

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

AMPEREX TECHNOLOGY LIMITED,
Petitioner,

v.

MAXELL, LTD.,
Patent Owner.

IPR2021-01441
Patent 9,077,035 B2

Before KRISTINA M. KALAN, WESLEY B. DERRICK, and
ELIZABETH M. ROESEL, *Administrative Patent Judges*.

ROESEL, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

A. *Background and Summary*

Amperex Technology Limited (“Petitioner”) filed a Petition (Paper 2, “Pet.”) seeking an *inter partes* review of claims 1–11 (the “challenged claims”) of U.S. Patent No. 9,077,035 B2 (Ex. 1001, “the ’035 Patent”). Maxell, Ltd. (“Patent Owner”) filed a Preliminary Response. Paper 9. We instituted an *inter partes* review. Paper 16. After institution, Patent Owner filed a Patent Owner Response (Paper 21, “PO Resp.”), Petitioner filed a Reply (Paper 24, “Pet. Reply”), and Patent Owner filed a Sur-reply (Paper 29, “PO Sur-reply”). We held an oral hearing on January 10, 2023, and a transcript is in the record. Paper 35 (“Tr.”).¹

We have jurisdiction under 35 U.S.C. § 6. This Final Written Decision is issued pursuant to 35 U.S.C. § 318(a). For the following reasons, we determine that Petitioner has shown by a preponderance of the evidence that all challenged claims of the ’035 Patent are unpatentable.

B. *Related Matters*

The parties identify the following district court litigation as a related matter: *Maxell, Ltd. v. Amperex Tech. Ltd.*, No. 6:21-cv-00347-ADA (W.D. Tex.). Pet. 67; Paper 7, 2 (Patent Owner’s updated mandatory notices).

Also pending before us are IPR2021-01440 and IPR2021-01443, which involve the same parties and similar technology, and IPR2021-01442, which involves the same parties.

¹ As agreed by the parties, oral arguments for three cases, IPR2021-01440, IPR2021-01441, and IPR2021-01443, were consolidated in a single hearing. Related case IPR2021-01442 was heard separately.

C. The '035 Patent (Ex. 1001)

The '035 Patent was issued on an application filed March 16, 2007, and asserts priority based on six Japanese applications, the earliest of which was filed March 20, 2006 (the “foreign priority date”). Ex. 1001, codes (22), (30).

The '035 Patent discloses a nonaqueous secondary battery with a positive electrode having a positive electrode mixture layer, a negative electrode, and a nonaqueous electrolyte. Ex. 1001, code (57), 2:58–67. The positive electrode contains, as an active material, at least two lithium-containing transition metal oxides having different average particle sizes. *Id.*; *see also id.* at 29:24–26 (claim 1); *see also id.* at 4:6–10:36 (discussing average particle size and composition of the positive electrode active material).

Positive electrode active material (A) has the largest average particle size, for example, 5 μm or more, and positive electrode active material (B) has the smallest average particle size, for example, 10 μm or less. Ex. 1001, 4:30–37, 4:41–42, 4:51–52. Positive electrode active material (B) has formula (1), $\text{Li}_x\text{M}^1_y\text{M}^2_z\text{M}^3_v\text{O}_2$, and positive electrode active material (A) has formula (2), $\text{Li}_a\text{M}^1_b\text{M}^2_c\text{M}^3_d\text{O}_2$. *Id.* at 6:7–34. In these formulae, M^1 represents at least one transition metal selected from Co, Ni and Mn; M^2 represents at least one metal selected from Mg, Ti, Zr, Ge, Nb, Al, and Sn; and M^3 represents an element other than Li, M^1 , and M^2 . *Id.* In formula (1), x , y , z , and v are defined by the equations, $0.97 \leq x < 1.02$, $0.8 \leq y < 1.02$, $0.002 \leq z \leq 0.05$, and $0 \leq v \leq 0.05$, and in formula (2), a , b , c , and d are defined by the equations, $0.97 \leq a < 1.02$, $0.8 \leq b < 1.02$, $0 \leq c \leq 0.02$, and $0 \leq d \leq 0.02$. *Id.* The '035 Patent discloses, for example, “a combination of the positive electrode active material (A) consisting of $\text{LiCo}_{0.998}\text{Mg}_{0.0008}\text{Ti}_{0.0004}\text{Al}_{0.0008}\text{O}_2$,

and the positive electrode active material (B) consisting of
 $\text{LiCo}_{0.334}\text{Ni}_{0.33}\text{Mn}_{0.33}\text{Mg}_{0.0024}\text{Ti}_{0.0012}\text{Al}_{0.0024}\text{O}_2$.” *Id.* at 10:33–36.

D. Illustrative Claim

Petitioner challenges all claims 1–11 of the ’035 Patent. Pet. 1.
Claim 1, reproduced below, is the sole independent claim and is illustrative
of the claimed subject matter.

1. A nonaqueous secondary battery comprising:

a positive electrode having a positive electrode mixture
layer, a negative electrode, and a nonaqueous electrolyte,

wherein the positive electrode comprises, as active
materials, at least two lithium-containing transition metal oxides
having different average particle sizes, and the lithium-
containing transition metal oxide having the smallest average
particle size is a lithium-containing transition metal oxide
represented by the formula (1):



wherein M^1 represents at least one transition metal
element selected from Co, Ni and Mn, M^2 represents Mg and at
least one metal element selected from the group consisting of Ti,
Zr, Ge, Nb, Al and Sn, M^3 represents at least one element
selected from the group consisting of Na, K, Rb, Be, Ca, Sr, Ba,
Sc, Y, La, Hf, V, Ta, Cr, Mo, W, Tc, Re, Fe, Ru, Rh, Cu, Ag, Au,
B, Ca, In, Si, P and Bi, and x, y, z and v are numbers satisfying
the equations respectively: $0.97 \leq x < 1.02$, $0.8 \leq y < 1.02$,
 $0.002 \leq z \leq 0.05$, and $0 \leq v \leq 0.05$, and has an average particle size
from 2 μm to 10 μm , and

the lithium-containing transition metal oxide having the
largest average particle size is a lithium-containing transition
metal oxide represented by the formula (2):



wherein M^1 , M^2 and M^3 are the same as defined in the
formula (1), and a, b, c and d are numbers satisfying the
equations respectively: $0.97 \leq a < 1.02$, $0.8 \leq b < 1.02$,

$0.0002 \leq c \leq 0.02$, and $0 \leq d \leq 0.02$, and has an average particle size from 5 μm to 25 μm ,

wherein said electrolyte contains a fluorine-containing organic solvent,

wherein the content of Co in the transition metal M^1 of the formulae (1) and (2) is from 30% by mole to 100% by mole,

wherein the content of said lithium-containing transition metal oxide having the smallest average particle size in the lithium-containing transition metal oxides is from 5% by weight to 60% by weight,

wherein the content of said lithium-containing transition metal oxide having the largest average particle size in the lithium-containing transition metal oxides is from 40% by weight to 95% by weight, and

wherein an amount of said fluorine-containing organic solvent is 0.1% by weight to 30% by weight based on the whole weight of the electrolyte.

Ex. 1001, 29:20–30:9.

E. Asserted Challenges to Patentability

Petitioner raises the following challenges to patentability.

Claim(s) Challenged	35 U.S.C. §²	References/Basis
1–11	103(a)	Choi, ³ Noh ⁴
1–6, 9–11	103(a)	Negishi, ⁵ Kita ⁶
8	103(a)	Negishi, Kita, Ishikawa ⁷
7	103(a)	Negishi, Kita, Awano ⁸

Pet. 1–2.

² The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112-29, 125 Stat. 284, 287–88 (2011), amended 35 U.S.C. § 103, effective March 16, 2013. Because the ’035 Patent was filed before this date, we refer to the pre-AIA version of Title 35. Ex. 1001, code (22).

³ Ex. 1005, US 2006/0257745 A1, published November 16, 2006 and filed February 15, 2006 (“Choi”). Petitioner asserts, without disagreement from Patent Owner, that Choi is prior art to the ’035 Patent under pre-AIA 35 U.S.C. § 102(e). Pet. 4.

⁴ Ex. 1006, US 2004/0197667 A1, published October 7, 2004 (“Noh”). Petitioner asserts, without disagreement from Patent Owner, that Noh is prior art to the ’035 Patent under pre-AIA 35 U.S.C. §§ 102(a) and (b). Pet. 4.

⁵ Ex. 1007, JP 2000-82466, published March 21, 2000, including certified English translation (“Negishi”).

⁶ Ex. 1008, JP 2002-270238, published September 20, 2002, including certified English translation (“Kita”).

⁷ Ex. 1009, US 2004/0142245 A1, published July 22, 2004 (“Ishikawa”).

⁸ Ex. 1029, US 2005/0271576 A1, published December 8, 2005 (“Awano”).

F. Testimonial Evidence

The record includes the Declaration of Dr. Walter van Schalkwijk (Ex. 1003) filed with the Petition, the deposition testimony of Dr. van Schalkwijk (Ex. 2016) filed with the Patent Owner Response, the Declaration of Dr. Brett Lucht (Ex. 2008) filed with the Preliminary Response, the Supplemental Declaration of Dr. Brett Lucht (Ex. 2015) filed with the Patent Owner Response, and the deposition testimony of Dr. Lucht (Ex. 1031) filed with the Reply.

