

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ARRIS GROUP, INC.,
Petitioner,

v.

CIRREX SYSTEMS, LLC.,
Patent Owner.

Case IPR2014-01191
Patent 6,222,970 B1

Before JAMESON LEE, LINDA M. GAUDETTE, and
CHRISTOPHER M. KAISER, *Administrative Patent Judges*.

GAUDETTE, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 318(a) and 37 C.F.R. § 42.73

I. INTRODUCTION

Arris Group, Inc. (“Petitioner”) filed a Petition (Paper 1, “Pet.”) on July 18, 2014, to institute an *inter partes* review of claims 59, 61, 74, 76, 78, and 87 (the “challenged claims”) of U.S. Patent No. 6,222,970 B1 (Ex. 1001, “the ’970 patent”). Cirrex Systems LLC (“Patent Owner”) timely filed a Preliminary Response (Paper 5, “Prelim. Resp.”). Based on these submissions, we instituted this trial on January 22, 2015, pursuant to 35 U.S.C. § 314. Paper 6 (“Dec. on Inst.”).

After institution, Patent Owner filed a Response (Paper 9, “PO Resp.”), and Petitioner filed a Reply to the Patent Owner Response (Paper 10, “Reply”).

Oral argument was held on October 6, 2015, and a transcript (Paper 14 (“Tr.”)) has been entered into the record.

We have jurisdiction under 35 U.S.C. § 6(c). This Final Written Decision is entered pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73.

For the reasons discussed below, we determine Petitioner has met its burden to prove, by a preponderance of the evidence, that claims 59, 61, 74, 76, 78, and 87 of the ’970 patent are unpatentable.

II. BACKGROUND

A. The ’970 Patent (Ex. 1001)

The ’970 patent relates “to optical fiber probes that use manipulated delivery and reception regions to improve sensitivity to specific light-matter interactions.” Ex. 1001, 1:25–27. One application of optical fiber probes is in Raman spectroscopy. *See generally, id.* at 1:52–3:30. Raman spectroscopy is a technique for chemical analysis and monitoring, and involves energizing a sample with a high-power, narrow-wavelength energy

source, such as a laser, to induce low intensity light emissions from the sample. *Id.* at 2:5–6.

In remote Raman spectroscopy, laser light is directed down an optical fiber to a remote probe, and exits the fiber to illuminate the sample. *Id.* at 2:57–59, 3:23–24. Another fiber receives the Raman-emitted light and returns it to an instrument for analysis. *Id.* at 2:59–61, 3:24–25. A problem that occurs during this process is that “[w]avelength-shifted light is generated due to inelastic light-matter interactions between propagation light and fiber materials.” *Id.* at 62:11–13. “This wavelength-shifted light manifests itself as interference in many fiber optic applications. Applications in which the signals of interest are weak—similar in strength to that of the interference—are particularly susceptible to detrimental influence.” *Id.* at 62:25–30.

To address the interference problem, the ’970 patent applies to a fiber end face a thin-film filter comprising between 20 and 150 stack layers of alternating high/low refractive indices. *Id.* at 62:65–63:1, 63:57–58. The filter is applied directly to the fiber end face, in contrast to the prior art technique of placing filter-coated thin wafers in standard fiber optic mating connector junctions between adjoining fiber end faces. *Id.* at 64:56–61. The ’970 patent discloses that the filter preferably has a packing density of at least 95%, and that this density can be achieved by using a thin-film deposition process that imparts sufficient energy to the depositing molecules. *Id.* at 63:58–59, 64:64–65. According to the ’970 patent, suitable deposition “processes include magnetron sputtering, single- and dual-beam ion sputtering, ion plating, and ion-assisted deposition (typically slightly less performance and lower packing densities).” *Id.* at 65:6–11; *see*

also id. at 65:17–19 (“Ion-assisted deposition produces films with densities typically in the 95% range.”).

B. Illustrative Claim

Of the challenged claims, claim 59 is independent. Remaining challenged claims 61, 74, 76, 78, and 87 depend directly from claim 59, reproduced below:

59. An optical fiber assembly, comprising:
an optical fiber segment, and
an integral filter having a packing density of at least ninety-five percent adhering to an end face of the optical fiber segment.

C. The Prior Art

The pending grounds of unpatentability in this *inter partes* review are based on the following prior art:

Reference	Publication	Date	Exhibit
Stone	US 5,037,180	August 6, 1991	Exhibit 1005
Takashashi	“Temperature stability of thin-film narrow-bandpass filters produced by ion-assisted deposition,” Applied Optics, Vol. 34, No. 4 (1995)	February 1, 1995	Exhibit 1006
Shioda	JPH03118503	May 21, 1991	Exhibit 1010
Garmon	US 4,946,239	August 7, 1990	Exhibit 1013
Ohmi et al.	US 5,981,075	November 9, 1999	Exhibit 1017

Petitioner also relies on the testimony of its expert, W. John Tomlinson, Ph.D. Dr. Tomlinson executed a first declaration under 37 C.F.R. §1.68 (Ex. 1003) in support of the Petition, and a second declaration under 37 C.F.R. §1.68 (Ex. 1020) in support of the Reply.

