

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SK INNOVATION CO., LTD.,
Petitioner,

v.

CELGARD, LLC,
Patent Owner.

Case IPR2014-00680
Patent 6,432,586 B1

Before FRANCISCO C. PRATS, DONNA M. PRAISS, and
CHRISTOPHER L. CRUMBLEY, Administrative Patent Judges.

PRATS, *Administrative Patent Judge*.

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

I. INTRODUCTION

A. Statement of the Case

SK Innovation Co., Ltd. (“Petitioner”) filed a Petition (Paper 2, “Pet.”) requesting *inter partes* review of claims 1–12, all of the claims, of U.S. Patent No. 6,432,586 B1 (Ex. 1001, “the ’586 patent”). Celgard, LLC, (“Patent Owner”) filed a Preliminary Response. Paper 8 (“Prelim. Resp.”).

We instituted trial only as to claims 7–11, for obviousness under 35 § 103(a) over Tsukamoto,¹ Lundquist,² and Tojo.³ Paper 11, 23–24 (“Decision to Institute,” or “Dec.”).⁴

After trial was instituted, Patent Owner filed a Response (Paper 32; “PO Resp.”), and Petitioner filed a Reply (Paper 39, “Reply”).

Both parties filed Motions to Exclude Evidence. Paper 43 (“Pet. Mot. to Exclude”) and Paper 46 (“PO Mot. to Exclude”).

Both parties filed Oppositions to the Motions to Exclude Evidence. Paper 48 (“Pet. Opp.”); Paper 49 (“PO Opp.”). Both parties filed Replies to the Oppositions to the Motions to Exclude Evidence. Paper 52 (“Pet. Reply Opp.”); Paper 54 (“PO Reply Opp.”).

¹ JP H11-283674 (published October 15, 1999) (Ex. 1031) (as translated, Ex. 1032).

² U.S. Patent No. 4,650,730 (issued Mar. 17, 1987) (Ex. 1008).

³ JP H11-80395 (published Mar. 26, 1999) (Ex. 1006) (as translated, Ex. 1007).

⁴ The application which issued as the ’586 patent was filed on April 10, 2000. Ex. 1001, cover page. Accordingly, the version of § 103 in effect before the Leahy-Smith America Invents Act (“AIA”) applies to the claims of the ’586 patent. See AIA, Public Law 112-29, § 3, 125 Stat. 288.

Petitioner supported its Petition with a Declaration by Craig B. Arnold, Ph.D. Ex. 1004 (“Arnold Decl.”).

In support of its Response, Patent Owner relied on Declarations by Ralph E. White, Ph.D., P.E., (Ex. 2002 (“White Decl.”)) and William J. Paulus (Ex. 2915 (“Paulus Decl.”)).

Oral Hearing was held on June 29, 2015, and the Hearing Transcript has been entered in the record. Paper 56 (“Tr.”).

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

“In an inter partes review instituted under this chapter, the petitioner shall have the burden of proving a proposition of unpatentability by a preponderance of the evidence.” 35 U.S.C. § 316(e).

We conclude that Petitioner has proved by a preponderance of the evidence that claims 7–11 of the ’586 patent are unpatentable, based on the obviousness ground on which trial was instituted.

Petitioner’s Motion to Exclude Evidence is granted-in-part, denied-in-part, and dismissed-in-part as moot. Patent Owner’s Motion to Exclude Evidence is denied.

A. Related Proceedings

Concurrently with the Petition under consideration herein, Petitioner filed a petition advancing additional challenges to the claims of the ’586 patent. Pet. 4; *SK Innov. Co., Ltd. v. Celgard, LLC*, Case IPR2014-00679, Paper 2 (May 9, 2014). The claims of the ’586 patent were challenged also by Mitsubishi Plastics, Inc. and LG Chem Ltd. in IPR2014-00524 and IPR2014-00692, respectively. Pet. 4. IPR2014-00524 was recently terminated after settlement between the parties.

Previously, the '586 patent was subject to an *inter partes* review, IPR2013-00637, which was terminated after petitioner Sumitomo settled the related litigation, as noted below. *Id.* at 3–4. Claims 1–6 and 11 of the '586 patent have also been challenged in *Ube Maxell Co. v. Celgard, LLC*, Case IPR2015-01511, Paper 1 (June 25, 2015).

The '586 patent has been asserted in the U.S. District Court for the Western District of North Carolina in *Celgard, LLC v. SK Innovation Co., Ltd.*, Case No. 3:13-cv-00254; *Celgard, LLC v. LG Chem, Ltd.*, Case No. 3:13-cv-00043; and *Celgard, LLC v. Sumitomo Chemical Co., Ltd.*, Case No. 3:13-cv-00122. Pet. 3. The Sumitomo Chemical Co., Ltd. case has settled. Pet. 3.

B. The '586 patent

The '586 patent discloses that commercializing lithium-containing high-energy rechargeable batteries has been difficult, mainly because of “dendrite growth that occurs after repetitive charge-discharge cycling.” Ex. 1001, 1:21–22. Specifically, “[w]hen lithium dendrites grow [from the lithium-containing anode] and penetrate the separator [between the electrodes], an internal short circuit of the battery occurs (any direct contact between anode and cathode is referred to as ‘electronic’ shorting, and contact made by dendrites is a type of electronic shorting).” *Id.* at 1:27–31. “Some shorting . . . may result in thermal runaway of the lithium battery, a serious safety problem for [a] lithium rechargeable battery.” *Id.* at 1:31–35.

To address those issues, the '586 patent describes an improved electrode separator for a high-energy rechargeable lithium battery. *Id.* at 1:40–53. The separator includes two specific layers: “[1] at least one

ceramic composite layer and [2] at least one polymeric microporous layer.” *Id.* at 1:46–47.

The ’586 patent explains that the ceramic composite layer “is, at least, adapted for preventing electronic shorting (e.g. direct or physical contact of the anode and the cathode) and blocking dendrite growth.” *Id.* at 2:54–57.