II. ANALYSIS

A. Legal Standards

“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”)); *see also* 37 C.F.R. § 42.104(b) (requiring a petition for *inter partes* review to identify how the challenged claim is to be construed and where each element of the claim is found in the prior art patents or printed publications relied upon).

A patent claim is unpatentable under 35 U.S.C. § 103 if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved based on 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) when presented, objective evidence of nonobviousness, i.e., secondary considerations. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

Additionally, the obviousness inquiry typically requires an analysis of “whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue.” *KSR*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006) (requiring “articulated reasoning with some rational underpinning to support the legal conclusion of obviousness”)). Petitioner cannot satisfy its burden of proving obviousness by employing “mere conclusory statements,” but “must instead articulate specific reasoning, based on evidence of record, to support the legal conclusion of obviousness.” *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016).

B. Level of Ordinary Skill in the Art

Petitioner contends that a person of ordinary skill in the art (“POSITA”) would have had “at least a bachelor’s degree in chemistry, chemical engineering, or materials science, as well as five or more years of experience in the field of batteries and battery materials.” Pet. 5 (citing Ex. 1003 ¶ 11). Patent Owner does not address the level of ordinary skill in the art. *See generally* PO Resp.

We find that Petitioner’s articulation of the level of ordinary skill in the art is consistent with the scope and content of the ’035 Patent and the asserted prior art. We apply Petitioner’s definition of a POSITA, with the caveat that the phrases “at least” and “or more” do not require significantly more education or experience than is explicitly set forth in Petitioner’s definition.

C. Claim Construction

In an *inter partes* review, we apply the same claim construction standard as would be used by a district court to construe a claim in a civil action involving the validity or infringement of a patent. 37 C.F.R. § 42.100(b). Under that standard, claim terms are given their ordinary and customary meaning, as would have been understood by a person of ordinary skill in the art at the time of the invention, in light of the language of the claims, the specification, and the prosecution history of record. *Id.*; *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–19 (Fed. Cir. 2005) (en banc); *Thorner v. Sony Comput. Entm’t Am. LLC*, 669 F.3d 1362, 1365–66 (Fed. Cir. 2012).

Neither party seeks express construction of any claim term. *See* Pet. 3–4; PO Resp.

We determine that no claim term requires express construction for purposes of resolving the controversy. *Realtime Data LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) (“The Board is required to construe ‘only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.’” (quoting *Vivid Techs., Inc. v. Am. Sci. Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

D. Petitioner’s Challenge based on Choi and Noh

Petitioner contends that claims 1–11 are unpatentable as obvious based on Choi and Noh. Pet. 7–37. Patent Owner opposes. PO Resp. 2–22. We provide an overview of the references before turning to the parties’ arguments and our analysis.

1. Choi (Ex. 1005)

Choi discloses a composite cathode active material for a lithium battery. Ex. 1005, codes (54), (57). The composite cathode active material

includes a large diameter active material and a small diameter active material. *Id.* at code (57), ¶¶ 10, 26, page 7 (claim 1). The large diameter active material is selected from compounds of Formulae 1 and 2, such as $\text{LiNi}_{0.8}\text{Co}_{0.1}\text{Mn}_{0.1}\text{O}_2$, LiNiO_2 , $\text{LiNi}_{0.9}\text{Co}_{0.1}\text{O}_2$, $\text{LiNi}_{0.9}\text{Co}_{0.1}\text{Al}_{0.1}\text{O}_2$, and the small diameter active material is selected from carbon-based materials, such as graphite, and compounds of Formulae 2–4, such as $\text{LiNi}_{1/3}\text{Co}_{1/3}\text{Mn}_{1/3}\text{O}_2$, LiMn_2O_4 , $\text{LiNi}_{0.5}\text{Mn}_{0.5}\text{O}_2$, $\text{LiCo}_{0.95}\text{Mg}_{0.05}\text{O}_2$, LiCoPO_4 and $\text{LiNi}_{1/2}\text{Mn}_{3/2}\text{O}_4$. *Id.* ¶¶ 10, 30–32, 39, 41, page 7 (claims 1–3).

2. *Noh (Ex. 1006)*

Noh discloses an electrolyte for a lithium secondary battery comprising lithium salts, a high-boiling point organic solvent, and a carbonate-based additive compound having substituents selected from a halogen, a cyano (CN), and a nitro (NO_2). Ex. 1006, code (57), ¶¶ 17, 37–41. Noh discloses that the electrolyte may further comprise an organic solvent with a low boiling point or an aromatic hydrocarbon organic solvent, where the latter may be a fluorinated aromatic hydrocarbon, such as fluorobenzene. *Id.* ¶¶ 46–49. Noh discloses that the electrolyte may further comprise a swelling-inhibiting additive that includes an organic sulfone-based compound or an anisole-based compound and provides examples that include halogen-substituted compounds, including fluoro-substituted compounds. *Id.* ¶¶ 50–56. Noh's Example 1 is an electrolyte composition containing fluorobenzene as one of the solvents and fluoroethylene carbonate as the carbonate-based additive. *Id.* ¶ 64.

3. *Motivation to Combine*

Petitioner contends that Choi discloses a nonaqueous secondary battery including all limitations of the challenged claims, except for the

limitations relating to a fluorine-containing organic solvent and fluorine-containing aromatic compound,⁹ which Petitioner contends are disclosed by Noh. Pet. 7–37. Petitioner contends “a POSITA would have looked to Noh’s inclusion of a fluorine-containing organic solvent in its electrolyte to improve thermal stability” of Choi’s battery. Pet. 8 (citing Ex. 1003 ¶¶ 145–149). According to Petitioner, Noh teaches that use of a fluorine-containing carbonate-based additive compound in the electrolyte improves thermal stability and discharge characteristics of the battery. *Id.* (citing Ex. 1006 ¶¶ 33, 37, 38; Ex. 1003 ¶ 149).

Patent Owner argues that the Petition fails to allege a sufficient motivation to combine Choi and Noh. PO Resp. 2–12. According to Patent Owner, Choi and Noh disclose completely dissimilar cathode technologies, and a POSITA would not have been motivated to combine the cathode in Choi with the electrolyte in Noh. *Id.*

For the reasons discussed below, we determine that the preponderance of the evidence favors Petitioner regarding motivation to combine.

- a) Petitioner shows that a POSITA would have been motivated by a desire for increased thermal stability and improved discharge characteristics*

Petitioner shows persuasively that a desire for increased thermal stability and improved discharge characteristics would have motivated a POSITA to modify the electrolyte in Choi’s battery by including fluorine-containing additives as taught by Noh. Pet. 7–9; Ex. 1003 ¶¶ 143–150.

⁹ Claim 1 recites, “wherein said electrolyte contains a fluorine-containing organic solvent.” Ex. 1001, 29:53–54. Claim 8 depends from claim 1 and recites “wherein said electrolyte further contains a fluorine-containing aromatic compound other than said fluorine-containing organic solvent.” *Id.* at 30:45–48.

Petitioner presents undisputed testimony that a POSITA “would have understood that improving thermal stability is critical to improving battery safety.” Ex. 1003 ¶ 144. The parties agree that both Choi and Noh are directed to improving thermal stability and discharge characteristics of a lithium battery. Pet. 7–8; Ex. 1003 ¶¶ 143, 144, 147; PO Resp. 6–7 (“Choi . . . addresses the problem that Noh seeks to solve by improving thermal stability and discharge characteristics.”).¹⁰ For example, Choi states that “a need exists for composite cathode active materials capable of improving high voltage stability, thermal stability and high rate discharge characteristics of lithium batteries.” Ex. 1005 ¶ 7. Noh aims to provide a lithium secondary battery that does not suffer from deterioration of safety and reliability caused by swelling from gas generation during high temperature storage. Ex. 1006 ¶¶ 3, 11, 15, 16.

Furthermore, the parties agree that Choi and Noh teach different ways to improve thermal stability. PO Resp. 7 (“Choi, however, addressed thermal stability differently [than Noh], by using complex lithium-containing transition metal oxides enhanced with dopants.”); Ex. 1003 ¶¶ 143–145, 147, 148. Choi teaches a composite cathode active material that includes large and small diameter particles. Ex. 1005, code (57), ¶¶ 10, 26. According to Choi, high thermal stability is possible by using highly stable and highly conductive materials as the small diameter active materials. *Id.* ¶¶ 26, 38. Noh, on the other hand, teaches improving thermal stability and discharge characteristics by providing electrolyte additive compounds that inhibit swelling caused by generation of gas inside the

¹⁰ We omit italicization of the Choi and Noh references when quoting from Patent Owner’s briefs and declarations.

battery. Ex. 1006, code (57), ¶¶ 15–17, 33, 37, 38, 50. According to Noh, “[t]he electrolyte improves discharge, low temperature, and cycle life characteristics of a lithium secondary battery.” *Id.* at code (57).

