

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
U.S. Patent No. 12,015,118

PATENT OWNER'S PRELIMINARY RESPONSE

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2001	Second Amended Complaint, <i>Ningde Amperex Tech. Ltd. v. Zhuhai CosMX Battery Co.</i> , Case No. 2:24-cv-00728-JRG, ECF No. 23 (E.D. Tex. Jan. 28, 2025)
2002	Scheduling Order, <i>Ningde Amperex Tech. Ltd. v. Zhuhai CosMX Battery Co.</i> , Case No. 2:24-cv-00728-JRG, ECF No. 27 (E.D. Tex. Feb. 6, 2025)
2003	CosMX Invalidity Contentions Cover Pleading, <i>Ningde Amperex Tech. Ltd. v. Zhuhai CosMX Battery Co.</i> , Case No. 2:24-cv-00728-JRG (E.D. Tex. Jan. 7, 2025)
2004	Summons to attend oral proceedings in German Case No. 3 Ni 12/23 (EP) (“Germany Order 1”)
2005	Summons to attend oral proceedings in German Case No. 3 Ni 12/24 (EP) (“Germany Order 2”)
2006	Docket Navigator Time-to-Trial Statistics for Judge Rodney Gilstrap (accessed July 2, 2025)
2007	Docket, <i>Ningde Amperex Tech. Ltd. v. Zhuhai CosMX Battery Co.</i> , Case No. 2:22-cv-00232 (E.D. Tex.)
2008	Joint Motion for Entry of Protective Order, <i>Ningde Amperex Tech. Ltd. v. Zhuhai CosMX Battery Co.</i> , No. 2:24-cv-00728-JRG, ECF No. 30 (E.D. Tex. Feb. 11, 2025)
2009	Amended Final Judgment, <i>Ningde Amperex Tech. Ltd. v. Zhuhai CosMX Battery Co.</i> , Case No. 2:22-cv-00232, ECF No. 427 (E.D. Tex.)
2010	Article, <i>Lithium battery manufacturer ATL won injunction against its Chinese rival COSMX in German Court</i> , China IP Today (April 6, 2024)
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2027	<i>DOE Energy Innovation Hubs</i> , available at: https://science.osti.gov/bes/Research/DOE-Energy-Innovation-Hubs (accessed on 12 May 2025)
2028	Amir-Sina Hamed, Fezzeh Pouraghajan, Fei Sun, Mojdeh Nikpour, & Dean R. Wheeler, <i>Interplay of Electrode Heterogeneity and Lithium Plating</i> , 169 J. Electrochem. Soc. 020551 (2022)
2029	Amir-Sina Hamed, Adrian Yao, Roxana Martin, Raymundo Roig, Michael Rivas Valadez, Donald Pile, Annadanesh Shellikeri, Baichuan Liu, and Dean R. Wheeler, <i>Multi-layer anodes for high-current applications</i> , 439 Electrochimica Acta 141649 (2023)

2030	Fezzeh Pouraghajan, Andrea I. Thompson, Emilee E. Hunter, Brian Mazzeo, Jake Christensen, Ram Subbaraman, Michael Wray, & Dean Wheeler, <i>The Effects of Cycling on Ionic and Electronic Conductivities of Li-ion Battery Electrodes</i> , 492 J. of Power Sources 229636 (2021)
2031	Amir-Sina Hamed, Edmund M. Shumway, & Dean R. Wheeler, <i>Electrode-Level Modeling of Silicon Anodes for Improved Cell Design</i> , 171 J. Electrochem. Soc. 120539 (2024)
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2040	Chris Meyer, et al., <i>Characterization of the Calendering Process for Compaction of Electrodes for Lithium-Ion Batteries</i> , 249 J. Materials Processing Tech. 172 (2017), https://doi.org/10.1016/j.jmatprotec.2017.05.031 .

I. INTRODUCTION

Ningde Amperex Technology Ltd. (“ATL” or “Patent Owner”) respectfully submits this Preliminary Response to the Petition for *inter partes* review filed by Petitioner Zhuhai CosMX Battery Co., Ltd. (“Petitioner” or “CosMX”). Paper 1 (“Pet.”). The Petition seeks *inter partes* review (“IPR”) of claims 1-20 (the “Challenged Claims”) of U.S. Patent No. 12,015,118 (the “’118 Patent,” Ex. 1001). The Petition should be rejected and institution should be denied for numerous reasons.

Petitioner fails to show that any of the references relied upon across the four grounds render the Challenged Claims unpatentable. None of the cited references discuss a two-layer electrode structure for a lithium ion battery that also satisfies the particle size limitations and density limitations of the claims. Petitioner thus relies heavily on two flawed foundational arguments: (1) that electrode density values achievable with one combination of active material and additives are also achievable and desirable for other combinations of different active materials with different additives and additive concentrations, and (2) that a POSITA would necessarily seek the highest electrode density value when constructing lithium ion electrodes.

Foundational argument (1) fails because Petitioner does not address that the density differences among the cited references are caused by differences in electrode composition, and so the density values cannot be arbitrarily switched among the

various references' disclosed electrodes without entirely overhauling the electrode's composition. Neither Petitioner nor Petitioner's expert, Dr. Guido, explains why a POSITA would apply or consider density values from different active materials (at different concentrations), with different particle size distributions and in different layer structures when determining relevant electrode densities for other active materials and electrode structures. Worse still, a POSITA would have known that choosing and calculating a density value for an electrode is highly dependent on the exact active material mixture generated, and density values from other active material mixtures are of little relevance. Finally, Petitioner never demonstrates that density values applicable to a single-layer electrode structure would be the same for a two-layer electrode structure.

Foundational argument (2) also fails because a POSITA would have known that lithium ion battery designers must consider more than just maximizing the theoretical energy density of a battery. Higher energy density batteries are more susceptible to catastrophic failure in the event of a short circuit, and so battery designers also seek to lower the density of an electrode in the interest of safety. Further, compacting electrode density layers to higher levels also can impede ion flow and lead to possible cracking or fractures. Dr. Guido did not express any discussion about why a POSITA would overlook these competing interests and solely focus on increasing the energy density of a battery.

In addition, Petitioner's specific arguments fail for at least the following additional reasons.

First, Ground 1 fails because Petitioner does not point to a single embodiment as disclosing a two-layer electrode structure with the claimed particle sizes and density. Instead, Petitioner points to Ishigaki's disclosure of a two-layer cathode structure for certain recitations, but separately, without explanation, points to Ishigaki's single-layer cathode disclosure for the particle size and cathode density. Petitioner does not explain why a POSITA would combine the teachings from these separate embodiments of Ishigaki and fails to explain why the Ishigaki's single-layer cathode disclosure would be applicable to a two-layer electrode structure.

Second, Ground 2 fails because Petitioner argues that a POSITA would have selected a cathode density value for Ishigaki's two-layer cathode structure based on Kim's disclosure of a composite cathode active material used in a single-layer cathode structure. But neither Petitioner nor its expert has explained why or how a POSITA would have cherry-picked Kim's density values (and ignored Kim's electrode composition and structure that achieved the density values) and used it with Ishigaki.

Third, Grounds 3-4 fail because Petitioner argues that a POSITA would have selected a cathode density value for Wang's two layer structure based on two irrelevant references – Saka (Ground 3) or Li (Ground 4). However, neither of these

references explain that their respective density values would (or even could) be used with cathodes having the composition disclosed in Wang. Specifically with respect to Ground 4, Li does not provide a comprehensive disclosure of a two-layer structure that would enable a POSITA to reproduce the cathode structure of Li.

II. BACKGROUND¹

A. Technology Overview

High energy capacity lithium ion batteries may be susceptible to dangerous short circuit conditions when the battery is punctured, thereby bypassing the punctured separator between the anode and cathode and electrically connecting the electrode materials of the battery with one another. Ex. 2015 ¶ 41. Short circuits can result in a fire or explosion and are therefore pose a safety risk to users. *Id.* Given the rapid popularization of lithium-ion batteries, and the safety risks associated with puncturing, manufacturers have placed increased attention on improving the safety of lithium-ion batteries. *Id.*

¹ Patent Owner's expert provided a technology overview and a summary of the '118 Patent. Ex. 2015, § IV.A-C, ¶¶ 41-52.

