

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ZHUHAI COSMX BATTERY CO., LTD.,
Petitioner,

v.

NINGDE AMPEREX TECHNOLOGY LTD.,
Patent Owner.

IPR2025-00524
Patent 12,015,118 B2

Before DONNA M. PRAISS, JOHN G. NEW, and DEBRA L. DENNETT,
Administrative Patent Judges.

NEW, *Administrative Patent Judge.*

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

I. INTRODUCTION

Petitioner Zhuhai CosMX Battery Co., Ltd. (“Petitioner”) has filed a Petition (Paper 1, “Pet.”) seeking *inter partes* review of claims 1–20 (all claims) of U.S. Patent 12,015,118 B2 (Ex. 1001, the “’118 patent”). Patent Owner Ningde Amperex Technology Ltd. (“Patent Owner”) filed a Preliminary Response (Paper 9, “Prelim. Resp.”).

Patent Owner also filed a Request with the Acting Director of the USPTO seeking discretionary denial of institution of *inter partes* review (Paper 7, the “Request”). Petitioner subsequently filed a brief opposing Patent Owner’s Request (Paper 8). On September 3, 2025, the Acting Director denied Patent Owner’s Request for discretionary denial of institution of *inter partes* review and referred the case to the panel for an institution decision on the merits (Paper 10).

Under 35 U.S.C. § 314, the Board “may not authorize an *inter partes* review to be instituted unless ... the information presented in the petition ... and any response ... 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.” For the reasons we explain below, we institute *inter partes* review of claims 1–20 of the ’118 patent.

II. BACKGROUND

A. *Real Parties-in-Interest*

Petitioner identifies Zhuhai CosMX Battery Co., Ltd. as the real party-in-interest. Pet. 72. Patent Owner identifies Ningde Amperex Technology Ltd. as the real party-in-interest. Paper 3, 1.

B. Related Matters

Both Petitioner and Patent Owner identify *Zhuhai CosMX Battery Co., Ltd., v. Ningde Ampere Technology Limited*, Case No. 2:24-cv-00728 (E.D. Tex.), filed September 6, 2024, as related litigation. Pet. 72, Paper 3, 1. Petitioner and Patent Owner both also state that that case above involves additional patents that are also the subject of petitions by the same Petitioner for *inter partes* review of patents in the following proceedings, *viz.*, IPR2025-00385 (US 10,964,927 B2) (institution denied, Director Review requested), IPR2025-00389 (US 11,923,498 B2) (instituted, Director Review requested), IPR2025-00405 (US 11,769,910 B2) (institution vacated by Director Review), IPR2025-00431 (US 11,799,131 B2) (instituted, Director Review requested), IPR2025-00432 (US 11,575,148 B2) (instituted August 26, 2025), IPR2025-00722 (US 11,799,131 B2) (institution denied September 3, 2025).

C. The Asserted Grounds of Unpatentability

Petitioner contends that claims 1–20 of the ’118 patent are unpatentable, based upon the following Grounds:

Ground	Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1	1–20	102(a)(1)	Ishigaki ^{1, 2}

¹ Ishigaki et al. (JP 2013-211096 A, March 28, 2012) (“Ishigaki”) Ex. 1004.

² The Ishigaki reference is an Unexamined Patent Application written in Japanese. *See* Ex. 1004, 99–183. Petitioner has produced a certified English translation of Ishigaki. *See* Ex. 1004, 1. Patent Owner does not contest the accuracy of the certified English translation, and all citations to Ishigaki in this Decision cite to the translation.

Ground	Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
2	1–20	103	Ishigaki, Kim ³
3	1–20	103	Wang ⁴ , Saka ⁵
4	1–20	103	Wang, Li ^{6, 7}

Pet. 8. Petitioner also relies upon the Declaration of Dr. Samuel P. Gido (the “Gido Declaration,” Ex. 1010). Patent Owner relies upon the Declaration of Dean R. Wheeler, Ph.D., (the “Wheeler Declaration,” Ex. 2015).

D. The ’118 Patent

The ’118 patent is directed to a lithium-ion (“Li-ion”) battery and, more specifically, to a cathodal electrode of the battery possessing a double layer design used for the active material layer in the electrode. Ex. 1001, col. 1, ll. 19–20, 45–49. The double layer design of the electrode is constructed in such a manner that internal short circuits of the battery that will cause the battery to fail are prevented. *Id.* The ’118 patent discloses that its electrode comprises:

[A] current collector, a first active material layer, comprising a first active material; and a second active material layer, comprising a second active material; wherein the first active

³ Kim et al. (US 2013/0302685 A1, November 14, 2013) (“Kim”) Ex. 1009.

⁴ Wang et al. (US 2011/0168550 A1, July 14, 2011) (“Wang”) Ex. 1005.

⁵ Saka et al. (US 2017/0256776 A1, September 7, 2017) (“Saka”) Ex. 1006.

⁶ Li et al. (CN 202905885 U, April 24, 2013) (“Li”) (Ex. 1003).

⁷ The Li reference is a Chinese utility patent written in Simplified Chinese. *See* Ex. 1003, 22–33. Petitioner has produced a certified English translation of Li. *See* Ex. 1003, 1. Patent Owner does not contest the accuracy of the certified English translation, and all citations to Li in this Decision cite to the translation.

material layer is arranged between the current collector and the second active material layer, the first active material layer is formed on at least one surface of the current collector, and a ratio of an average particle size of the second active material to an average particle size of the first active material is from 1:1 to 40:1.

Id. at col. 1, ll. 51–59. Figure 2 of the '118 patent depicts a schematic view of the double-layered active material layer structure of its electrode and is reproduced below:

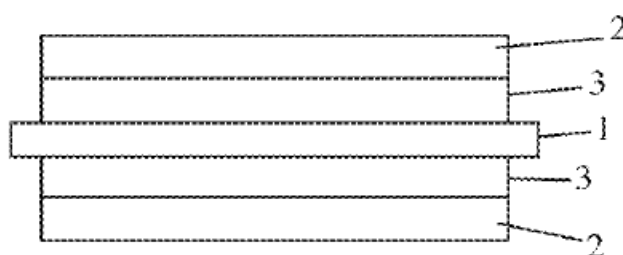


Fig. 2

Figure 2 of the '118 patent is a schematic diagram of its double-layered active material electrode

The '118 patent explains that, in Figure 2:

[A]n additional active material layer **3** is formed between the active material layer **2** and the positive electrode collector **1**. The material and formulation of the active material layer **3** are optimized so that the adhesive force between the active material layer **3** and the positive electrode current collector **1** is increased, thereby protecting the positive electrode current collector **1**, and the active material layer **3** will not come off during the nail process.^[8] Also, the short-circuit mode of the positive electrode

⁸ The “nail process” or “nail penetration test” involves driving a metallic nail through a charged Li-ion cell at a prescribed speed. The cell/chemistry is deemed to have passed if there is no smoke or flame following the nail penetration (visual evaluation, sometimes as a severity level). See U.S. Dept. of Energy, *The Relationship of the Nail Penetration Test to Safety of*

current collector-negative electrode active material layer does not occur during the nail process, thereby ensuring the safety performance of the lithium-ion battery.

Ex. 1001, col. 4, ll. 1–12.

The '118 patent discloses that the first active material has an average particle size in a range of 0.2 μm to 15 μm . Ex. 1001, col. 1, ll. 60–61. The '118 patent explains that “the average particle size (Dv50) refers to a particle size that reaches a volume accumulation of 50% from the small particle size side in a volume-based granularity distribution.” *Id.* at col. 1, ll. 61–64.

The '118 patent further discloses that, in its electrode, “a particle size of 90% accumulative volume of the first active material is less than 40 μm .” Ex. 1001, col. 1, ll. 65–66. The '118 patent explains that “a particle size of 90% accumulative volume (Dv90) refers to a particle size that reaches a volume accumulation of 90% from the small particle size side in a volume-based granularity distribution.” *Id.* at cols. 1–2, ll. 66–6. The '118 patent additionally discloses that the first active material layer of its electrode has a thickness of 2 μm to 30 μm and the second active material layer has a thickness equal to or more than 30 μm . *Id.* at col. 2, ll. 4–7.

The '118 patent additionally discloses that:

The positive electrode is cold-pressed under a certain pressure, and the active material layer is pressed into an electrode having a certain thickness. Since the active material layer of the present application has a double-layer structure, the compaction density of the positive electrode can be divided into the compaction density of the second active material layer, the compaction density of the first active material layer, and the overall compaction density. To ensure the energy density of a

Li-Ion Cells, available at: <https://www.energy.gov/eere/vehicles/articles/relationship-nail-penetration-test-safety-li-ion-cells> (last visited September 25, 2025) Ex. 3002.

Li-ion battery, it is required that the positive electrode has a higher compaction density, the compaction density of the first active material layer is greater than 2.8 g/cc, the compaction density of the second active material layer is greater than 3.3 g/cc and the compaction density of the all active material layers is greater than 3.2 g/cc.

Ex. 1001, col. 6, ll. 13–27.

E. Representative Claim

Claim 1 is representative of the challenged claims and recites:

[1.P] An electrode, comprising:

[1.1] a current collector;

[1.2] a first layer comprising a first material; and

[1.3] a second layer comprising a second material;

[1.4] wherein the first layer is arranged between the current collector and the second layer, the first layer is formed on a surface of the current collector, and a particle size of 90% accumulative volume of the first material is less than 40 μm ;

[1.5] wherein a total compaction density of the first layer and the second layer is greater than 3.2 g/cc.

Ex. 1001, cols. 18–19, ll. 2–5 (annotations in brackets added to reflect Petitioner’s designations). Independent claims 10 and 19 similarly claim, respectively, “an electrochemical device” and “an electronic device” having identical properties. *Id.* at col 10, ll. 40–51; col. 11, ll. 37–50.

III. ANALYSIS

A. *A Person of Ordinary Skill in the Art*

Petitioner contends that a person of ordinary skill in the art, as of the claimed priority date, would have had at least an undergraduate degree in chemistry, chemical engineering, polymer science and engineering, or materials science and engineering and two years of experience in the field of battery materials and construction. Pet. 9. Petitioner notes that a higher level of education, such as a Master's Degree in one of these same fields, could substitute for the requisite work experience. *Id.* For the purposes of its Preliminary Response, Patent Owner adopts the definition proposed by Petitioner. Prelim. Resp. 8.

Petitioner's proposed definition of the level of ordinary skill in the art appears to be generally consistent with the level of skill presented in the cited prior art. *See generally, e.g.,* Exs. 1005–1008; *see also Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (the prior art itself may reflect an appropriate level of skill in the art). Consequently, and for the purposes of this Decision, we adopt Petitioner's proposed definition as defining a person of ordinary skill in the art as a person who would have had at least an undergraduate degree in chemistry, chemical engineering, polymer science and engineering, or materials science and engineering and two years of experience in the field of battery materials and construction, or a Master's Degree in one of these same fields, could substitute for the requisite work experience.

B. Claim Construction

The Board applies the same claim construction standard that would be used to construe the claims in a civil action under 35 U.S.C. § 282(b). *See* 37 C.F.R. § 100(b) (2020). Under that standard, claim terms “are generally given their ordinary and customary meaning” as understood by a person of ordinary skill in the art at the time of the invention. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc). “In determining the meaning of the disputed claim limitation, we look principally to the intrinsic evidence of record, examining the claim language itself, the written description, and the prosecution history, if in evidence.” *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 469 F.3d 1005, 1014 (Fed. Cir. 2006) (citing *Phillips*, 415 F.3d at 1312–17). Extrinsic evidence is “less significant than the intrinsic record in determining ‘the legally operative meaning of claim language.’” *Phillips*, 415 F.3d at 1317 (quoting *C.R. Bard, Inc. v. U.S. Surgical Corp.*, 388 F.3d 858, 862 (Fed. Cir. 2004)).

Petitioner states that no term of the challenged claims requires construction to resolve the challenges in this Petition beyond its plain meaning in view of the specification. Pet. 9. Patent Owner does not contest Petitioner’s assertion for the purpose of this institution Decision. Prelim. Resp. 8.

We find, for the purposes of this Decision, that no term of the challenged claims requires construction beyond the ordinary and customary meaning of the terms, as understood by a person of ordinary skill in the art at the time of the invention. *Phillips*, 415 F.3d at 1312–13; *see also Vivid*

Techs., Inc. v. Am. Sci. & Eng’g, Inc., 200 F.3d 795, 803 (Fed. Cir. 1999) (tribunal construes claims only to the extent necessary to resolve a dispute).

C. Ground 1: Alleged Anticipation of Claims 1–20 by Ishigaki

1. Principles of law

“A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference.” *Schering Corp. v. Geneva Pharms.*, 339 F.3d 1373 (Fed. Cir. 2003) (quoting *Verdegaal Bros., Inc. v. Union Oil Co. of Cal.*, 814 F.2d 628, 631 (Fed. Cir. 1987)). It is well settled that “a reference can anticipate a claim even if it ‘d[oes] not expressly spell out’ all the limitations arranged or combined as in the claim, if a person of skill in the art, reading the reference, would ‘at once envisage’ the claimed arrangement or combination.” *Kennametal, Inc. v. Ingersoll Cutting Tool Co.*, 780 F.3d 1376, 1381 (Fed. Cir. 2015) (quoting *In re Petering*, 301 F.2d 676, 681 (C.C.P.A. 1962)).

2. Petitioner’s arguments

a. Independent claim 1

i. 1.P

Petitioner argues that Ishigaki discloses an electrode. Pet. 10 (citing Ex. 1004, Abstr.). Petitioner also contends that Ishigaki further discloses “(1) A positive electrode for lithium rechargeable batteries on a current collecting foil, a mixture of an electrode.” *Id.* (quoting Ex. 1004 ¶ 14).

ii. 1.1

Petitioner argues that Ishigaki’s electrode comprises a current collector foil. Pet. 11 (citing Ex. 1004 ¶ 14). Petitioner contends that this is

the same structure as the recited current collector of limitation 1.1. *Id.* (citing Ex. 1010 ¶ 74).

iii. 1.2

Petitioner contends that Ishigaki's electrode comprises an electrode mixture on a current collector. Pet. 11 (citing Ex. 1004 ¶ 14). Petitioner argues that the electrode mixture comprises a first positive electrode mixture layer, which corresponds to the first layer of claim 1.2. *Id.* (citing Ex. 1010 ¶ 75; Ex. 1004 ¶¶ 153, 347, 348). Petitioner argues that Ishigaki's first layer, in turn, comprises a first positive electrode active material, which is the first material of claim 1.2. *Id.* (citing Ex. 1010 ¶ 75; Ex. 1004 ¶ 153).

iv. 1.3

Petitioner contends that Ishigaki's electrode mixture comprises a second positive electrode mixture layer. Pet. 12 (citing Ex. 1004 ¶ 153). According to Petitioner, this disclosure corresponds to the second layer of claim 1.3. *Id.* (citing Ex. 1010 ¶ 76). Petitioner also argues that Ishigaki further discloses "a second positive electrode mixture layer containing a second positive electrode active material," and that this corresponds to the second material in the second layer of claim 1.3. *Id.* (citing Ex. 1004 ¶ 14; Ex. 1010 ¶ 76).

v. 1.4

Petitioner argues that Ishigaki's first and second layers are "sequentially laminated and formed on the current collector" foil. Pet. 13 (citing Ex. 1004 ¶¶ 14, 153, 366). Petitioner asserts that Ishigaki's first layer is arranged between the current collector and the second layer. *Id.* (citing

Ex. 1010 ¶ 77). In support of this, Petitioner points to Figure 5 of the Declaration of Dr. Guido, which is reproduced below:

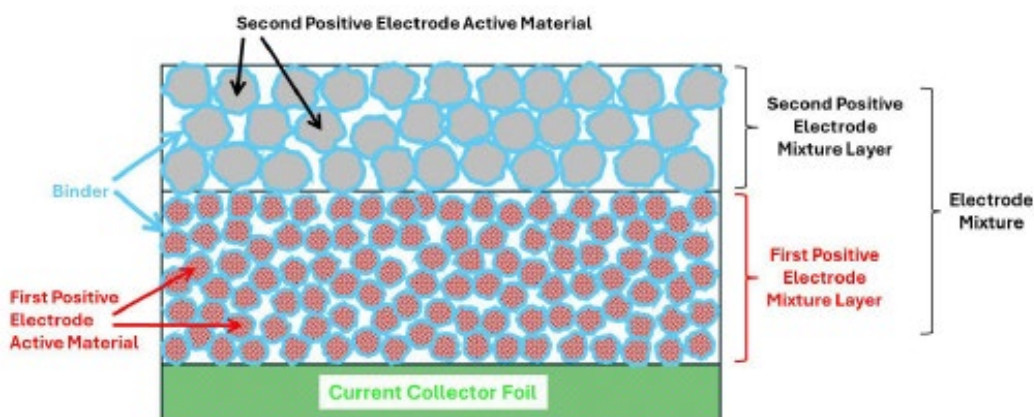


Figure 5 of the Guido Declaration is an annotated schematic, cross-sectional diagram of the electrode disclosed by Ishigaki.