The ’586 patent explains that the ceramic composite layer is composed of a mixture of two types of components: “[1] a matrix material having [2] inorganic particles dispersed therethrough.” *Id.* at 3:9–10 (drawing reference numerals removed). The ’586 patent explains that the “[c]eramic composite layer is nonporous (it being understood that some pores are likely to be formed once in contact with an electrolyte, but ion conductivity of [that] layer is primarily dependent upon choice of the matrix material and particles).” *Id.* at 3:10–14 (drawing reference numerals removed).

The ’586 patent explains that the matrix component of the ceramic composite layer can be “any gel forming polymer suggested for use in lithium polymer batteries or in solid electrolyte batteries.” *Id.* at 3:32–34. The ’586 patent discloses that a variety of inorganic particles may be used in the ceramic composite layer, including, “for example, silicon dioxide (SiO₂), aluminum oxide (Al₂O₃), calcium carbonate (CaCO₃), titanium dioxide (TiO₂), SiS₂, SiPO₄, and the like, or mixtures thereof. The preferred inorganic particle is SiO₂, Al₂O₃, and CaCO₃.” *Id.* at 3:53–57.

Turning to the polymeric microporous layer of the ’586 patent’s separator, the patent explains that that layer “is, at least, adapted for blocking (or shutting down) ionic conductivity (or flow) between the anode and the cathode during the event of thermal runaway.” *Id.* at 2:58–60.

In contrast to the substantially non-porous ceramic composite layer discussed above, the '586 patent explains that the polymeric microporous layer “consists of any commercially available microporous membranes (e.g. single ply or multi-ply), for example, those products produced by Celgard Inc. of Charlotte, North Carolina, Asahi Chemical of Tokyo, Japan, and Tonen of Tokyo, Japan.” *Id.* at 3:60–64.

Claim 7, the sole independent claim for which trial was instituted, reads as follows:

7. A separator for a high energy rechargeable lithium battery comprises:

at least one ceramic composite layer or coating, said layer including a mixture of 20–95% by weight of inorganic particles selected from the group consisting of SiO₂, Al₂O₃, CaCO₃, TiO₂, SiS₂, SiPO₄, and mixtures thereof, and 5–80% by weight of a matrix material selected from the group consisting of polyethylene oxide, polyvinylidene fluoride, polytetrafluoroethylene, copolymers of the foregoing, and mixtures thereof; and

at least one polyolefinic microporous layer having a porosity in the range of 20–80%, an average pore size in the range of 0.02 to 2 microns, and a Gurley Number in the range of 15 to 150 sec.

Ex. 1001, 4:66–5:13.⁵

⁵ The phrase “and the like” was removed from claim 7 by Certificate of Correction, entered April 23, 2013. Ex. 1001, 6.

II. ANALYSIS

A. *Claim Construction*

In an *inter partes* review, the Board interprets claims in an unexpired patent using the “broadest reasonable construction in light of the specification of the patent in which [they] appear[.]” 37 C.F.R. § 42.100(b); *In re Cuozzo Speed Tech., LLC*, 793 F. 3d 1268, 1275 (Fed. Cir. 2015). Under that standard, the Board applies to claim terms their ordinary and customary meaning, as would be understood by one of ordinary skill in the art in the context of the entire disclosure. *In re Translogic Tech. Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007).

We conclude that, for the purposes of this decision, based on the parties’ contentions and the record developed during trial, no claim terms require express construction. Terms in the challenged claims will be given their ordinary and customary meaning, as would be understood by one of ordinary skill in the art in the context of the entire disclosure of the ’586 patent. *See id.*

B. *Obviousness over Tsukamoto, Lundquist, and Tojo*

1. *Prior Art Evidence of Obviousness*

We instituted trial based on Petitioner’s challenge to claims 7–11 of the ’586 patent for obviousness under 35 U.S.C. § 103(a) over Tsukamoto, Lundquist, and Tojo. Dec. 24.

As the Supreme Court has stated, when evaluating claims for obviousness, “the scope and content of the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained; and the level of ordinary skill in the pertinent art resolved.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007) (quoting *Graham v.*

John Deere Co., 383 U.S. 1, 17–18 (1966)). Secondary considerations, if present, also must be considered. *Id.*

As to the level of ordinary skill in the pertinent art, the parties’ experts advance slightly different opinions. *See* Ex. 1004 ¶¶ 26–27 (Arnold Decl.); Ex. 2002 ¶¶ 74–75 (White Decl.). Nonetheless, neither party specifically asserts error in the opinion of the other party’s expert, and neither party asserts specifically that the conclusion of obviousness turns on adoption of a particular level of ordinary skill. In that regard, both experts generally agree that an ordinarily skilled artisan at the critical time would have had a degree in chemistry, physics, material science, or chemical engineering; at least two to three years of experience in the battery industry or research and development of lithium batteries; and knowledge of the components and problems of lithium batteries, including dendrite growth, electronic shorting, and separators. *See id.*

When evaluating the parties’ contentions regarding the scope and content of the prior art, and the differences between the prior art and the challenged claims, we take into consideration both parties’ assertions regarding the level of ordinary skill. We note also that the level of ordinary skill in the art may be evidenced by the cited references. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001).

As to the scope of the prior art, and its differences from the challenged claims, Petitioner relies on the combination of Tsukamoto and Lundquist as teaching a separator and battery having the basic components required by claim 7, except that

[t]o the extent that [Tsukamoto] and [Lundquist] fail to disclose a polyolefinic microporous layer having the narrower recited

properties, i.e., “a porosity in the range of 20-80%, an average pore size in the range of 0.02 to 2 microns, and a Gurley Number in the range of 15 to 150 sec,” a polyolefinic microporous layer with these properties is obvious in view of [Tojo]. [Tojo] provides the necessary teaching and motivation to use its polyolefinic microporous layer in the separator of [Tsukamoto], in view of [Lundquist]

Pet. 49.

Patent Owner contends that Petitioner failed to show that an ordinary artisan would have been motivated to combine the cited references to prepare a separator having the features required by claims 7–11. PO Resp. 16–23. In particular, Patent Owner contends that the supporting testimony of Petitioner’s expert witness, Dr. Arnold, is conclusory and unfounded. *Id.* at 18–21.