Petitioner shows persuasively that Noh discloses the same types of cathode and anode materials as Choi. Pet. 8 (citing, *inter alia*, Ex. 1005 ¶¶ 10, 11; Ex. 1006 ¶¶ 35, 36; Ex. 1003 ¶¶ 150, 151). Petitioner’s contention is supported by Dr. van Schalkwijk’s testimony (Ex. 1003 ¶¶ 145, 150), as well as the disclosures of Choi and Noh. Dr. van Schalkwijk testifies that Noh “teaches the same types of cathode and anode materials as Choi, namely lithium-cobalt-based oxide cathode active materials and carbon (or graphite) anode active materials.” Ex. 1003 ¶ 145.

Dr. van Schalkwijk’s testimony is supported by Choi and Noh, both of which disclose lithium-containing transition metal oxides as cathode active materials. Ex. 1005 ¶¶ 10, 11 (disclosing Formulae 1–4, which are lithium-containing oxides of cobalt, nickel, and/or manganese, and examples of these oxides); Ex. 1006 ¶ 35 (“positive active materials include a lithium-cobalt-based oxide, a lithium-manganese-based oxide, a lithium-nickel-based oxide, a lithium-nickel-manganese-based oxide”). Choi and Noh also both disclose carbon (or graphite) anode active materials. Ex. 1005 ¶¶ 53, 54, 87; Ex. 1006 ¶ 36.

Petitioner also shows persuasively that Noh “identifies limitations of these [cathode and anode] materials, including gas generation at high temperatures, which may result in thermal runaway.” Pet. 8 (citing, *inter alia*, Ex. 1006 ¶¶ 35, 36; Ex. 1003 ¶ 150). For example, Noh discloses:

Currently-used positive active materials include a lithium-cobalt-based oxide, a lithium-manganese-based oxide, a lithium-nickel-based oxide, a lithium-nickel-manganese-based oxide, and the like. The lithium-nickel-based or lithium-nickel-

manganese-based oxide is inexpensive and represents a high discharge capacity, but has a limitation due to gas generation during high-temperature storage. However, the electrolyte of the present invention may solve the problem of deterioration of battery performance even when the lithium-nickel-based or lithium-nickel-manganese-based oxide is used as a positive active material, and a conventional carbonaceous material is used as a negative material.

Ex. 1006 ¶ 35; *see* Ex. 1003 ¶ 145 (quoting the above excerpt from Noh to show limitations of cathode active materials). As further discussed in subsection b) below, we find that Noh's teachings concerning electrolyte additives that inhibit the generation of gas inside the battery are not limited to any particular class of cathode active materials. Ex. 1006, code (57), ¶¶ 15–17, 33, 35, 37–41, 50–56.

We are also persuaded by Petitioner's contention and Dr. van Schalkwijk's testimony that Choi and Noh disclose similar electrolyte materials. Pet. 8; Ex. 1003 ¶¶ 146, 150. Both Choi and Noh teach an electrolyte solution comprising (1) a nonaqueous organic solvent such as ethylene carbonate, propylene carbonate, butylene carbonate, dimethyl carbonate, diethyl carbonate, methyl ethyl carbonate, methyl propyl carbonate, acetonitrile, γ -butyrolactone, dimethylformamide, and dimethylsulfoxide; and (2) a lithium salt such as LiPF_6 , LiBF_4 , LiSbF_6 , LiAsF_6 , LiClO_4 , LiCF_3SO_3 , $\text{Li}(\text{CF}_3\text{SO}_2)_2\text{N}$, $\text{LiC}_4\text{F}_9\text{SO}_3$, LiSbF_6 , LiAlO_4 , LiAlCl_4 , $\text{LiN}(\text{C}_x\text{F}_{2x+1}\text{SO}_2)(\text{C}_y\text{F}_{2y+1}\text{SO}_2)$, LiCl , and LiI . Ex. 1005 ¶ 61; Ex. 1006 ¶¶ 42, 45, 49.

We agree with Petitioner that Noh teaches that use of a fluorine-containing carbonate-based additive compound in its electrolyte improves thermal stability and discharge characteristics. Pet. 8 (citing Ex. 1003 ¶ 149; Ex. 1006 ¶¶ 33, 37, 38). For example, Noh discloses:

The carbonate-based additive compound that is added to the lithium salt-containing organic solvent with a high boiling point may inhibit swelling caused by gas generation inside the battery, and may solve problems of deterioration of the capacity and cycle life characteristics due to the use of an organic solvent with a high boiling point. . . .

The carbonate-based additive compound includes electron-withdrawing groups with high electronegativity selected from the group consisting of a halogen, a cyano (CN), and a nitro (NO₂).

Ex. 1006 ¶¶ 38, 39; *see also* Ex. 1003 ¶ 147 (discussing Noh’s teaching).

As Dr. van Schalkwijk points out (Ex. 1003 ¶¶ 141, 148), Noh teaches another swelling-inhibiting electrolyte additive that may include an anisole-based compound. Ex. 1006 ¶ 50. According to Noh, the anisole-based compound “inhibits gas generation at a high temperature, and thus, decreases swelling of a battery.” *Id.* ¶ 56. Noh discloses examples of anisole-based compounds, including 3-fluoroanisole and other fluoro-substituted compounds. *Id.*

In view of the foregoing teachings of Noh, we credit

Dr. van Schalkwijk’s testimony that:

In light of these disclosures [in Noh], a person of ordinary skill in the art would have been motivated to improve the properties and benefits of the Choi battery by including the aforementioned electrolyte additives of Noh to increase thermal stability (e.g., by “inhibit[ing] swelling caused by gas generation inside the battery”) and improve discharge characteristics in the resultant batteries. . . . Accordingly, a person of ordinary skill in the art would have been motivated to apply the electrolyte additive teachings of Noh to the battery of Choi to arrive an improved nonaqueous secondary battery.

Ex. 1003 ¶ 149 (citing Ex. 1006 ¶ 38).

Noh explicitly teaches that the lithium secondary batteries are in need of improved thermal stability and discharge characteristics

and further teaches that its fluorine-containing carbonate-based additive compound and an additional fluorine-containing aromatic compound improve thermal stability and discharge characteristics of its battery. . . . In light of these teachings, a person of ordinary skill in the art would have expected the addition of the fluorine-containing carbonate-based additive compound and the additional fluorine-containing aromatic compound of Noh to the battery of Choi to be effective.

Ex. 1003 ¶ 150 (citing Ex. 1006 ¶¶ 33, 37, 38, 56, 64).

b) Petitioner establishes a motivation to combine despite differences in cathode materials

Patent Owner argues that Choi discloses “complex” lithium-containing transition metal oxides that “include dopants” and lead to improved charge/discharge characteristics and greater stability, as compared with conventional lithium batteries that use “basic transition metal oxides such as LiCoO_2 .” PO Resp. 4–5 (citing Ex. 1005, code (57), ¶¶ 3, 4, 95, claim 1; Ex. 2008 ¶ 31). According to Patent Owner, Noh discloses “the same kind of basic lithium-containing transition metal oxides criticized in Choi as lacking [these] benefits.” *Id.* at 6 (citing Ex. 1005 ¶ 8). Patent Owner argues that “because Choi disclosed a much more complex cathode active material compared to Noh, with enhancements not even contemplated by Noh, a POSITA would not be motivated to combine these two wholly different references disclosing starkly contrasting technologies.” *Id.* (citing Ex. 1003 ¶ 31); *see also* PO Sur-reply 3–4 (similar argument).

Having considered both Petitioner’s and Patent Owner’s arguments, we are persuaded that a POSITA would have been motivated to combine the teachings of Choi and Noh as set forth by Petitioner. As discussed above, Choi and Noh both disclose lithium-containing transition metal oxides as cathode active materials. Ex. 1005 ¶¶ 10, 11; Ex. 1006 ¶ 35; *see also*

Ex. 1003 ¶ 145 (“Noh . . . teaches the same types of cathode and anode materials as Choi.”). Patent Owner and Dr. Lucht assert that Noh does not describe the particle size of the cathode material and does not disclose “complex” lithium-containing transition metal oxides including “dopants.” PO Resp. 5–6; PO Sur-reply 2–4; Ex. 2008 ¶¶ 30, 31. Noh’s silence on particle size and dopants does not, however, mean that Noh’s cathode active material is “wholly different” from Choi’s cathode active material, as asserted by Patent Owner and Dr. Lucht. PO Resp. 6; Ex. 2008 ¶ 31. Patent Owner does not dispute that Choi and Noh both disclose lithium-containing transition metal oxides as cathode active materials. PO Resp. 5–6 (discussing Noh and citing Ex. 1006 ¶ 35); *see also* Ex. 2008 ¶ 31 (same). Moreover, Dr. Lucht does not explain how Kim’s silence on particle size and dopants would have affected a POSITA’s motivations and expectations regarding the electrolyte—the modification of Choi proposed by Petitioner. For this reason and as further explained below, Dr. Lucht’s testimony that “[t]he Choi reference and the Noh reference describe wholly different cathode active material technologies” (Ex. 2008 ¶ 31) is not sufficient to rebut Dr. van Schalkwijk’s testimony that a POSITA would have been motivated to include the electrolyte additives of Noh in the battery of Choi “to increase thermal stability . . . and improve discharge characteristics in the resultant batteries” and “would have expected the addition of the fluorine-containing carbonate-based additive compound and the additional fluorine-containing aromatic compound of Noh to the battery of Choi to be effective.” Ex. 1003 ¶¶ 149, 150.