Petitioner notes that Ishigaki explains that “slurry 1 was coated on one side and dried on an aluminum foil (thickness: 15 μm) as a collector foil with a doctor blade. Then the slurry 2 was applied on one side with a doctor blade and dried.” Pet. 13 (quoting Ex. 1004, Example 2); Ex. 1010 ¶ 78). Petitioner argues that Ishigaki’s first layer is formed by applying a slurry of the first active material on a surface of the current collector. *Id.* (citing Ex. 1004 ¶ 366; Ex. 1010 ¶ 79). Specifically, argues Petitioner, Ishigaki discloses that a uniform slurry of active material and binder is applied to one side of the current-collecting aluminum foil, and allowed to dry. *Id.* at 14 (citing Ex. 1004 ¶ 366; Ex. 1010 ¶ 80).

Petitioner additionally contends that Ishigaki’s first positive electrode material has particles with 90% cumulative diameter of less than 10 μm . Pet. 14 (citing Ex. 1004 ¶¶ 38, 39; Ex. 1018; Ex. 1010 ¶ 81).

Petitioner additionally argues that Ishigaki further discloses:

[A] 90% cumulative diameter (D90) of the secondary particles of the lithium transition metal compound powder of the present invention is normally 10 μm or less, preferably 8 μm or less, more preferably 6 μm or less, and most preferably 5 μm or less, and normally 0.5 μm or more, preferably 0.8 μm or more, more preferably 1 μm or more and, most preferably 1.5 μm or more.

Pet. 15 (quoting Ex. 1004 ¶ 38). Petitioner asserts that this range falls completely within the '118 patent's claimed range of $<40 \mu\text{m}$. *Id.* (citing Ex. 1004 ¶¶ 14, 40, 346; Ex. 1010 ¶¶ 83–84).

vi. 1.5

Petitioner argues that this limitation (as well as the identical limitations of independent claims 10 and 19) requires a total compaction density of the first layer and the second layer greater than 3.2 g/cc. Pet. 15. Petitioner contends that a person of ordinary skill in the art would have understand the plain meaning of “compaction density” to refer to the density of the electrode-material layer after it has been subjected to the compression step of the electrode-formation process. *Id.* (citing Ex. 1010 ¶¶ 67–68).

Petitioner argues that the total compaction density of Ishigaki's first layer is disclosed both expressly and inherently as the density of the electrode material layer after it has been subjected to the compression step of the electrode formation process. Pet. 15–16. Petitioner asserts that the inherent disclosure comes from the density that a skilled artisan could calculate from the densities of the layer components; the active material, the conductive additive, and the binder. *Id.* at 16 (citing Ex. 1010 ¶ 85). Petitioner contends that the maximum density of Ishigaki's cathode layers has an upper limit of 4.4 g/cm^3 (when porosity is zero), as derived from the

weight ratios of the components in Ishigaki's Example 2. *Id.* (citing Ex. 1010 ¶ 85). According to Petitioner, the density of the active material is 4.8 g/cm³, and the densities of the conductive carbon and the binder are 1.8 g/cm³. *Id.* (citing Ex. 1010 ¶¶ 89–92). Petitioner notes that Ishigaki emphasizes maximizing energy density, preferring compaction densities that approach the upper boundary, thus inherently disclosing a range (<4.4 g/cc), a value that overlaps the claimed range (>3.2 g/cc). *Id.* (citing Ex. 1010 ¶¶ 85, 93).

Petitioner argues that, additionally, Ishigaki expressly teaches a density range of 2.0 to 4.2 g/cm³. Pet. 17. Petitioner contends that this range overlaps the claimed range, and expressly emphasizes densities towards the upper bound of this range. *Id.* (citing Ex. 1010 ¶ 85). According to Petitioner, Ishigaki specifically discloses treating the electrode mixture with pressure to increase the packing density. *Id.* (citing Ex. 1010 ¶ 86; Ex. 1004 ¶ 24). Petitioner asserts that the density that results from this treatment is compaction density. *Id.* (citing Ex. 1010 ¶ 86).

Petitioner notes that Ishigaki also discloses “[t]he electrode density of the positive electrode after pressing has a lower limit of ... particularly preferably 2.6 g/cm³ or more, and an upper limit of normally 4.2 g/cm³ or less, preferably 4.0 g/cm³ or less, and particularly preferably 3.8 g/cm³ or less.” Pet. 17 (citing Ex. 1004 ¶ 151; Ex. 1004 ¶ 25). Petitioner states that these numeric ranges overlap the range of the claims and disclose specific values within that range, e.g., 3.8 g/cc, 4.0 g/cc, and 4.2 g/cc. *Id.* (citing Ex. 1010 ¶ 87).

Additionally, Petitioner argues that Ishigaki explains why the preferred boundaries are what they are. Pet. 17 (citing Ex. 1010 ¶ 88).

Petitioner notes Ishigaki's disclosure that "since space is required in the positive electrode plate to hold the electrolyte in the electrode plate and to supply lithium ions, the upper limit is preferably 3.6 g/cm³ or less, more preferably 3.5 g/cm³ or less, and particularly preferably 3.4 g/cm³ or less." *Id.* (citing Ex. 1004 ¶ 25). Specifically, argues Petitioner, Ishigaki teaches a person of ordinary skill in the art to choose the highest density possible in order to maximize energy capacity, constrained by the space needed to allow the flow of ions. Ex. 1010 ¶¶ 88–89. The result, Petitioner argues, is numerous preferred embodiments all with compaction densities greater than 3.2 g/cc as claimed. *Id.* at 17–18.

b. Claim 2

Petitioner argues that the combined thickness of Ishigaki's first and second layers is between 10 and 200 microns. Pet. 18 (citing Ex. 1004 ¶ 25; Ex. 1010 ¶ 95). Petitioner notes that this combined thickness is divided in a ratio of "normally 60:40 ... preferably 70:30, more preferably 80:20, and particularly preferably 90:10." *Id.* (citing Ex. 1004 ¶ 216). Therefore, argues Petitioner, Ishigaki teaches that at a minimum, the thickness of the first active material layer is 60% of the total active material thickness, which is 60% of 10 to 200 µm, or 6 to 120 µm. *Id.* (citing Ex. 1010 ¶¶ 96–97). Petitioner states that Ishigaki's preferred embodiment has a first layer thickness of 90% of 10 to 200 µm, or 9 to 180 µm. *Id.* (citing Ex. 1010 ¶ 98).

Additionally, Petitioner argues, Ishigaki's "volume ratio of the positive electrode active material having a particle diameter of 5 µm or more is 10 vol% or less," teaches that Dv90 of the active material particles is 5 µm

or less. Pet. 18 (citing Ex. 1004 ¶ 14, claim 4; Ex. 1010 ¶ 99). Therefore, Petitioner contends, Ishigaki's Dv90 of the first material particles (consistent with claim 1) is smaller than the smallest possible first layer thickness (6 μm), and smaller than the most preferable smallest first layer thickness (9 μm). *Id.* (citing Ex. 1010 ¶¶ 100–101).

c. Claim 3

Petitioner notes that Claim 3 (and claims 4, 12, and 13) uses the term “average particle size.” Pet. 19. Petitioner asserts that this term is ambiguous because there are different mathematical ways to determine averages, and different concepts in physics and chemistry of how to define the size of a particle. *Id.* (citing Ex. 1010 ¶¶ 69–70). Petitioner contends that the '118 patent discloses that the claim term “average particle size” means Dv50. *Id.* (citing Ex. 1001 col. 1, ll. 60–646; Ex. 1010 ¶ 102).

Petitioner's Declarant, Dr. Gido, attests that Dv50 is a standard granulometric measure in this art (together with Dv10 and Dv90). *Id.* (citing Ex. 1010 ¶ 69). Petitioner states that Dv50 denotes the maximum particle diameter below which 50% of the sample volume exists. *Id.* (citing, *e.g.*, Ex. 1021 (disclosing that Dv50 is also known as the median particle size by volume)).

Petitioner argues that Ishigaki discloses the average particle sizes of the layers have a ratio that falls within the range of claim 3. Pet. 19. Petitioner notes that Ishigaki uses “median diameter” rather than average when describing the general size of its particles. *Id.* (citing Ex. 1004 ¶ 14, claim 8). According to Petitioner, a person of ordinary skill in the art would equate “median” with the middle value of a distribution, which could be

weighted by number, volume, or mass. *Id.* (citing Ex. 1010 ¶¶ 103–104). Petitioner contends that Ishigaki’s “median diameter, as the average particle diameter, and the 90% cumulative diameter (D90) are measured by a well-known laser diffraction/scattering particle size distribution measuring device.” *Id.* (quoting Ex. 1004 ¶¶ 39, 184, 342).

Petitioner argues further that Ishigaki discloses an “average diameter” of primary particles based on the number of individual particles seen in electron microscope (SEM) images. Pet. 20 (citing Ex. 1004 ¶¶ 41, 185). Petitioner notes that Ishigaki discloses two different size distributions because the active materials relevant to these kinds of battery electrodes form primary and secondary particles when viewed at different scales, and that laser diffraction only detects the secondary particles. *Id.* (citing Ex. 1010 ¶¶ 107–110).

d. Claim 4

Petitioner argues that Ishigaki’s first active material has a median diameter (Dv50) of 0.1 to 5 μm . Pet. 22 (citing Ex. 1004 ¶¶ 14, 37; Ex. 1010 ¶ 118). Petitioner contends that at least some of Ishigaki’s compositions with a Dv50 of 0.1 to 5 μm will necessarily have an average particle size in a range of 0.2 to 15 μm . *Id.* (citing Ex. 1010 ¶¶ 119–120).

e. Claim 5

Petitioner contends that Ishigaki’s electrode mixture has a compaction density (density after pressing) between 2.0 g/cm^3 and 4.2 g/cm^3 . Pet. 22 (citing Ex. 1004 ¶¶ 25, 151). Petitioner argues that this leads to a range of combinations for the individual densities of layers 1 and 2, many of which

have compaction densities for the first layer greater than 2.8 g/cc and the second layer greater than 3.3 g/cc and, therefore, directs the person of ordinary skill in the art to increase energy capacity by increasing layer densities. *Id.* at 22–23 (citing Ex. 1004 ¶ 25; Ex 1010 ¶¶ 122–123).

f. Claim 6

Petitioner argues that Ishigaki discloses that a second “active material has a higher bulk density than the first active material.” Pet. 23 (citing Ex. 1004 ¶ 216). According to Petitioner, the bulk densities of the first and second materials are proxies for the compaction densities of the first and second layers. *Id.* (citing Ex. 1010 ¶ 124). Petitioner notes that Ishigaki discloses the bulk density ratios as a means for obtaining a high energy density in the final product, and teaches that corresponding compaction densities achieve Ishigaki’s goal of high energy density. *Id.*

Petitioner argues further that a skilled artisan would recognize multiple embodiments of Ishigaki in which the average density over both layers is greater than 3.2 g/cc, as in claim 5, and the second layer density is greater than the first, as in claim 6. Pet. 23 (citing Ex. 1004 ¶ 216; Ex. 1010 ¶¶ 125–126).

g. Claim 7

Petitioner argues that Ishigaki’s first material in the first layer is lithium nickel cobalt manganese oxide (LiNiMnCoO₂). Pet. 25 (citing Ex. 1004 ¶ 27, claims 5, 9). Petitioner contends that Ishigaki therefore discloses a composition selected from the recited Markush group. *Id.* (citing Ex. 1010 ¶¶ 128–129).

h. Claim 8

Petitioner argues that Ishigaki's second material in the second layer is also lithium nickel cobalt manganese oxide (LiNiMnCoO_2). Pet. 25 (citing Ex. 1004 ¶ 27 claims 5, 9). Petitioner contends that Ishigaki therefore discloses a composition selected from the recited Markush group. *Id.* (citing Ex. 1010 ¶¶ 129–130).

i. Claim 9

Petitioner contends that Ishigaki's first material alternatively comprises natural graphite, artificial graphite, soft carbon and/or hard carbon. Pet. 25 (citing Ex. 1004 ¶ 110, claim 6; Ex. 1010 ¶¶ 131–132; Ex. 1020). Petitioner argues that Ishigaki therefore discloses multiple compositions selected from the recited Markush group. *Id.*

j. Independent claim 10

i. 10.P

The preamble to independent claim 10 recites: "An electrochemical device, comprising an electrode, wherein the electrode comprises:"

Ex. 1001, col. 19, ll. 40–41.

Petitioner argues that Ishigaki discloses an electrochemical device (a Li-ion battery) that comprises an electrode. Pet. 25 (citing Ex. 1004, Abstr.). Petitioner notes that Ishigaki further discloses "(1) A positive electrode for a lithium secondary battery comprising, on a current collector foil, an electrode mixture." *Id.* at 25–26 (citing Ex. 1004 ¶ 14).

ii. 10.1–10.5

The remaining limitations of claim 10 are identical to those of independent claim 1. *Compare* Ex. 1001, col. 19, ll. 42–51, *with id.* at cols. 18–19, ll. 63–5. Petitioner makes essentially identical arguments with respect to limitations 10.1–10.5 as were made with respect to limitations 1.1–1.5 above. Pet. 25–26 (*see* Section III.C.2.a.ii–iv *supra*).

k. Claims 11–18

Petitioner acknowledges that dependent claims 11–18 duplicate claims 2–9. Pet. 26. Petitioner argues that Ishigaki therefore anticipates claims 11–18 for the same reasons. *Id.*

l. Independent claim 19

i. 19.P

The preamble to claim 19 recites: “An electronic device, comprising an electrochemical device, the electrochemical device comprising an electrode, wherein the electrode comprises.” Ex. 1001, col. 20, ll. 37–39.

Petitioner asserts that Ishigaki discloses “electronic devices,” and “lithium rechargeable batteries for use in these devices.” Pet. 26 (citing Ex. 1004 ¶ 2). Petitioner points to Ishigaki’s examples of “notebook computers, mobile phones, and handheld video cameras, as well as hybrid electric vehicles.” *Id.* (citing Ex. 1004 ¶ 4). Petitioner argues that Ishigaki further discloses “(1) A positive electrode for a lithium secondary battery comprising, on a current collector foil, an electrode mixture.” *Id.* (citing Ex. 1004 ¶ 14). Petitioner contends that this is the same kind of electronic device, electrochemical device, and electrode used in the same context for the same purpose as the ’118 patent. *Id.* (citing Ex. 1010 ¶ 181).

ii. 19.1–19.5

The remaining limitations of claim 19 are identical to those of independent claims 1 and 10. *Compare* Ex. 1001, col. 20, ll. 40–50, *with id.* at cols. 18–19, ll. 63–5. Petitioner makes essentially identical arguments with respect to limitations 19.1–19.5 as were made with respect to limitations 1.1–1.5 above. Pet. 25–26 (*see* Section III.C.2.a.ii–iv *supra*).

m. Claim 20

Petitioner acknowledges that dependent claim 20 duplicates dependent claims 6 and 15. Pet. 26. Petitioner argues that Ishigaki therefore anticipates claim 20 for the same reasons. *Id.*

3. Patent Owner’s Preliminary Response

Patent Owner responds that: (a) Petitioner fails to show that Ishigaki discloses a particle size of 90% accumulative volume of the first material is less than 40 μm ; and (b) Petitioner fails to show that Ishigaki discloses a two-layer electrode with a compaction density of at least 3.2 g/cc. Prelim. Resp. 9, 15.

a. Particle size of 90% accumulative volume of the first material is less than 40 μm

Patent Owner argues that, contrary to Petitioner’s position, there is no disclosure of 90% accumulative volume values for any of Ishigaki’s particles, and that Petitioner’s assumption that Ishigaki’s “90% cumulative diameter (D90)” is equivalent to the claimed 90% accumulative volume is consequently misguided. Prelim. Resp. 10 (citing Ex. 2015 ¶ 62).

