

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

Case IPR2025-00524
U.S. Patent No. 12,015,118

PETITIONER'S REPLY TO PATENT OWNER RESPONSE

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<i>In re Peterson</i> , 315 F.3d 1325 (Fed. Cir. 2003)	14
<i>Syntex (U.S.A.) LLC v. Apotex, Inc.</i> , 407 F.3d 1371 (Fed. Cir. 2005)	14, 23

PETITIONER’S UPDATED EXHIBIT LIST

Exhibit No.	Description
1001	U.S. Patent No. 12,015,118
1002	File History of U.S. Patent No. 12,015,118
1003	Chinese Publication No. 202905885 with Certified English Language Translation (“Li”)
1004	Japanese Publication No. 2013-211096 with Certified English Language Translation (“Ishigaki”)
1005	U.S. Patent Publication No. 2011/0168550 (“Wang”)
1006	U.S. Patent Publication No. 2017/0256776 (“Saka”)
1007	Excel Spreadsheet of Saka Calculations
1008	U.S. Patent Publication No. 2016/0013480 (“Sikha”)
1009	U.S. Patent Publication No. 2013/0302685 (“Kim”)
1010	Declaration of Dr. Samuel Gido
1011	<i>Curriculum Vitae</i> of Dr. Samuel Gido
1012	Certified Translation of the File History of Chinese Patent No. 109004170
1013	“Lithium Ion Battery Nickel Manganese Cobalt Oxide Nmc Cathode Raw Material For Lab Battery Research,” Alibaba, accessed at https://www.alibaba.com/product-detail/Lithium-Ion-Battery-Nickel-Manganese-Cobalt_1600084022147.html
1014	<i>Intentionally Left Blank</i>
1015	File History of U.S. Patent No. 11,664,528
1016	File History of U.S. Patent No. 11,322,774
1017	File History of U.S. Patent No. 10,693,181
1018	ISO 13320-1 standard
1019	<i>Intentionally Left Blank</i>

Exhibit No.	Description
1020	Kim, J., et al., “Structure Dependent Electrochemical Behaviors of Hard Carbon Anode Materials Derived from Natural Polymers for Next-Generation Sodium Ion Battery” <i>Polymers</i> , 15(22):4373 (Nov. 2023)
1021	Malvern Instruments Ltd., “A basic guide to particle characterization,” accessed at https://www.malvernpanalytical.com/en/learn/knowledge-center/whitepapers/wp120620basicguidepartchar
1022	“Battery Capacity,” accessed at https://www.pveducation.org/pvcdrom/battery-characteristics/battery-capacity
1023	“What is the difference between hard carbon black and soft carbon black?,” <i>Dery Chemical</i> , accessed at https://www.dr-carbonblack.com/what-is-the-difference-between-hard-carbon-black-and-soft-carbon-black
1024	“Overview of carbon black industry in China,” Henan Jinhe Industry Co., Ltd., accessed at https://www.jinhetec.com/blog/overview-of-carbon-black-industry-in-china-53773.html
1025	Abanades, A., et al., “Experimental analysis of direct thermal methane cracking,” <i>International Journal of Hydrogen Energy</i> , Vol. 36, pp. 12877-86 (Aug. 2011)
1026	Kim, M., et al., “Preparation of high-crystallinity synthetic graphite from hard carbon-based carbon black,” <i>Applied Physics</i> , Vol. 127:156 (Feb. 2021)
1027	Dick, J.S., et al., “Alternate Instrumental Methods of Measuring Scorch and Cure Characteristics,” <i>Polymer Testing</i> , Vol. 14, pp. 45-84 (April 1994)
1028	Schlögl, R., “Part A: 2.1.10 Carbons,” <i>Department of Inorganic Chemistry, Fritz-Haber-Institute of the MPG</i> (2008)
1029	“PGR and IPR Institution Rates over Time,” Biologics HQ, accessed at https://biologicsshq.com/stats_entry/pgr-and-iprinstitution-rates-over-time/ (last accessed Aug. 4, 2025)
1030	Declaration of John C. Evans

Exhibit No.	Description
1031	“Particle Size Distribution,” <i>Anton Paar Wiki</i> , accessed at https://wiki.anton-paar.com/en/particle-size-distribution/ (last accessed March 3, 2026)
1032	“Particle Size Analysis – Laser diffraction methods” Abstract, ISO 13320:2009, accessed at https://www.iso.org/standard/44929.html (last accessed at March 3, 2026)
1033	“Top 10 Errors in Particle Analysis and How to Avoid Them,” Microtrac MRB White Paper
1034	“Explanation of Data Reported by Microtrac Instruments,” Microtrac MRB
1035	<i>Intentionally Left Blank</i>
1036	Deposition Transcript of Dean R. Wheeler, Ph.D. (March 30, 2026)
1037	Supplemental Declaration of Dr. Samuel P. Gido, Ph.D.
1038	Particle Size Analyzer Function and Features, https://www.microtrac.com/products/particle-size-shape-analysis/laser-diffraction/bluewave/ , last accessed on April 29, 2026
1039	Kim, Y. “Lithium Nickel Cobalt Manganese Oxide Synthesized Using Alkali Chloride Flux: Morphology and Performance As a Cathode material for Lithium Ion Batteries,” <i>ACS Appl. Mater. Interfaces</i> , 4 (2012), 2329-2333
1040	National Center for Biotechnology Information (2026). PubChem Compound Summary for CID 172866199, Carbon Black. Retrieved April 29, 2026, from https://pubchem.ncbi.nlm.nih.gov/compound/172866199 .
1041	“Solef PVDF for Li-Ion Batteries,” Syensqo
1042	“Kynar HSV 302 Powder,” Technical Data Sheet, Kynar
1043	Pushnov, A.S. Calculation of average bed porosity. <i>Chem Petrol Eng</i> 42, 14-17 (2006).

