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Paper 59
Date: December 8, 2023

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MOTOROLA MOBILITY LLC,
Petitioner,

v.

LARGAN PRECISION CO., LTD.,
Patent Owner.

IPR2022-01022
Patent 8,514,499 B2

Before JON M. JURGOVAN, NORMAN H. BEAMER, and JOHN D. HAMANN, *Administrative Patent Judges*.

HAMANN, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
Denying Patent Owner's Contingent Motion to Amend
35 U.S.C. § 318(a)
Denying in Part Patent Owner's Motion to Strike
37 C.F.R. § 42.5
Denying Patent Owner's Motion to Exclude
37 C.F.R. § 42.64

I. INTRODUCTION

In this *inter partes* review, instituted pursuant to 35 U.S.C. § 314 (2018), Motorola Mobility LCC ("Petitioner") challenges the patentability of claims 15 and 18 ("the challenged claims") of U.S. Patent No. 8,514,499 B2 (Ex. 1001, "the '499 patent"), owned by Largan Precision Co., Ltd. ("Patent Owner"). We have jurisdiction under 35 U.S.C. § 6. This Final Written Decision is entered pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73 (2022). For the reasons discussed herein, we determine that Petitioner shows by a preponderance of the evidence that the challenged claims are unpatentable, and that Patent Owner's proposed contingent substitute claims are unpatentable. In addition, we deny in part Patent Owner's Motion to Strike and Patent Owner's Motion to Exclude, for the reasons below.

A. Procedural History

Petitioner filed a Petition requesting *inter partes* review of the challenged claims of the '499 patent. Paper 2 ("Pet."). Patent Owner filed a Preliminary Response. Paper 6. With our authorization, Petitioner filed a Preliminary Reply (Paper 7) addressing the issue of real parties-in-interest, and Patent Owner filed a Preliminary Sur-reply (Paper 8) in response. We instituted *inter partes* review of the challenged claims of the '499 patent on all of the grounds raised in the Petition. Paper 9 ("Dec. on Inst."), 43.

Following institution, Patent Owner filed a Response to the Petition. Paper 18[1] ("PO Resp."). Petitioner filed a Reply to Patent Owner's

[1] Patent Owner filed a redacted version of its Response as Paper 18, which we refer to throughout this Decision. The unredacted version of Patent Owner's Response was filed as Paper 17, which we ordered sealed. *See* Paper 54, 4.

Response. Paper 28 ("Pet. Reply"). Patent Owner filed a Sur-reply to Petitioner's Reply. Paper 37 ("PO Sur-reply").

In addition, Patent Owner filed a Contingent Motion to Amend, seeking to amend (i) claim 15 (proposing substitute claim 26) and (ii) claim 18 (proposing substitute claim 27), if we "determine[] any challenged claim of the '499 patent to be unpatentable." Paper 19 ("MTA"), 1–2, App. Petitioner filed an Opposition to the Motion to Amend. Paper 30 ("Opp. MTA"). We issued Preliminary Guidance (Paper 35) for the Motion to Amend. Paper 35. Patent Owner filed a Reply to Petitioner's Opposition for the Motion to Amend. Paper 36 ("PO Reply MTA"). Petitioner filed a Sur-reply to Patent Owner's Reply for the Motion to Amend. Paper 49 ("Pet. Sur-reply MTA").

In addition, with our authorization (Paper 23), Petitioner filed a Motion for Additional Discovery seeking information via an interrogatory to Patent Owner relating to indicia of non-obviousness. Paper 26.[2] Patent Owner filed an Opposition to this motion. Paper 27. We granted Petitioner's Motion for Additional Discovery, and ordered Patent Owner to respond to the interrogatory. Paper 57,[3] 12. Patent Owner filed its verified interrogatory response as Exhibit 2041. We also authorized the parties to file papers concerning the significance of the produced information. Paper 57, 12. Petitioner filed an Explanation of the Significance of Patent Owner's

[2] Petitioner filed a redacted version of its motion as Paper 26. The unredacted version of the motion was filed as Paper 25, which we ordered sealed. *See* Paper 55, 3.

[3] Paper 57 was entered on November 29, 2023, and is a redacted version of our Board and Parties only version of the Order, which was entered on July 19, 2023 as Paper 39.

Interrogatory Response. Paper 45. Patent Owner filed a Response to Petitioner's Explanation brief. Paper 46.

In addition, Patent Owner filed a Motion to Strike. Paper 33 ("Mot. Strike"). Petitioner filed an Opposition to this motion. Paper 34 ("Opp. Mot. Strike").

In addition, Patent Owner filed a Motion to Exclude. Paper 48 ("Mot. Excl."). Petitioner filed an Opposition to this motion. Paper 50 ("Opp. Mot. Excl.").

An oral hearing was held on September 13, 2023. A transcript of the oral hearing is included in the record. Paper 56 ("Tr.").

B. Real Parties-In-Interest

Petitioner states that it "is the sole real party-in-interest." Pet. ix. Petitioner adds that "for the purposes of disclosing potential conflicts only, Petitioner notes that Motorola Mobility Holdings, LLC, owns 100% of Motorola Mobility LLC's stock and is, indirectly, a wholly owned subsidiary of Lenovo Group Limited." *Id.* Patent Owner states that it is the owner of the challenged patent. Paper 4, 2.

C. Related Matter

The parties identify *Largan Precision Co. v. Motorola Mobility LLC*, No. 4:21-cv-09138-JSW (N.D. Cal.) (the "related litigation") as a matter that may affect, or be affected by, a decision in this proceeding. Pet. ix; Paper 4, 2.

D. The Challenged Patent

The '499 patent "relates to an optical image capturing lens assembly," and particularly "to a compact optical image capturing lens assembly applicable to electronic products." Ex. 1001, 1:13–16. In describing the

prior art, the ’499 patent states that “[a] conventional compact optical lens assembly employed in a portable electronic product mainly adopts a four-element lens structure.” *Id.* at 1:29–31. The ’499 patents adds that “[d]ue to the popularity of mobile products with high-end specifications, such as smart phones and PDAs (Personal Digital Assistants), the pixel and image-quality requirements of the compact optical lens assembly have increased rapidly.” *Id.* at 1:31–35. “However, the conventional four-element lens structure cannot satisfy the requirements of the compact optical lens assembly,” according to the ’499 patent. *Id.* at 1:35–37. In response, the ’499 patent teaches embodiments of optical image capturing lens assemblies comprising six lens elements. *See generally id.* at 1:46–3:7 (summarizing embodiments of the ’499 patent).

Figure 1 of the ’499 patent is reproduced below, and shows one such embodiment.

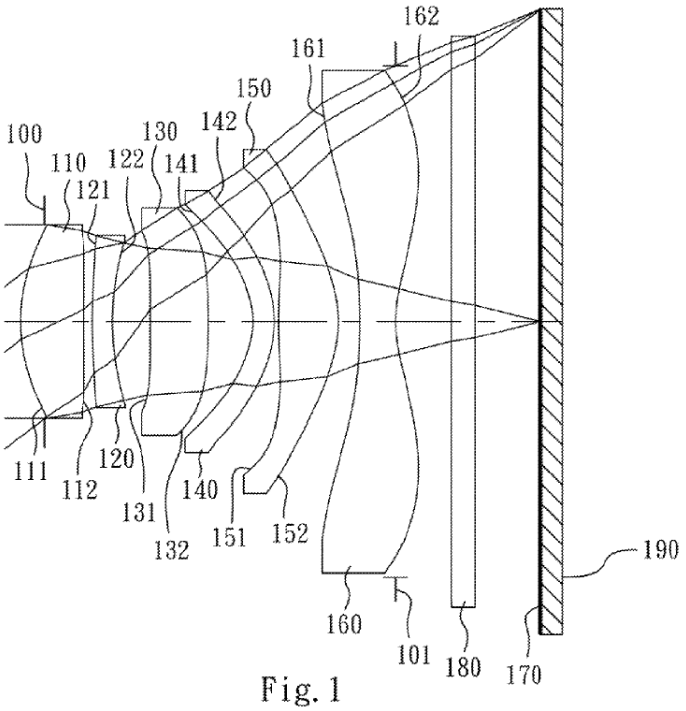


Fig. 1

Figure 1, shown above, "is a schematic view of an optical image capturing lens assembly according to the [first] embodiment of the" '499 patent. *Id.* at 3:15–17. As illustrated, the "assembly includes, in order from an object side to an image side, an aperture stop 100, the first lens element 110, the second lens element 120, the third lens element 130, the fourth lens element 140, the fifth lens element 150, the sixth lens element 160, a stop 101, an IR-filter 180, an image plane 170 and an image sensor 190." *Id.* at 6:58–62.

"The first lens element 110 with positive refractive power has a convex object-side surface 111 and a concave image-side surface 112, and is made of plastic material." *Id.* at 6:66–7:1. "The object-side surface 111 and the image-side surface 112 of the first lens element 110 are aspheric." *Id.* at 7:1–3.

"The second lens element 120 with negative refractive power has a convex object-side surface 121 and a concave image-side surface 122, and is made of plastic material." *Id.* at 7:4–6. "The object-side surface 121 and the image-side surface 122 of the second lens element 120 are aspheric." *Id.* at 7:6–8.

"The third lens element 130 with positive refractive power has a convex object-side surface 131 and a convex image-side surface 132, and is made of plastic material." *Id.* at 7:9–11. "The object-side surface 131 and the image-side surface 132 of the third lens element 130 are aspheric." *Id.* at 7:11–13.

"The fourth lens element 140 with negative refractive power has a concave object-side surface 141 and a convex image-side surface 142, and is made of plastic material." *Id.* at 7:14–16. "The object-side surface 141 and

the image-side surface 142 of the fourth lens element 140 are aspheric." *Id.* at 7:16–18.

"The fifth lens element 150 with positive refractive power has a convex object-side surface 151 and a convex image-side surface 152, and is made of plastic material." *Id.* at 7:19–21. "The object-side surface 151 and the image-side surface 152 of the fifth lens element 150 are aspheric." *Id.* at 7:21–23.

"The sixth lens element 160 with negative refractive power has a concave object-side surface 161 and a concave image-side surface 162, and is made of plastic material." *Id.* at 7:25–27. "The object-side surface 161 and the image-side surface 162 of the sixth lens element 160 are aspheric." *Id.* at 7:27–29. "Furthermore, the sixth lens element 160 has inflection points formed on the object-side surface 161 and the image-side surface 162 thereof." *Id.* at 7:29–31.

The '499 patent also provides values for the characteristics of these components, as well as for the components of the other disclosed embodiments. *See, e.g.*, *id.* at Tables 1–14.

E. Illustrative Claim

Petitioner challenges independent claim 15 and claim 18, which depends therefrom. Claim 15 is illustrative of the challenged claims, and reads as follows:

> 15. An optical image capturing lens assembly comprising, in order from an object side to an image side:
> a first lens element with positive refractive power having a convex object-side surface;
> a second lens element with negative refractive power;
> a third lens element with refractive power;
> a fourth lens element with refractive power;

> a fifth lens element with positive refractive power made of plastic material, wherein an object-side surface and an image-side surface of the fifth lens element are aspheric; and
>
> a sixth lens element with negative refractive power made of plastic material and having a concave image-side surface, wherein an object-side surface and the image-side surface of the sixth lens element are aspheric, and the sixth lens element has at least one inflection point formed on at least one of the object-side surface and the image-side surface thereof;
>
> wherein the first through sixth lens elements are six independent and non-cemented lens elements, a focal length of the optical image capturing lens assembly is f, an entrance pupil diameter of the optical image capturing lens assembly is EPD, a distance perpendicular to the optical axis between a non-axial critical point on the image-side surface of the sixth lens element and the optical axis is Yc, and a distance perpendicular to the optical axis between the maximum effective diameter position and the optical axis is Yd, the following relationships are satisfied:
>
> 1.5<f/EPD<2.5 : and
>
> 0.2<Yc/Yd<0.9.

Ex. 1001, cert. of corr. at 1–2.

F. Instituted Grounds of Unpatentability

We instituted trial based on the following grounds of unpatentability, which are all the grounds of unpatentability raised in the Petition:

Claim(s) Challenged	35 U.S.C. §[4]	Reference(s)/Basis
15, 18	103(a)	KR872[5]
15, 18	103(a)	KR872, Baba[6]

[4] The Leahy-Smith America Invents Act ("AIA") included revisions to 35 U.S.C. § 103 that became effective on March 16, 2013. Because the '499 patent issued from an application filed before March 16, 2013, we apply the pre-AIA version of the statutory basis for unpatentability.
[5] KR 10-2011-0024872, published Mar. 9, 2011 (Ex. 1004, "KR872").
[6] US 2011/0157725 A1, published June 30, 2011 (Ex. 1009, "Baba").

Claim(s) Challenged	35 U.S.C. §[4]	Reference(s)/Basis
15, 18	103(a)	KR357[7]
15, 18	103(a)	KR357, Baba

Pet. 3, 24–87.

G. Declarations

Petitioner submits in support of its arguments the following declarations from its expert: the Declaration of Tom. D. Milster, Ph.D. (Ex. 1003)[8] and the Reply Declaration of Tom. D. Milster, Ph.D. (Ex. 1039). Patent Owner submits in support of its arguments the following declarations from its expert: the Declaration of Julie L. Bentley Ph.D. (Ex. 2001), the Supplemental Declaration of Julie L. Bentley, Ph.D. (Ex. 2036), and the Declaration of Julie L. Bentley, Ph.D. in Support of Patent Owner's Reply for the Motion To Amend (Ex. 2040). Patent Owner also submits in support of its arguments the Declaration of Wang, Shen-Lien (Ex. 2037).[9]

In addition, the parties rely on declarations or affidavits from other proceedings or matters. We address those documents where necessary below in the context of the parties' arguments and our analysis.

[7] KR 10-2010-0040357, published Apr. 20, 2010 (Ex. 1005, "KR357").
[8] Petitioner served the Supplemental Declaration of Tom. D. Milster, Ph.D. (Ex. 2030) on Patent Owner in response to Patent Owner's Objections to Petitioner's Petition Evidence (Paper 11). As such, this declaration was for the admissibility of such evidence. Patent Owner, however, filed this declaration and provides substantive merits arguments. *See, e.g.*, PO Resp. 6, 9, 14, 21, 23, 27.
[9] Patent Owner filed a redacted version of this declaration as Ex. 2037, which we refer to in this Decision. The unredacted version of this declaration was filed as Ex. 2038, which we ordered sealed. *See* Paper 54, 4.

II. LEVEL OF ORDINARY SKILL IN THE ART

To determine whether an invention would have been obvious at the time it was made, we consider the level of ordinary skill in the pertinent art at the time of the invention. *Graham v. John Deere Co.*, 383 U.S. 1, 17 (1966). In assessing the level of ordinary skill in the art, various factors may be considered, including the "type of problems encountered in the art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field." *In re GPAC, Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (citing *Custom Accessories, Inc. v. Jeffrey-Allan Indus., Inc.*, 807 F.2d 955, 962–63 (Fed. Cir. 1986)). "[O]ne or more factors may predominate." *Id.*

In our Decision on Institution, we adopted the definition Petitioner proposes for one having ordinary skill in the art at the time of the invention of the '499 patent. Dec. on Inst. 9–10. Namely, we found that one of ordinary skill in the art at the time of the invention of the '499 patent would have had "(i) a Bachelor's degree in Physics, Optical Sciences, or equivalent training, as well as (ii) approximately three years of experience in designing multi-lens optical systems." *Id.* at 9 (quoting Pet. 15 (citing Ex. 1003 ¶ 33)). We also found that "[l]ack of work experience could have been offset by additional education, and vice versa," and that one of ordinary skill in the art "would have had experience in analyzing, tolerancing, adjusting, and optimizing multi-lens systems for manufacturing, and would have been familiar with the specifications of lens systems and their fabrication." *Id.* (quoting Pet. 15; Ex. 1003 ¶¶ 33–34) (alteration in original).