D. The Instituted Grounds of Unpatentability

We instituted the instant *inter partes* review on the following grounds of unpatentability:

Claims	Basis	References
59, 78	§ 103(a)	Stone and Takashashi
61, 87	§ 103(a)	Stone, Takashashi, and Shioda
74	§ 103(a)	Stone, Takashashi, and Ohmi
76	§ 103(a)	Stone, Takashashi, and Garmon

III. ANALYSIS

A. Claim Construction

In an *inter partes* review, claim terms in an unexpired patent are interpreted according to their broadest reasonable construction in light of the specification of the patent in which they appear. 37 C.F.R. § 42.100(b); *In re Cuozzo Speed Techs., LLC*, 793 F.3d 1268, 1275–79 (Fed. Cir. 2015). Even under the rule of broadest reasonable interpretation, claim terms generally also are given their ordinary and customary meaning, as would be understood by one of ordinary skill in the art in the context of the entire disclosure. *See In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). Only terms which are in controversy need to be construed,

and only to the extent necessary to resolve the controversy. *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999).

In its Petition, Petitioner proposes the following construction for the phrase “an integral filter . . . adhering to an end face of the optical fiber segment” (claim 59): “filter coating deposited on a substrate comprising an end face of the optical fiber segment.” Pet. 12 (emphasis omitted).

Petitioner contends a person of ordinary skill would not interpret the claims as encompassing structures formed by depositing a thin-film filter on a wafer and then placing the wafer in optical communication with the fiber. *Id.*

In its Response, Patent Owner does not comment on Petitioner’s proposed claim construction, or advance proposed constructions for any claim terms. *See generally*, PO Resp.

We determined no express claim construction was required for purposes of our Decision on Institution. Dec. on Inst. 6. Having now considered Patent Owner’s Response and Petitioner’s Reply, and evidence in support thereof, we remain of the opinion that an express claim construction is unnecessary to a determination of patentability of the challenged claims in this *inter partes* review. *See Vivid Techs.*, 200 F.3d at 803. As discussed more fully below in our analysis of Petitioner’s challenges to the claims, we apply the plain and ordinary meaning of the claim terms in our analysis of the patentability challenges.

B. Level of Ordinary Skill in the Art

Petitioner contends a person of ordinary skill in the art would have “[an] education and/or experience in the field of optics” and “in the sub-field of thin-film filters.” Pet. 15 (citing Ex. 1003 ¶ 24). According to Petitioner, such person would have, at a minimum, (1) more than three years of relevant

work experience and hold a basic Bachelor's degree, or (2) less than three years of relevant work experience, but hold a more advanced degree, such as a Masters or a Ph.D. *Id.* (citing Ex. 1003 ¶ 24). Patent Owner does not comment on Petitioner's proposed definition of the level of ordinary skill in the art, or offer an alternative definition. *See generally*, PO Resp.

Petitioner relies on the testimony of Dr. Tomlinson, *see* Pet. 15–20, who testified that he is “an expert in the field of optical assemblies and . . . [has] been an expert in this field since prior to 1965.” Ex. 1003 ¶ 11. Dr. Tomlinson testified that he is “familiar with the knowledge and capabilities of one of ordinary skill in the art” by virtue of his “work as a research assistant, scientist, researcher, supervisor of Ph.D. level researchers and engineers, and project manager.” *Id.* ¶ 23; *see also id.* ¶¶ 13–18 (wherein Dr. Tomlinson discusses the specifics of his work). We find Dr. Tomlinson is qualified to give an opinion as to the level of ordinary skill in the art in the field of optics, and adopt Petitioner's definition of the level of ordinary skill in the art for purposes of this proceeding. *Cf. Sundance, Inc. v. DeMonte Fabricating Ltd.*, 550 F.3d 1356, 1363–64 (Fed. Cir. 2008) (explaining that to testify as an expert under Federal Rule of Evidence (FRE) 702, a person need not be a person of ordinary skill in the art, but rather “qualified in the pertinent art.”).

C. Principles of Law

To prevail in its challenges to the patentability of the claims, a petitioner must prove unpatentability by a preponderance of the evidence. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d) (Sept. 16, 2012).

A claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the subject matter sought to be patented 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 ordinary skill in the art; and (4) objective evidence of nonobviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 18 (1966).

An invention “composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art.” *KSR*, 550 U.S. at 418. Petitioner must also show there was a reason to combine those elements to achieve the claimed invention with a reasonable expectation of success. *See PAR Pharm., Inc. v. TWI Pharms., Inc.*, 773 F.3d 1186, 1193 (Fed. Cir. 2014). To make that determination, we can look to “interrelated teachings of multiple patents; the effects of demands known to the design community or present in the marketplace; and the background knowledge possessed by a person having ordinary skill in the art.” *KSR*, 550 U.S. at 418. We can also look to the nature of the problem to be solved. *In re Gartside*, 203 F.3d 1305, 1319 (Fed. Cir. 2000) (holding that the suggestion to combine “may come from, *inter alia*, the teachings of the references themselves and, in some cases, from the nature of the problem to be solved”).

We analyze the instituted grounds of unpatentability in accordance with these principles.