Exhibit No.	Description
1044	Akimoto et al. “Synthesis and Structure Refinement of LiCoO ₂ Single Crystals” <i>J. of Solid State Chemistry</i> , vol. 141, 298-302, 1998.
1045	Oljaca et al., “Novel Li(Ni _{1/3} Co _{1/3} Mn _{1/3}) O ₂ cathode morphologies for high power Li-ion batteries,” <i>Journal of Power Sources</i> , 248 (2014) 729-738

I. INTRODUCTION

The Petition presented four Grounds, each challenging all claims of the '118 patent. Paper 1 (“Pet.”), 8. In the Institution Decision, the Board found all four grounds likely to succeed for all claims. Paper 11 (“DI”), 38, 51, 73, 81. Further development of the record confirms that the Board was correct. Every claim is unpatentable four times over. Patent Owner’s (“PO”) arguments misconstrue the Petition, the Petitioner’s expert testimony, the prior art, and the law. They do not defeat any grounds presented in the Petition, much less all four.

II. PETITIONER’S EXPERT QUALIFICATIONS

PO suggests that Petitioner’s expert, Dr. Gido, does not meet Petitioner’s definition of a POSITA because he does not have “two years of experience in the field of battery materials *and construction*.” Paper 22 (“POR”), 5. PO does not take a position on the level of skill in the art and does not argue that Dr. Gido’s testimony should be excluded as lacking qualification. POR, 4. PO merely perceives a disconnect between how Petitioner characterizes Dr. Gido’s expertise and the relevant field of the '118 patent. There is no disconnect.

The relevant field does not require one of ordinary skill to have first-hand experience constructing batteries. Rather, the field of “battery *materials and construction*” requires one to have experience with *materials used in battery*

construction and how those materials relate to battery functionality. EX1037, ¶11.

Dr. Guido has that experience. *See* EX1037, ¶¶1-11, 108; EX1010, ¶¶4-15.

Dr. Guido has worked on multiple teams designing and constructing batteries. Like most experts, he has a specialty within the relevant field. EX1037, ¶¶3-4. As a polymer specialist, he designs materials for use in battery separators. EX1037, ¶¶6-7. He understands principles of battery construction to design polymers that achieve the goals of a working battery. EX1037, ¶¶7, 10-11. His extensive knowledge in his specialty gives him an understanding of the level of ordinary skill, and what a POSITA would know and be motivated to do. Throughout his testimony, Dr. Guido has demonstrated the depth of his understanding of battery materials and construction. *See, e.g.*, EX2050, 29:16-43:17. PO's passing challenge to his qualifications is misplaced.

III. PO DOES NOT DISPUTE CLAIM CONSTRUCTION.

While PO's Response includes a claim-construction section, PO never argues that Petitioner's plain-meaning constructions for the terms "average particle size" or "compaction density" are incorrect. POR, 6-7. PO's expert, Dr. Wheeler, took no issue with Dr. Guido's plain-meaning interpretations. *See* EX1036, 12:15-22:6. Rather, PO disputes Dr. Guido's *application* of those terms to the prior art, to the extent he compared the concepts of "compaction density" and "average particle

size,” to disclosures of press density and D50/D90. *Id.* That is not a claim-construction dispute.

For instance, both experts agree that press density is not the “same thing” as compaction density and both agree on the definitions of each term. EX2050, 124:5-125:18; EX1036, 12:15-22:6, 78:3-10. Press density measures the active material alone while compaction density measures the finished electrode. EX1037, ¶¶32, 57. PO omits, however, that immediately prior to acknowledging the difference between these metrics, Dr. Guido noted “they are related as I just explained at some length.” EX2050, 125:2-3; *see also id.*, 122:1-123:18 (explaining the relationship). Where the two experts diverge, therefore, is that Dr. Wheeler considers press density “entirely irrelevant” to compaction density, dismissing the numbers in Kim without a second thought. EX2058, ¶143. As the Board found, that is erroneous. DI, 54. Kim’s press density is *informative* of the claimed compaction density. *Id.*

For “average particle size,” both experts agree on the plain meanings of the terms D50, D90, Dv50, and Dv90 in this art. *See* EX2015, ¶¶64-65, 68, 76; EX1010, ¶¶69, 81, 83; EX1037, ¶¶14, 17-19. The experts diverge on whether the D90 values in Ishigaki are volume-weighted (Dv90) rather than number-weighted (Dn90), based on the context of other disclosures in Ishigaki and a POSITA’s understanding of “well-known laser diffraction” outputs. EX1004, ¶39. Again, that

is not a claim-construction dispute. It is a dispute over how a POSITA would interpret Ishigaki's disclosure.

PO thus does not present any claim-construction argument that disqualifies the particle-size teachings of Ishigaki or the density teachings of Kim.