B. The '118 Patent Claims a Two-Layer Electrode Design with Improved Safety, Increased Manufacturability, and Higher Energy Density

The '118 Patent describes a two-layer electrode to improve safety when the cell is punctured. Ex. 1001, 2:58-64; Ex. 2015 ¶ 46. A first layer, which is positioned closest to the current collector of the electrode, comprises active material particles having a small size to promote adhesion of the active material to the current collector. *Id.*, 3:50-57; 4:55-62; Ex. 2015 ¶ 47. The first layer improves safety by reducing the likelihood of the active material delaminating or otherwise separating from the current collector when the battery is punctured, and thereby maintains a barrier between the cathode current collector and the anode to prevent a short circuit. *Id.*, 4:3-12; Ex. 2015 ¶ 48. While electrode compositions with smaller particles promote adhesion, they have a lower compaction density and consequently lower energy capacity for the cell. *Id.*, 4:62-67; 5:14-18; Ex. 2015 ¶ 48.

To achieve a higher compaction density and increase the overall energy storage in the cell while maintaining the safety of the lower compaction density near the current collector, the '118 Patent includes a second layer with larger particles positioned farther from the current collector than the first layer, which increases the overall density of the electrode structure of the cell. *Id.*, 6:4-12; Ex. 2015 ¶¶ 48-50. This structure provides improved safety, increased manufacturability of the electrode (for instance, to withstand the compacting forces when both layers are

simultaneously compacted in a single calendering step) and improved the energy density of the cell. *Id.*, 5:28-36; 6:7-12; Ex. 2015 ¶¶ 51-52.

For example, the '118 Patent claims:

1. An electrode, comprising:
a current collector;
a first layer comprising a first material; and
a second layer comprising a second material;

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 ;

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

Id., Claim 1.

III. LEGAL STANDARDS

For an anticipation rejection, the Petition must establish “each and every element in a claim, arranged as is recited in the claim, [is] found in a single prior art reference.” *ZTE v. ContentGuard*, IPR 2013-00134, Paper 12 at 24 (PTAB June 19, 2013). If a reference discloses every element of a claim, but the disclosure spans multiple embodiments in the reference, the Petition must establish that the “reference teaches that the disclosed components or functionalities may be combined and one

of skill in the art would be able to implement the combination.” *Blue Calypso, LLC v. Groupon, Inc.*, 815 F.3d 1331, 1341 (Fed. Cir. 2016).

For an obviousness rejection, the Petition must both “clearly point out the differences between the claimed invention and [the prior art]” and “explain why a person of ordinary skill in the art would have found the claimed subject matter obvious in spite of those differences.” *Synopsys, Inc. v. Mentor Graphics Corp.*, IPR2012-00041, Paper 16 at 14 (PTAB Feb. 22, 2013). Petitioner must recite where the challenged limitation is found in the reference(s) and explain why a POSITA would have modified the primary reference with the recited limitation from the secondary reference(s). *Microsoft Corp. v. Secure Web Conf. Corp.*, IPR2014-00745, Paper 12, 11-13 (P.T.A.B. Sept. 29, 2014).

In addition, the Board institutes based on what the Petition *actually presents* and not what it could have reasonably contained. *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1381 (Fed. Cir. 2016). The Board cannot “deviate from the grounds in the petition and raise its own” theories of invalidity. *Sirona Dental Sys. GmbH v. Institut Straumann AG*, 892 F.3d 1349, 1356 (Fed. Cir. 2018).

IV. LEVEL OF ORDINARY SKILL IN THE ART

Each of the arguments below should be considered from the standpoint of a person of ordinary skill in the art (“POSA” or “POSITA”) in the field of the ’118 Patent. For purposes of this Patent Owner’s Preliminary Response, Patent Owner

adopts the definition proposed by Petitioner. Patent Owner reserves the right to further address the level of ordinary skill in the art if this proceeding is instituted.

V. CLAIM CONSTRUCTION

Petitioner puts forth no claim construction positions in the Petition. Pet., 9. While Patent Owner reserves all rights to dispute the constructions advanced in Petition, no claim construction is necessary to deny institution because Patent Owner's arguments for denial do not rely on the outcome of an actual controversy about claim interpretation, and institution should be denied even under Petitioner's constructions. *See Wellman, Inc. v. Eastman Chem. Co.*, 642 F.3d 1355, 1361 (Fed. Cir. 2011) (“[C]laim terms need only be construed to the extent necessary to resolve the controversy”). The failure to render obvious the claims is clear in view of the arguments below without construing any specific claim term or phrase.

VI. THE BOARD SHOULD NOT INSTITUTE INTER PARTES REVIEW ON THE MERITS

A. Ground 1: Ishigaki Does Not Anticipate Claims 1-20

Petitioner fails to establish there is a reasonable likelihood at least one challenged claim of Ground 1 is unpatentable, for the reasons discussed below. Pet., 9-27; *see also* Ex. 2015 ¶¶ 59-89. Specifically, Petitioner fails to establish that Ishigaki discloses each limitation of the independent claims, arranged as is recited in the claims. Instead, Petitioner improperly combines teachings from different and unrelated embodiments from Ishigaki in support of the alleged anticipation rejection.

See Blue Calypso, 815 F.3d at 1341 (anticipation is not appropriate where a reference does not disclose the claim elements arranged in the same way as the claim). Even still, Petitioner has failed to show that this improper combination of embodiments supports an anticipation rejection, as detailed below.

1. Petitioner Fails to Show that Ishigaki discloses a particle size of 90% accumulative volume of the first material is less than 40 μm

Each of the independent claims of the '118 Patent, requires, *inter alia*, a first layer comprising a first material, wherein the first layer is arranged between the current collector and a second layer, and a particle size of 90% accumulative volume of the first material is less than 40 μm . Ex. 1001, Claims 1, 10, and 19.

Ishigaki describes positive electrodes (i.e., cathodes) formed by depositing one or two positive electrode active material layers onto a positive electrode current collecting foil. Ex. 1004 ¶¶ [0345]-[0366]; Ex. 2015 ¶ 60. Ishigaki also describes that the positive electrode active material layer includes “a positive electrode material used in the present invention, a conductive material used in the present invention, a binder, [and] a thickener.” *Id.* ¶ [0138]; Ex. 2015 ¶ 60. Ishigaki explains that the positive electrode active material comprises larger “secondary particles,” which are formed from aggregating smaller “primary particles.” *Id.* ¶ [0092] (“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.”); Ex. 2015 ¶ 60.

Petitioner alleges that Ishigaki’s secondary particles disclose “a particle size of 90% accumulative volume of the first material is less than 40 µm.” Pet., 14-15; *see also* Ex. 1010 ¶¶ 81-84; Ex. 2015 ¶ 61. Specifically, Petitioner states that “Ishigaki’s first positive electrode material has particles with 90% cumulative diameter less than 10 µm,” and “[t]en microns is less than 40 µm, which meets this limitation.” *Id.* 14-15 (citing Ex. 1004 ¶¶ 38-39, Ex. 1010 ¶ 81); Ex. 2015 ¶ 61. But there is no disclosure of 90% accumulative volume values for any of Ishigaki’s particles, and the assumption that Ishigaki’s “90% cumulative diameter (D90)” is equivalent to the claimed 90% accumulative volume is misguided. Ex. 2015 ¶ 62.

First, Petitioner points to Ishigaki’s disclosure of “a particle diameter standard as a volume standard” and makes the conclusory statement 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).” Pet., 14; n.1 (internal citations omitted); Ex. 2015 ¶¶ 63-64. But Petitioner misinterprets Ishigaki. Ex. 2015 ¶¶ 65-69. 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. Ex. 2015 ¶ 70. Ishigaki confirms.

In Ishigaki's description of what is meant by "Median Diameter and 90% Cumulative Diameter (D90)," Ishigaki states that its measurements are performed by laser diffraction:

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.

Ex. 1004 ¶ [0039]; Ex. 2015 ¶ 65. Petitioner and its expert assert that the use of a laser diffraction instrument in Ishigaki necessarily stipulates the type of distribution Ishigaki had in mind. Pet., 14-15; Ex. 1010 ¶ 84 ("This type of device and this method of particle size measurement is specifically sensitive to particle volume and thus the median diameter or average diameter it measures is Dv50 and the 90% cumulative diameter it measures is Dv90."). Not so.

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 POSITA that the diameter of a particle is determined from the estimated volume of the particle. Ex. 2015 ¶ 65 (citing Ex. 1004 ¶ [0039]). The size

of a particle is agnostic to the actual distribution.² Ex. 2015 ¶ 66. 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.