D. Alleged Obviousness of Claims 59, 61, 74, 76, 78, and 87

Petitioner’s obviousness challenges as to claims 59, 61, 74, 76, 78,

and 87 are based on contentions that: (1) Stone discloses an optical assembly comprising an integral filter formed on an optical fiber segment using an electron-beam deposition technique; (2) Takashashi discloses optical filters having near unity packing densities have desirable properties and can be achieved using evaporation techniques based on reactive-ion-plasma processing; and (3) one of ordinary skill in the art would have been motivated to replace the electron-beam deposition technique used by Stone with one of the reactive-ion-plasma processing techniques disclosed in Takashashi in order to produce an optical assembly with a higher-quality thin-film filter, i.e., a filter having a packing density of at least 95%. Pet. 32–34.

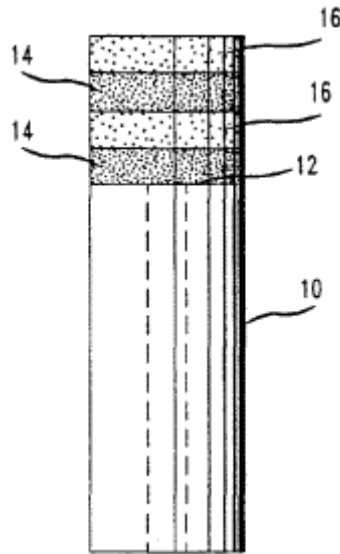
Patent Owner’s principal argument is that Petitioner has not met its burden to show unpatentability of claims 59, 61, 74, 76, 78, and 87, because a preponderance of the evidence fails to support Petitioner’s contention that one of ordinary skill in the art would have been motivated to combine Stone and Takashashi in the manner recited in claim 59. *See generally*, PO Resp. 2–7. Patent Owner presents additional arguments in support of patentability of dependent claims 76 and 78 (*id.* at 8–10). Patent Owner has not filed any additional evidence, and relies on Petitioner’s evidence in support of the arguments made in its Response. *See generally*, PO Resp.

1. The Applied Prior Art

a. Stone (Ex. 1005)

Stone discloses “a thin film filter which is an integral part of an optical fiber,” and can be used in the design of a long-pass, a short-pass, and a bandpass filter. Ex. 1005, 1:5–7, 2:1–4. The filter is made by depositing “a multilayer, thin-film stack of low and high index of refraction material”

onto the end of an optical fiber by thin-film deposition techniques such as “electron beam evaporation, sputtering and the like.” *Id.* at 1:30–32, 67–68. Figure 1 of Stone, reproduced below, illustrates “a side view of an optical fiber in combination with an optical filter in accordance with the principles of the invention.” *Id.* at 1:45–47.



Stone Figure 1, above, illustrates fiber 10 having end 12 coated with a filter comprising alternating layers of Si 14 and SiO₂ 16. *Id.* at 2:61–64. Prior to depositing the Si 14 and SiO₂ 16 layers, end 12 was polished “normal to the fiber axes.” *Id.* at 2:60–61. According to Stone, “filters deposited on perpendicular facets of single-mode optical fibers reflect most of the power which is not transmitted. This reflected light, if fed back to a laser or an amplifier can cause a problem, particularly if the associated isolators do not adequately block the reflections.” *Id.* at 3:58–63. Stone discloses that one solution to this problem is to bevel the fiber end face so that reflected power is not coupled back into the waveguide. *Id.* at 3:63–66.

b. Takashashi (Ex. 1006)

Takashashi is an article titled “Temperature stability of thin-film narrow-bandpass filters produced by ion-assisted deposition.” Ex. 1006, Title. Takashashi discloses that the center wavelength of a narrow-bandpass filter (“NBPF”) lengthens upon exposure to the atmosphere due to absorption of atmospheric water vapor by the filter. *Id.* at 667.

This phenomenon can be explained by the fact that the effective index of refraction (EIR) of the film varies according to the absorbed moisture level. Variations in the absorbed moisture level cause the effective optical thickness (expressed as the product of the index of refraction and physical thickness) of the film to change, which in turn shifts the center wavelength of the filter.

Id. According to Takashashi, “[t]he amount of water absorbed . . . is greatly influenced by ambient humidity and temperature; thus, changes in either of these two factors vary the center wavelength of a[n] NBPF to a considerable degree.” *Id.* Takashashi discloses the effect of ambient moisture on center wavelength is more pronounced in an NBPF produced by conventional methods, such as electron-beam evaporation, due to the filter’s low packing density. *Id.* Takashashi discloses that more accurate measurement of wavelength variations caused solely by temperature changes, i.e., temperature stability of the center wavelength (“TSCW”), is possible in NBPFs produced by newer evaporation techniques based on the reactive-ion-plasma process (RIPP), e.g., ion-assisted deposition (IAD). *Id.* at 667–68. According to Takashashi, RIPP techniques can produce dense films of near-unity packing density that “appear to be little affected by ambient moisture.” *Id.* at 667. Takashashi explains that averaged packing density (“APD”) of an NBPF can be determined by measuring the cubic volume V_0

of a region within a specific film and the volume V actually occupied by evaporated film materials within volume V_0 . *Id.* at 669. APD (P_0) is equal to V/V_0 . *Id.*