Patent Owner argues that Petitioner cites Ishigaki's disclosure of "a particle diameter standard as a volume standard," and concludes that "[a] particle size of 90% accumulative volume is a standard metric in the art also known as D90 or Dv90. Ishigaki's particle size is measured by volume, which corresponds to Dv90 (the volume standard)." Prelim. Resp. 10 (quoting Pet. 14; n.1 (citations omitted); Ex. 2015 ¶¶ 63–64. But Patent Owner contends that Petitioner misinterprets Ishigaki. Prelim. Resp. 10 (citing Ex. 2015 ¶¶ 65–69). Patent Owner contends that the fact that a particle size is described as "a particle diameter standard as a volume standard" does not dictate how a distribution of said particle sizes is constructed or defined. *Id.* (citing Ex. 2015 ¶ 70). Patent Owner points to Ishigaki's description of what is meant by "Median Diameter and 90% Cumulative Diameter (D90)":

Note that, in the present invention, the median diameter, as the average particle diameter, and the 90% cumulative diameter (D90) are measured by a well-known laser diffraction/scattering particle size distribution measuring device, with a set refractive index of 1.60a 0.10i, and a particle diameter standard as a volume standard. In the present invention, for the dispersion medium used during measurement, measurement was performed using a 0.1 wt% sodium hexametaphosphate aqueous solution.

Id. at 11 (quoting Ex. 1004 ¶ 39; citing Ex. 2015 ¶ 65).

Patent Owner argues that Petitioner and its Declarant, Dr. Guido, assert that the use of a laser diffraction instrument in Ishigaki necessarily stipulates the type of distribution Ishigaki had in mind. Prelim. Resp. 11 (citing Pet. 14–15; Ex. 1010 ¶ 84). However, Patent Owner contends, the use of laser diffraction, which is a measurement technique that is used to estimate the volume of a particle, is not indicative of a particular type of distribution, but, instead, teaches a person of ordinary skill in the art that the diameter of a

particle is determined from the estimated volume of the particle. *Id.* (citing Ex. 2015 ¶ 65 (citing Ex. 1004 ¶ 39)). According to Patent Owner, because all distributions require a measurement of particle sizes, knowing only particle sizes is not indicative of the particular statistical method used to describe the distribution of measured particle sizes. *Id.* at 11–12.

Patent Owner argues that the D90 value of a cumulative number distribution of a set of particles differs substantially from a Dv90 value for the same particle set because number-based distributions are fundamentally different from volume-based distributions. Prelim. Resp. 12 (citing Ex. 2015 ¶ 68; Ex. 1010 ¶ 83). Patent Owner adds that the measured Dv90 value will always be greater than the D90 value for any continuous non-uniform distribution (i.e., for any set of differently-sized particles). *Id.* at 13 (citing Ex. 2015 ¶ 68). Patent Owner argues that a person of ordinary skill in the art would understand that Dv90 and D90 values will only be the same if all particles are the same size; such a distribution would not occur from a realistic manufacturing process, especially one that includes pulverizing or grinding of the active material, as is the case in Ishigaki. *Id.* (citing Ex. 2015 ¶ 68; Ex. 1004 ¶ 89).

Patent Owner argues further that Ishigaki does not disclose volume-based distributions of particles, and that Petitioner has failed to show that Ishigaki's D90 value corresponds to a 90% accumulative volume value. Prelim. Resp. 13 (citing Ex. 2015 ¶¶ 69–70). Patent Owner points to other disclosures in Ishigaki that, Patent Owner contends, undercut Petitioner's theory and suggest that the D90 values are numbers-based distributions. *Id.* (citing Ex. 2015 ¶¶ 71–74).

Patent Owner argues that, whereas the secondary particle diameters are described in Ishigaki as being measured using a laser diffraction instrument, the primary particle diameters are described in Ishigaki as being measured by a completely different method, namely by means of particle size counting using SEM images. Prelim. Resp. 13 (citing Ex. 1004 ¶¶ 41, 185; Ex. 2015 ¶ 71). Patent Owner contends that a skilled artisan would understand this disclosure of Ishigaki to mean that SEM imaging was used to generate SEM images of primary particles, and then the diameters of the primary particles visible within the generated image were manually measured. *Id.* at 14 (citing Ex. 2015 ¶ 71). Patent Owner argues that, because the SEM images only provide a 2D view of the particles, other, non-SEM methods are commonly used for determining volume-based size distributions of particles. *Id.* (citing Ex. 2015 ¶ 72). According to Patent Owner, this suggests to those of ordinary skill in the art that Ishigaki's use of SEM to measure the diameters of primary particles was to provide a number-based (not a volume-based) distribution for the primary particles. *Id.* (citing Ex. 2015 ¶ 72; Ex. 1004 ¶ 185).

Patent Owner contends that a skilled artisan would have used the same type of distribution for both primary and secondary particles (e.g., using a D90 or a Dv90 for both). Prelim. Resp. 14 (citing Ex. 2015 ¶¶ 73–75). Patent Owner argues that, given that Ishigaki uses a number-based distribution for the primary particles, Ishigaki would use the same number-based distribution for the secondary particles so that the sizes of both types of particles could be directly compared. *Id.* at 14–15 (citing Ex. 2015 ¶¶ 73–75).

Furthermore, argues Patent Owner, in addition to using a number-based distribution to maintain consistency between measurements of the primary and secondary particles, Ishigaki would also use a number-based distribution for D90 because its companion, median diameter, is based on a number-based distribution. Prelim. Resp. 15 (citing Ex. 2015 ¶ 76).

Petitioner argues that, because Petitioner cannot show that the D90 value is a volume-based distribution, Petitioner cannot show that Ishigaki discloses 90% accumulative volume values at all, much less a particle size of 90% accumulative volume of the first material is less than 40 μm where the first material is comprised in a first layer arranged between the current collector and a second layer. *Id.*

- b. A two-layer electrode with a compaction density greater than 3.2 g/cc

Independent claims 1, 10, and 19 each require that the “total compaction density of the first layer and the second layer is greater than 3.2 g/cc. Patent Owner argues that the only instance in which Ishigaki discloses “mixture density” values for two-layer cathode structures, it describes a density value of 2.4 g/cc. Prelim. Resp. 15 (citing Ex. 1004 ¶ 366; Ex. 2015 ¶ 86). Patent Owner disputes Petitioner’s assertion that the “mixture density” values provided in Ishigaki’s paragraph [0025], and the “electrode density” values provided in paragraph [0151], anticipate “a first layer and a second layer, wherein a total compaction density of the first layer and the second layer is greater than 3.2 g/cc.” *Id.* at 16 (citing Pet. 15–18; Ex. 1010 ¶¶ 87–88). According to Patent Owner, these values in Ishigaki relate to single-layer cathode structures and are thus irrelevant to the claimed two-layer electrode. *Id.* (citing Ex. 2015 ¶¶ 81–84).

Patent Owner asserts that Ishigaki provides no disclosure suggesting that the provided range of single-layer cathode structure mixture densities or electrode densities apply to multi-layer electrode structures. Prelim.

Resp. 16. Rather, Ishigaki describes density ranges in the context of a single-layer cathode structure. *Id.* (citing Ex. 1004 ¶ 25; Ex. 2015 ¶ 81). Patent Owner contends that paragraph [0025] of Ishigaki describes a range of densities for “the positive electrode” in which “[t]he thickness of the positive electrode active material layer is usually about 10 to 100 μm .” *Id.* (quoting Ex. 1005 ¶ 25). According to Patent Owner, this disclosure only refers to a single “positive electrode active material layer.” *Id.* (citing Ex. 1004 ¶ 25; Ex. 2015 ¶ 81). Patent Owner argues that paragraph [0025] does not mention or otherwise indicate that the positive electrode includes multiple positive electrode active material layers, nor does this disclosure provide a total density for multiple positive electrode active material layers. *Id.*

Patent Owner contends that Ishigaki’s paragraph [0051] is similarly applicable only to a cathode with a single layer of active material. Prelim. Resp. 16–17 (quoting Ex. 1004 ¶ 51). Patent Owner argues that Ishigaki provides a range of densities for “the positive electrode after pressing” in which “the positive electrode active material layer [is] obtained by coating and drying [and] is preferably compressed by a roller press.” *Id.* at 18 (quoting Ex. 1004 ¶ 51). Patent Owner contends that this disclosure of Ishigaki does not indicate that the positive electrode includes multiple positive electrode active material layers, nor does this disclosure provide total density for multiple positive electrode active material layers. *Id.* at 18–19 (citing Ex. 2015 ¶ 81). Patent Owner argues that a person of ordinary

skill in the art would therefore interpret this disclosure consistently with Ishigaki's paragraph [0025] as describing a density range applicable to a single-layer cathode structure. *Id.* at 19 (citing Ex. 2015 ¶ 81).

Patent Owner argues further that an artisan of ordinary skill would similarly not assume that densities provided for a single-layer cathode structure would be applicable to a two-layer cathode (or anode) structure, at least because the compaction of an electrode structure would change upon formation of a second layer. Prelim. Resp. 19 (citing Ex. 2015 ¶ 82). Patent Owner contends that such a skilled artisan would understand that when Ishigaki's second, wet cathode material layer is applied to Ishigaki's first, pre-dried layer, the solvent of the second layer re-wets the first layer, causing the two layers to partially mix and to change the compaction of the first layer. *Id.* (citing Ex. 1004 ¶ 366).

Patent Owner also disputes Petitioner's contention that "Ishigaki further explains why the preferred boundaries [of the provided density ranges] are what they are," because Ishigaki states that "space is required in the positive electrode plate to hold the electrolyte in the electrode plate and to supply lithium ions, the upper limit is preferably 3.6 g/cm³ or less, more preferably 3.5 g/cm³ or less, and particularly preferably 3.4 g/cm³ or less." Prelim. Resp. 20 (citing Pet. 17 (quoting Ex. 1004 ¶ 25); Ex. 2015 ¶¶ 83–84). Patent Owner again contends that a person of ordinary skill would have understood that the compaction density values provided in Ishigaki would have only applied to a single-layer cathode structure because the provided values are disclosed as being sufficient to leave adequate space "to hold the electrolyte," based on the particle size distribution, active material densities, and additive concentration disclosed for Ishigaki's single-layer cathode

composition. *Id.* (citing Ex. 1004 ¶ 25; Ex. 2015 ¶ 84). According to Patent Owner two-layer cathode constructions have additional variables to be considered when determining whether the construction leaves space “to hold the electrolyte,” and neither Petitioner nor its Declarant explains that Ishigaki’s disclosed compaction density values for single-layer cathode structures would have provided adequate space for a two-layer cathode structure to “hold the electrolyte,” as Ishigaki requires. *Id.* at 20–21 (citing Ex. 2015 ¶¶ 83–84).

Patent Owner argues that the only disclosed value for a two-layer cathode structure in Ishigaki is 2.4 g/cm³, and, further, that Ishigaki’s examples make clear that the density of the two-layer cathode structure is less than the densities of the single-layer cathode structures, which are well below the claimed 3.2 g/cc compaction density. Prelim. Resp. 21 (citing Ex. 1004 ¶¶ 348–349, 356–357, 361–363, 366). According to Patent Owner, Petitioner fails to address Ishigaki’s examples or provide any explanation as to why the only two-layer cathode structure example in Ishigaki is: (1) at the lower limit of Ishigaki’s disclosed range; (2) of lesser value than all other disclosed examples; and (3) well below the claimed 3.2 g/cc compaction density. *Id.* (citing Ex. 2015 ¶ 88).

4. Analysis

a. Challenged claim 1

Having reviewed the parties’ arguments and the evidence of record, as presently developed, we conclude, for the purposes of this Decision, that Petitioner has met its burden of demonstrating a reasonable likelihood of prevailing at trial in showing that Ishigaki anticipates the challenged claims.

With respect to challenged claim 1, Ishigaki discloses an electrode with: (1) a current collector foil (Ex. 1004 ¶ 14); (2) a first cathodal electrode mixture layer (Ex. 1004 ¶¶ 153, 347, 348); and (3) a second cathodal electrode mixture layer (Ex. 1004 ¶ 153). These disclosures of Ishigaki are generally undisputed by the parties at this point in the proceeding.

Limitation 1.4 of claim 1 recites “wherein the first layer is arranged between the current collector and the second layer, the first layer is formed on a surface of the current collector, and a particle size of 90% accumulative volume of the first material is less than 40 μm .” Ex. 1001, cols. 18–19, ll. 64–3.

Ishigaki discloses that its first and second layers are “sequentially laminated and formed on the current collector” foil, with the first layer positioned between the current collector and the second layer. Ex. 1004, ¶¶ 14, 77, 153, 366.

Ishigaki further discloses:

[A] 90% cumulative diameter (D90) of the secondary particles of the lithium transition metal compound powder of the present invention is normally 10 μm or less, preferably 8 μm or less, more preferably 6 μm or less, and most preferably 5 μm or less; and normally 0.5 μm or more, preferably 0.8 μm or more, more preferably 1 μm or more, and most preferably 1.5 μm or more. If the 90% cumulative diameter (D90) exceeds the upper limit, a reduction in battery performance may be brought about, whereas if the lower limit is exceeded, an issue may arise in the coating properties when forming the positive electrode active material layer.

Ex. 1004 ¶ 38. Ishigaki adds:

Note that, in the present invention, the median diameter, as the average particle diameter, and the 90% cumulative

diameter (D90) are measured by a well-known laser diffraction/scattering particle size distribution measuring device, with a set refractive index of 1.60a 0.10i, and *a particle diameter standard as a volume standard*. In the present invention, for the dispersion medium used during measurement, measurement was performed using a 0.1 wt% sodium hexametaphosphate aqueous solution.

Id. ¶ 39 (emphasis added). Petitioner contends that these disclosures anticipate claim 1's recital of "a particle size of 90% accumulative volume of the first material is less than 40 µm." Pet. 15. Patent Owner disagrees, arguing that "[t]he fact that a particle size is described as 'a particle diameter standard as a volume standard' does not dictate how a distribution of said particle sizes is constructed or defined." Prelim. Resp. 10 (quoting Ex. 1004 ¶ 39). According to Patent Owner, the use of laser diffraction, which is a measurement technique that is used to estimate the volume of a particle, is not indicative of a particular type of distribution. *Id.* at 11 (citing Ex. 1004 ¶ 39).

Patent Owner explains that, because all distributions require a measurement of particle sizes, knowing only particle sizes is not indicative of the particular statistical method used to describe the distribution of measured particle sizes. *Id.* at 12. Dr. Wheeler, Patent Owner's Declarant, opines that "[Petitioner's] logic is unsupported and flawed because determining particle sizes (e.g., by volume) is separate from the choice of how to construct or define a particle distribution once the particle sizes are known. Ex. 2015 ¶ 66.

Based upon the record, as presently developed, we are not persuaded by Patent Owner's position. We acknowledge Patent Owner's point that Ishigaki discloses values of "D90" as opposed to "Dv90." Prelim. Resp. 12.

Notwithstanding the slightly different nomenclature used by Ishigaki, Hutin⁹ teaches how volumetric weighted distributions are determined:

Volume weighted distributions: Static Light Scattering (SLS) techniques such as laser diffraction will give a volume weighted distribution. The contribution of each particle in the distribution relates to the volume of that particle (equivalent to mass if the density is uniform), i.e. the relative contribution will be proportional to (size). This is useful from a commercial perspective as the distribution represents the composition of the sample in terms of its volume/mass.

Ex. 3003, 10 (footnote omitted). Hutin further teaches that laser diffraction calculates a distribution based around volume terms:

Volume moment mean D[4,3]:

[10]

$$D[4, 3] = \frac{\sum d^4}{\sum d^3}$$

The volume moment mean (De Brouckere mean diameter) is relevant for many samples as it reflects the size of those particles which constitute the bulk of the sample volume. It is most sensitive to the presence of large particulates in the size distribution.

These formulas indicate around which central point of the frequency the surface area or volume/mass distribution would rotate. The advantage of this method of calculation is obvious: the formulas do not contain the numbers of particles and therefore calculations of the means and distributions do not require knowledge of the number of particles involved. *For example, laser diffraction initially calculates a distribution*

⁹ A. Hutin, SIZE ANALYSIS OF DISPERSIONS IN LIQUID PHASE: I. PARTICLE SIZE ANALYSIS (PSA), 1st Ed. (2022) (“Hutin”) Ex. 3003.