We also agreed with Petitioner and found that one of ordinary skill in the art "would have understood the fundamentals of optical aberration

theory, and understood and used standard techniques for making lenses cheaper and more effective, especially for lens systems used in mobile devices." *Id.* (quoting Pet. 15; Ex. 1003 ¶ 35). We also agreed with Petitioner and found that one of ordinary skill in the art "would have known how to use lens design software such as Code V, Oslo, and ZEMAX, and would have taken a lens design course or had equivalent training." *Id.* at 9–10 (quoting Pet. 15–16; Ex. 1003 ¶ 34). We also agreed with Petitioner and found that one of ordinary skill in the art "would have regularly used such software to create new lens designs, often using pre-existing lens designs as a starting point and then performing routine optimizations to reach a desired design." *Id.* at 10 (quoting Pet. 16; Ex. 1003 ¶ 34). We also agreed with Petitioner and found that one of ordinary skill in the art "would have followed and regularly consulted books, articles, and other publications by the Society of Photo-Optical Instrumentation Engineers ('SPIE')." *Id.*

Patent Owner does not identify a level of skill in the art that one would have had at the time of the invention of the '499 patent or identify any shortcoming in Petitioner's formulation. *See generally* PO Resp.

Because Petitioner's definition of the level of skill in the art is consistent with the '499 patent and the asserted prior art, we maintain it for purposes of this Final Written Decision. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001); *In re GPAC*, 57 F.3d at 1579; *In re Oelrich*, 579 F.2d 86, 91 (CCPA 1978).

III. CLAIM CONSTRUCTION

Because the Petition was filed after November 13, 2018, we apply the same claim construction standard that would be used in a civil action under 35 U.S.C. § 282(b), following the standard articulated in *Phillips v. AWH*

Corp., 415 F.3d 1303 (Fed. Cir. 2005) (en banc). 37 C.F.R. § 42.100(b) (2019); 83 Fed. Reg. 51,340, 51,340–41, 51,343 (Oct. 11, 2018). In applying such standard, claim terms are generally given their ordinary and customary meaning, as would be understood by a person of ordinary skill in the art, at the time of the invention and in the context of the entire patent disclosure. *Phillips*, 415 F.3d at 1312–13. "In determining the meaning of the disputed claim limitation, we look principally to the intrinsic evidence of record, examining the claim language itself, the written description, and the prosecution history, if in evidence." *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 469 F.3d 1005, 1014 (Fed. Cir. 2006) (citing *Phillips*, 415 F.3d at 1312–17).

Petitioner "contends that no claim terms require specific construction to resolve the unpatentability issues presented herein." Pet. 23. Patent Owner does not identify any claim terms for construction. *See generally* PO Resp.

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

IV. PRINCIPLES OF LAW

"In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable." *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (requiring *inter partes* review

petitions to identify "with particularity . . . the evidence that supports the grounds for the challenge to each claim")). This burden of persuasion never shifts to Patent Owner. *See Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (discussing the burden of proof in *inter partes* review).

A claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time of the invention to a person having ordinary skill in the art. *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 non-obviousness, if present. *See Graham*, 383 U.S. at 17–18. When evaluating a claim for obviousness, we also must "determine 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)).

V. OBJECTIVE INDICIA OF NONOBVIOUSNESS

Objective indicia of non-obviousness "play[s] an important role as a guard against the statutorily proscribed hindsight reasoning in the obviousness analysis." *WBIP, LLC v. Kohler Co.*, 829 F.3d 1317, 1328–30 (Fed. Cir. 2016). It "may often be the most probative and cogent evidence in the record," and "must be considered in every case." *Id.* at 1328 (emphasis omitted). Objective indicia of nonobviousness may include long-felt but unsolved need, failure of others, unexpected results, commercial success,

copying, licensing, industry praise, and expert skepticism. *Mintz v. Dietz & Watson, Inc.*, 679 F.3d 1372, 1379 (Fed. Cir. 2012).

Objective indicia are only relevant to the obviousness inquiry if there is a nexus between the claimed invention and the objective indicia of nonobviousness. *In re Affinity Labs of Tex., LLC*, 856 F.3d 883, 901 (Fed. Cir. 2017) (citing *Ormco Corp. v. Align Tech., Inc.*, 463 F.3d 1299, 1312 (Fed. Cir. 2006)); *Volvo Penta of the Americas, LLC v. Brunswick Corp.*, 81 F.4th 1202, 1210 (Fed. Cir. 2023) (citing *In re GPAC*, 57 F.3d 1573, 1580 (Fed. Cir. 1995) ("For objective evidence of secondary considerations to be relevant, there must be a nexus between the merits of the claimed invention and the objective evidence.")). "The patentee bears the burden of showing that a nexus exists." *Volvo*, 81 F.4th at 1211 (quoting *Fox Factory, Inc. v. SRAM, LLC*, 944 F.3d 1366, 1373 (Fed. Cir. 2019)). "A showing of nexus can be made in two ways: (1) via a presumption of nexus, or (2) via a showing that the evidence is a direct result of the unique characteristics of the claimed invention." *Id.* at 1210.

"A patent owner is entitled to a presumption of nexus when it shows that the asserted objective evidence is tied to a specific product that 'embodies the claimed features, and is coextensive with them.'" *Id.* (quoting *Brown & Williamson Tobacco Corp. v. Philip Morris, Inc.*, 229 F.3d 1120, 1130 (Fed. Cir. 2000)). In other words, "[a] presumption of nexus requires both that the product embodies the invention and is coextensive with it." *Id.* at 1211 (citing *Brown*, 229 F.3d at 1130). Patent Owner fails to show either of these requirements.

First, Patent Owner argues that its 60079, 60120, 60122, and 9610 products practice the challenged claims (as well as the proposed substitute

claims). PO Resp. 49–51, 56–57; PO Sur-reply 19–20. For independent claim 15's claimed ratios of "f/EPD" and "Yc/Yd," Patent Owner lists values for each of these parameters for the 60079, 60120, and 60122 products which cause the claimed ratios to meet the claimed ranges. PO Resp. 50, 57. Patent Owner, however, does not cite from where the values were obtained. *Id.* Rather, elsewhere in its arguments, Patent Owner broadly asserts that the products are covered by the challenged claims, citing Dr. Bentley's Supplemental Declaration. *See id.* at 49 (citing Ex. 2036 ¶¶ 26–37), 51 (citing same), 56 (citing Ex. 2036 ¶ 38).

Turning to this declaration, Dr. Bentley states that she was "informed by" Patent Owner of the values for f, EPD, Yc, and Yd for each of the 60079, 60120, and 60122 products. Ex. 2036 ¶ 35. As to the 9610 product, Dr. Bentley states that she relies on "information provided to me by" Patent Owner, which included f and EPD, but Dr. Bentley does not identify what values were provided by Patent Owner for any parameter or make reference to Yc and Yd. *Id.* ¶ 38. Moreover, Dr. Bentley testifies that she received the data from Patent Owner's outside counsel. Ex. 1038 (Depo. Trans.), 119:8–23; *see also id.* at 108:10–109:14 (testifying that she worked with counsel to get the "data . . . needed to go through the claims," and she did not speak with anyone at Patent Owner). Notably, there is nothing in the record to support factually the values that Dr. Bentley says she was given. For example, there are no datasheets or product specifications of record for Patent Owner's products. Nor is there any provenance provided for the data Patent Owner relies on beyond Dr. Bentley's testimony.

Simply put, we find that Patent Owner does not provide sufficient evidence to show that any of its four products practice claim 15's claimed

ratios of "f/EPD" and "Yc/Yd." And we give little weight to Dr. Bentley's testimony in this regard as the testimony lacks sufficient factual corroboration. *See In re Am. Acad. of Sci. Tech Ctr.*, 367 F.3d 1359, 1368 (Fed. Cir. 2004) ("[T]he Board is entitled to weigh the declarations and conclude that the lack of factual corroboration warrants discounting the opinions expressed in the declarations."); 37 C.F.R. § 42.65(a) ("Expert testimony that does not disclose the underlying facts or data on which the opinion is based is entitled to little or no weight.").

In sum, we are not persuaded that any of Patent Owner's products practice claim 15's claimed ratios. Claim 18 depends from claim 15, substitute claim 26 includes these claimed ratios, and substitute claim 27 depends from claim 26. Thus, Patent Owner does not show that any of its products practice any of the challenged claims or the substitute claims.

Second, even assuming that Patent Owner's products practice claim 15's ratios—which has not been shown—Patent Owner does not show that any of its products are coextensive with the challenged or substitute claims. Instead, Patent Owner argues that the products are "marketed and sold as a single product," rather than being "sold as a subcomponent of a larger system or assembly," and thus, "each product corresponds exactly to each of the [c]hallenged [c]laims, and to each of the substitute claims." PO Resp. 51 (citing Ex. 2036 ¶¶ 26–37, 50–52; Ex. 2037 ¶ 8). Simply put, there is no logical basis to argue that because a product is sold as a single, stand-alone

product it must be coextensive with a claim.[10] Rather, a single product could have additional unclaimed, critical features. And again, there are no datasheets, specifications, or other product literature of record for Patent Owner's products that evidences the scope of the products' features. Nor does Patent Owner provide an analysis showing that its products are coextensive with the challenged or substitute claims to support a presumption. *See Lectrosonics, Inc. v. Zaxcom, Inc.*, IPR2018-01129, Paper 33 at 33 (PTAB Jan. 24, 2020) (precedential) (finding a presumption of nexus is inappropriate where a patent owner does not provide an analysis demonstrating that its products are coextensive with the challenged claims).

Likewise, we find unavailing Dr. Bentley's testimony "that each of the lens products marketed and sold by Largan as 60120, 60122, and 60079 embodies the features of both claim 15 and claim 18 of the '499 patent and, in fact, is coextensive with those claims. That is, these claims are not directed to a sub-component of the entire lens product; they cover the entirety of each lens product." Ex. 2036 ¶ 26; *see also id.* ¶ 50 (providing similar testimony regarding the substitute claims). Again, just because a lens product is not a sub-component does not mean that the lens product is coextensive with a claim. In addition, Dr. Bentley provides no basis for her testimony that the claims "cover the entirety of each lens product," and thus, we do not find this testimony persuasive. *Id.* ¶ 26; *In re Am. Acad.*, 367 F.3d

[10] *Fox Factory* explains that "'[w]hen the thing that is commercially successful is not coextensive with the patented invention—for example, if the patented invention is only a component of a commercially successful machine or process,' the patentee is not entitled to a presumption of nexus." 944 F.3d at 1373 (quoting *Demaco Corp. v. F. Von Langsdorff Licensing Ltd.*, 851 F.2d 1387, 1392 (Fed. Cir. 1988)). But this does not mean that showing a product is not a component shows being coextensive. *Id.*

at 1368; 37 C.F.R. § 42.65(a). Nor does Patent Owner cite any testimony to support that the 9610 product is coextensive with any claim. *See* PO Resp. 48–63.

Lastly, we need not consider whether there is an actual nexus because Patent Owner has not shown that its products practice any of the challenged or substitute claims. Regardless, Patent Owner does not provide any specific arguments or evidence to show that any commercial success of its products is the direct result of the unique characteristics of the claimed invention. *See Id.* at 53–55. Nor does Patent Owner show "evidence of . . . access to [a] patented product combined with substantial similarity to the patented product." *Wyers v. Master Lock Co.*, 616 F.3d 1231, 1246 (Fed. Cir. 2010). Again, Patent Owner does not show that its products are patented products. Moreover, Patent Owner does not explain how the purported copies satisfy the claimed ratios of "f/EPD" and "Yc/Yd." *See* PO Resp. 56–62.

In sum, we find that Patent Owner does not show a presumption of nexus or an actual nexus between the merits of the claimed invention and the objective evidence. Thus, we do not find Patent Owner's purported objective evidence of secondary considerations to be relevant.

VI. ALLEGED OBVIOUSNESS OVER KR872

Petitioner argues that KR872 renders claims 15 and 18 obvious. Pet. 24–55. For the reasons that follow, we determine that Petitioner shows by a preponderance of the evidence that KR872 renders these claims obvious.

A. Summary of KR872

KR872 "relates to a lens module, and more particularly, to a lens module suitable for a camera module using a high-resolution image sensor

and having a plurality of lenses to reduce sensitivity." Ex. 1004 ¶ 1. According to KR872, "attempts have been made to configure a high-resolution lens module using five lenses." *Id.* ¶ 3. KR872 discloses that the structure of the previously attempted lens modules "failed to exhibit satisfactory optical characteristics or aberration characteristics in some cases, and thus, there is a need for a high-resolution lens module having a new power structure." *Id.* In response, KR872 discloses "a lens module having a new power structure in which the number of lenses is increased and to provide a lens module having the characteristics in which the flare phenomenon is reduced and the sensitivity is decreased, and having excellent aberration characteristics." *Id.* ¶ 4. Figure 1, shown below, illustrates an embodiment of KR872. *Id.* ¶ 24.

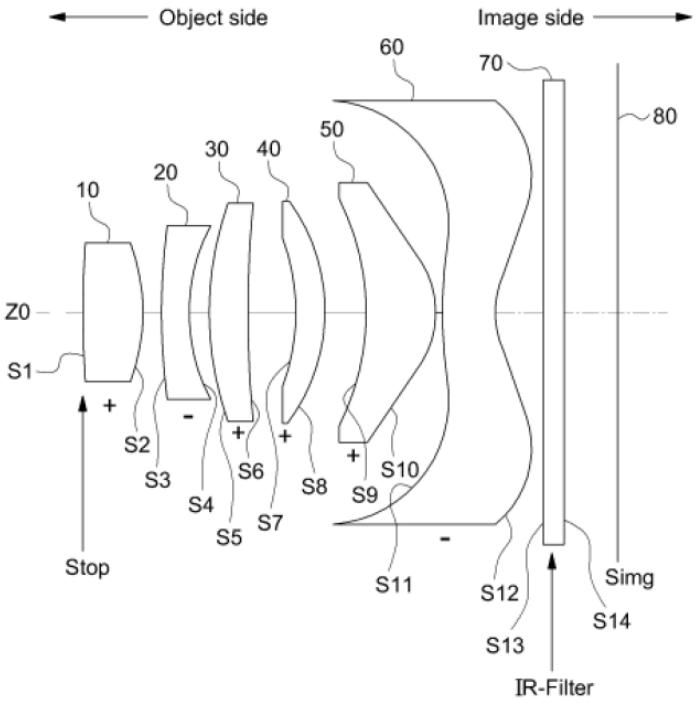


Figure 1 "is a side configuration diagram illustrating the state of arrangement of the lens with an optical axis (Z0) at the center" for an embodiment of KR872. *Id.* "Referring to Fig. 1, the camera lens module

. . . has a configuration in which a first lens (10), a second lens (20), a third lens (30), a fourth lens (40), a fifth lens (50), a sixth lens (60), a filter (70), and a light receiving element (80) are disposed sequentially from the object side." *Id.* ¶ 25. KR872 also provides tables of values for the characteristics of these components, in accordance with its disclosure. *See id.* at Tables 1–2.

KR872 discloses that "[t]he first lens (10) has positive (+) refractive power, and the object-side surface (S1) is formed to be convex." *Id.* ¶ 28. "The second lens (20) has negative (-) refractive power, and the object-side surface (S3) is formed to be convex." *Id.* "The third lens (30), the fourth lens (40), and the fifth lens (50) have positive (+) refractive power, and the sixth lens (60) has negative (-) refractive power." *Id.* ¶ 29.

In addition, KR872 discloses that "[a]t least one of the object-side surface and image-side surface of the first lens (10), the second lens (20), the third lens (30), the fourth lens (40), the fifth lens (50), and the sixth lens (60) is configured to be an aspherical surface, but it is not limited thereto and both surfaces may be provided as an aspherical surface." *Id.* ¶ 30.

