

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

IPR2025-00431
Patent 11,799,131

PATENT OWNER'S 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 Statistics for Judge Rodney Gilstrap (accessed May 5, 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.)

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2011	General Docket, <i>Ningde Amperex Tech. Ltd. v. Zhuhai CosMX Battery Co.</i> , No. 25-1037 (CAFC)
2012	U.S. Patent No. 10,833,363 (“the ’363 Patent”)
2013	Darts IP Reports: CN109301326, CN104466097, CN206490141, CN108352492 (May 6, 2025)
2014	Dec. 20, 2021 memo titled “New PE2E Search Tool Using AI Search Features” by Acting Deputy Director Andrew Hirshfeld
2015	Declaration of Dean R. Wheeler, Ph.D.
2016	<i>Curriculum Vitae</i> of Dean R. Wheeler, Ph.D.
2017	Sigma-Aldrich Safety Data Sheet, “Lithium hexafluorophosphate solution in ethylene carbonate-d ₄ (99 atom % D) and ethyl-d ₅ methyl-d ₃ carbonate (98 atom % D), 1.0 M LiPF ₆ in EC-d ₄ /EMC-d ₈ =3:7 (v/v), battery grade”, dated July 11, 2016
2018	Safety Data Sheet, “Lithium Hexafluorophosphate in EC/EMC 3:7”, dated September 2018
2019	Sigma-Aldrich Product Specification, “Lithium hexafluorophosphate solution - in ethylene carbonate and diethyl carbonate, 1.0M LiPF ₆ in EC/DEC=50/50 (v/v), battery grade”
2020	Sigma-Aldrich Product Specification, “Lithium hexafluorophosphate solution - in diethyl carbonate, 1.0M LiPF ₆ in DEC, battery grade”

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2021	Sigma-Aldrich Product Specification, “Lithium hexafluorophosphate solution - in ethylene carbonate and dimethyl carbonate, 1.0M LiPF ₆ in EC/DMC=50/50 (v/v), battery grade”
2022	Chinese Patent Application No. CN104051787A to Yongjun et al. (including English translation, translation affidavit, and copy of original document in Chinese)
2023	Wenbo Zhang et al., <i>Interfacial processes and influence of composite cathode microstructure controlling the performance of all-solid-state lithium batteries</i> , 9 ACS Applied Materials & Interfaces 17835–17845 (2017).
2024	BYU DIPPR® (Design Institute for Physical Properties) Thermophysical Properties Laboratory Data Information Sheet for n-Propyl Propionate
2025	2016 Batteries Conference GRC, available at: https://www.grc.org/batteries-conference/2016/ (accessed on 12 May 2025).
2026	<i>Hubs – Department of Energy</i> , available at: https://www.energy.gov/hubs (accessed on 12 May 2025)
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	Fei Sun and Dean R. Wheeler, <i>The Effects of Lithium Ions and pH on the Function of Polyacrylic Acid Binder for Silicon Anodes</i> , 170 J. Electrochem. Soc. 080502 (2023)

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2031	Amir-Sina Hamedi, Edmund M. Shumway, & Dean R. Wheeler, <i>Electrode-Level Modeling of Silicon Anodes for Improved Cell Design</i> , 171 J. Electrochem. Soc. 120539 (2024)
2032	Jerome Workman, Jr., <i>A Comprehensive Review of Spectroscopic Techniques for Lithium-Ion Battery Analysis</i> , 39 Spectroscopy 6 (2024), https://doi.org/10.56530/spectroscopy.ii3689u3
2033	Anup Barai et al., <i>A Comparison of Methodologies for the Non-Invasive Characterisation of Commercial Li-Ion Cells</i> , 72 Progress in Energy and Combustion Science 1-31 (2019)
2034	<i>Lithium-ion Battery Design: Effects of Optimal Compaction Density</i> , available at: https://www.neware.net/news/lithium-ion-battery-design-effects-of-optimal-compaction-density/230/83.html (accessed on May 23, 2025)
2035	Shu Lu, et al., <i>Binder-Free LiCoO₂/Carbon Nanotube Cathodes for High-Performance Lithium Ion Batteries</i> , 24 Adv. Mater. 2294-2298 (2012)
2036	Lei-Lei Lu, et al., <i>Wood-Inspired High-Performance Ultrathick Bulk Battery Electrodes</i> , Adv. Mater. 1706745 (2018)
2037	Yasuhiko Takahashi, et al., <i>Structure and electron density analysis of electrochemically and chemically delithiated LiCoO₂ single crystals</i> , 180 Journal of Solid State Chemistry 313-321 (2007), https://doi.org/10.1016/j.jssc.2006.10.018

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2038	<i>Carbon Black</i> , Available at: https://pubchem.ncbi.nlm.nih.gov/compound/carbon%20black , (accessed on May 23, 2025)
2039	Sankar Mandal, et al., <i>The Role of Carbon Black in LiMn₂O₄-Based Composites as Cathodes for Rechargeable Lithium Batteries</i> . 148 J. Electrochem. Soc. A24-A29 (2001)
2040	<i>Ethylene Carbonate</i> , https://www.m-chemical.co.jp/en/products/departments/mcc/c2/product/1200981_7910.html (accessed on June 8, 2025)
2041	<i>Declaration of Brady Cox in Support of Patent Owner's Notice of Intent to Designate Provisionally Recognized PTAB Attorney Under 37 C.F.R. § 42.10(c)(2)</i>
2042	Deposition Transcript of Brett Lucht, Ph.D., dated September 13, 2022, IPR2021-01440
2043	Declaration of Dr. Brett Lucht, dated September 15, 2023, IPR2023-01016
2044	<i>Reserved</i>
2045	Alison L. Michan, et al., <i>Fluoroethylene Carbonate and Vinylene Carbonate Reduction: Understanding Lithium-ion Battery Electrode Additives and Solid Electrolyte Interphase Formation</i> , Chemistry of Materials 2016 28 (22), 8149-8159
2046	Sha Tan, et al., <i>Review on Low-Temperature Electrolytes for Lithium-Ion and Lithium Metal Batteries</i> , Electrochemical Energy Reviews (2023) 6:35, https://doi.org/10.1007/s41918-023-00199-1
2047	Supplemental Declaration of Dean R. Wheeler, Ph.D. in support of Patent Owner Response

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2048	Lidan Xing et al., <i>Deciphering the Ethylene Carbonate–Propylene Carbonate Mystery in Li-Ion Batteries</i> , 51 Accounts of Chemical Research 282-289 (2018), https://doi.org/10.1021/acs.accounts.7b00474
2049	Academic Press Dictionary of Science and Technology (Christopher Morris ed., 1992)
2050	Deposition Transcript of Brett Lucht, Ph.D., dated October 22, 2025, and executed Errata Sheet IPR2025-00431

I. INTRODUCTION

Ningde Amperex Technology Ltd. (“ATL” or “Patent Owner”) respectfully submits this Patent Owner Response (“POR”). Zhuhai CosMX Battery Co., Ltd. (“CosMX” or “Petitioner”) filed the Petition (“Petition”) for, and the Board instituted (Paper 15, “Decision”), *inter partes* review (“IPR”) of claims 1-7, 12,¹ and 14-17 (“Challenged Claims”) of Patent No. 11,799,131 (“the ’131 Patent,” Ex. 1001). The Board should find the Challenged Claims not unpatentable as Petitioner failed to meet its burden of proving “by a preponderance of evidence” that any of its twelve grounds render the Challenged Claims unpatentable. 35 U.S.C. § 316(e).

In Grounds 1-8, Petitioner relies on Zeng, but Zeng never discloses a propyl propionate (“PP”) weight percentage (“wt%”) (Z) based on a *total weight of the electrolyte solution* or otherwise provides sufficient information from which to determine Z. Petitioner, ignoring the disclosure of Zeng, also relies on an unfounded central assumption that Zeng’s lithium salt is added in *solid* form in a failed attempt to back-calculate an undisclosed PP wt% and in turn, a purported value for the claimed Y/Z.

¹ The Decision did not institute review of Claim 12. Paper 15, 78 (ordering “post grant review of claims 1-7 and 14-17 of the ’131 Patent....”).

Petitioner relies on Sunose in each of Grounds 1-12. But the POSITA would have had no reason to rely on Sunose because Sunose's purported density values would be *physically impossible* values for electrode compaction densities using Sunose's materials. Worse still, Sunose is not enabled for the purposes of preparing electrodes. Accordingly, *all* Grounds fail to render obvious at least the claimed electrode compaction densities and corresponding ratio.

In Grounds 2, 4, 6, and 8, Petitioner's attempts to cure the electrolyte failures of Zeng by further relying on Matsuoka in the alternative also necessarily fail. There is no "explicit[] disclos[ure] of an appropriate amount of PP" in Matsuoka and Dr. Lucht's assumption that a person of ordinary skill in the art ("POSITA") would single out and apply Matsuoka's preferred "non-nitrile additive" ranges to *only* PP completely disregards the other components of Zeng's electrolyte that would also or instead be considered "non-nitrile additives." Petitioner's illogical leap is not supported.

In Grounds 9-12, Petitioner relies on Zhou for the electrolyte limitations of the Challenged Claims even though *none* of the examples include PP. Instead, Petitioner relies on Dr. Lucht's hindsight-driven testimony that a POSITA would have substituted PP, one-for-one, for ethyl acetate in Example 8 without otherwise balancing any such substitution with the characteristics of other molecules in the electrolyte. Petitioner's argument oversimplifies the technical challenges and

blatantly ignores the nuanced decision-making that Petitioner's own expert previously testified would be necessary in the complex and unpredictable art of battery chemistry.

In Grounds 3, 4, 7, 8, 10, and 12, Petitioner's attempts to cure the electrolyte failures by further relying on Kim in the alternative, with or without Matsuoka, also necessarily fail. Kim does not render obvious the PP wt% or the claimed Y/Z ratio, Petitioner fails to make a motivation to combine argument with respect to Kim, nor does Kim cure the other failures of Zeng, Zhou, Sunose, and/or Matsuoka in their respective Grounds.

Petitioner fails to prove the existence of all elements of the Challenged Claims in the cited references and fails to prove that a POSITA would have been motivated to make any of the purported combinations with any expectation of arriving at the claimed subject matter. Accordingly, Patent Owner requests the Board find the Challenged Claims not unpatentable.

II. BACKGROUND²

A. Technology Overview

In lithium-ion batteries, the properties of the solid electrolyte interphase (SEI) depend on the combined effects of solvents, additives, and lithium salts, as well as their respective concentrations. Ex. 2015 ¶¶41-45.