¹⁰ Where $\sum d$ is the sum of the diameters of all of the particles.

based around volume terms and this is why the D[4,3] is reported in a prominent manner.

Id. at 12 (emphasis added). Finally, Hutin notes that, with respect to means and percentiles, Dv50 is referred to as D50:

For volume weighted particle size distributions, *such as those measured by laser diffraction*, it is often convenient to report parameters based upon the maximum particle size for a given percentage volume of the sample.

Percentiles are then defined as *XaB* where:

- *X*: usually D for diameter,
- *a*: distribution weighting, e.g., *n* for number, *s* for surface, *v* for volume, and *i* for intensity.
- *B*: percentage of sample below this particle size e.g. 50 % or 0.5.

For example, the Dv50 would be the maximum particle diameter below which 50% of the sample volume exists, also known as the median particle size by volume. *Since the primary result from laser diffraction is a volume distribution, D50 is often cited in reference to the Dv50 without including the v.*

Id. at 13 (emphases added).

In view of the record as presently developed and understood with Hutin's definitions, we find Petitioner's Declarant more credible than Patent Owner's Declarant with respect to Ishigaki. We therefore conclude, for the purposes of this Decision, that a person of ordinary skill in the art would understand that Ishigaki's disclosure that the volumetric measures are derived from the well-known, laser diffraction/static light scattering ("SLS") method and that "the median diameter, as the average particle diameter, and the 90% cumulative diameter (D90) are measured by a well-known laser diffraction/scattering particle size distribution measuring device, with a set refractive index of 1.60a 0.10i, and *a particle diameter standard as a volume*

standard” (Ex. 1004 ¶ 39 (emphasis added)) confirms that Ishigaki is indeed disclosing a Dv90 volume-weighted distribution.

Furthermore, we are equally not persuaded, based upon the present record, by Patent Owner’s argument that the primary particle diameters are described in Ishigaki as being measured by a different method, namely by means of particle size counting using SEM images. Prelim. Resp. 13 (citing Ex. 1004 ¶¶ 41, 185. Patent Owner argues that Ishigaki discloses that, whereas measurement of secondary particle diameter is made by volumetric determination *via* a laser diffraction/SLS method, primary particle diameter is measured from images obtained *via* SEM. *Id.*

We fail to see the relevance of this argument. Ishigaki discloses:

In the method for producing a lithium transition metal compound powder such as a lithium nickel manganese cobalt complex oxide powder of the present invention, a slurry obtained by wet-pulverizing a raw material compound and additive is spray-dried to obtain a powder in which primary particles are aggregated to form secondary particles. The spray-dried powder made by primary particles aggregating and forming secondary particles is characterized in the shape of the spray-dried powder of the present invention.

Ex. 1004 ¶ 92. Additionally, as we noted above, Ishigaki discloses that:

[A] 90% cumulative diameter (D90) of the secondary particles of the lithium transition metal compound powder of the present invention is normally 10 μm or less, preferably 8 μm or less, more preferably 6 μm or less, and most preferably 5 μm or less; and normally 0.5 μm or more, preferably 0.8 μm or more, more preferably 1 μm or more, and most preferably 1.5 μm or more.

Id. ¶ 38. It is thus evident from these disclosures that it is the secondary particles, and not their constituent primary particles, that constitute the particles of the first and second layers of Ishigaki’s cathode, and the

cumulative diameter $D(v)90^{11}$ of these particles that correspond to the claimed “particle size of 90% accumulative volume of the first material is less than 40 μm .”

Limitation 1.5 of claim 1 requires that “a total compaction density of the first layer and the second layer is greater than 3.2 g/cc.” Ex. 1001, col. 19, ll. 4–5. Ishigaki discloses that:

The mixture density of the electrode of the present invention is characterized as 2.0 g/cm³ or more, and from the viewpoint of increasing capacitance density, it is preferably 2.0 g/cm³ or more, and particularly preferably 2.5 g/cm³ or more. The upper limit is not particularly limited, but since space is required in the positive electrode plate to hold the electrolyte in the electrode plate and to supply lithium ions, the upper limit is preferably 3.6 g/cm³ or less, more preferably 3.5 g/cm³ or less, and particularly preferably 3.4 g/cm³ or less.

Ex. 1004 ¶ 25.

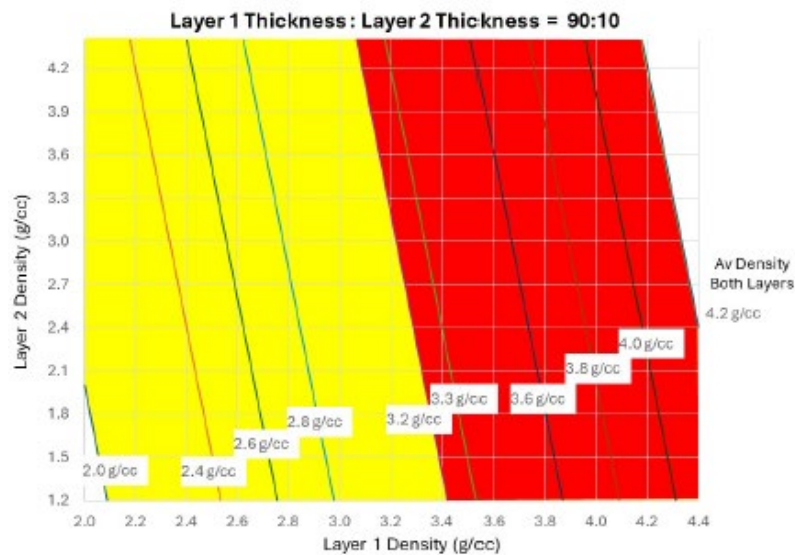
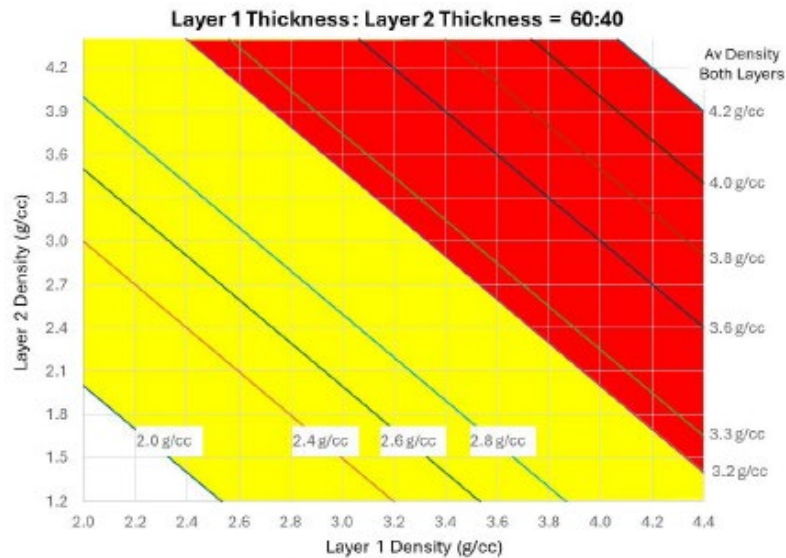
Ishigaki’s Example 2 is an embodiment of a cathode with the claimed first and second active layers. *See* Ex. 1004 ¶ 366. Dr. Gido, Petitioner’s Declarant, testifies that:

The maximum density of the Ishigaki cathode layers is constrained by the densities of its components ... resulting in a theoretical upper limit of 4.4 g/cm³ when porosity is zero. This density is derived from the weight ratios of these components in Ishigaki’s Example 2. The density of the active material is 4.8 g/cm³, and the densities of both the conductive carbon and the binder are 1.8 g/cm³. The presence of porosity lowers the overall density, with Ishigaki teaching a range of 2.0 to 4.2 g/cm³. The calculations and graphs provided throughout the discussion below demonstrate that combinations of the two layers can achieve densities greater than 3.2 g/cm³, with the red areas highlighting the higher density ranges Ishigaki emphasizes for maximizing energy density. These ranges are consistent with

¹¹ *See* Ex. 3003, 13, quoted *supra*.

and anticipate “a total compaction density of the first layer and the second layer is greater than 3.2 g/cc.”

Ex. 1010 ¶ 85; *see also* Ex. 1010 ¶ 90 (providing the calculations by which these figures were derived). Dr. Guido also provides the following demonstrative graphs, referred to in the passage quoted above, to illustrate his calculations:



These calculations by Dr. Gido are consistent with the disclosure of paragraph [0025] of Ishigaki quoted above.

Patent Owner responds that Ishigaki discloses a compaction density of 2.4 g/cm³ for its Example 2, and that this is the only value disclosed by Ishigaki for a two-layer cathodal electrode. Prelim. Resp. 15. Patent Owner also contends that Ishigaki's paragraph [0025] quoted above pertains only to a single active layer electrode, and not to the claimed double layer electrode. *Id.* at 16.

Patent Owner's Declarant, Dr. Wheeler, opines that:

The densities described in paragraphs [0025] and [0151] of Ishigaki, which Dr. Gido relies on, are described for single-layer cathode structures and Ishigaki provides no information suggesting that the provided densities also apply to multi-layer cathode (or anode) structures. *See* Ex. 1010 ¶¶ 87–88. Rather, both paragraphs [0025] and [0151] refer only to “the positive electrode active material *layer*,” which a POSITA would interpret as a single layer.

Ex. 2015 ¶ 81. Dr. Wheeler also points out that Ishigaki's Example 2 reports a compaction density of only 2.4 g/cm³, which is below the claimed range. *Id.* ¶ 86. Notably, Dr. Wheeler does not directly dispute Dr. Gido's calculations quoted above, which, as we have discussed above, are consistent with Ishigaki's paragraph [0025].

We are persuaded that Petitioner has met its initial burden of showing a reasonable likelihood of success at prevailing at trial in showing that Ishigaki discloses limitation 1.5 of claim 1. Moreover, based upon the record thus far developed, Patent Owner's arguments are insufficient to overcome Petitioner's initial showing.

Dr. Gido's calculations demonstrate that the range of possible compaction densities of the 2-layer electrode disclosed by Example 2 of

Ishigaki significantly overlap the claimed range of compaction densities recited in limitation 1.5 of claim 1. Moreover, these calculations are consistent with the range of compaction densities disclosed by Ishigaki's paragraph [0025].

Patent Owner contends that the latter range of densities pertain only to a cathode possessing a single layer, as opposed to two layers, based upon the language of Ishigaki in the same paragraph, stating that "[t]he thickness of the positive electrode active material layer is usually about 10 to 200 μm ." However, the paragraphs preceding Ishigaki's paragraph [0025] address the nature of the recesses in the current collector foil, a feature which is common to all of the embodiments of Ishigaki's invention. *See* Ex. 1004 ¶¶ 20–23. The paragraph preceding that (paragraph [0019]), entitled "Positive Electrode for Lithium Rechargeable Batteries," as well as subsequent paragraph [0024], discuss the *general* structure of Ishigaki's invention, with current collector and active material layers. *See, e.g., id.* ¶ 19 (stating that "the present invention is a positive electrode for lithium rechargeable batteries made by containing, on a current collecting foil, a mixture of an electrode made by including a positive electrode active material of a compound capable of absorbing and releasing lithium, a conductive material, and a binder").

Furthermore, the relevant passage of Ishigaki's paragraph [0025] begins by stating that "[t]he mixture density of *the electrode of the present invention* is characterized as." *Id.* ¶ 25 (emphasis added). The use of the phrase "of the invention" rather than, for example, "of this embodiment" indicates to the reader that the recited compaction densities of paragraph [0025] are meant to apply to the whole invention.

Therefore, a holistic reading of this section of Ishigaki paragraphs [0019]–[0025] indicates to the reader that these paragraphs are describing the general structure and properties of Ishigaki’s claimed invention, and distinguishing the active material layer from the current collector layer. Elsewhere, Ishigaki teaches that the “positive electrode active material” can consist of one or two “electrode mixture layers.” *See* Ex. 1004 ¶ 14 (1), (6). We can discern no language or suggestion in any of Ishigaki’s paragraphs [0019]–[0025] to indicate, Patent Owner’s arguments to the contrary notwithstanding, that the properties described therein relate solely to the embodiments of Ishigaki’s invention possessing only a single layer.

We agree with Patent Owner that Ishigaki’s Example 2 provides a double active layer cathode that has a compaction density of 2.4 g/cm³. Ex. 1004 ¶ 366. However, “a reference is not limited to the disclosure of specific working examples.” *In re Mills*, 470 F.2d 649, 651 (C.C.P.A. 1972); *see also In re Burckel*, 592 F.2d 1175, 1179 (C.C.P.A. 1979) (holding that a reference is not limited to its preferred embodiment, but must be evaluated for all of its teachings, including its teachings of non-preferred embodiments).

We therefore conclude, based upon the record as presently developed, that Petitioner has established a reasonable likelihood of prevailing at trial in showing that Ishigaki anticipates challenged claim 1. Furthermore, because we determine that Petitioner has demonstrated a reasonable likelihood of success at trial in showing that at least one claim is unpatentable on at least one of the stated Grounds, we institute *inter partes* review of all challenged claims of the ’118 patent, based on all of the remaining grounds identified in the Petition. *See* 37 C.F.R. § 42.208(a); *SAS Inst., Inc. v. Iancu*, 584 U.S.

357, 371 (2018); *PGS Geophysical AS v. Iancu*, 891 F.3d 1354, 1360 (Fed. Cir. 2018) (interpreting the statute to require “a simple yes-or-no institution choice respecting a petition, embracing all challenges included in the petition”).

We offer the following views on the remaining claims and Ground for the parties’ consideration.

b. Challenged claims 2–20

Independent claims 10 and 19 are identical to claim 1, with the exception of the preamble language, which recite “[a]n electrochemical device, comprising an electrode” and “[a]n electronic device, comprising an electrochemical device, the electrochemical device comprising an electrode,” respectively. Consequently, our reasoning presented above with respect to challenged claim 1 applies equally to claims 10 and 19.

With respect to challenged dependent claims 2–9, 11–18, and 20, based upon Petitioner’s arguments, we conclude, based upon the record presently before us, and as described in the preceding sections, that Petitioner has established a reasonable likelihood of prevailing at trial. Patent Owner presents no separate arguments with respect to these claims, reserving the right to do so at trial. *See* Prelim. Resp. 22.

D. *Ground 2: Alleged Obviousness of Claims 1–20 over Ishigaki and Kim*

1. Principles of Law

A claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the

invention was made to a person having ordinary skill in the art to which that subject matter pertains. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) objective evidence of non-obviousness, if present. *KSR*, 550 U.S. at 406.

“[W]hen a patent ‘simply arranges old elements with each performing the same function it had been known to perform’ and yields no more than one would expect from such an arrangement, the combination is obvious.” *KSR*, 550 U.S. at 417 (quoting *Sakraida v. Ag Pro, Inc.*, 425 U.S. 273, 282 (1976)). But in analyzing the obviousness of a combination of prior art elements, it can also be important to identify a reason that would have prompted one of skill in the art “to combine ... known elements in the fashion claimed by the patent at issue.” *Id.* at 418.

“[I]n considering the disclosure of a reference, it is proper to take into account not only specific teachings of the reference but also the inferences which one skilled in the art would reasonably be expected to draw therefrom.” *In re Preda*, 401 F.2d 825, 826 (C.C.P.A. 1968). Moreover, a precise teaching directed to the specific subject matter of a challenged claim is not necessary to establish obviousness. *KSR*, 550 U.S. at 418. Rather, “any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed.” *Id.* at 420. Accordingly, a party that petitions the Board for a determination of unpatentability based on obviousness over a combination of references must show that “a skilled artisan would have been

motivated to combine the teachings of the prior art references to achieve the claimed invention, and that the skilled artisan would have had a reasonable expectation of success in doing so.” *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1381 (Fed. Cir. 2016) (quoting *Intelligent Bio-Sys., Inc. v. Illumina Cambridge, Ltd.*, 821 F.3d 1359, 1367–68 (Fed. Cir. 2016)).