IV. ISHIGAKI ANTICIPATES CLAIMS 1-20 (GROUND 1).

Ishigaki discloses an electrode with every limitation of the claims. *See* Pet., 9-27. PO disputes two limitations. Both disputes fail. *First*, PO disputes that Ishigaki discloses a particle size of Dv90 less than 40 μm , based on a misapprehension of Ishigaki's disclosed particle size. POR, 8-15; EX1004, ¶39. *Second*, PO admits that Ishigaki's compaction densities overlap the claimed range, but wrongly argues that this *prima facie* anticipation is overcome by criticality. POR, 36-38.

A. Ishigaki discloses the claimed particle size.

Ishigaki discloses a particle size of 90% accumulative volume of the first material less than 40 μm . *See* EX1004, ¶39 (disclosing D90 measured by well-known laser diffraction/scattering and a "particle diameter standard as a volume standard"); EX1018 (explaining laser diffraction is a volume-based measurement). The laser-diffraction machine used in Ishigaki is well known, and intrinsically produces a volume-weighted distribution. EX1031 (describing laser diffraction as intrinsically a volume-weighted distribution); EX1032 (explaining the size

distribution for light scattering based on a volumetric sum); *see also* EX1037, ¶¶25-28.

In disputing Ishigaki's D90 value, PO presents information about the Microtrac Particle Size Analyzer S35 that a POSITA would have known when interpreting Ishigaki. EX2051; EX1037, ¶¶12-13. But PO mischaracterizes both Dr. Gido's opinions and laser diffraction.

First, Dr. Gido never testified that laser-diffraction machines only output cumulative-volume distributions. *Contra* EX1036, 22:14-24:19. Rather, he explained that laser diffraction uses a volume-based standard and inherently generates a volume-weighted distribution. EX2050, 43:2-17; *see also* EX1037, ¶¶20-27. While the settings on certain machines can be selected to convert that volume-weighted distribution into other outputs, like number-weighted distributions, those conversions use assumptions and approximations that render the output "less accurate." EX1033, 6; EX2050, 43:2-17; EX1037, ¶20. As such, the default for D90 measured by laser diffraction is Dv90. *See* EX2051. A POSITA would read Ishigaki's D90 values to reflect Dv90 in the absence of a specific statement otherwise. *See* EX1033, 6 ("laser diffraction cannot determine number distributions" and "the volume distribution should be used whenever possible"); *see also* EX1037, ¶¶20-27.

Dr. Wheeler cites two documents as supporting that laser diffraction outputs number-weighted distributions and that a POSITA would interpret Ishigaki's D90 values accordingly. *See* EX2058, ¶¶36-42 (citing EX2018; EX2051). These exhibits are from an Internet website, but do not contain all the pertinent information available from that website. In fact, additional webpages that link directly from these exhibits confirm Dr. Guido's explanation. *See, e.g.*, EX1031, 2-3 (listing laser diffraction as "volume-weighted."); EX1032, 1 (noting ISO 13320:2009 guidance on instrument qualification for size distribution based on the scattering pattern for a volumetric sum); EX1033, 6 ("[laser diffraction] provides volume-based distributions"); EX1034, 4 (using "D50" to denote "the percentage of the volume ... smaller than the size indicated"); *see also* EX1037, ¶¶20-27.

Dr. Wheeler acknowledges that his opinions are not entirely consistent with the information in these additional webpages, *see* EX1036, 26:1-47:3, which provide further details about the machines on which his opinions are based. Accordingly, Dr. Wheeler's analysis regarding Ishigaki's D90 value was not based on complete information and conflicts with the manufacturer's own descriptions of the machines he discusses. It should be given no weight.

Finally, PO suggests that because Ishigaki utilized particle-size counting from SEM images for primary particles, that "a direct, apples-to-apples comparison of the primary particle sizes to the secondary particle sizes would

require the statistical approach to be the same” and a POSITA therefore would expect a number-based distribution for both the primary and secondary particles of Ishigaki. EX2058 ¶¶ 47, 48. That is baseless conjecture. Just because Dr. Wheeler can hypothesize a reason why a POSITA might want to deviate from the intrinsic volume-weighted distribution recommended for laser diffraction does not mean a POSITA would assume Ishigaki actually did so, absent some indication in Ishigaki. EX1037, ¶¶28-30. Accordingly, a POSITA would interpret Ishigaki’s D90 value to be a Dv90 value. EX1033, 6; EX1032, 1; *see also* EX1034, 4 (using D50 to denote Dv50); EX1004, ¶39; *see also* EX1037, ¶¶17-30.

B. Ishigaki discloses a two-layer electrode with compaction densities in the claimed ranges.

Ishigaki discloses a two-layer electrode and numerous density values. The numeric ranges disclosed in Ishigaki overlap the claimed ranges, and various embodiments fall within the claimed ranges. EX1004, ¶151. PO attempts to overcome that presumption of anticipation by arguing (1) the claimed range is critical, and (2) Ishigaki’s higher densities do not apply to Ishigaki’s two-layer embodiment.¹ Both arguments fail.

