

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD.,
Petitioner,

v.

RJ TECHNOLOGY, LLC,
Patent Owner.

IPR2023-01183
Patent 7,749,641 B2

Before JON B. TORNQUIST, CHRISTOPHER M. KAISER, and
BRIAN D. RANGE, *Administrative Patent Judges*.

TORNQUIST, *Administrative Patent Judge*.

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

I. INTRODUCTION

Samsung Electronics Co., Ltd., (“Petitioner”) filed a Petition requesting *inter partes* review of claims 1–18 of U.S. Patent No. 7,749,641 B2 (Ex. 1001, “the ’641 patent”). Paper 1 (“Pet.”). RJ Technology LLC (“Patent Owner”) filed a Preliminary Response. Paper 7.

An *inter partes* review may not be instituted “unless . . . the information presented in the petition . . . shows that there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.” 35 U.S.C. § 314(a) (2018). Having considered the arguments and evidence presented by Petitioner and Patent Owner, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing on at least one of the challenged claims of the ’641 patent. Accordingly, we institute an *inter partes* review as to all the challenged claims of the ’641 patent on all the grounds of unpatentability set forth in the Petition.

II. BACKGROUND

A. Related Matters

The parties indicate that the ’641 patent is the subject of *RJ Technology LLC v. Apple Inc.*, 8:22-cv-01874 (C.D. Cal., filed 2022) and *RJ Technology LLC v. Samsung Electronics Co., Ltd.*, 22-cv-00401 (E.D. Tex., filed Oct. 13, 2022). Pet. 62; Paper 6, 1.

B. Real Parties in Interest

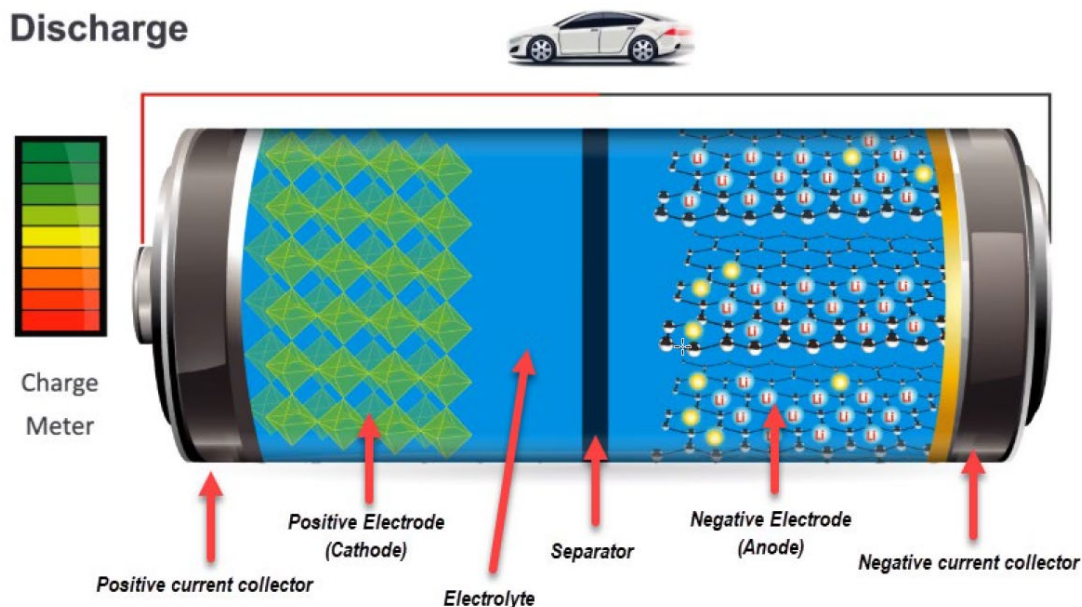
Petitioner identifies Samsung Electronics, Co., Ltd. and Samsung Electronics America, Inc. as the real parties in interest. Pet. 62.

Patent Owner identifies itself as the real party in interest. Prelim.
Resp. 1.

C. Overview of Lithium-Ion Secondary Battery Technology

The '641 patent is directed to secondary lithium-ion cells or batteries. Ex. 1001, code (57). A lithium battery is typically “made up of a positive electrode (often called a cathode) consisting of an active material coated onto a current collector, a negative electrode (often called an anode) consisting of an active material coated onto a current collector, an electrolyte, a separator, and a container or cell case.” Ex. 1002 ¶ 14.¹

A depiction of the elements of a secondary lithium-ion battery is reproduced below:



¹ The general background of lithium ion batteries is taken from Dr. Juzkow's declaration. Ex. 1002. This overview is supported by, among other things, a description provided by the United States Department of Energy in "How Lithium-ion Batteries Work." See <https://www.energy.gov/energysaver/articles/how-lithium-ion-batteries-work>.

The above depiction, annotated by Petitioner's declarant Dr. Juzkow, is based on a depiction provided in "How Lithium-ion Batteries Work," and shows a battery having a positive current collector, a positive electrode, an electrolyte, a separator, a negative electrode, and a negative current collector. *Id.* Dr. Juzkow explains that the positive electrode stores lithium atoms and releases the lithium as ions when the battery is being charged. *Id.* ¶ 15. The negative electrode stores lithium atoms and releases the lithium as ions when the battery is being discharged. *Id.* ¶¶ 15–16. The separator, which is filled with electrolyte (which includes mobile lithium ions), allows the lithium ions to flow from the negative electrode to the positive electrode and vice versa. *Id.* ¶ 15. "The process by which lithium is inserted into the structure of the positive and negative electrode materials is called 'intercalation.'" *Id.* ¶ 17.

D. The '641 patent

The '641 patent discloses "a new method for improving capacity, average operating voltage and specific energy of a secondary lithium ion cell or battery." Ex. 1001, code (57).

The '641 patent notes that the positive and negative electrode materials used in current secondary lithium ion batteries have high theoretical capacities, but a "lower actual utilization rate of said capacity." *Id.* at 1:36–40. According to the '641 patent, the lower utilization rate is "mainly caused by the limitation of charge cut-off² voltage commonly used

² The '641 patent uses the term "cut-off," whereas the parties use the term "cutoff." Ex. 1001, 1:46–47; Pet. 17; Prelim. Resp. 5; Ex. 1002 ¶ 21. We understand these terms to be equivalent and use them interchangeably.

in the art,” which is “no more than 4.2 V.” *Id.* at 1:44–47. The ’641 asserts that the technical requirement that the charge cut-off voltage not exceed 4.2 V is “well accepted” in the industry and “all lithium ion batteries in the markets around the world are manufactured under this technical requirement.” *Id.* at 1:46–51.