As acknowledged by Petitioner's expert, 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. Ex. 2015 ¶ 68 (citing Ex. 1010 ¶ 83 "Ishigaki's statement 'cumulative diameter (D90)' may be alleged to be, by itself, insufficient to establish that the parameter Ishigaki is teaching corresponds to Dv90" because

² A POSITA would have understood that the particle distribution can be constructed or defined using multiple statistical approaches, including a volume-based or number-based approach. Ex. 2015 ¶ 67. The number-based distribution is constructed by counting the number of particles within each size range such that equal weight is given to all of the particles regardless of size, whereas the volume-based distribution is constructed by measuring the volume of particles within each size range such that larger particles contribute more to the distribution, given that their volume is greater. *Id.* Either method of defining a particle distribution requires *measuring* the particles, for example, using a laser diffraction instrument. *Id.*

“[t]here are multiple ways of ‘accumulating’ the particle size distribution” and “[t]hese different accumulation averages do not necessarily yield the same number values.”). Indeed, 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.* ¶ 68. A POSITA would understand that Dv90 and D90 values will only be the same if all particles are the same size, and 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. 1004 ¶ [0089]).

Second, Ishigaki does not disclose volume-based distributions of particles, and Petitioner has failed to show that Ishigaki’s D90 value corresponds to a 90% accumulative volume value. Ex. 2015 ¶¶ 69-70. Indeed, other disclosures in Ishigaki undercut Petitioner’s theory and suggest that the D90 values are numbers-based distributions. *Id.* ¶¶ 71-74. Petitioner fails to address these disclosures and thus cannot meet its burden of showing that Ishigaki discloses a 90% accumulative volume value.

Specifically, while 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. Ex. 1004

¶¶ [0041], [0185]; Ex. 2015 ¶ 71. Ishigaki states, “Note that the average primary particle diameter in the present invention is an average diameter observed using a scanning electron microscope (SEM), which may be determined as an average value of a particle diameter of approximately 10 to 30 primary particles using a 30,000x SEM image.” Ex. 1004 ¶ [0041]. A POSITA 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. Ex. 2015 ¶ 71. 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.* ¶ 72. This suggests to a POSITA 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. 1004 ¶ [0185]).

Neither Petitioner nor Ishigaki explains how or why purported primary particle sizes distributions differ, if at all, in statistical approach from the purported secondary particle sizes distributions, but a POSITA would have used the same type of distribution for both primary and secondary particles (e.g., using a D90 or a Dv90 for both). Ex. 2015 ¶¶ 73-75. Given that Ishigaki uses a number-based distribution for the primary particles, for the reasons above, 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.* Moreover, in addition to using a number-based distribution to maintain internal consistency between metrics for 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. *Id.* ¶ 76. Given that 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.

2. Petitioner Fails to Show that Ishigaki discloses a two-layer electrode with a compaction density of at least 3.2 g/cc

Each of the Challenged Claims of the '118 Patent also requires, *inter alia*, 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. Ex. 1001, Claims 1, 10, and 19. The only time Ishigaki discloses “mixture density” values for two-layer cathode structures, Ishigaki *only describes a density value of 2.4 g/cc*. Ex. 1004 ¶ [0366]; Ex. 2015 ¶ 86. Therefore, Ishigaki cannot anticipate the '118 patent claims' compaction density value of greater than 3.2 g/cc for all active material layers in a two-layer electrode structure. Ex. 1001 6:20-27 (“To ensure the energy density of a lithium-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 [*sic*] active material layers is greater than 3.2 g/cc.”).

Regardless of this shortcoming and its reliance on anticipation, Petitioner asserts that the “mixture density” values provided in Paragraph [0025] of Ishigaki, and the “electrode density” values provided in Paragraph [0151] of Ishigaki allegedly 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.” Pet., 15-18; *see also e.g.*, Ex. 1010 ¶¶ 87-88 (citing Paragraphs [0025] and [0151], which disclose densities of single-layer cathode structures). But these values in Ishigaki relate to single-layer cathode structures and are thus irrelevant to the claimed two-layer electrode. Ex. 2015 ¶¶ 81-84.

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. Rather, Ishigaki describes density ranges in the context of a single-layer cathode structure. *Id.* ¶ 81. For example, regarding “mixture density” values, Ishigaki states:

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.

The thickness of **the positive electrode active material layer** is usually about 10 to 200 μm.

Ex. 1004 ¶ [0025] (emphasis added).

As shown above, this disclosure in Ishigaki provides 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.* (emphasis added). In other words, this disclosure *only* refers to a *single* “positive electrode active material *layer*.” *Id.* (emphasis added); Ex. 2015 ¶ 81. This disclosure of Ishigaki 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.* That is, this disclosure of Ishigaki is careful to specify that the positive electrode to which the provided densities apply only includes a single positive electrode active material layer with a particular thickness. *Id.* A POSITA would therefore understand that Ishigaki’s disclosed

density range in paragraph [0025] applies only to a positive electrode with a single active material layer, *i.e.*, a single-layer cathode structure. *Id.*

Further, regarding “electrode density” values, Ishigaki states:

The **electrode density** of the positive electrode after pressing has a lower limit of normally 2.0 g/cm³ or more, preferably 2.4 g/cm³ or more, and 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.

Note that **the positive electrode active material layer** obtained by coating and drying is preferably compressed by a roller press or the like in order to increase the packing density of the positive electrode active material.

Thus, the positive electrode for lithium rechargeable batteries of the present invention can be prepared.

Ex. 1004 ¶ [0151] (*emphasis added*).

As shown above, this disclosure in 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.* (*emphasis added*). In other words, this disclosure also ***only*** refers to a ***single “positive electrode active material layer.”*** *Id.* (*emphasis added*). This disclosure of Ishigaki does not 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. Ex. 2015 ¶ 81. Indeed, this disclosure of Ishigaki is careful to specify that the positive electrode to which the provided densities apply only includes a single positive electrode active material layer that is preferably compressed by a roll press. A POSITA would therefore interpret this disclosure consistently with Ishigaki's paragraph [0025]: describing a density range applicable to a single-layer cathode structure. *Id.*

Nothing in Ishigaki would lead a POSITA to consider the range of densities described in paragraphs [0025] and [0151] (described for single-layer cathode embodiments) as being applicable to a two-layer electrode structure, and neither Petitioner nor Dr. Gido provide any arguments to explain why a POSITA would combine these teachings. Ex. 2015 ¶¶ 81-84; Ex. 1004 ¶¶ [0025], [0151]. That is, a POSITA would not assume that densities clearly provided for a single-layer cathode structure are 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. Ex. 2015 ¶ 82. For example, a POSITA 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 ¶ [0366] ("Next, the slurry 1 was applied and dried on one side of aluminum foil (thickness

15 μm) of the current collecting foil using a doctor blade. Then, the slurry 2 was applied to one side of the substrate using a doctor blade and dried.”)); *see also* Ex. 2019, 51. Consequently, a POSITA would not extrapolate Ishigaki’s density specification for a two-layer cathode structure from Ishigaki’s density recited for a single-layer cathode structure. *Id.*

Petitioner also asserts 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.” Pet., 17 (citing Ex. 1004 ¶ [0025]). But this assertion is likewise misguided. Ex. 2015 ¶¶ 83-84.

A POSITA 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**. Ex. 2015 ¶ 84 (citing Ex. 1004 ¶ [0025]). 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

expert 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.* ¶¶ 83-84.

What's worse, the *only* disclosed value for a two-layer cathode structure in Ishigaki is 2.4 g/cm³, and 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. *Id.* ¶¶ 85-87 (citing Ex. 1004 ¶¶ [0348]-[0349], [0356]-[0357], [0361]-[0363], [0366]).

Thus, contrary to Petitioner's assertion that "Ishigaki instructs a POSA to choose the highest density possible in order to maximize energy capacity," (Pet., 17) Ishigaki never states that two-layer cathode structures have density values above 3.2 g/cc. *Id.* Ishigaki's only mention of a total density for a two-layer structure is in the examples, which teach a POSITA to work in the *lower* density ranges provided in Ishigaki and, in particular, in a range below 2.6 g/cm³. *Id.* ¶ 88. Neither Petitioner nor its expert addresses Ishigaki's examples or provides 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) lower than all other disclosed examples, and (3) well below the claimed 3.2 g/cc compaction density. *Id.*

Thus, Petitioner has failed to show that Ishigaki discloses a compaction density value greater than 3.2 g/cc for all active material layers in the two-layer electrode structure. *Id.* ¶ 89.