The '131 Patent describes a novel lithium-ion battery electrolyte solution that provides a firm protective SEI film on the surface of the device's cathode that is not easily decomposed, effectively inhibits the increase in DC internal resistance, and achieves high-capacity density, with excellent cycle and storage performances, by that solution comprising a dinitrile compound, a trinitrile compound, and PP in specific wt% concentrations and ratios. *Id.* 1:55-62, 3:8-20; 27:16-19, 28:49-64. Specific dinitrile, trinitrile, and PP wt% ratio ranges were unexpectedly found to provide a firm, protective SEI film on the surface of the cathode that was not easily decomposed, and which could provide performance improvements by allowing a battery to operate at a high potential of 4.45V and effectively reduce DC internal resistance of the battery. *Id.* 1:49-60, 2:9-24, 2:39-52, 28:49-64.

² Patent Owner's expert provided a technology overview and a summary of the '131 Patent. Ex. 2015, § IV.A-B, ¶¶41-53; Ex. 2047 ¶¶18-19.

The inventors further discovered that by controlling the electrode compaction density ratio (D1/D2), the effects of the cathode and anode active materials are well exerted, so that the electrode can obtain good electrical conductivity, which is also important to control the expansion of electrochemical devices, resulting in high capacity density and excellent cycle and storage performances. *Id.* 20:65-21:20. Moreover, the '131 Patent describes a discovered synergistic effect between the combined electrolyte additives and the electrode compaction density ratio. *Id.* 31:49-57.

III. LEGAL STANDARDS

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

IV. LEVEL OF ORDINARY SKILL IN THE ART

For purposes of this POR, ATL adopts the definition proposed by Petitioner. Pet., 16; Ex. 2015 ¶¶54-56; Ex. 2047 ¶¶20-22.

V. CLAIM CONSTRUCTION

Petitioner contends that “[n]o claim terms require express construction.” Pet., 17. Petitioner further asserts that its own proffered construction of Claim 14—that an electrode having a current collector with both single- and double-sided coating portions satisfies Claim 14—is wrong. Paper 8, 3 (“The [] ’431 Petition challenges the claims under PO’s interpretation that both claims 1 and 14 correspond to Figure 4 while the ’722 Petition challenges only claims 14-17 under *the correct view* that these claims correspond to Figures 2 and 3”). Ex. 2047 ¶¶23-25. The failure of the Petition to render obvious the Challenged Claims is clear without construing any specific claim term or phrase and, as outlined below, Petitioner’s argument also fails with regard to Claims 14-17 under its own interpretation.

VI. ARGUMENT

A. Ground 1: Zeng and Sunose Do Not Render Obvious Claims 1, 2, 4-7, 12, 14, 15, and 17

Petitioner relies on Zeng for all elements of claims 1 and 14, except elements [1.5], [1.6], [14.5], and [14.6], for which Petitioner relies on Sunose. Pet. 28-40; Ex. 2015 ¶60. Zeng/Sunose fails.

1. Zeng and Sunose Do Not Render Obvious the Claimed *Y/Z* Ratio

Zeng never discloses the PP wt% (Z) used in its electrolyte solutions based on a *total weight of the electrolyte* or the critical claimed ratio of the wt% of trinitrile to PP (Y/Z). Importantly, Zeng provides a relative mass ratio of each solvent

component in a base solvent mixture but then adds other additives and an undefined amount of a lithium salt solution thereto. Ex. 1006 ¶[0037]; Ex. 2015 ¶¶93-95. But Zeng is unconcerned with the PP wt% based on a *total weight of the electrolyte* and with Y/Z. Ex. 2015 ¶¶64, 90-96. Given the critical nature of the claimed ratio, Zeng's lack of disclosure is *fatal*. See Section VI.A.1.b., *infra*.

Zeng provides insufficient information from which a POSITA could determine PP wt% or the claimed Y/Z ratio. *Id.* ¶95. Indeed, Zeng discloses three different concentration units for its various components without providing three different measurements—*total mass of the organic solvents*, *total weight of the electrolyte solution*, and *total volume of the lithium salt solution*—each of which are necessary for a POSITA to even consider, let alone calculate, a theoretical PP wt% based on the *total weight of the electrolyte solution*, and in turn, a ratio of trinitrile to PP. *Id.* ¶96.

Despite these clear shortcomings, Petitioner's argument relies solely on Dr. Lucht's unsupported and incorrect assumptions to purportedly reach an alleged Z, and in turn, an alleged (but undisclosed) Y/Z ratio. *Id.* ¶97. Indeed, one such error is Petitioner's assumption that Zeng's lithium salt is added in *solid* form, which error permeates and renders wrong every calculation, since the lithium salt is unmistakably added as a *liquid solution* as it is indisputably referred to as a solution

with the units of mol/L. Such flawed assumptions render Dr. Lucht's resulting calculations unreliable. *Id.* ¶¶98-106.

a. Dr. Lucht's Solid LiPF_6 Assumption is Wrong

Zeng's Embodiments rely on Embodiment 1's description, which recites "*then, lithium hexafluorophosphate of a concentration of 1.0 mol/L is slowly added to the mixed solution.*" Ex.1006 ¶¶[0037] (emphasis added), [0044]; Ex. 2015 ¶107; Ex. 2047 ¶29. The language of Zeng in the certified translation is clear and speaks for itself, and a POSITA would understand that LiPF_6 is added *in the form of a solution* (i.e., dissolved in a liquid) already having a molarity of 1.0 mol/L. Ex. 2047 ¶¶30, 33. Word choice matters, cannot be ignored, and the plain and ordinary meaning of the terms "of a concentration" and "mol/L" must control—and they necessarily require the existence of a *liquid* salt solution. *Id.* Crucially, Dr. Lucht admits that "[m]olarity is moles per liter," "[m]olarity is a measurement of something being dissolved into a liquid," "[a] solid salt would not have a molarity," and that "concentration of 1 mol/L" "is a context used in terms of liquid solutions and liquid electrolytes of lithium batteries."³ Ex. 2050 75:8-16, 83:6-20; *see also*, Ex. 2047 ¶33, n.21, Ex. 2045 (Dr. Lucht using molarity in his publication when

³ The Board confirms that whether Zeng says what Petitioner asserts it does is, at best, unclear—which is insufficient to meet Petitioner's burden. Paper 15, 28.

referring to solutions). Indeed, consistent with Dr. Lucht's testimony, the very definition of molarity or molar concentration is the number of moles of solute per liter of solution (Ex. 2049, p. 1401), which necessarily requires a mixture of more than one species. Ex. 2047, ¶33, n.21. Moreover, without additional volume information Zeng does not provide the POSITA with sufficient information to produce a mass fraction of the lithium salt in the total electrolyte solution, and therefore, a POSITA cannot determine the weight percentage (or mass fraction) of the non-additive constituents (i.e. salt and solvents) in the total electrolyte mixture. *Id.*, ¶33.

Despite this explicit recitation and faced with the reality that addition of an indeterminate volume of 1.0 mol/L lithium salt solution renders impossible any calculation of the PP wt% based on a *total weight of the electrolyte solution*, Petitioner and Dr. Lucht contort this description, asserting that “a POSITA would understand this to mean adding (solid) LiPF_6 to the specified...solvent mixture ***to reach*** a concentration of 1.0 mol/L LiPF_6 .” Pet. 21-22, n. 4 (citing Ex. 1003 ¶80) (emphasis added); Ex. 2015 ¶¶108-109. Such assumptions that (1) LiPF_6 is a solid, and (2) enough solid LiPF_6 is added to the solvent mixture to obtain a target 1.0 mol/L concentration of LiPF_6 in the final electrolyte solution, oppose and contradict the literal text set forth in Zeng, which expressly states that a liquid solution of LiPF_6 (which already has a concentration of 1.0 mol/L) is *slowly added to the mixed*

solution. Ex. 2015 ¶109. Essentially, Petitioner argues that Zeng’s literal disclosure is incorrect, indirectly implying the possibility of an error in their own certified translation, and argues that if Zeng had written something else, then *that* imagined disclosure would render obvious the Challenged Claims. Ex. 2047 ¶36. Indeed, when Petitioner attempted to argue the same interpretation of Zeng before a German patent court, that court sided with Patent Owner, holding that Zeng (NK5) lacks “[i]nformation on how to determine the wt-% for the individual components of the solvent and thus also for PP in the final electrolyte composition,” and “conversion of the mass fractions” “does not seem possible” using Zeng’s disclosure. Ex. 2004, 3-5.

Petitioner’s own evidence reinforces the clear meaning that Zeng’s LiPF_6 is added to the solvent mixture, not as a solid, *but as a salt solution already having a certain concentration*. Ex. 2015 ¶111; Ex. 1023 ¶¶[0237], [0245], [0255]; Ex. 1024 ¶[0048]; Ex. 1025 ¶¶[0090], [0100]. Moreover, the commercial distribution of “battery grade” 1.0 mol/L LiPF_6 premixed solutions was well known and a known way to achieve a desired electrolyte mixture for use in batteries. Ex. 2015 ¶110; Exs. 2017-2021; *see also*, Ex. 1003 ¶80, n.6.

Another patent application by the same applicant and two common Zeng inventors demonstrates that when the Zeng inventors intended to add lithium salt in *solid* form, they specifically indicated mixing the solvents in proportion and

dissolving the lithium salt in the recited solvent mixture, such that the concentration of the lithium salt in the organic solvent is 1.0 mol/L. Ex. 2022; Ex. 2015 ¶¶112; 2047 ¶¶34-36. Despite the clear difference in language, the Decision disagreed that Ex. 2022 “support[s] Dr. Wheeler’s interpretation of Zeng” and instead turned Ex. 2022 on its head, alleging that “Dr. Lucht’s interpretation of Zeng’s disclosure leads to information that a POSITA could have employed with confidence to produce Zeng’s Embodiments similar to Exhibit 2022.” Paper 15, 26-28. But, even if Exhibit 2022 was part of the ground at issue (which it is not), the test for obviousness is what the POSITA *would* have done—not *could* have done. Here, the explicit words of Zeng control. If the Zeng inventors had intended to disclose dissolving a *solid* salt into the liquid solvent mixture, they would have used wording or descriptions similar to Ex. 2022—but they chose not to because they instead *slowly added* a liquid solution of LiPF₆ (which already had a concentration of 1.0 mol/L) *to the mixed solution*. Ex. 2047 ¶¶34-36.