"[T]he sixth lens (60) has an aspherical shape in which both the object-side surface (S11) and the image-side surface (S12) have an inflection point." *Id.* ¶ 31. "As illustrated, the image-side surface (S12) of the sixth lens (60) is bent toward the image side as it goes toward the periphery from the center portion with the optical axis (Z0) at the center and is bent toward the object side as it goes toward the outermost region from the periphery away from the optical axis (Z0) again, forming an aspherical inflection point." *Id.*

B. Challenged Claim 15

1. Optical Image Capturing Lens Assembly

Petitioner argues that KR872 teaches "[a]n optical image capturing lens assembly comprising, in order from an object side to an image side," as recited in claim 15's preamble. Pet. 27–28. In particular, Petitioner argues that KR872 teaches "a lens module suitable for a camera module using a high-resolution image sensor and having a plurality of lenses to reduce sensitivity." *Id.* at 27 (quoting Ex. 1004 ¶ 1; citing Ex. 1003 ¶ 85). According to Petitioner, "[t]he optical image capturing lens assembly of KR872 includes six lenses, arranged 'sequentially from the object side' to an image side." *Id.* (quoting Ex. 1004 ¶ 6; citing *id.* at Fig. 1).

After reviewing Petitioner's arguments and evidence, which are not addressed by Patent Owner (*see generally* PO Resp.), we determine that Petitioner demonstrates by a preponderance of the evidence that KR872 teaches "[a]n optical image capturing lens assembly comprising, in order from an object side to an image side." In light of our finding, we need not, and thus do not, reach whether claim 15's preamble is limiting.

2. First Lens Element

Petitioner argues that KR872 teaches "a first lens element with positive refractive power having a convex object-side surface," as recited in claim 15. Pet. 28–29. In particular, Petitioner argues that KR872 teaches a "first lens (10)[, which] has positive (+) refractive power, and the object-side surface (S1) is formed to be convex." *Id.* at 28 (quoting Ex. 1004 ¶ 28; citing *id.* ¶¶ 16, 25, code (57); Ex. 1003 ¶ 86). Petitioner argues that KR872's Figure 1 "uses a '+' sign underneath the first lens 10, to reflect the positive refractive power of the lens." *Id.* (annotating Ex. 1004, Fig. 1).

Petitioner adds that "[t]able 1 of KR872 confirms that the first lens 10 has a convex object-side surface S1, as surface number 1 has a positive radius of curvature (4.06mm)." *Id.* at 29 (citing Ex. 1004 ¶ 57; Ex. 1003 ¶ 87).

After reviewing Petitioner's arguments and evidence, which are not addressed by Patent Owner (*see generally* PO Resp.), we determine that Petitioner demonstrates by a preponderance of the evidence that KR872 teaches "a first lens element with positive refractive power having a convex object-side surface."

3. Second Lens Element

Petitioner argues that KR872 teaches "a second lens element with negative refractive power," as recited in claim 15. Pet. 30. In particular, Petitioner argues that KR872 teaches a "second lens (20)[, which] has negative (-) refractive power." *Id.* (quoting Ex. 1004 ¶ 28; citing *id.* ¶¶ 25–26, code (57), claim 1). Petitioner argues that KR872's Figure 1 "reflects this negative refractive power with a '-' sign underneath second lens 20." *Id.* (annotating Ex. 1004, Fig. 1).

After reviewing Petitioner's arguments and evidence, which are not addressed by Patent Owner (*see generally* PO Resp.), we determine that Petitioner demonstrates by a preponderance of the evidence that KR872 teaches "a second lens element with negative refractive power."

4. Third Lens Element

Petitioner argues that KR872 teaches "a third lens element with refractive power," as recited in claim 15. Pet. 31. In particular, Petitioner argues that KR872 teaches a third lens (30) with positive (+) refractive power. *Id.* (citing Ex. 1004 ¶¶ 16, 25, 29, code (57), claim 1). Petitioner

argues that KR872's Figure 1 "reflects the positive refractive power of third lens 30 with a '+' sign." *Id.* (citing Ex. 1004, Fig. 1).

After reviewing Petitioner's arguments and evidence, which are not addressed by Patent Owner (*see generally* PO Resp.), we determine that Petitioner demonstrates by a preponderance of the evidence that KR872 teaches "a third lens element with refractive power."

5. Fourth Lens Element

Petitioner argues that KR872 teaches "a fourth lens element with refractive power," as recited in claim 15. Pet. 32. In particular, Petitioner argues that KR872 teaches a fourth lens (40) with positive (+) refractive power. *Id.* (citing Ex. 1004 ¶¶ 16, 25, 29, code (57), claim 1). Petitioner argues that KR872's Figure 1 "reflects the positive refractive power of fourth lens 40 with a '+' sign." *Id.* (citing Ex. 1004, Fig. 1).

After reviewing Petitioner's arguments and evidence, which are not addressed by Patent Owner (*see generally* PO Resp.), we determine that Petitioner demonstrates by a preponderance of the evidence that KR872 teaches "a fourth lens element with refractive power."

6. Fifth Lens Element

Petitioner argues that KR872 teaches "a fifth lens element with positive refractive power made of plastic material, wherein an object-side surface and an image-side surface of the fifth lens element are aspheric," as recited in claim 15. Pet. 33–38. More specifically, Petitioner argues that KR872 teaches a fifth lens (50) with positive (+) refractive power. *Id.* at 33 (citing Ex. 1004 ¶¶ 16, 25, 29, code (57), claim 1; Ex. 1003 ¶ 99). Petitioner argues that KR872's Figure 1 "confirms this, showing the fifth lens 50 with

positive refractive power denoted by the '+' symbol below the lens." *Id.* (annotating Ex. 1004, Fig. 1).

In addition, Petitioner argues that "KR872 Table 1 uses an asterisk (*) to indicate an aspheric object-side surface (Surface number 9) and aspheric image-side surface (Surface number 10) of the fifth lens 50." *Id.* at 34 (citing Ex. 1004 ¶ 57). Petitioner adds that "KR872 Table 2 provides aspheric coefficients for the object-side surface and the image-side surface of the fifth lens." *Id.* at 34–35 (citing Ex. 1004 ¶ 61; Ex. 1003 ¶ 101).

In addition, Petitioner argues that one of ordinary skill in the art "would have found it at least obvious to use plastic for the aspheric fifth lens of KR872." *Id.* at 35. According to Petitioner, "[b]y 2010 and earlier, plastic was a well-known and commonly used lens material." *Id.* at 35–36 (citing Ex. 1006,[11] 12:37–42; Ex. 1011,[12] 8; Ex. 1012,[13] 6; Ex. 1003 ¶ 103). Petitioner argues that one of ordinary skill in the art "knew that plastic lenses were the most cost-effective and best-suited material for aspheric lenses such as the fifth lens 50 of KR872, thus especially motivating [one of ordinary skill in the art] to use plastic for this lens in KR872." *Id.* at 36 (citing Ex. 1006, 12:37–42; Ex. 1013,[14] 3; Ex. 1015,[15] 264; Ex. 1012, 4, 88, 90, 94). According to Petitioner, the "well-known benefits of

[11] US 8,054,562 B2, issued Nov. 8, 2011 ("Asami").
[12] Jane Bareau & Peter P. Clark, *The Optics of Miniature Digital Camera Modules* (2006) ("Bareau").
[13] Michael P. Schaub, *The Design of Plastic Optical Systems* (SPIE Press 2009) ("Schaub").
[14] Rob Bates, *Performance and tolerance sensitivity optimization of highly aspheric miniature camera lenses*, Proc. SPIE 7793 (Aug. 23, 2010) ("Bates").
[15] Stefan Bäumer, *Handbook of Plastic Optics* (2d ed. 2010) ("Bäumer").

cost-efficiency, ease of manufacturing, and ease of assembly would have motivated [one of ordinary skill in the art] to implement the fifth lens using plastic, with a reasonable expectation of success." *Id.* at 37 (citing Ex. 1003 ¶ 105).

After reviewing Petitioner's arguments and evidence, which are not addressed by Patent Owner (*see generally* PO Resp.), we determine that Petitioner demonstrates by a preponderance of the evidence that KR872 teaches "a fifth lens element with positive refractive power made of plastic material, wherein an object-side surface and an image-side surface of the fifth lens element are aspheric."[16]

7. Sixth Lens Element

Petitioner argues that KR872 teaches "a sixth lens element with negative refractive power made of plastic material and having a concave image-side surface, wherein an object-side surface and the image-side surface of the sixth lens element are aspheric, and the sixth lens element has at least one inflection point formed on at least one of the object-side surface and the image-side surface thereof," as recited in claim 15. Pet. 38–41. More specifically, Petitioner argues that KR872 teaches a sixth lens (60) that has negative (-) refractive power. *Id.* at 38 (citing Ex. 1004 ¶¶ 16, 25, 29, code (57), claim 1; Ex. 1003 ¶ 109). Petitioner adds that Figure 1 "indicates the negative refractive power of the sixth lens 60 with a '-' below the lens." *Id.* at 40–41 (annotating Ex. 1004, Fig. 1; citing Ex. 1003 ¶ 113).

[16] Petitioner relies on Asami, Bareau, Schaub, Bates, and Bäumer for this limitation to evidence the knowledge that one of ordinary skill in the art would have had. Pet. 35–36. We appropriately consider such knowledge as part of our obviousness analysis. *See Randall Mfg. v. Rea*, 733 F.3d 1355, 1362–63 (Fed. Cir. 2013).

In addition, Petitioner argues that KR872's "[t]able 1 discloses that both surfaces of the sixth lens 60 are aspheric because both the object-side surface (S11) and the image-side surface (S12) are denoted with an asterisk." *Id.* at 39 (citing Ex. 1004 ¶¶ 57–58) (emphasis omitted). "KR872 further confirms these surfaces are aspheric, by providing aspheric coefficients for both the object-side surface (S11) and the image-side surface (S12) of the sixth lens 60 in Table 2," according to Petitioner. *Id.* at 39–40 (citing Ex. 1004 ¶ 61; Ex. 1003 ¶ 110). Moreover, KR872's Figure 1 "shows the concave image-side surface [and] aspheric surfaces on both the object and image side," according to Petitioner. *Id.* at 40–41 (annotating Ex. 1004, Fig. 1; citing Ex. 1003 ¶ 113).

In addition, Petitioner argues that one of ordinary skill in the art "would have been motivated to implement the aspheric sixth lens element with a plastic lens material," for the same reasons discussed for the fifth lens. *Id.* at 40 (citing Pet. 35–37; Ex. 1003 ¶ 111) (emphasis omitted).

In addition, Petitioner argues that "KR872 also discloses inflection points for these aspheric surfaces." *Id.* (emphasis omitted). More specifically, Petitioner argues that KR872 teaches that "the sixth lens (60) has an aspherical shape in which both the object-side surface (S11) and the image-side surface (S12) have an inflection point." *Id.* (quoting Ex. 1004 ¶ 31; citing Ex. 1003 ¶ 112). Moreover, KR872's Figure 1 shows "inflection points on both the object-side and image-side surfaces (where the curvature changes from positive to negative and vice versa)," according to Petitioner. *Id.* at 40–41 (annotating Ex. 1004, Fig. 1; citing Ex. 1003 ¶ 113).

After reviewing Petitioner's arguments and evidence, which are not addressed by Patent Owner (*see generally* PO Resp.), we determine that

Petitioner demonstrates by a preponderance of the evidence that KR872 teaches "a sixth lens element with negative refractive power made of plastic material and having a concave image-side surface, wherein an object-side surface and the image-side surface of the sixth lens element are aspheric, and the sixth lens element has at least one inflection point formed on at least one of the object-side surface and the image-side surface thereof."

8. Independent and Non-Cemented Lens Elements

Petitioner argues that KR872 teaches "wherein the first through sixth lens elements are six independent and non-cemented lens elements," as recited in claim 15. Pet. 42–43. More specifically, Petitioner argues that KR872 teaches "its first through sixth lens elements as six independent and non-cemented lens elements, as shown in Fig[ure] 1." *Id.* at 41–42 (annotating Ex. 1004, Fig. 1). According to Petitioner, "[a] lens element is independent and non-cemented if the lens element is not cemented to any adjacent lens element and there is an air space between the lens element and any adjacent lens element." *Id.* at 42 (citing Ex. 1001, 4:5–8). Petitioner argues that "[a]s depicted, each lens is spatially separated by a gap from each adjacent lens, so each lens is independent and non-cemented." *Id.* at 43 (citing Ex. 1004, Fig. 1; citing Ex. 1003 ¶ 116).

After reviewing Petitioner's arguments and evidence, which are not addressed by Patent Owner (*see generally* PO Resp.), we determine that Petitioner demonstrates by a preponderance of the evidence that KR872 teaches "wherein the first through sixth lens elements are six independent and non-cemented lens elements."

9. 1.5 <f/EPD<2.5

Claim 15 further recites "wherein . . . a focal length of the optical image capturing lens assembly is f, an entrance pupil diameter of the optical image capturing lens assembly is EPD, . . . the following relationship[is] satisfied: 1.5< f/EPD <2.5." Ex. 1001, cert. of corr. at 2. We agree with Petitioner and find that one of ordinary skill in the art would have found this limitation obvious in view of KR872. Pet. 43–48; Pet. Reply 3–12. In particular, we find that one of ordinary skill in the art would have found it obvious to implement an f-number within the claimed range (e.g., 2.0) with KR872's lens system, for the reasons we discuss below.

We are persuaded that the claimed ratio of focal length to entrance pupil diameter (i.e., *f/EPD*) was known to one of ordinary skill in the art as, *inter alia*, the "f-number" of a lens system. *See* Ex. 1012, 71 ("The ratio of the focal length of the lens system to the entrance pupil diameter is the *f* number (*f*/#) of the system."); Ex. 1003 ¶ 117 n.13. We are also persuaded that a lens assembly's f-number "describes the system's light capturing ability," with a smaller f-number indicating more light capturing ability, i.e., a "faster" or "brighter" lens system. *See* Ex. 1010,[17] 611; Ex. 1012, 71. A smaller f-number also indicates a larger aperture, resulting in more light entering the system. Ex. 1012, 71.

In addition, we agree with the parties that although KR872 does not specify a value for the f-number or either of its constituent parts, *f* and *EPD*, one of ordinary skill in the art would have known that KR872's lens system has an f-number. Ex. 1003 ¶ 119 (citing Ex. 1012, 78); Ex. 2035 (Milster Depo.), 162:12–16; Ex. 2036 ¶ 5; Pet. 44; PO Resp. 6. We also agree that

[17] Warren J. Smith, *Modern Lens Design* (2d ed. 2005) (excerpts) ("Smith").

KR872's lens system has an f-number of about 3 to 4. Ex. 2035, 105:16–23; Ex. 2036 ¶ 6.

In addition, we find that one of ordinary skill in the art, designing a lens system in accordance with KR872's teachings, would have been motivated to use a smaller f-number (e.g., 2.0). In particular, we find persuasive Dr. Milster's testimony that one of ordinary skill in the art "would have been motivated to use a lower f-number (greater aperture) to allow more light into the system and thus provide better images in action and low-light settings." Ex. 1003 ¶ 121 (citing Ex. 1012, 71); *see also id.* ¶¶ 69, 118 (testifying that one of ordinary skill in the art would have been motivated to use an f-number of 2.0 "in order to achieve a lens system that worked well in low-light and high-action settings"). We also find persuasive Dr. Milster's testimony that it was known that smaller f-numbers were desirable for high-action photography and to improve performance in low light conditions, as this testimony is supported by the prior art. *Id.* ¶¶ 122–123 (citing Ex. 1006, 1:34–35, 15:8, 16:18, 22:46–49; Ex. 1007,[18] 7:5–11); Ex. 1007, 7:5–11 ("[A] large maximum aperture (small f-number) delivers more illumination to a focal plane, allowing a faster shutter speed," which "can mitigate blurriness of an image.").

In addition, we find that one of ordinary skill in the art would have had a reasonable expectation of success in implementing an f-number within the claimed range (e.g., 2.0) with KR872's lens system, as we discuss below. "The reasonable expectation of success requirement refers to the likelihood of success in combining references to meet the limitations of the claimed invention." *Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.*, 821 F.3d

[18] US 8,559,118 B2, issued Oct. 15, 2013 ("Engelhardt").