As discussed above, Choi and Noh teach different ways to improve thermal stability. Whereas Choi’s small diameter cathode active materials confer thermal stability (Ex. 1005 ¶¶ 26, 38), Noh teaches that thermal

stability and discharge characteristics are improved by the use of electrolyte additives for inhibiting swelling caused by gas generation. Ex. 1006, code (57), ¶¶ 15–17, 33, 37, 38, 50. At his deposition, Dr. van Schalkwijk explained:

Choi is improving thermal stability by improving the cathode itself, the cathode material. . . .

Whereas, Noh -- Noh discloses the addition of the fluorine-containing carbonate-based active compound as an electrolyte additive to improve thermal stability and discharge characteristics.

So it's doing it -- Noh is improving the battery's characteristics, thermal stability and discharge via the electrolyte and film forming on the cathode; whereas, Choi does it by altering the formulation of the cathode itself.

So now you have *two modes, one via the cathode, one via the electrolyte, of improving the thermal stability and discharge characteristics of the battery.*

Ex. 2016, 66:7–67:18 (emphasis added).

On this record, there is no evidence that Choi's dopants would have interfered with the function of the electrolyte additives taught by Noh. Ex. 1006, code (57), ¶¶ 15–17, 33, 37, 38, 50 (disclosing that electrolyte additives inhibit swelling caused by the generation of gas inside the battery). Accordingly, Patent Owner's distinction between "complex" and "basic" lithium-containing transition metal oxides (PO Resp. 4–6; Ex. 2008 ¶ 31) does not undermine Dr. van Schalkwijk's testimony that a POSITA would have been motivated to improve the thermal stability of Choi's battery by including Noh's electrolyte additives and would have expected that the addition of those additives to be effective. Ex. 1003 ¶¶ 149, 150.

*c) Choi's improved thermal stability does not undermine
Petitioner's showing of motivation to combine*

Patent Owner argues that a "POSITA would not have been motivated to combine . . . the electrolyte of Noh with the cathode active material of Choi because Choi already sufficiently addresses" the thermal stability problem "by using complex lithium-containing transition metal oxides enhanced with dopants." PO Resp. 6–8 (citing Ex. 2008 ¶ 31); *see also* PO Sur-reply 5–7 (similar argument).

After considering the arguments and evidence, we are persuaded by Petitioner's contention that a POSITA would have understood that thermal stability could be "**further** improved by using an electrolyte including a fluorine-containing organic solvent." Pet. Reply 5 (citing Ex. 1003 ¶¶ 142–151; Ex. 1006 ¶¶ 33, 35–38, 64).

An expectation of further improvement is supported by undisputed evidence that Noh's electrolyte additives confer thermal stability by a **different mechanism** than Choi's complex lithium-containing transition metal oxides. Ex. 1003 ¶¶ 143–145, 147, 148; Ex. 1005, code (57), ¶¶ 10, 26, 38; Ex. 1006, code (57), ¶¶ 15–17, 33, 37, 38, 50; Ex. 2016, 66:7–67:18. We are persuaded by Petitioner's contention that "a POSITA would recognize that one could achieve additional benefits" by using "electrolyte additives (like Noh's)." Pet. Reply 5–6. These additional benefits that are not addressed by Choi's cathode material include "'inhibit[ing] swelling caused by gas generation inside the battery,' 'solv[ing] problems of deterioration of the capacity and cycle life characteristics due to the use of an organic solvent with a high boiling point,' and 'inhibit[ing] swelling resulting from gas generation on the negative electrode at initial charging.'"

Id. at 6 (citing Ex. 1006 ¶ 33; 38, 56; Ex. 2016, 66:7–67:23; Ex. 1023,¹¹ 21–22).

We credit the above-quoted deposition testimony of Dr. van Schalkwijk (page 18, *supra*), which provides persuasive support for Petitioner’s position that Choi and Noh disclose two different modes for improving the thermal stability and discharge characteristics of the battery, one via the cathode and another via the electrolyte. Ex. 2016, 66:7–67:18. We also credit Dr. van Schalkwijk’s testimony about improving Choi’s thermal stability:

Q Choi says that it’s thermally stable. So what is there to be improved?

A Thermally stable can always be improved to be stable to a higher temperature.

Id. at 67:20–23. The foregoing testimony shows that a POSITA would have been motivated to modify the electrolyte of Choi to improve thermal stability even though Choi teaches that its cathode active materials improve thermal stability.

d) Petitioner shows that a POSITA would have considered a fluorine-containing organic solvent

Patent Owner argues that Choi discloses electrolyte compounds that “already offer the benefits of Noh’s electrolyte” and “a POSITA would not have a good reason to depart from Choi to pursue the nonaqueous electrolyte

¹¹ R. McMillan et al., *Fluoroethylene carbonate electrolyte and its use in lithium ion batteries with graphite anodes*, J. Power Sources, 81–82, 20–26 (1999) (“McMillan”). Dr. van Schalkwijk directs us to McMillan’s disclosure concerning the benefits of a fluoro-containing electrolyte additive, fluoroethylene carbonate (“Fluoro-EC”), for lithium ion cells having a graphite anode. Ex. 1003 ¶ 223; Ex. 1023, 21–22.

having a fluorine-containing organic solvent.” PO Resp. 8–9. According to Patent Owner, Choi discloses two mononitrile solvents (benzonitrile and acetonitrile) that offer “superior benefits to an electrolyte like Noh’s with a fluorine-containing organic solvent” and “significant benefits for improving both thermal stability and discharge characteristics.” PO Resp. 9–11 (citing Ex. 1005 ¶ 61; Ex. 2008 ¶ 34; Ex. 2015 ¶ 10; Ex. 2016, 53:15–54:10; Ex. 2017¹² ¶¶ 1, 41, 45); *see also* PO Sur-reply 7–8 (similar argument).

After considering the arguments and evidence, we are persuaded by Petitioner’s contention that “regardless of the alleged benefits of a mononitrile, the evidence of record provides that the fluorine-containing organic solvent of Noh would be added to the electrolyte solution of Choi.” Pet. Reply 9.

Patent Owner’s arguments are premised on an incorrect characterization of the Petition. According to Patent Owner, Petitioner proposes “substituting Choi’s electrolyte in its entirety with Noh’s electrolyte” and “incorporating just one compound from Noh into Choi’s electrolyte is not before the Board.” PO Resp. 11 (citing Pet. 9). We disagree. The Petition argues “a POSITA would have looked to Noh’s inclusion of a fluorine-containing organic solvent in its electrolyte to improve thermal stability” of Choi’s battery. Pet. 8 (citing Ex. 1003 ¶¶ 145–149). Furthermore, Dr. van Schalkwijk testifies that a POSITA “would have been motivated to improve the properties and benefits of the Choi battery by including the aforementioned electrolyte additives of Noh to increase thermal stability . . . and improve discharge characteristics in the resultant batteries” and “would have expected the addition of the fluorine-

¹² US 2005/0208371 A1, published September 22, 2005 (“Kim”).

containing carbonate-based additive compound and the additional fluorine-containing aromatic compound of Noh to the battery of Choi to be effective.” Ex. 1003 ¶¶ 149, 150. Petitioner plainly proposes modifying Choi’s battery by incorporating fluorine-containing electrolyte additives as taught by Noh. We are not limited to considering a wholesale electrolyte substitution, as argued by Patent Owner.

Furthermore, Dr. van Schalkwijk’s deposition testimony supports Petitioner’s position more strongly than Patent Owner’s. *Compare* Pet. Reply 8 (citing Ex. 2016, 54:11–13, 59:7–15), *with* PO Resp. 11 *and* PO Sur-reply 8 (citing Ex. 2016, 53:15–54:10). In the context of discussing a reference asserted in IPR2021-01440 (Koshiishi), Dr. van Schalkwijk explained that including a fluorine atom-containing compound in the electrolyte enhances and strengthens film formation at both the anode and cathode, as compared with an electrolyte with succinonitrile (a dinitrile compound) alone. Ex. 2016, 52:1–53:13; *see also id.* at 49:15–17 (introducing Koshiishi). When asked whether an additive containing a fluorine atom-containing compound could be used as a replacement for a dinitrile compound, or whether they are used together, Dr. van Schalkwijk responded that “[i]n general, they’re used together” because “the succinonitrile protects more than just the cathode; it protects the other metal surfaces in the battery.” *Id.* at 53:15–54:10. Dr. van Schalkwijk concluded, “[s]o, yes, the succinonitrile and the fluorinated compounds would be used in conjunction with each other.” *Id.* In the context of discussing the disclosure of the challenged patent in IPR2021-01440, Dr. van Schalkwijk explained that a fluorinated solvent, such as fluorinated diethyl carbonate, “is not intended as a substitute for nitrile, just a -- again, these are different

types of molecules trying to make a film.” *Id.* at 59:2–10; *see also id.* at 54:17–59:18 (context).