2. Petitioner’s arguments

a. Independent claim 1

i. 1.P–1.4

Petitioner argues that limitations 1.P–1.4 are obvious over Ishigaki for the same reasons that these limitations are anticipated by Ishigaki, based upon the same arguments presented in Sections III.C.2.a.i–v above. Pet. 30 (citing Ex. 1010 ¶ 215).

ii. 1.5

Petitioner argues that Ishigaki teaches this limitation as discussed in Ground 1. Pet. 30 (citing Ex. 1010 ¶ 216). Petitioner further argues that, to the extent that Ishigaki does not explicitly teach the criticality of the total compaction density being at least 3.2 g/cc, Kim teaches a cathode layer density of 3.31 g/cc or greater, and of 3.4 to 4.0 g/cc. *Id.* (citing Ex. 1009 ¶ 36). Petitioner contends that Kim explains that compaction densities, which is the density of the electrode material layer after it has been subjected to the compression step of the electrode formation process, below 3.31 g/cc “may be too small to obtain a high electrical capacity.” *Id.* (quoting Ex. 1009 ¶ 36).

Petitioner argues that Kim’s ranges are compatible with Ishigaki, and would have encouraged a person of ordinary skill in the art to pursue

compaction densities towards the higher end of Ishigaki's range. Pet. 30 (citing Ex. 1004 ¶ 25; Ex. 1010 ¶ 218). Furthermore, argues Petitioner, Ishigaki teaches increasing the battery capacity by "packing [the] electrode active material ... as densely as possible," preferably at least 2.5 g/cc and up to 3.6 g/cc. *Id.* at 30–31 (citing Ex. 1004 ¶ 7). According to Petitioner, a skilled artisan, reading Ishigaki, would have been motivated to choose compaction densities as high as possible, and would be further motivated by Kim to choose a compaction density greater than 3.2 g/cc in order to avoid a compaction density that is too small to obtain the desired electrical capacity. *Id.* at 31 (quoting Ex. 1010 ¶ 219). Petitioner argues that Kim's express teaching that compaction densities lower than 3.31 g/cc may be too small to obtain high energy capacity would motivate a person of ordinary skill to choose densities of 3.31 g/cc or higher in practicing Ishigaki because achieving high energy capacity is a primary objective of Ishigaki. *Id.* (citing Ex. 1010 ¶ 220). Petitioner contends that such a skilled artisan would expect compaction densities of 3.31 or higher to be successful in Ishigaki's battery because Ishigaki expressly embraces densities of 3.4 g/cc, 3.5 g/cc and 3.6 g/cc. *Id.* (citing Ex. 1010 ¶ 220).

b. Claims 2–4

Petitioner argues that Ishigaki teaches claims 2–4 as discussed in Ground 1. Pet. 31 (citing Ex. 1010 ¶¶ 221–223).

c. Claim 5

Petitioner argues that Ishigaki teaches claim 5 for the same reasons presented above with respect to Ground 1. Pet. 32. Furthermore, Petitioner

contends that Kim teaches a cathode layer density of 3.31 g/cc or greater, and of 3.4 to 4.0 g/cc. *Id.* (citing Ex. 1009 ¶ 36). According to Petitioner, Kim explains that compaction densities below 3.31 g/cc “may be too small to obtain a high electrical capacity.” *Id.* (quoting Ex. 1009 ¶ 36).

In addition to the reasons presented with respect to claim 1, Petitioner asserts that it would have been well known to a person of ordinary skill in the art that higher compaction densities were commonplace in the art and that common sense dictates choosing the highest workable compaction density for a given application. Pet. 33 (citing Ex. 1010 ¶ 227; Ex. 1004 ¶ 7). Petitioner argues that a skilled artisan would have a greater expectation of success using the compaction densities in the higher end of the range taught by Ishigaki as compared to the lower end of that range. *Id.* (citing Ex. 1003 ¶ 44). Petitioner contends that a such a skilled artisan would have been motivated to choose densities 3.31 g/cc or greater for both layers in view of Kim’s teaching that densities less than 3.31 g/cc may be too small. *Id.* (citing Ex. 1009 ¶ 36; Ex. 1010 ¶ 227).

d. Claims 6–9

Petitioner argues that Ishigaki teaches claims 6–9 as presented with respect to these claims in Ground 1 above. Pet. 33 (citing Ex. 1010 ¶¶ 228–231).

e. Independent claim 10

i. 10.P–10.4

Petitioner argues that Ishigaki teaches limitations 10.P–10.4 for the same reasons presented with respect to Ground 1. Pet. 33 (citing Ex. 1010 ¶ 232). Furthermore, argues Petitioner, limitations 10.1–10.4 of claim 10

(other than the preamble) duplicate the corresponding limitations of claim 1, and Ishigaki renders these limitations obvious for the same reasons as claim 1 of Ground 2. *Id.* at 33–34.

ii. 10.5

Petitioner argues that Ishigaki teaches the compaction density limitation of 10.5 for the same reasons as presented with respect to limitation 1.5 above. Pet. 34. Petitioner additionally argues that, to the extent Ishigaki does not teach the criticality of the compaction density being at least 3.2 g/cc, Kim teaches this feature, as argued with respect to limitation 1.5. *Id.* (citing Ex. 1010 ¶¶ 233–234).

f. Claims 11–18

Petitioner notes that claims 11–18 duplicate claims 2–9. Pet. 34. Petitioner argues that Ishigaki alone or in combination with Kim renders these claims obvious for the same reasons presented with respect to those claims above. *Id.* (citing Ex. 1010 ¶¶ 235–245).

g. Independent claim 19

i. 19.P–19.4

Petitioner argues that Ishigaki teaches limitations 19.P–19.4 for the same reasons presented with respect to Ground 1. Pet. 34 (citing Ex. 1010 ¶ 232). Furthermore, argues Petitioner, limitations 19.1–19.4 of claim 19 (other than the preamble) duplicate the corresponding limitations of claim 1,

and Ishigaki renders these limitations obvious for the same reasons as claim 1 of Ground 2. *Id.*

ii. 19.5

Petitioner argues that Ishigaki teaches the compaction density limitation of 19.5 for the same reasons as presented with respect to limitation 1.5 above. Pet. 34. Petitioner additionally argues that, to the extent Ishigaki does not teach the criticality of the compaction density being at least 3.2 g/cc, Kim teaches this feature, as argued with respect to limitation 1.5. *Id.* (citing Ex. 1010 ¶¶ 233–234).

h. Claim 20

Petitioner argues that claim 20 duplicates the limitations of claim 6. Pet. 35. Petitioner contends that Ishigaki teaches the limitations of claim 20 as argued with respect to Ground 1, and the combination of Ishigaki and Kim also renders these claims obvious as argued with respect to claim 6 above. *Id.* (citing Ex. 1010 ¶ 249).

3. Patent Owner's Preliminary Response

Patent Owner responds that: (a) Petitioner fails to show that Kim would motivate a person of ordinary skill in the art to pursue compaction densities above 3.2 g/cc; and (b) the '118 patent's claimed density ranges are critical. Prelim. Resp. 22, 32.

a. Kim's teaching of compaction density ranges

Patent Owner again argues that Ishigaki teaches that two-layer cathode structures should be provided with lower densities as compared with

single-layer cathode structures. i.e., with a density below 3.2 g/cc. Prelim. Resp. 23 (citing Ex. 2015 ¶¶ 87–88, 95, 97–98). Additionally, Patent Owner argues, Ishigaki teaches that densities below 3.2 g/cc are sufficient to meet Ishigaki’s objectives. *Id.* (citing Ex. 2015 ¶ 97 (citing Ex. 1004 ¶¶ 382–383); also citing *R.J. Reynolds Vapor Co. v. Fontem Holdings I B.V.*, IPR2016-01692, Paper 45 (PTAB Mar. 2, 2018)). Patent Owner repeats that the only disclosed value for a two-layer cathode structure in Ishigaki is 2.4 g/cm³, and Ishigaki’s examples teach that the density of the two-layer cathode structure is less than the densities of the single-layer cathodes, which are well below the claimed 3.2 g/cc compaction density. *Id.* ¶¶ 86–88 (citing Ex. 1004 ¶¶ 348–349, 356–357, 361–363, 366). Patent Owner asserts that, in view of these teachings of Ishigaki, Petitioner is without a rationale for combining Kim and Ishigaki. *Id.*

Patent Owner further alleges that Petitioner does not appreciate that Kim’s densities are not densities of a complete cathode layer (as described in Ishigaki), but, rather, describe the density values of the active material, excluding additives, such as conducting agents and binders, that Kim includes in its completed cathode. Prelim. Resp. 24 (citing Ex. 1009 ¶ 36, 40; Ex. 2015 ¶¶ 99–106).

Specifically, argues Patent Owner, Kim discloses two density-related terms, namely “press density” and “volume density.” Prelim. Resp. 24 (citing Ex. 1009 ¶ 36; Ex. 2015 ¶¶ 100–101, 105. Patent Owner notes that Petitioner relies on these disclosures to assert that “Kim explains that compaction densities, which is the density of the electrode material layer after it has been subjected to the compression step of the electrode formation process, below 3.31 g/cc “may be too small to obtain a high electrical

capacity.” *Id.* at 2425 (quoting Pet. 30 (citing Ex. 1009 ¶ 36)). However, Patent Owner argues, Kim’s “press density” and “volume density” for its active material do not correspond to a “compaction density” of a cathode as disclosed in Ishigaki. *Id.* at 25 (citing Ex. 2015 ¶¶ 101–106).

By way of example, Patent Owner points to Kim’s Example 1 which teaches that “ $\text{Li}_{1.03}\text{Ni}_{0.8}\text{Co}_{0.1}\text{Mn}_{0.1}\text{O}_2$ powder having an average particle diameter of about 15 μm and $\text{Li}_{0.9}\text{Ni}_{0.8}\text{Co}_{0.1}\text{Mn}_{0.1}\text{O}_2$ powder having an average particle diameter of about 5 μm were mixed in a weight ratio of about 95:5 to prepare a composite cathode active material.” Prelim. Resp. 25 (quoting Ex. 1009 ¶ 070; Ex. 2015 ¶ 102). Patent Owner notes that Kim also teaches that a slurry used to form the cathode active material layer includes “5 g of the composite cathode active material powder of Example 1, 0.15 g of a carbon conducting agent, and 0.15 g of polyvinylidene difluoride (PVDF) as a binder.” *Id.* (quoting Ex. 1009 ¶ 79; Ex. 2015 ¶ 102).

According to Patent Owner, the term “composite cathode active material” refers only to active material constituent, and not the entire “cathode active material composition” of Kim’s cathode that also includes a conductive agent and binder. Prelim. Resp. 25 (citing Ex. 1009 ¶ 40; Ex. 2015 ¶ 102). Patent Owner contends that, once additives, including conducting agents and binders are added to form Kim’s “cathode active material composition,” the density of the “cathode active material composition” would be lower than Kim’s recited density of just the “composite cathode active material.” *Id.* (citing Ex. 1004 ¶ 110). Patent Owner notes that Petitioner’s Declarant, Dr. Gido, recognizes that conducting agents, binders, and other additives lower the overall density of an electrode. *Id.* at 26 (citing Ex. 1010 ¶ 85; Ex. 2015 ¶ 84).

Patent Owner asserts that a person of ordinary skill in the art would understand that Kim's "press density" is a density of only the active material constituent of a cathode active material layer and not the density of an electrode layer, such as the cathode layer disclosed in Ishigaki. Prelim. Resp. 26 (citing Ex. 2015 ¶¶ 101–102). Patent Owner argues that this interpretation of press density is consistent with Kim's paragraph [0037], which describes the press density as "an apparent press density when the composite cathode active material powder is pressed at a pressure of 2.5 ton/cm²." *Id.* (citing Ex. 2015 ¶ 102 (citing Ex. 1009 ¶ 37)).

Patent Owner next argues that Kim does not disclose a two-layer structure, much less a two-layer structure having a total compaction density of greater than 3.2 g/cc. Prelim. Resp. 27 (citing Ex. 2015 ¶ 107). Therefore, argues Patent Owner, even if a skilled artisan were to consider the press densities of Kim to be compatible with the densities of Ishigaki, the press densities of Kim are only provided for a specific composite active material composition for use in single-layer cathode structures and are therefore not compatible with or applicable to Ishigaki's two-layer cathode structure. *Id.* (citing Ex. 2015 ¶¶ 108–109). According to Patent Owner, Kim is directed to a composite cathode active material for use in "a single active material layer." *Id.* (citing Ex. 2015 ¶¶ 108–109 (citing Ex. 1010 ¶ 65); Ex. 1009, Abstr.). Patent Owner explains that Kim's statement that "volume density of the composite cathode active material may be too small to obtain a high electrical capacity when the press density of the composite cathode active material is less than 3.31 g/cm³" is only applicable to the specific mixture of two different cathode active materials in the single layer, and not to cathode active materials in general (which may have smaller

densities in usable cathode compositions). *Id.* (citing Ex. 2015 ¶¶ 112, 117–121).

Patent Owner argues that a person of ordinary skill in the art would have understood that, among other things, electrode composition and active material particle size directly impact the resultant density of an electrode layer. Prelim. Resp. 28 (citing Ex. 2015 ¶¶ 119–121). Patent Owner also contends that a skilled artisan would therefore have understood that the density values discussed in Kim are relevant only to a structure formed from mixing together two different active materials having two different particle size distributions, and that Kim’s densities would not have been applicable to Ishigaki’s two-layer cathode structure that is formed by separately depositing two different active material mixtures. *Id.* at 28–29 (citing Ex. 2015 ¶¶ 109–112).

According to Patent Owner, Kim acknowledges this difference between its composite active material and “conventional” active materials, such as are used in Ishigaki. Prelim. Resp. 29 (citing Ex. 1009 ¶ 36 (the volume density of the composite cathode active material of Kim “may exceed a conventional density range); Ex. 2015 ¶ 120). Patent Owner contends that a skilled artisan would have understood that Kim’s disclosures mean that its volume densities, and thus its press densities, are only applicable to Kim’s composite cathode active material and not applicable or comparable to Ishigaki’s conventional single-active material cathode layers. *Id.*

Patent Owner argues that a skilled artisan would not have assumed that Kim’s compaction of a layer in a single-layer cathode structure is the same as a two-layer cathode structure as disclosed in Ishigaki. Prelim.

Resp. 30 (citing Ex. 2015 ¶¶ 113–115). Consequently, argues Patent Owner, a person of ordinary skill in the art would not have directly applied the compaction density of a layer in the single-layer cathode structure to a two-layer cathode structure. *Id.* (citing Ex. 2015 ¶ 113).

Finally, Patent Owner concludes that Kim and Ishigaki are directed to completely different problems. Prelim. Resp. 31. Patent Owner contends that Kim is not concerned with preventing short circuits due to recesses, but rather aims to maximize energy density by mixing two different active materials into an otherwise homogenous positive electrode, such that there is only a single layer. *Id.* (citing Ex. 2015 ¶ 127 (citing Ex. 1009 ¶ 6)).

b. Allegedly critical density ranges of the '118 patent

Patent Owner next argues that the claimed density ranges are critical to providing the advantages of the '118 patent's invention, and that this criticality is disclosed neither by Ishigaki nor Kim. Prelim. Resp. 32 (citing Ex. 2015 ¶ 129; *E.I. du Pont de Nemours & Co. v. Synvina C.V.*, 904 F.3d 996, 1006 (Fed. Cir. 2018)). Patent Owner explains that the '118 patent also teaches that its claimed electrode compaction densities, including a compaction density value greater than 3.2 g/cc for all active material layers in the two-layer electrode structure, is required to achieve, the desired energy density of a Li-ion battery. *Id.* at 32–33 (citing Ex. 1001, col. 6, ll. 4–12, ll. 20–27; Ex. 2015 ¶¶ 122, 130–131).

Patent Owner contends that Ishigaki never mentions the alleged criticality of a compaction density value greater than 3.2 g/cc for the combined active material layers of any electrode structure, much less a two-layer electrode structure, rather, Ishigaki teaches that densities much lower

than 3.2 g/cc satisfy its goals. Prelim. Resp. 33 (citing Ex. 2015 ¶¶ 132–134). According to Patent Owner, Ishigaki aims to improve adhesion and to reduce the likelihood of short circuits by reducing recesses in the surface of the current collector. *Id.* (citing Ex. 1004 ¶¶ 378–383; Ex. 2015 ¶ 98). Patent Owner contends that Ishigaki attributes the superior performance of its Examples 1 and 2 relative to its Comparative Examples 1 and 2 to the fact that Examples 1 and 2 have “a smaller ratio of recessed portions.” *Id.* (citing Ex. 1004 ¶¶ 98; Ex. 2015 ¶¶ 134–139). Patent Owner therefore concludes that Ishigaki fails to render obvious the claimed density ranges, because Ishigaki’s disclosure is directed to a completely different problem that would not have led a skilled artisan to the ’118 patent’s allegedly critical range of density values. *Id.* at 34.

