2) how an ordinarily skilled artisan would have combined the chosen layers into an optical filter. Nor does Petitioner point out evidence showing that an ordinarily skilled artisan would have selected and incorporated appropriate layers to achieve the claimed optical filter.

Even further, Petitioner has not presented adequate evidence or argument that there would have been a reasonable expectation of success in

combining Gibbons, Lairson, and Yoda's filter layers in Pilgrim's optical filter to result in an optical filter with the required properties.

Petitioner must show not only "that a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention," but also, "that the skilled artisan would have had a reasonable expectation of success in doing so" (*Kinetic Concepts, Inc. v. Smith & Nephew, Inc.* 688 F.3d 1342, 1360 (Fed. Cir. 2012)).

Petitioner's assertion that a POSITA would have expected to succeed in optimizing the parameters and designing a filter for Pilgrim's application and to meet Pilgrim's design goals in light of the guidance about how various processes and parameters impacted the index of refraction and extinction coefficient of Si:H and the POSITA's ability to simulate the performance of the filter designs using the optimized materials (Pet. 22) does not address whether a POSITA would have had a reasonable expectation of success in creating an optical filter with the required properties using the filter layers described by Gibbons, Lairson, and Yoda. Petitioner has not shown the POSITA has the "ability to simulate the performance of the filter designs" (Pet. 22); for example, Petitioner has not discussed what specific simulation techniques or tools would have been used by the POSITA. Furthermore, although Petitioner's expert asserts

the POSITA would have reasonably expected to succeed in devising a filter to meet Pilgrim's design goals using hydrogenated silicon with the claimed parameters . . . since the POSITA knew previously that controlling various process parameters could modify the amount of hydrogen added to the silicon during the formation of the hydrogenated silicon material (Ex. 1002 ¶ 172), that statement does not explain how the ability to "modify the amount of hydrogen added to the silicon" in a filter layer would have led

to successfully creating an optical filter with the required passband characteristics. Rather, as Patent Owner points out, the evidence cited in the record before us suggests “the design of [an optical] bandpass interference filter with a narrow bandwidth and low center wavelength shift is not trivial” (Prelim. Resp. 42 (citing Ex. 1001, Fig. 7C)). Specifically, in detailing the requisite filter layers for an exemplary filter, the ’269 Patent describes 48 layers of materials having varying thicknesses, an “[antireflective] coating includ[ing] 5 layers, and the total coating thickness [being] about 5.7 μm ” (Ex. 1001, 8:1–12, Figs. 7B–7C).

Accordingly, upon our review of Petitioner’s asserted contentions, we determine Petitioner fails to make a sufficient showing that the combination of Pilgrim, Gibbons, Lairson, and Yoda would have rendered claim 1 obvious. Petitioner’s arguments on independent claims 22 and 30 reference and rely on the same arguments as claim 1 (Pet. 35–39). Accordingly, for the same reasons discussed above, Petitioner fails to make a sufficient showing that the combination of Pilgrim, Gibbons, Lairson, and Yoda would have rendered claims 22 and 30 obvious.

Claims 2–7, 9, 10, 12–14, 17, 18, 20, 21, 23, 27, and 41 depend from claims 1, 22, or 30. Petitioner’s arguments regarding those claims do not overcome the shortcomings discussed above. As such, Petitioner fails to make a sufficient showing that the combination of Pilgrim, Gibbons, Lairson, and Yoda would have rendered claims 2–7, 9, 10, 12–14, 17, 18, 20, 21, 23, 27, and 41 obvious.

8. Conclusion

Based on the record before us, we determine Petitioner’s proffered arguments, evidence, and supporting testimony fails to establish a reasonable

likelihood that Petitioner would prevail in showing that claims 1–7, 9, 10, 12–14, 17, 18, 20–23, 27, 30, and 31 would have been obvious over Pilgrim, Gibbons, Lairson, and Yoda.

G. Remaining Grounds

Petitioner’s remaining grounds of unpatentability, Grounds II–VII, reference and rely on the same arguments to support the combination of Pilgrim, Gibbons, Lairson, and Yoda as in Ground I (*see* Pet. 39–64). Accordingly, for the same reasons discussed above, Petitioner fails to establish a reasonable likelihood that Petitioner would prevail in showing any of the claims challenged in those grounds would have been obvious.

III. CONCLUSION

Petitioner has not demonstrated a reasonable likelihood of showing at least one of the claims challenged in the Petition would have been obvious. Accordingly, for the reasons stated herein, we deny the Petition.

IV. ORDER

In consideration of the foregoing, it is hereby

ORDERED that the Petition is *denied* and no *inter partes* review as to any claim of the ’269 Patent is instituted.

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Patent 9,588,269 B2

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