¹ To the extent PO suggests that Ishigaki teaches away from densities towards the higher end of the disclosed range, *see, e.g.*, EX2058, ¶72, that argument is inapplicable to anticipation. *See Krippelz v. Ford Motor Co.*, 667 F.3d 1261, 1269 (Fed. Cir. 2012) (“[T]eaching away is not relevant to an anticipation analysis; it is

1. The claimed compaction densities are not critical.

The '118 patent does not ascribe any criticality to compaction densities of 3.2 g/cc, or to individual layer densities of 2.8 g/cc or 3.3 g/cc. EX1037, ¶¶35-37. The specification mentions compaction density greater than 3.2 g/cm³ only once, without discussion of why that value makes a difference to the alleged invention. EX1001, 6:20-27; EX1037, ¶¶35. Table 1 reports energy densities for fifty examples, but does not report compaction density for any. EX1001, Table 1. There is no discussion of critical energy density, or how any examples meet target energy densities (or not) in relation to the comparative example. EX1001, 17:39-44; EX1037, ¶¶35. No data in the '118 patent relate the claimed compaction densities to the energy densities of the electrodes, or identify unexpected results. *Id.* Any incremental improvement in energy density from increased compaction density would be an expected difference of degree, and not an unexpected difference in kind. *Id.*; EX1037, ¶¶34-36; EX1010, ¶¶85, 93. Reciting arbitrary cutoff points does not overcome the presumption of anticipation.

2. Ishigaki's compaction densities apply to two-layer structures.

Ishigaki discloses one and two-layer electrodes. It teaches the materials, manufacture, and attributes of “a layer,” including compaction density. EX2050,

only a component of an obviousness analysis.”).

107:2-108:11 (describing EX1004, ¶¶153, 347, 348). Ishigaki then explains that one can apply a second layer onto the first layer. EX1004, ¶153. A POSITA would therefore understand Ishigaki's teachings about one layer, including the compaction process and density, applies to both single-layer and two-layer electrodes. EX2050, 107:2-108:11; *see also* EX1004, ¶¶153, 347, 348; EX1037, ¶¶15, 31-33; EX1010 ¶¶87-88.

Specifically, Ishigaki teaches compaction densities of “normally 4.2 g/cm³ or less, preferably 4.0 g/cm³ or less, and particularly preferably 3.8 g/cm³ or less,” all of which satisfy the claim language of greater than 3.2 g/cc. *See, e.g.*, EX1004, ¶151. These are not just disclosures of overlapping numeric ranges, they are also disclosures of anticipatory embodiments (embodiments at the preferred upper limit) that fall within the claimed range. EX1037, ¶37.

Ishigaki also discloses a two-layer example, for which it reports the compaction density as a single value. EX1004, ¶366. A POSITA would understand that number refers to the average density across the two layers. EX1036, 12:13-13:10; EX1037, ¶¶38-39. Taken as a whole, a POSITA would understand that the compaction-density values in Ishigaki can refer to a single layer, the first of two layers, or the average across two layers. *Id.* Ishigaki therefore discloses two-layer electrodes with total densities of, for example, 3.8 or 4.0 g/cc, as well as a second layer with a density of, for example, 4.0 or 4.2 g/cc.

PO's suggestion that Dr. Gido admitted that "Ishigaki's density ranges are only applicable to the first layer of a two-layer electrode structure" is a mischaracterization of his testimony and simply incorrect. POR, 17. Dr. Gido explained, "I don't think there is any place in Ishigaki where any of these specifications apply specifically only to one layer." EX2050, 106:20-107:1. The Board similarly noted: "We can discern no language or suggestion in any of Ishigaki's paragraphs [0019]–[0025] to indicate, ... that the properties described therein relate solely to the embodiments of Ishigaki's invention possessing only a single layer." DI, 38. Those readings of Ishigaki are correct. The total compaction densities for claims 1, 10, and 19 as well as the individual-layer compaction densities for claims 5 and 14 are disclosed.

3. Dr. Gido's demonstratives are consistent with Ishigaki's inherent and express disclosures.

Dr. Gido prepared demonstratives to illustrate the express and inherent disclosure of Ishigaki. *See generally* EX1010; *see also* EX1037, ¶¶16, 44-55, 58-59, 64-65. Dr. Wheeler agreed with Dr. Gido's basic premise regarding total density for a two-layer structure: where one layer has a lower density, the other could have a higher density to compensate. EX1036, 59:17-60:11. When Ishigaki expressly discloses an electrode density of 3.8 g/cm³, EX1004, ¶151, it inherently discloses values for a two-layer structure that are higher and lower, resulting in an average of 3.8 g/cc. EX1037, ¶¶38-39, *see also id.* ¶89.

Dr. Wheeler does not disagree with any of Dr. Gido's calculations, and has done no calculations himself. EX1036, 70:1-10, 73:14-76:16. Rather, Dr. Wheeler's objection to the demonstratives is solely that *the Board* might be misled into thinking that the *theoretical maximum* density used in the calculations is an *achievable* density for a realistic electrode. *Id.*; EX2058, ¶64; *see also* EX1036, 74:12-14 (admitting a POSITA could calculate Ishigaki's theoretical maximum density), 76:4-16 (suggesting that the Board may be misled by Dr. Gido's demonstratives); *see also* EX1037, ¶45. The Board's prior findings on this issue confirm that the Board was not confused and has already interpreted the demonstratives and their relevance correctly. DI, 34-39.