1359, 1367 (Fed. Cir. 2016). In other words, "one must have a motivation to combine accompanied by a reasonable expectation of achieving what is claimed in the patent-at-issue." *Id.*

We find that multi-lens systems with f-numbers as low as 1.5 were well-known in the art. Ex. 1003 ¶ 123 (citing Ex. 1006, 1:34–35, 6:7–11, 15:8, 16:18, 22:46–49) (testifying that "lens systems for use in various electronic devices, with f-numbers ranging from 1.5–2.0" were known in the art). In particular, examples of prior art multi-lens systems with f-numbers in the claimed range include: (i) Asami's systems having f-numbers of 1.5 to 2.0; (ii) Baba's system having an f-number of 2.0, (iii) Kitahara's eight systems having f-numbers of 1.8 to 2.5, and (iv) Matsusaka's systems having an f-number of 1.8 or 2.0. *See* Ex. 1006, 1:14–21, 14:33, 15:7, 16:18, 16:55, 17:23, 19:42, 20:51, Figs. 3–5 (teaching six lens systems with an f-number of 1.5 to 2.0 for uses such as a mobile terminal camera); Ex. 1009 ¶¶ 4, 6, 13, 46 (teaching multi-lens systems with an f-number of 2.0 for use in mobile phones and other electronic devices); Ex. 1023,[19] 16:7–8, 17:4–5 (teaching multi-lens systems with an f-number of 1.8 to 2.5 for use in a mobile terminal camera); Ex. 1024,[20] 4:21–28, 24:58, 25:28, 25:55, 26:55 (teaching multi-lens systems with an f-number of 1.8 or 2.0 for use in electronic devices, such as cellular phones or PDAs); Ex. 1003 ¶ 124 (testifying that the examples of systems with f-numbers within the claimed range were well-known designs). In addition, we agree with Petitioner and find that it was known as desirable for cell phone cameras to have an f-number between two and three. Pet. 44; Ex. 1007, 1:56–62, 2:10–11, 7:14–

[19] US 7,911,712 B2, issued Mar. 22, 2011 ("Kitahara").
[20] US 6,867,933 B2, issued Mar. 15, 2005 ("Matsusaka").

16, 10:12–13 (Engelhardt describing a "five lens system" with "an f-number of about 2.4").

In view of these well-known examples, we find that one of ordinary skill in the art would have perceived a reasonable expectation of success in implementing an f-number of 2.0 with KR872's multi-lens system. *See Amgen v. F. Hoffman–La Roche Ltd.*, 580 F.3d 1340, 1362 (Fed. Cir. 2009) ("An obviousness determination requires that a skilled artisan would have perceived a reasonable expectation of success in making the invention in light of the prior art."); Ex. 1003 ¶¶ 120–124; Ex. 1039 ¶ 8.

We find unavailing Patent Owner's argument that the above examples of well-known lens systems having an f-number within the claimed range do not also teach "all the other elements of the [c]hallenged [c]laims." PO Resp. 18. Petitioner relies on KR872's teachings, as well as one of ordinary skill in the art's knowledge of using an f-number within the claimed range, to show that the challenged claims are obvious. *See Koninklijke Philips N.V. v. Google LLC*, 948 F.3d 1330, 1338 (Fed. Cir. 2020) (finding obviousness can rely on supported expert testimony to supply an element of a claim). Patent Owner's argument is directed to the f-number prior art teachings individually, which is the incorrect focus. *Cf. In re Merck & Co.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986) ("Non-obviousness cannot be established by attacking references individually where the rejection is based upon the teachings of a combination of references"); *In re Keller*, 642 F.2d 413, 425 (CCPA 1981). Again, Petitioner also relies on KR872's teachings.

Patent Owner also argues that all of the above example multi-lens systems, save Asami, teach five-lens systems, rather than six-lens systems, as claimed. PO Resp. 19. This argument incorrectly limits the examples to

their specific lens systems, and again focuses on the examples individually. *See EWP Corp. v. Reliance Universal Inc.*, 755 F.2d 898, 907 (Fed. Cir. 1985) ("A reference must be considered for everything it *teaches* by way of technology and is not limited to the particular *invention* it is describing and attempting to protect."); *In re Merck*, 800 F.2d at 1097. Regardless, Asami teaches six lens systems. *See, e.g.*, Ex. 1006, Figs. 3–5.

We also find unavailing Patent Owner's argument that relies on testimony from Dr. Milster in another proceeding to argue that designing for a low f-number was difficult. PO Resp. 5 (citing Ex. 2031[21] ¶ 80). In particular, the statements Patent Owner cites have an unclear context, and seem to refer to a different time period. *Id.* For example, Dr. Milster states in the other proceeding that "[a]s Kingslake says, creating lenses with small f-number has required 'tremendous efforts of lens designers and manufacturers.'" Ex. 2031 ¶ 80. But the Kingslake exhibit[22] Dr. Milster refers to is dated 1992, and Dr. Milster states "has required" (i.e., much of the efforts have occurred). *See id.* ¶¶ 78–80. In contrast, the prior art of 2011 includes numerous examples of multi-lens systems having an f-number within the claimed range, as we discuss above.

We also find unavailing Patent Owner's argument that one of ordinary skill in the art "would not have tried to modify KR872 to have an f-number of 2.0 (or otherwise in the claimed range) because KR872 was designed for a much slower f-number, and therefore would not have supplied the 'starting point' that all lens design processes begin with." PO Resp. 3–4 (citing

[21] *Apple Inc. v. Corephotonics Ltd.*, IPR2020-00896, Ex. 2001 (Declaration of Tom D. Milster, Ph.D.) (filed Mar. 12, 2021).
[22] *Apple Inc.*, IPR2020-00896, Ex. 1013 (filed May 5, 2020).

Ex. 2032,[23] 20; Ex. 1029,[24] 168, 171 ("The starting point should . . . be a configuration which is inherently capable of meeting the specifications [such as the f-number] for the design.")).[25]

Rather, we find persuasive Dr. Milster's testimony that one of ordinary skill in the art "at the time knew that multi-lens systems such as KR872 . . . were inherently capable of supporting low f-numbers." Ex. 1039 ¶ 18 (citing Ex. 1003 ¶ 124); Ex. 1003 ¶ 124 (discussing example prior art multi-lens designs, including Asami's six lens system, that achieve f-numbers ranging from 1.5 to 2.8). We find that this testimony is supported by the cited prior art examples. *See* Ex. 1003 ¶ 124. We also find persuasive Dr. Milster's testimony that "[a]s an example of a lens system that is 'inherently capable of meeting the specifications for the design,' Fischer explains that a single lens element may be suitable for meeting a specification of a slow f-number of 10, but 'a very complex six- to seven-element' system would be . . . a more suitable starting point for meeting a specification of a fast f-number of 1.2." Ex. 1039 ¶ 18 (quoting Ex. 1029, 171–72).

Moreover, KR872 does not need to be the best starting point for reducing to an f-number within the claimed range, but only a suitable option, which as we discuss above, multi-lens systems are suitable for f-numbers within the claimed range. *Intel Corp. v. Qualcomm Inc.*, 21 F.4th 784, 800

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[23] Warren J. Smith, *Modern Lens Design* (2d ed. 2005) (Chapters 1 & 2 only) ("Smith").
[24] Robert E. Fischer et al., *Optical System Design* (2d ed. 2008) (excerpts) ("Fischer").
[25] Patent Owner also broadly cites to sixteen paragraphs of Dr. Bentley's declaration, but does so without further explanation. PO Resp. 4 (citing Ex. 2001 ¶¶ 53–68).

(Fed. Cir. 2021) (quoting *PAR Pharm., Inc. v. TWI Pharms., Inc.*, 773 F.3d 1186, 1197–98 (Fed. Cir. 2014)) ("It's not necessary to show that a combination is 'the *best* option, only that it be a *suitable* option.'") (alterations in original).

Accordingly, we are persuaded that one of ordinary skill in the art would have understood that KR872 was a good starting point, and would perceived a reasonable expectation of success in implementing an f-number within the claimed range (e.g., 2.0) with KR872's lens system. We also note that Fischer teaches that "[y]ou can use a *patent* as a starting point"—KR872 is a published patent application. Ex. 1029, 172; Ex. 1004, face.

Accordingly, for the reasons above, we find that Petitioner has shown one of ordinary skill in the art would have been motivated to modify KR872's lens system to have an f-number within the claimed range (e.g., 2.0), and would have had a reasonable expectation of success. *OSI Pharms., LLC v. Apotex Inc.*, 939 F.3d 1375, 1382 (Fed. Cir. 2019) ("An obviousness determination requires finding that a person of ordinary skill in the art would have been motivated to combine or modify the teachings in the prior art and would have had a reasonable expectation of success in doing so.").

We now turn to additional support in the record for our above findings. In particular, we also find that one of ordinary skill in the art would have viewed modifying KR872's lens system to have an f-number within the claimed range (e.g., 2.0) as an iterative process. *See, e.g.*, Ex. 1019,[26] 8–9 (describing an iterative process for lens system design); Ex. 1029, 171–76 (same); Ex. 1003 ¶ 65 (analogizing the lens design

[26] Rudolf Kingslake & R. Barry Johnson, *Lens Design Fundamentals* (2d ed. 2010) ("Kingslake").

process to the process performed by an optometrist, who begins with your old lens prescription, and then flips through a series of potential modifications—asking whether number 1 or number 2 is better—to develop a new, optimized lens prescription). For example, Kingslake explains that "[a] closed mathematical solution for the constructional data of a lens in terms of its desired performance would be much too complex to be a real possibility," and thus, "[t]he best we can do is to use our knowledge of optics to set up a likely first approach to the desired lens, evaluate it, make judicious changes, reevaluate it, and so on." Ex. 1019, 8–9. Kingslake's Figure 1.4, shown below, illustrates this process.

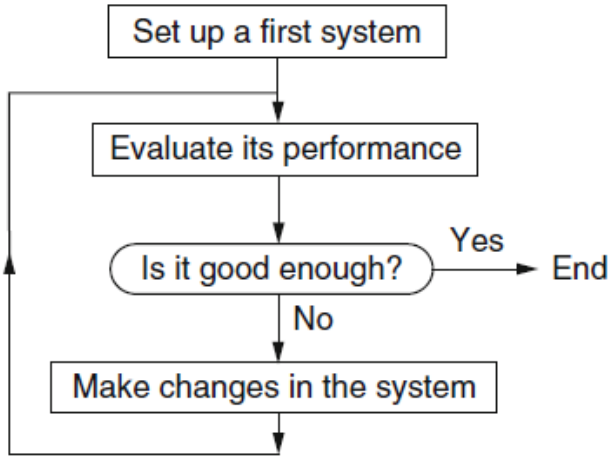


Figure 1.4 Lens design flow chart.

Figure 1.4 illustrates a simple flow chart of the lens system design process. *Id.* at 9. As illustrated, the process begins by "Set[ting] up a first system." *Id.* The next step is "Evaluat[ing] its performance." *Id.* If the performance is "good enough," the process ends. *Id.* Otherwise, the next step "Make[s] changes in the system," and then the process loops back to "Evaluat[ing] its performance." *Id.*

In addition, we find that one of ordinary skill in the art would have known that a "common scenario" faced by lens designers was to improve an existing design by lowering its f-number (i.e., "increasing the aperture"). Ex. 1037,[27] 49 ("Many techniques exist . . . to extend an existing design over new requirements without changing the basic design form," and "[t]he most common scenario arises when a designer must 'push' a legacy design to increased aperture . . . ") (emphasis omitted); Ex. 2032, 36 ("Very often, the lens designer is faced with the necessity of increasing the speed . . . of an existing optical system . . . to adapt an existing design . . . to an application that requires a larger aperture . . . ."). One of skill in the art would also have known that "[i]ncreasing the aperture . . . of an existing design can lead to ray failures during lens evaluation and optimization," and that "[t]he solution is to slowly 'walk' up to the desired aperture . . . in small increments, optimizing the lens at each step." Ex. 1037, 49.

Accordingly, because one of ordinary skill in the art would have known that (i) lens design was an iterative process of adjustment, and (ii) a common scenario faced by lens designers was to improve or adapt an existing design by lowering its f-number (without changing the basic design form), we find that one of ordinary skill in the art would have found it obvious to try modifying KR872's lens system to have an f-number within the claimed range (e.g., 2.0). *See KSR*, 550 U.S. at 417 ("When there is a design need or market pressure to solve a problem [(i.e., need for a faster or brighter lens assembly)] and there are a finite number of identified,

[27] Julie Bentley & Craig Olson, *Field Guide to Lens Design* (2012) ("Bentley Guide"). Dr. Bentley's testimony shows that this Guide, published in 2012, evidences knowledge of one of ordinary skill in the art in 2011. Ex. 1038, 17:15–18:14, 19:8–14, 20:15–16; Tr. 13:8–10.

predictable solutions, [(i.e., lowering the f-number)] a person of ordinary skill has good reason to pursue the known options within his or her technical grasp [(i.e., performing the iterative design process)]. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense. In that instance the fact that a combination was obvious to try might show that it was obvious under § 103."); Ex. 1037, 49; Ex. 2032, 36; Ex. 1039 ¶ 40.

Additionally, although not necessary to show obviousness, Petitioner shows actual success in modifying KR872's lens system to have an f-number of 2.0 using ZEMAX modeling, such as would have been performed by one of ordinary skill in the art. Pet. 46–47; Pet. Reply 10–12. Modern lens design relies on ZEMAX or other software programs, which "are highly sophisticated and enable the designer to perform a wide range of designs and analyses." Ex. 1012, 80; Pet. 18.

In particular, we are persuaded by Dr. Milster's testimony that one of ordinary skill in the art would have had actual success in modifying KR872's lens system to have an f-number of 2.0, as evidenced by ZEMAX modeling. Ex. 1003 ¶¶ 125–127; Ex. 1039 ¶¶ 20–34. In this regard, Dr. Milster performed ZEMAX modeling for the Petition and for Petitioner's Reply. More specifically, for the Reply, Dr. Milster again optimized KR872's lens system to have an f-number of 2.0, but also corrected typographical errors and changed the image height from the Petition's ZEMAX modeling to address arguments raised by Patent Owner in its Response. *See* Ex. 1039 ¶ 21. Both of Dr. Milster's modeling efforts, however, show that one of ordinary skill in the art would have had actual

success in modifying KR872's lens system to have an f-number of 2.0. Ex. 1003 ¶¶ 125–127; Ex. 1039 ¶¶ 20–40.[28]

Focusing on the Reply's ZEMAX modeling, for example, Dr. Milster testifies that he followed the "iterative, incremental approach to optimize the lens system disclosed in Tables 1 and 2 of KR872 to an f-number of 2.0," for "[a]n image height of 3.0mm [which] is disclosed in KR872." Ex. 1039 ¶¶ 20–21. Dr. Milster testifies that he "entered the lens data from Tables 1 and Tables 2 of KR872 into ZEMAX to create a starting point," and "select[ed] reasonable Abbe numbers for each material consistent with the disclosure of KR872." *Id.* ¶ 22. Dr. Milster describes then optimizing this starting point design. *Id.* ¶¶ 24–25 (testifying to changes made during the iterative optimization process). Dr. Milster testifies that one of ordinary skill in the art "would have observed that the lens system achieved a desirable performance at each step, which would have encouraged [one of ordinary skill in the art] to continue the iterative process." *Id.* ¶ 26. Dr. Milster provides the results of the lens system optimization for an f-number of 2.0. *Id.* ¶¶ 27–28, 30–31. These results "satisf[y] all limitations of claims 15 and 18 of the '499 patent." *Id.* ¶ 32; *compare id.* ¶ 32, *with* Ex. 1001, cert. of corr. 1–2 (reciting claim 1) *and id.* at 29:23–34 (reciting claim 18).