Although it was known in the art that capacity could be improved by increasing the charge cut-off voltage, the ’641 patent reports that the “opinions in the prior art research results and documents” were that “the positive electrode materials and negative electrode materials will undergo structure change, the electrolyte may decompose, and the recycle property of the cell will be adversely affected when the charge cut-off voltage is greater than 4.2 V.” *Id.* at 1:57–63.

The ’641 patent reports that, after conducting “a large number of experiments and studies,” it was determined that “the efficacy of electrode active materials is greatly increased by increasing the charge cut-off voltage and proper[ly] adjusting the ratio of positive electrode material to negative electrode material of [a] single lithium ion cell.” *Id.* at 3:3–12. The ’641 patent further reports that “[w]ithin a certain range of charge cut-off voltage,” it was determined that “the decomposition of little electrolyte solution brings about negligible effect on the recycle property of [the] cell.” *Id.* at 5:19–21

E. Illustrative Claims

Claims 1 and 5 are the only independent claims of the ’641 patent, with challenged claims 2–4 and 15–18 depending from claim 1, and challenged claims 6–14 depending directly or indirectly from independent

claim 5. Claims 1 and 5 are illustrative of the challenged claims and are reproduced below.

1. A method for improving the capacity, average operating voltage and specific energy of a secondary lithium ion cell or battery, characterized in that the charge cut-off voltage of the secondary lithium ion cell or battery is greater than 4.2 V but less than 5.8 V; and a ratio of positive electrode material to negative electrode material of the secondary lithium ion cell or battery is from 1:1.0 to 1:2.5 as calculated by a specific capacity with a charge voltage limited to 4.2 V.

Ex. 1001, 16:54–61.

5. A secondary lithium ion cell or battery, characterized in that the secondary lithium ion cell or battery has a charge cut-off voltage of greater than 4.2 V but less than 5.8 V, and a ratio of positive electrode material to negative electrode material of the secondary lithium ion cell or battery is from 1:1.0 to 1:2.5, as calculated by a theoretic capacity with a charge cut-off voltage set at 4.2 V.

Id. at 17:5–11.

F. Asserted Grounds of Unpatentability

Petitioner asserts the following grounds of unpatentability (Pet. 7):³

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–8	102(e)	Uemura ⁴
1–8, 11–18	103(a)	Uemura
11–18	103	Uemura, Guyomard ⁵

³ The relevant sections of the Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112–29, took effect on March 16, 2013. The ’641 patent issued July 6, 2010. Ex. 1001, code (45). Thus, we apply the pre-AIA versions of §§ 102 and 103.

⁴ US 2002/0012830 A1, published January 31, 2002. Ex. 1009 (“Uemura”).

⁵ D. Guyomard and J.M. Tarascon, *Li Metal-Free Rechargeable*

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–8	102(b)	Abe ⁶
1–8	103(a)	Abe
2–4, 6–8, 11–18	103(a)	Abe, Guyomard
9	103	Uemura, Iwaizono ⁷
9–10	103	Uemura, Iwaizono, Guyomard
9–10	103	Abe, Guyomard, Iwaizono

III. ANALYSIS

A. Legal Standard

A claim may be invalid as anticipated if “each and every limitation is found either expressly or inherently in a single prior art reference.” *Sanofi–Synthelabo v. Apotex, Inc.*, 470 F.3d 1368, 1375 (Fed. Cir. 2006) (internal quotation marks omitted). Anticipation under § 102 may be established by showing, as a matter of fact, that all elements arranged as specified in a claim are disclosed within the four corners of a reference, either expressly or inherently, in a manner enabling one skilled in the art to practice an embodiment of the claimed invention without undue experimentation. *See ClearValue, Inc. v. Pearl River Polymers, Inc.*, 668 F.3d 1340, 1344 (Fed. Cir. 2012).

A patent claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter and “the prior art are such

LiMn₂O₄/Carbon Cells: Their Understanding and Optimization, J. Electrochem. Soc. 1992, (937–948). Ex. 1015 (“Guyomard”).

⁶ JP Patent Application Publication No. H10[1998]-189052, published July 21, 1998. Ex. 1005 (“Abe”).

⁷ US 6,577,105 B1, issued June 10, 2003. Ex. 1007 (“Iwaizono”).

that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) when in evidence, objective evidence of nonobviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

B. Level of Ordinary Skill in the Art

In order to determine whether an invention would have been obvious at the time the application was filed, we consider the level of ordinary skill in the pertinent art. *Graham*, 383 U.S. at 17. The resolution of this question is important because it allows us to “maintain[] objectivity in the obviousness inquiry.” *Ryko Mfg. Co. v. Nu-Star, Inc.*, 950 F.2d 714, 718 (Fed. Cir. 1991).

In assessing the level of ordinary skill in the art, various factors may be considered, including the “type of problems encountered in the art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field.” *In re GPAC, Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (quotation omitted).

Petitioner contends that a person of ordinary skill in the art “would have had a Master’s degree in material science, chemical engineering, chemistry, or similar field with four years of experience designing testing, and building secondary lithium batteries.” Pet. 11 (citing Ex. 1002 ¶ 51).

Petitioner further contends that a person of ordinary skill in the art would have been aware of “(1) positive electrode materials, (2) negative electrode materials, (3) separators, (4) electrolytes, (5) charge-discharge parameters, and (6) protection circuits, as well as ‘battery failure modes’ such as plating and the formation of dendrites.” *Id.*

For purposes of this Decision, “Patent Owner does not dispute Petitioner’s definition, except noting that other majors may provide equivalent education and experience designing, testing, and building lithium batteries.” Prelim. Resp. 19.

Upon review of the prior art of record and the parties’ arguments, we adopt Petitioner’s unopposed definition of the person of ordinary skill in the art for purposes of this Decision. The parties may further address at trial whether “other majors” should be added to this definition, and whether such a modification would have any impact on the unpatentability determination in this case.