The *theoretical maximum* is not an embodiment, but is used to calculate the range of densities inherently disclosed in Ishigaki. EX1010, ¶90; EX2050, 115:20-116:3; EX1037, ¶¶43-50, 59. A POSITA readily understands the need for pores to allow the passage of lithium ions, and would understand the maximum possible density to be a *theoretical* boundary. EX2050, 14:21-15:7; EX1037, ¶¶43-50, 59, *see also Id* 87. The demonstratives could more closely track the range of *working* embodiments by removing the area between Ishigaki's disclosed upper boundary (4.2 g/cc) and the theoretical maximum (4.4 g/cc). EX2050, 112:22-114:4. Dr. Gido has done so in his supplemental declaration, and shown that Ishigaki's inherent anticipation does not change. EX1037, ¶¶43-50.

PO also criticizes the demonstratives for not reflecting Ishigaki's teaching that the second layer should have different characteristics than the first layer.

EX2025, ¶66. Again, the demonstratives do not purport to show preferred embodiments. A POSITA could nonetheless discern from them workable embodiments for a given application. EX2050, 117:17-118:3; EX1037, ¶59.

Ishigaki anticipates the claimed compaction densities.

C. The remaining dependent claims are unpatentable.

PO does not present new challenges to Ground 1 for claims 2-4, 7-9, 11-13, and 16-18 other than to incorporate by reference the challenges discussed above. POR, 27-28. Those challenges likewise fail. *See* EX1037, ¶51; DI, 39.

Finally, PO's arguments for claims 6, 15, and 20 that the "bulk density" disclosed by Ishigaki does not satisfy the claimed layer ratios ignores the context of Ishigaki's layer/thickness ratio discussion, wherein the thickness ratio is increased "in order to obtain a high energy density." EX1004, ¶216. The reason for choosing a lower bulk density for the first active material compared to the second is to achieve a lower density in the first layer of the finished electrode. *Id.* That is consistent with Ishigaki's teaching that the second layer should have greater thickness, to achieve "high energy density" in the final product. *Id.* Increasing the thickness of the layer with higher bulk density only improves the energy density of

the overall product if that layer also has higher compaction density. *See* EX1037, ¶¶56-59.

V. ISHIGAKI AND KIM RENDER CLAIMS 1-20 OBVIOUS (GROUND 2).

PO repeats for Ground 2 many of the same arguments discussed above, disputing Ishigaki's disclosures of a D90 value and overlapping ranges for compaction density. Those arguments have even less merit in the context of obviousness, where a POSITA can readily mix and match teachings using ordinary creativity. EX1037, ¶¶55.

PO further argues that "the density values relied on by Dr. Gido are only described as suitable for the specific particle-size distribution, active material densities, and additive concentration in a single layer." EX2058, ¶77; POR, 26-27. PO doubts such densities would have provided adequate space for a two-layer electrode to "hold the electrolyte," as Ishigaki requires. EX2058, ¶77; POR, 26-27. As discussed above, divorcing Ishigaki's two-layer teachings from its more general density teachings is a misreading of Dr. Gido's opinions and Ishigaki's disclosure. EX1037, ¶¶31-50; DI, 38. PO provides no reason that a POSITA could not apply Ishigaki's teachings outside the context of each specific example. The POSITA is not an automaton that can only understand examples exactly as they are disclosed, as opposed to appreciating all Ishigaki teaches.

PO also adds arguments of teaching away and unexpected results, attempting to defeat Ishigaki's overlapping numeric ranges. EX1037, ¶35; *In re Peterson*, 315 F.3d 1325, 1329 (Fed. Cir. 2003) (explaining *prima facie* obviousness of ranges). Such overlap creates a presumption of obviousness. *Galderma Labs., L.P. v. Tolmar, Inc.*, 737 F.3d 731, 737–38 (Fed. Cir. 2013). The burden then falls upon PO to come forward with evidence of nonobviousness. *Ormco Corp. v. Align Technology, Inc.*, 463 F.3d 1299, 1311 (Fed. Cir. 2006) (“The presumption can be rebutted if it can be shown that the prior art teaches away from the claimed range, or the claimed range produces new and unexpected results.”). PO has not met that burden here.

“Teaching away” is a high bar. *In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004). It is not met by mere disclosure of alternatives or even a description that a disclosed embodiment is inferior. *Galderma*, 737 F.3d at 738; *Bayer Pharma AG v. Watson Labs., Inc.*, 874 F.3d 1316, 1327 (Fed. Cir. 2017). A statement that a particular combination is not preferred does not teach away absent clear discouragement of that combination. *See Syntex (U.S.A.) LLC v. Apotex, Inc.*, 407 F.3d 1371, 1380 (Fed. Cir. 2005). That bar is not satisfied here.

A. Kim would motivate a POSITA to choose densities towards the higher end of Ishigaki's range.

Even if the claimed numeric ranges were critical or produced unexpected results—for which there is no evidence—Kim teaches that electrode active

material press densities below 3.31 g/cc may be too low to achieve high energy capacity. EX1009, ¶36. EX1037, ¶¶60-63. That is the criticality PO uses to try to distinguish Ishigaki. EX1037, ¶¶66-67. The press density of Kim's active material is largely responsible for the energy density of Kim's battery. EX2050, 122:1-123:18, 156:3-20. EX1037, ¶64. Kim's teaching of a 3.31 g/cc threshold would suggest to a POSITA to pursue compaction densities not below around 3.3 g/cc. EX1009, ¶36; EX1010, ¶¶93, 122-123. EX1037, ¶62.