We find unavailing Patent Owner's argument that modifying KR872 to have an f-number of 2.0 was not simple and straightforward because a

[28] Patent Owner identifies certain typographical errors that Dr. Milster listed for the data for the starting point of the Petition's ZEMAX modeling. PO Resp. 21–22 (citing Ex. 2030 ¶¶ 9–10). We agree with Petitioner that the errors are inconsequential, as shown by the Reply's ZEMAX modeling, which "results in a lens system that similarly satisfies each limitation of claims 15 and 18." Pet. Reply 11–12 (citing Ex. 1039 ¶¶ 20–34, 47–54).

value of 2.0 could not be plugged directly into KR872's lens system. PO Resp. 6–7. Similarly, we find unavailing Patent Owner's argument that "direct evidence from Dr. Bentley . . . shows that attempting to use ZEMAX or CODE V to create a starting point from KR872 with an f-number of 2.0 returns an 'error' message." *Id.* at 7–9 (citing Ex. 2036 ¶ 8). These arguments ignore that one of ordinary skill in the art would have understood that lens design is an iterative process where changes need to slowly be made to the starting point design. *See* Ex. 1019, 8–9; Ex. 1029, 171–76; Ex. 1037, 49 (disclosing that "[i]ncreasing the aperture . . . of an existing design can lead to ray failures during lens evaluation and optimization," and that "[t]he solution is to slowly 'walk' up to the desired aperture . . . in small increments, optimizing the lens at each step").

We also find unavailing Patent Owner's argument that failure is possible, and that a lens designer may select a starting point design that is inherently incapable of being optimized to reach a desired end design. PO Resp. 12 (citing Ex. 1029, 171–72; Ex. 2036 ¶ 12). As we discuss above, we find that one of ordinary skill in the art would view KR872 as a suitable starting position. In addition, "[o]bviousness does not require absolute predictability of success . . . all that is required is a reasonable expectation of success." *In re Kubin,* 561 F.3d 1351, 1360 (Fed. Cir. 2009) (quoting *In re O'Farrell,* 853 F.2d 894, 903–04 (Fed. Cir. 1988)) (alterations in original).

We also find unavailing Patent Owner's arguments contrasting Dr. Milster's experience with the experience of one of ordinary skill in the art. PO Resp. 15–18. More specifically, Patent Owner contrasts Dr. Milster who "is a Ph.D. and professor in optical sciences with over forty years of research, writing, teaching, and peer-reviewed publications to his name"

with one of ordinary skill who has "(i) a *Bachelor's degree* in Physics, Optical Sciences, or equivalent training, as well as (ii) approximately *three years of experience* in designing multi-lens optical systems." *Id.* at 15 (citing Ex. 1003, App. A, ¶ 33). Patent Owner, however, does not dispute that one of ordinary skill in the art also "would have known how to use lens design software such as . . . ZEMAX," and "would have regularly used such software to create new lens designs, often using pre-existing lens designs as a starting point and then performing routine optimizations to reach a desired design." *See supra* Section II (finding the level of ordinary skill in the art); Ex. 1003 ¶ 34. Such knowledge and regular use of ZEMAX for optimizing pre-existing lens designs is directly tied to Petitioner's showing for actual success, and shows that one of ordinary skill in the art had the needed experience.

In addition, Patent Owner argues that because Dr. Milster required 20 hours for his optimization that one of ordinary skill in the art "would have needed weeks or months, with no guarantee that they could reach *any* workable solution, ever" in modifying KR872 to have an f-number of 2.0. PO Resp. 15–16 (citing Ex. 2036 ¶ 14). We find that this argument, and Dr. Bentley's cited testimony, are speculative and lack factual support. Simply put, Patent Owner provides no basis to argue that because Dr. Milster is more experienced than one of ordinary skill in the art that they would need orders of magnitude longer to optimize KR872's lens system for an f-number of 2.0 using ZEMAX. *Id.* Again, one of ordinary skill in the art would have regularly used ZEMAX with pre-existing lens designs as a starting point and performed routine optimizations to reach a desired design. Ex. 1003 ¶ 34.

Similarly, we find no factual support for Dr. Bentley's testimony that "[a] person of ordinary skill . . . with only three years of experience, has little hope of successfully navigating this difficult situation." Ex. 2036 ¶ 16 (emphasis omitted). Rather, we find persuasive the following testimony from Dr. Milster:

> Q. How can you be certain that your years of experience did not affect your decision-making in a way that would differentiate it from the decisions of a POSITA?
>
> . . . .
>
> THE WITNESS: So I didn't use any expert-level settings on the ZEMAX program. They were all pretty standard types of choices that I could make. And to the best of my ability, I made choices that were reasonable considering the experience of a POSITA after three years of experience and training in optical design in this -- in this field.
>
> So I can't say exactly that my experience didn't influence some small part. I did my best to differentiate, though, any expert-level considerations that could have been applied here.

Ex. 2039, 150:16–151:23. On the whole, this testimony supports that one of ordinary skill in the art would have performed comparably to Dr. Milster. *Id.*

We also find unavailing Patent Owner's argument that because Dr. Milster used ZEMAX software from 2019 that the ZEMAX data he provides "has no evidentiary value in the present proceeding, and conveys nothing about the expectations of success, reasonable or otherwise, of [one of ordinary skill in the art] in 2011." PO Resp. 25. Patent Owner argues that Dr. Milster "had not reviewed the code to confirm that the 2011 and 2019 versions were identical, nor did he know whether or to what degree the algorithm had improved over the ensuing eight years." *Id.* (citing Ex. 2035, 167:17–168:13) (emphasis added). In addition, Patent Owner that "[t]he

2019 manual (2,410 pages) is three times the length of the 2011 version (805 pages), so the new and different things, whatever they are, required some 1,600 pages to explain." *Id.* (comparing Ex. 2034 with Ex. 1028). These arguments, however, are not focused on the functionality Dr. Milster employed in his modeling for this proceeding.

Rather, we are persuaded by Dr. Milster's testimony that he has "used ZEMAX software on a regular basis since at least the year 1990," and that "ZEMAX has always been grounded in principles of geometrical ray tracing, and the ZEMAX modeling and lens data . . . relies on ZEMAX functionality available in 2011." Ex. 1003 ¶ 74 (citing Ex. 1027;[29] Ex. 1028[30]). We also find persuasive Dr. Milster's testimony that one of ordinary skill in the art "using ZEMAX software in September 2011 would have naturally reached the same designs." *Id.*; *see also* Ex. 2030 ¶¶ 5–7.

In addition, we agree with Patent Owner that Dr. Milster followed an iterative process in optimizing KR872's lens system to have an f-number of 2.0 using ZEMAX. PO Resp. 9–11; Ex. 1039 ¶¶ 20–40. We also agree that computer-assisted lens design is not automatic. PO Resp. 10; Ex. 1019, 8–9; Ex. 1029, 171–76; Ex. 1003 ¶ 65. We also agree that Dr. Milster took many hours and made many iterations in the iterative lens design process in modifying the KR872 lens system to have an f-number of 2.0. PO Resp. 9; Ex. 1039 ¶¶ 27, 35, 44. And we agree with Patent Owner that values for numerous parameters can be varied as part of that iterative process. PO Resp. 14; Ex. 1039 ¶¶ 20–40. However, we disagree with Patent Owner that the iterative process is unpredictable. PO Resp. 12 (citing Ex. 2031 ¶ 53).

[29] *ZEMAX*, Optical Design Program User's Guide (June 9, 2009).
[30] *ZEMAX*, Optical Design Program User's Manual (July 8, 2011).

Simply put, that the values of parameters may change between iterations in an unpredictable fashion, does not mean that the process as a whole is unpredictable.

Rather, we find persuasive Dr. Milster's testimony that one of ordinary skill in the art "would have known how to increase the aperture of an existing lens system because this was one of the most common modifications that a lens designer applied to existing lens systems." Ex. 1039 ¶ 11; Ex. 2032, 36 ("One may want to adapt an existing design . . . to an application that requires a larger aperture . . . than that for which the original lens has been configured."); Ex. 1037, 49 ("The most common scenario arises when a designer must 'push' a legacy design to increased aperture.") (emphasis omitted). We also find persuasive Dr. Milster's testimony that to avoid ray failures, one of ordinary skill in the art "would have started with a smaller aperture and incrementally increased the aperture to the target aperture while optimizing the lenses at each iteration," as this is supported by the cited art. Ex. 1039 ¶ 11 (citing Ex. 2032, 36–37; Ex. 1037, 49). Nor do we view the required number of iterations or time involved for each iteration as changing the predictability of the iterative process. In addition, we find the time Dr. Milster took for optimizing KR872's lens system for an f-number of 2.0 was reasonable. *See* Ex. 1038, 15:20–16:24 (Dr. Bentley testifying that the typical design process can take anywhere from several weeks to several years).

We also find unavailing Patent Owner's arguments that Dr. Milster employed impermissible hindsight in optimizing KR872's lens system for an f-number of 2.0. PO Resp. 19; PO Sur-reply 2–3, 8. In particular, we find unavailing Patent Owner's argument that the number of individual decisions

made by Dr. Milster, along with the trial-and-error nature of lens design, shows impermissible hindsight. PO Resp. 19; PO Sur-reply 8 (Ex. 2036 ¶ 17). As Dr. Milster explains, however, values are changed to optimize the lenses as the f-number is slowly adjusted. Ex. 1039 ¶¶ 20–27. Notably, the specific values for the lenses, such as the starting point values shown in Tables 1 and 2 of KR872, generally are not part of the claims. Hence, a change in these values (which does not change the basic design form of the lens system) during the iterative optimization process does not raise hindsight concerns.

Moreover, we find unavailing Patent Owner's argument that "[t]he question is whether [one of ordinary skill in the art] would have been motivated to [optimize for an 2.0 f-number], while also ensuring, without using hindsight, that the end result has all the other features of the [c]hallenged [c]laims." PO Sur-reply 11–12. Rather, we find that one of ordinary skill in the art would have known to maintain KR872's "basic design form." Ex. 1037, 49 ("Many techniques exist . . . to extend an existing design over new requirements without changing the basic design form," and "[t]he most common scenario arises when a designer must 'push' a legacy design to increased aperture . . . ."). We also find persuasive Dr. Milster's testimony that during ZEMAX optimization that he "wanted to follow as closely as possible the guidance of the [KR]872 tabular data and the lens drawing, because I wanted to appreciate the advantages specified by the problem that the [KR]872 was trying to solve." Ex. 2035, 144:23–145:6; *see also* Ex. 1039 ¶¶ 40, 45, 103 (providing similar testimony). In addition, whether there are also other end designs for KR872's lens system with a 2.0 f-number, one of ordinary skill in the art would have understood that the

differences relate to values rather than KR872's "basic design form." Ex. 1037, 49; Ex. 2035, 144:23–145:6; Ex. 1039 ¶¶ 40, 45, 103.

We also find unavailing Patent Owner's arguments concerning manufacturability of the ZEMAX designs. PO Sur-reply 16–18. Nowhere in its Response does Patent Owner make these arguments. *See generally* PO Resp. Nor do these arguments respond to arguments made in the Reply. Accordingly, we do not consider Patent Owner's manufacturability arguments because they were not made in the Patent Owner Response and are beyond the proper scope of the Sur-reply, and thus, are waived. *See* Paper 10 (Scheduling Order), 9 ("Patent Owner is cautioned that any arguments not raised in the response may be deemed forfeited."); 37 C.F.R. § 42.23 (b).

We also find unavailing Patent Owner's argument that the limitations of the challenged claims, other than for the f-number, "relate to the claims' intended purpose of 'providing an optical lens assembly for use in a mobile electronic product that has excellent imaging quality without too long total track length.'" PO Sur-reply 14. Patent Owner argues that Petitioner thus "has failed to carry its burden because none of its evidence addresses the reasonableness of the expectation of success in the context of the entire invention." *Id.* Simply put, the language of the challenged claims do not limit their scope to mobile electronic products. *See* Ex. 1001, cert. of corr. 1–2, 29:22–34; *In re Hiniker Co.*, 150 F.3d 1362, 1369 (Fed. Cir. 1998) (finding "the name of the game is the claim"). Nor does Patent Owner identify any claim terms for which such a limitation should be imported from the Specification of the '499 patent, or provide an appropriate justification to do so. *See generally* PO Resp. To the contrary, the

Specification teaches that its "invention relates to a compact optical image capturing lens assembly *applicable to electronic products*," rather than being limited to mobiles. Ex. 1001, 1:14–16 (emphasis added).

In addition, we find unavailing Patent Owner's argument that we "should disregard the ZEMAX optimization evidence as unsupported by underlying facts and data." PO Resp. 20; PO Sur-reply 10 (arguing that we should disregard all of Dr. Milster's ZEMAX optimizations under 37 C.F.R. § 42.65(a)). In particular, Patent Owner faults Dr. Milster for not generating a table of data for each of the iterations that he ran in the ZEMAX optimization process. PO Resp. 19. We do not. Rather, we view Dr. Milster's ZEMAX modeling as being directed to showing that the iterative optimization process would have resulted in actual success. *E.g.*, Ex. 1003 ¶¶ 125–127; Ex. 1039 ¶¶ 20–27. Thus, the data for the tests Petitioner relies on has been produced. And we view the earlier iterations as separate tests that each failed.

In sum, we are persuaded that Petitioner shows that one of ordinary skill in art would have been motivated to modify KR872's lens system to have a 2.0 f-number, and would have had a reasonable expectation of success.

10. 0.2<Yc/Yd< 0.9

Claim 15 further recites "wherein . . . a distance perpendicular to the optical axis between a non-axial critical point on the image-side surface of the sixth lens element and the optical axis is Yc, and a distance perpendicular to the optical axis between the maximum effective diameter position and the optical axis is Yd, the following relationship[] [is] satisfied:

0.2< Yc/Yd < 0.9." Ex. 1001, cert. of corr. 2. We agree with Petitioner and find that KR872 teaches this limitation. Pet. 49–51; Pet. Reply 12–15.

We are persuaded by Dr. Milster's testimony that "[t]he aspheric coefficients, conic constant k, and radius of curvature R provided in KR872 Tables 1–2 confirm that lens 6 satisfies 0.2<*Yc/Yd*<0.9." Ex. 1003 ¶ 131; Ex. 1004 ¶¶ 56–61; *see also* Ex. 1039 ¶ 57 (plotting data from Tables 1 and 2, which shows a Yc/Yd of 0.67). This testimony is supported by KR872's teachings. We also are persuaded by his testimony that ZEMAX modeling shows that KR872 as implemented by one of ordinary skill in the art with f-number of 2.0, would have had a sixth lens with a *Yc/Yd* in the claimed range. Ex. 1003 ¶¶ 132–134; Ex. 1039 ¶ 30 (testifying that ZEMAX modeling shows that "optimized KR872 lens system shows a Yc=2.043mm and a Yd=3.00mm, so Yc/Yd=0.681, which is within the claimed range 0.2<Yc/Yd<0.9"), 56 (showing Yc/Yd within the claimed range).

We find unavailing Patent Owner's argument that "[u]sing an image size of 3.00, for example (and taught by KR872 at Fig. 2), the aberrations would be extreme and unacceptable, and out-of-step with the stated purpose of the KR872 lens system of delivering 'excellent aberration characteristics.'" PO Resp. 27 (citing Ex. 1004 ¶¶ 4, 17; Ex. 2036 ¶ 19). This argument relies on Dr. Bentley's testimony, which we find to be conclusory, and she fails to explain specifically what aberrations would result and why they would be extreme and unacceptable. Ex. 2036 ¶ 19.

We also find unavailing Patent Owner's argument that Dr. Milster's ray trace output shows the image-side surface of lens 6 with no critical points. PO Resp. 27 (citing Ex. 2035, 54:9–12). Rather, we agree with Petitioner that this argument is premised incorrectly on a "starting

optimization diagram [that] does not reflect the full shape of the sixth lens disclosed by KR872." Pet. Reply 14; Ex. 1039 ¶¶ 59–60; Ex. 2035, 84:9–86:9 (explaining that he set his initial model to a smaller image height (about 1.4mm) for optimizing). We similarly find Patent Owner's arguments, Dr. Bentley's testimony, and her CODE V ray trace unpersuasive as they are based on the starting smaller image height of about 1.41247, rather than an image height such as 3.0, which is disclosed in KR872. *See* PO Resp. 27–29; Ex. 2036 ¶ 20.