C. Claim Construction

In an *inter partes* review proceeding, a patent claim is construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b). 37 C.F.R. § 42.100(b) (as amended Oct. 11, 2018). This rule adopts the same claim construction standard used by Article III federal courts, which follow *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc), and its progeny. Under this standard, the words of a claim are generally given their “ordinary and customary meaning,” which is the meaning the term would have to a person

of ordinary skill at the time of the invention, in the context of the entire patent including the specification. *See Phillips*, 415 F.3d at 1312–13.

Petitioner provides constructions for the preamble term “A method for improving . . . characterized in that,” “ratio of positive electrode material to negative electrode material as calculated by a theoretic capacity with a charge cut-off voltage set at 4.2 V” (claim 5), and “as calculated by a specific capacity with a charge cut-off voltage set at 4.2 V” (claim 1), and “at least 7500 of capacity” (claim 11). Pet. 8–11.

Patent Owner contends the Board is precluded from addressing the issue of the preamble in this case and “takes no position” on Petitioner’s proposed constructions of how the theoretic and specific capacity are calculated. Prelim. Resp. 16–17. Patent Owner also “takes no position as to the appropriate construction of ‘charge cut-off voltage,’ other than to state that the term . . . should be construed as ‘the charge cut-off voltage of a full-cell (two-electrode) system.’” *Id.* at 17–18.

For purposes of this decision, we determine that no claim terms require express construction. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (“[O]nly those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy.”)). We do, however, address Patent Owner’s arguments regarding a two-electrode system in our discussion of Petitioner’s grounds based on Abe.

D. Anticipation by Uemura

Petitioner asserts that claims 1–8 are anticipated by Uemura under 35 U.S.C. § 102(e). Pet. 16–28.

1. *Uemura*

Uemura discloses a “non-aqueous electrolytic rechargeable lithium battery” and, more particularly, “a negative electrode material and a positive electrode material for improving cyclic resistance.” Ex. 1009 ¶ 2.

The positive electrode of Uemura “is not particularly limited,” but is preferably a “Li deficient type lithium manganese complex oxide of a layer structure, which is represented by a general formula $\text{Li}_{1-x}\text{MnO}_2$, $\text{Li}_{1-x}\text{Mn}_{1-y}\text{M}_y\text{O}_2$, or $\text{Li}_{1-x}\text{Mn}_{1-y}\text{M}_y\text{O}_{2-\delta}$.” *Id.* ¶ 35. Uemura explains that when the lithium deficient quantity x is small, “the quantity of lithium deficient from a congruent composition of the lithium-containing complex oxide is reduced, leading to a tendency of deterioration of the battery during the charge-discharge by Li ion movement, which is not preferable.” *Id.* ¶ 43. “When the lithium deficient quantity is too much, the quantity of lithium deficient from the congruent composition is increased, leading to a tendency that a sufficient capacity cannot be secured.” *Id.*

The negative electrode is preferably “a carbon material for use in a typical non-aqueous electrolytic secondary battery.” *Id.* ¶ 53. The irreversible capacity of the carbon material can be selected by controlling the carbon content in the material. *Id.*

Uemura explains that the capacity balance ratio B/A of the total capacity B of the negative electrode material to the total capacity A of the positive electrode material is preferably “fixed at a range of 1 to 1.5.” *Id.* ¶ 33. Uemura explains that “[i]f the capacity balance ratio B/A is below 1, lithium ion holding sites on the negative electrode material become insufficient,” and dendrite crystals may form, potentially causing a short circuit within the battery. *Id.* In contrast, “[i]f the capacity balance ratio

B/A exceed 1.5, negative electrode sites that do not contribute to the charge-discharge are increased, leading to the wasteful use of materials.” *Id.*

Uemura discloses 17 exemplary batteries using its disclosed positive and negative electrode materials. *Id.* ¶ 69. Charge-discharge of these batteries was “repeatedly performed at a constant current of 0.5 mA/cm² and a voltage ranging from 4.3 V to 2.0 V at an atmospheric temperature of 60° C.” *Id.* ¶ 81.

2. Analysis: Independent Claim 1

Petitioner contends that Uemura anticipates claim 1. In particular, to the extent the preamble of claim 1 is limiting, Petitioner contends that Uemura expressly discloses negative and positive electrode materials that improve “cyclic resistance” and capacity (and therefore provide a higher specific energy).⁸ Pet. 16. Petitioner further contends that Uemura discloses a charge cut-off voltage of 4.3 V, which is “greater than 4.2 V but less than 5.8 V, as recited in claim 1.” *Id.* at 17 (citing Ex. 1002 ¶ 113; Ex. 1009 ¶ 81). Petitioner further contends that the ratio of positive to negative electrode material of Uemura is “preferably fixed at a range of 1 to 1.5, which falls within the claimed range of 1:1.0 to 1:2.5,” and Uemura provides specific examples of capacity balance Pc:Nc of 1:1.3 and 1:1.5. *Id.* at 17–18.

⁸ Claim 1 recites a method with no identified steps. Ex. 1001, 16:54–61. The parties do not dispute, at present, that use of a battery that has the disclosed limitations would satisfy the method of claim 1. Pet. 8–9; Prelim. Resp. 16. For purposes of this Decision, because the issue is not in dispute, we likewise determine that use of a battery with the disclosed limitations would satisfy the recited method.

Petitioner contends that, although Uemura's ratios would have been calculated using a charge cutoff voltage of 4.3 V, i.e., the charge cutoff voltage used in the battery, a person of ordinary skill in the art would have understood that Uemura's ratio of positive to negative capacity "would remain within the range of the '641 patent when determined at a charge cutoff voltage of 4.2 V instead of 4.3 V." *Id.* at 20 (citing Ex. 1002 ¶¶ 121–123).

Patent Owner contends Petitioner's anticipation ground based on Uemura fails because (1) Uemura fails to disclose the claimed capacity ratio limitation; (2) Uemura fails to disclose the claimed capacity ratio with sufficient specificity; and (3) Uemura fails to describe the claimed charge cut-off voltage range with sufficient specificity. We address each issue below.