Takashashi describes the development of a new equation for calculating the TSCW of an NBPF at wavelength λ . *Id.* at 669–70. The equation is based on a finding that the TSCW is a function of both temperature coefficient of refractive index (“TCRI”) of the film materials and coefficient of linear expansion (“CLE”) of the substrate, *Id.* at 667–68. Takashashi discloses that the new equation includes five unknown parameters: N_0 (averaged refractive index of the portion of the film actually occupied by evaporated materials), δ (normalized temperature coefficient of refractive index (“NTCRI”), α (coefficient of linear expansion of the substrate (“CLES”)), β (coefficient of linear expansion of the filter (“CLEF”)), and s (Poisson ratio). *Id.* at 671. Takashashi provides an analysis of the dependency of the TSCW on each of the parameters related to the film materials, i.e., NTCRI, CLEF, s , P_0 (average packing density), and N_0 . *See id.* at 671–72, Figs. 4–8. Based on the analysis, Takashashi determines that the film properties having the greatest effect on the TSCW values are the TCRI and the CLEF. *Id.* at 671–72. With respect to dependency of the TSCW on P_0 , Takashashi discloses that “the packing density of a film produced by the RIPP is nearly unity. For P_0 ’s ranging from 0.9 to 1.0, although calculation indicates slight dependency of the TSCW (CLES) on P_0 , the more porous the film, the less steep the slope of the TSCW (CLES).” *Id.* at 672. Takashashi also discloses that, based on calculated substrate dependencies of the TSCWs of exemplary NBPFs, it was found that the “TSCW of a[n] NBPF varies with changes in packing

density, which, in turn, is a function of volumetric distortion caused by stress applied to the NBPF from the substrate.” *Id.* at 668. Takashashi ultimately concludes that “[t]he TSCW of a[n] NBPF with near-unity APD produced by ion-assisted deposition is determined chiefly by the TCRI of the film materials and by the CLE of the substrate. *Id.* at 675.

c. Garmon (Ex. 1013)

Garmon discloses an optical power isolator “for improving the isolation between the light source and an optical waveguide in an optical communications system.” Ex. 1013, 3:28–30. The isolator comprises an input core surrounded by a layer of cladding material. *Id.* at 4:27–29. An antireflection coating can be applied to an end to minimize reflection back to a laser diode. *Id.* at 7:9–11. The isolator may “be fabricated by employing thin film deposition techniques utilized in the manufacture of integrated optics devices.” *Id.* at 9:28–30. Garmon discloses that the length of the isolator is 7.0–11.5 centimeters. *Id.* at 8:5–12.

2. Analysis

a. Claim 59: alleged unpatentability under 35 U.S.C. § 103(a) over Stone and Takashashi

Petitioner contends Stone discloses “[a]n optical fiber assembly, comprising: ‘an optical fiber segment, and an integral filter . . . adhering to an end face of the optical fiber segment’ (claim 59). Pet. 32. Petitioner concedes Stone does not disclose that the filter has “a packing density of at least ninety-five percent,” as further recited in claim 59. *See id.* at 33.

Petitioner contends “Takashashi is directed to deposition techniques to overcome the problem of ‘film absorption of atmospheric water vapor caus[ing] the center wavelength of the filter to become longer’ in narrow

bandpass filters.” *Id.* at 32 (quoting Ex. 1006, 667). Petitioner further contends Takashashi teaches that new evaporation techniques based on the reactive-ion-plasma process, such as ion-assisted deposition, enable the growth of dense films of near unity packing densities, and that “the wavelengths of these new RIPP-produced filters appear to be little affected by ambient moisture.” *Id.* at 33 (quoting Ex. 1006, 667). Petitioner contends “Takashashi teaches that ‘near unity packing densities’ were desirable because ‘the wavelengths of these new RIPP-produced filters appear to be little affected by ambient moisture.’” *Id.* (quoting Ex. 1006, 667). Petitioner, at oral argument, explained that “near unity,” in the context of Takashashi’s discussion of moisture instability problems in filters, “means at a hundred percent or as close as possible to a hundred percent . . . above 95[%].” Tr. 16:3–6.

Petitioner argues that, based on Takashashi’s teaching that filters having near-unity packing densities are desirable because they are less susceptible to ambient moisture and its negative impact on wavelength, one of ordinary skill in the art would have been motivated to produce Stone’s optical assembly with a filter having a near-unity packing density in order to reduce the effect of ambient moisture on filter performance. Pet. 33. Petitioner further contends one of ordinary skill in the art would have recognized that a filter with a near-unity packing density could be achieved predictably by substituting the filter-forming technique used by Stone, e.g., electron-beam deposition, with one of the newer RIPP techniques described in Takashashi, e.g., IAD, reactive ion plating and ion beam sputtering, for producing filters having near-unity packing densities. *Id.* at 33–34.