We find that the foregoing deposition testimony has limited value in the current proceeding because it addresses whether a POSITA would have had a reason to add a **dinitrile** to an electrolyte that includes a fluorine-containing compound. Here, in contrast, the issue is whether a POSITA would have had a reason to add a fluorine-containing compound (as disclosed in Noh) to an electrolyte that may contain a **mononitrile** solvent (as disclosed in Choi). PO Resp. 9–11; Pet. Reply 6–9; PO Sur-reply 7–8. In this regard, we note that Noh itself teaches both a mononitrile electrolyte solvent (acetonitrile) and fluorine-containing organic solvents and additives. Ex. 1006 ¶ 45 (the high boiling point organic solvent can be, e.g., acetonitrile); *id.* ¶ 49 (the aromatic hydrocarbon organic solvent can be, e.g., fluorobenzene); *id.* ¶¶ 50, 52, 56 (the swelling-inhibiting additive can be, e.g., fluorophenylvinyl sulfone or 3-fluoroanisole).

Patent Owner relies on Kim to argue that mononitrile compounds provide safety and cycle life improvements equivalent to the dinitrile compounds disclosed in Kim. PO Resp. 11 (citing Ex. 2017 ¶ 45). We agree with Petitioner, however, that Kim is “speculative” (Pet. Reply 7), as it merely states there is a “high possibility” of equivalence between an aliphatic mononitrile and an aliphatic dinitrile. Ex. 2017 ¶ 45. Moreover, we are persuaded by Petitioner’s evidence that a POSITA would have expected better performance from a dinitrile compound than a mononitrile compound. Ex. 1032¹³ ¶ 108, Table 1; *see* Pet. Reply 7 (discussing Abe).

¹³ US 2004/0013946 A1, published January 22, 2004 (“Abe”).

Even assuming that mononitriles and dinitriles provided equivalent benefits, however, Dr. van Schalkwijk's testimony about dinitriles and fluorine atom-containing compounds does not support Patent Owner's position. Ex. 2016, 52:15–54:10, 59:7–15. Choi's disclosure of two mononitrile electrolyte solvents (Ex. 1005 ¶ 61) does not mean that Choi's battery would not benefit from the addition of a fluorine-containing organic solvent. As discussed above, Dr. van Schalkwijk's testimony demonstrates that dinitriles and fluorine-containing solvents are generally used together because they have different and complementary functionality. Ex. 2016, 53:15–54:13, 59:2–10.

Patent Owner relies on Dr. Lucht's testimony that "a POSITA would have understood that those mononitrile solvents [in Choi] offer superior benefits to an electrolyte like Noh's with a fluorine-containing organic solvent." Ex. 2015 ¶ 10. Dr. Lucht's testimony is conclusory and unsupported by any technical explanation or citation to objective evidence. For these reasons, it is outweighed by the evidence discussed above, including Dr. van Schalkwijk's deposition testimony. *See* 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."); *Ashland Oil, Inc. v. Delta Resins & Refractories, Inc.*, 776 F.2d 281, 294 (Fed. Cir. 1985) ("Lack of factual support for expert opinion going to factual determinations, however, may render the testimony of little probative value in a validity determination.").

For these reasons, we determine that Petitioner has met its burden of proof to show a motivation to combine Choi and Noh.

4. *Independent Claim 1*

The parties' dispute for claim 1 focuses on the composition of the lithium-containing transition metal oxides. Claim 1 recites formula (1) $\text{Li}_x\text{M}^1_y\text{M}^2_z\text{M}^3_v\text{O}_2$ and formula (2) $\text{Li}_a\text{M}^1_b\text{M}^2_c\text{M}^3_d\text{O}_2$.¹⁴

Petitioner contends that claim 1's formula (1) is taught by Choi's Formula 2 and that claim 1's formula (2) is taught by Choi's Formulae 1 and 2. Pet. 12, 19–20. Choi's Formula 1 is $\text{Li}_x\text{Co}_{1-y}\text{M}_y\text{O}_{2-\alpha}\text{X}_\alpha$, and Choi's Formula 2 is $\text{Li}_x\text{Co}_{1-y-z}\text{Ni}_y\text{M}_z\text{O}_{2-\alpha}\text{X}_\alpha$, where (in both formulae) $0.90 \leq x \leq 1.1$, $0 \leq y \leq 0.9$, $0 \leq z \leq 0.5$, $0 \leq \alpha \leq 2$, M is at least one selected from Al, Ni, Mn, Cr, Fe, Mg, Sr, V or rare earth elements, and X is selected from O, F, S and P. Ex. 1005 ¶¶ 10, 11.¹⁵

Patent Owner argues that Choi does not disclose three aspects of the lithium-containing transition metal oxides of claim 1: (1) the required presence of Mg and another element that satisfies M^2 ; (2) the molar amount of M^2 ; and (3) an element that satisfies M^3 . PO Resp. 12–21.¹⁶ We discuss

¹⁴ Formula (2) differs from formula (1) only with respect to the molar amounts of M^2 and M^3 , which are $0.002 \leq z \leq 0.05$ and $0 \leq v \leq 0.05$ in formula (1) and $0.0002 \leq c \leq 0.02$ and $0 \leq d \leq 0.02$ in formula (2), respectively. Ex. 1001, 29:39–41, 29:49–51.

¹⁵ Choi's Formulae 1 and 2 differ in only two respects: (1) Formula 2 lists Co and Ni as transition metals, whereas Formula 1 lists only Co; and (2) in Formula 1, the molar amount of element M is $0 \leq y \leq 0.9$ instead of $0 \leq z \leq 0.5$ as in Formula 2. Ex. 1005 ¶¶ 10, 11. In both Choi Formula 1 and Choi Formula 2, however, element M could include Ni. *Id.*

¹⁶ Petitioner presents essentially the same contentions for formulae (1) and (2) of claim 1, and our discussion focuses on Petitioner's contentions for claim 1's formula (1). Pet. 12–24. Patent Owner presents the same arguments for formulae (1) and (2) of claim 1. PO Resp. 21.

each of these aspects below and then address the remaining limitations of claim 1.

a) Element M²

Claim 1 recites that, in formula (1), “M² represents Mg and at least one metal element selected from the group consisting of Ti, Zr, Ge, Nb, Al and Sn.” Ex. 1001, 29:33–35.

Petitioner contends that M² is taught by M in Choi’s Formula 2, where “M is selected from the group consisting of Al, Ni, Mn, Cr, Fe, Mg, Sr, V, rare earth elements and mixtures thereof.” Pet. 15 (citing Ex. 1005 ¶¶ 10, 11). According to Petitioner, a “POSITA would have been motivated to select Mg and Al from the elements taught by Choi.” *Id.* (citing Ex. 1003 ¶¶ 178–180; Ex. 1024¹⁷).

Patent Owner argues that Choi does not disclose the required presence of “Mg and at least one metal element selected from the group consisting of Ti, Zr, Ge, Nb, Al and Sn,” as recited in claim 1. PO Resp. 13–16.

For the reasons discussed below, we determine that the preponderance of the evidence favors Petitioner’s position regarding element M².

There is no dispute that Choi discloses Mg and Al as possible constituents of a cathode active material. PO Resp. 14–15; Ex. 1005 ¶¶ 10, 11 (disclosing Formula 2, $\text{Li}_x\text{Co}_{1-y-z}\text{Ni}_y\text{M}_z\text{O}_{2-\alpha}\text{X}_\alpha$, where “M is selected from the group consisting of Al, Ni, Mn, Cr, Fe, Mg, Sr, V, rare earth elements and mixtures thereof”).

Undisputed evidence shows that a POSITA would have had several reasons to select Mg and Al from the options Choi discloses for element M.

¹⁷ S. Madhavi et al., *Cathodic properties of (Al, Mg) co-doped $\text{LiNi}_{0.7}\text{Co}_{0.3}\text{O}_2$* , Solid State Ionics 152–153, 199–205 (2002) (“Madhavi”).

These undisputed reasons include: (1) that Mg would enhance the cathode material's electronic conductivity; (2) that Al would provide structural enhancement to the cathode; (3) that Mg and Al would be less likely to disrupt the structure of the cathode material because they are the smallest elements in Choi's list; and (4) that Mg and Al would not be oxidized or reduced because they each have singular oxidation states. Pet. 15–16 (citing Ex. 1003 ¶¶ 178–180; Ex. 1024).

We credit the following un rebutted testimony of Dr. van Schalkwijk:

First, each doping element (e.g., Mg, Al, etc.) plays a different role in modifying the material properties of the host material (e.g., lithium cobalt oxide). . . . Mg atoms were first successfully doped into the LiCoO₂ lattice, the result being an increase in the electronic conductivity of the material. . . . Mg doping also altered the phase transition behavior of the delithiation process, which is the removal of lithium ions from the cathode during battery charging. . . . Mg's effect was to increase the charge voltage available to the cathode; however, this was not a large effect because the solubility of Mg in the cathode was quite small, i.e. only small amounts of Mg could be doped into LiCoO₂. . . . Al was another dopant that was used at the time of Choi and the '035 Patent. . . . However, it did not enhance the conductivity of the cathode as much as the effect from Mg doping. The strength of Al was that it was able to affect the same structural enhancements to the cathode, and it was much more soluble in the cathode, i.e. more aluminum could be doped into the cathode. . . . The motivation to use two dopants (and Mg and Al were common co-dopants) was the structural enhancement of the larger concentration of Al and the electronic conductivity enhancement due to the Mg. . . .