PO disregards Kim's teaching because of two alleged disconnects. POR, 29. First, PO argues that press density is irrelevant to compaction density. POR, 30-33. Second, PO argues that Kim's electrode is a single layer, and therefore its attributes are inapplicable. POR, 29-30. Neither argument defeats the motivation to combine the teachings of Ishigaki and Kim.

At a fundamental level, the energy capacity of a battery is a function of the amount of active material packed into the electrode. EX1037, ¶36-39; EX1010, ¶214; EX1004, ¶7. Both press density of the active material and compaction density of the layer describe that amount of active material. EX1037, ¶56-57; EX2050, 122:1-123:18; EX1010, ¶68. Whether the electrode consists of one or two layers is of little moment. *See also* EX1037, ¶¶40-42. An electrode with an average compaction density of 3.1 g/cc across two layers, or a gradient, or a single layer will have roughly the same amount of active material. EX1037, ¶39.

A POSITA would understand that a lower density closer to the current collector will improve adhesion, and that resulting loss of energy capacity can be compensated by increasing the density further away from the current collector, such as in a second layer. EX1037, ¶39; EX1010, ¶¶39-42; EX1036, 61:4-22. Accordingly, a POSITA would consider any teaching about the desired net density of an electrode to be informative regardless of internal structure.

PO tries to bolster its argument by suggesting that Dr. Guido admitted that press density values are “irrelevant” to final electrode compaction densities. POR, 2. To the contrary, Dr. Guido explained that the press density of an active material (as disclosed in Kim) and compaction density (as disclosed in Ishigaki and as claimed) are related. EX2050, 122:1-123:18, 124:20-125:4; EX1037, ¶75. Kim teaches electrode layers that are over 94% active material powder with less than 3% each of vinylidene fluoride (binder) and carbon black (conductive additive). EX2050, 122:6-124:1. EX1037, ¶66. The addition of the binder and conductive additive does not significantly change the resulting density of the layer. Pet., 28-29; EX1010, ¶211; *see also* EX1037, ¶¶67-74. There are two reasons for that.

First, the sheer amount of other materials is insignificant. Compaction density will be similar to press density because the main driver of density in both cases is the active material. EX1009, ¶79. *Second*, the binder and conductive materials are added in such a way that they do not add their full volume to the

resulting mixture. Rather, they fill the interstices between active particles, displacing air included in the press density. EX2050 122:11-123:18. The net difference between the press density of the active material in Kim, and the compaction density of the electrode formed from that active material is therefore minimal. *See id.* (“And because there is such a small amount of [binder/additive], the [compaction] density values that you would get are not much different from the [press-density] values given [in Kim]. Like 3.31 could be a little bit lower like 3.2 or a little bit higher. . . . but probably not below 3.2.”). The Board’s observation that press-density is instructive of compaction density is correct. DI, 52-53.

Ishigaki teaches that a goal of its electrode is to promote high energy capacity in the battery. EX1004, ¶¶2, 216. EX1037, ¶76. The Federal Circuit has repeatedly applied broadly applicable goals such as increasing energy in electrical devices to provide a motivation to modify and combine references. *See, e.g., Intel Corp. v. Qualcomm Inc.*, 21 F.4th 784, 796-97 (Fed. Cir. 2021); *DyStar Textilfarben GmbH v. C.H. Patrick Co.*, 464 F.3d 1356, 1368 (Fed. Cir. 2006). To that end, Ishigaki teaches a range of compaction densities and the objective of achieving high energy density in the resulting electrode.

Ishigaki does not, however, disclose a precise correlation between the compaction density of a layer and the resulting energy capacity. Nor does it provide thresholds for the workable densities with the highest energy capacities.

For that, a POSITA would look to Kim, which teaches a similar battery electrode and has the same goals as Ishigaki. EX1009, ¶6. Kim expressly teaches the density of active material that needs to be packed into the electrode in order to achieve high energy capacity, directing a POSITA towards the higher end of Ishigaki's density range. EX1009, ¶36; EX1037, ¶61; EX1010, ¶210-214.

B. The dependent claims are unpatentable

PO does not present any new challenges to Ground 2 for the dependent claims other than to incorporate by reference or repeat the challenges discussed above. POR, 38-40. They fail for the same reasons. *See also* Pet., 31-35; DI, 51-54; EX1037, ¶¶60-76.

**VI. MOTIVATION TO COMBINE WANG WITH SAKA OR LI
(GROUNDS 3 AND 4)**

PO challenges two aspects of Grounds 3 and 4, which fail for similar reasons. PO argues that a POSITA would not combine Wang with Saka or Li because (1) a POSITA would not look beyond Wang in the first place, and (2) even if he did, a POSITA would not consider Saka or Li because their density values are not “immediately combinable” with Wang's process. POR, 42-43, 54; EX2058, ¶170. Neither attack prevails, for reasons already identified in the Institution Decision. DI, 70-73, 80-81. PO even raised these arguments in its Request for Director Review, and the Director did not find them compelling. Paper 14 (“Request”), 13-15; Order, 3-4.