- a. *A ratio of positive electrode material to negative electrode material of the secondary lithium ion cell or battery is from 1:1.0 to 1:2.5 . . . measured at a charge cut-off voltage set at 4.2V*

Uemura discloses a capacity ratio of between 1:1.0 and 1:1.5, with specific examples of 1:1, 1:1.3, and 1:1.5. Ex. 1009 ¶ 33, Fig. 3. Charge-discharge performance of the disclosed batteries was tested using a constant current of 0.5 mA/cm² and a voltage ranging from 4.3 V to 2.0 V. *Id.* ¶ 81. Dr. Juzkow testifies that one of ordinary skill in the art would have understood that the ratio of positive to negative electrode capacities would be measured at the cut-off voltage used in the battery, i.e., 4.3 V in Uemura. Ex. 1002 ¶ 117. Dr. Juzkow further testifies that calculating the ratio of positive to negative electrodes using 4.2 V (as opposed to 4.3 V) would increase the ratio, as less lithium is extracted from the positive electrode at

this voltage, but one of ordinary skill in the art would have understood that with a decrease in the charge cutoff voltage of 0.1 V, the decreased amount of lithium extracted from the cathode would not have caused the disclosed range to fall outside of the claimed range. *Id.* ¶ 122 (pointing to charge/discharge curves for lithium manganese oxides, showing “that the capacity does not change rapidly with the addition (or subtraction) of additional voltage above about 4.2 V”). Thus, Dr. Juzkow testifies the one of ordinary skill in the art, reading Uemura’s express disclosures, “would have understood that Uemura’s capacity ratio of between 1:1 to 1:1.5 would have been slightly higher at a cutoff voltage of 4.2 V, but would still have fallen within the range of between 1:1.0 and 1:2.5 as recited in claim 1.” *Id.* ¶ 123.

Patent Owner contends Uemura does not disclose a capacity ratio measured at any voltage level, let alone 4.2 V. Prelim. Resp. 19–20. According to Patent Owner, to overcome this deficiency in the express disclosures of Uemura, Petitioner asserts that a person of ordinary skill in the art “would have” known or “understood” that Uemura’s battery capacity would have been measured at the charge cut-off voltage required under the ’641 Patent. *Id.* at 20. Patent Owner contends Petitioner’s speculative assertions as to how a person of ordinary skill in the art might interpret Uemura “cannot substitute for the lack of detail and specificity required for anticipation by the Federal Circuit, which has held that ‘the Board [may not] fill in missing limitations even when a skilled artisan would immediately envision them.’” *Id.* at 20–21 (citing *Nidec Motor Corp. v. Zhonshan Broad*

Ocean Motor Co., 868 F.3d 1013, 1274–75 (Fed. Cir. 2017)).⁹ According to Patent Owner, Petitioner’s anticipation arguments require “precisely the types of gymnastics which the Federal Circuit has admonished are not permitted in the context of evaluating whether a reference anticipates where it does not expressly disclose a limitation.” *Id.* at 21 (asserting that Uemura discloses experiments performed at a broad range of voltages—between 4.3 to 2.0 V—without any guidance as to the voltage for which a person of ordinary skill in the art “should or should not measure or design the capacity ratio”).

As Patent Owner notes, anticipation requires “that a single reference ‘describe the claimed invention *with sufficient precision and detail* to establish that the subject matter existed in the prior art.’” *Wasica Finance GmbH v. Continental Automotive Systems, Inc.*, 853 F.3d 1272, 1284 (Fed. Cir. 2017) (quoting *Verve, LLC v. Crane Cams, Inc.*, 311 F.3d 1116, 1120 (Fed. Cir. 2002)). And, “‘the Board [may not] fill in missing limitations even when a skilled artisan would immediately envision them.’” *Nidec*, 851 F.3d at 1274–1275. That does not mean, however, that the absence of any expressly disclosed limitation will bar an anticipation finding. Rather, “[a]nticipation is established when ‘one skilled in the art would reasonably understand or infer from the prior art reference’s teaching that every claim [limitation] was disclosed in that single reference.’” *Genentech, Inc. v. Hospira, Inc.*, 946 F.3d 1333, 1340 (Fed. Cir. 2020) (quoting *CRFD Research, Inc. v. Matal*, 876 F.3d 1330, 1338 (Fed. Cir. 2017)); *Wasica*, 853

⁹ The quotation comes from *Nidec Motor Corp. v. Zhonshan Broad Ocean Motor Co.*, 851 F.3d 1270, 1274–1275 (Fed. Cir. 2017).

F.3d at 1284 (“Anticipation is an inquiry viewed from the perspective of one of ordinary skill in the art.”).

On this record, Petitioner sufficiently explains why one of ordinary skill in the art would have understood that the charge cut-off voltage in Uemura is 4.3 V. Ex. 1002 ¶¶ 111, 113, 117. Petitioner also sufficiently explains why one of ordinary skill in the art would have measured the capacity ratio using the charge cut-off voltage used in the battery. *Id.* ¶ 117. And, although Uemura’s charge cut-off value of 4.3 V is higher than the 4.2 V used to measure capacity ratio in claim 1, Dr. Juzkow sufficiently explains that this difference of 0.1 V would not shift the capacity ratio below the 1:1.0 lower limit or over the 1:2.5 upper limit set forth in claim 1, when measured at 4.2 V. *Id.* ¶ 122. *See Wasica*, 853 F.3d at 1284 (noting that “it was reasonable for the Board to accept” expert testimony over “bare attorney argument”).

b. Specificity of the Disclosed Ranges

Patent Owner contends that Uemura’s charge cutoff range of 4.3 V to 2.0 V only partially overlaps the claimed range of “greater than 4.2 V but less than 5.8 V,” and Uemura’s capacity ratio of 1:1 to 1:1.5 only partially overlaps the claimed range of 1:1 to 1:2.5. Prelim. Resp. 30, 37. And, because these claimed ranges are critical to the operation of the battery, Patent Owner contends Uemura does not anticipate the claimed ranges. *Id.*

Patent Owner’s arguments do not dissuade us from instituting trial. Dr. Juzkow testifies that the disclosure in Uemura of applying a charge-discharge cycle to the batteries at a voltage ranging from 4.3 V to 2.0 V, means that the batteries were repeatedly charged to a cutoff voltage of 4.3 V and then discharged through 2.0 V. Ex. 1002 ¶¶ 111, 113 (“The 4.3 V value

is the charge cutoff voltage because it reflects the maximum voltage to which Uemura's batteries are charged to.”) (citing Ex. 1009 ¶ 81). Thus, the evidence of record supports that Uemura does not disclose a range of cutoff voltage values, but rather a single charge cutoff voltage of 4.3 V. Ex. 1009 ¶ 81; Ex. 1002 ¶ 113.