Having reviewed Petitioner’s analysis and supporting evidence in light of Patent Owner’s arguments and evidence, we find that a preponderance of the evidence supports Petitioner’s position that an ordinary artisan would have been prompted to use Tojo’s polyolefinic microporous layer as the separator element in Tsukamoto’s battery, thereby producing a construct having both layers of the separator required by claim 7.

As to the ceramic composite layer required by claim 7, Tsukamoto describes a battery in which each of the electrodes is coated with a “gel-like electrolyte membrane,” with a separator interposed between the coated electrodes. Ex. 1032 ¶¶ 16, 30; *see also id.* at Fig. 1. As Petitioner discusses, Tsukamoto discloses that the gel-like electrolyte membranes coated onto the electrodes may be composed of a PVDF polymer encompassed by claim 7, mixed with Al₂O₃ particles also encompassed by claim 7. Pet. 54; Ex. 1032 ¶¶ 14, 16. As Petitioner discusses also (Pet. 57),

Tsukamoto exemplifies a gel-like electrolyte membrane that has 70% inorganic particles (Ex. 1032 ¶ 20), falling within claim 7's range of 20 to 95% inorganic particles (Ex. 1001, 5:2–3), the exemplified gel-like electrode membrane being composed also of 30% PVDF-based copolymer resin (Ex. 1032 ¶ 20), which falls within claim 7's range of 5 to 80% for the matrix material (Ex. 1001, 5:5–6). Given these teachings, Petitioner persuades us that Tsukamoto teaches or suggests that its gel-like electrolyte membrane has all of the components claim 7 requires of its ceramic composite layer.

As to the polyolefinic microporous layer recited in claim 7, Petitioner relies on the teachings in Tojo. As Petitioner discusses (Pet. 50–51), Tojo describes using, as one layer of a multi-layered battery separator, a microporous polyolefinic membrane layer having quick pore closure (Ex. 1007 ¶ 15). The polyolefinic membrane layer has excellent shutdown function (“SD,” *id.* ¶ 13), which refers to the membrane's capacity to “halt[] battery reactions by closing pores thereby increasing electrical resistance at an appropriate temperature” (*id.* ¶ 3).

As Petitioner discusses (Pet. 54–55), Tojo describes its polyolefinic microporous membrane as having a porosity of “usually 40 to 50%” (Ex. 1007 ¶ 29), and a preferable average pore size of 0.1 to 1.0 microns (*id.* ¶ 15). Both values fall within the ranges required by claim 7. *See* Ex. 1001, 5:10–11 (porosity of 20–80%); *id.* at 5:11–12 (average pore size 0.02 to 2 microns).

As to the Gurley Number porosity requirement of claim 7, Petitioner contends that the ranges described in Tojo at ¶ 15 overlap the claimed ranges, once Tojo's values are converted to the units used in the '586 patent. Pet. 55 (citing Ex. 1004 ¶¶ 129–142 (Arnold Decl.)). Patent Owner does not

dispute the accuracy of the calculations presented by Dr. Arnold at the cited paragraphs, and, given Dr. Arnold's qualifications and experience (Ex. 1004 ¶¶ 4–8), we credit his testimony on this issue. In sum, given the cited teachings, we find that Tojo teaches or suggests that its polyolefinic microporous membrane has all of the features claim 7 requires of its microporous layer.

We also find that an ordinary artisan would have been prompted to use Tojo's polyolefinic microporous membrane as the separator element in Tsukamoto's battery. Specifically, as Petitioner discusses, and as noted above, Tojo teaches that its microporous membrane has the desirable properties of quick pore closure and excellent shutdown function, which halt battery reactions so as to avoid excessive temperature increase. Pet. 49–50; Ex. 1007 ¶¶ 3, 13, 15. As Petitioner also discusses, Tsukamoto recognizes the concerns of battery overheating. Pet. 51–52; Ex. 1032 ¶¶ 3, 29.

Given these teachings, an ordinary artisan would have been prompted to use Tojo's microporous polyolefinic membrane as the separator element in Tsukamoto's battery, to impart to Tsukamoto's battery the desirable properties of Tojo's membrane. Moreover, because using Tojo's membrane as the separator component in Tsukamoto's battery assembly would produce, between the battery's electrodes, a combination of layers having all of the features required by claim 7 of the '586 patent, the combination of Tsukamoto and Tojo suggests a separator having all of the features required by claim 7.

As to claims 8–11, which all depend from claim 7, Patent Owner does not dispute Petitioner's contentions (Pet. 55–57) that all elements of the separators and battery recited in those claims are taught by the combination

of Tsukamoto, Lundquist, and Tojo. We have reviewed Petitioner's contentions and supporting evidence (*see id.*), and find that the cited references teach the elements of claims 8–11 as asserted by Petitioner.

Patent Owner's arguments do not persuade us that Petitioner failed to establish that an ordinary artisan would have been prompted to use Tojo's microporous polyolefinic membrane as the separator element in Tsukamoto's battery.

Patent Owner contends that we should disregard Dr. Arnold's testimony that Tojo's membrane would have provided a redundant safety feature to Tsukamoto's battery. PO Resp. 18 (citing Ex. 2009, 266:6–272:11 (Arnold Depo.)). Specifically, Patent Owner contends, Tsukamoto already solved the thermal runaway problem, and an ordinary artisan would have placed a premium on a thin separator to reduce voltage loss, and would not have added a redundant functionality to Tsukamoto's battery. *Id.* (citing Ex. 2002 ¶¶ 78–94 (White Decl.)).

In addition to the thermal reliability-increasing inorganic particle-containing layers between the two electrodes, however, Tsukamoto discloses that its lithium battery also includes a “polyethylene separator of 25 μm in thickness.” Ex. 1032 ¶ 21. Accordingly, we are not persuaded that an ordinary artisan would have considered a separator element a redundant feature of Tsukamoto's battery. Rather, an ordinary artisan seeking to practice Tsukamoto needed to provide a suitable separator.

As Petitioner contends (Reply 3), Patent Owner's expert, Dr. White, testified that Tojo's microporous polyolefinic separator membrane was “well-known at the time that Tojo was filed in 1997.” Ex. 2002 ¶ 86. As Petitioner points out also (Pet. 54–55), Tojo describes its membrane as being

preferably composed of polyethylene, and preferably having a maximum thickness of 30 μm . Ex. 1007 ¶¶ 14, 15. As noted above, moreover, Tojo teaches that its membrane base material has the desirable properties of quick pore closure and excellent shutdown function, which halt battery reactions so as to avoid excessive temperature increase. *Id.* ¶¶ 3, 13, 15.