3. Claims 2-9, 11-18, and 20 Are Not Unpatentable

Claims 2-9, 11-18, and 20 are not unpatentable for at least the same reasons as discussed above with respect to independent claims 1, 10, and 19. Patent Owner reserves the right to address claims 2-9, 11-18, and 20 individually if this proceeding is instituted. Ex. 2015 ¶ 90.

B. Ground 2: Ishigaki and Kim Do Not Render Obvious Claims 1-20

Petitioner relies on the disclosure of Ishigaki for all elements of independent claims 1, 10, and 19, except for elements [1.5], [10.5], and [19.5], which recite, wherein a total compaction density of the first layer and the second layer is greater than 3.2 g/cc, for which Petitioner allegedly relies on the disclosure of Kim. Pet., 27-31; *see also* Ex. 1010 ¶¶ 216-220. However, Ishigaki and Kim fail for at least the following reasons.

1. Petitioner Fails to Show that Kim would motivate a POSITA to pursue compaction densities above 3.2 g/cc

Petitioner's motivation to combine is found in a *single paragraph* on page 29 of the Petition and does not evidence any true analysis or appreciation for the unpredictable nature of the subject matter. Specifically, Petitioner asserts that "Kim's compaction density ranges are compatible with the teachings of Ishigaki,

and encourage a POSA to pursue compaction densities towards the higher values of the range taught by Ishigaki.” Pet., 29. Petitioner misreads both Ishigaki and Kim. Ex. 2015 ¶¶ 95-96.

As discussed with respect to Ground 1, Ishigaki teaches that two-layer cathode structures should be provided with lower densities as compared with single-layer cathode structures—and with a density *below* 3.2 g/cc. Section IV.A.2, *supra*; *see also* Ex. 2015 ¶¶ 87-88, 95, 97-98. What’s more, Ishigaki teaches that densities *well below* 3.2 g/cc are sufficient to meet Ishigaki’s objectives. Ex. 2015 ¶ 97 (citing Ex. 1004 ¶¶ [0382]-[0383]); *see also R.J. Reynolds Vapor Co. v. Fontem Holdings I B.V.*, IPR2016-01692, Paper 45 (P.T.A.B. Mar. 2, 2018) (finding no motivation to combine where the prior art already disclosed a reliable solution); *see also BMW of North America, LLC v. Carrum Techs., LLC*, IPR2019-00902, Paper 10 (P.T.A.B. Oct. 18, 2019). What’s worse, the *only* disclosed value for a two-layer cathode structure in Ishigaki is 2.4 g/cm³, and 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. *Id.* ¶¶ 86-88 (citing Ex. 1004 ¶¶ [0348]-[0349], [0356]-[0357], [0361]-[0363], [0366]). In view of the actual teachings of Ishigaki, Petitioner is without a single rationale for combining Kim and Ishigaki. *Id.*

Regardless, Petitioner's motivation to combine fails for several additional reasons. **First**, Petitioner does not appreciate that Kim's densities are *not* densities of a complete cathode layer (as described in Ishigaki). Ex. 2015 ¶¶ 99-106. Kim *only* describes the density values of the *active material*, excluding additives, such as conducting agents and binders, that Kim includes in its completed cathode. Ex. 1009 ¶ [0036] (Kim describing that "a press density of ***the composite cathode active material*** may be about 3.31 g/cm³ or greater"); [0040] (Kim describing that "***the composite cathode active material***, a conducting agent, a binder, and a solvent are mixed to prepare ***the cathode active material composition***."); Ex. 2015 ¶¶ 101-106. Therefore, Kim does not provide any guidance regarding an electrode density value achievable in an electrode composition that has been mixed with additives and coated (in any number of layers) onto a current collector. Ex. 2015 ¶ 106.

Kim discloses two density-related terms, namely "press density" and "volume density." Ex. 1009 ¶ [0036]; Ex. 2015 ¶¶ 100-101, 105. For instance, Kim states that the "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." *Id.* Petitioner relies on this disclosure of Kim 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.” Pet., 30 (citing Ex. 1009 ¶ [0036]). This is *not* what Kim discloses. 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. Ex. 2015 ¶¶ 101-106.

For instance, Kim describes Example 1 stating that “*Li_{1.03}Ni_{0.8}Co_{0.1}Mn_{0.1}O₂ powder* having an average particle diameter of about 15 μm and *Li_{0.9}Ni_{0.8}Co_{0.1}Mn_{0.1}O₂ 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*.” Ex. 1009 ¶ [0070] (emphasis added); Ex. 2015 ¶ 102. Kim also states 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.” Ex. 1009 ¶ [0079] (emphasis added); Ex. 2015 ¶ 102. Thus, the term “composite cathode active material” refers *only* to active material constituent, and *not* the entire “cathode active material composition” (Ex. 1009 ¶ [0040]) of Kim’s cathode that also includes a conductive agent and binder. Ex. 2015 ¶ 102. 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.” Ex. 1004 ¶ [0110] (explaining that Ishigaki’s “positive electrode active material layer” includes

between 1 mass% to 15 mass% of a conductive material); Ex. 2015 ¶ 84. Dr. Gido recognizes that conducting agents, binders, and other additives *lower* the overall density of an electrode. Ex. 1010 ¶ 85; Ex. 2015 ¶ 84. And yet, Neither Petitioner nor Dr. Gido discusses the density of an *electrode* including Kim’s “composite cathode active material.” Instead, Petitioner incorrectly assumes, without explanation, that Kim’s “composite cathode active material” density would be the same as “a cathode layer density.” Pet., 28; *see also e.g.*, Ex. 2015 ¶ 103.

A POSITA 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. Ex. 2015 ¶¶ 101-102. This interpretation of press density is consistent with paragraph [0037] of Kim, 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.* ¶ 102 (citing Ex. 1009 ¶ [0037]).

In contrast to Kim, Ishigaki provides “mixture density” values for a positive electrode active material layer that includes an active material, a conductive material, a binder, and a solvent that is subsequently removed by drying. Ex. 1004 ¶¶ [0349] (Ishigaki explaining for Example 1 that “[t]he active material, conductive material (HS100 made by Denki Kagaku Kogyo), and binder PVdF (Kureha Corporation: KF Polymer L#1120)” were weighed and mixed with N-

methylpyrrolidone (NMP) to form a slurry that was “applied and dried on one side of an aluminum foil,” and then “pressed to 2.6 g/cm³ mixture density using a roll press to produce a one-sided positive electrode.”); [0366] (Ishigaki explaining for Example 2 that “[t]his coating film was made into a test positive electrode using a roll press ...and the mixture density was 2.4 g/cm³.); Ex. 2015 ¶ 103. Thus, at least because Kim’s press density values *only* apply to the active material constituent of the cathode active material layer, they cannot be compared to Ishigaki’s density values. Ex. 2015 ¶ 103-104.

Second, Kim does not disclose a two-layer structure at all, much less a two-layer structure having a total compaction density of greater than 3.2 g/cc. Ex. 2015 ¶ 107. Thus, even if a POSITA were to consider the press densities of Kim to be compatible with the densities of Ishigaki, which they are not, 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. Ex. 2015 ¶¶ 108-109.

As acknowledged by Petitioner’s expert, Kim is directed to a composite cathode active material for use in “a single active material layer.” *Id.* ¶¶ 108-109 (citing Ex. 1010 ¶ 65); *see also* Ex. 1009, Abstract. Kim explains that the composite cathode active material of Kim, which is used in a single layer, includes “at least one large-diameter active material” and “at least one small-diameter active material” and

“the inclusion of the large-diameter active material and the small-diameter active material in a specific particle diameter ratio and in a specific weight ratio may improve volume density, and thus leading to further increased electrical capacity of a lithium battery.” Ex. 1009 ¶ [0035]; *see also* Ex. 2015 ¶ 112, 118. Therefore, 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 as discussed in Kim, and not to cathode active materials in general (which may have smaller densities in usable cathode compositions). *Id.*, ¶¶ 112, 117-121.

A POSITA would have understood that, among other things, electrode composition and active material particle size directly impact the resultant density of an electrode layer. Ex. 2015 ¶¶ 119-121. That is, the active material composition limits the theoretical maximum compaction density, and the active material particle size limits the porosity (e.g., smaller particles can fit in the gaps or interstitial spaces between the larger particles, thus decreasing the porosity and increasing possible compaction density). Ex. 2015 ¶119.