Petitioner’s concerns that adding such a premixed salt solution—as Zeng *does*—would “render[] the ultimate concentration of LiPF₆ and amounts of the

solvent components uncertain”⁴ and somehow “disrupt the carefully-crafted solvent and additive [wt%] central to Zeng’s invention” also ring hollow. Pet. 21-22, n. 4; Ex. 2015 ¶¶113-117. Indeed, in an about face to its argument here in Ground 1, Petitioner fails to address any such alleged “disruption of the carefully-crafted solvent...central to Zeng’s invention” in Grounds 2-4 and 6-8 when arguing that a POSITA would supposedly be led by Matsuoka and/or Kim to freely adjust the PP amount in Embodiments 4 and 6. Moreover, while there is insufficient information from which to determine the exact composition of the total electrolyte solution, if there were sufficient information, the POSITA would still not be motivated to alter the base solvent mixture of Zeng at least in view of the complexities and unpredictability of battery chemistry. Electrolyte components are subject to a complex matrix of requirements and tradeoffs and interactions such that successfully adding or removing components would require extensive experimentation. Ex. 2047 ¶33.

⁴ Because Zeng *does* teach using a premixed liquid salt solution, Petitioner admits it cannot ascertain the ultimate concentration of LiPF_6 and the claimed amounts of the solvent components and Dr. Lucht admits he did not provide any opinion or calculation on what the PP wt% would be if LiPF_6 was added as a premixed liquid salt solution (Ex. 2050 80:11-81:13), so Petitioner’s Zeng-based grounds fail.

Dr. Lucht purports to estimate an alleged upper limit PP wt% in each of Embodiments 4 and 6 based on this erroneous solid salt assumption. Ex. 1003, ¶¶80-84, 87-88; Ex. 2015 ¶¶98-105. The PP wt% and the Y/Z ratio in the final electrolyte solutions cannot be determined due to at least the unknown solvent components in the lithium salt solution and the unknown amount of lithium salt solution added. Ex. 2015 ¶¶105, 115-117. These unknowns render Dr. Lucht's estimates of the alleged PP wt% and, in turn, the back-calculated Y/Z values, incorrect. *Id.* ¶¶118-119.

b. The Y/Z Range is Critical

Zeng fails to render obvious claims 1 and 14 because the claimed Y/Z ranges are *critical* to providing the advantages of the '131 Patent and are not disclosed by Zeng. *E.I. du Pont de Nemours & Co. v. Synvina C.V.*, 904 F.3d 996, 1006 (Fed. Cir. 2018).

The '131 Patent explains that “using a mixture of a dinitrile compound, a trinitrile compound and [PP],” which includes such mixture in the *specific wt% ratio ranges* (Y/Z) claimed by the '131 Patent, was unexpectedly found to provide a firm, protective SEI film on the surface of the cathode that was not easily decomposed, and which could provide performance improvements by allowing a battery to operate at a high potential of 4.45V and having a “great effect” on reducing DC internal resistance, with a “better inhibition effect” within the Y/Z range of 0.01-0.3. Ex. 2015 ¶123; Ex. 1001, 1:55-62; 28:56-64. Seemingly determining that the '131

Patent refers only to “a mixture of a dinitrile compound, a trinitrile compound and [PP],” the Decision disagrees that the ’131 Patent states it is the “the specific [wt%] ratio ranges [that] unexpectedly were found to provide the benefits.” Paper 15, 38-39. However, it is such mixture of a dinitrile compound, a trinitrile compound, and PP that contributes to the stability of the protective film and Y/Z being “*within the range of 0.01-0.3*” is critical to achieving “*a better inhibition effect on the increase in DC internal resistance*”—which is a requirement of such stable structure of the composite protective film. Zeng fails to disclose or appreciate any such criticality of the claimed Y/Z value ranges or any advantages of the ’131 Patent that such narrow, specific Y/Z value ranges provide to the protective film. Ex. 2015 ¶¶120, 123-124, 127; *see also* Ex. 1001, 22:24-34, 1:43-62, 28:59-64, Table 2 (demonstrating a better inhibition effect on the increase in DC internal resistance after 400 cycles in (i) S2-2 compared to D2-3; and (ii) S2-5 compared to D2-4); Ex. 2047 ¶¶37-40. Accordingly, the ’131 Patent establishes the criticality of “about $0.01 \leq (Y/Z) \leq 0.3$ ”, such claimed range is not obvious in view of Zeng, and Petitioner fails to address or counter such criticality. *E.I. du Pont*, 904 F.3d at 1008.

2. Zeng and Sunose Do Not Render Obvious D1, D2, or D1/D2

Sunose does not disclose the claimed electrode compaction densities (D1, D2) or ratio (D1/D2) thereof.

a. Physically Impossible Density Values

Sunose's purported density values are *physically impossible* for electrodes using the LiCoO₂ (LCO) active materials identified, as such reported values far exceed even the 5.1 g/cm³ true or crystalline density of just the LCO active material of Sunose's electrode plates. Ex. 2047 ¶¶46-48; Ex. 2015 ¶¶71, 133-145; Exs. 2034-2037; Ex. 1010 ¶¶[0031], [0032], [0036], [0037], [0041], Table 1 ("active material density (M)" values of 5.7, 6.5, and 8 g/cc for the "single-side coated portion" of the positive electrode plates of Embodiment 1, Comparative Examples 2-3, respectively). Even Dr. Lucht admits that the compaction density of Sunose's composites should never exceed that of crystalline LCO. Ex. 2050 87:18-89:4; Ex. 2047 ¶51. He further admitted that many of Sunose's values seemed "high" for compaction density, and that Dr. Wheeler's calculations of the maximum possible compaction density were "reasonable." Ex. 2050 99:19-100:19, 111:3-21.

The density of the final coating (in units of mass per volume) of an electrode film is controlled by two factors: (1) crystalline density and relative amounts of components that make up the composite; and (2) porosity of the film. Ex. 2015 ¶136. With respect to (1), using a "rule of mixtures," material scientists routinely can estimate the density of a solid composite at zero porosity, representing the *theoretical upper bound* of density for a film made of a given combination. Porosity

of the film only scales the potential composite density *downward* from that theoretical maximum. *Id.*; Ex. 2050 109:5-110:3.

The positive electrode plates of Sunose were prepared using LCO and small amounts of carbon black and a binder, which are less dense than LCO. Ex. 2015 ¶137; Ex. 1010 ¶¶[0029]-[0037]. Sunose's positive electrode plates would have a theoretical maximum compaction density of 4.5 g/cm³. *Id.* ¶¶137-141; Exs. 2031, 2034-2039; Ex. 2050 111:3-21 (Dr. Lucht confirming Dr. Wheeler's calculations and resulting value are reasonable). Because this value is based on an electrode with a porosity of zero, Sunose's compaction densities would necessarily be less than 4.5 g/cm³. *Id.* ¶142. That is, any electrode compaction density of over 4.5 g/cm³ would be *impossible*. *Id.*; Ex. 2047 ¶48.

A POSITA also would have understood that electrode compaction density is calculated *after* the electrode has been compressed (i.e., constructed) and would involve measurements including weight and thickness. *Id.* ¶143; Ex. 2047 ¶55; Ex. 2050 98:19-99:9. Sunose discloses that the single-side active material portion of Comparative Example 3 broke during rolling (i.e., compression). Ex. 1010 [0040] ("could not undergo a bending test due to breakage"). Despite the fact that there would not be any "compacted" single-side active material layer left from which weight or thickness could be measured to determine density for Comparative Example 3 (due to such breakage), Comparative Example 3 purportedly has a

density of 8 g/cc for the single-side coated portion. *Id.* 8 g/cc corresponds to the density of solid steel, which is much denser than each of Sunose's constituent materials and thus, cannot possibly refer to an electrode compaction density value. Ex. 2015 ¶¶142, n.20, 143; Ex. 2047 ¶55. Moreover, Sunose's "active material layer weights" differ from coating weight or loading values for cathodes by a factor of roughly 10,000, revealing to the POSITA that the active material layer weights and density values of Sunose are clearly erroneous, a factor not addressed or even realized by Dr. Lucht in his analysis. *Id.* ¶153, Ex. 2047 ¶54; Ex. 2050 98:8-18 ("I don't think I noticed [that the SI unit was incorrect] as I was writing my declaration. It was a good catch by Dr. Wheeler."); Ex. 1010 ¶¶[0029]-[0030]. Indeed, Dr. Lucht never realized 5.7 g/cm³ was physically impossible to refer to a compaction density value using Sunose's materials. Ex. 2050 115:2-116:2.

Sunose's packing densities cannot be treated quantitatively the same as the electrode compaction densities of the '131 Patent, which are determined carefully from measurements of mass and volume. Ex. 2015 ¶144; Ex. 2047 ¶52. Even Dr. Lucht admits Sunose does not provide any indication of how its purported density values were determined, whether they were experimentally measured or somehow calculated (or miscalculated), or otherwise "prescribed" in error. Ex. 2050 119:2-7, 119:21-120:8, 144:13-145:1; Ex. 2047 ¶¶49-50; Ex. 1010 ¶¶[0008], [0010], [0015]. Sunose also fails to provide accurate "active material layer weights" or even disclose

thicknesses of the coatings. Ex. 1010 [0008], [0010], [0015]. Sunose does not present sufficient data to fully diagnose its mistakes.

Dr. Lucht's opinion that Embodiments 2-4 may "have active material densities that appear to be reasonable and correct" (Ex. 2050, 116:20-118:9, 119:10-14) necessarily fails as a POSITA would understand the physically impossible density values to be either the result of a *fundamental error* in Sunose's density methodology, or else must be a reference to some other physical characteristic that is *not* compaction density, such that a POSITA would discount the accuracy of all Sunose's purported densities and would know that they could not interpret *any* of the listed densities as corresponding to the claimed "electrode compaction density" of the '131 Patent. Ex. 2047 ¶¶50, 52, 56. Dr. Lucht admits that Sunose doesn't "specify how they measure the compaction densities" and he is not certain "how exactly [Sunose] determined the [active material density] value[s]," but tries to save face by asserting "as a POSITA[he] can [purportedly] look at the values and see what the active material densities are"—disregarding the fact that many are impossible. Ex. 2050, 144:13-146:6, 231:12-17; Ex. 2047 ¶¶50, 53. Worse, Dr. Lucht could not point to a substantive flaw in Dr. Wheeler's assumptions or equations or otherwise propose a scientifically valid alternative. Ex. 2050, 99:19-108:16, 111:3-21. Merely expressing uncertainty or vague confidence in Sunose is not satisfactory on this density question.

b. Sunose is not Enabled

A POSITA would also not find Sunose to be enabled for the purposes of preparing electrodes (*e.g.*, “For the density N, ‘*rolling was performed using a roll press machine* to obtain a density of the active material layer on the two-side coated portion,’ resulting in the density values N in the Examples. Likewise, for the density M, ‘a density of the active material on the single-side coated portion,’ resulting in the density values M of the Examples.”), and thus, would expressly reject its teachings when preparing electrode(s) for an electrochemical device. *See* Pet., 33-35. A POSITA would understand that Sunose offers no teaching to enable electrodes having electrode compaction densities or ratios thereof in the way taught and claimed by the ’131 Patent. Ex. 2047 ¶57.