At the outset, Dr. Wheeler does not dispute that a POSITA would have a reasonable expectation of success in using Wang's calendaring process to achieve densities disclosed in Saka and Li. EX1036, 105:16-19 ("If someone has a desired net density, they would have understood even before they got to Wang that you can do that by calendaring. Everybody knows that."). There is also no dispute that a POSITA would understand how to balance the desire for high energy capacity with the other known design tradeoffs. EX1036, 108:19-109:8 (agreeing that it "would be base knowledge that a POSITA would have" that any functional battery must have some balance among the tradeoffs among energy density, ion flow-through, rate performance, and safety). EX1037, ¶¶98-100. A POSITA would therefore combine Wang with Saka or Li (as discussed further below) with a reasonable expectation of success. *See* EX1037, ¶¶77-79, 101.

A. A POSITA would look beyond Wang for a "desired density"

Wang teaches a POSITA to use compaction to achieve a "desired net density" in a multi-layer electrode without teaching what any desired density might be, inviting a POSITA to look elsewhere for that information. EX1005, ¶¶67, 73, 89, 92, 106, 109. As the Board correctly found, this is a classic motivation to combine. DI, 72, 73.

PO counters that Wang discloses various porosities, and because porosity is the inverse of density, a POSITA would not look outside Wang to learn a

“desired net density.” POR, 42, 43; EX2058, ¶124. There are two problems with this approach. *First*, Wang does not teach any porosity as the end goal. Rather, it teaches a range of possible porosities that one can manipulate through calendaring as a means for achieving the goal of a desired density. EX1005, ¶¶ 15, 67, 73, 89, 92, 106, 109, 124; EX1037, ¶¶80. *Second*, even if a POSITA calculated densities from Wang’s porosities and materials, that exercise would still lead them to Saka and Li. EX1037, ¶¶82. Wang’s porosities correspond to densities that are (1) compatible with Saka’s and Li’s densities, and (2) within the claimed ranges of the ’118 patent. *See* EX1037, ¶¶77-90 (calculating the compaction densities implicated by Wang’s disclosed porosities to include 2.83 g/cm³ and 3.78 g/cm³ for the first and second layers, respectively, and 3.46 g/cc total).

A POSITA practicing Wang would therefore find Saka and Li informative about desirable densities, would expect success in using Wang’s process and materials to achieve those densities, and would arrive at the claimed values in doing so. EX1037, ¶¶91-93.

B. PO’s arguments rely on improper bodily incorporation.

PO argues that density values disclosed in one reference are so case-specific that a POSITA cannot apply them to any other reference. POR, 45-46. This amounts to an improper argument against bodily incorporation. PO argues that Dr. Gido admitted that one cannot plug numbers from one reference into another, but

that mischaracterizes Dr. Guido’s testimony and Petitioner’s argument. *Id.* (citing EX2050, 134:17-135:8, 136:7-137:10). Dr. Guido explained that a POSITA does not merely pluck numbers from one reference and insert them into another without context. EX1037, ¶¶106-107. Rather, a POSITA considers the teachings of the references as a whole, and combines those *teachings*. *See* EX2050, 136:7-137:10.

“The test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference ...” *Allied Erecting & Dismantling Co. v. Genesis Attachments, LLC*, 825 F.3d 1373, 1381 (Fed. Cir. 2016). Instead, the question is whether “a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention.” *Id.* (quoting *Pfizer, Inc. v. Apotex, Inc.*, 480 F.3d 1348, 1361 (Fed. Cir. 2007)); *see also In re Mouttet*, 686 F.3d 1322, 1332 (Fed. Cir. 2012) (“obviousness based on teachings from multiple references does not require an actual, physical substitution of elements.”); *In re Etter*, 756 F.2d 852, 859 (Fed. Cir. 1985) (*en banc*) (explaining that the test for obviousness is “not whether the references could be physically combined but whether the claimed inventions are rendered obvious by the teachings of the prior art as a whole”).

Here, a POSITA reading Wang would learn the range of densities that are possible to achieve using Wang’s method. *See* EX1037, ¶¶82-90. Those densities fall within the claimed numeric range. Wang also teaches that its method can be

used to achieve any “desired net density,” but not what densities are desired.

EX1005, ¶¶15, 67, 73, 89, 92, 106, 109, 124; EX1037, ¶79. Saka and Li also disclose batteries with compaction densities in the claimed range. EX1006, ¶¶51, 23, claim 5; EX1003, ¶44. A POSITA would therefore learn from those references the kinds of densities that are desirable to pursue using a method like Wang.

That is not to say that a POSITA would simply look at Saka and Li, pluck numbers out, and plug them into Wang. That straw-man argument misapprehends the law and the Petition. Saka and Li teach ranges of densities that achieve their goals and result in a working battery. EX1006, ¶¶51, 23, claim 5; EX1003, ¶44. A POSITA could take the teachings of Saka or Li and apply them to Wang, knowing that it may take some experimentation to find the offsetting design criteria to make the electrode work. EX2050, 136:7-137:10; *see also* EX1037, ¶¶106-107. Any routine optimization of the various parameters in Wang, or the specific densities of Saka or Li to facilitate the combination, would not take the resulting battery outside the scope of the claims.