In sum, we find that KR872 teaches this limitation.

11. Summary

In summary, we determine that Petitioner shows by a preponderance of the evidence that claim 15 would have been obvious to one of ordinary skill in the art in view of KR872.

C. Challenged Claim 18

Claim 18 depends from claim 15 and recites:

> The optical image capturing lens assembly of claim 15, further comprising:
>
> a stop located between an object and the first lens element;
>
> wherein the focal length of the optical image capturing lens assembly is f, the entrance pupil diameter of the optical image capturing lens assembly is EPD, an Abbe number of the first lens element is V1, and an Abbe number of the second lens element is V2, the following relationships are satisfied:
>
> $1.7<f/EPD<2.2$; and
> $25<V1-V2<42$.

Ex. 1001, 29:23–34. We agree with Petitioner and find that KR872 teaches the limitations of claim 18. Pet. 51–55; Pet. Reply 15–16.

In particular, we agree with Petitioner and find that KR872 teaches having "a stop located on the object side of the first lens 10." Pet. 51–52; Ex. 1004, Fig. 1. We find persuasive Dr. Milster's testimony that one of ordinary skill in the art "would have understood that this stop was located between the object and the first lens element 10," as it is consistent with KR872. Ex. 1003 ¶¶ 137–138. In addition, as we find above, one of ordinary skill in the art would have known to use a 2.0 f-number with KR872's lens system, and an f-number of 2.0 falls within the 1.7 to 2.2 range. *See supra* Section VI.B.9.

In addition, we agree with Petitioner and find that KR872 teaches that the Abbe numbers V2 and V3 for the second and third lenses, respectively, are between 20 and 30, and that the Abbe numbers V4, V5, and V6 for the fourth, fifth, and sixth lenses, respectively, are between 50 and 60. Ex. 1004 ¶¶ 39–42, 51, 53; Pet. 53.

We also agree with Petitioner and find that KR872 does not explicitly disclose the Abbe number V1 of the first lens. Pet. 53. We find persuasive Dr. Milster's testimony that the Abbe number and refractive index are both lens parameters that correspond to a particular lens's material, and that KR872's Table 1 indicates that the refractive index (N) of the first lens is the same as the refractive index for the fourth, fifth, and sixth lenses. Ex. 1003 ¶ 141; Ex. 1004 ¶ 57 (listing refractive index (N) of 1.53 for lenses 1 and 4–6). We also find persuasive Dr. Milster's testimony that one of ordinary skill in the art would have chosen the same lens material for lenses 1 and 4–6 "so as to minimize the number of different lens materials used in the system." Ex. 1003 ¶ 142.

In addition, we find persuasive Dr. Milster's testimony that "the Abbe number of a lens is a measure of the dispersion of the lens material, where dispersion is the change of refractive index as a function of wavelength, [and thus, one of ordinary skill in the art] would have understood that the Abbe number V1 for the first lens should be consistent with the Abbe numbers V4, V5, and V6 of the fourth through sixth lenses because KR872 teaches a same refractive index N = 1.53 for the first, fourth, fifth, and sixth lenses." *Id.* ¶ 143.

In addition, we find that Bäumer teaches well-known plastics with (i) a refractive index of approximately nd=1.61 and an Abbe number of approximately 27.0, and (ii) a refractive index of approximately nd=1.53 with an Abbe number of approximately 57.0. Ex. 1015, 127; Ex. 1003 ¶ 145. We find persuasive Dr. Milster's testimony that one of ordinary skill in the art would have been motivated to implement with KR872's lens system, with a reasonable expectation of success, using such well-known plastics. Ex. 1003 ¶ 145. Thus, we find that claim 18's V1-V2 ratio would have been met (i.e., 57.0-27.0=30).

We find unavailing Patent Owner's argument that one of ordinary skill in the art "would have known that different lens materials can have the same refractive index and different Abbe numbers," and "that for many different indices of refraction, multiple optical materials exist with different Abbe numbers." PO Resp. 35–36 (citing Ex. 1012, 15; Ex. 2001 ¶ 84); *see also id.* at 37–38 (arguing that no reason is taught for which materials having a same N to choose, and some of these materials have Abbe numbers that cause the claimed range not to be met).

As we find above, one of ordinary skill in the art would have been motivated to choose the same lens material for lenses 1 and 4–6 "so as to minimize the number of different lens materials used in the system." Ex. 1003 ¶ 142. And as we also find above, Bäumer teaches well-known plastics for which one of ordinary skill in the art would have found it obvious to employ with KR872's lens system. Ex. 1015, 127; Ex. 1003 ¶ 145. We find that the well-known plastics Petitioner cites were suitable options for one of ordinary skill in the art to choose for the lenses, which is a sufficient showing. *See Intel*, 21 F.4th at 800 ("It's not necessary to show that a combination is 'the *best* option, only that it be a *suitable* option.'").

In sum, we find that KR872 teaches the limitations of claim 18.

VII. REMAINING GROUNDS

Petitioner argues that claims 15 and 18 are rendered obvious by (i) the combination of KR872 and Baba, (ii) KR357, and (iii) the combination of KR357 and Baba. Pet. 56–87. Thus, these grounds of unpatentability challenge claims which we already determine are unpatentable. *See supra* Sections VI.B–C (determining Petitioner shows claims 15 and 18 are unpatentable). Under the circumstances of this case, analyzing additional grounds challenging the same claims, which we have determined to be unpatentable, would not be an efficient use of the Board's time and resources. *See Bos. Sci. Scimed, Inc. v. Cook Grp. Inc.*, 809 F. App'x 984, 990 (Fed. Cir. 2020) ("We agree that the Board need not address issues that are not necessary to the resolution of the proceeding.").

Accordingly, we do not reach these remaining grounds. *Cf. In re Gleave*, 560 F.3d at 1338 (not reaching other grounds of unpatentability after affirming the anticipation ground); *see also Beloit Corp. v. Valmet Oy*, 742

F.2d 1421, 1423 (Fed. Cir. 1984) (determining once a dispositive issue is decided, there is no need to decide other issues).

VIII. CONTINGENT MOTION TO AMEND

Patent Owner filed a Contingent Motion to Amend, presenting substitute claims 26 and 27. MTA 1–2. Patent Owner states that "[i]f the Board determines any challenged claim of the '499 patent to be unpatentable, Patent Owner respectfully requests the Board look to the present motion to see whether the corresponding substitute claim is patentable." *Id.* at 1. Because we conclude that Petitioner has shown by a preponderance of the evidence that the challenged claims are unpatentable, we consider Patent Owner's Motion to Amend with respect to the substitute claims.

"Before considering the patentability of any substitute claims, . . . the Board first must determine whether the motion to amend meets the statutory and regulatory requirements set forth in 35 U.S.C. § 316(d) and 37 C.F.R. § 42.121." *See Lectrosonics, Inc. v. Zaxcom, Inc.*, IPR2018-01129, Paper 15 at 4 (PTAB Feb. 25, 2019) (precedential). Patent Owner bears the burden of persuasion to show by a preponderance of the evidence that the Motion to Amend complies with these requirements. 37 C.F.R. § 42.121(d)(1). Specifically, Patent Owner must demonstrate the following: (1) the amendment proposes a reasonable number of substitute claims, (2) the amendment responds to a ground of unpatentability involved in the trial, and (3) the amendment does not seek to enlarge the scope of the claims of the patent or introduce new subject matter. *See* 35 U.S.C. § 316(d); 37 C.F.R. § 42.121.

As also provided under our Rules, Petitioner bears the burden of persuasion to show, by a preponderance of the evidence, that any proposed substitute claim is unpatentable. 37 C.F.R. § 42.121(d)(2).

Patent Owner, as we find below, has met its burden of persuasion to show that the amendments comply with the requirements set forth in 35 U.S.C. § 316(d) and 37 C.F.R. § 42.121. As we also find below, however, Petitioner demonstrates by a preponderance of the evidence that each of the proposed substitute claims is unpatentable over the prior art under 35 U.S.C. § 103.

A. Proposed Substitute Claims

Patent Owner proposes to amend the '499 patent by adding new claims 26 and 27 as respective substitutes for original claims 15 and 18. *See* MTA 2, App. 1–3. Of the proposed substitute claims, claim 26 is an independent claim. Claim 26, which is proposed as a substitute for original independent claim 15, is reproduced below[31] and is illustrative.

> 26. (Substitute for original claim 15) An optical image capturing lens assembly comprising, in order from an object side to an image side
>
> a first lens element with positive refractive power having a convex object-side surface;
>
> a second lens element with negative refractive power;
>
> a third lens element with refractive power;
>
> a fourth lens element with refractive power;
>
> a fifth lens element with positive refractive power made of plastic material, wherein an object-side surface and an image-side surface of the fifth lens element are <u>convex and</u> aspheric; and

[31] Underlined language in the proposed substitute claim reflects subject matter added to corresponding original claim, and double brackets indicate deletions.

> a sixth lens element with negative refractive power made of plastic material and having a concave image-side surface, wherein an object-side surface and the image-side surface of the sixth lens element are aspheric, and the sixth lens element has at least one inflection point formed on at least one of the object-side surface and the image-side surface thereof;
>
> wherein the first through sixth lens elements are six independent and non-cemented lens elements, a focal length of the optical image capturing lens assembly is f, an1 entrance pupil diameter of the optical image capturing lens assembly is EPD, a distance perpendicular to the optical axis between a non-axial critical point on the image-side surface of the sixth lens element and the optical axis is Yc, [[and]]a distance perpendicular to the optical axis between the maximum effective diameter position and the optical axis is Yd, a maximum image height of the optical image capturing lens assembly is ImgH, and an axial distance between the object-side surface of the first lens element and an image plane is TTL, the following relationships are satisfied:
> $1.5<f/EPD<2.5$[[: and]];
> $0.2<Yc/Yd<0.9$[[.]]; and
> $TTL/ImgH<1.8$.

Id.

B. Requirements for Amendment

Patent Owner argues that it meets all of the statutory and regulatory requirements set forth in 35 U.S.C. § 316(d) and 37 C.F.R. § 42.121. Petitioner argues that the amendment introduces new subject matter. For the reasons below, we determine that Patent Owner has satisfied all of the statutory and regulatory requirements.

1. Reasonable Number of Substitute Claims

A motion to amend must "propose a reasonable number of substitute claims." 35 U.S.C. § 316(d)(1)(B); *see also* 37 C.F.R. § 42.121(a)(3) ("A motion to amend may cancel a challenged claim or propose a reasonable number of substitute claims."). "There is a rebuttable presumption that a

reasonable number of substitute claims per challenged claim is one (1) substitute claim." *Lectrosonics*, IPR2018-01129, Paper 15 at 4; *see also* 37 C.F.R. § 42.121(a)(3). Here, Patent Owner proposes no more than one substitute claim for each challenged claim. MTA 2, 6, 7, App. 1–5. Petitioner does not argue that the number of substitute claims is unreasonable. *See generally* Opp. MTA. We determine that this requirement is met.

2. Responsive to Ground of Unpatentability

"A motion to amend may be denied where. . . [t]he amendment does not respond to a ground of unpatentability involved in the trial." 37 C.F.R. § 42.121(a)(2)(i). The Petition asserts that claims 15 and 18 are unpatentable over the cited prior art. Pet. 3, 24–87. Patent Owner responds, through the Motion to Amend, to the grounds of unpatentability involved in the trial by proposing substitute claims 26 and 27 for challenged claims 15 and 18 that each recite new elements. *See* MTA 6–23, App. 1–5. Petitioner does not contend that the proposed amendments fail to respond to a ground of unpatentability in this trial. *See generally* Opp. MTA. We determine that this requirement is met.

3. May Not Enlarge the Claim Scope

An amendment may not seek to enlarge the scope of the claims of the patent. 35 U.S.C. § 316(d)(3); 37 C.F.R. §§ 42.121(b)(1)–(2). Patent Owner asserts that substitute claims 26 and 27 do not seek to enlarge the scope of challenged claims 15 and 18. MTA 2–3. We agree and find that each proposed substitute claim includes amendments that narrow the claim scope. *See id.* at 1–5. Petitioner does not contend that any proposed

substitute claim enlarges the scope of any challenged patent claim. *See generally* Opp. MTA. We determine that this requirement is met.

4. No New Matter

An amendment may not introduce new matter. 35 U.S.C. § 316(d)(3); 37 C.F.R. §§ 42.121(b)(1)–(2). New subject matter is any addition to the claims that lacks sufficient support in the subject patent's original disclosure. *See TurboCare Div. of Demag Delaval Turbomach. v. Gen. Elec. Co.*, 264 F.3d 1111, 1118 (Fed. Cir. 2001) ("When [an] applicant adds a claim . . . , the new claim[] . . . must find support in the original specification."). Patent Owner also is required to show written description support in "the original disclosure of the patent for each claim that is . . . amended," and in "an earlier-filed disclosure for each claim for which benefit of the filing date of the earlier filed disclosure is sought." 37 C.F.R. §§ 42.121(b)(1)–(2).

For the reasons below, we agree with Patent Owner and find written description support for the proposed amendments. More specifically, we find that Patent Owner shows that the entirety of substitute claims 26 and 27 has support in the '499 patent's original application, as well as the foreign application from which the '499 patent derives priority. *See* MTA 3–6 (citing Ex. 1002 ('499 patent file history), 22–61; Ex. 2029[32] (Taiwanese priority document)) (providing specific cites to the original application and the English translation of the priority document).

We find unavailing Petitioner's arguments that the newly added limitations of the substitute claims 26 and 27 lack support because Patent Owner "cites to disparate disclosures from different parts of the application,"

[32] TW 201312154 A1, published Mar. 16, 2013 (Ex. 2029) (original and English translation).

and "[n]one of these disclosures alone describes all elements of the proposed claims." Opp. MTA 1. For example, we find unavailing Petitioner's argument that "the summary of the invention passage . . . does not describe the newly added 'convex' fifth lens or the newly added ratio, TTL/ImgH<1.8." *Id.* at 1–2 (citing Ex. 1002, 24). Rather, we find that the application discloses "[t]he fifth lens element with positive refractive power is made of plastic, and has a convex object-side surface." Ex. 1002, 29:12–14. And for the TTL/ImgH<1.8 ratio, the application discloses "[w]hen an axial distance between the object-side surface of the first lens element and the image plane is TTL, and a maximum image height of the optical image capturing lens assembly is ImgH, the following relationship is satisfied: TTL/ImgH < 1.8." *Id.* at 31:21–24. In addition, the application discloses "[t]he sixth lens element . . . has a concave object-side surface" for the newly added limitation of claim 27. *Id.* at 29:16–17.

Moreover, we do not agree with Petitioner that with respect to these passages, the application provides disparate disclosures and Patent Owner is "picking and choosing claim elements from different embodiments that are never linked together in the specification." MTA Opp. 1–2. The passages are not specific to a particular embodiment but rather would lead a skilled artisan to understand that the newly added convex limitation and the TTL/ImgH ratio relationship of claim 26, and the newly added concave limitation of claim 27 may apply to all relevant embodiments. Petitioner does not explain why from these disclosures, a skilled artisan would not have found it obvious "to combine [them] in order to make the claimed invention." *See id.* at 2.

In sum, we determine that this requirement is met.

5. Conclusion Regarding the Requirements for Amendment

We determine that Patent Owner has met its burden of persuasion to show that the amendments comply with the requirements set forth in 35 U.S.C. § 316(d) and 37 C.F.R. § 42.121. The burden of persuasion now lies with Petitioner to show, by a preponderance of the evidence, that any proposed substitute claim is unpatentable. 37 C.F.R. § 42.121(d)(2).

C. Grounds of Unpatentability

Petitioner contends that the substitute claims are unpatentable based on the following grounds:

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
15, 18	103(a)	KR872
15, 18	103(a)	KR357

Opp. MTA 3–20.