Patent Owner contends Uemura's disclosure is ambiguous as to whether 4.3 V is the actual “charge cut-off” value or “simply a *potential* maximum value in a set of experiments that a [person of ordinary skill in the art] may or may not follow.” Prelim. Resp. 35–36. Patent Owner's attorney argument raises, at most, a material issue of fact as to how one of ordinary skill in the art would interpret the 4.3 voltage disclosure of Uemura that is best resolved on a complete trial record.

With respect to the claimed range for the ratio of positive electrode material to negative electrode material, we note that the disclosed range of Uemura of 1:1 to 1:1.5 is completely encompassed by the claimed range of 1:1.0 to 1:2.5. See Ex. 1002 ¶¶ 121–123 (noting that measuring the ratio at a voltage of 4.3 V means that the ranges of Uemura would be slightly higher than the values measured at a cutoff voltage of 4.2 V). That is sufficient to anticipate. In addition, Petitioner points to specific examples in Uemura that utilize a ratio of positive to negative electrode material of 1:1.3, a value that falls squarely within the claimed range. Pet. 18–19; Ex. 1002 ¶¶ 115–116, 127; Ex. 1009, Fig. 3.

c. Conclusion – Claim 1

For the reasons set forth above, Petitioner demonstrates a reasonable likelihood that claim 1 of the '641 patent is anticipated by Uemura.

3. Analysis: Independent Claims 5

Claim 5 contains the same limitations as independent claim 1, but is directed to a “secondary lithium ion cell or battery,” as opposed to a method. Ex. 1001, 16:54–61; 17:5–11. For the reasons set forth above with respect to independent claim 1, Petitioner demonstrates a reasonable likelihood that claim 5 is anticipated by Uemura.

4. Analysis: Dependent claims 2–4 and 6–8

Petitioner contends claims 2–4 and 6–8, which narrow the ranges for the charge cut-off voltage and capacity ratios, are anticipated for the same reasons discussed above with respect to independent claim 1. Pet. 27–28. Patent Owner does not address Petitioner’s arguments with respect to claims 2–4 and 6–8, apart from its arguments for independent claims 1 and 5.

Upon review of the arguments and evidence of record, we determine that Petitioner demonstrates a reasonable likelihood that claims 2–4 and 6–8 are anticipated by Uemura.

E. Claims 1–8 as Obvious over Uemura

Petitioner contends that claims 1–8 would also have been obvious over Uemura. Pet. 16–28.

Patent Owner contends claims 1–8 would not have been obvious over Uemura because the prior art teaches against the claimed charge cut-off voltage ranges, practicing the claimed capacity ratio range, and modifying the claimed charge cut-off voltage range and capacity ratio in tandem. Prelim. Resp. 38–48.

a. *Modifying Charge Cut-off Voltage Above 4.2 V*

Patent Owner contends the prior art expressly cautioned against increasing the amount of lithium extracted from the cathode, which is the result of increasing the charge cut-off voltage. Prelim. Resp. 38–44. In support of its position, Patent Owner identifies multiple prior art references which caution against applying excess charging voltage, which can result in overcharging, destabilization of the cathode, and thermal runaway and fires. *Id.* at 38–41; Ex. 2001. Patent Owner also contends that Uemura “teaches that it is desirable to reduce the amount of lithium ions in circulation in the battery because it improves the battery’s operation characteristics.” Prelim. Resp. 39 (citing Ex. 1009 ¶ 40).

On this record, Patent Owner’s arguments do not dissuade us from instituting trial. As noted by Patent Owner, certain lithium cathode materials have an upper limit charging cutoff voltage of 4.2 V. Ex. 2001, 53 (“Lithium-ion batteries have voltage charging limits that are specific to the chemistry of the positive/negative electrode couple and electrolyte materials.”). In particular, batteries using LiCoO_2 , the “most common cathode material,” have an upper limit of 4.2 V. *Id.* Uemura, however, does not use LiCoO_2 as its cathode material, and specifically notes that this material is both expensive and “unstable under an environment where a battery is operated.” Ex. 1009 ¶ 6. Rather, Uemura uses $\text{Li}_{1-x}\text{MnO}_2$, $\text{Li}_{1-x}\text{Mn}_{1-y}\text{M}_y\text{O}_2$, or $\text{Li}_{1-x}\text{Mn}_{1-y}\text{M}_y\text{O}_{2-\delta}$ cathode materials in its examples. Ex. 1009 ¶¶ 35, 83–99 (Examples 1–17). These materials were subjected to multiple “charge-discharge” cycles at a constant current and “a voltage ranging from 4.3 V to 2.0 V.” *Id.* ¶ 81. To the extent that the 4.3 V number reported in Uemura constitutes the “charge cut-off voltage,” as testified to

by Dr. Juzkow, we can discern no negative operational concerns in Uemura from using this voltage level. Indeed, Uemura reports that its example batteries achieved “cyclic resistance of roughly 10 to 35 times that” of the “comparison example.” Ex. 1009 ¶ 102. As such, on this record, we are not persuaded that Uemura, or the prior art as a whole, teaches against using a charge cut-off voltage of 4.3 V in Uemura.

b. Increasing Capacity Ratio

Patent Owner contends the prior art taught against adapting batteries to practice the claimed capacity ratio. Prelim. Resp. 44. First, Patent Owner contends Uemura teaches that increasing anode capacity beyond what is needed for the “charge-discharge” leads to “wasteful use of materials.” *Id.* at 44–45 (citing Ex. 1002 ¶ 188). Second, Patent Owner contends the purported reasons for increasing the capacity ratio to allow higher charge cut-off voltages is taught against by the prior art. *Id.* at 45. Finally, Patent Owner contends Petitioner has failed to identify a single reference containing a disclosure that would otherwise motivate one of ordinary skill in the art “to practice the claimed capacity ratio ranges for the purpose of raising the charge cut-off voltage.” *Id.*