VII. SAKA TEACHES COMPACTION DENSITIES WITHIN THE CLAIMED RANGES (GROUND 3).

PO argues that Saka does not teach the claimed compaction densities because (1) Saka does not have a single complete example with those densities, and (2) Saka teaches away from higher densities because one of the tested

examples showed poorer performance than an example with a lower density. POR, 44-47; EX2058, ¶131. Both challenges fail. EX1037, ¶¶95-98.

First, Saka teaches several working embodiments in which the compaction density of the first layer is greater than 2.8 g/cc. *See* EX1007. There is therefore no dispute that Saka teaches the first layer density. While none of Saka's examples have a compaction density for the second layer that is greater than 3.3 g/cc, many are very close (around 3.1 g/cc) and a POSITA would find it obvious to compact the second layer above 3.3 g/cc in view of Saka's more general teaching of compaction densities up to 3.5 g/cc. EX1006, ¶51; EX1037, ¶¶95-98.

Saka also reports superior performance for one example with 2.8 g/cc electrode density and that performance decreased at 3.0 g/cc. EX2058, ¶132. While this 3.0 g/cc electrode was weaker in one metric, an embodiment need not be preferred to be obvious. *See Fulton*, 391 F.3d at 1201; *Galderma*, 737 F.3d at 738; *Bayer Pharma*, 874 F.3d at 1327. A statement that a particular combination is less preferred does not teach away absent clear discouragement. *See Syntex*, 407 F.3d at 1380. Even reporting lower performance does not teach away from an embodiment that still works. *Cf. Baxter Int'l, Inc. v. McGaw, Inc.*, 149 F.3d 1321, 1328 (Fed. Cir. 1998) (finding no teaching away where nothing in the prior art suggested that the claimed invention was unlikely to work). The 3.0 g/cc density embodiment is

still a working embodiment, as are densities up to 3.5 g/cc. EX1006, ¶¶51, 109, 179; EX1037, ¶¶94-96.

Every POSITA knows that designing a battery involves balancing various tradeoffs. EX2050, 15:8-20, 63:12-70:8; EX1037, ¶99. Higher energy density is always an overarching objective. *Id*; EX1001, 1:36-41, 4:18-24, 6:7-12, 6:20-27; EX1004, ¶216; Pet., 16 (citing EX1010, ¶¶85, 93); EX1010, ¶211. It is offset by limitations like safety and rate performance. EX2050, 136:7-137:10; EX1037, ¶99. A POSITA would how to balance those limitations depending on his priorities for a particular application. EX2050, 64:18-21. A POSITA would also understand Saka for all that it teaches. Total densities of 3.2 g/cc and second layer densities greater than 3.3 g/cc are therefore obvious. *Contra* EX2058, ¶149.

VIII. WANG AND LI'S TEACHINGS ARE COMPATIBLE.

Dr. Wheeler objects to combining Wang with Li because “there’s no evidence that Li’s battery is the best battery that everyone wants,” and “there’s no reason to believe that you could just take what Li did, Li’s density value, and that that would just plug into Wang’s procedure.” EX1036, 110:2-113:20. Both of Dr. Wheeler’s premises are based on misapplications of the relevant legal standard.

A motivation to combine does not require that a POSITA believe that Li discloses “the best battery that everyone wants.” *Id.*; *PAR Pharm., Inc. v. TWI Pharms., Inc.*, 773 F.3d 1186, 1197-98 (Fed. Cir. 2014) (“Our precedent, however,

does not require that the motivation be the *best* option, only that it be a *suitable* option”). Nor does obviousness require that a POSITA could bodily incorporate Li’s density into Wang’s process without any experimentation. It is enough that a POSITA reading Wang would look to Li to learn more about desirable densities, and would believe that Wang’s calendaring process could be used to achieve densities in the claimed range, based on Li’s teachings. EX1037, ¶¶103-105.

Both Li and Wang cite a desire to maintain high energy capacity and describe similar approaches to achieving that goal. EX2050, 169:13-20. A POSITA would look beyond Wang, to Li and would learn what densities would be desirable for an electrode made using Wang’s process. EX2050, 165:20-166:11; EX1037, ¶¶106-107. Dr. Wheeler does not dispute that compatibility and expectation of success. EX1036, 105:16-19.

IX. GROUNDS 3 AND 4 RENDER ALL DEPENDENT CLAIMS UNPATENTABLE.

PO arguments in defense of the remaining dependent claims under Grounds 3 and 4 fail for the same reasons discussed above. *Contra* POR, 50-51, 60; *see* EX1037, ¶¶78, 90, 92, 97, 102, 107.

X. CONCLUSION

The Board should cancel all claims as unpatentable.

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CERTIFICATE OF WORD COUNT (37 C.F.R. § 42.24(d))

1. This Petitioner's Reply complies with the type-volume limitation of 5,600 words, comprising 5,577 words, excluding the parts exempted by 37 C.F.R. § 42.24(c).

2. This Petitioner's Reply complies with the general format requirements of 37 C.F.R. § 42.6(a) and has been prepared using Microsoft® Word 2016 in 14-point Times New Roman font.

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CERTIFICATE OF SERVICE (37 C.F.R. § 42.6(e))

I certify that the above-captioned **PETITIONER'S REPLY TO PATENT OWNER'S RESPONSE**, and associated Exhibits 1031-1034 and 1036-1045, were served in their entirety upon the Patent Owner on April 30, 2026, upon the following parties via email:

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