Petitioner acknowledges Takashashi does not explicitly describe forming a “filter having a packing density of at least ninety-five percent” as recited in claim 59. *See id.* at 36. Petitioner contends, however, that achieving a packing density of at least 95% would have been a matter of optimization well within the skill of [the ordinary artisan].” *Id.* at 34 In support of this argument, Petitioner relies on Dr. Tomlinson’s opinion that one of ordinary skill in the art would have understood from Takashashi’s discussion of TSCW dependency on filter packing densities “ranging from 0.9 to 1.0” (Ex. 1006, 672, Fig. 7) that “a thin film filter with a packing density of 100% . . . is achievable using the disclosed RIPP deposition methods.” Pet. 37 (citing Ex. 1003 ¶¶93, 94, 101). Dr. Tomlinson further opined that one of ordinary skill in the art would have been motivated to make Stone’s filter with a packing density of greater than 95%, because Takashashi teaches that the effect of ambient moisture on filter performance and variations in the properties of a thin film filter are minimized with higher packing densities. Ex. 1003 ¶¶ 98–100, cited in Pet. 38. Dr. Tomlinson relies on Fulton (Ex. 1004) as additional evidence that “thin film deposition processes for producing dense filters were well known at the time of the alleged invention.” Ex. 1003 ¶ 42.

Fulton is an article titled “Application of ion-assisted-deposition using a gridless end-Hall ion source for volume manufacturing of thin-film optical filters.” Ex. 1004, Title. Fulton discloses that “bombardment of a growing film with energetic ions enhances the performance of the thin-film properties for optical filter applications. Improved film adhesion is achieved by ionic bombardment of the substrate prior to film deposition. Densification of the film, deposited on either heated or unheated substrates, is achieved with

IAD.” *Id.* at 375. Fulton further discloses that “[t]hin-film properties, such as packing density, adhesion, and stress, improve by low-energy ion bombardment due to the increase in film density” (*id.* at 388), and that “[p]orosity, reduced packing density, and a lower refractive index result in a deterioration of the film’s performance in humid environmental conditions, primarily due to adsorption of water vapor” (*id.* at 377).

Patent Owner argues the evidence does not support Petitioner’s contention that one of ordinary skill in the art would have been motivated to replace the electron-beam deposition technique used by Stone with one of the reactive-ion-plasma processing techniques disclosed in Takashashi, e.g., ion-assisted deposition, in order to produce an optical assembly with a filter having a near unity packing density. *See* PO Resp. 4–6. Patent Owner directs us to a discussion of Stone in column 63, lines 24–46 of the ’970 patent, which state, in relevant part, that the detrimental effects of filter inefficiencies can be minimized for many applications using Stone’s technique of “bevel[ing] the filter/fiber end face such that the filter’s rejected light is reflected at an angle which cannot be propagated by the fiber.” *Id.* at 4 (quoting Ex. 1001, 63:42–46); *see also id.* (citing Ex. 1005, 4:17–19, 23–25 (discussing the effects of beveling)). Patent Owner argues that, when considering the teachings of Stone and Takashashi as a whole,

it is likely that the person of ordinary skill would adopt *Stone’s* teachings concerning the use of beveled end faces for the optical fiber on which the filter is deposited inasmuch as such beveled ends provide considerably reduced reflected power with no walk-off losses and leave the filter spectra “essentially unaltered.”

Id. at 6.

We have considered Patent Owner's arguments and evidence, but are not persuaded that one of ordinary skill in the art would have understood that the filter inefficiencies created by ambient moisture could be addressed adequately by merely beveling Stone's filter/fiber end face, i.e., we are not persuaded that the ordinary artisan would not have been motivated to increase filter packing density in Stone's optical assembly. As pointed out by Petitioner, Stone discloses that optical fibers having multilayer thin-films deposited directly on their end faces have advantageous properties, regardless of whether the filters are deposited on perpendicular fiber end faces or on beveled fiber end faces. *See* Reply 10 (citing Ex. 1005, 1:60–67). We further agree with Petitioner that Stone's teaching of a preference for using a beveled end face is limited to "certain situations in which power would be reflected back into the waveguide in a problematic way" (*id.* at 10–11 (quoting Ex. 1005, 3:57–65)). Patent Owner has not argued, however, nor do we find any language in the claims or specification of the '970 patent that supports a narrow reading of claim 59 as limited to an optical fiber assembly that is capable of use in an application in which reflected light is problematic.

We credit Dr. Tomlinson's testimony that one of ordinary skill in the art: "would not [have] use[d] a beveled end face for applications where reducing reflected power is not necessary because a beveled end face requires additional machining and, as illustrated by Stone's Figure 6, makes connection to other fibers more problematic" and "would generally use a perpendicular end face as shown in Stone Figure 1 unless a particular application called for a beveled end face" (Ex. 1020 ¶ 23). We also credit Dr. Tomlinson's testimony that one of ordinary skill in the art would have

been motivated by Takashashi's description of the benefits provided by a higher packing density, e.g., a reduction in the effect of ambient moisture on filter performance,

to substitute one known method of thin film deposition – i.e., the “electron-beam deposition” of Stone – for another known method of thin film deposition – i.e. the reactive-ion plasma process of Takashashi – because the substitution would have yielded a favorable and predictable result. Namely, the combination of Stone and Takashashi would have yielded a thin-film filter with a higher packing density which was less susceptible to volumetric distortion of the film due to ambient moisture, as taught by Takashashi.

Ex. 1003 ¶ 100.