Enablement requires teaching how to make and use the claimed invention without “undue experimentation.” *See In re Vaeck*, 947 F.2d 488, 496 (Fed. Cir. 1991); *see also Amgen Inc. v. Sanofi*, 143 S. Ct. 1243, 1254 (2023). Sunose purportedly sets forth the steps for forming an electrode plate in Embodiment 1 and each of the Embodiments and Comparative Examples necessarily rely on the disclosure of Embodiment 1. Ex. 1010 [0029]-[0037]; Ex. 2047 ¶58. Only Embodiment 1 sets forth purported “coating amounts” or “active material layer weights” that would be necessary for creating each respective single-sided coated portion of a positive electrode plate of the remaining examples. Ex. 1010 ¶¶[0029]-

[0037]. None of Embodiments 2-4 or Comparative Examples 2-3 identify to what “coating amount” the single-side coated portion is purportedly changed and Sunose provides no explanation of how Comparative Example 1 has a different density value than Embodiment 1 despite “rolling *without changing the coating amount* of the single-sided coated portion.” Ex. 1010 ¶¶[0029]-[0037] (emphasis added); Ex. 2047 ¶58; Ex. 1010 ¶[0016]. Even Dr. Lucht admits that the active material weights or “coating amounts” are not disclosed in Sunose. Ex. 2050, 121:19-122:17, 123:10-126:14, 129:15-131:5. It would be beyond the skill of the POSITA to be able to figure out how to prepare such positive electrode plates without undue experimentation.⁵

The *Wands* factors provide a guide in determining what constitutes undue experimentation but need not be applied rigidly in every case. *In re Wands*, 858 F.2d 731, 737 (Fed. Cir. 1988); *Liebel-Flarsheim Co. v. Medrad, Inc.*, 481 F.3d 1371, 1378-80 (Fed. Cir. 2007). At least *Wands* factors (1)-(7) are instructive here: (1) the quantity of experimentation or amount of effort and testing required to make and use

⁵ A POSITA also would not be able to simply just “vary the amount of material that you put on there” to obtain a different density than the physically impossible 5.7 g/cm³ density of Embodiment 1 as Dr. Lucht purports. Ex. 2050, 124:11-125:15; Ex. 2047 ¶58, n.26.

the electrodes of Sunose would be insurmountable in view of the missing and/or erroneous information as described *supra*; (2) Sunose fails to provide sufficient direction or guidance for how much “coating amount” or “active material layer weight” or even at what thickness a POSITA would apply to the respective single-sided coated portions of Embodiments 2-4 or Comparative Examples 2-3, and only supplies a “coating amount” for the single-sided coated portion of Embodiment 1 that is clearly erroneous and off by a factor of roughly 10,000; (3) a POSITA would not be able to replicate any of the examples of Sunose as Sunose fails to provide a single working example of an electrode with accurate or listed coating amounts AND physically possible compaction densities; (4) the nature of Sunose’s invention is clearly not electrodes having compaction densities and ratios thereof that meet the claims of the ’131 Patent; (5) the state of the prior art concerning electrode compaction density was not understood well enough to allow Sunose to omit such instructions; (6) the POSITA’s level of knowledge and experience in electrodes does not make up for the lack of teachings in Sunose; and (7) the predictability or unpredictability of electrodes also does not make up for the lack of teachings in Sunose. Ex. 2047 ¶59. With respect to factors (5) and (6), there are multiple methods of achieving a given compaction density that nevertheless will have differing effects on the porous structure and therefore on cell performance. *Id.* Sunose’s method has unique and unexpected aspects with respect to thickness, pressure, and density

control and Sunose's incomplete and erroneous descriptions cannot be overcome by an appeal to standard or expected operating procedures a POSITA could be expected to know. *Id.* With respect to factor (7), as confirmed by Dr. Wheeler, there is no single customary of expected value of thickness or of compaction density and they are part of the core cell design that must be disclosed in order to replicate or learn from Sunose. *Id.*

Although an individual reference need not be enabled for purposes of obviousness and "it qualifies as a prior art, regardless, for whatever is disclosed therein," *Amgen Inc. v. Hoechst Marion Roussel, Inc.*, 314 F.3d 1313, 1357 (Fed. Cir. 2003), in order to render a claimed apparatus obvious, the cited prior art still must, as a whole, enable one skilled in the art to make and use the apparatus that it allegedly renders obvious. *Beckham Instruments, Inc. v. LKB Produkter AB*, 892 F.2d 1547, 1551 (Fed. Cir. 1989). Here, as all examples rely on the non-enabling disclosure of Embodiment 1, Sunose fails to disclose an electrode compaction density of a single-side coated portion of a cathode that a POSITA would be able to obtain without undue experimentation. Sunose and all that it teaches fails to enable a POSITA to make and use the invention of the '131 Patent, which is required to render an invention unpatentable for obviousness. Ex. 2047 ¶60.

As such, none of the purported density values can be relied upon. Petitioner's sole reliance on Sunose for the compaction density-related limitations thus fails as

Sunose does not provide an enabling disclosure. *Raytheon Techs. Corp. v. Gen. Elec. Co.*, 993 F.3d 1374, 1380-81 (Fed. Cir. 2021). Petitioner presents no “other evidence to establish that a skilled artisan could have made the claimed [electrode] with the recited [compaction densities and ratio thereof].” *Id.*, 1381-82.

c. Sunose’s N/M Ratios Incommensurable with D1/D2

Dr. Lucht cannot opine that Sunose’s method of calculating the active material density ratio is correct and admits that “if any value in any published or patented thing is wrong, then if you try and calculate something from that number, then the number might not be correct either.” Ex. 2050, 119:21-120:8. As established herein, the methodology used by Sunose to purportedly determine density in all of its examples contained a *fundamental error* and/or *physical impossibility* such that none of Sunose’s packing densities (M and N), including those of Examples 2-4, can possibly correspond to the claimed electrode compaction densities and Sunose’s range of $0.7 < N/M < 1.0$, including the N/M ratios of Examples 2-4, therefore cannot be directly compared with the claimed D1/D2 ratio range as Sunose’s M and N densities are incommensurable with the claimed electrode compaction densities and claimed ratio thereof. *Id.* ¶144; Ex. 2047 ¶61.

d. The Claimed D1/D2 Range is Critical

Even if one were to assume that Dr. Lucht’s flawed assumptions regarding the “packing densities” of Sunose were reasonable and that those values did correspond

to electrode compaction densities, the '131 Patent explains that its specific electrode compaction ratio, including D1/D2 values of 0.8-1.2, has a *synergistic* effect between the combined electrolyte additives and the electrode compaction density ratio on the cycle performance. Ex. 1001, 31:53-57; Ex. 2015 ¶¶146-149. Sunose never mentions such criticality of the claimed D1/D2 value ranges, nor the advantages that such narrow, specific D1/D2 value ranges provide. *Id.* Sunose and the Petition provide no reason to select this narrow range.

The Decision's reliance on *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985), and assertion that "the asserted synergy between the claimed ratio and the electrolyte would be expected to flow from the combination of Sunose's Examples 2-4 with Zeng's electrolyte" is misplaced. Paper 15, 36. Under this flawed extension of *Obiaya*, **any** unexpected results or criticality identified by a patent's inventors—even if the prior art never appreciated those benefits—could be overcome if they are in fact true benefits. The Board presupposed that the asserted "synergy" would have been obvious, without any evidence demonstrating that a POSITA would have appreciated or expected synergy between the claimed ratio and the electrolyte.

3. A POSITA Would Not Combine Sunose with Zeng

Petitioner's assertion that "[a] POSITA reading Zeng would have looked to other references, like Sunose, for electrode structure and implementation details"

fails. Pet. 36-37. Indeed, Dr. Lucht’s purported “*need* to use some rolled electrode configuration in Zeng’s batteries” as some alleged basis for prompting a POSITA to adopt Sunose’s electrode configuration (Ex. 1003 ¶123 (emphasis added)) is non-existent and cannot arise from Zeng itself, and is also disingenuous as he separately advocated that a POSITA would use Zeng in a laminated (not rolled) electrode structure in his declaration in support of the petition in IPR2025-00722, in which the ’131 Patent was also at issue. IPR2025-00722, Ex. 1003 ¶¶112-113; Ex. 2015 ¶152; Ex. 2047 ¶¶41-44. Any such purported “need” for a POSITA to find implementation, especially the specific “need to use some rolled configuration,” is unfounded. Ex. 2047 ¶¶43 (a purported application is not enough as multitude of engineering and economic consideration go into design decisions”), 44. Nothing in Zeng requires or suggests using Zeng as a rolled electrode configuration, and the Petition contains no reason or justification for a POSITA to do so. Moreover, ensuring compatibility between electrode and electrolyte designs requires extensive testing and even minor changes to one may result in large changes to the other. *See e.g.*, Ex. 2047 ¶44; Ex. 2050, 62:18-64:5 (Dr. Lucht testifying that “typically you would do a whole bunch of testing” and that both small and large changes can result in large differences). Indeed, the surface chemistry and the design of compatibility of electrodes and electrolyte is so complex, one would not simply combine Zeng and Sunose without

a contrived, hindsight-driven motivation. Indeed, the combination of Sunose's electrodes may deteriorate the performance in Zeng.

Sunose and Zeng teach different remedies to entirely different problems in a complicated engineering system, so a POSITA would not combine them. *See e.g.*, Ex. 1006 (focused on a wide-temperature range homogenous non-aqueous electrolyte solution for increasing battery performance, which is a ***chemical*** solution); Ex. 1010, ¶¶[0007]-[0010], [0015]-[0018] (***mechanically*** trying to overcome documented shortcomings of Sunose's roller mill equipment); Ex. 2015 ¶¶150-151, 154, 157, 65-73. Sunose discloses a proposed mechanical solution to a manufacturing problem that is specific to the physical limitations of particular piece of roller mill equipment, such that a POSITA would find no benefit to apply Sunose's workarounds to generalized electrode compacting operations. Ex. 2015 ¶67. Moreover, a POSITA would not be motivated to utilize the non-enabled teachings of Sunose in preparing an electrode having electrode compaction densities or ratios thereof in the way taught and claimed by the '131 Patent. Section VI.A.2.b, *supra*.

Petitioner does not provide a sufficient motivation to combine Sunose with Zeng, and, thus, Ground 1 fails. Ex. 2015 ¶158; Ex. 2047 ¶62.

4. Dependent Claims

Claims 2, 4-7, 12, 15, and 17 are not unpatentable for the same reasons. Ex. 2015 ¶159; Ex. 2047 ¶63.