4. Analysis

Having reviewed the parties’ arguments and the evidence of record, as presently developed, we conclude, for the purposes of this Decision, that Petitioner has met its burden of demonstrating a reasonable likelihood of prevailing at trial in showing that the challenged claims are obvious over Ishigaki and Kim.

As an initial matter, we have explained, in Section III.C.4 above, why we conclude that Petitioner has established a reasonable likelihood of prevailing at trial in showing that Ishigaki anticipates the challenged claims. For the same reasons, we conclude, based upon the present record, that the challenged claims are reasonably likely to be obvious over Ishigaki. *See In re McDaniel*, 293 F.3d 1379, 1385 (Fed. Cir. 2002) (holding that “[i]t is well

settled that ‘anticipation is the epitome of obviousness’” (quoting *Connell v. Sears Roebuck & Co.*, 722 F.2d 1542, 1548, (Fed. Cir. 1983)).

Additionally, Kim teaches a cathode active material layer density of 3.31 g/cc or greater, and of 3.4 to 4.0 g/cc. Ex. 1009 ¶ 36. Kim explains that compaction densities, which is the density of the electrode material layer after it has been subjected to the compression step of the electrode formation process, below 3.31 g/cc “may be too small to obtain a high electrical capacity.” Ex. 1009 ¶ 36.

As in the Petition’s other § 103 grounds, Patent Owner’s arguments against institution of *inter partes* review focus principally upon limitation 1.5 (and, by implication, the identical limitations 10.5 and 19.5). Patent Owner contends that the compaction densities taught by Kim are not densities of a complete cathode layer, but, rather, of the density values of the active material, exclusive of additives (e.g., conducting agents and binders) that Kim includes in its completed cathode. Prelim. Resp. 24.

Patent Owner also argues that the claimed compaction density of limitation 1.5 of challenged claim 1 is critical. Prelim. Resp. 31. According to Patent Owner, the ’118 patent also explains that its requirement of a compaction density value greater than 3.2 g/cc for all active material layers in the two-layer electrode structure, ensures, and is required to achieve, the desired energy density of a Li-ion battery. *Id.* at 32–33 (citing Ex. 1001, col. 6, ll. 4–12, 20–27). Patent Owner argues that Petitioner does not explain that a skilled artisan would have known of the unexpected benefits discovered by the inventors of the ’118 patent. *Id.* at 33.

On the record as presently developed, Kim’s disclosures concerning its exemplary embodiments appear to support Patent Owner’s interpretation. Kim teaches that:

Separately, 3 g of each of the composite cathode active materials of Examples 1 to 5 and Comparative Examples 1 to 4 was put into a mold having a diameter of about 1.2 cm, and then pressed at about 2.6 ton/cm² to obtain pellets. Densities of the pellets were measured. The results are shown in Table 1 below.

Ex. 1009 ¶ 90. Kim teaches that the active materials of Examples 1–4 were combined with “0.15 g of a carbon conducting agent, and 0.15 g of polyvinylidene difluoride (PVDF) as a binder” and incorporated into Li-ion batteries. Ex. 1009, Examples 6–10, Comparative Examples 6–8, ¶¶ 79–89. Table 1 of Kim is reproduced below:

TABLE 1

	Press density [g/cm ³]	Discharge capacity (mAh/g)	Maximum heat flow temperature [° C.]
Example 6	3.32	174.8	290
Example 7	3.36	174.2	290
Example 8	3.41	173.7	292
Example 9	3.45	173.5	294
Example 10	3.42	171.2	295
Comparative Example 5	3.30	174.9	290
Comparative Example 6	3.14	162.2	295
Comparative Example 7	3.42	175.1	272
Comparative Example 8	3.43	160.3	298

Table 1 of Kim presents data concerning press densities, discharge capacities, and maximum heat flow temperatures of Kim’s exemplary embodiments.

Concerning Table I, Kim teaches, relevantly, that “the lithium batteries of Examples 6 to 10 each using a mixture of a *high-lithium content large-diameter active material* and a *low-lithium content small-diameter*

active material had a press density of about 3.31 g/cm² or greater.”

Ex. 1009 ¶ 90 (emphasis added).

Nevertheless, Kim’s teaching that higher active material press densities (i.e., > 3.31 g/cm³; *see* Ex. 1009 ¶ 36) are preferable, because lower densities may be too small to obtain a high electrical capacity, is consistent with Ishigaki’s teaching that the “the upper limit [of active material layer compaction density] is preferably 3.6 g/cm³ or less, more preferably 3.5 g/cm³ or less, and particularly preferably 3.4 g/cm³ or less.” Ex. 1004 ¶ 25. *See Burckel*, 592 F.2d at 1179 (holding that a reference is not limited to its preferred embodiment, but must be evaluated for all of its teachings, including its teachings of non-preferred embodiments).

On the record as presently developed, we find that a person of ordinary skill in the art, comparing the teachings of Kim and Ishigaki, would have been motivated to select a compaction density exceeding 3.3 g/cm³. The parties are invited to further develop their positions at trial.

E. Ground 3: Alleged Obviousness of Claims 1–20 over Wang and Saka

1. Petitioner’s arguments

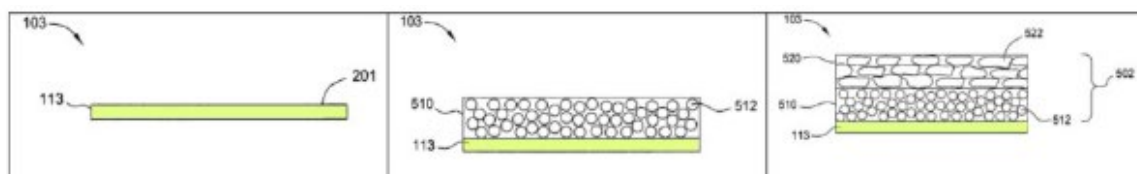
a. Claim 1

i. 1.P

Petitioner states that Wang’s cathode structure 103 is an electrode. Pet. 37 (citing Ex. 1005 ¶¶ 10, 11, 35). Petitioner notes that Wang teaches that “[t]he primary functional components of Li-ion battery 100 include an anode structure 102, a cathode structure 103, [and] a separator layer 104.” *Id.* (citing Ex. 1005 ¶ 41).

ii. 1.1

Petitioner argues that Wang's current collector 113 is the claimed current collector. Pet. 38 (citing Ex. 1010 ¶¶ 259, 10, 11; Ex. 1005 ¶ 42). Petitioner notes that Wang teaches that "FIGS. 5A–5C are schematic cross-sectional views of one embodiment of a graded cathode electrode structure 103 having a particle size gradient." *Id.* (citing Ex. 1005 ¶ 80). Petitioner's annotated versions of Wang's Figures 5A–5C are reproduced below:



Petitioner's annotated Figures 5A–5C of Wang depict a cross-sectional schematic of a cathodal electrode

iii. 1.2

Petitioner argues that Wang's electrode comprises a first layer, which comprises a first material. Pet. 38 (citing Ex. 1005 ¶¶ 10, 11). Petitioner contends that Wang's first layer 510 is the claimed first layer, and that its first cathodically active particles 512 are the claimed first material. *Id.* According to Petitioner, Wang teaches "a first layer 510 having first cathodically active particles 512 having a first diameter is formed over a surface 201 of the current collector 113." *Id.* at 39 (quoting Ex. 1005 ¶ 81, Figs. 5A–5C (*supra*)).

iv. 1.3

Petitioner argues that Wang teaches the electrode comprises a second layer, which comprises a second material. Pet. 39 (citing Ex. 1005 ¶¶ 10,

11). Petitioner contends that Wang's second layer 520 is the claimed second layer, and that its second cathodically active particles 522 is the claimed second material. *Id.* (citing Ex. 1010 ¶ 263). Petitioner notes that Wang teaches that "a second layer 520 having second cathodically active particles 522 having a second diameter is formed over the first layer 510." *Id.* (quoting Ex. 1005 ¶ 83, Fig. 5C).

v. 1.4

Petitioner argues that Wang's first layer is arranged between the current collector and the second layer. Pet. 40 (citing Ex. 1005 ¶¶ 10, 11, 38; Ex. 1010 ¶ 265). Petitioner contends that Wang teaches "a first layer 510...is formed over a surface 201 of the current collector 113" and that "a second layer 520...is formed over the first layer 510." *Id.* (citing Ex. 1005 ¶¶ 81, 83, Figs. 5A–5C).

Petitioner also contends that Wang teaches that a particle size of 90% accumulative volume of the first material is less than 40 μm . Pet. 41 (citing Ex. 1005 ¶ 81). In various embodiments, argues Petitioner, Wang teaches that the first cathodally active particles 512 "are nano-scale particles," with a diameter of "between about 1 nm and about 100 nm" (0.001 μm to 0.1 μm), or between "about 2 μm and about 15 μm ." *Id.* (quoting Ex. 1005 ¶ 81; Ex. 1010 ¶ 26). According to Petitioner, the Dv90 of this particle size distribution is necessarily less than the upper end of these ranges, i.e., 0.1 μm or 15 μm , which are both less than 40 μm . *Id.* (citing Ex. 1010 ¶¶ 269, 272).

vi. 1.5

Petitioner argues that Wang teaches that, following the deposition of “cathodically active particles over the vertically oriented flexible conductive substrate,” the cathode is further compacted using a “compression process” to compress the layers “to a desired net-density.” Pet. 43 (citing Ex. 1005 ¶¶ 15, 58; Ex. 1010 ¶ 274). Petitioner contends that Wang additionally teaches there can be one or two compression steps. *Id.* (citing Ex. 1005 ¶ 92). According to Petitioner, Wang thus teaches the processes required for achieving the desired compaction density of the layers, in order to achieve a high packing density of active material in the cathode layers and, therefore, a high energy density for the battery. *Id.* (citing Ex. 1010 ¶ 275).

Petitioner acknowledges that Wang may not expressly teach the numeric value for the desired compaction density. Pet. 43 (citing Ex. 1010 ¶ 276). Petitioner argues that Wang assumes that a skilled artisan would have already had in mind a desired density, and teaches the method one would use to achieve it. *Id.* at 43–44. Petitioner therefore contends that a person of ordinary skill in the art would look to a reference such as Saka to determine what net density to pursue. *Id.* at 44 (citing Ex. 1010 ¶ 276).

Petitioner asserts that Saka teaches an electrode having a positive electrode mixture 12 on a current collector 11, where positive electrode mixture 12 includes a first layer 12a and a second layer 12b. Pet. 44 (citing Ex. 1006, Fig. 5). Petitioner states that Saka teaches that “the dried positive electrode mixture layer 12 may be pressed using a rolling mill or the like to adjust the thickness and the mixture density thereof.” *Id.* (citing Ex. 1006 ¶ 51). Petitioner argues that, after being pressed, the density of mixture layer 12 is a compaction density. *Id.* (citing Ex. 1010 ¶ 277). Petitioner

notes that Saka additionally teaches that “[t]he mixture density of the positive electrode mixture layer 12 is, for example, 2.5 g/cm³ to 3.5 g/cm³.” *Id.* (citing Ex. 1006 ¶ 51). Petitioner therefore asserts that Saka teaches the compaction density of the positive electrode mixture layer 12 (including both first and second layers 12a and 12b) can be greater than 3.2 g/cc. *Id.* (citing Ex. 1010 ¶ 277).

Petitioner concludes that it would have been obvious to those of ordinary skill in the art to combine Wang and Saka. Pet. 45 (citing Ex. 1010 ¶ 279). Petitioner contends that, first, Wang and Saka are analogous art to each other and to the ’118 patent. *Id.* (citing Ex. 1010 ¶ 279). Petitioner argues that both Wang and Saka teach first and second layers of active material on the cathodal current collector, with particles of different sizes or of different compositions. *Id.* (citing Ex. 1006, Fig. 5). Petitioner argues further that both Wang and Saka teach compression treatments to the active materials to consolidate the bilayer structure and increase its density. *Id.* at 45 (citing Ex. 1006 ¶ 7).

Petitioner acknowledges that, although Wang does not expressly provide values for the compaction density, a person of ordinary skill in the art, upon comprehending the teachings of Wang, would reasonably understand the purpose and the outcome of the compression treatment, and would be reasonably motivated to review additional teachings about quantitative values or ranges of the compaction density, which Saka teaches, to supplement Wang’s teaching by combining Saka’s range of the compaction density with the properties of the active material in Wang’s cathode structure. *Id.* (citing Ex. 1010 ¶¶ 280–282).

b. Claim 2

Petitioner argues that Wang discloses the thickness of the first layer is not less than the Dv90 of the first material. Pet. 46 (citing Ex. 1010 ¶ 283; Ex. 1005 ¶ 81). Specifically, Petitioner contends that Wang teaches that the first layer 510 has a thickness between about 10 µm to about 150 µm, or between about 50 µm to about 100 µm, with particle sizes that are between about 1 nm and about 100 nm, or between about 2 µm and about 15 µm. *Id.* at 46–47 (citing Ex. 1005 ¶ 81; Ex. 1010 ¶ 284). Petitioner asserts that the respective Dv90s of these particle size distributions must necessarily be less than the upper end of the claimed range. *Id.* at 47.

c. Claim 3

Petitioner argues that Wang teaches a second layer 520 having second cathodically active particles 522 having a second diameter formed over the first layer 510. Pet. 48 (citing Ex. 1005 ¶ 83). Petitioner points to one embodiment of Wang, in which “the second cathodically active particles 522 have a second diameter greater than five times the particle size of the particles of the first layer.” *Id.* (citing Ex. 1005 ¶ 83). Petitioner asserts that this is within the claimed numeric range of 1:1 to 40:1. *Id.* (citing Ex. 1010 ¶ 287; Ex. 1005 ¶ 84).

d. Claim 4

Petitioner argues that Wang discloses a first material with an average particle size within the claimed range, as described above for claims 1–3. Pet. 48 (citing Ex. 1005 ¶ 81; Ex. 1010 ¶ 289).

e. Claim 5

Petitioner repeats its arguments with respect to Wang and Saka and limitation 1.5 above. Pet. 49. Briefly, Petitioner contends that Wang teaches that one or both active material layers can be exposed to a compression process to compact the packing density of the particles and achieve a desired net density. *Id.* (citing Ex. 1005 ¶¶15, 58; Ex. 1010 ¶ 292). Petitioner acknowledges that Wang does not expressly teach the numeric values of the compaction densities for the two layers. *Id.* However, Petitioner asserts Saka teaches that “[t]he mixture density of the positive electrode mixture layer 12 is, for example, 2.5 g/cm³ to 3.5 g/cm³.” *Id.* (citing Ex. 1006 ¶ 51).

Petitioner further argues that Saka teaches a layering process with compression steps, comparable to the process described by Wang. Pet. 50 (citing Ex. 1010 ¶ 294). Petitioner notes that Saka’s layers are labeled opposite to the convention used in the ’118 patent and Wang, namely, the “first” layer is the outer (top) layer of the structure. *Id.* (citing Ex. 1010 ¶ 297).

Petitioner argues further that Saka goes discloses the numeric values of several properties of the layers across numerous embodiments. Pet. 51. Petitioner acknowledges that, although Saka does not directly provide compaction densities for the individual layers, Saka does provide ample information from which a skilled artisan could readily calculate those compaction densities using standard formulas and simple algebra. *Id.* (citing Ex. 1010 ¶ 294). Specifically, argues Petitioner, Saka teaches the relative amounts (ratios) by weight (mass) of the various components of the layers (particles, additive, and binder) and the relative volumes of the layers. *Id.*

Petitioner argues that a person of ordinary skill in the art could have calculated the separate layer densities from the data thus provided. *Id.* Petitioner contends that Saka also provides data as to how porosity also affects the density of the layers. *Id.* (citing Ex. 1007; Ex. 1010 ¶ 295). Petitioner asserts that the layer densities of Saka's examples render obvious the compaction densities recited in claim 5. *Id.* (citing Ex. 1010 ¶ 313).

Petitioner argues that a person of ordinary skill in the art would have been motivated to combine the teachings of Wang with Saka for the purpose of learning and incorporating Saka's specific compaction densities into the layers taught by Wang. Pet. 49 (citing Ex. 1010 ¶¶ 292–293). Petitioner argues that a skilled artisan would also have had a reasonable expectation of success in using Wang's method to make a battery with a compaction density greater than 2.8 g/cc in the inner layer and greater than 3.3 g/cc in the outer layer based on Saka's various battery examples, Saka's teaching of a density of 3.5 g/cc, and the porosities of Saka's layers. *Id.* (citing Ex. 1006 ¶ 51).