Patent Owner argues that even if one of ordinary skill in the art had been motivated to modify Stone's process to produce a filter with a high packing density, the evidence does not support Petitioner's contention that the ordinary artisan would have produced a filter with a packing density as high as 95%. *See* PO Resp. 6–7. Patent Owner asserts that a “prior art reference must be considered in its entirety, *i.e.*, as a whole, including portions that would lead away from the claimed invention (*id.* at 5–6 (citing *W.L. Gore & Assoc., Inc. v. Garlock, Inc.*, 721 F.2d 1540 (Fed. Cir. 1983))),¹ and argues that

considering the teachings of *Stone* and *Takashashi* as a whole, a person of ordinary skill in the art would understand that if ion-assisted deposition were used to create thin-film filters having high packing densities, those filters should have packing

¹ In *Gore*, the Federal Circuit found that “the district court erred in . . . considering the references in less than their entireties, *i.e.*, in disregarding disclosures in the references that diverge from and *teach away* from the invention at hand.” *Id.* at 1550 (emphasis added).

densities near 90% so as to best maintain center wavelength temperature stability.

(*id.* at 6). Patent Owner's argument relies on Takashashi's statement that "[f]or P_0 's ranging from 0.9 to 1.0, although calculation indicates slight dependency of the TSCW (CLES) on P_0 , the more porous the film, the less steep the slope of the TSCW (CLES)" (Ex. 1006, 667). *See* PO Resp. at 4–5; *cf.* Ex. 1006, 672 (noting that the creating of pores in the film results in a reduction in the packing density). Patent Owner argues Dr. Tomlinson's testimony that "Takashashi teaches depositing a filter having a packing density of at least ninety-five percent" (Ex. 1003 ¶ 91) "ignores *Takashashi's* report concerning increased temperature-induced center wavelength instabilities with increased packing densities." PO Resp. 6.

Relying on Dr. Tomlinson's testimony, Petitioner argues that even if one of ordinary skill in the art were to read Takashashi as teaching that packing densities nearer 90% provide better temperature stability (*id.* at 3), the ordinary artisan would have understood from Takashashi that: (1) a packing density above 95% provides advantages that outweigh any negative impact on temperature stability (Reply 4–6 (citing Ex. 1020 ¶¶ 9–14)); (2) any dependency of temperature stability on packing density is trivial (*id.* at 6 (citing Ex. 1020 ¶ 16)); (3) temperature stability can be improved best by selecting materials for the thin film filter that are appropriate for the expansion characteristics of the substrate, not by reducing packing density (*id.* at 6–7 (citing Ex. 1020 ¶¶ 17–18)); and (4) any preference for packing densities closer to 90% is only applicable to a small subset of filters (*id.* at 8 (citing Ex. 1020 ¶ 19)).

Dr. Tomlinson testified that one of ordinary skill in the art “understood that packing density is a measure of how well a thin film filter is deposited,” and that “[i]n the ideal case, the film is deposited with zero voids (considered defects), which means the film has unity, or 100%, packing density.” Ex. 1020 ¶ 9. Dr. Tomlinson testified that Fulton and Takashashi evidence that one of ordinary skill in the art was aware “that as packing density decreases from unity, the number of voids (defects) increase, making the filter susceptible to moisture induced instabilities and reduction of refractive index.” *Id.* According to Dr. Tomlinson, one of ordinary skill in the art would have understood Takashashi Figure 7 as “show[ing] a negligible difference in temperature stability between [] 90% and 100% packing densit[ies].” *Id.* ¶ 16. Dr. Tomlinson further testified that, to the extent Takashashi indicates a preference for a 90% packing density, such preference is only indicated “in the context of extremely narrowband filters having a FWHM [(full width at half-maximum)] of between 0.5 and 1.1 nanometer.” *Id.* ¶ 19; *cf.* Ex. 1006, 667, Abstract (noting that the four types of narrow-bandpass filters examined had FWHMs from 0.5 to 1.1 nm). Dr. Tomlinson explained that, after consideration of multiple factors (“Poisson ratio, s , (Fig. 6), average refractive index, N_0 , (Fig. 8), coefficient of linear expansion of the filter, CLEF or β , (Fig. 5), and the normalized temperature coefficient of the refractive index, NTCRI, (Fig. 4)”), Takashashi concluded the TCRI and the CLEF had the greatest effect on temperature stability values. Ex. 1020 ¶ 17 (citing Ex. 1006, 672). Dr. Tomlinson testified that one of ordinary skill in the art would have understood from this disclosure in Takashashi that the way to achieve a narrowband filter with an upper limit on its temperature stability is “by the

selection of materials for the thin film filter relative to the expansion characteristics of the substrate, namely the substrate's coefficient of linear expansion. “*Id.* ¶ 18.

We have considered Patent Owner's arguments and evidence, but find a preponderance of the evidence support's Petitioner's contention that one of ordinary skill in the art would have been motivated to modify Stone's method to produce a filter with a packing density of at least 95%. We credit Dr. Tomlinson's testimony that a person of ordinary skill in the art “would not [have] read Takashashi as criticizing, discrediting or discouraging the claimed solution, i.e., thin film filters having 95% and higher packing density,” but would have understood Takashashi as teaching, at most, a slight preference for using a packing density closer to 90%, applicable only to a small subset of high performance filters (Ex. 1020 ¶ 8). *See Syntex (U.S.A.) LLC v. Apotex, Inc.*, 407 F.3d 1371, 1379–80 (Fed. Cir. 2005) (“A statement that a particular combination is not a preferred embodiment does not teach away absent clear discouragement of that combination.”); *In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004) (“The prior art's mere disclosure of more than one alternative does not constitute a teaching away from any of these alternatives because such disclosure does not criticize, discredit, or otherwise discourage the solution claimed in the . . . application.”); *see also Santarus, Inc. v. Par Pharmaceutical, Inc.*, 694 F.3d 1344, 1356 (Fed. Cir. 2012) (“Describing a formulation as ‘second best’ is not a ‘clear discouragement,’ as is required by our precedent.”). We further credit Dr. Tomlinson's testimony that one of ordinary skill in the art, in considering Takashashi in its entirety, would have concluded that the advantages of using a packing density as close as possible to unity (100%)