Moreover, Mg and Al are the smallest elements in the list taught by Choi, which means that Mg and Al are less likely to disrupt the structure of the positive electrode active material. . . . Additionally, Mg and Al have singular oxidation states of +2 and +3, respectively. . . . As such, a person of ordinary skill in the art

would have been motivated to select Mg and Al from the list of elements for “M” taught by Choi.

Ex. 1003 ¶¶ 179, 180 (citing Exs. 1022,¹⁸ 1024).

We also credit Dr. van Schalkwijk’s deposition testimony explaining how Mg alters the phase transition behavior of the delithiation process “so that the battery reaction is much more reversible.” Ex. 2016, 88:22–90:4. When asked whether the other elements Choi lists for M would also have that benefit, Dr. van Schalkwijk answered that “[m]agnesium has the biggest benefit of conductivity and phase transition alteration.” *Id.* at 90:5–9. Dr. van Schalkwijk also explained how Al provides structural support to the cathode material. *Id.* at 90:10–20; *see also* Ex. 1003 ¶ 44 (explaining how Al “enhance[s] the structure and hold[s] the lithium-containing layer a bit wider” as lithium ions are removed during battery charging). When asked how the structural benefit of aluminum compares with Choi’s other elements, Dr. van Schalkwijk answered that “manganese has multiple oxidation states” and “doesn’t do anything structural,” and that chromium, iron, strontium, and vanadium either have “multiple oxidation states,” are “too large,” or both. Ex. 2016, 90:25–91:12. When asked about the rare earth elements, as listed by Choi, Dr. van Schalkwijk responded that they are “physically too large” and “most of them would be cost prohibitive.” *Id.* at 91:19–92:7; *see* Pet. Reply 10 (citing Dr. van Schalkwijk’s deposition testimony).

Dr. van Schalkwijk’s testimony is supported by Tukamoto, which discloses that Mg doping of LiCoO₂ can significantly increase its

¹⁸ H. Tukamoto and A.R. West, *Electronic Conductivity of LiCoO₂ and Its Enhancement by Magnesium Doping*, J. Electrochem. Soc. 144, 3164–168 (1997) (“Tukamoto”).

conductivity without degrading electrochemical performance, with only a small reduction in capacity and good reversibility. Ex. 1022, 2, 6.¹⁹

Tukamoto Table I provides conductivity data for LiCoO_2 with various dopants, including Al, Ni, Mn, Cr, Fe, Mg, Sr, and V, which Choi lists as options for M in Formula 2, and six rare earth elements, Sc, Y, La, Ce, Pr, and Nd, which are also options for Choi's M. *Id.* at 3. The data show that doping with Mg resulted in the highest conductivity. *Id.* (“of these various dopants only Mg led to a significant increase in conductivity”).

Dr. van Schalkwijk's testimony is supported by Tukamoto's conclusion that “Mg-doped LiCoO_2 , remains as a single-phase material throughout the charge/discharge cycle, in contrast to LiCoO_2 , and this may lead to improved long-term stability on cycling.” *Id.* at 6.

Dr. van Schalkwijk's testimony is further supported by Madhavi, which discloses that Al and Mg doping of $\text{LiNi}_{0.7}\text{Co}_{0.3}\text{O}_2$ improves reversibility, capacity retention, and thermal stability, as compared to undoped cathode material. Ex. 1024, 1, 7. According to Madhavi, doping $\text{LiNi}_{0.7}\text{Co}_{0.3}\text{O}_2$ with Mg and Al resulted in the formation of a single crystalline phase with a well-defined layer structure and no impurity phases. *Id.* at 2. Madhavi teaches that doping with Al and Mg provides benefits that doping with Al alone does not provide. *Id.* at 3 (Table 1 showing discharge capacity); *id.* at 6 (discussing capacity-fading); *id.* at 7 (discussing heat evolution and decomposition temperature).

Petitioner shows persuasively that using both Mg and Al as dopants provides additional benefits over using one element alone. Pet. 17 n.4

¹⁹ We cite to Exhibits 1022 and 1024 using the page numbers added by Petitioner in the lower right corner of each page.

(citing Ex. 1017²⁰ ¶ 96, Table 2). Sato Table 2 shows that doping LiCoO₂ with both Al and Mg provides better charge/discharge characteristics than doping with either element alone or undoped material. Ex. 1017, Table 2.

Dr. Lucht does not controvert Dr. van Schalkwijk's testimony that the small size and singular oxidation states of Mg and Al would have prompted a POSITA to select these elements from Choi's list of options for M.

Ex. 1003 ¶ 180 (citing Ex. 1024); *see also* Ex. 2016, 97:22–99:24

(explaining why singular oxidation states for Mg and Al makes them better additive metals than the others listed by Choi). Dr. Lucht agrees that size and oxidation state of a dopant are considerations when developing a lithium-ion battery. Ex. 1031, 116:16–118:4. According to Dr. Lucht, the size of dopants should be similar to the size of the other metals “so they don't disrupt the overall crystal structure of the material.” *Id.*

at 117:16–118:4; *see* Pet. Reply 10–11 (citing Dr. Lucht's deposition testimony).

Patent Owner does not dispute Petitioner's evidence that a POSITA would have selected Mg and Al from the elements Choi teaches for M. Instead, Patent Owner argues that, in Choi's Formula 2, “M isn't required at all,” and Mg and Al are just “one pair of elements out of a possible 600 pairs of elements from Choi's list of 25 possible elements.” PO Resp. 15 (referring to Choi's list of eight elements plus seventeen rare earth elements that are options for M); PO Sur-reply 9–10 (similar argument). Patent Owner argues that Petitioner and Dr. van Schalkwijk rely on “improper hindsight bias,” that none of Choi's examples incorporates either Mg or Al, and that Choi discloses only one compound containing Mg, and that

²⁰ US 2005/0266315 A1, published December 1, 2005 (“Sato”).

compound does not include Al. PO Resp. 15 (citing Ex. 1005 ¶¶ 41, 65–84); PO Sur-reply 9–10.

For the reasons discussed above, we find that Petitioner and Dr. van Schalkwijk do not rely on improper hindsight bias and instead rely on undisputed evidence from before the foreign priority date of the '035 Patent showing that a POSITA would have had multiple reasons to select Mg and Al from the elements Choi teaches for M. Pet. 15–16, 17 n.4; Pet. Reply 10–11; Ex. 1003 ¶¶ 179, 180; Exs. 1017, 1022, 1024; Ex. 2016, 88:22–92:7, 97:22–99:24. Although Choi does not disclose any example compounds that contain both Mg and Al, the absence of such an example is not dispositive. *In re Mills*, 470 F.2d 649, 651 (CCPA 1972) (When evaluating obviousness, “[a]ll the disclosures in a reference must be evaluated, including nonpreferred embodiments, . . . and a reference is not limited to the disclosure of specific working examples.” (citation omitted)). Choi’s examples illustrate the effects of particle size on electrode density, discharge capacity, and thermal stability. Ex. 1005 ¶¶ 65–94. Petitioner has provided other evidence to illustrate how the selection of a dopant affects conductivity, capacity retention, and thermal stability. Ex. 1003 ¶¶ 179, 180; Exs. 1017, 1022, 1024; Ex. 2016, 88:22–92:7, 97:22–99:24.

Petitioner’s un rebutted evidence that a POSITA would have selected Mg and Al from the elements Choi teaches for M distinguishes this case from the precedent cited by Patent Owner.²¹ PO Sur-reply 10–11. In

²¹ *In re Baird*, 16 F.3d 380, 383 (Fed. Cir. 1994) (“A disclosure of millions of compounds does not render obvious a claim to three compounds, particularly when that disclosure indicates a preference leading away from the claimed compounds.”).

contrast to *Baird*, Petitioner's evidence shows that a POSITA would have been led toward, not away from, the claimed invention.

For these reasons, we determine that Petitioner has met its burden of proof for element M^2 as recited in claim 1.

b) Molar Amount of M^2

Claim 1 recites that, in formula (1), the molar amount²² of M^2 is z , where z satisfies the equation, $0.002 \leq z \leq 0.05$. Ex. 1001, 28:48–56.

Petitioner contends that the molar amount of M^2 is taught by Choi, which discloses that, in Formula 2, the subscript for M is z , where $0 \leq z \leq 0.5$. Pet. 16 (citing Ex. 1005 ¶¶ 10, 11). Petitioner contends that the concentration of element M , in this case Mg and Al , is a result-effective variable that would have been optimized by a POSITA's routine experimentation. *Id.* at 16–17 (citing Ex. 1003 ¶¶ 181, 182; Exs. 1017, 1018,²³ 1022, 1024).

Patent Owner contends that Choi does not disclose the molar amount of M^2 , as recited in claim 1. PO Resp. 16–18.

For the reasons discussed below, we determine that the preponderance of the evidence favors Petitioner's position regarding the molar amount of M^2 .