B. Ground 2: Zeng, Sunose, and Matsuoka Do Not Render Obvious Claims 1, 2, 4-7, 12, 15, and 17

For the same reasons as discussed *supra* at Section VI.A in Ground 1, Petitioner fails to establish that at least one Challenged Claim of Ground 2 is unpatentable in view of Zeng and Sunose and likewise fails with respect to the additionally cited Matsuoka. Ex. 2047 ¶64-65.

1. A POSITA Would Not Have Selected PP from Matsuoka's Numerous "Non-Nitrile Additives"

Matsuoka lists numerous non-nitrile additives with Lowest Unoccupied Molecular Orbital (LUMO) and Highest Occupied Molecular Orbital (HOMO) levels appropriate for use in its acetonitrile- and organic lithium salt-based electrolytes. Ex. 2015 ¶¶163, 176; Ex. 1007 ¶¶[0036], [0038]-[0040]). Yet, Petitioner leaps to the conclusion that "Matsuoka teaches two preferred weight proportion ranges for the non-nitrile additive (e.g., PP) in the total electrolyte" and "Matsuoka [] discloses *a [wt%] of the PP is Z*," simply purporting that "Matsuoka identifies benefits of PP as an electrolyte additive" and "lists PP isomers as having LUMO [] and HOMO [] energies falling in or near most-preferred ranges." Pet. 49-50. Petitioner omits that such PP isomers (i.e., n-propyl propionate and isopropyl

propionate) are contained in two lists of 75+ *other* potential “non-nitrile additive” components. Ex. 2015 ¶¶163-166; Ex. 1007 ¶¶[0038], [0040]. Petitioner’s alleged reliance on PP isomers having such energies “falling in or near most-preferred ranges” is of no consequence as nearly all of the additives in the LUMO list fall within the most-preferred LUMO ranges and a majority of the additives in the HOMO list fall within or near the most-preferred HOMO range. Ex. 2015 ¶165. Neither PP isomer is given special significance in Matsuoka, nor is the effect or benefit of such PP compounds clearly stated. Ex. 2015 ¶164; Ex. 1007 ¶¶[0038], [0040]. Indeed, each PP compound is merely listed as one of numerous possible compounds, but neither is tested for functionality. *Id.*; Ex. 1007 ¶[0108], Table 2. To further support the shortcomings of Petitioner’s ground, when considering a related European patent before a German patent court, the court opined that trinitriles are not relevant and PP is not a preferred non-nitrile additive, and thus, “the ratio of trinitrile compound to PP is also not of significance” in Matsuoka (NK9) Ex. 2005, 12. Matsuoka fails to provide any reason a POSITA would select PP among the numerous other “non-nitrile additives” in combination with the other references. Ex. 2015 ¶¶166-168.

The Decision’s assertion that Petitioner purportedly “relies on Zeng’s disclosure to include PP in the solvent, not Matsuoka, and alternatively relies on Matsuoka in addition to Zeng for an appropriate amount of PP” does not change this

result. Paper 15, 44. Petitioner fails to explain why the POSITA would selectively apply Matsuoka's teachings to PP and not also or instead rely on Matsuoka for an appropriate amount or modification of any of the other solvent components and additives present in Zeng Embodiments 4 and 6 that are also "non-nitrile additives" according to Matsuoka, including fluoroethylene carbonate (FEC), vinylene carbonate (VC), ethyl propionate (EP), 1,3-propane sultone (PS), and/or fluorobenzene (FB), each of which is also contained in Zeng's Embodiments 4 and 6. *Compare* Ex. 1007 [0038], [0040] *to* Ex. 1006 [0037], [0046], [0048]-[0049]. Indeed, any such alleged motivations with respect to PP would equally apply to at least FEC, VC, EP, PS, and/or FB in Zeng, if not more so to FEC, VC, and PS, each of which is used in numerous examples and/or disclosed with significance in Matsuoka. Ex. 2047 ¶70-77.

Even if the Board were to accept Petitioner's rationale for applying Matsuoka's non-nitrile additive ranges to Zeng (which the Board should not at least for the reasons set forth below in Section VI.B.3), such non-nitrile additive ranges would necessarily apply to the *aggregate* of such overlapping components in Zeng's Embodiments 4 and 6, not just PP as Petitioner implies in its hindsight-driven assumption. Ex. 2015 ¶169. Petitioner ignores significant features of the respective references and there would be numerous variables for the POSITA to adjust such that Matsuoka does not "explicitly disclose[] an appropriate amount of PP (Z)." *Id.*

A POSITA would understand Matsuoka to teach that its preferred non-nitrile additive ranges would apply to the **aggregate** of **all** non-nitrile components, not just one non-nitrile additive. *Id.*; Ex. 1007 ¶[0035] (“by a combined use of two or more ingredients...***preferably contains two or more of the non-nitrile additives.***”), ¶[0038] (“used singly or in combination of two or more”). Any argument that Matsuoka also teaches that non-nitrile additives may be used “singly” or that many of the electrolyte solutions (d) in Matsuoka only have a single additive does not change the fact that, in addition to the PP isomers, Matsuoka also identifies many of the other components present in Zeng’s Embodiments 4 and 6 as non-nitrile additives: FEC, VC, EP, PS, and/or FB. *Id.*; Ex. 1007 ¶¶[0038], [0040]. The presence of these overlapping components that Matsuoka identifies as non-nitrile additives could not be ignored by the POSITA when considering the applicability of Matsuoka’s preferred non-nitrile additive ranges to Zeng. Ex. 2015 ¶169.

Petitioner’s singling out of PP without any guidance in Zeng or Matsuoka to do so over **many** other compounds is textbook hindsight. *Sci. Plastic Prods. Inc. v. Biotage AB*, 766 F.3d 1355, 1359 (Fed. Cir. 2014). Nothing supports cherry-picking the disclosures this way. *Takeda Chem. Indus. v. Alphapharm Pty., Ltd.*, 492 F.3d 1350, 1356-1357 (Fed. Cir. 2007).

2. The Petition Fails to Show That Matsuoka Renders Obvious the Claimed Y/Z Range of Claims 1 and 14

Because Petitioner fails to show that Matsuoka renders obvious Z, Petitioner also fails to show that Matsuoka renders obvious the claimed Y/Z range, the criticality of which is established *supra* at Section VI.A.1.b. Ex. 2015 ¶¶167, 170-173. Petitioner’s hindsight-contrived purpose of PP purportedly keeping internal resistance low fail to appreciate that any such benefits are based on Matsuoka’s fundamentally different electrolyte system. *Id.* ¶¶174-177.

3. A POSITA Would Not Combine Matsuoka with Zeng and Sunose

Petitioner purports to cure, with Matsuoka, any deficiencies as a result of Zeng’s ambiguity “about adding LiPF_6 [of a certain concentration,] making the weight proportion of the solvent components in the electrolyte [] unclear.” Pet. 49. Petitioner asserts that “[t]o the extent Zeng’s recipe is hypothetically unclear about how much PP to use, that would have prompted the POSITA to consider Matsuoka’s teachings about appropriate amounts of PP to include in Zeng’s electrolytes,” in support of its allegation that there is some teaching, suggestion, or motivation to combine Matsuoka with Zeng. Pet. 52. Petitioner’s allegation that “any potential ambiguity can be dispelled by Matsuoka, which explicitly discloses an appropriate amount of PP (Z)” is nonsensical. Nothing in Zeng would instigate, prompt, or otherwise motivate a POSITA to even need to determine “an appropriate amount of

PP” based on a *total weight of the electrolyte* because Zeng already provides the POSITA with the necessary amount of PP to include in a relative mass ratio of the *base solvent mixture*. Ex. 2015 ¶¶160-162, 178. The PP wt% based on the *total weight of the electrolyte* is simply not a consideration nor relevant to Zeng and Zeng’s “recipe” is sufficient for its purpose—Zeng already provides the POSITA with the necessary amount of PP to include in a *relative mass ratio of the base solvent mixture* and Petitioner’s convoluted and hindsight-driven allegations do not change that fact. Ex. 2015 ¶¶162, 178. Therefore, there is no motivation to modify the amount of PP in Zeng’s electrolyte system. *See 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). Properly and objectively viewed, a POSITA reading Zeng would not have, without knowledge of the ’131 Patent, looked beyond Zeng in order to determine “an appropriate amount of PP” based on a *total weight of the electrolyte*.

This position that Zeng already provides the POSITA with the necessary amount of PP to include in a relative mass ratio of the base solvent mixture is *not* inconsistent with the position that “Zeng does not provide sufficient detail that would allow the POSITA to determine that Zeng discloses the claimed [wt%] of [PP] (Z),”

as purported by the Board. Paper 15, 44; Ex. 2047 ¶¶66-68. Zeng’s “recipe” is very clear about how much PP to use in its *base* solvent mixture—by specifying the mass ratio of PP to other solvent components in the base solvent. Ex. 2047 ¶69. The POSITA knows exactly how much PP to include at this stage. After making its base solvent mixture, however, Zeng is not concerned with, nor is a POSITA reading Zeng motivated to, even identify, or determine the PP wt% *based on a total weight of the electrolyte, i.e.,* after adding lithium salt and various additives. Zeng’s focus is *solely* on the mass ratio within the base solvent mixture, not on the final composition after all components are added. Absent using the ’131 Patent as a guide or otherwise contriving some purpose in hindsight, there is no reason why a POSITA would look beyond Zeng for “appropriate amounts of PP to include in Zeng’s [final] electrolytes” when Zeng is only concerned with, if at all, the specified mass ratio of PP in its *base solvent mixture*.

Petitioner argues that “the desire for balanced performance” would have motivated the combination with Matsuoka and that the POSITA would “have had a reasonable expectation of success.” Pet. 53. However, the electrolyte solutions of Zeng and Matsuoka are so fundamentally different and seek to solve issues in those different electrolyte systems in entirely different ways such that the POSITA would not be motivated to combine or have an expectation of success in any such combination. Ex. 2015 ¶¶178-191; Ex. 2042 at 249:3-7, 156:5-6; Ex. 2047 ¶78-82.

First, the electrolyte component “buckets” of Zeng and Matsuoka are not comparable, such that a POSITA would not consider comparisons or applicability of amounts or ranges between the references as having predictable results given the inherent unpredictability of the interactions of these components. Ex. 2015 ¶179. Matsuoka identifies at least PP, EP, and FB as “non-nitrile additives,” however, Zeng considers and accounts for at least PP, EP, and FB as *solvent* components in the initial solvent mass ratio. *Id.*; Ex. 1007 ¶¶[0038], [0040]; Ex. 1006 ¶[0037]. The significance of a reference identifying a component as either a solvent or additive is not inconsequential to the POSITA because it matters what role the component is serving. Ex. 2047 ¶82, n.30. Any argument that the solvents, lithium salt, and additives are simply added together in both references for use as electrolyte solutions is inapposite. To a POSITA, when a component is a “solvent,” its purpose is to serve as a host and allow ions to move around and when a component is an “additive,” it has a more specific purpose, such as forming a passivating film and a POSITA would not apply such alleged PP “non-nitrile additive” teachings of Matsuoka to the PP “solvent” component of Zeng. *Id.* Even Matsuoka does not apply its “non-nitrile additive” teachings to its solvent components. *See e.g.*, Ex. 2047 ¶82.