Thus, an ordinary artisan was advised by the cited prior art that Tsukamoto's battery required a separator, which was suitably composed of polyethylene. The artisan was further advised that Tojo's well-known polyethylene-containing separator membrane not only had a thickness suitable for use in Tsukamoto's battery, but also provided a thermal protection functionality, a concern expressed in Tsukamoto as well (Ex. 1032 ¶¶ 3, 29). Accordingly, although we acknowledge Dr. White's testimony that ordinary artisans would not have added redundant functionality to a battery (Ex. 2002 ¶ 91), given that Tojo's separator membrane was well-known and had a composition and thickness suitable for use in Tsukamoto's battery, we find that an ordinary artisan selecting a separator for use in Tsukamoto's battery would have been prompted to select Tojo's well-known separator membrane.

Patent Owner has not established that Dr. Arnold lacks adequate qualifications to testify regarding the teachings of Tsukamoto, Tojo, and Lundquist. See PO Resp. 18–21. Specifically, Patent Owner contends that Dr. Arnold's lack of industry experience renders him unqualified to opine as to whether an ordinary artisan would have added the redundant safety functionality of Tojo's separator to Tsukamoto's battery. *Id.* at 19 (citing Ex. 2009, 47:20-48:10, 115:22-117:2, 138:8-11 (Arnold Depo.)). For the reasons discussed above, however, the teachings in the cited references

themselves support a finding that an ordinary artisan would have been prompted to use Tojo's separator membrane in Tsukamoto's battery, despite any supposed concerns about excessive safety redundancy.

Patent Owner contends that Dr. Arnold does not meet his own definition of a person of ordinary skill in the art, as evidenced by the areas of focus of his academic research as a physics professor, as well as his deposition testimony. PO Resp. 19–20 (citing Ex. 2009, 12:16–21:5, 66:17–68:2, 240:6–14).

As Petitioner contends, however (Reply 9–10), in addition to his Ph.D. in physics (Ex. 1005), in his deposition Dr. Arnold testified extensively regarding his research with separators and lithium batteries, and articles he had published on those subjects. *See* Ex. 2009, 29 (Dr. Arnold earned postdoctoral position based on micro battery design proposal he authored); *id.* at 43–46 (discussing unpublished research regarding ceramic coated separators); *id.* at 138–141 (discussing published papers describing laser engineered lithium ion batteries). Given his education and experience, which we also address below in reference to Patent Owner's Motion to Exclude Evidence, we find that Dr. Arnold is qualified to opine as to how an ordinary artisan would view the teachings of the cited references. Moreover, as discussed above, the actual teachings in the cited references support Dr. Arnold's opinion that an ordinary artisan would have been prompted to use Tojo's separator membrane in Tsukamoto's battery.

As to the issue of whether Dr. Arnold authored his declaration, and the length of time he spent working on this matter (PO Resp. 20–21), Dr. Arnold signed his declaration, and it includes the proper averment regarding the truth of the statements contained therein. Ex. 1004, 76–77. Patent

Owner, moreover, does not explain why Dr. Arnold's deposition testimony, that he did not understand the meaning of invalidity (PO Resp. 20 (citing Ex. 2009, 8:13–97), demonstrates that he is unqualified to opine as to the technical issues involved in this proceeding.

As to the combination of references advanced by Petitioner, Patent Owner contends that Tsukamoto is directed to a different battery issue than that addressed by Tojo and Lundquist. PO Resp. 21–22. Specifically, Patent Owner contends, Tsukamoto coats its electrodes with a polymer electrolyte to prevent, proactively, undesired battery temperature increases caused by interaction between the electrolyte solvent and electrode. *Id.* at 21. In contrast, Patent Owner contends, Lundquist and Tojo do not attempt to prevent temperature elevation by preventing contact between the solvent with the electrode, but instead provide “a reactive solution to prevent thermal runaway once the cell heats up to the point of melting the separator.” *Id.* at 22.

Moreover, Patent Owner contends, Tojo is concerned with maintaining the integrity of a separator during assembly and storage, whereas Tsukamoto addresses thermal runaway during battery use. *Id.* Accordingly, Patent Owner contends, because of the different problems addressed, and because Tojo does not address any deficiency identified by Tsukamoto, an ordinary artisan would not have combined the references, and the combination posited by Petitioner involves improper hindsight bias. *Id.* at 22–23 (citing Ex. 2002 ¶¶ 78–95 (White Decl.)).

We are not persuaded. As discussed above, the teachings of the cited references support Petitioner's contention that an ordinary artisan would have been prompted to use Tojo's separator membrane in Tsukamoto's

battery. Because the teachings in the prior art support Petitioner's posited combination of references, Petitioner's contentions of obviousness are not based on improper hindsight.

Moreover, even if the cited references do not address precisely the same problems, as Petitioner contends (Reply 5–6), each of Tsukamoto, Tojo, and Lundquist are in the field of lithium battery improvement, and address the issue of avoiding the undesirable effects of increased battery temperature. *See* Ex. 1032 ¶¶ 2–3 (Tsukamoto discussing lithium batteries and potential battery fires due to temperature increase); Ex. 1007 ¶ 3 (Tojo discussing separator shutdown function to prevent excessive temperature increase in high energy lithium batteries); Ex. 1008, 2:47–53 (Lundquist discussing use of battery separator in lithium batteries to stop thermal runaway and explosive reaction); *see also In re Klein*, 647 F.3d 1343, 1348 (Fed. Cir. 2011) (A reference is analogous prior art when it is “from the same field of endeavor, *regardless of the problem addressed . . .*”) (emphasis added).

In sum, for the reasons discussed, having considered the prior art advanced by Petitioner in light of Patent Owner's arguments and evidence regarding the cited references' teachings, we find, based on the teachings in those references, that an ordinary artisan would have been prompted to use Tojo's microporous membrane as the separator element in Tsukamoto's battery. Accordingly, an ordinary artisan would have been prompted to prepare a separator having all of the features required by claim 7, as well as its dependent claims 8–11.