outweigh any negative effect on TSCW caused by using a packing density of greater than 95% versus a packing density closer to 90%. (*see* Ex. 1020 ¶ 18).

In sum, we determine Petitioner has met its burden to show that claim 59 is unpatentable under 35 U.S.C. § 103(a) over Stone and Takashashi.

b. Claim 78: alleged unpatentability under 35 U.S.C. § 103(a) over Stone and Takashashi

Claim 78 depends directly from claim 59 and recites “wherein said end face substantially lies within a plane perpendicular to the longitudinal axis of the optical fiber.” Ex. 1001, 84:3–5. Patent Owner concedes this feature is described in Stone Figure 1.² PO Resp. 8. Patent Owner argues, however, that given Stone’s preference for beveled end faces and “indicat[ion] that the use of such bevels results in no walk-off losses and filter spectra remaining ‘essentially unaltered,’” one of ordinary skill in the art would have used an optical fiber with a beveled end face for deposition of thin-film filters. *Id.* (citing Ex. 1005, 4:17–19, 23–25).

Patent Owner’s argument regarding Stone’s preference for beveled end faces, and Petitioner’s response thereto, were discussed above in connection with claim 59. *See* Section III.D.2.a. For the same reasons, we determine a preponderance of the evidence supports Petitioner’s contention that it would have been obvious to one of ordinary skill in the art to have used an optical fiber having a perpendicular end face to deposit an integral filter. Accordingly, we determine Petitioner has met its burden to show that

² Given Patent Owner’s concession, we need not address Petitioner’s alternative contention that it would have been obvious to shape Stone’s optical fiber with an end face as claimed. *See* Pet. 40.

claim 78 is unpatentable under 35 U.S.C. § 103(a) over Stone and Takashashi.

c. Claim 76 alleged unpatentability under 35 U.S.C. § 103(a) over Stone, Takashashi, and Garmon

Claim 76 depends directly from claim 59 and recites “wherein said optical fiber segment is less than 24 inches in length.” Ex. 1001, 83:66–67. Petitioner relies on Garmon for a disclosure of an optical fiber having a length between “7 and 11.5 centimeters (2.76 to 4.53 inches)” (Pet. 56 (citing Ex. 1013, Table 3)), i.e., “less than 24 inches in length” (Ex. 1001, 83:67). Pet. 56. Petitioner contends “[o]ptical fiber length was recognized as a result-effective variable in the art” (*id.* at 57), relying on Dr. Tomlinson’s testimony that one of ordinary skill in the art “would have known of the advantages of working with short lengths of optical fibers,” i.e., “[s]hort lengths of optical fibers were preferred for the ease of use and manipulation while working with the fibers” (Ex. 1003 ¶ 48 (citing U.S. Patent No. 5,684,907 (Ex. 1018, 5:4–5) for a teaching that the purpose of using an 11.875 inch length of fiber was its ease of manipulation during an encasement process)). Pet. 20. Petitioner contends “it would have been obvious to implement the fiber of Stone with a short length as taught by Garmon to [] improve ease of manipulation of the optical fiber during processing” or for the purpose of “implement[ing] the fiber of Stone as a short optical link between two other systems, as taught by Garmon.” *Id.* at 56 (citing Ex. 1003 ¶ 121).

Patent Owner contends Petitioner’s arguments are based on speculation and argues Petitioner has not identified sufficient evidentiary support for its contention that one of ordinary skill in the art would have

been motivated to combine the teachings of Stone, Takashashi, and Garmon to arrive at the invention recited in claim 76. *See* PO Resp. 9–10. Patent Owner argues, more specifically, that Dr. Tomlinson’s testimony, alone, is insufficient to support Petitioner’s contention that it was known in the art to use short fiber lengths. *Id.*

“A recognition in the prior art that a property is affected by the variable is sufficient to find the variable result-effective.” *In re Applied Materials, Inc.*, 692 F.3d 1289, 1297 (Fed. Cir. 2012). Dr. Tomlinson’s opinion that optical fiber length was recognized as a result-effective variable in the art (*see* Ex. 1003 ¶ 48) is based on his familiarity (as an expert in the field of optical assemblies since 1965) with the knowledge and capabilities of one of ordinary skill in the art (*see id.* ¶¶ 11–25). Dr. Tomlinson’s opinion is further supported by disclosure in U.S. Patent No. 5,684,907 (Ex. 1018). We credit Dr. Tomlinson’s testimony, and find that Patent Owner has not identified evidence to rebut Dr. Tomlinson’s opinion. Accordingly, we determine a preponderance of the evidence supports Petitioner’s contention that fiber length was recognized as result-effective variable that could be optimized to allow ease of manipulation during processing or use of the fiber.