Therefore, a POSITA would have understood that the density values discussed in Kim are only relevant to a structure formed from mixing together two different active materials having two different particle size distributions. Ex. 2015 ¶ 109. As

such, 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 (including active material 1 and active material 3, respectively) such that they form two distinct layers. *Id.* ¶¶ 109-112. In other words, the total compaction density of a mixture of active materials (as is the case in Kim) will be different from the total compaction density of multiple active layers within a two-layer cathode structure (as is the case in Ishigaki). *Id.* (citing Ex. 1009 ¶¶ [0006], [0035]); *see also* Ex. 1010 ¶ 65, *see also* Ex. 2040.

Kim itself acknowledges this difference between its composite active material and "conventional" active materials, such as are used in Ishigaki. For instance, Kim explains that the volume density of the composite cathode active material of Kim "may exceed a *conventional* density range." Ex. 2015 ¶ 120 (citing Ex. 1009 ¶ [0036], *emphasis added*). Kim also explains that "*conventional* cathode active materials" refers to any cathode active material that "has at least one different technical feature, for example, in terms of composition, particle diameter, and the like, in comparison with the composite cathode active material." *Id.* (citing Ex. 1009 ¶ [0042]). A POSITA would therefore understand that these disclosures of Kim mean that Kim's volume densities, and thus Kim's 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.* Any

changes in composition and/or particle diameter relative to Kim's composite cathode active material will necessarily result in changes to the associated volume/press density. *Id.* Thus, Kim and Ishigaki are directed to substantially different cathode active materials, and these references do not, alone or in combination, disclose any two-layer structure with a density greater than 3.2 g/cc. Ex. 2015 ¶ 121 (citing Ex. 1009 ¶¶ [0070]-[0090]; Ex. 1004 ¶¶ [0346], [0355], [0360], and [0366]).

Moreover, ignoring, *arguendo*, that Kim focuses only on active materials (and not complete electrode mixtures) *and* even if each individual layer in Ishigaki's two-layer cathode structure could be found to be compatible with Kim's composite active material, which they are not, Kim's densities would still not be relevant to Ishigaki's two-layer cathode structure because wetting effects between the layers lead to difference in compaction densities. Ex. 2015 ¶¶ 113-115. As such, a POSITA would not assume that the compaction of a layer in a single-layer cathode structure (e.g., including Kim's composite cathode active material) is the same as a two-layer cathode structure as disclosed in Ishigaki. *Id.* Consequently, a POSITA would not directly apply the compaction density of a layer in the single-layer cathode structure (much less the density of only Kim's composite cathode active material) to a two-layer cathode structure. *Id.* ¶ 113.

In other words, a POSITA would not have been motivated to combine Ishigaki with Kim as alleged by Petitioner at least because Kim and Ishigaki are directed to

different active material mixtures and different cathode structures. Indeed, a POSITA starting with Ishigaki's two-layer cathode structure would have no reason to look to Kim's teachings regarding the density of a composite cathode active material (without additives) that Kim teaches to include as a part of a single-layer cathode structure. Ex. 2015 ¶¶ 126 (citing Ex. 1004 ¶ [0366], Ex. 1009 ¶¶ [0070], [0079]-[0080]). In addition to the densities of Kim not being relevant to Ishigaki's two-layer structure, adding a second layer into a single-layer cathode structure (e.g., to form a two-layer cathode structure as Ishigaki allegedly attempts to do) would necessarily require modifying other parameters of the battery, which would discourage the POSITA from looking to Kim's single-layer cathode structure (much less Kim's composite cathode active material densities) for guidance on densities for a two-layer cathode structure. Ex. 2015 ¶ 116. Thus, contrary to Petitioner's assertion, the densities of Kim are not "compatible with the teachings of Ishigaki," and would not have been applicable to structures other than those described in Kim. *Id.* ¶¶ 121 (citing Ex. 1010 ¶¶ 211-112), 128; *see also* Pet., 29.

Third, Kim and Ishigaki are also directed to completely different problems. Kim is not concerned with preventing short circuits due to recesses. Rather, Kim 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. Ex. 2015 ¶ 127 (citing Ex. 1009 ¶ [0006]). Thus, Kim's teachings related to press

densities are not beneficial or applicable to Ishigaki because such teachings rely on the unique microstructures that are only achievable by combining two different active materials, which are intended for use in a single-layer cathode structure. *Id.*

Therefore, Petitioner has failed to show that Kim would motivate a POSITA to pursue compaction densities above 3.2 g/cc. Ex. 2015 ¶ 124.

2. The '118 Patent's Claimed Density Ranges are Critical

Moreover, even if one were to accept Petitioner's flawed interpretations of Ishigaki and Kim, and that Ishigaki discloses a range of compaction density values that fall within or overlap the claimed ranges of independent claims 1, 10, and 19, Ishigaki and Kim still fails to render obvious claims 1, 10 and 19 because the claimed density ranges are **critical** to providing the advantages of the '118 Patent and such criticality is not disclosed by Ishigaki or Kim. Ex. 2015 ¶ 129; *see also E.I. du Pont de Nemours & Co. v. Synvina C.V.*, 904 F.3d 996, 1006 (Fed. Cir. 2018) (a "claimed range that demonstrates [] unexpected results is referred to as a 'critical' range, and the patentee has the burden of proving criticality") (citation omitted).

The '118 Patent describes a two-layer electrode structure that can improve safety by avoiding internal short circuits of the lithium-ion battery caused by external forces puncturing the battery. *Id.*, 1:45-49. The '118 Patent also explains that its specific 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,

ensures, and is required to achieve, the desired energy density of a lithium-ion battery. *Id.*, 6:4-12; 6:20-27; *see also* Ex. 2015 ¶¶ 122, 130-131.

Neither Petitioner nor its expert explains that a POSITA would have known of the unexpected benefits discovered by the inventors of the '118 Patent in view of Ishigaki, Kim, or otherwise. Ex. 2015 ¶¶ 123, 132. Indeed, Ishigaki never mentions such criticality of a compaction density value greater than 3.2 g/cc for all active material layers of any electrode structure, much less a two-layer electrode structure. *Id.* ¶¶ 132-133.

In contrast to the '118 Patent, Ishigaki teaches that densities much lower than 3.2 g/cc satisfy its goals. *Id.* ¶ 134. Ishigaki aims to improve adhesion and reduce the likelihood of short circuits by reducing recesses in the surface of the current collector. Ex. 2015 ¶ 98; *see also* Ex. 1004 ¶¶ [0378]-[0383]. That is, Ishigaki's goal is to prevent short circuits by reducing recess in the surface of the current collector, and Ishigaki's experimental data show that this singular goal of Ishigaki is achieved with electrode densities no greater than 2.6 g/cm³. *Id.* Ishigaki does not contemplate or suggest that the density of its examples had anything to do with the observed results and does not suggest that higher electrode densities would improve its results. Rather, Ishigaki attributes the superior performance of Examples 1 and 2 relative to Comparative Examples 1 and 2 to the fact that Examples 1 and 2 have "a smaller ratio of recessed portions." *Id.* ¶¶ 98, 134-139; *see also* Ex. 1004 ¶ [0383].

Thus, Ishigaki fails to render obvious the claimed density ranges, and because Ishigaki's disclosure is directed to a completely different problem (too many recesses), Ishigaki's disclosure would not lead a POSITA to the '118 Patent's critical range of density values for a two-layer electrode structure, and instead teaches away from using values higher than 2.6 g/cm^3 . *Id.*

3. Claims 2-9, 11-18, and 20 Are Not Unpatentable

Claims 2-9, 11-18, and 20 are not unpatentable for at least the same reasons as discussed above with respect to independent claims 1, 10, and 19. Patent Owner reserves the right to address claims 2-9, 11-18, and 20 individually if this proceeding is instituted. Ex. 2015 ¶ 90.

C. Ground 3: Wang and Saka Do Not Render Obvious Claims 1-20

Petitioner fails to establish there is a reasonable likelihood at least one challenged claim of Ground 3 is unpatentable, for the reasons discussed below. Pet, 35-59. Specifically, Petitioner fails to establish that Wang in view of Saka teaches each limitation of the independent claims, or that a POSITA would be motivated to combine those references. Ex. 2015 ¶ 141.