Claims 1 and 5 require a ratio of positive electrode material to negative electrode material of between 1:1.0 and 1:2.5, when measured at a cut-off voltage of 4.2 V. The range of 1:1.0 to 1:1.5 suggested in Uemura falls entirely within the claimed range and this suggestion is sufficient to support an obviousness conclusion. *See In re Peterson*, 315 F.3d 1325, 1329 (Fed. Cir. 2003) (“a *prima facie* case of obviousness typically exists when the ranges of a claimed composition overlap the ranges disclosed in the prior art.”). Petitioner also provides reasoning as to why such a range would be

adopted by one of ordinary skill in the art. In particular, Uemura expressly discloses that the capacity ratio of a lithium-ion battery should not be below 1, as the “lithium holding sites on the negative electrode material become insufficient.” Ex. 1009 ¶ 33. Conversely, if the capacity ratio exceeds 1.5, “negative electrode sites” that do not contribute to the charge-discharge are increased, “leading to wasteful use of materials.” *Id.*

With respect to Patent Owner’s counter-arguments, we note that for the reasons discussed above, we are not persuaded that the prior art teaches away from a charge cutoff value of 4.3 V. Moreover, contrary to Patent Owner’s arguments, we do not understand Petitioner to argue that one of ordinary skill in the art would increase the capacity of Uemura’s anode, but rather that one of ordinary skill in the art would have understood that Uemura already discloses a range of positive to negative electrode material that is fully encompassed by the claimed range, when measured at 4.2 V. *See* Pet. 24–25.

c. Charge Cut-off Voltage Range in Tandem with Capacity Ratio Range

Patent Owner contends the claims specify a charge cut-off voltage (greater than 4.2 V) that is higher than the charge voltage used to calculate the ratio of positive electrode material to negative electrode material (4.2 V). Prelim. Resp. 46. Patent Owner further contends that Uemura does not suggest a charge cut-off voltage that is higher than the charge voltage used to determine the ratio of positive to negative electrode material, and Dr. Juzkow testifies that one of ordinary skill in the art would not have used different values for these voltages. *Id.* at 46–47. Indeed, Patent Owner contends the prior art of record “consistently taught away from a charge cut-

off voltage higher than the design capacity voltage.” *Id.* at 47.

On this record, we understand independent claims 1 and 5 to require a ratio of positive electrode material to negative electrode material that is from 1:1.0 to 1:2.5, when measured at a charge cut-off voltage of 4.2 V.

Ex. 1001, 16:58–60, 17:5–11. We do not understand the claims to require that the calculation actually be conducted at 4.2 V, as long as the battery has properties such that the ratio of positive to negative electrode material in the disclosed battery falls within the range of 1:1.0 to 1:2.5 when measured at 4.2 V. Dr. Juzkow testifies that Uemura teaches or suggests such a ratio.

With respect to Patent Owner’s teaching away arguments, Patent Owner points to evidence that one of ordinary skill in the art would avoid calculating a capacity balance between the positive and negative electrode using a voltage that is higher than or lower than the charge cutoff voltage. Ex. 1002 ¶ 132. We do not understand Petitioner’s argument, however, to be that one of ordinary skill in the art would calculate the capacity ratio using a voltage other than the charge cut-off voltage. Rather, Petitioner contends that one of ordinary skill in the art would have understood that Uemura, when applied by one of ordinary skill in the art, would calculate the capacity ratio at the charge cut-off voltage of 4.3 V, and that the capacity ratio of the battery would fall within the claimed ranges, when measured at 4.2 V.

d. *Conclusion*

For the reason discussed above, we determine that Petitioner demonstrates a reasonable likelihood that claims 1–8 would have been obvious over Uemura.

F. Claims 11–18 over Uemura or Uemura in view of Guyomard

Claims 11–14 depend from claim 5 and further require “wherein the secondary lithium ion cell or battery maintains at least 75%¹⁰ of capacity after 400 cycles” (claim 11), 75.83% capacity after 400 cycles (claim 12), 80% capacity after 400 cycles (claim 13), and 80.72% capacity after 400 cycles (claim 14). Ex. 1001, 18:4–16. Claims 15–18 further limit the method of claim 1, and require the same retention of battery capacity as recited in claims 11–14, respectively. *Id.* at 18:17–28.

Petitioner contends the subject matter of claims 11–18 would have been obvious over the combined disclosures of Uemura or Uemura and Guyomard. Pet. 28–34.

1. *Guyomard*

Guyomard discloses “electrolyte compositions that are capable of resisting decomposition normally resulting from oxidation which occurs in $\text{Li}_{1+x}\text{Mn}_2\text{O}_4$ /carbon cells during recharging under conditions of greater than about 4.5 V or 55° C.” Ex. 1008, 1:11–15.

Guyomard reports that in a cell recycling test, test cells comprising a $\text{Li}_{1+x}\text{Mn}_2\text{O}_4$ /carbon positive electrode, a carbon (graphite or petroleum coke) negative electrode, and an electrolyte of 1 M LiPF_6 in 95 DMC (dimethylcarbonate):5 EC (ethylene carbonate), “were repeatedly charged and discharged over two hours cycles at about 25° C and 55° C and at charging cut-off voltages of 4.9 V and 4.5 V, respectively.” *Id.* at 8:23–37.

¹⁰ Claim 11 recites “at least 7500 of capacity.” Both parties agree that this is a typographical error and should be read as “at least 75% of capacity.” Pet. 11; Prelim. Resp. 17.

Guyomard notes that “[e]ven at this cycling rate and high charging voltage . . . there was no significant loss of cell capacity, verifying the high voltage stability of the electrolyte.” *Id.* at 8:37–9:5. According to Guyomard, “[t]he ability of the electrolyte to extend the cycle life of the batteries was amply demonstrated by the remarkable fact that the cell capacities after 500 cycles was only about 10% less than after 5 cycles.” *Id.* at 9:5–8.