Indeed, Matsuoka’s preparation method teaches adding its additives, including the purported “non-nitrile additives,” *only after* forming a mother electrolyte solution of solvent(s) and lithium salt, and a POSITA would consider this

when considering how Matsuoka determines or applies its purported preferred mass % ranges of non-nitrile additives. Ex. 2047 ¶82; *see also*, Ex. 2050 35:16-36:7 (Dr. Lucht admitting that additives are something that is added to the primary electrolyte formulation). Although Petitioner need not demonstrate bodily incorporation of Matsuoka into Zeng, a prior art reference must be considered in its entirety, *i.e.*, as a whole, and Petitioner fails to provide any argument or evidence explaining *how* a POSITA would apply Matsuoka's non-nitrile additive teachings to Zeng in view of the different roles and preparation methods. Ex. 2047 ¶82. Moreover, regardless of how a PP is "adjusted" in Zeng, it would necessarily affect the "carefully-crafted solvent mass ratio" to which Dr. Lucht referred in support of his opinion in Ground 1 yet failed to consider with respect to Ground 2. Ex. 2047 ¶¶81-82.

Second, Matsuoka considers acetonitrile (a mononitrile) to not only be essential to its electrolyte solution, but the solitary or main solvent component. Ex. 2015 ¶180; Ex. 1007 ¶¶[0043], [0109], Tables 3-5. Zeng's Embodiments 4 and 6, on the other hand, do not include any mononitriles as a solvent or an additive. *Id.*; Ex. 1006 ¶¶[0045]-[0049]. A POSITA would consider the electrolyte systems of Zeng and Matsuoka to be fundamentally different and, as a result of such fundamental differences, a POSITA would not have any indication as to whether the preferred non-nitrile additive range described in Matsuoka as advantageous for an acetonitrile solvent-based electrolyte would have any positive effect on other electrolyte

solutions which do not contain acetonitrile as a solvent component, such as Zeng. *Id.* ¶181; Ex. 1007 ¶[0041] (“by adjusting the content of the non-nitrile additive in the above described range, ***the excellent performance of acetonitrile can be sufficiently exhibited*** without impairing a basic function as a non-aqueous secondary battery.”) (emphasis added). Matsuoka takes great pains to explain LUMO and HOMO energies and how ranges of same are used to select the non-nitrile additives. Ex. 1007 [0036]-[0040]; Ex. 2047 ¶89. The non-nitrile additives are selected in Matsuoka for their potential ability to be more reactive than acetonitrile and thereby form a protective film on the anode. Ex. 2047 ¶¶88-90. Therefore, Petitioner’s “desire for balanced performance” argument fails.

Third, Matsuoka also teaches away and otherwise dissuades the POSITA from the mixed solvent electrolyte systems of Zeng due to Zeng’s focus on lower discharge capacity at low temperatures compared to Matsuoka’s acetonitrile solvent-based electrolyte. Ex. 1007, Table 3, Table 9; Ex. 2015 ¶¶182-186. The Board’s assessment that the mixed solvent examples demonstrate better performance than the acetonitrile-only solvents at 25°C is inapposite. Paper 15, 47. Although Zeng is not drawn to low-temperature non-aqueous electrolyte solutions (Paper 15, 47), the Board overlooks the fact that stability of electrolyte solutions at -30°C is a major focus of Zeng. Ex. 1006 [0038] (describing a storage test conducted at -30°C with respect to its wide-temperature range homogenous non-aqueous electrolyte

solution). Indeed, a POSITA would consider the performance or stability at low temperatures to better distinguish electrolyte options in Zeng's established framework than any non-discriminating results at 25°C. Ex. 2047 ¶¶83-87. For Zeng, if an electrolyte solution fails or does not perform as well at low temperature, then that is sufficient enough evidence to remove that electrolyte from further consideration for its wide-temperature range electrolyte solution. *See e.g., id.*; Ex. 1006 [0045]-[0047].

Fourth, the lithium salt requirements used in the electrolyte systems of Zeng and Matsuoka are so materially different such that a POSITA would not be motivated to apply the teachings of Matsuoka to the electrolyte solvent of Zeng. Ex. 2015 ¶¶187-188; Ex. 1007 ¶[0014], [0029], [0030], Table 1. Indeed, Matsuoka teaches away from electrolyte solutions incorporating *only* inorganic lithium salt. Ex. 1007, Table 1, Table 3, Table 6; Ex. 2015 ¶189 (explaining that the organic lithium salt system of SL1 of Matsuoka's Example 1 had a much higher discharge capacity than the inorganic lithium salt system of the SL1 of Comparative Example 1). On the whole, Matsuoka requires at least acetonitrile and organic lithium salt. Ex. 1007 [0014]; Ex. 2050 162:15-20 (Dr. Lucht admitting that most of Matsuoka's embodiments, if not all of them, are organic lithium salts). To the extent that an inorganic lithium salt, such as LiPF_6 , is present in Matsuoka's electrolyte solutions, Matsuoka teaches that it cannot "impair the effect of SEI formation by the organic

lithium salt” and it cannot exceed the molar quantity of the organic lithium salt. Ex. 1007 [0031]-[0032] (if an inorganic lithium salt is present, it is preferable for the organic lithium salt to be present in a molar amount 1-20 times more than the inorganic lithium salt). Ex. 2047 ¶90. Accordingly, the lithium salts used in the electrolyte systems of Zeng and Matsuoka are so materially different such that a POSITA would not be motivated to apply the teachings of Matsuoka to Zeng and even if a POSITA were motivated to apply the teachings of Matsuoka to Zeng, the POSITA would also incorporate Matsuoka’s disclosure with respect to organic lithium salt and acetonitrile, materially altering the electrolyte system of Zeng and not arriving at the Challenged Claims. Although Petitioner need not demonstrate bodily incorporation of Matsuoka into Zeng, Matsuoka must be considered in its entirety, *i.e.*, as a whole, and Petitioner fails to provide any argument or evidence explaining *how* a POSITA would apply Matsuoka’s required acetonitrile and organic lithium salt teachings to Zeng. Nothing supports cherry-picking Matsuoka this way. *Takeda Chem. Indus. v. Alphapharm Pty., Ltd.*, 492 F.3d 1350, 1356-1357 (Fed. Cir. 2007).

Petitioner cannot establish that a POSITA *would have* combined Matsuoka with Zeng and Sunose in the proposed manner, which is needed for motivation to combine, thus, Ground 2 fails. Ex. 2015 ¶190; 2047 ¶91.

4. Dependent Claims

Claims 2, 4-7, 12, 15, and 17 are not unpatentable for the same reasons. Ex. 2015 ¶¶191; 2047 ¶¶92.

C. Grounds 3 and 4: Zeng, Sunose, and Kim, with or without Matsuoka, Do Not Render Obvious Claims 1, 2, 4-7, 12, 14, 15, and 17

For the reasons as discussed *supra* at Sections VI.A and VI.B with respect to Grounds 1-2, Petitioner also fails with respect to Grounds 3 and 4. Ex. 2015 ¶¶193-194. Petitioner further fails to establish that at least one challenged claim of Grounds 3 and 4 is unpatentable in further view of Kim. *Id.* ¶192.

Petitioner purports to cure, with Kim, the deficiencies in Zeng or Zeng/Matsuoka, as a result of “Elements [1.7] and [14.7] requir[ing] specific focus on *Y/Z* (the ratio of trinitrile to PP) and criticiz[ing] Zeng and Matsuoka for not highlighting the ratio of HTC_N to PP, specifically.” Pet. 55. Petitioner’s arguments based on Kim necessarily fail. Ex. 2047 ¶¶93-94.

1. The Petition Fails to Show That a POSITA Would Have Been Motivated to Combine Kim with Zeng or Zeng/Matsuoka and Sunose

Contrary to the Board’s holding that “Petitioner identifies motivations to combine Kim with Zeng to adjust the relative amounts of trinitrile and PP” ((Paper 15, 56) (citing Pet. 56, 60)), Petitioner *never makes any motivation to combine argument at all* for Grounds 3 and 4 and never evaluates reasonable expectation of

success and, thus fails to make out a *prima facie* case of obviousness to combine Kim with the other references. Paper 15, 56 (nakedly asserting, without citation, that “Kim . . . motivates adjusting relative amounts of these two components (i.e., Y/Z) to improve performance”). Petitioner’s argument with respect to Kim at Pet. 55-60 is devoid of any rationale to support a motivation to combine, such as any assertion of yielding predictable results, obvious to try, or some teaching, suggestion, or motivation. Indeed, Petitioner’s failure to provide such an argument is fatal to this Ground and others depending on Kim. *L.A. Biomedical Rsch. Inst. at Harbor-UCLA Med. Ctr. v. Eli Lilly and Co.*, 849 F.3d 1049, 1064 (Fed. Cir. 2017) (citations omitted). Identifying the results of a proposed combination is not the same as providing a *prima facie* reason to make the combination.

Regardless, Petitioner mischaracterizes Kim’s measurements and teachings and fails to demonstrate that a POSITA would apply any discerned teachings. Ex. 2015 ¶¶195-214; 2047 ¶¶95-99. To infer anything from Kim, a POSITA must examine Kim as a whole, including the experiments on which the disclosure is based. This is difficult, if not impossible, because Kim is woefully inadequate on experimental procedure details and the POSITA would need to depend on Kim for how to understand and therefore interpret Kim’s capacity and thickness measurements. Ex. 2015 ¶196; Ex. 1008, Tables 2, 3, FIGS. 3-7.