1. Petitioner Fails to Show Why a POSITA Would Have Had a "Desired Density in Mind" Greater than 3.2 g/cc When Combining Wang and Saka

Petitioner relies on the disclosure of Wang for all elements of independent claims 1, 10, and 19, except for elements [1.5], [10.5], and [19.5], which recite,

“wherein a total compaction density of the first layer and the second layer is greater than 3.2 g/cc,” for which Petitioner relies on the disclosure of Saka. Pet., 43-46. Specifically, Petitioner admits Wang “does not provide values for the density that results from that compression” (Pet., 36) and then states that “Wang assumes the reader already has *a desired density in mind*, and teaches the method one would use to achieve any such density. A POSA would look to a reference such as Saka to determine what net density to pursue.” Pet., 43-44 (citing Ex. 1010 ¶ 276) (emphasis added). Petitioner’s allegation is built on an unsupported foundation—assuming that the POSITA already has a “desired density in mind” that is greater than 3.2 g/cc. *Id.*; *see also* Ex. 2015 ¶ 142. Petitioner’s “desired density in mind” theory that is not found in any document, which results in a density that is greater than 3.2 g/cc, is unsupported and, thus, Petitioner’s theory must fail.

Wang is directed to a gradient, multi-layer cathode and focuses on implementing specific porosity targets in each layer. Ex. 1005 ¶ [0056]; Ex. 2015 ¶¶ 143, 146-147. A POSITA 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. Ex. 2015 ¶¶ 143-145. Indeed, Wang 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.” Ex. 1005 ¶ [0058]; Ex. 2015 ¶ 143. In other words, 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. Ex. 2015 ¶ 143 (citing Ex. 1005 ¶¶ [0058], [0067], [0073], [0092]).

As Petitioner acknowledges, because Wang focuses on achieving porosity targets by using compression, Wang “does not provide values for the density that results from that compression.” Pet., 36. However, Petitioner’s assertion that the lack of numerical values in Wang would motivate a POSITA “to look to another reference, such as Saka, for numerical values,” is misguided. Pet., 37; Ex. 2015 ¶ 145. A POSITA would not need a density “in mind” to implement Wang’s disclosed porosity target. *Id.*

For example, even if a POSITA reviewing Wang had a “desired density in mind,” that density would be already 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. Ex. 2015 ¶¶ 148-151. Even Wang itself acknowledges this by stating “the cathode electrodes have graded properties, such as, porosity, conductivity, particle size, and combinations thereof that vary throughout the cathode electrode structure,” and “it is desirable to modify the properties of the cathode electrode through the inclusion

of additives such as conductive additives and/or binding agents ... 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.” Ex. 1005 ¶ [0035]; *see also e.g.*, ¶¶ [0051] (Wang describing that particle size impacts density), [0058] (Wang describing that porosity impacts density), [0086] (Wang describing that particle shape impacts density). A POSITA would not have been driven to select a new density for Wang’s cathodes using Petitioner’s inaccurate suggestion that the POSITA “would be motivated to look to another reference, *such as Saka*, for numerical values of a desired cathode density” (and doing so would necessarily move away from, and alter, Wang’s targeted porosity). Ex. 2015 ¶¶ 152-155.

Wang discloses a list of available active materials and additives that can be used in a cathode structure constructed according to Wang’s disclosure, (Ex. 1005 ¶¶ [0043], [0052]-[0053]), but neither Petitioner nor its expert discusses how the active materials and additives would impact the maximum possible density values that a POSITA could “have in mind” when implementing the disclosure of Wang, nor whether a density of 3.2 g/cc would be achievable in a cathode including Wang’s active materials and additives while achieving Wang’s disclosed porosity values. Ex. 2015 ¶¶ 152-153.

Moreover, Wang suggests *higher porosity*, which translates to *lower density* values, relative to solid films formed of the same material. Ex. 1005 ¶ [0056] (“In one embodiment, the first porosity is between about 40% and about 70% as compared to a solid film formed from the same material and the second porosity is between about 20% and about 40% as compared to a solid film formed from the same material.”); 2015 ¶¶ 154-155. And Petitioner has not explained why a POSITA 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.* ¶ 156. Wang explains that the porosity values for a given cathode layer can range between 20%-70%, depending on the chosen embodiment (Ex. 1005 ¶ [0056]), but again neither Petitioner nor Dr. Guido discuss Wang’s porosity limitations and how those porosity values impact the maximum possible density values that a POSITA could “have in mind” when implementing the disclosure of Wang and still achieving Wang’s targeted porosity. Therefore, Dr. Guido’s analysis falls short of explaining how a POSITA would have achieved a density value greater than 3.2 g/cc based on Wang’s disclosure. Ex. 2015 ¶¶ 154-156.

Petitioner asserts that “Saka further 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,’” therefore “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.” Pet., 44 (citing Ex. 1006 ¶ [0051], Ex. 1010 ¶ 277). But to learn anything from Saka’s disclosure, a POSITA must examine the experiments on which the disclosure is based. Ex. 2015 ¶ 161-163. Saka performs experiments on 23 example batteries—all of which had density values of **3.0 g/cm³ or less**. Ex. 1006, FIG. 7 (Table 1). *Id.* Saka never discusses porosity *at all*, and neither Petitioner nor Dr. Gido has explained whether Saka’s density values would have been achievable in a cathode structure having a porosity value compatible with Wang’s teachings. Ex. 2015 ¶ 157. All that Petitioner says is a POSITA “would have been motivated 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.” Pet., 46 (citing Ex. 1010 ¶ 282). Yet Petitioner has not provided any foundation to support this conclusion.

In fact, 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. Ex. 1006 ¶ [0179]; Ex. 2015 ¶ 162. Saka attributes this decrease in performance of example high-density batteries (having density values of 3.0 g/cm³) to the collapse of pores during pressing, which resulted in “the pore size of the positive electrode mixture layer [being] small.” *Id.* Therefore, at best, Saka teaches using a density no greater than 2.8 g/cm³ when implementing a

cathode with a desired pore size, and a POSITA reading Saka would have expected even more pore collapse and smaller pore sizes (and worse performance) with density values higher than 3.0 g/cm^3 . *Id.* This further supports the earlier argument about the second fatal conclusion in Petitioner's arguments: the Petition provides no justification for why a POSITA would believe that higher electrode density is always desirable above all other characteristics, and Saka confirms that batteries with higher densities can have *worse* performance than batteries with lower densities.

Finally, 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, and 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). Ex. 2015 ¶¶ 45, 95, 163-164. Thus, Petitioner fails to show why a POSITA would have had a "desired density in mind," particularly one that is greater than 3.2 g/cc , when implementing Wang and/or Saka. Ex. 2015 ¶ 165.

2. Petitioner Fails to Show that a POSITA Would Have Combined Wang with Saka

Petitioner fails to show that a POSITA would have combined Wang with Saka at least because neither Petitioner nor its expert have explained why Saka's 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 structure. Ex. 2015 ¶ 157. Indeed, a POSITA would have recognized that the differences between Wang and Saka's respective cathode compositions would necessitate differences in compaction density between these structures. *Id.*

For example, as discussed above, Wang discloses a combination of characteristics for the cathode active material layer (e.g., a list of 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 POSITA to construct the cathode active layer for a lithium ion battery. Ex. 2015 ¶ 158 (citing Ex. 1005 ¶¶ [0051], [0056]-[0057], [0081]-[0083]). Thus, contrary to Petitioner's assertion, a POSITA would not be motivated to look to another reference, such as Saka, for numerical density values, because the porosity value ranges restrict the possible density values achievable using Wang's cathode manufacturing method. *Id.* ¶¶ 152, 158-159; *see also* Pet., 37. Moreover, Saka mentions a *maximum* pore size between 0.5-0.70 µm, but does not discuss porosity. Therefore, a POSITA would not have been motivated to combine Saka's density values—particularly the density values above 3.2 g/cc—

with Wang's cathode having disclosed target cathode porosity values. Ex. 2015 ¶ 160.

Petitioner points to Saka's "mixture layer 12" as allegedly teaching a compaction density greater than 3.2 g/cc. Pet., 44 (citing Ex. 1006 ¶ [0051]); *see also* Ex. 2015 ¶ 160. However, the first layer of Saka's mixture layer 12 includes a composite of "LPF 1 and NMC 2." Ex. 1006 ¶ [0056]. As discussed *supra* in Section VI.B.1 with respect to Kim, 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. Ex. 1005 ¶ [0053]; Ex. 2015 ¶ 160. Neither Petitioner nor its expert provides any discussion to demonstrate that the density values provided in Saka for composite electrode mixture 12 would have been compatible with Wang's porosity values. Ex. 2015 ¶ 160.