2. Analysis

Petitioner contends that Uemura provides test results showing that certain tested batteries “provided between 330–350 cycles before the remaining capacity dropped to 90%.” Pet. 28–29 (citing Ex. 1009 ¶ 81, Fig. 3). Petitioner further contends that because 90% capacity remained at 330 or 350 cycles, one of ordinary skill in the art would understand that “Uemura suggests that its batteries would maintain at least 80.72% of its initial capacity after 400 cycles.” *Id.* at 30–31 (citing Ex. 1002 ¶¶ 137–141).

Petitioner further contends that one of ordinary skill in the art would have understood that Uemura’s cyclability could have been further improved by using the electrolyte of Guyomard, which can withstand high voltage charging without significant oxidation. *Id.* at 31 (citing Ex. 1002 ¶¶ 143–152). In particular, Petitioner contends that one of ordinary skill in the art would have been motivated to adjust the molar concentration of LiPF_6 in Uemura’s electrolyte to compensate for the higher temperature used by Uemura. *Id.* at 32–33.

Patent Owner does not address Petitioner’s arguments with respect to dependent claims 11–18.

On this record, we determine that Petitioner demonstrates a reasonable likelihood that claims 11–18 would have been obvious in view of at least Uemura and Guyomard.

G. Anticipation of Claim 1–8 by Abe

Petitioner contends claims 1–8 are anticipated by Abe. Pet. 34–41.

1. *Abe*

Abe discloses “non-aqueous electrolyte-based secondary batteries” that have “no risk of rupture and ignition, excellent cycle characteristics, and good stability against higher loads.” Ex. 1005, code (57). Abe notes that “in the case of overcharging lithium-ion secondary batteries or when the charging current is increased, etc., needle-like lithium may be precipitated on the surface of the negative electrode,” which makes “it easier to break through the separator and short out.” *Id.* ¶ 9.

In its disclosed secondary batteries, Abe notes that “the design capacity of the negative electrode is adjusted so that the design capacity of the negative electrode is greater than the design capacity of the cathode.” *Id.* ¶ 78. “The design capacity is determined, for example, from the initial charge capacity per unit weight of the active material in a predetermined charging voltage range and the amount of active material coated on the current collector.” *Id.* “The charging capacity can be obtained, for example, by continuously recording a voltage that changes over time by applying a constant current using a three-electrode cell in which both the counter and the reference pole are made of metal lithium.” *Id.* For LiMn_2O_4 positive electrodes, the voltage is set at 4.2 to 4.3 V, preferably 4.2 V. *Id.*

Abe compares two disclosed embodiments to three comparative examples. *Id.* ¶ 94. The negative electrode/cathode design capacity of Embodiment 1 was 1.2 and the design capacity of Embodiment 2 was 1.1. *Id.* Abe also discloses a negative electrode “having a design capacity of more than 1 and less than or equal to 1.6 for the design capacity of the positive electrode.” *Id.* ¶ 18.

Abe concludes that its disclosed non-aqueous electrolyte-based secondary batteries “have high electrical conductivity,” “excellent cycle characteristics,” “high capacity,” and “a long service life.” *Id.* ¶ 121.

2. Analysis – Independent Claim 1

Petitioner contends that the preamble of claim 1 is disclosed in Abe because its batteries “exhibit high capacity,” have “high energy density and excellent cycle characteristics,” and have a charge cutoff voltage of 4.2–4.3 V. Pet. 34–35 (citing Ex. 1005 ¶¶ 11, 17, 78; Ex. 1002 ¶¶ 156–159). Petitioner further contends that a charge cutoff voltage of greater than 4.2 but less than 5.8 V is disclosed by Abe’s charge cutoff voltage range of 4.2–4.3 V. *Id.* at 36. Petitioner further contends that a ratio of positive to negative electrode material from 1:1.0 to 1:2.5 as calculated at 4.2 V is disclosed by Abe’s example battery with a ratio of 1.1 and a disclosed range of 1 to 1.6. *Id.* at 37, 40. According to Petitioner, although the ratio would have been calculated at a charge cutoff of 4.3 V, this ratio would only increase slightly and would still remain less than 1:2.5 when measured at 4.2 V. *Id.* at 39 (citing Ex. 1002 ¶¶ 120–123, 167).

Patent Owner contends that Abe measures its voltage in a three-electrode cell, whereas the ’641 patent describes the “charge cut-off voltage” as the full cell voltage between the negative electrode and the positive

electrode. Prelim. Resp. 22–24. According to Patent Owner, “because Abe discloses a voltage range in a different battery cell than that claimed in the ’641 patent, Abe does not disclose the claimed voltage range.” *Id.* at 24.

Dr. Juzkow testifies that Abe expressly discloses a charge cutoff voltage range of 4.2 to 4.3 V. Ex. 1002 ¶ 161. This range overlaps the claimed range. Patent Owner’s counter-argument regarding measuring the voltage using a three-electrode cell raises, at most, a material issue of fact as to how one of ordinary skill would have interpreted Abe’s disclosure of a charge cutoff voltage of 4.2–4.3 V that is best resolved on a full trial record and after reviewing cross-examination testimony of each parties’ declarant(s).

Patent Owner also argues that the claimed ranges are critical and, therefore, the charge cut-off range of 4.2–4.3 V and the capacity ratio of “more than 1 and less than or equal to 1.6” in Abe do not anticipate the broader ranges of greater than 4.2 V but less than 5.8 V and 1:1.0 to 1:2.5. Prelim. Resp. 25–33. According to Patent Owner, taken at face value, Dr. Juzkow’s opinions confirm that the recited cut-off voltage and capacity ratio ranges recited in claims 1 and 5 are “critical.” *Id.* at 27–30.

Once Petitioner presents evidence of an overlapping range, the burden of production to present evidence demonstrating criticality rests on Patent Owner. *See Genentech*, 946 F.3d at 1338. Patent Owner presents citations to the ’641 patent and Dr. Juzkow’s testimony to show that one of ordinary skill in the art “would expect that a battery would operate differently if it were charged to a lower voltage than the claimed voltage range,” or if “its anode capacity were not adjusted in a capacity ratio range that corresponds to the claimed voltage range.” Prelim. Resp. 28–30; *Ineos USA LLC v.*

Berry Plastic Corp., 783 F.3d 865, 870 (Fed. Cir. 2015) (determining whether the patent owner presented evidence that the novel properties of the disclosed invention “would differ if the range from the prior art . . . [were] substituted for the range” recited in the claim). Petitioner, however, has not yet had an opportunity to address this evidence. Accordingly, Patent Owner’s arguments raise, at most, a material issue of fact that is best resolved on a complete trial record.¹¹

In view of the foregoing, we determine that Petitioner demonstrates a reasonable likelihood that claim 1 is anticipated by Abe.