First, Kim does not specify how its “capacity” values are measured. Ex. 2015 ¶¶197-199. Depending on the intended application, many different tests can be used to measure capacity and cycling. *Id.* Likewise, Kim does not provide sufficient information regarding its “thickness” values from which a POSITA could make reasonable inferences. *Id.*

Second, Kim’s data shows, but Kim does not discuss, that its capacity results are highly dependent on cell format. Ex. 2015 ¶¶199-200; Ex. 1008 [0095], [0099], Tables 2-3. A POSITA would not be confident in the individual measurements due to their manifest differences by cell format and could not infer or make any conclusory judgements about the purported efficacy embodied in Examples 1 and 2 compared to Comparative Examples, because such comparisons cannot be reliably made, as acknowledged by Dr. Lucht. *Id.*; Ex. 2047 ¶99; Ex. 2046.⁶

Third, Kim’s disclosure with respect to linear sweep voltammetry contradicts itself. Ex. 1008 ¶¶[0099]-[0100], Table 3; Ex. 2015 ¶201. Because of the vertical scale used in Kim’s FIG. 2, a POSITA cannot determine the stability/currents for Examples and Comparative Examples at more realistic potentials, i.e. around 4.4V

⁶ Ex. 2046, 10 (Dr. Lucht’s publication indicating “caution should be taken in comparing the performance [of low-temperature electrolytes] since the results from different chemistry and cell designs are not comparable.”)

and, contrary to Kim's assertion that Examples 1 and 2 are the most stable (Ex. 1008 ¶¶0094), Comparative Examples 1 and 2 actually have lower oxidation currents than Examples 1 and 2 at potential 6.5V, which is certainly a "higher voltage." Ex. 2015 ¶202, Ex. 1008 FIG. 2.

Fourth, regarding Kim's life cycle measurements, Kim lacks any information on *how* its battery cell was cycled, which is particularly relevant as even small differences in operating voltages can have significant effects on battery life which would prevent a POSITA from combining the teachings of Kim with Zeng or Zeng/Matsuoka with any reasonable expectation of success (even though Petitioner fails to allege such an expectation). Ex. 2015 ¶203; Ex. 1008 ¶¶[0055]-[0056]). Moreover, even if Kim provided information regarding how its battery cell was cycled, Kim's summary of cycle life in Table 4 is inconsistent with the cycle life data presented in FIG. 7:

FIG. 7

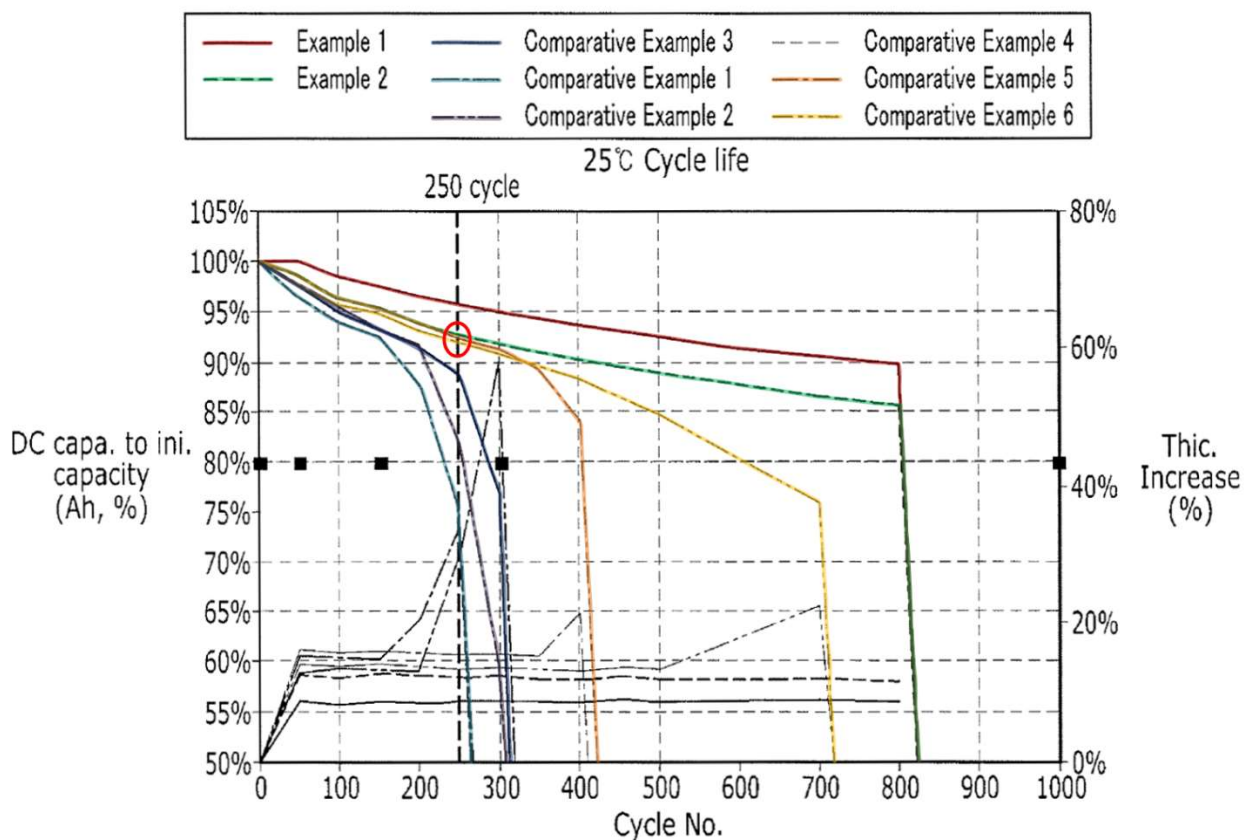


TABLE 4

	initial capacity [mAh]	Capacity after 250 cycles [mAh]	Capacity retention	Initial thickness [mm]	Thickness after 250 cycles [mm]	Thickness variation ratio
Example 1	2112	2021	95.7%	3.32	3.61	8.7%
Example 2	2109	1956	92.7%	3.30	3.60	9.2%
Comparative Example 1	2040	1532	75.1%	3.27	4.39	34.4%
Comparative Example 2	2099	1720	82.0%	3.25	4.23	30.2%
Comparative Example 3	2061	1895	92.0%	3.28	3.73	13.6%
Comparative Example 4	2105	1870	88.9%	3.29	3.71	12.8%
Comparative Example 5	2122	1608	75.8%	3.26	3.78	15.7%
Comparative Example 6	2060	1551	75.3%	3.28	3.73	13.6%

Ex. 2015 ¶¶204-206 (noting significant discrepancies in capacity retention values for at least Comparative Examples 3-6); Ex. 1008, Table 4 (annotated above), FIG. 7 (annotated above); Ex. 2047 ¶98, *see also, id.*, n.36. To summarize, there are notable unexplained discrepancies between Figure 7 and Table 4's capacity retention values, which would prevent a POSITA from inferring anything from Kim with any level of confidence, and would ultimately deter the POSITA from relying on or applying any teachings from Kim, particularly those related to cycle performance. *Id.*

Fifth, Kim's Examples 1 and 2 would not motivate a POSITA to adjust the relative amounts of PP and a trinitrile as Petitioner claims. Ex. 2015 ¶206. A POSITA would note that Example 2 is inferior to Example 1 in Kim's only data on cell cycle life, as shown in Table 4 and FIG. 7. A POSITA seeking to maximize cycle life (as Zeng seeks to do) would be taught by Kim, if anything, to consider Example 1's superior composition over Example 2's inferior composition requiring substitution of a portion of the PP and PC solvent fractions used in Example 2 with a substantial EP solvent fraction used in Example 1. *Id.* Thus, at best, Kim would deter a POSITA seeking to improve cell cycle life from using an even higher fraction of PP and would draw the POSITA's attention, if any, to the ratio of PP to EP (rather than PP to HTCEN as asserted by Petitioner). *Id.*; Pet. 59. Indeed, had Kim intended to connect any comparison of PP to HTCEN, Kim would have aligned their proportion

bases rather than express PP in volume percentage in the solvents and HTCIN in wt% in the total electrolyte.

Sixth, Petitioner fails to address the fact that Examples 1 and 2 of Kim are devoid of diethyl carbonate (DEC). Ex. 1008, Table 1; Ex. 1003 ¶¶182-196. Kim does not disclose, nor does Dr. Lucht address, the effect DEC has on the examples of Kim, such as the inference that the presence of DEC in such a large volume % in Comparative Examples 1 and 2 may also be affecting the performance thereof. Accordingly, Kim would teach a POSITA to remove DEC from Zeng's solvent mixture, which would affect Zeng's carefully-crafted solvent ratio. Ex. 2047 ¶¶96-97; Ex. 2046 at 7; Ex. 2042 at 249:3-7, 156:5-6.

Seventh, Petitioner's assertion that "Kim's Examples also highlight the superiority of PP" is based on a comparison of Example 2 to Comparative Examples 5 and 6. However, considering the data presented in Figure 7 of Kim, Example 2 is just as successful as Comparative Examples 5 and 6. Ex. 1008 (FIG. 7 depicting 92.7%, 92.5%, and 92.3%, respectively); Ex. 2047 ¶98. Nothing in Kim indicates a preference for (much less mandates) the presence of PP, and other alkyl propionates are disclosed. Ex. 1008 ¶¶[0013]-[0014] ("C3 to C5 alkyl propionate"), [0040]-[0041]; Ex. 2015 ¶207. A POSITA reviewing Kim could not make any inference about the efficacy of various alkyl propionates and at best would see a suggestion

from Example 1 that substituting C3 alkyl propionate (PP) with C2 alkyl propionate (EP) could be beneficial. *Id.*

Eighth, Kim also fails to provide a POSITA with any guidance with respect to a wt% ratio of a trinitrile compound to PP based on a *total weight of the electrolyte* and no information from Kim would enable a POSITA to convert the volume percentages mentioned therein into weight percentages. *Id.* ¶¶208-209; Ex. 2040; Ex. 1008 ¶¶[0013], Table 1. A POSITA would not be motivated to turn to Kim from Zeng at least because Zeng's solvents are set forth in a relative mass ratio and Kim only discloses its solvents in volume percentages. *Id.*

There is little variation of dinitrile and trinitrile amounts and no experimentation in Kim to suggest to a POSITA that there should be a preferred or critical range of values for the ratio of dinitrile (X) and trinitrile (Y) compounds, and Petitioner and Dr. Lucht fail to provide any motivation to modify Kim or Zeng to arrive at the claimed values or ranges. Ex. 2015 ¶210; Ex. 1008, Table 1.

Petitioner does not provide ***any*** motivation to combine Kim with Zeng/Sunose or Zeng/Matsuoka/Sunose. Grounds 3-4 fail.

2. Dependent Claims

Claims 2, 4-7, 12, 15, and 17 are not unpatentable over Zeng, Sunose, and Kim, with or without Matsuoka, for at least the reasons discussed with respect to claims 1 and 14. Ex. 2015 ¶215; Ex. 2047 ¶100.

D. Grounds 5-8

The deficiencies discussed with respect to Zeng and Sunose in combination with Matsuoka and/or Kim in Grounds 1-4 apply equally to Grounds 5-8 and Su does not cure such deficiencies. Petitioner fails to establish that Claims 3 and 16 are unpatentable. Ex. 2015 ¶¶216-219; Ex. 2047 ¶¶102-104.