Instead, Petitioner relies on its expert to allegedly show that Saka suggests that high cathode density values—greater than the claimed 3.2 g/cc—would have been desirable for any lithium ion battery. Ex. 1010 ¶ 281; Pet., 45-46; Ex. 2015 ¶ 161. Specifically, Petitioner relies on its expert's statement that "common sense dictates choosing the highest compaction density that is workable for a given

application.” Ex. 1010 ¶ 281³; Ex. 2015 ¶ 161. But this statement by its expert acknowledges that a workable compaction density depends on the application for which the density is being selected. Ex. 2015 ¶¶ 162-163. Even if Dr. Gido’s statement were true, it suggests at most that a POSITA would select the highest compaction density that could be achieved, *while satisfying other battery characteristics*, including desired porosity values. As discussed above, Wang targets higher porosity, and therefore targets lower density values. *Id.* So even if such a statement were supported by evidence, which Patent Owner does not concede, a lower range of compaction densities is workable (and necessary) for the application of Wang. *Id.*

Moreover, the rationale provided by Petitioner’s expert is based on a disclosure from Kim, which states that “densities less than 3.31 g/cc ‘may be too

³ Conclusory statements and unspecific expert testimony are insufficient to justify the use of general knowledge to modify a reference or provide a missing limitation.” *Arendi S.A.R.L. v. Apple Inc.*, 832 F.3d 1355, 1362 (Fed. Cir. 2016) (“[R]eferences to ‘common sense’—whether to supply a motivation to combine or a missing limitation—cannot be used as a wholesale substitute for reasoned analysis and evidentiary support, especially when dealing with a limitation missing from the prior art references specified.”).

small to obtain a high electrical capacity.” Ex. 1010 ¶ 281 (citing Ex. 1009 ¶ [0036]); Ex. 2015 ¶ 161. But *all* of Saka’s disclosed examples have density values of 3.0 g/cc *or less*, demonstrating that this disclosure in Kim is irrelevant and inapplicable to Saka. Ex. 2015 ¶ 161 (citing Ex. 1006, FIGS. 7, 8, 10, 11).

A POSITA 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, and that other characteristics of the mixture, such as possible interactions between the various materials in an electrode (e.g., between the multiple active materials discussed in Saka), how the various particles “fit” into the interstices of one another (i.e., how a smaller particle fills the space between adjacent larger particles) and whether the resulting mixture leaves sufficient space for lithium ion movement during charging and discharging processes need to be considered. Ex. 2015 ¶ 164. Thus, workable density values are specific to the materials used in a particular electrode, and a POSITA would not have been motivated to look at density values that are described for use with other electrode structures having different material compositions. *Id.* ¶ 165.

Thus, Petitioner Fails to Show that a POSITA would have combined Wang with Saka. Ex. 2015 ¶ 165.

3. Claims 2-9, 11-18, and 20 Are Not Unpatentable

Claims 2-9, 11-18, and 20 are not unpatentable for at least the same reasons as discussed above with respect to independent claims 1, 10, and 19. Patent Owner reserves the right to address claims 2-9, 11-18, and 20 individually if this proceeding is instituted.

D. Ground 4: Wang and Li Do Not Render Obvious Claims 1-20

Petitioner fails to establish there is a reasonable likelihood at least one challenged claim of Ground 4 is unpatentable, for the reasons discussed below. Pet., 59-70. Specifically, Petitioner fails to establish that Wang in view of Li teaches each limitation of the independent claims.

1. Petitioner Fails to Show Why a POSITA Would Have Had a “Desired Density in Mind” Greater than 3.2 g/cc When Combining Wang and Li

Petitioner relies on the disclosure of Wang for all elements of independent claims 1, 10, and 19, except for elements [1.5], [10.5], and [19.5], which recite, wherein a total compaction density of the first layer and the second layer is greater than 3.2 g/cc, for which Petitioner allegedly relies on the disclosure of Li. Pet., 61-65. Specifically, Petitioner states that “Wang assumes the reader already has a desired density in mind, and teaches the method one would use to achieve any such density,” therefore, a POSITA would be “motivated to look to a reference such as Li, which provides the specific numeric densities that result from the compaction

steps of a process like Wang's." Pet., 60 (citing Ex. 1010 ¶ 428). As with the combination desiring a density in the mind, especially one that is unsupported by the cited references, is fatal to Petitioner's ground.

For the same reasons as discussed in reference to Ground 3, Petitioner's argument that a POSITA would have had a "desired density in mind" (Ex. 1010 ¶ 428) that is greater than 3.2 g/cc when implementing Wang is unsupported by the disclosure of Wang or the knowledge of a POSITA. Ex. 2015 ¶¶ 166-167.

Wang is directed to a gradient, multi-layer cathode and focuses on implementing specific porosity targets in each layer (Ex. 1010 ¶ [0056]), so a POSITA would not need to have a "desired density in mind," because the density values are redundant characteristics of a cathode with a defined porosity. Ex. 2015 ¶ 168. Indeed, Wang 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." Ex. 1010 ¶ [0058]; Ex. 2015 ¶¶ 168-170. In other words, 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. Ex. 2015 ¶¶ 169 (citing Ex. 1005 ¶¶ [0058], [0067], [0073], [0092]).

Wang focuses on achieving porosity targets by using compression, so Wang “does not provide numeric values for the density that results” from that compression. Pet., 60. Thus, Petitioner’s assertion that the lack of numerical values in Wang would motivate a POSITA to “look to another reference, such as Li, for numerical values,” is misguided. Pet., 61; Ex. 2015 ¶ 171. A POSITA would not need a density “in mind” to implement a porosity target. Ex. 2015 ¶ 168. For example, even if a POSITA reviewing Wang had a “desired density in mind,” that density would be driven 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. Ex. 2015 ¶ 174. Even Wang itself acknowledges this by stating “the cathode electrodes have graded properties, such as, porosity, conductivity, particle size, and combinations thereof that vary throughout the cathode electrode structure,” and “it is desirable to modify the properties of the cathode electrode through the inclusion of additives such as conductive additives and/or binding agents ... 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.” Ex. 1005 ¶ [0035]; *see also e.g.*, Ex. 1005 ¶¶ [0051] (Wang describing that particle size impacts density), [0058] (Wang describing that porosity impacts density), [0086] (Wang describing that particle shape impacts density); Ex. 2015 ¶ 173. The POSITA

would not have been motivated to select a density for Wang's cathodes using Petitioner's inaccurate suggestion that a POSITA "would be motivated to look to another reference, *such as Li*, for numerical values of a desired cathode density." Ex. 2015 ¶ 174.

Wang discloses a list of available active materials and additives that can be used in a cathode structure constructed according to Wang's disclosure, (Ex. 1005 ¶¶ [0043], [0052]-[0053]), but neither Petitioner nor its expert discusses how the active materials and additives would impact the maximum possible density values that a POSITA could "have in mind" when implementing the disclosure of Wang, nor whether a density of 3.2 g/cc would be achievable in a cathode including Wang's active materials and additives while achieving Wang's disclosed porosity values. Ex. 2015 ¶ 178.

Moreover, Wang suggests higher porosity, which translates to lower density values, relative to solid films formed of the same material. Ex. 1005 ¶ [0056] ("In one embodiment, the first porosity is between about 40% and about 70% as compared to a solid film formed from the same material and the second porosity is between about 20% and about 40% as compared to a solid film formed from the same material."); Ex. 2015 ¶¶ 178-179. And Petitioner has not explained why a POSITA 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. Ex. 2015 ¶¶ 180-181. Wang explains that the porosity values for a given cathode layer can range between 20%-70%, depending on the chosen embodiment (Ex. 1005 ¶ [0056]), but again neither Petitioner nor Dr. Gido discuss Wang's porosity limitations and how those porosity values impact the maximum possible density values that a POSITA could "have in mind" when implementing the disclosure of Wang. Ex. 2015 ¶ 177, 179. Therefore, Dr. Gido's analysis falls short of explaining how a POSITA would have achieved a density value greater than 3.2 g/cc based on Wang's disclosure. Ex. 2015 ¶ 177.

Petitioner asserts that "Li's examples 2-13 specifically disclose a method of 'coating twice and compaction twice' with a resulting first compaction density of 3.8 g/cm³ for the first layer, and then an average compaction density of 4.1 g/cm³ across the two-layer structure following the second compaction." Pet., 64 (citing Ex. 1003 ¶ [0044]). But a POSITA would have understood that Li's high-density examples (e.g., higher than 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. Ex. 2015 ¶¶ 176-177. Like Saka, Li does not discuss porosity *at all* and neither Petitioner nor Dr. Gido has explained whether Li's density values would have been achievable in a cathode structure having a porosity value compatible with Wang's targets. Ex. 2015 ¶¶ 177-179.

In sum, Petitioner has left many questions unanswered, and has not articulated how or why a POSITA would have combined Wang and Li. Based on the disclosure of Wang and Li, a POSITA 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.