2. Secondary Considerations/Objective Indicia

Before concluding whether the challenged claims would have been obvious, in addition to the teachings in the prior art, the objective indicia of nonobviousness must be considered “as part of all the evidence, not just when the decision maker remains in doubt after reviewing the art.”

Eurand, Inc. v. Mylan Pharm. Inc. (In re Cyclobenzaprine Hydrochloride Extended-Release Capsule Patent Litig.), 676 F.3d 1063, 1076–77 (Fed. Cir. 2012) (citation omitted).

Although Petitioner bears the ultimate burden of persuasion under 35 U.S.C. § 316(e), as Petitioner contends (Reply 10–11), Patent Owner must establish a nexus between the objective evidence of nonobviousness and the claimed subject matter. *See In re GPAC Inc.*, 57 F.3d 1573, 1580 (Fed. Cir. 1995) (“For objective evidence to be accorded substantial weight, its proponent must establish a nexus between the evidence and the merits of the claimed invention.”).

In particular, the objective indicia “must be tied to the novel elements of the claim at issue” and must ““be reasonably commensurate with the scope of the claims.”” *Institut Pasteur & Universite Pierre Et Marie Curie v. Focarino*, 738 F.3d 1337, 1347 (Fed. Cir. 2013) (quoting *Rambus Inc. v. Rea*, 731 F.3d 1248, 1257 (Fed. Cir. 2013)).

Patent Owner contends that objective evidence of nonobviousness shows that the claimed separator was copied by LG Chem, the alleged infringer in one of the copending district proceedings (PO Resp. 24–27); achieved wide industry acceptance (*id.* at 27–30); and experienced significant commercial success (*id.* at 30–34).

Petitioner replies that Patent Owner established neither copying nor an adequate nexus between the objective indicia advanced by Patent Owner and the subject matter recited in the claims. Reply 10–17. Petitioner also contends that Patent Owner has incorporated excessive argument into its Response from its supporting documents. *Id.* at 11.

As to incorporation by reference, 37 C.F.R. § 42.6(a)(3) states that “[a]rguments must not be incorporated by reference from one document into another document.”

To show a nexus between the claims and the objective evidence of nonobviousness, Patent Owner relies on testimony by Dr. White from one of the copending district court proceedings noted above, to show that LG Chem’s allegedly infringing product contains all of the features of the claims. *See* PO Resp. 26–27, 30–31. Specifically, in addition to the declaration by Dr. White prepared for this proceeding (Ex. 2002), Patent Owner cites to a declaration by Dr. White submitted in support of Patent Owner’s motion for preliminary injunction in the copending district court litigation (Ex. 2903 (“White PI Declaration”)). PO Resp. 26–27, 30–31.

Patent Owner cites to numerous paragraphs of the White Declaration prepared for this proceeding, but does not, in its Response, discuss with any specificity the information and arguments presented in that Declaration. *See* PO Resp. 26 (citing Ex. 2002 ¶¶ 110–53); *id.* at 30 (same). The White Declaration itself, in turn, cites extensively to additional evidence, including a Declaration by Premanand Ramadass (Ex. 2907), which was also prepared to support Patent Owner’s motion for preliminary injunction in the copending infringement proceeding. Ex. 2002 ¶¶ 132, 134–39, 141, 145.

Patent Owner also cites to Exhibits 13, 17, and 21 of the White PI Declaration. PO Resp. 26, 30. Exhibits 13, 17, and 21 of the White PI Declaration contain extensive claims charts and analysis. *See* Ex. 2903 at Exhibit 13, 1–8; *id.* at Exhibit 17, 1–11; *id.* at Exhibit 21, 1–20. As to claims 7–11 at issue here, only claim 7 is discussed, which occurs at pages 3–7 of Exhibit 17 of the White PI Declaration, and at pages 6 through 13 of Exhibit 21 of the White PI Declaration.

In its Patent Owner Response, however, Patent Owner does not discuss with any specificity the information or arguments presented in the two declarations by Dr. White, the accompanying claim charts, or the accompanying declaration by Mr. Ramadass. Accordingly, Petitioner persuades us that Patent Owner’s Response improperly incorporates by reference the arguments and claims analysis from both of Dr. White’s declarations, as well as the declaration by Mr. Ramadass.

Even disregarding the procedural infirmities in Patent Owner’s Response, however, Petitioner persuades us that the evidence of secondary considerations is not entitled to substantial weight, because Patent Owner has not established a sufficient nexus between the merits of the claimed subject matter and that evidence. Petitioner persuades us also that the evidence of secondary considerations is not reasonably commensurate in scope with the claimed subject matter.

As evidence of nexus, Patent Owner relies on the district court’s order granting a preliminary injunction to show that LG Chem’s allegedly infringing product, on which Patent Owner bases most of its contentions regarding secondary considerations of obviousness, includes all of the

features of the challenged claims. PO Resp. 26–27, 30–31 (citing Ex. 2904 (“PI Order”)).

As Petitioner contends (Reply 13), the PI Order mentions only claim 1 of the ’586 patent. See Ex. 2904, 8 (“Having reviewed description of the claims detailed the claim charts, it appears likely that the SRS [safety reinforced separator] sold, offered for sale, used, and imported into this country by defendants infringes at least claim 1 of the ’586 patent.”).

In contrast, as seen above, this proceeding involves only claims 7–11. Moreover, on appeal of the PI Order, the Federal Circuit found that the district court had not made adequate findings of fact regarding infringement, and remanded the case back to the district court. *Celgard, LLC v. LG Chem, Ltd.*, No. 2014-1675, 2015 WL 4757745, at *3, *6 (Fed. Cir. Aug. 12, 2015). Accordingly, the district court’s grant of a preliminary injunction, now overruled, does not demonstrate a nexus between the subject matter recited in claims 7–11 of the ’586 patent, and the objective evidence of nonobviousness advanced by Patent Owner.