3. Analysis – Claims 2–8

Petitioner contends that claims 2–8 are also anticipated by Abe. Pet. 34–41. Patent Owner does not address Petitioner’s arguments with

¹¹ Patent Owner asserts that criticality of a claimed range may be demonstrated by showing that “a battery would operate differently if it were charged to a lower voltage than the claimed voltage range.” Prelim. Resp. 29. There is support for Patent Owner’s contention that a range is “critical” when the invention would “operate differently” outside of the claimed range. *Ineos*, 783 F.3d at 869. We note, however, that other cases have defined “critical” ranges as those that “produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art.” *In re Aller*, 220 F.2d 454, 456 (CCPA 1955); *In re Wertheim*, 541 F.2d 257, 267 (CCPA 1976) (noting that the “criticality in the claimed range” can be shown “by evidence of unexpected results”); *El DuPont de Nemours & Co. v. Synvina C.V.*, 904 F.3d 996, 1006 (Fed. Cir. 2018) (“A claimed range that demonstrates such unexpected results is referred to as a ‘critical’ range.”). The parties are encouraged to address during trial what differences in operation would demonstrate that a particular range is critical to the claimed lithium-ion batteries, and whether the doctrine of “criticality” is even applicable when the prior art range falls entirely within the claimed range.

respect to these claims, apart from its arguments directed to independent claim 1 (and independent claim 5).

Upon review of the arguments and evidence of record, we determine that Petitioner demonstrates a reasonable likelihood that claims 2–8 are anticipated by Abe.

H. Claims 1–8 as Obvious in view of Abe

Petitioner also contends that claims 1–8 would have been obvious in view of the disclosures of Abe. Pet. 34–41. In particular, to the extent the voltage range of 4.2–4.3 V and capacity ratio of 1 to 1.6 set forth in Abe do not anticipate, Petitioner contends these disclosures would have rendered the claimed ranges *prima facie* obvious. *Id.* at 36, 40.

Patent Owner presents the same arguments against obviousness based on Abe as its arguments against obviousness based on Uemura. Prelim. Resp. 38–48. For the reasons set forth above with respect to obviousness based on Uemura, we determine that Patent Owner’s arguments raise, at most, material issues of fact that are best resolved on a complete trial record.

With respect specifically to Abe, Patent Owner also argues that Petitioner has not advanced any argument as to why a person of ordinary skill in the art “would be motivated to adapt Abe’s system to practice the claimed voltage range in the ’641 Patent’s two-electrode (or full-cell battery).” *Id.* at 43–44.

Patent Owner asserts that the ’641 patent “nowhere mentions a battery having a third electrode” and consistently describes adjusting the ratio of electrode material based on the voltage between two electrodes in a two-electrode systems. *Id.* at 17–18. Abe’s perceived failure to disclose a three-electrode system, however, does not, by itself, support importing unrecited

structural limitations into claims 1 and 5. *See Hill-Rom Services, Inc. v. Stryker Corp.*, 755 F.3d 1367, 1371 (Fed. Cir. 2014) (noting that absent words or expressions of manifest exclusion or restriction, limitations may not be imported from the specification into the claims); *Liebel-Flarsheim Co. v. Medrad, Inc.*, 358 F.3d 898, 906 (Fed. Cir. 2004) (“Even when the specification describes only a single embodiment, the claims of the patent will not be read restrictively unless the patentee has demonstrated a clear intention to limit the scope of the claim.”). Accordingly, we are not persuaded, on the current record, that Petitioner was obligated to explain why one of ordinary skill in the art would modify Abe’s three-electrode system¹² to a two-electrode system.

I. Remaining Grounds

Petitioner contends that the subject matter of claims 2–4, 6–8, and 11–18 would have been obvious in view of the combined disclosures of Abe and Guyomard (Pet. 41–51), claim 9 would have been obvious in view of the combined disclosures of Uemura and Iwaizono (*id.* at 51–57), claims 9 and 10 would have been obvious over the combined disclosures of Uemura, Guyomard, and Iwaizono (*id.* at 57–59), and claims 9 and 10 would have

¹² Abe discloses determining charge capacity using a three-electrode cell in which both the counter and the reference poles are made of metal lithium. Ex. 1005 ¶ 78. The disclosed embodiments of Abe, however, appear to use only a single positive and negative electrode. *Id.* ¶¶ 87–93. The parties are encouraged to address during trial whether Abe’s disclosures are limited to a three-electrode battery or cell.

been obvious over the combined disclosures of Abe, Guyomard, and Iwaizono (*id.* at 60–61).

Patent Owner does not address Petitioner’s arguments with respect to these grounds, apart from its arguments with respect to independent claims 1 and 5. Prelim. Resp. 48.

Upon review of the arguments and evidence of record, and for the reasons set forth above with respect to independent claims 1 and 5, we determine that Petitioner demonstrates a reasonable likelihood of prevailing with respect to the remaining grounds identified above.

IV. CONCLUSION

For the foregoing reasons, we determine that there is a reasonable likelihood that Petitioner would prevail with respect to at least one of the claims challenged in the Petition. We, therefore, institute *inter partes* review.

V. ORDER

For the foregoing reasons, it is:

ORDERED that, pursuant to 35 U.S.C. § 314(a), *inter partes* review of claims 1–18 of the ’641 patent is instituted on all ground of unpatentability set forth in the Petition;

FURTHER ORDERED that, pursuant to 35 U.S.C. § 314(a) and 37 C.F.R. § 42.4, notice is given of institution of trial commencing on the entry date of this Decision; and

FURTHER ORDERED that the parties shall review the present decision and shall jointly inform the Board, no later than one week after issuance of this decision, of the redactions necessary to prepare a public

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version that does not divulge any material the parties have sought to seal in this proceeding.

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