A POSITA would have understood that Li's compaction density ranges are not combinable with Wang's gradient cathode structure. Ex. 2015 ¶ 180. Moreover, Li does not discuss benefits of using the example high density values that would lead a POSITA to implement those values with Wang's cathode structure (notwithstanding the possibility that Li's density values are incompatible with Wang's porosity ranges). *Id.* Li does not discuss how the cathode composition would impact cell performance at all; Li only focuses on the geometry created by the disclosed gap coating method. *Id.*

Thus, at least because Petitioner does not explain how the densities described in Li are achievable by a cathode including Wang's active materials and additives, while staying within Wang's disclosed porosity ranges, Petitioner fails to show why

a POSITA would have had a “desired density in mind” that is greater than 3.2 g/cc when implementing Wang in light of Li.

2. Petitioner Fails to Show that a POSITA Would have Combined Wang and Li

Petitioner has failed to demonstrate that a POSITA would have sought to compact Wang’s cathode structure to a compaction density greater than 3.2 g/cc based on Li’s disclosure. Ex. 2015 ¶¶ 172, 175.

First, Petitioner’s suggestion to modify Wang to use a density value disclosed in Li is not supported by the disclosures of Wang and Li. Ex. 2015 ¶ 176 (citing Ex. 1010 ¶ 406; Pet., 60). In fact, Petitioner’s suggestion to modify Wang based on Li’s disclosure amounts to a mere 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. *Id.* (citing Ex. 1010 ¶ 434 (“Wang states that its method can be used to achieve any desired net density.”)).

Petitioner asserts that it “would have been obvious to a POSA to combine Wang and Li “because “[b]oth are directed towards battery electrodes, particularly cathodes, having a current collector and a bilayer structure of active materials,” and “Li describes the same overall structure, and provides the compaction densities that are missing from Wang.” Pet., 63. In other words, Petitioner bases its assertion that a POSITA would be motivated to combine Wang and Li on “Li’s battery [allegedly

having] a similar layer structure, including a cathode with two active layers, made of the same materials as Wang.” Pet., 60. Such a generic summary of Wang and Li is insufficient to support a motivation to combine.

But those are not the only cathode characteristics that a POSITA would consider when choosing a compaction density target for a cathode. Ex. 2015 ¶ 176. Indeed, a POSITA would also consider 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. *Id.* (citing Ex. 1003, Abstract). That is, Li’s explanation of its examples does not provide enough detail to *exactly* reproduce the battery described in the examples. *Id.* (citing Ex. 1003 ¶ [0038]). For example, Li does not explain what cathode particle distribution is used, or how the energy density or discharge performance differs from prior electrode designs. *Id.* Li focuses only on the “gap coated” *geometry* of a cathode, and does not provide enough disclosure to determine the *composition* of its electrodes such that a POSITA would be able to determine that Li’s composition is the “same” or “compatible” with Wang. *Id.* ¶ 177.

Therefore, neither Petitioner nor its expert has not shown that Li does, in fact, disclose compaction density values “that work in a battery like Wang’s” (Pet., 61)

because Li does not convey sufficient information to determine Li's examples are analogous to Wang's cathode structure. Ex. 2015 ¶ 177-178. Moreover, nothing in Li indicates that the compaction density used in the examples are desirable to be implemented with Wang's teachings. *Id.* ¶ 179.

Second, Wang discloses a combination of characteristics for the cathode active material layer (e.g., a list of 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 POSITA to construct the cathode active layer for a lithium ion battery. Ex. 2015 ¶ 178 (citing Ex. 1005 ¶¶ [0051], [0056]-[0057], [0081]-[0083]). Thus, contrary to Petitioner's assertion, a POSITA 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. *Id.*

Wang's disclosed cathode materials (e.g., active material, conducting material, and binder) and characteristics (e.g., particle size and porosity) limit what compaction densities are achievable based on the structure disclosed therein, and neither Petitioner nor its expert explain what density values are possible for Wang's disclosure, other than providing conclusory statements that Li's density values "work in a battery like Wang's." Ex. 2015 ¶ 179 (citing Ex. 1010 ¶ 408; Pet., 61).

Moreover, neither Petitioner nor its expert discuss whether Li's density ranges would allow the resulting cathode composition to overlap with Wang's porosity values, and never discuss why a POSITA would look outside of Wang for a density value that may be contradictory with Wang's own teachings. *Id.* And so Petitioner has not conclusively supported its assertion that Li's density values would work with Wang's battery.

Li's focus is on something entirely unrelated to compaction density—or the composition of a cathode at all—and therefore fails to describe cathode *compositions* in sufficient detail to allow a POSITA to fully replicate the examples. Ex. 2015 ¶ 180. Indeed, because Li's examples only provide sufficient detail for a POSITA to replicate the described geometry of a cathode—which is the focus of Li—Li's examples provide compaction density values, but they do not provide particle size distributions, quantities of solvent used to provide the described positive electrode slurry, nor quantities of electrolyte mixed with the described positive electrode composition. *Id.* (citing Ex. 1003 ¶¶ [0038], [0044]). Thus, a POSITA could not determine whether Li's density values are usable with Wang's disclosure, as suggested by Petitioner. *Id.* Moreover, even though Li does not provide sufficient details to reproduce the exact example discussed, a POSITA would have understood that Li's high-density examples (e.g., higher than 3.8 g/cc) would only be possible with certain specific cathode materials, additives, particle size distributions, and

porosity values. *Id.* ¶ 181. Consequently, the POSITA would have also understood that Li's compaction density ranges are not combinable with Wang's gradient cathode structure, and Petitioner has not shown that a POSITA would be able to achieve Li's quoted compaction density with Wang's materials and targeted porosities. *Id.*

Third, a POSITA 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, and that other characteristics of the mixture, such as possible interactions between the various materials in an electrode (e.g., between the multiple active materials discussed in Li), how the various particles "fit" into the interstices of one another (i.e., how a smaller particle fills the space between adjacent larger particles) and whether the resulting mixture leaves sufficient space for lithium ion movement during charging and discharging processes need to be considered. Ex. 2015 ¶ 182. Thus, workable density values are specific to the materials used in a particular electrode, and a POSITA would not have been motivated to look at density values that are described for use with other electrode structures having different material compositions. *Id.*

Thus, at least because neither Petitioner nor its expert discusses how or why a POSITA would have specifically looked at the density values of Li to modify

Wang, Petitioner Fails to Show that a POSITA would have combined Wang with Li.
Id.

3. Claims 2-9, 11-18, and 20 Are Not Unpatentable

Claims 2-9, 11-18, and 20 are not unpatentable for at least the same reasons as discussed above with respect to independent claims 1, 10, and 19. Patent Owner reserves the right to address claims 2-9, 11-18, and 20 individually if this proceeding is instituted.

E. Petitioner's four Different Flawed Grounds Merit Denial

Given that all grounds lack merit, it would not be an efficient use of resources for the Board to institute. *See Chevron Oronite Co. v. Infieum USA LP*, IPR2018-00923, Paper 9, 9-11 (P.T.A.B. Nov. 7, 2018) (informative).

VII. CONCLUSION

Patent Owner respectfully submits that the Board should deny institution of all Grounds of the Petition.

Dated: August 5, 2025

Respectfully submitted,

By: / Christopher TL Douglas /
Christopher TL Douglas, Reg. No. 56,950

CERTIFICATION UNDER 37 C.F.R. §42.24

Pursuant to 37 C.F.R. §42.24(d), I certify that this reply complies with the type-volume limits of 37 C.F.R. §42.24(c)(1) because it contains 13,106 words, according to the word-processing system used to prepare this reply, excluding the parts of this reply that are exempted by 37 C.F.R. §42.24(c) (including the table of contents, a table of authorities, a listing of facts which are admitted, a certificate of service or this certificate word count, and appendix of exhibits).

Dated: August 5, 2025

By: / Christopher TL Douglas /
Christopher TL Douglas

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §42.6(e), the undersigned hereby certifies that true and correct copies of the foregoing **PATENT OWNER'S PRELIMINARY RESPONSE and NINGDE AMPEREX TECH. EXHIBITS 2015-2021; 2025-2031; 2034-2040** were served in its entirety on August 5, 2025 by filing this document through the PTAB's P-TACTS Filing System as well as delivering a true and correct copy by electronic mail on Petitioner's lead and backup counsel at the following email addresses (as agreed by counsel for Petitioner):

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Dated: August 5, 2025

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