As to the issue of copying, Patent Owner contends that it had a business relationship with LG Chem, in which Patent Owner provided base separator material to LG Chem, and LG Chem applied a ceramic coating to that material, thereby practicing the claimed invention. PO Resp. 25–27 (citing Ex. 2915 ¶¶ 6–10, 12, 15, 16 (Paulus Decl.)).⁶ Patent Owner contends that, after switching to a different base film supplier, “[r]ather than develop a new product, LG Chem merely copied its old SRS [safety

⁶ Mr. Paulus testifies that he is Patent Owner’s Vice President, Product Development, and that until April of 2014 he was Patent Owner’s Director of Marketing, Electric Vehicles. Ex. 2915 ¶ 2.

reinforced separator] products it developed with Celgard and which infringe the '586 patent. Thus, this secondary consideration favors a finding of nonobviousness.” *Id.* at 27.

The Federal Circuit has explained, however, that “[n]ot every competing product that arguably falls within the scope of a patent is evidence of copying; otherwise, ‘every infringement suit would automatically confirm the nonobviousness of the patent.’” *Wyers v. Master Lock Co.*, 616 F.3d 1231, 1246 (Fed. Cir. 2010) (quoting *Iron Grip Barbell Co. v. USA Sports, Inc.*, 392 F.3d 1317, 1325 (Fed. Cir. 2004)). Rather,

copying requires evidence of efforts to replicate a specific product, which may be demonstrated through internal company documents, direct evidence such as disassembling a patented prototype, photographing its features, and using the photograph as a blueprint to build a replica, or access to the patented product combined with substantial similarity to the patented product.

Id.

As Petitioner contends (Reply 14), in testifying that the product asserted as infringing claim 7 includes all of the claimed features, Dr. White noted that the ceramic composite layer of the allegedly infringing product is expressly described as being porous. Ex. 2903 at Exhibit 17, 3 (White PI Decl.). In contrast, as noted above, the '586 patent describes its ceramic composite layer as nonporous, except for some pores that may result from contact with electrolyte. Ex. 1001, 3:10–12.

Given this significant difference in the descriptions of the ceramic composite layer of the '586 patent, as compared to that of LG Chem's allegedly infringing product, Patent Owner has not advanced evidence

adequate to support a finding that LG Chem copied the product described in the '586 patent.

As to the issue of industry praise and acceptance, Patent Owner advances the testimony of Mr. Paulus as evidence that, as of 2013: (1) about 46% of all plug-in electric vehicles in the United States used batteries with ceramic coated separators; (2) that figure was 70.8% when calculated by megawatt hour; (3) about 56% of all plug-in electric vehicles sold in the United States having a ceramic-coated battery separator were supplied by LG Chem; and (4) LG Chem supplies batteries to 26% of all plug-in vehicles sold in the United States that use a lithium-ion battery. PO Resp. 27–28 (citing Ex. 2915 ¶¶ 21–24 (Paulus Decl.)). Moreover, Patent Owner contends, “[i]ndustry participants have adopted advertising materials touting the benefits of and importance of ceramic coating on safety and more specifically in the prevention of dendrite growth.” *Id.* at 29 (citing Ex. 2002 ¶¶ 105, 107, 159–164; Ex. 2901; Ex. 2902; Ex 2903 at Exhibit 11; Ex. 2912).

For the reasons discussed above, the grant of the preliminary injunction in the related district court proceeding does not demonstrate a nexus between the subject matter recited in claims 7–11 and the evidence of industry praise and acceptance. Claims 7–11, moreover, do not require the ceramic composite layer to be adapted to at least block dendrite growth and prevent electronic shorting, the safety features that Patent Owner contends provide the basis for the cited advertising documents, as well as the alleged industry praise and acceptance.

Further, as Petitioner contends (Reply 15–16), certain of the advertising documents advanced by Patent Owner point to a number of

features, aside from dendrite blocking and short prevention, as desirable properties of the advertised lithium ion batteries. *See* Ex. 2903 at Exhibit 11 (LG Chem website noting that the “lithium-ion batteries of LG Chem’s Mobile Battery Division have outstanding competitiveness in terms of high capacity, ultra slimness, and safety”); Ex. 2912, 1–2 (LG Chem Power Inc. website noting the reliability, cost, power density, energy density, light weight, and environmental friendliness of its lithium-ion batteries). Accordingly, viewing the totality of the record on this issue, Patent Owner has not advanced evidence adequate to establish a sufficient nexus, or commensurateness of scope, between the subject matter recited in claims 7–11, and the evidence of industry praise and acceptance.

As to commercial success, Patent Owner again relies on evidence relating to LG Chem. Specifically, Patent Owner contends it saw “a huge increase in sales once LG Chem started practicing the ’586 patent.” PO Resp. 31. More specifically, Patent Owner contends, before its relationship with LG Chem, it sold only \$10,000,000 worth of base separator material, whereas from 2009 to mid-2013, Patent Owner sold \$100,000,000 worth of separator material to LG Chem for ceramic coating and use in electric vehicles. *Id.* (citing Ex. 2915 ¶ 21 (Paulus Decl.)). Patent Owner contends that LG Chem has stated that it annually sells approximately \$2.4 billion of infringing batteries worldwide. *Id.* (citing Ex. 2002 ¶ 157). Patent Owner reiterates its contentions, noted above, regarding LG Chem’s share of the plug-in hybrid battery market. *Id.* at 31–32 (citing Ex. 2915 ¶¶ 23, 24).

Patent Owner contends that the asserted commercial success of LG Chem’s allegedly infringing products “is attributable, at least in part to the novel feature of the ’586 patent – the ability of the ceramic layer to block

dendrite growth.” PO Resp. 32. As evidence, Patent Owner directs us to marketing and other statements by LG Chem, which Patent Owner contends advertise the safety of LG Chem’s separators. *Id.* at 32–33 (citing Ex. 2002 ¶¶ 159–164; Ex. 2903 at Exhibit 11; Ex. 2912; Ex. 2913). Moreover, Patent Owner contends, “that the commercial success of LG Chem’s products is attributable at least in part to the SRS technology is shown by the fact that the ceramic coating increases cost of the total battery and adds mass to the battery and thus decreases driving range,” which are negatives that LG would not add to its separators absent some economic benefit. *Id.* at 34.