“[D]iscovery of an optimum value of a result effective variable . . . is ordinarily within the skill of the art.” *In re Boesch*, 617 F.2d 272, 276 (CCPA 1980). “The outcome of optimizing a result-effective variable may still be patentable if the claimed ranges are ‘critical’ and ‘produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art.’” *Applied Materials*, 692 F.3d at 1297 (quoting *In re Aller* 220 F.2d 454, 456 (CCPA 1955)).

Patent Owner contends column 62, lines 7–8 of the '970 patent “explain[] the importance of using a fiber less than 24 [inches] in length.” PO Resp. 9. The language of the '970 patent relied upon by Patent Owner reads: “Many of the phenomena associated with light propagation in optical fibers are dependent on travel distance in the fiber.” Ex. 1001, 62:7–8.

In its Reply Brief, Petitioner relies on Dr. Tomlinson’s testimony that column 62, lines 7–8 of the '970 patent do not provide any evidence of criticality in a fiber length of 24 inches or less. Reply Br. 15–16 (citing Ex. 1020 ¶ 31). Dr. Tomlinson further testified that the disclosure cited by Patent Owner

refers to accumulation of interference caused by fluorescence and Raman effects, but a [person of ordinary skill in the art] would understand that the '970 Patent teaches that such interference accumulation is unacceptable after just a few inches, well below the claimed range of less than 24 inches: “interference accumulates rapidly in even a short segment of optical fiber (more than a few inches).”

Ex. 1020 ¶ 31 (quoting Ex. 1001, 47:38–40). Petitioner contends the only disclosure in the '970 patent pertaining to a fiber length of less than 24 inches is found in column 63, line 66 to column 64, line 2 (Reply Br. 15), which read: “In an exemplary embodiment, a short fiber segment, preferably less than 24" but optimally 1.5" or less, has an integral filter applied to its end face. The segment can be joined to a longer fiber” (Ex. 1001, 63:66–64:2). Petitioner contends this disclosure likewise fails to provide any evidence of criticality, and argues that, to the contrary, the '970 patent suggests there is no criticality in the recited length, directing us to column 68, lines 27–29, which read: “Fibers are first cut to a manageable length. This length may be anything from *a few inches to many meters*

depending on the required volume. (emphasis added)” (Reply 15–16). We agree with Petitioner that Patent Owner has not identified persuasive evidence that a fiber length of 24 inches or less is critical and produces a new and unexpected result.

We credit Dr. Tomlinson’s testimony that one of ordinary skill in the art would have been motivated to utilize a fiber length of less than 24 inches, as exemplified by Garmon, to “ease the coating process required by Stone” (Ex. 1020 ¶ 26), or for the purpose of using Stone’s optical assembly to “connect[] optical components that are disposed in close proximity to each other, i.e., less than 24 inches” (*id.* ¶ 27). *See also* Ex. 1003 ¶121 (“[M]otivation would have been to implement a short length as taught by Garmon to improve ease of manipulation of Stone’s optical fiber during processing . . . [or] to use the integral filter of Stone and Takashashi as a short optical link between two other systems as taught by Garmon.”). We determine a preponderance of the evidence supports Petitioner’s contention that one of ordinary skill in the art would have been motivated to use a length of 24 inches or less for the optical fiber segment of Stone, as modified by Takashashi and that Petitioner has met its burden to show that claim 76 is unpatentable under 35 U.S.C. § 103(a) over Stone, Takashashi, and Garmon.

d. Claims 61, 74, and 87: alleged unpatentability of claims 61 and 87 under 35 U.S.C. § 103(a) over Stone, Takashashi, and Shioda; and alleged unpatentability of claim 74 under 35 U.S.C. § 103(a) over Stone, Takashashi, and Ohmi

Patent Owner does not advance separate arguments in support of patentability of claims 61, 74, and 87, but contends these claims (as well as claim 76) are patentable over the cited references, because Petitioner has

failed to meet its burden to show unpatentability of claim 59, from which these claims depend. PO Resp. 7–8. In Section III.D.2.a., we determined Petitioner had met its burden to show that claim 59 is unpatentable under 35 U.S.C. § 103(a) over Stone and Takashashi. We have considered the arguments and evidence presented in the Petition in support of unpatentability of claims 61, 74, 87 (*see* Pet. 44–53), and 76 (discussed in Section III.D.2.c.), and likewise determine Petitioner has met its burden to show unpatentability of these claims by a preponderance of the evidence.

IV. CONCLUSION

Petitioner has met its burden to show, by a preponderance of the evidence, unpatentability of: claims 59 and 78 under 35 U.S.C. §103(a) based on Stone and Takashashi; claims 61 and 87 under 35 U.S.C. §103(a) based on Stone, Takashashi, and Shioda; claim 74 under 35 U.S.C. §103(a) based on Stone, Takashashi, and Ohmi; and claim 76 under 35 U.S.C. §103(a) based on Stone, Takashashi, and Garmon.

V. ORDER

For the reasons given, it is

ORDERED that, by a preponderance of the evidence, claims 59, 61, 74, 76, 78, and 87 are unpatentable; and

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

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