It is undisputed that Choi's disclosed range ($0 \leq z \leq 0.5$) encompasses the claimed range ($0.002 \leq z \leq 0.05$), which is sufficient to establish prima facie obviousness. Pet. 16; PO Resp. 16; Ex. 1005 ¶¶ 10, 11; *E.I. DuPont de Nemours & Company v. Synvina C.V.*, 904 F.3d 996, 1006 (Fed. Cir. 2018)

²² In formula (1), the molar amounts of the elements Li , M^1 , M^2 , and M^3 are denoted by the subscripts x , y , z , and v , respectively. Ex. 1001, 29:31.

²³ US 2006/0194109 A1, published August 31, 2006 (“Watanabe”).

(“‘[a] *prima facie* case of obviousness typically exists when the ranges of a claimed composition overlap the ranges disclosed in the prior art’” (quoting *In re Peterson*, 315 F.3d 1325, 1329 (Fed. Cir. 2003))). It is also undisputed that Choi discloses a specific cathode active material containing an amount of Mg within the claimed range. Ex. 1005 ¶ 41 (disclosing $\text{LiCo}_{0.95}\text{Mg}_{0.05}\text{O}_2$ as an example of a small diameter cathode active material); see PO Resp. 14 (asserting “Choi discloses only one compound containing Mg, but it does not include Al” (citing Ex. 1005 ¶ 41))).

Petitioner shows persuasively that, while Choi discloses the possibility of excluding “M” from Formula 2, a POSITA would have understood that the inclusion of Mg and Al would provide benefits and enhancements to the cathode. Pet. 16 (citing Ex. 1003 ¶ 181). We credit Dr. van Schalkwijk’s un rebutted testimony that a POSITA “would have understood that including Mg would increase the electronic conductivity of the material, alter the phase transition behavior of the de-lithiation process, and increase the charge voltage available to the cathode” and “including an additional dopant such as Al would provide structural enhancements to the cathode.” Ex. 1003 ¶ 181 (citing Exs. 1022, 1024). Dr. van Schalkwijk’s testimony is supported by the teachings of Tukamoto and Madhavi, as discussed above.

Undisputed evidence establishes that a POSITA would have understood that the concentration of Mg and Al in the cathode active material is a result-effective variable, and the optimum range of Mg and Al concentration would have been discovered by a POSITA by routine experimentation. Pet. 16 (citing Ex. 1003 ¶ 182); see *In re Applied Materials, Inc.*, 692 F.3d 1289, 1295 (Fed. Cir. 2012) (where the prior art discloses overlapping ranges, “it is not inventive to discover the optimum or

workable ranges by routine experimentation,” if the parameter is known to be a result-effective variable) (quoting *In re Aller*, 220 F.2d 454, 456 (CCPA 1955)).

We credit Dr. van Schalkwijk’s un rebutted testimony that a POSITA would have used the smallest amount of Mg possible to stabilize the structure because the Mg does not participate in the electrochemical reaction, and it’s present at the expense of Co and/or Ni, which are electrochemically active and, therefore, contribute to the battery’s capacity.

Ex. 1003 ¶ 182 (citing Ex. 1017 ¶¶ 29, 96; Ex. 1018 ¶ 36; Ex. 1022, Fig. 6). We also credit Dr. van Schalkwijk’s deposition testimony explaining that a POSITA would have determined the smallest amount of magnesium (Mg) and aluminum (Al) that stabilizes the structure by looking at battery cycling data and X-ray or other analysis of the cathode structure to determine whether solubility limits have been reached. Ex. 2016, 104:19–106:3; *see* Pet. Reply 13 (citing this testimony).

Dr. van Schalkwijk’s testimony is supported by Tukamoto Figure 6, which compares the discharge profile (potential versus capacity) of Mg-doped cathode compositions with various Mg contents, namely $\text{LiMg}_x\text{Co}_{1-x}\text{O}_2$, where $x = 0.01, 0.05, \text{ and } 0.08$. Ex. 1022, Fig. 6. Tukamoto observes that, as the amount of Mg increases, the discharge capacity decreases, which Tukamoto attributes to reduced Co^{3+} content in the composition since “only Co^{3+} and not Co^{4+} may be oxidized upon removal of Li during charging.” *Id.* at 5. Tukamoto also observes that, “in compositions with low Mg content, e.g., $x = 0.01$, . . . there is a flat potential range toward the end of the discharge cycle” and “[a]t higher Mg contents, this flat region is lost, and instead a gradual decay in potential occurs.” *Id.* at 5–6 (citing Fig. 6). Tukamoto’s observations indicate that, of the three

cathode compositions, the one with the lowest Mg content, i.e., $x = 0.01$, had the best discharge characteristics. *Id.*

Dr. van Schalkwijk's testimony is further supported by Sato, which discloses a cathode active material of the formula, $\text{Li}_t\text{CoM}_s\text{O}_2$, where M is "at least one element selected from Mg and Al." Ex. 1017 ¶ 27. Sato teaches that, "when s is larger than 0.03, the initial capacity is disadvantageously lowered" and "[t]herefore, it is preferred that s falls in the range: $0 \leq s \leq 0.03$." *Id.* ¶ 29. Similarly, Sato teaches that

in the . . . cathode active material represented by a general formula: $\text{Li}_t\text{CoM}_s\text{O}_2$, when the metal M is at least one member selected from Al and Mg and s falls in the range: $0 \leq s \leq 0.03$, not only can the capacity retaining ratio after the 150th cycle be improved, but also the lowering of the initial capacity can be suppressed.

Id. ¶ 101 (discussing Table 2). Further support for Dr. van Schalkwijk's testimony is provided by Sato's disclosure of a cathode active material of the formula, $\text{Li}_{1.00}\text{CoAl}_{0.015}\text{Mg}_{0.015}\text{O}_2$, which Sato teaches has optimum capacity retention and initial capacity and which has a molar amount of Mg and Al (M^2) falling within the claimed range. Ex. 1017 ¶¶ 96, 101, Table 2 (Example 8); *see* Pet. 17 n.4 (discussing Sato Table 2 and example with the above formula).

Dr. van Schalkwijk's testimony is still further supported by Watanabe, which discloses cathode active materials of the formula $\text{Li}_x\text{Co}_{1-y}\text{M}_y\text{O}_2$, where element M is preferably at least one of Mg, Al, and Mn, and x and y fall within the ranges $1.0 \leq x \leq 1.03$ and $0.005 \leq y \leq 0.15$. Ex. 1018 ¶¶ 32, 36. Watanabe teaches that "element M contributes to stabilization of the crystal structure of the composite oxide," and to produce this effect, "at least $0.005 \leq y$ is required to be satisfied." *Id.* ¶ 36. Watanabe cautions that,

“when $0.15 < y$, the problem of capacity degradation of the positive electrode active material arises.” *Id.*

Patent Owner does not dispute Petitioner’s evidence that a POSITA would have understood that the concentration of Mg and Al in the cathode active material is a result-effective variable that would have been optimized through routine experimentation. Instead, Patent Owner argues that “limiting the amount of the Mg-containing M^2 ” to the claimed range is “critical,” that Choi’s range is “substantially larger” than the ’035 Patent’s range, and that Choi provides “no reason to select an amount of M^2 ” within the claimed range. PO Resp. 16–17 (citing Ex. 1001, 7:48–50, 8:16–18; Ex. 2008 ¶¶ 39–41); PO Sur-reply 10–11.

In IPR proceedings,

“where there is a range disclosed in the prior art, and the claimed invention falls within that range, the burden of production falls upon the patentee to come forward with evidence” of teaching away, unexpected results or criticality, or other pertinent objective indicia indicating that the overlapping range would not have been obvious in light of that prior art.

DuPont, 904 F.3d at 1008 (quoting *Galderma Labs., L.P. v. Tolmar, Inc.*, 737 F.3d 731, 738 (Fed. Cir. 2013)). Here, Patent Owner does not meet its burden to produce evidence of non-obviousness of the claimed range for the molar amount of M^2 .

Patent Owner directs us to the ’035 Patent’s teachings that, by requiring Mg, “the safety of the battery is more effectively improved,” but that a large quantity of Mg should be avoided because “the load characteristic of the battery tends to decrease.” PO Resp. 16 (citing Ex. 1001, 7:48–50; 8:16–18); PO Sur-reply 11 (same). We agree with Petitioner, however, that these teachings are *not* unexpected. Pet.

Reply 12–13. The un rebutted evidence discussed above demonstrates that a POSITA would have known to use as small an amount of Mg and Al as necessary to stabilize the structure without substantively interfering with the electrochemical reaction and also would have understood that amounts within the claimed range would provide these beneficial results. Ex. 1003 ¶¶ 181, 182; Ex. 1017 ¶¶ 29, 96, 101, Table 2; Ex. 1018 ¶ 36; Ex. 1022, Fig. 6; Ex. 2016, 104:19–106:3. Petitioner’s evidence meets the applicable legal standard, which does not require identifying disclosure of the optimum or workable ranges in the prior art. *In re Aller*, 220 F.2d at 456 (“[W]here the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation.”).