As noted above, however, claims 7–11, unlike the other claims of the ’586 patent, do not require the ceramic composite layer to be adapted to block dendrite growth and prevent shorting. Claims 7–11, therefore, do not include the asserted novel feature to which Patent Owner at least partly attributes LG Chem’s commercial success. Patent Owner, moreover, does not explain with any specificity how a separator having the features recited in claims 7–11 would necessarily provide the dendrite-blocking and short-preventing features that Patent Owner alleges provide the improved safety that forms the basis of the asserted commercial success.

We acknowledge Patent Owner’s contention that the “extremely high amount of nanoceramic used in [LG Chem’s] SRS products leads to tiny, tortuous pores and a layer that is adapted to block dendrite growth—a key element for safe lithium-ion batteries.” PO Resp. 33 (citing Ex. 2002 ¶¶ 162–64). Patent Owner does not explain with any specificity, however, how or why claims 7–11 require the recited separators to contain ceramic particles of the type and concentration required to provide the dendrite-

blocking functionality asserted as the basis for LG Chem's commercial success.

Moreover, as noted above, and as Petitioner contends (Reply 17), the advertising documents advanced by Patent Owner point to a number of features, aside from dendrite blocking and short prevention, as desirable properties of the advertised lithium ion batteries. See Ex. 2903 at Exhibit 11 (LG Chem website noting that the "lithium-ion batteries of LG Chem's Mobile Battery Division have outstanding competitiveness in terms of high capacity, ultra slimness, and safety"); Ex. 2912, 1–2 (LG Chem Power Inc. website noting the reliability, cost, power density, energy density, light weight, and environmental friendliness of its lithium-ion batteries).

In sum, viewing the totality of the record on this issue, we agree with Petitioner that Patent Owner has not advanced evidence adequate to establish a sufficient nexus, or commensurateness of scope, between the subject matter recited in claims 7–11, and the evidence of commercial success.

3. Ultimate Conclusion of Obviousness

As discussed above, having considered the prior art advanced by Petitioner in light of Patent Owner's arguments and evidence regarding the cited references' teachings, Petitioner persuades us, based on the teachings in Tsukamoto, Lundquist, and Tojo, that an ordinary artisan would have been prompted to prepare separators and a battery having all of the features required by claims 7–11. As also discussed above, having considered Patent Owner's evidence and arguments regarding objective indicia of nonobviousness, Petitioner persuades us that Patent Owner's evidence does

not show a sufficient nexus, or commensurate scope, between the subject matter recited in claims 7–11 and the objective indicia.

Accordingly, under these circumstances, taking into consideration the record as a whole, we conclude that Petitioner has shown by a preponderance of the evidence that an ordinary artisan would have considered the separators recited in claims 7–10, and the battery recited in claim 11, obvious in view of Tsukamoto, Lundquist, and Tojo.

C. Motions to Exclude Evidence

1. Petitioner's Motion to Exclude

a. Dr. White's Deposition Testimony (Ex. 1040)

Petitioner moves to exclude portions of Dr. White's redirect testimony (Ex. 1040, 150:2-154:13 (White Deposition)) as being substantially more prejudicial than probative under Federal Rule of Evidence ("FRE") 403 because Dr. White's testimony in those portions was the result of improper coaching. Pet. Mot. to Exclude 1–6; Pet. Reply Opp. 1–2.

Patent Owner contends that Dr. White was not coached, but was instead instructed not to answer questions involving allegedly privileged subject matter that was discussed during a witness conference between cross-examination and redirect examination. PO Opp. 1–5.

We deny Petitioner's motion to exclude the disputed testimony. That Dr. White's testimony in the disputed portion of his deposition might be inconsistent with his testimony elsewhere in deposition, or inconsistent with his declaration testimony, goes to his credibility and to the ultimate weight to be accorded to the disputed testimony.

b. Exhibits 2013, 2016, and 2900

Petitioner moves to exclude Exhibits 2013, 2016, and 2900 as irrelevant under FRE 401 and 402 because Patent Owner did not rely on these documents with any particularity during this proceeding. Pet. Mot. to Exclude 6–7.

Patent Owner responds that, “[w]hile Exhibits 2013 and 2016 were not cited by Patent Owner with regard to this petition, they provide useful background regarding the knowledge of one of ordinary skill in the art and are thus relevant under 401 and 402.” PO Opp. 5. Patent Owner contends that Exhibit 2900 similarly provides background information “regarding trends in the battery market and provides background information regarding problems with dendrite formation in Lithium metal batteries.” *Id.*

Because Patent Owner does not explain where it cited Exhibits 2013, 2016, and 2900 in this proceeding, we grant Petitioner’s Motion to Exclude Exhibits 2013, 2016, and 2900.

c. Exhibits 2901–2903, 2905, and 2911–2913

Petitioner moves to exclude as hearsay under FRE 801 and 802 Exhibits 2901–2903, 2905, and 2911–2913, which include materials from the websites of MTI, Ube, LG Chem, and Green Car Congress, advanced by Patent Owner as evidence of commercial success of ceramic composite separators. Pet. Mot. to Exclude 7–9.

Patent Owner responds that under FRE 703, it is proper for its expert, Dr. White, to rely on otherwise inadmissible evidence in forming his opinion. PO Opp. 5–6. Patent Owner contends, moreover, that FRE 703 allows the proponent of the expert opinion to disclose the evidence underlying the opinion to the jury if the probative value of the evidence

outweighs its prejudicial effect. *Id.* at 6. In that regard, Patent Owner contends, Petitioner has identified no prejudice in admitting the disputed exhibits. *Id.*

Petitioner replies that FRE 703 is not intended to be a vehicle for evading the prohibition against hearsay evidence. Pet. Reply Opp. 2–3.

We agree with Patent Owner on this issue. As Patent Owner contends, FRE 703 allows the proponent of the expert opinion to disclose the evidence underlying an expert opinion to the jury if the “probative value in helping the jury evaluate the opinion substantially outweighs [its] prejudicial effect.”

As evidenced by the discussion on the merits above, we find that these exhibits have substantial probative value in helping us to evaluate Dr. White’s opinion. Moreover, because the Board is not a lay jury, and has significant experience in evaluating expert testimony, the danger of prejudice in this proceeding is considerably lower than in a conventional district court trial.