D. Alleged Obviousness over KR872

Petitioner argues that substitute claims 26 and 27 would have been obvious over KR872. The parties both focus their arguments on the amended aspects of the proposed substitute claims, namely the limitations Patent Owner added in an attempt to overcome KR872's teachings that are asserted in the Petition against the original claims. *See* MTA 6–15; Opp. MTA 3–18; PO Reply MTA 1–10; Pet. Sur-reply MTA 1–12; *see also supra* Sections VI.B–C (finding original claims unpatentable). We likewise focus our discussion here on the amended aspects. For the reasons we discuss below, we determine that Petitioner shows by a preponderance of the evidence that proposed substitute claims 26 and 27 are unpatentable. We thus deny Patent Owner's Contingent Motion to Amend.

1. Substitute Claim 26

a. Surfaces of Fifth Lens Element

Substitute claim 26 recites "wherein an object-side surface and an image-side surface of the fifth lens element are convex and aspheric." MTA, App. 2. Above we find that KR872 teaches that an object-side surface and an image-side surface of the fifth lens element are aspheric. *See supra* Section VI.B.6. Patent Owner's proposed amendment to this limitation adds that the surfaces are also convex. MTA, App. 2. Hence, we now turn to Petitioner's showing that these surfaces are also convex.

We agree with Petitioner and find that KR872 teaches a convex image-side surface of the fifth lens element. Opp. MTA 4; Ex. 1004, Fig. 1, ¶ 57 (showing a negative curvature radius for the image-side surface (surface #10) of the fifth lens). We also agree with Petitioner that its showing for KR872's lens system optimized with an f-number of 2.0 maintains this lens shape. Opp. MTA 4–5; Ex. 2030 ¶ 10.

As to the object-side surface of the fifth lens element, KR872 teaches that it is concave. Ex. 1004 ¶ 57 (showing a negative curvature radius for the object-side surface (surface #9) of the fifth lens); Ex. 2030 ¶ 10. We agree with Petitioner, however, and find persuasive Dr. Milster's testimony that one of ordinary skill in the art would have found it obvious to implement KR872's optimized lens system with a convex object-side surface for the fifth lens element. Ex. 1039 ¶ 106.

In particular, we agree with Petitioner and find that one of ordinary skill in the art would have known of six lens systems with low f-numbers where the fifth element is "ordinarily . . . biconvex." Opp. MTA 5

(alteration in original); Ex. 1044,[33] 329; *see also id.* at 319 (teaching that a double-Gauss type design "is the basis of most normal-focal-length, 35-mm camera lenses," including for "a lens of extremely high speed"), 324 (illustrating a six-element lens featuring an f-number of 2.0 and a biconvex fifth lens from a U.S. patent filed in 1951); Ex. 1040,[34] 125 (depicting various six-element lens designs, each with an f-number of 2.0 or less and a biconvex fifth lens). Hence, we find persuasive Dr. Milster's testimony that in light of this knowledge, implementing the optimized KR872 lens system with a biconvex fifth lens would have been an obvious design choice with a reasonable expectation of success for one of ordinary skill in the art. Ex. 1039 ¶ 107.

In addition, we find persuasive Dr. Milster's testimony that one of ordinary skill in the art would have found it obvious to replace the concave object-side surface of the fifth lens element taught by KR872 with a convex object-side surface because this would have been "the simple substitution of one known element for another." *Id.* ¶ 108; *KSR*, 550 U.S. at 417. In addition, one of ordinary skill would have had a reasonable expectation of success given the knowledge of similar systems that use a fifth lens that was biconvex. *Id.* ¶ 108; Ex. 1044, 324, 329; Ex. 1040, 125.

In addition, we find persuasive Dr. Milster's testimony that it would have been obvious to one of ordinary skill in the art to substitute the concave object-side surface disclosed by KR872 with a convex object-side surface to obtain the predictable results of changing spherical aberrations and/or coma. Ex. 1039 ¶ 108; *see also* Ex. 1010, 47 (listing thirty-four "standard

[33] Warren J. Smith, *Modern Lens Design* (2d ed. 2005) (excerpts) ("Smith").
[34] Rudolf Kingslake, *A History of the Photographic Lens* (1989).

improvement techniques" for "improving a design," where the first listed technique is: "Bend an element. Change its shape but maintain its power."); Ex. 1037, 54 ("[F]or a fixed focal length, a lens may take on any number of different shapes or 'lens bendings,' and the aberrations of the lens (primarily spherical aberration and coma) will change as the shape is changed.").

In addition, we find persuasive Dr. Milster's testimony that "the curvature radius[35] for the object-side surface of the fifth lens is not a particularly critical parameter because the fifth and sixth lenses function as field correctors." Ex. 1039 ¶ 110 (citing Ex. 1037, 34, 41, 61; Ex. 1045,[36] 80). And one of ordinary skill in the art "would have known that a pair of field-correcting lenses, such as the fifth and sixth lenses of KR872, "in combination, are approximately of zero power." *Id.*; Ex. 1044, 473. Thus, one of ordinary skill in the art "would not have been concerned about whether the object-side surface of the fifth lens is convex or concave at the optical axis, but instead would focus on the aspheric surface overall," and thus, making whether the object-side surface was convex a design choice. Ex. 1039 ¶ 110.

We find unavailing Patent Owner's argument that "KR872 teaches against [] using a shape other than concave for the object-side surface of the fifth lens" because "KR872 explicitly claims 'the object-side surface of the fifth lens is formed to be concave' . . . and explains that that shape is part of

[35] The curvature radius indicates how curved a lens surface is, and the sign (+/-) of the radius indicates whether that surface is concave or convex. Ex. 1003 ¶ 53. For an object-side lens surface, a positive radius denotes a convex surface and a negative radius denotes a concave surface. *Id.*
[36] Robert E. Fischer et al., *Optical System Design* (2d ed. 2008) (additional excerpts).

the '[m]eans to solve the problem' of flare, sensitivity, and aberration." PO Reply MTA 2 (citing Ex. 1004, claim 3, ¶¶ 4–5, 8). Patent Owner argues that thus one of ordinary skill in the art "would not have modified the object-side surface of KR872's fifth lens to be convex as this would be contrary to KR872's stated objectives." *Id.*

Teaching away requires a reference to actually criticize, discredit, or otherwise discourage the claimed solution. *See In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004). The cited portions of KR872, however, do not criticize having the object-side surface of the fifth lens be convex. *See* Ex. 1004, claim 3, ¶¶ 4–5, 8. Rather, KR872 simply teaches an embodiment where the object-side surface of the fifth lens is concave, which is insufficient to show teaching away. *Id.* ¶ 8; *Galderma Labs., L.P. v. Tolmar, Inc.*, 737 F.3d 731, 738 (Fed. Cir. 2013) ("A reference does not teach away . . . if it merely expresses a general preference for an alternative invention but does not criticize, discredit, or otherwise discourage investigation into the invention claimed.") (citation omitted). In fact, KR872 teaches that "the spherical and aspherical shapes [of the lenses] have been presented as an example only and are not limited thereto," and that "a person with ordinary skill in the art will be able to understand that the present invention can be implemented with various modifications and changes." Ex. 1004 ¶¶ 24, 65; *see also id.* at claim 3 (reciting as a dependent claim the shape of the fifth lens, and its independent claim does not limit shape). Allowing for such modifications is contrary to teaching away. In addition, we agree with Petitioner and find that "KR872 only expressly discloses the shape of the object-side surface of the third lens in particular, not the fifth lens, as

relating to the reduction in flare phenomenon and decreasing the sensitivity of the lens." Pet. Sur-reply MTA 7–8 (citing Ex. 1004 ¶ 29).

We also find unavailing Patent Owner's arguments concerning KR872 not being a double-Gauss design. PO Reply MTA 2–6, 10. While we agree that Petitioner does not show that KR872's lens system is a double-Gauss design, we disagree that the "'ordinarily . . . biconvex' nature of the fifth lens element of six-element double-Gauss lens systems would *not* have provided any basis for [one of ordinary skill in the art] to have 'a reasonable expectation of success' in implementing the optimized KR872 with a biconvex fifth lens element." Opp. MTA 1–2; PO Reply MTA 6 (citing Ex. 2040 ¶ 6). Rather, we find that these designs show that six-element lens forms with low f-numbers were long known. We also agree with Petitioner and find that one of ordinary skill in the art would have known that a biconvex fifth lens was a common and ordinary feature across the "many variations" of the double-Gauss lens form. Opp. MTA 2; Ex. 1040, 124; Ex. 1039 ¶¶ 107, 109. In fact, "[m]odern designs build on . . . basic forms, often incorporating aspheres to reduce package size, improve performance, and/or increase the aperture or field size." Ex. 1037, 27. Hence, one of ordinary skill in the art implementing KR872 with a low f-number would have looked to existing and well-known basic lens forms to achieve improvements to KR872. *See EWP Corp. v. Reliance Universal Inc.*, 755 F.2d 898, 907 (Fed. Cir. 1985) ("A reference must be considered for everything it *teaches* by way of technology and is not limited to the particular *invention* it is describing and attempting to protect."); *see also Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1374 (Fed. Cir. 2019) ("A motivation to combine may be found 'explicitly or implicitly in market

forces; design incentives; . . . and the background knowledge, creativity, and common sense of the person of ordinary skill.'") (quoting *ZUP, LLC v. Nash Mfg., Inc.*, 896 F.3d 1365, 1371 (Fed. Cir. 2018)).

We also find unavailing Patent Owner's argument that bending an element and changing its shape while maintaining its power is not a simple substitution because KR872 has aspherical lens surfaces. PO Reply MTA 6–7. More specifically, Patent Owner argues that the teachings "Petitioner cites relate to changing the radii of, or bending, *spherical* surfaces, not *aspherical* surfaces." *Id.* at 7 (citing Ex. 1010, 48). Patent Owner argues that one of ordinary skill in the art "would have known that changing the radius of a lens surface, e.g., the object-side of the fifth lens in KR872, while maintaining the optical power of that element is much different for spherical surfaces than it is for aspherical surfaces." *Id.*; Ex. 2040 ¶ 8.

Patent Owner changes for the optimized KR872 lens system the object-side surface of the fifth lens to convex and also "the radius of the image-side surface is changed to maintain the power of the element *without changing any other parameters (e.g., aspheric coefficients, conic constant of lens 5)*." PO Reply MTA 7–8 (citing Ex. 2040 ¶ 8; Ex. 1039 ¶ 28) (emphasis added). Patent Owner then argues, using CODE V output, "that changing the object-side surface of the fifth lens from concave to convex is not the 'simple substitution' that Petitioner argues it to be," and many more changes are needed. *Id.*

We agree with Petitioner that Patent Owner makes "a number of incorrect assertions" in "argu[ing] that it would not have been a simple substitution of the concave object-side surface disclosed by KR872." Pet.

Sur-reply MTA 4. For example, we agree with Petitioner that Smith does not teach that only the radii of spherical surfaces can be changed, but instead also teaches aspherizing surfaces to address different types of aberrations. *Id.*; Ex. 1010, 48. Similarly, the Bentley Guide explains that "aspheres are effective at correcting spherical aberration when increasing the aperture." Ex. 1037, 28. Thus, we agree with Petitioner that one of ordinary skill in the art "would have understood that the overall shape of an aspherical lens surface, which is defined by both the curvature radius and aspheric coefficients, would be relevant to correcting spherical aberrations." Pet. Sur-reply MTA 5; Ex. 1010, 4–5.

Accordingly, we find that one of ordinary skill in the art would have also changed other parameters (e.g., aspheric coefficients) of lens 5, which Patent Owner states it did not do. PO Reply MTA 7–8. Patent Owner limits too much what changes one of ordinary skill in the art would have considered in making a simple substitution. But, "a person of ordinary skill is also a person of ordinary creativity, not an automaton," and "in many cases a person of ordinary skill will be able to fit [multiple] teachings . . . together like pieces of a puzzle." *KSR*, 550 U.S. at 420–21.

We also agree with Petitioner that one of ordinary skill in the art "would implement such substitutions according to their skill and knowledge, and within the larger context of optimizing a lens design to achieve desirable imaging performance." Pet. Sur-reply MTA 7; Ex. 1039 ¶¶ 121–122. Similarly, we find unavailing Patent Owner's argument that "a change to the curvature (i.e., radius) of one surface must be offset by a corresponding change to the opposite surface" for the same reasons. PO Reply MTA 8–9 (citing Ex. 1037, 54); Ex. 1039 ¶¶ 121–122; Ex. 1037, 54 ("[T]here are an

infinite number of combinations of radii R1 and R2 that will yield a lens with a given focal length.").

We also find unavailing Patent Owner's arguments that Petitioner relies on impermissible hindsight. PO Reply MTA 10–12. Patent Owner argues that "[i]nstead of starting with KR872 . . . , Petitioner starts with the *optimized* version[] described in the Petition." PO Reply MTA 11 (citing Opp. MTA, 4, 19; Ex. 1039 ¶¶ 106, 117). Similarly, Patent Owner argues that for the ZEMAX modeling, Petitioner uses the KR872 optimization having the 3.00mm image height. *Id.* (citing Ex. 1039 ¶ 122). Patent Owner argues that "[t]hese starting points are not prior art accessible to [persons of ordinary skill in the art] in 2011," and thus, by "relying on them instead of real prior art, Petitioner betrays the influence of hindsight on its arguments." *Id.*

We disagree. KR872 was accessible to one of ordinary skill in the art in 2011, and as we find above, one of ordinary skill in the art would have been motivated to optimize KR872's lens system for a 2.0 f-number, with a reasonable expectation of success. *See supra* Sections VI.B–C. In other words, one of ordinary skill in the art would have found modifying KR872's lens system for a 2.0 f-number to be obvious. As we also find above, one of ordinary skill in the art would have found it obvious to implement KR872's optimized 2.0 f-number lens system with a convex object-side surface for the fifth lens element. Multiple obvious modifications of KR872's lens system does not equate to impermissible hindsight. Rather, such occurrences are common. *See* Ex. 1039 ¶ 129 ("[P]erforming . . . optimizations serially . . . is quite reasonable and would have been done by a POSITA, as clients will sometimes provide additional design requests based

on their desired specifications."). Furthermore, KR872 recognized in 2011 that one of ordinary skill in the art would make obvious modifications to its embodiments. *See* Ex. 1004 ¶ 65 ("The present invention has been described above with reference to embodiments, but a person with ordinary skill in the art will be able to understand that the present invention can be implemented with various modifications and changes within the scope of not departing from the idea and scope of the present invention," and "[t]herefore, it is not limited to the embodiments described above . . . .").

In sum, we find that one of ordinary skill in the art would have found it obvious to implement KR872's optimized lens system with a convex object-side surface for the fifth lens element.

b. TTL/ImgH<1.8

Substitute claim 26 further adds wherein "a maximum image height of the optical image capturing lens assembly is ImgH, and an axial distance between the object-side surface of the first lens element and an image plane is TTL, the following relationship[] is satisfied: *TTL/ImgH*<1.8." MTA, App. 3. We agree with Petitioner and find that KR872 teaches this added limitation. Opp. MTA 10–14; Pet. Sur-reply MTA 8–12.

In particular, we agree with Petitioner and find that KR872 teaches a maximum image height ImgH and an axial distance TTL. Ex. 1004 ¶ 57 (disclosing thickness values that sum to give TTL=6.57mm), Fig. 2 (disclosing an image height ImgH=3.00mm). We also agree with Petitioner that one of ordinary skill in the art would have been motivated to apply known techniques for reducing the TTL of the optimized KR872 to create a smaller design, thus optimizing for both f-number and size; KR872 would have a TTL/ImgH ratio less than 1.8. Ex. 1039 ¶ 112.

In addition, we agree with Petitioner that one of ordinary skill in the art "would have been motivated to shorten the TTL because '[t]hinner devices (e.g., smartphones) require smaller lens systems.'" Opp. MTA 11; Ex. 1011, 3, 8; Ex. 1006, 1:27–29; *see also* Ex. 1011, 11 (explaining in 2006 that "[r]ecent lenses for ¼'' formats are being held to TTLs<5.0mm and there are plans for new lenses for the same format to be even shorter"). We also find persuasive Dr. Milster's testimony that by the 2011, one of ordinary skill in the art would have been motivated to achieve shorter TTLs. Ex. 1039 ¶ 113.