Petitioner asserts that this is because Wang teaches that its compression method decreases porosity. Pet. 52–53. Petitioner explains that porosity, as a percentage of the layer volume, is also calculated for the various Saka examples. *Id.* at 53 (citing Ex. 1007; Ex. 1010 ¶ 313). By way of example, Petitioner points to Saka's exemplary battery A1, in which the porosity of layer 1 is 19% and the porosity of layer 2 is 30%. *Id.* Petitioner contends that these porosity values reinforce the comparison between the density values of Saka and the compaction density values of claim 5. *Id.* (citing Ex. 1010 ¶¶ 313–315).

Petitioner argues further that a skilled artisan would also have been motivated to use Wang's compression method to achieve an outer layer density of 3.5 g/cc in view of the knowledge in the art that higher densities are more desirable and that densities below 3.1 may be too low for sufficient energy capacity. *Id.* (citing, *e.g.*, Ex. 1009 ¶ 36).

f. Claim 6

Petitioner argues that Wang teaches that "it is desirable to perform a calendaring process after deposition of the second porous layer in order to increase the packing density of the particles of the second layer relative to the particles of the first layer." Pet. 54 (citing Ex. 1005 ¶ 92). Petitioner adds that Saka also teaches the first layer has a lower compaction density than the second layer, because all of its examples list a compaction density for the first layer that is less than for the second layer. *Id.* (citing Ex. 1007).

Petitioner argues that, in addition to the reasons stated with respect to claim 1 above, a person of ordinary skill in the art would have been motivated to combine the teachings of the two references because they are consistent and mutually reinforce one another in the context of the first layer having a lower compaction density than the second layer. Pet. 54 (citing Ex. 1010 ¶ 318).

g. Claim 7

Petitioner argues that Wang teaches that the first cathodically active material 212 is selected from the group comprising: lithium cobalt dioxide (LiCoO₂), lithium manganese dioxide (LiMnO₂), titanium disulfide (TiS₂), LiNi_xCo_{12x}MnO₂, LiMn₂O₄, LiFePO₄, LiFe_{1-x}MgPO₄, LiMoPO₄, LiCoPO₄, Li₃V₂(PO₄)₃, LiVOPO₄, LiMP₂O₇, LiFe₁₋₅P₂O₇, LiVPO₄F,

LiAlPO₄F, Li₅V(PO₄)₂F₂, Li₅Cr(PO₄)₂F₂, Li₂CoPO₄F,
Li₂NiPO₄F, Na₅V₂(PO₄)₂F₃, Li₂FeSiO₄, Li₂MnSiO₄, Li₂VOSiO₄,
LiNiO₂, and combinations thereof.

Pet. 55 (quoting Ex. 1005 ¶ 51). Petitioner therefore asserts that Wang teaches most items in claim 7's Markush group. *Id.* (citing Ex. 1010, ¶¶ 319–320).

Petitioner notes that Saka similarly teaches that the particles of its first (inner) layer are lithium nickel cobalt manganese oxide

(LiNixCo_{1-2x}MnO₂). Pet. 56 (quoting Ex. 1006 ¶ 10). Petitioner argues that Saka therefore also teaches a species within the Markush group that is common to Wang. *Id.* (citing Ex. 1010 ¶ 322).

h. Claim 8

Wang teaches that the second

cathodically active material 222 is selected from the group comprising: lithium cobalt dioxide (LiCoO₂), lithium manganese dioxide (LiMnO₂), titanium disulfide (TiS₂), LiNixCo_{1-2x}MnO₂, LiMn₂O₄, LiFePO₄, LiFe_{1-x}MgPO₄, LiMoPO₄, LiCoPO₄, Li₃V₂(PO₄)₃, LiVOPO₄, LiMP₂O₄, LiFe₁₋₅P₂O₇, LiVPO₄F, LiAlPO₄F, Li₅V(PO₄)₂F₂, Li₅Cr(PO₄)₂F₂, Li₂CoPO₄F, Li₂NiPO₄F, Na₅V₂(PO₄)₂F₃, Li₂FeSiO₄, Li₂MnSiO₄, Li₂VOSiO₄, LiNiO₂, and combinations thereof.”

Pet. 56 (citing Ex. 1005 ¶ 55). Petitioner asserts that Wang therefore teaches all species in claim 8's Markush group except lithium nickel cobalt aluminum oxide. *Id.* (citing Ex. 1010 ¶¶ 325–326). Petitioner also notes that Saka teaches that the second material is lithium iron phosphate (LFP) and lithium nickel cobalt manganese oxide (NCM), which are also species recited by claim 8. *Id.* at 57 (citing Ex. 1006 ¶ 10).

i. Claim 9

Petitioner argues that Wang teaches the first material can be graphite, soft carbon, hard carbon, silicon, silicon carbide, and lithium titanate. Pet. 57 (citing Ex. 1005 ¶ 52). Petitioner asserts that Wang therefore teaches several species in claim 9's Markush group. *Id.* (citing Ex. 1010 ¶ 329). Petitioner adds that Saka teaches acetylene black (a form of hard carbon black) as a material for the first (inner) layer, and uses this form of hard carbon in its examples. *Id.* (citing Ex. 1006 ¶ 75; Ex. 1020).

j. Claims 10–20

Petitioner argues that claims 10–20, including independent claims 10 and 19, essentially duplicate claims 1–9, and Petitioner's argument regarding these claims are essentially identical to those presented above for claims 1–9. Pet. 58–59.

2. Patent Owner's Preliminary Response

Patent Owner responds that: (a) Petitioner fails to show why a person of ordinary skill in the art would have had a “desired density in mind” greater than 3.2 g/cc when combining Wang and Saka; and (b) Petitioner fails to show why a skilled artisan would have combined Wang with Saka Prelim. Resp. 34, 40.

a. Desired density of greater than 3.2 g/cc

Patent Owner responds that Wang is directed to a gradient, multi-layer cathode, and focuses on implementing specific porosity values in each layer. Prelim. Resp. 35 (citing Ex. 1005 ¶ 56; Ex. 2015 ¶¶ 143, 146–147). Patent Owner argues that a person of ordinary skill in the art would not have

needed to have a “desired density in mind,” because the density values are redundant, already-defined characteristics for a cathode with a defined porosity. *Id.* (citing Ex. 2015 ¶¶ 143–145).

Patent Owner points out that Wang expressly recognizes the relationship between density and porosity, stating that in certain embodiments “at least one of the first porous layer 210 and the second porous layer 220 is exposed to a compression process such as a calendaring process to increase the density of and decrease the porosity of the first porous layer 210 and/or the second porous layer 220.” Prelim. Resp. 35–36 (citing Ex. 1005 ¶ 58; Ex. 2015 ¶ 143). Patent Owner explains that Wang uses “compression steps” to adjust the density from one layer to the next, such that the resulting cathode structure satisfies the target porosity values for each cathode layer. *Id.* at 36 (citing Ex. 2015 ¶ 143 (citing Ex. 1005 ¶¶ 58, 67, 73, 92)).

Patent Owner disputes Petitioner’s assertion that the lack of numerical values in Wang would motivate a person of ordinary skill in the art “to look to another reference, such as Saka, for numerical values.” Prelim. Resp. 36 (quoting Pet. 37; Ex. 2015 ¶ 145). Patent Owner reasons that a person of ordinary skill in the art would not need a density “in mind” to implement Wang’s disclosed porosity target values. *Id.* According to Patent Owner, even if a skilled artisan, having comprehended Wang, would have had a “desired density in mind,” that density would already have been defined by Wang’s porosity values, active material selection, particle size selection, binder selection, conductor selection, and other characteristics of the specific cathode materials described in Wang. *Id.* (citing Ex. 2015 ¶¶ 148–151).

Patent Owner contends that Wang expressly teaches this. *Id.* at 36–37 (citing Ex. 1005 ¶¶ 35, 51, 58, 86).

Patent Owner points out that Wang discloses a list of available active materials and additives that can be used in a cathode structure constructed according to Wang’s disclosure. Prelim. Resp. 37 (citing Ex. 1005 ¶¶ 43, 52–53). However, argues Patent Owner, Petitioner fails to explain how the active materials and additives would impact the maximum possible density values that a skilled artisan would have had in mind when implementing the disclosure of Wang, or whether a density of 3.2 g/cc would be achievable in a cathode including Wang’s active materials and additives would impact the maximum possible density values, while achieving Wang’s disclosed porosity values. *Id.* (citing Ex. 2015 ¶¶ 152–153).

Petitioner additionally argues that, in one embodiment, Wang suggests higher porosity, which translates to lower density values, relative to solid films formed of the same material. Prelim. Resp. 38 (citing Ex. 1005 ¶ 56; 2015 ¶¶ 154–155). Patent Owner asserts that Petitioner has not explained why a person of ordinary skill in the art would seek out lower porosity values based on Wang’s disclosure, nor has Petitioner provided any discussion of whether density values greater than 3.2 g/cc are even achievable within Wang’s porosity targets. *Id.* (citing Ex. 2015 ¶ 156).

With respect to Saka, Patent Owner acknowledges that Saka teaches that “[t]he mixture density of the positive electrode mixture layer 12 is, for example, 2.5 g/cm³ to 3.5 g/cm³,” but argues that, to learn anything from Saka’s disclosure, a person of ordinary skill in the art must have examined the experiments on which the disclosure is based. Prelim. Resp. 38–39 (citing Ex. 2015 ¶¶ 161–163). According to Patent Owner, Saka describes

experiments on 23 example batteries, all of which had density values of 3.0 g/cm³ or less. *Id.* at 39 (citing Ex. 1006, Fig. 7 (Table 1)). Patent Owner points out that Saka never discusses porosity, and Petitioner does not explain whether Saka's density values would have been achievable in a cathode structure having a porosity value compatible with Wang's teachings. *Id.* (citing Ex. 2015 ¶ 157). In fact, argues Patent Owner, Saka teaches that superior battery performance was achieved with a density of 2.8 g/cm³, and that its measured battery performance decreased when density values reached 3.0 g/cm³. *Id.* (citing Ex. 1006 ¶ 179; Ex. 2015 ¶ 16).

Summarizing, Patent Owner argues that Petitioner's argument relies on the flawed assumption that density values are interchangeable among references that discuss electrodes having disparate porosity values, active material compositions, particle size distributions, binder concentrations, and conductor concentrations. Prelim. Resp. 40. Patent Owner contends that Petitioner's position further assumes that the highest possible density values are always desirable (even if they restrict ion movement or can result in undesirable cracking and fracturing of particles). *Id.* (citing Ex. 2015 ¶¶ 45, 95, 163–164).

b. Reason to combine

Patent Owner argues that Petitioner has failed to explain why Saka's disclosed density range would be relevant to Wang's disclosed porosity values and, specifically, why density values greater than 3.2 g/cc for a two-layer cathode structure would have been relevant for Wang's cathode. Prelim. Resp. 40–41 (citing Ex. 2015 ¶ 157). According to Patent Owner, those of ordinary skill in the art would have recognized that the differences

between Wang and Saka's respective cathodes would necessitate differences in compaction density between these electrodes. *Id.* at 41 (citing Ex. 2015 ¶ 157).

By way of example, Patent Owner points to Wang's disclosure of a combination of characteristics for the cathode active material layer (e.g., possible cathode active materials and additive materials, a range of possible particle sizes for the cathode active material, and a range of possible porosity values for cathode structures) that would be sufficient for a skilled artisan to construct the cathode active layer for a lithium ion battery. Prelim. Resp. 41 (citing Ex. 2015 ¶ 158 (citing Ex. 1005 ¶¶ 51, 56–57, 81–83)). Patent Owner asserts that, contrary to Petitioner's position, a skilled artisan would not be motivated to look to another reference, such as Saka, for numerical density values, because Wang's porosity value ranges restrict the possible density values achievable using Wang's cathode manufacturing method. *Id.* (citing Ex. 2015 ¶¶ 152, 158–159; Pet. 37). Patent Owner also notes that Saka mentions a maximum pore size between 0.5–0.70 μm , but does not discuss porosity. *Id.* Therefore, argues Petitioner, a person of ordinary skill in the art would not have been motivated to combine Saka's density values, and particularly the density values above 3.2 g/cc, with Wang's cathode having disclosed target cathode porosity values. *Id.* at 41–42 (citing Ex. 2015 ¶ 160).

With respect to Petitioner's reliance upon Saka's "mixture layer 12" as allegedly teaching a compaction density greater than 3.2 g/cc, Patent Owner rejoins that the first layer of Saka's mixture layer 12 includes a composite of "LPF 1 and NMC 2." Prelim. Resp. 42 (citing Ex. 1006 ¶ 56). Petitioner argues that, because composition and particle size directly impact

density, the compaction of an active layer formed from a mixture of two different active materials will be different from the compaction of a single active material. *Id.* (citing Ex. 1005 ¶ 53; Ex. 2015 ¶ 160). Patent Owner contends that Petitioner has failed to demonstrate that the density values provided in Saka for composite electrode mixture 12 would have been compatible with Wang's porosity values. *Id.* (citing Ex. 2015 ¶ 160).

Patent Owner also disputes Petitioner's reliance on its Declarant's statement that "common sense dictates choosing the highest compaction density that is workable for a given application." Prelim. Resp. 42–43 (citing Ex. 1010 ¶ 2813; Ex. 2015 ¶ 161). Rather, argues Patent Owner, an artisan of ordinary skill a would have selected the highest compaction density that could be achieved, while satisfying other battery characteristics, including desired porosity values. *Id.* at 43.

Patent Owner also points out that Petitioner's reliance upon Kim's statement that densities less than 3.31 g/cc "may be too small to obtain a high electrical capacity.'" Prelim. Resp. 43–44 (citing Ex. 1010 ¶ 281 (citing Ex. 1009 ¶ 36); Ex. 2015 ¶ 161). However, Patent Owner argues, all of Saka's disclosed exemplary embodiments have density values of 3.0 g/cc or less. *Id.* at 44; Ex. 2015 ¶ 161 (citing Ex. 1006, FIGS. 7, 8, 10, 11).

Summarizing, Patent Owner argues that a person of ordinary skill in the art would have understood that workable density values are specific to the materials used in a particular electrode, and that a skilled artisan would not have been motivated to look at density values that are described for use with other electrode structures having different material compositions. Prelim. Resp. 44 (citing Ex. 2015 ¶ 165).

3. Analysis

Wang is directed, generally, to electrodes to components for Li-ion batteries. Ex. 1005 ¶ 3. Wang teaches, in one embodiment:

[A] graded cathode structure.... The graded cathode structure comprises a conductive substrate, a first porous layer comprising a first cathodically active material having a first porosity formed on the conductive substrate, and a second porous layer comprising a second cathodically active material having a second porosity formed on the first porous layer.

Id. ¶ 10. More specifically, Wang teaches:

[T]he cathode electrodes have graded properties, such as, porosity, conductivity, particle size, and combinations thereof that vary throughout the cathode electrode structure. In certain embodiments, it is desirable to modify the properties of the cathode electrode through the inclusion of additives such as conductive additives and/or binding agents. In certain embodiments, the graded properties of the cathode electrode may be further modified during the manufacturing process through the use of such techniques as calendaring, annealing, and various drying processes.

Id. ¶ 35.

With respect to limitation 1.4, Wang teaches:

[A] first layer **510** having first cathodically active particles **512** having a first diameter is formed over a surface **201** of the current collector **113**.... In one embodiment, the particles of the powder include aggregated micro-scale particles. In one embodiment, the micro-scale particles have a diameter between about 2 µm and about 15 µm. In one embodiment, the first diameter is less than 10 µm. In one embodiment, the first diameter is about 5 µm.

Ex. 1005 ¶ 81.

Wang does not expressly teach the compaction density of the cathode active layers recited in limitation 1.5 (i.e., 3.2 g/cc). However, Petitioner points to Wang's teaching that:

[T]he first porous layer may be exposed to an optional compression process. After the particles are deposited over the conductive substrate, the particles may be compressed using compression techniques, for example, a calendaring process, to achieve a desired net density of compacted particles while planarizing the surface of the layer. In certain embodiments, it is desirable to perform a calendaring process after deposition of the first porous layer in order to increase the net density of the first porous layer.