In sum, for the reasons discussed, we deny Petitioner’s motion to exclude Exhibits 2901–2903, 2905, and 2911–2913.

d. Ramadass Declaration (Ex.2907)

Petitioner moves to exclude under FRE 403 the Declaration of Mr. Premanand Ramadass, which was prepared by Patent Owner in support of its motion for preliminary injunction in the copending district court infringement proceeding, and which was cited by Dr. White at ¶¶ 132, 134–39, 141, and 145 of his declaration (Ex. 2002). Pet. Mot. to Exclude 9–12. Among other things, Petitioner asserts prejudice in that Mr. Ramadass failed to agree to appear at a deposition. *Id.* at 10–12.

Patent Owner, among other things, contends that Petitioner was not prejudiced, as evidenced by Petitioner's submission of a subsequent declaration by Mr. Ramadass. PO Opp. 9–11 (citing Ex. 1052).

Paragraphs 132, 134–39, 141, and 145 of the White Declaration were advanced by Petitioner to show that LG Chem's allegedly infringing product contained all of the features of claims 1 and 4 of the '586 patent, and that a nexus therefore existed between those claims and the secondary evidence of nonobviousness. See Ex. 2002 ¶ 147 (concluding based on the previous paragraphs citing the Ramadass Declaration, that "it is my opinion that the LG Chem-coated Celgard base films have each and every element of claims 1 and 4 of the '586 patent").

As seen above, however, this proceeding involves only claims 7–11 of the '586 patent. Accordingly, because the disputed testimony in the Ramadass Declaration relates to claims 1 and 4 of the '586 patent, and was not relied on for this Decision, we dismiss Petitioner's motion to exclude the Ramadass Declaration as moot.

f. Paulus Declaration (Ex. 2915)

Petitioner moves to exclude under FRE 602 certain paragraphs of the Paulus Declaration because the declaration does not adduce any evidence that Mr. Paulus had any firsthand knowledge of the matters asserted in those portions of the declaration. Pet. Mot. to Exclude 14. Petitioner moves to exclude under FRE 701 certain other paragraphs of the Paulus Declaration because that testimony goes beyond permissible lay opinion and Mr. Paulus does not qualify as an expert in this field. *Id.*

As Patent Owner contends, however (PO Opp. 12), Mr. Paulus states expressly in his declaration that he has "personal knowledge of the matters

set forth in this declaration, except where otherwise indicated, and if called to testify I could and would competently testify to them.” Ex. 2915 ¶ 1.

Petitioner provides no clear basis for refuting Mr. Paulus’s express statement. Moreover, Paulus testified based on his personal knowledge, not as an expert. That Mr. Paulus might not have provided documentary support for all of his testimony goes to his credibility and to the ultimate weight to be accorded to the disputed testimony, and is not an adequate basis for exclusion. Accordingly, we deny Petitioner’s motion to exclude the Paulus Declaration.

2. Patent Owner’s Motion to Exclude

a. Dr. Arnold’s Testimony

Patent Owner moves to exclude under FRE 402 and 702 the entirety of Dr. Arnold’s testimony in both his declaration (Ex. 1004) and deposition (Ex. 2009). PO Mot. to Exclude 1. We deny Patent Owner’s motion.⁷

As to Dr. Arnold’s alleged failure to understand the legal concepts involved in determining anticipation and obviousness (PO Mot. to Exclude 2–4), as Petitioner contends (Pet. Opp. 3–7), Dr. Arnold ultimately opined as to technical issues rather than legal issues, as evidenced by his declaration’s concluding statement, to which Patent Owner directs us. Ex. 1004 ¶ 161 (“[I]t is my opinion that the prior art disclose or suggest all of the features recited in the claims of the ’586 patent.”).

We are not persuaded, moreover, that any potential deficiencies in Dr. Arnold’s understanding of the legal concepts of unpatentability warrant

⁷ Because we deny Patent Owner’s motion on the merits, we decline to decide whether Patent Owner’s objections were identified with sufficient particularity. See Pet. Opp. 1–2.

excluding his testimony entirely. *See Nutrition 21 v. United States*, 930 F.2d 867, 871 n.2 (Fed.Cir.1991) (“An expert’s opinion on the ultimate legal conclusion is neither required nor indeed ‘evidence’ at all.”) (citing *Newell Cos. v. Kenney Mfg. Co.*, 864 F.2d 757, 767 (Fed. Cir. 1988)).

Patent Owner also does not persuade us that Dr. Arnold fails to qualify as an expert in the art at issue. *See* PO Mot. to Exclude 4–7.

As Petitioner contends (Pet. Opp. 7–8), in addition to his Ph.D. in physics (Ex. 1004 ¶ 4), Dr. Arnold testifies that he has co-authored at least eleven articles relating to lithium batteries, at least three of which involve lithium battery separators, and at least three of which involve dendrite growth. Ex. 1004 ¶ 7. Accordingly, that most of Dr. Arnold’s research areas as a professor might not involve lithium batteries (PO Mot. to Exclude 5–6), and that Dr. Arnold testified that he was not an industry insider (*id.* at 6), do not persuade us that he is not qualified to testify as an expert under FRE 702. Lastly, as noted above, because the Board, unlike a lay jury, has significant experience in evaluating expert testimony, the danger of prejudice in this proceeding is considerably lower than in a conventional district court trial.

In sum, for the reasons discussed, we deny Patent Owner’s motion to exclude Dr. Arnold’s testimony.

III. CONCLUSION

For the foregoing reasons, Petitioner has shown by a preponderance of the evidence that claims 7–11 of the ’586 patent are unpatentable under 35 U.S.C. § 103(a) for obviousness over Tsukamoto, Lundquist, and Tojo.

IV. ORDER

For the reasons given, it is

ORDERED that claims 7–11 of the '586 patent have been shown by a preponderance of the evidence to be unpatentable;

FURTHER ORDERED that Petitioner's Motion to Exclude is granted-in-part, denied-in-part, and dismissed-in-part as moot;

FURTHER ORDERED that Exhibits 2013, 2016, and 2900 are excluded from the record;

FURTHER ORDERED that Patent Owner's Motion to Exclude is denied; and

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

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