Furthermore, Patent Owner presents no data, comparative or otherwise, to back up the statements in the ’035 Patent regarding safety and load characteristics of the battery. Patent Owner’s reliance on conclusory statements in the specification is not enough to satisfy its burden to come forward with evidence of unexpected results or criticality. *In re De Blauwe*, 736 F.2d 699, 705 (Fed. Cir. 1984) (“It is well settled that unexpected results must be established by factual evidence. Mere argument or conclusory statements in the specification does not suffice.”). We have also considered Dr. Lucht’s testimony. Ex. 2008 ¶¶ 39–41. Dr. Lucht relies on the same specification statements and presents no objective evidence of unexpected results or criticality for the molar range for M^2 . *Id.* Dr. Lucht’s testimony is therefore not sufficient to satisfy Patent Owner’s burden of production. *See In re Lindner*, 457 F.2d 506, 508 (CCPA 1972) (mere conclusory statements in the specification and affidavits are entitled to little weight and are not sufficient to show unexpected properties for the claimed compositions).

For these reasons, we determine that Petitioner has met its burden of proof for the molar amount of M^2 as recited in claim 1.

c) Element M^3

Claim 1 recites that, in formula (1), “ M^3 represents at least one element selected from the group consisting of Na, K, Rb, Be, Ca, Sr, Ba, Sc, Y, La, Hf, V, Ta, Cr, Mo, W, Tc, Re, Fe, Ru, Rh, Cu, Ag, Au, B, Ca, In, Si, P and Bi.” Ex. 1001, 29:35–38. Claim 1 further recites that, in formula (1), the molar amount of M^3 is “ v ,” where “ $0 \leq v \leq 0.05$.” *Id.* at 28:39–41.

Petitioner contends that M^3 is taught by X in Choi’s Formula 2, where “X is selected from . . . O, F, S and P,” asserting that “Choi teaches ‘P’ as M^3 .” Pet. 17 (citing Ex. 1005 ¶¶ 10, 11). Petitioner asserts that the amount of element M^3 in formula (1) in claim 1 may be zero and that Choi similarly teaches that the amount of element X in Formula 2 may be zero. Pet. 18 (citing Ex. 1001, 9:24; Ex. 1005 ¶¶ 10, 11). Petitioner contends that a POSITA would have omitted element X from Choi’s Formula 2 to make it easier to synthesize. Pet. 18 (citing Ex. 1003 ¶ 184).

Patent Owner argues that Choi does not disclose element M^3 , which “must be a metal,” and Choi “requires that X be a nonmetal.” PO Resp. 18–19 (citing Ex. 1001, 9:25–34; Ex. 2008 ¶ 43). In addition, Patent Owner argues that “[n]othing disclosed in Choi about X matters, because X must be excluded for Choi to provide an O_2 oxide like the ’035 Patent.” *Id.* at 20 (citing Ex. 2015 ¶ 11).

For the reasons discussed below, we determine that the preponderance of the evidence favors Petitioner’s position regarding element M^3 .

We agree with Petitioner that it would be improper to read M^3 as limited to a metal. Pet. Reply 13. The portion of the ’035 Patent

specification cited by Patent Owner (Ex. 1001, 9:25–34) merely provides examples of element M^3 and does not demonstrate either patentee lexicography or a disavowal of claim scope. *Thorner*, 669 F.3d at 1365 (“To act as its own lexicographer, a patentee must ‘clearly set forth a definition of the disputed claim term’ other than its plain and ordinary meaning.”); *id.* at 1365 (“The standard for disavowal of claim scope is similarly exacting.”). Understanding M^3 as not limited to a metal is consistent with the specification’s description of elements M^1 , M^2 , and M^3 , where M^1 represents a “transition metal element,” M^2 represents a “metal element,” and M^3 represents “an element other than Li, M^1 and M^2 .” Ex. 1001, 6:12–16, 9:17–20.

Regardless of the breadth of element M^3 , however, there is no dispute that formula (1) in claim 1 can omit element M^3 altogether and that Choi similarly discloses that Formula 2 can omit element X. Pet. 18; PO Resp. 20–21 (“Choi teaches that the value of α (indicating the amount of X) is $0 \leq \alpha \leq 2$ ” and “the amount ‘v’ for M^3 can be in the range $0 \leq v \leq 0.05$, meaning that M^3 could be excluded”). In other words, element M^3 is **optional** in claim 1, and Choi’s element X is likewise optional. *See* Ex. 1001, 9:20–24 (disclosing that the cathode active material “may contain no M^3 ”).

Furthermore, undisputed evidence demonstrates a POSITA would have had a reason to omit X in Choi’s Formula 2. Dr. van Schalkwijk testifies that a POSITA “would have understood that by setting ‘ α ’ at 0, [Choi’s] Formula 2 would provide an oxide O_2 , as the value of oxygen in Formula 2 (‘ $O_{2-\alpha}$ ’) is dependent upon the value of ‘ α .’” Ex. 1003 ¶ 184 (citing Ex. 1005 ¶¶ 10, 11). Patent Owner and Dr. Lucht agree that, when the value of “ α ” is zero, Choi’s Formula 2 is an oxide O_2 . PO Resp. 20;

Ex. 2015 ¶ 11. We credit Dr. van Schalkwijk's un rebutted testimony that a POSITA "would have understood that providing an oxide would make the positive electrode active material easier to synthesize because [if X were included] extra materials would have to be carefully added to the formulation to substitute for any amount of oxygen." Ex. 1003 ¶ 184.

Dr. van Schalkwijk's testimony is consistent with Choi's exemplary cathode active materials, all but one of which are oxides that omit element X.

Ex. 1005 ¶¶ 39, 41; *see also* Ex. 1017 ¶ 39 (describing a method of synthesizing a lithium-transition metal composite oxide).

For these reasons, we determine that Petitioner has met its burden of proof for element M³ as recited in claim 1.

d) Remaining Limitations of Claim 1

Based on the undisputed argument and evidence presented by Petitioner, we find that Choi teaches or suggests all remaining limitations of claim 1, except for the limitations reciting a fluorine-containing organic solvent, which are taught or suggested by Noh. Pet. 9–15, 18–21, 24–28; Ex. 1003 ¶¶ 152–177, 185–196, 204–211, 218–244; Ex. 1005 ¶¶ 9–11, 17, 18, 34, 39, 41, 46–48, 52, 61, 62, 65, 73–76, 86, Fig. 2; Ex. 1006 ¶¶ 32, 37, 39–41, 45, 64, 65.

5. Dependent Claims 2–11

Petitioner contends that the additional limitations of dependent claims 2–7, 10, and 11 are taught or suggested by Choi and the additional limitations of dependent claims 8 and 9 are taught or suggested by Noh. Pet. 28–37. Patent Owner does not present arguments for dependent claims 2–11 apart from its arguments for independent claim 1. *See* PO

Resp. 13 (asserting that “[d]ependent claims 2–11 depend from claim 1 and, due to their dependence on claim 1, these claims are not obvious”).

Based on the undisputed argument and evidence presented by Petitioner, we find that Choi teaches or suggests the additional limitations of dependent claims 2–7, 10, and 11 and that Noh teaches or suggests the additional limitations of dependent claims 8 and 9. Pet. 28–37; Ex. 1003 ¶¶ 245–322; Ex. 1005 ¶¶ 10, 11, 40, 45, 61, 73, 75, 76, 88; Ex. 1006 ¶¶ 37, 39, 50, 54–56, 64; Exs. 1017, 1018, 1022. For the same reasons as set forth above for independent claim 1, we determine that Petitioner has met its burden of proof for the limitations of dependent claims 2–11 that are incorporated by reference. *See* 35 U.S.C. 112, para. 4 (2006) (“A claim in dependent form shall be construed to incorporate by reference all the limitations of the claim to which it refers.”).

6. Conclusion for Petitioner’s Challenge based on Choi and Noh

We determine that Petitioner has shown by a preponderance of the evidence that claims 1–11 are unpatentable as obvious based on Choi and Noh.

E. Petitioner’s Negishi-led Challenges

Because we determine that Petitioner has shown that all challenged claims are unpatentable based on Choi and Noh, we do not reach Petitioner’s challenges based on Negishi and Kita, by themselves or with Ishikawa or Awano. *See SAS Inst. Inc. v. Iancu*, 138 S. Ct. 1348, 1359 (2018) (holding a petitioner “is entitled to a final written decision addressing all of the claims it has challenged”); *Boston Sci. Scimed, Inc. v. Cook Grp. Inc.*, 809 F. App’x 984, 990 (Fed. Cir. 2020) (nonprecedential) (“We agree

that the Board need not address [alternative grounds] that are not necessary to the resolution of the proceeding.”).

III. CONCLUSION

In summary:

Claim(s)	35 U.S.C. §²⁴	References	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1–11	103(a)	Choi, Noh	1–11	
1–6, 9–11	103(a)	Negishi, Kita		
8	103(a)	Negishi, Kita, Ishikawa		
7	103(a)	Negishi, Kita, Awano		
Overall Outcome			1–11	

²⁴ We do not reach Petitioner’s challenges based on Negishi and Kita, by themselves or with Ishikawa or Awano, because we determine that Petitioner has shown that all challenged claims are unpatentable based on Choi and Noh.

IV. ORDER²⁵

In consideration of the foregoing, it is hereby:

ORDERED that Petitioner has shown by a preponderance of the evidence that claims 1–11 of the '035 Patent are unpatentable; and

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

²⁵ 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*, 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).

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