Ex. 1005 ¶ 67. Petitioner therefore contends that a person of ordinary skill in the art would look to the teachings of Saka to determine a desirable compaction density. *See* Pet. 43–44.

Saka is directed to “A positive electrode mixture layer (12) includes a first layer (12a) that has a main surface MS and a second layer (12b) formed closer to the positive electrode current collector (11) side than the first layer (12a).”¹² Ex. 1006, Abstr. Relevantly, Saka teaches that “the dried positive electrode mixture layer 12 may be pressed using a rolling mill or the like to adjust the thickness and the mixture density thereof. The mixture density of the positive electrode mixture layer 12 is, for example, 2.5 g/cm³ to 3.5 g/cm³). *Id.* ¶ 51; *see also id.* ¶ 23, claim 5.

¹² We note here that Saka reverses the terminology of the other cited references, in which the first layer is the layer closest to the current collector and the second layer overlays the first. *Compare, e.g.,* Ex. 1006, Abstr. (“A positive electrode mixture layer (12) includes a first layer (12a) that has a main surface MS and a second layer (12b) formed closer to the positive electrode current collector (11) side than the first layer (12a)”), *with* Ex. 1004 ¶ 14 (“The positive electrode ... characterized in that a first positive electrode mixture layer containing a first positive electrode active material and a second positive electrode mixture layer containing a second positive electrode active material ... are sequentially laminated and formed on the current collector”) *and with* Ex. 1005 ¶¶ 80–83, Figs 5A–5C.

Patent Owner contends that a person of ordinary skill in the art would not need to have a “desired density in mind,” because the density values are redundant already-defined characteristics for a cathode with an already-defined porosity. Prelim. Resp. 35. According to Patent Owner, Wang uses “compression steps” to adjust the density from one layer to the next, such that the resulting cathode structure satisfies the target porosity values for each cathode layer. *Id.* at 36. Patent Owner argues further that Saka teaches that superior battery performance was achieved with a density of 2.8 g/cm³, and that its measured battery performance decreased when density values reached 3.0 g/cm³. *Id.* at 39 (citing Ex. 1006 ¶ 179).

Patent Owner additionally argues that for these same reasons, a person of ordinary skill in the art would not have been motivated to combine the references. Prelim. Resp. 42.

Having reviewed the parties’ arguments and the evidence of record, as presently developed, we conclude, for the purposes of this Decision, that Petitioner has met its burden of demonstrating a reasonable likelihood of prevailing at trial in showing that the challenged claims are obvious over Wang and Saka.

As we described above, Wang’s paragraph [0067] directly invites those of ordinary skill in the art to select a compaction density that best suits their needs. This would seem to contradict Patent Owner’s position that a skilled artisan would have had no need to consult Saka, since the desired porosity measurement, which is a goal of Wang’s, provides sufficient information with respect to the compaction density. Such an invitation would encourage a person of ordinary skill in the art to consult other sources to determine the optimal compaction density to suit their requirements. *See,*

e.g., *Ex parte Tonniessen*, 2016 WL 4579902, *4 (PTAB Aug. 30, 2016) (holding that when the teachings of a reference are not complete, but exemplary, a skilled worker would have had good reason to combine those teachings with other relevant teaching).

As to Patent Owner’s argument that the object of Wang’s invention is to obtain a desired porosity in the cathode active layers, and that a person of ordinary skill in the art would have had no reason to consult an external reference such as Saka, a prior-art reference “must be considered for everything it teaches by way of technology and is not limited to the particular invention it is describing and attempting to protect.” *Netflix, Inc. v. DivX, LLC*, 2023 WL 2298768, at *4, Fed. Cir. Mar. 1, 2023); *see also*, *e.g.*, *In re Kahn*, 441 F.3d 977, 990 (Fed. Cir. 2006) (“[T]he teaching of the ... reference is not limited to the specific invention disclosed.”);

Patent Owner’s point that Saka teaches that battery performance decreases at compaction densities greater than 3.0 g/cm³ is well taken. Nevertheless, the compaction density range taught by Saka directly overlaps the claimed range, and “all disclosures of the prior art, including unpreferred embodiments, must be considered.” *Merck & Co., Inc. v. Biocraft Laboratories, Inc.*, 874 F.2d 804, 807 (Fed. Cir. 1989) (quoting *In re Lamberti*, 545 F.2d 747, 750 (C.C.P.A. 1976)).

Having reviewed the parties’ arguments and the evidence of record, as presently developed, we conclude, for the purposes of this Decision, that Petitioner has met its burden of demonstrating a reasonable likelihood of prevailing at trial in showing that the challenged claims are obvious over Wang and Saka. We invite the parties to further develop their arguments at trial.

F. Ground 4: Alleged Obviousness of Claims 1–20 over Wang and Li

1. Petitioner's arguments

a. Claim 1

i. 1.P–1.4

Petitioner argues that Wang teaches limitations 1.P–1.4 of claim 1 for the same reasons set forth in Ground 3 above. *See* Section III.E.1.a.i–v, *supra*.

ii. 1.5

Petitioner relies upon Wang as teaching the same portions of limitation 1.5 as in Ground 3. Pet. 62, *see* Section III.E.1.a.vi, *supra*.

Petitioner argues that Li teaches a Li-ion battery, with a cathode that include a current collector onto which is deposited two active material layers, including the same materials disclosed in Wang and the '118 patent. Pet. 62 (citing Ex. 1003 ¶¶ 1–2, 6, 26, 27; Ex. 1010 ¶ 429). Petitioner contends that Li expressly discloses a compaction density of 3.8 g/cm³ for the first layer, and an average compaction density of 4.1 g/cm³ across the two-layer structure following the second compaction, and in which Li's compaction density is the density of the electrode material layer after it has been subjected to the compression step of the electrode formation process. *Id.* at 62–63 (citing Ex. 1010 ¶ 429; Ex. 1003 ¶ 44).

Petitioner concludes that would have been obvious to a person of ordinary skill in the art to combine Wang and Li, which are analogous art to each other and to the problem in the '118 patent. *Id.* (citing Ex. 1010 ¶ 431). Petitioner asserts that both references are directed towards battery electrodes, particularly cathodes, having a current collector and a bilayer

structure of active materials. *Id.* Petitioner contends that a skilled artisan Having reviewed Li, a POSA would have been motivated to combine Wang's teachings with Li's range of the compaction density with the properties of the active material in Wang's cathode, because the resulting combination would have provided more detailed characteristics of Wang's cathode. Pet. 65 (citing Ex. 1010 ¶ 435). Petitioner also argues that a person of ordinary skill in the art would have had a reasonable expectation of success that the active material as taught by Wang could reach the quantitative range of the compaction density, and thus battery energy densities, as taught by Li after it's compression treatments. *Id.*

b. Claims 2–4

Petitioner relies upon the same arguments presented with respect to these claims on Ground 3. Pet. 65, *see* Section III.E.1.b–d, *supra*.

c. Claim 5

Petitioner argues that Wang in view of Li teaches that a compaction density of the first layer is greater than 2.8 g/cc and the second layer is greater than 3.2 g/cc. Pet. 65. Petitioner notes that Li specifically discloses a compaction density of 3.8 g/cm³ for the first layer, and an average compaction density of 4.1 g/cm³ across the two-layer structure following the second compaction. *Id.* (citing Ex. 1003 ¶ 44). Petitioner notes that Li teaches that its compaction process will compact the first layer even further or, possibly, that it will not, but that the compaction density of the first layer will be at least 3.8 g/cc, which satisfies the first-layer density element of claim 5. *Id.* at 65–66.

d. Claim 6

Petitioner argues that Wang teaches that “it is desirable to perform a calendaring process after deposition of the second porous layer in order to increase the packing density of the particles of the second layer relative to the particles of the first layer.” Pet. 67 (citing Ex. 1005 ¶ 92). According to Petitioner, this implies the particles of the first layer have a lower compaction density than the second layer. *Id.* (citing Ex. 1010 ¶ 449). Petitioner also notes Li teaches that the first layer has a lower compaction density than the second layer. *Id.* Petitioner contends that Li expressly discloses a compaction density of 3.8 g/cm³ for the first layer, and an average compaction density of 4.1 g/cm³ across the two-layer structure. *Id.* (citing Ex. 1003 ¶ 44).

e. Claims 7 and 8

Petitioner asserts that Wang teaches the limitations of claims 7 and 8 as presented above with respect to Ground 3. Pet. 68 (citing Ex. 1010 ¶¶ 452–457; *see* Section III.E.1.g, h, *supra*). Petitioner argues further that Li teaches the positive electrode slurry comprises at least one of lithium cobalt oxide, lithium manganese oxide, nickel-cobalt-manganese, or lithium iron phosphate, and therefore teaches, together with Wang, species of the Markush group recited in claims 7 and 8. *Id.* (citing Ex. 1012 ¶ 17).

f. Claim 9

Petitioner asserts that Wang teaches the limitations of claim 9 as presented above with respect to Ground 3. Pet. 69 (citing Ex. 1010 ¶¶ 458; *see* Section III.E.1.i, *supra*). Petitioner contends that, to the extent a person

of ordinary skill in the art would have looked to Li for compatibility, examples of Li disclose acetylene black as a cathode layer conductive additive. *Id.* (citing, *e.g.*, Ex. 1003 ¶¶ 38, 44). Petitioner notes that Li further teaches electrode material comprising natural graphite, artificial graphite, carbon-silicon material, soft carbon, or hard carbon, as recited in the Markush group of claim 9. *Id.* (citing Ex. 1012 ¶ 20).

g. Claims 10–20

Petitioner argues that claims 10–20, including independent claims 10 and 19, essentially duplicate claims 1–9, and Petitioner’s argument regarding these claims are essentially identical to those presented above for claims 1–9. Pet. 69–70.

2. Patent Owner’s Preliminary Response

Patent Owner’s preliminary response to Ground 4 is largely repetitive of its arguments with respect to Ground 3 above, *viz.* Patent Owner responds that: (a) Petitioner fails to show why a person of ordinary skill in the art would have had a “desired density in mind” greater than 3.2 g/cc when combining Wang and LI; and (b) Petitioner fails to show why a skilled artisan would have combined Wang with Li. Prelim. Resp. 45, 51. We briefly summarize these arguments below.

a. Desired density of greater than 3.2 g/cc

Patent Owner repeats its arguments with respect to Wang in Ground III above. *See* Section III.E.2 *supra*. Patent Owner additionally argues that a person of ordinary skill in the art would have understood that Li’s high-

density examples (i.e., those with a compaction density exceeding 3.8 g/cc) would only be possible with certain specific cathode compositions (i.e., with certain cathode materials, additives, and particle size distributions) and Li does not provide sufficient details to reproduce the exact example discussed. Prelim. Resp. 49 (citing Ex. 2015 ¶¶ 176–177). Petitioner argues that Li does not discuss porosity and that Petitioner does not explain whether Li’s density values would have been achievable in a cathode structure having a porosity value compatible with Wang’s targets. *Id.* (citing Ex. 2015 ¶¶ 177–179).

Patent Owner alleges that Petitioner has not articulated how or why a skilled artisan would have combined Wang and Li. Prelim. Resp. 50. Patent Owner argues that, based upon the disclosures of Wang and Li, a person of ordinary skill in the art would not have known: (1) whether Li’s disclosed density values were achieved with a cathode material comparable to Wang’s disclosed cathode material (including whether Li used the same or similar particular size distribution and the additive types and concentrations) and (2) whether Li’s disclosed density values would be achievable within Wang’s porosity value ranges, such that a POSITA would have had Li’s density value “in mind” when implementing Wang. *Id.*

b. Reason to combine

Patent Owner argues that Petitioner’s suggestion to modify Wang based on Li’s disclosure amounts to a suggestion that Wang’s cathode composition would necessarily have some compaction density value, but not necessarily a compaction density value of 3.2 g/cc or greater. Prelim. Resp. 51 (citing Ex. 2015 ¶ 176; Ex. 1010 ¶ 434).

Patent Owner contends that, in addition to Petitioner's contention that a person of ordinary skill in the art would have been motivated to combine the references because both teach "a cathode with two active layers, made of the same materials," a skilled artisan would have considered target porosity values, particle size distributions, cathode thicknesses, and other characteristics of a cathode, none of which are discussed by Li, except to the extent necessary to describe Li's new geometry of a cathode with thicker regions and thinner regions that assist in folding an electrode structure into a prismatic battery form. Prelim. Resp. 51 (citing Ex. 1003, Abstr., Ex. 2015 ¶ 176). Patent Owner asserts that Petitioner has not shown that Li does, in fact, disclose compaction density values that work in a battery like Wang's, because Li does not convey sufficient information to determine Li's examples are analogous to Wang's cathode structure. *Id.* at 51–52 (citing Ex. 2015 ¶ 177–178).

Next, Patent Owner again argues, as in Ground 3 above, that contrary to Petitioner's position, those of ordinary skill in the art would not be motivated to look to another reference, such as Li, for numerical density values, because the porosity value ranges dictate the possible density values achievable using Wang's cathode manufacturing method. Prelim. Resp. 53. *See* Section III.E.2.b *supra*. Patent Owner contends that Li's focus is on something entirely unrelated to compaction density, or the composition of a cathode at all, and fails to describe cathode compositions in sufficient detail to allow a skilled artisan to fully replicate the examples. *Id.* (citing Ex. 2015 ¶ 180).

Finally, Patent Owner argues that a person of ordinary skill in the art would have understood that compaction densities (and/or porosities) of

electrode materials are not based solely on the densities of the contained active materials and additives. Prelim. Resp. 55 (citing Ex. 2015 ¶ 182). Patent Owner contends that other characteristics of the mixture, e.g., possible interactions between the various materials in an electrode, how the various particles “fit” into the interstices of one another, and whether the resulting mixture leaves sufficient space for lithium ion movement during charging and discharging processes would have needed to be considered. Prelim. Resp. 55 (citing Ex. 2015 ¶ 182). Patent Owner asserts that workable density values are specific to the materials used in a particular electrode, and that a skilled artisan would not have been motivated to look at density values that are described for use with other electrode structures having different material compositions. *Id.*

c. Analysis

The parties’ arguments upon this Ground are similar to those set forth above for Ground 3. Li is also directed to Li-ion battery electrodes comprising a cathode with two active layers. Ex. 1003 ¶ 44. Petitioner relies upon Li’s teaching that:

After the double-layer coating, a total weight of double-layer electrode coating in the double-layer coating region was 20.13 mg/cm² for the positive electrode 1 and 8.86 mg/cm² for the negative electrode 2. *The electrodes were compacted such that an average density of electrode layers in the double-layer coating region was 4.1 g/cm³ for the positive electrode.*

Id. (emphasis added).

As we explained in the preceding Section, Patent Owner’s arguments are similar to those presented with respect to Ground 3. *See* Prelim. Resp. 45–55.

Having reviewed the parties' arguments and the evidence of record, as presently developed, we conclude, for the purposes of this Decision, that Petitioner has met its burden of demonstrating a reasonable likelihood of prevailing at trial in showing that the challenged claims are obvious over Wang and Li, for the same reasons we explained with respect to Ground 3. *See* Section III.E.3, *supra*. We invite the parties to further develop their arguments at trial.

IV. CONCLUSION

Because we have determined that Petitioner has demonstrated a reasonable likelihood of success at trial in showing that at least one claim is unpatentable on at least one of the stated Grounds, we institute *inter partes* review of all challenged claims of the '118 patent, based on all of the remaining grounds identified in the Petition. *See* 37 C.F.R. § 42.208(a); *SAS*, 584 U.S. at 371; *PGS Geophysical*, 891 F.3d at 1360.

At this stage of the proceeding, the Board has not made a final determination as to the patentability of any challenged claim or to the construction of any claim term. Therefore, our view with regard to any conclusion reached in the foregoing may change upon consideration of Patent Owner's merits response and the completion of the record.

Consequently, and in keeping with our mission of resolving patentability disputes in a just, speedy, and efficient manner, and for the reasons we have explained in the foregoing Sections, we institute *inter partes* review as set forth in the following Order.

V. ORDER

In consideration of the foregoing, it is hereby:

ORDERED, pursuant to 35 U.S.C. § 314(a), that the Petition for *inter partes* review of challenged claims 1–20 of U.S. Patent 12,015,118 B2 is GRANTED with respect to all Grounds and challenged claims in the Petition; and

FURTHER ORDERED that, pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4(b), *inter partes* review of the '118 patent shall commence on the entry date of this Order, and notice is hereby given of the institution of trial.

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Patent 12,015,118 B2

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