In addition, we find that a known approach to reducing the TTL would have included scaling the optimized KR872 system (with an f-number of 2.0) down to reduce the TTL. Ex. 1039 ¶ 115. We are persuaded that lens scaling was a regularly used technique for reducing track length, and that one of ordinary skill in the art would have been motivated to use it with a reasonable expectation of success to reduce TTL. *Id.*; Ex. 1044, 96 ("A lens prescription can be scaled to any desired focal length simply by multiplying all of its dimensions by the same constant.").

In addition, we find that another known approach to reducing the TTL of a lens system includes optimizing all on-axis lens thicknesses, air spaces, and curvature radii to reduce the TTL. Ex. 1039 ¶ 116; Ex. 2032, 14 (noting that "[s]pecific construction parameters, such as radii, thicknesses, and spaces … can be controlled"); Ex. 1010, 50 (noting that "object to image distance, or TTL" can be constrained during optimization). We are persuaded that reducing the distances between lens elements and the center thicknesses of elements would reduce the total track length. Ex. 1039 ¶ 116.

Accordingly, we are persuaded that one of ordinary skill in the art would have been motivated, with a reasonable expectation of success, to scale the KR872 lens system towards a TTL of 5.0mm, with an image height ImgH of 3.00mm as suggested by KR872, and scaling the TTL of 6.57mm down to 5.00mm would result in TTL/ImgH = 5.00/3.00 = 1.67, which is within the claimed range. Ex. 1039 ¶ 117.

We find unavailing Patent Owner's hindsight arguments. PO Reply MTA 11–12. In particular, we find unavailing Patent Owner's argument that because the motivation to shorten TTL existed pre-2011, one of ordinary skill in the art optimizing KR872 for a 2.0 f-number would have reduced the TTL in the original optimization, yet "Petitioner made no attempt to reduce the TTL of KR872 until *after* seeing claim 26, and specifically the restriction" on TTL. *Id.* (citing Ex. 1039 ¶¶ 112–118). Thus, "Petitioner use[s] impermissible hindsight to optimize KR872 to the point that it satisfies" the TTL limitation for claim 26, according to Patent Owner.

Instead, as we discuss above, we find that serially making obvious modifications of KR872's lens system does not equate to impermissible hindsight. *See* Ex. 1039 ¶ 129; Ex. 1004 ¶ 65; *see supra* Section VIII.D.1.a. Nor do we find that a petitioner initially should be required to show every possible obvious modification of a prior art embodiment, rather than just mapping the prior art to the challenged claims.

We also find unavailing Patent Owner's argument that the "scaling" approach Petitioner identifies is the flawed product of hindsight. PO Reply MTA 12. More specifically, Patent Owner argues that "Dr. Milster acknowledged . . . , scaling involves multiplying *all system dimensions* by *the same constant*," but "[d]espite this, he reduced TTL but held ImgH to

achieve the claimed TTL/ImgH value of < 1.8." *Id.* (citing Ex. 1039 ¶¶ 115 (citing Ex. 1044, 96), 117). Patent Owner argues that "[p]roper scaling would have involved reducing ImgH as well, which would have caused the TTL/ImgH ratio to fall outside the claimed range of < 1.8." *Id.* (citing Ex. 2040 ¶ 13). We do not view Dr. Milster's testimony as including image height as a physical system dimension that would be scaled by a same constant. Ex. 1039 ¶ 115. And we find that Dr. Bentley's testimony on this issue is conclusory, and does not explain why image height would be scaled by the same constant. Ex. 2040 ¶ 13. Hence, we afford this testimony little weight.

In sum, we find that one of ordinary skill in the art would have found this limitation of claim 26 obvious in view of KR872.

2. Substitute Claim 27

Patent Owner's substitute claim 27 adds "wherein the object-side surface of the sixth lens element is concave." MTA, App. 3. We agree with Petitioner and find that KR872 teaches this limitation. Opp. MTA 14–15.

In particular, we agree with Petitioner and find that one of ordinary skill in the art "would have found that whether the object-side surface of the sixth lens element is concave or convex is arbitrary for the same reasons provided above regarding" claim 26. Opp. MTA 14; *see supra* Section VIII.D.1.a.

We also agree with Petitioner and find that one of ordinary skill in the art would have recognized the interchangeability of the sign for the curvature radius of the object-side surface of the sixth lens and would have found it obvious to try changing the sign of the curvature radius of the object-side surface of the sixth lens. Opp. MTA 15; Ex. 1039 ¶ 120.

Accordingly, we are persuaded that KR872 teaches "wherein the object-side surface of the sixth lens element is concave."

E. Alleged Obviousness Over KR357

Petitioner argues that substitute claims 26 and 27 are rendered obvious by KR357. Opp. MTA 18–20. Thus, this ground of unpatentability challenges claims which we already determine are unpatentable. *See supra* Section VIII.D (determining Petitioner shows substitute claims 26 and 27 are unpatentable). Under the circumstances of this case, analyzing an additional ground challenging the same claims, which we have determined to be unpatentable, would not be an efficient use of the Board's time and resources. *See Bos. Sci. Scimed, Inc.*, 809 F. App'x at 990.

Accordingly, we do not reach this ground. *Cf. In re Gleave*, 560 F.3d at 1338; *see also Beloit Corp.*, 742 F.2d at 1423.

IX. PATENT OWNER'S MOTION TO STRIKE

Patent Owner filed a Motion to Strike (i) portions of Dr. Milster's Reply Declaration and the related portions of the Reply and (ii) arguments which Patent Owner contends are improperly incorporated by reference. *See generally* Mot. Strike.

Patent Owner argues that we should strike "¶¶ 20–34 of the Reply Decl. and related reliance in the Reply at § II.B.6.b and § II.B.6.c." Mot. Strike 1. Patent Owner argues that "[t]his material improperly presents 'new evidence or argument in reply that it could have presented earlier, e.g. to make out a prima facie case of unpatentability.'" *Id.* (quoting Consolidated Trial Practice Guide (November 2019)[37] ("CTPG"), 73). We disagree. Rather, these portions of Dr. Milster's Reply Declaration and the Reply

[37] *Available at* https://www.uspto.gov/TrialPracticeGuideConsolidated.

respond to arguments about errors, alterations, and image height that Patent Owner made in its Response. *See id.* at 1; Opp. Mot. Strike 1–2. We find that thus these arguments are responsive to arguments made by Patent Owner in its Response, rather than being a new direction with a new approach, and thus, are allowed by our Rules. *See* PO Resp. 21–23, 43; Ex. 1039 ¶ 21 (explaining that modeling responds to Patent Owner's arguments); 37 C.F.R. § 42.23(b) ("A reply may only respond to arguments raised in the corresponding . . . patent owner response . . . ."); CTPG, 74.

In addition, Patent Owner argues that we should "strike ¶¶ 35–40 of the Reply Decl. and related reliance in the Reply at § II.B.6.a and § II.B.6.b," because "[t]his material improperly presents 'new evidence or argument.'" Mot. Strike 2 (citing CTPG, 73). We disagree. Rather, these portions of Dr. Milster's Reply Declaration and the Reply respond to Patent Owner's arguments made in its Response about multiple iterations during the ZEMAX optimization. *See id.* at 2; Opp. Mot. Strike 2–3. We find that thus these arguments are responsive to arguments made by Patent Owner in its Response, rather than being a new direction with a new approach, and thus, are allowed by our Rules. *See* PO Resp. 19–21; 37 C.F.R. § 42.23(b); CTPG, 74.

In addition, Patent Owner argues that we should "strike ¶¶ 55–60 of the Reply Decl. and § II.C of the Reply (excluding § II.C.1)," because "[t]hese portions . . . present new evidence and argument based on the new Zemax optimization of ¶¶ 20–34 that targets a different image height than in the Petition." Mot. Strike 2–3. We disagree. Rather, these portions of Dr. Milster's Reply Declaration and the Reply respond to Patent Owner's arguments made in its Response about image height and lens shape. *See id.*

at 3; Opp. Mot. Strike 2. We find that thus these arguments are responsive to arguments made by Patent Owner in its Response, rather than being a new direction with a new approach, and thus, are allowed by our Rules. *See* PO Resp. 26–27; 37 C.F.R. § 42.23(b); CTPG, 74.

In addition, Patent Owner argues that we should "strike ¶¶ 66–96 of the Reply Decl. and related reliance in the Reply at § II.B.4 and § VI" concerning arguments relating to Sano[38] as evidence of "simultaneous invention." Mot. Strike 3–4. Because we find Petitioner's other arguments sufficient to show a motivation to combine, with a reasonable expectation of success, we did not reach Petitioner's arguments concerning Sano. *See supra* Section XI.B.9. Thus, we dismiss this portion of Patent Owner's Motion to Strike as moot.

Lastly, Patent Owner argues that "[t]he Reply and [the Opposition to the Motion to Amend] both rely heavily on incorporation by reference." Mot. Strike 5. Patent Owner identifies the following as improper incorporations: "Reply, 5 n. 1 (¶¶ 7, 9–12), 7 (¶¶ 9–12), 8 (¶¶ 15–16, 97–103), 9 (¶¶ 17–19), 10 (¶¶ 35–44), 11 (¶¶ 20–34, 38–40, 45–46, 47–54), 12 (¶¶ 20–34, 55), 13 (¶¶ 57–58), 14 (¶¶ 55–56, 56, 59–60, 61–62), 25 (¶¶ 66–96); MTA Opp'n, 16 (¶¶ 121–129), 22 (¶¶ 67–90), 23 (¶¶ 91–96)." Patent Owner argues that Petitioner improperly incorporates large portions of Dr. Milster's Reply Declaration, "which is 105 pages of advocacy from Dr. Milster." *Id.*

We disagree with Patent Owner. 37 C.F.R. § 42.6(a)(3) states that "[a]rguments must not be incorporated by reference from one document into another document." Patent Owner, however, does not identify arguments

[38] US 8,786,961 B2, issued July 22, 2014 (Ex. 1043, "Sano").

that are improperly incorporated. Mot. Strike 5. Rather, Petitioner cites to portions of Dr. Milster's Reply Declaration, which is evidence—not argument. *Guardant Health, Inc. v. Vidal*, No. 2021-1104, 2023 WL 3262962, at *5 n.4 (Fed. Cir. May 5, 2023) ("The Director argues Guardant improperly incorporated arguments from Dr. Quackenbush's declaration in violation of 37 C.F.R. § 42.6(a)(3)," but "[t]his argument is inapt because Guardant's response brief maps claim 1's elements . . . by relying on the evidence and expert declaration, not by incorporating legal arguments.").

Moreover, we view Petitioner's citations to Dr. Milster's Reply declaration here as providing the detailed explanations that we require of an expert to support their opinions, rather than attempting to make additional legal arguments or circumvent page limits.

In sum, we deny Patent Owner's Motion to Strike, except as it relates to the Sano reference for which we dismiss that portion of the motion as moot.

X. PATENT OWNER'S MOTION TO EXCLUDE

Patent Owner filed a Motion to Exclude Dr. Milster's ZEMAX modeling related testimony for the purposes Petitioner relies on it, arguing that it is not relevant, and that it is incomplete and unsupported. Mot. Excl. 3. In particular, Patent Owner "requests the exclusion of those parts of the first Milster declaration, Exhibit 1003, as supplemented by Exhibit 2030, that rely on Dr. Milster's use of Zemax software, namely, ¶¶ 125–127, 131–135, 159–160, 165–167, 173, 177, 180, 183, 198, 204–207, and 210 of Ex. 1003, and ¶¶ 9–10 of Ex. 2030." *Id.* at 5. Similarly, Patent Owner request that we "exclude all testimony in Exhibit 1039 that relies on Zemax data, i.e., ¶¶ 20–54, 56–60, and 121–129." *Id.* at 8.

Patent Owner argues that the identified evidence is not relevant under Federal Rules of Evidence 401 because it is based on use of the 2019 version of ZEMAX, which was not available at the time of the invention, September 2011. *Id.* at 5 (citing Ex. 1003 ¶ 31), 9; *see also id.* at 6–7, 9 (arguing that the 2019 version of ZEMAX is not relevant). We address above Patent Owner's arguments on this issue, and we find the arguments unavailing for the same reasons. *See* Section VI.B.9. In sum, above we find that Dr. Milster relies on ZEMAX functionality that was available in 2011. *Id.*

In addition, Patent Owner argues that the identified evidence for Exhibit 1003 and Exhibit 2030 violates Federal Rules of Evidence 702 and 37 C.F.R. § 42.65(b) "because Dr. Milster did not supply a full recitation of all the facts and data for each of the" iterations required for each optimization presented in his declarations. Mot. Excl. 7–11. We above address these arguments, and we find the arguments unavailing for the same reasons. *See* Section VI.B.9.

In addition, Patent Owner argues that the identified evidence for Exhibit 1039 is incomplete under Federal Rule of Evidence 106. Mot. Excl. 9. We disagree. Rather, we agree with Petitioner that "[t]his rule does not impose a requirement for an expert witness to record and produce any and all transient data that might arise while the expert witness" performs tests. Opp. Mot. Excl. 8.

In addition, we disagree with Patent Owner that Petitioner violated 37 C.F.R. § 42.65(b) or its obligations under 37 C.F.R. §§ 42.11(a), 42.51(b)(iii). Rather, each iteration is a separate test in the context of lens design and ZEMAX modeling, and thus, Petitioner has provided the table data for each test Petitioner's relies upon. And Dr. Milster testifies that the

intermediate tests showed that the intermediate iterations did not perform. *E.g.*, Ex. 2035, 43:13–44:1. Similarly, we find unavailing Patent Owner's arguments that Petitioner violates Rule 702 and *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579 (1993) because "an expert 'may not rely' on 'extrinsic evidence' that 'was never disclosed.'" Again, Petitioner provided in the record the table data showing the starting point and the end design. Thus, the "extrinsic evidence" is present in the record so Patent Owner's argument is unpersuasive.

For the reasons given, we deny Patent Owner's Motion to Exclude.

XI. CONCLUSION[39]

Based on the full record, we determine that Petitioner shows by a preponderance of the evidence that claims 15 and 18 are unpatentable over KR872. In addition, we determine that Petitioner shows by a preponderance of the evidence that proposed substitute claims 26 and 27 would have been obvious over KR872. Because Petitioner has met its burden as to every proposed substitute claim, we *deny* Patent Owner's Contingent Motion to Amend. We also deny in part Patent Owner's Motion to Strike and deny Patent Owner's Motion to Exclude.

We provide the following tables summarizing our disposition.

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

Claim(s)	35 U.S.C. §	Reference(s) /Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
15, 18	103(a)	KR872	15, 18	
15, 18	103(a)[40]	KR872, Baba		
15, 18	103(a)[41]	KR357		
15, 18	103(a)[42]	KR357, Baba		
Overall Outcome			15, 18	

Motion to Amend Outcome	Claim(s)
Original Claims Cancelled by Amendment	
Substitute Claims Proposed in the Amendment	26, 27
Substitute Claims: Motion to Amend Granted	
Substitute Claims: Motion to Amend Denied	26, 27
Substitute Claims: Not reached	

XII. ORDER

In consideration of the foregoing, it is hereby

ORDERED that, pursuant to 35 U.S.C. § 314(a), Petitioner has shown by a preponderance of the evidence that claims 15 and 18 of the '499 patent are unpatentable;

FURTHER ORDERED that Patent Owner's Contingent Motion to Amend is *denied*;

FURTHER ORDERED that Patent Owner's Motion to Strike (Paper 33) is *denied in part* and *dismissed in part* as moot;

[40] Because we determine that claims 15 and 18 are unpatentable over KR872, we decline to address them for this ground.
[41] Because we determine that claims 15 and 18 are unpatentable over KR872, we decline to address them for this ground.
[42] Because we determine that claims 15 and 18 are unpatentable over KR872, we decline to address them for this ground.

FURTHER ORDERED that Patent Owner's Motion to Exclude (Paper 48) is *denied*; and

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

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