Grounds 5-8, addressing dependent claims wherein the electrode is an anode and wherein Petitioner additionally relies on Su for purportedly disclosing the claimed electrode compaction density of the double-sided coating—“ $1.2 \text{ g/cm}^3 \leq D2 \leq 1.8 \text{ g/cm}^3$ ”—of such anode, also fails. Ex. 2047 ¶102. Dependent claims 3 and 16 inherit all limitations of the independent claim from which they depend, including the requirement that “the electrode” also meet the inherited $D1/D2$ formula. When read together with the limitations of claim 1, claim 3 (underlined) requires: wherein the electrode is an anode, wherein, about $0.8 \leq D1/D2 \leq \text{about } 1.2$ and $1.2 \text{ g/cm}^3 \leq D2 \leq 1.8 \text{ g/cm}^3$. Ex. 2047 ¶¶105 (depicting Claim 3 with all of its inherited limitations), 106. Petitioner never identifies an “anode” that meets both about $0.8 \leq D1/D2 \leq \text{about } 1.2$ and $1.2 \text{ g/cm}^3 \leq D2 \leq 1.8 \text{ g/cm}^3$. Ex. 2047 ¶107; Pet., 44-48; Ex. 1003 ¶¶115-119, 152-155.

Because claim 3 defines “the electrode” as an “anode,” it is insufficient for Petitioner to continue to rely on the cathode of Sunose to meet the $D1/D2$ formula (“about $0.8 \leq D1/D2 \leq \text{about } 1.2$ ”) as it did in claim 1. When faced with the narrower

limitation of claim 3, Petitioner fails to show that the anode of Su meets both of the required formulas. Ex. 2047 ¶¶108-109; Ex. 1003 ¶¶152-155; Pet., 44-48. Nor does Petitioner argue that Sunose's cathode is modified by Su to become an anode that meets both formulas. Ex. 2047 ¶¶110-112; Ex. 1003 ¶¶153, 157. Petitioner does not provide a separate analysis with respect to claim 16, equating Claims 1 and 14. Pet. 43-48; Ex. 2047 ¶¶113-114. Because Petitioner cannot fix its absence of argument, Petitioner forfeits any challenge of Claims 3 and 16. Ex. 2047 ¶¶115-121.

E. Ground 9: Zhou and Sunose Do Not Render Obvious Claims 1, 2, 4-7, 12, 14, 15, and 17

Petitioner alleges that Zhou and Sunose render obvious Challenged Claims 1, 2, 4-7, 12, 14, 15, and 17. Pet. 60; Ex. 2015 ¶¶236-240; Ex. 2047 ¶¶122-123. However, Zhou and Sunose fail to teach, suggest, disclose, or otherwise render obvious at least the claimed electrode compaction density ratio and the trinitrile to PP (Y/Z) ratio. Ex. 2015 ¶¶220-235; Ex. 2047 ¶124.

1. A POSITA Would Not Select or Implement Zhou in General

Zhou is fundamentally different from the '131 Patent and the electrolyte formulation purposes in Zhou are not aligned with the objective task underlying the '131 Patent. Ex. 2015 ¶¶241-242; Ex. 1001, 1:30-39, 1:55-62, 3:8-20, 22:24-29. Although a POSITA need not see the identical problem of the invention addressed in a prior art reference, it is important that Zhou is not analogous art to the '131

Patent because it is directed to batteries with a lower charging voltage of only 4.35V, which a POSITA would know is substantially different from and much lower than the high working voltages (e.g., above 4.4V, such as 4.45V). *Id.* ¶¶243-245; Ex. 1014 ¶[0003]. 4.35V is also considered the extreme upper voltage limit for commercially produced cells employing LCO, meaning that any operation over short or long periods of time above this voltage limit would substantially impair the life of the battery. *Id.* 4.45V, as disclosed in the '131 Patent, would be well outside the conventional operating limit for both cell safety and longevity. *Id.* A POSITA would also find Zhou's AC impedance testing/focus different from the DC internal resistance of the '131 Patent. Ex. 2015 ¶¶246-247.

2. A POSITA Would Not Select or Implement Zhou's Example 8

Petitioner fails to provide sufficient rationale for implementing Zhou's Example 8. Ex. 2015 ¶261.

First, Petitioner relies on Dr. Lucht's wrong assumption that Example 8 outperforms all other example batteries depicted in FIG. 4 of Zhou based on his misunderstanding of kinetic performance data depicted by AC impedance spectra. Ex. 2015 ¶¶249-253. In particular, Dr. Lucht indicates that Example 8 "outperformed four other Examples on low impedance" and specifically, "outperformed Examples 1, 2, 4, and 6 in internal impedance." Ex. 1003 ¶¶209, 212;

Ex. 2015 ¶249. Petitioner's interpretations of FIG. 4 of Zhou (reproduced below) are wrong and the Decision overlooked this major shortcoming:

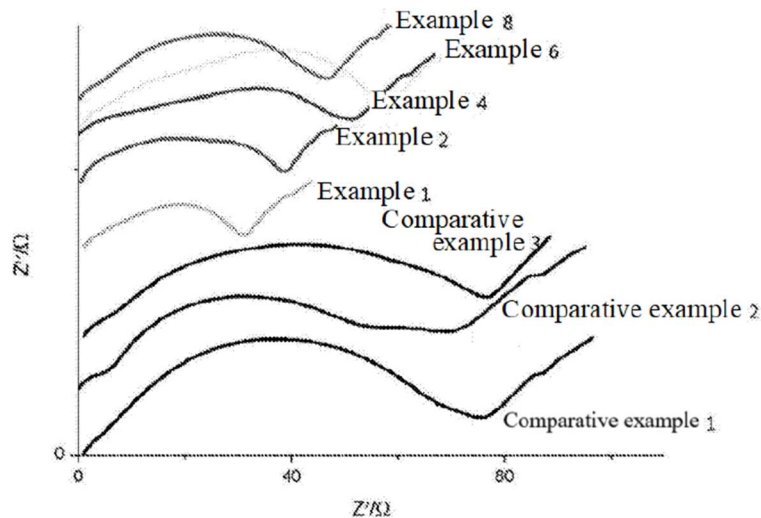


FIG. 4

Ex. 1014, FIG. 4; Ex. 2015 ¶¶249-250.

FIG. 4 of Zhou is a Nyquist plot and a common way of presenting AC impedance data. Ex. 2015 ¶251. Dr. Lucht wrongly assumed that Example 8 outperformed all of the other batteries depicted in FIG. 4 simply because it is positioned at the *top* of the figure. *Id.* However, the results for each of the different Examples 1, 2, 4, 6, and 8 and Comparative Examples 1-3 are only stacked vertically so that the depicted spectra do not overlap for easier viewing by the reader. *Id.* The key value in such a Nyquist plot is not the vertical placement of a spectrum, but rather the *horizontal position of the elbow or sharp dip* of the spectrum, with the elbow or sharp dip located further to the left being preferable as it indicates lower

“real” impedance for the electrode interface. *Id.* ¶¶252-253; Ex. 2023, FIG. 4 (reflecting “[s]*tacked* Nyquist plots of [solid-state batteries]...during (a) the charge and (b) the discharge process”).

Indeed, with respect to FIG. 4, Zhou specifically provides “that the *corresponding semicircle in the AC impedance curve can characterize the impedance behavior* of lithium-ions in the SEI film. *The larger the radius of the arc, the worse the kinetic performance, and the smaller the radius, the better the kinetic performance of the battery.*” Ex. 1014 ¶[0058] (emphasis added); Ex. 2015 ¶251. Because the radius of each of Example 1 and 2 is smaller (i.e., the elbow or sharp dip is positioned further left) than the radius of Example 8 (i.e., the elbow or sharp dip is positioned further right), Dr. Lucht has misinterpreted these results—Examples 1 and 2 both *outperformed* Example 8 with respect to AC internal impedance, by a wide margin. Ex. 2015 ¶253. A POSITA implementing Zhou in combination with other references would have no reason to use Zhou’s inferior Example 8.

Second, FIG. 3 of Zhou is the only figure that purports to depict battery cycle performance at high temperatures and Zhou indicates that 1,3,6-hexane trinitrile is particularly preferred to improve high temperature performance. Ex. 2015 ¶¶254-257; Ex. 1014 ¶¶[0023], [0024], [0049], [0050], [0059], [0063], FIGS. 1-4. Petitioner fails to address the fact that the electrolyte solutions of Examples 4 and 8

of Zhou are the only examples that include a trinitrile (1,3,6-hexane trinitrile), yet, significantly, *neither Example 4 nor Example 8 is depicted in FIG. 3*, such that a POSITA would not be able to infer or draw any conclusions therefrom with respect to the effect of a trinitrile on high temperature performance or otherwise select or implement Example 8 over any other Examples. Ex. 2015 ¶257. As such, Petitioner's assertion that "[t]he tests showed 'an efficient high temperature additive,' such as 'nitrile compounds containing 2 or 3 nitrile functional groups,' compensates for the fact that 'the high temperature performance is often challenged when using a fast charging solvent system'" (Pet. 66) fails to support any alleged "reasonable expectation of success" for implementing Example 8 because neither Example 8 nor a trinitrile were included in such high temperature performance testing. *Id.*; Ex. 1014 FIG. 3.

Third, Zhou dissuades, if not teaches away from, the combination of dinitriles and trinitriles in its electrolyte solutions because dinitriles contain less nitrile groups for the same volume. Ex. 1014 ¶¶ [0046]-[0047], [0059]. The Board's holding that "Zhou seems to encourage use of HTC�, the trinitrile used in Example 8" (Paper 15, 70) overlooks the fact that from Zhou's disclosures, a POSITA would determine that there is no indication that there is benefit to having a *mixture* of trinitrile and dinitrile (so as to avoid excessive nitrile and density concerns). Ex. 2047 ¶¶136-137,

A POSITA would not have selected or implemented Example 8 because it contains both a dinitrile and a trinitrile. Ex. 2015 ¶ 258.

Finally, the POSITA would perceive an error in the solvent composition of Example 8 as the sum of the mass ratio of the solvent components in Example 8 ***only adds up to 90***, while the mass ratios of all other Examples' and Comparative Examples' components add up to 100, dissuading the POSITA from implementing Example 8. Ex. 2015 ¶260; *compare* Ex. 1014 ¶¶[0046]-[0047] ("Example 8...mass ratio of 25:30:10:20:5) with Ex. 1014 ¶¶[0032]-[0033] ("Example 1...mass ratio of 25:35:20:20"). Petitioner never addresses this discrepancy, and such discrepancy is only exacerbated by Dr. Lucht's further unjustified assumption in his declaration that such mass ratio directly corresponds to wt% of the identified solvent components. *Id.*; Ex. 1003 ¶203 (equating each solvent component relative mass ratio of 25:30:10:20:5 in Example 8 to ***weight percentages*** of 25, 30, 10, 20, and 5 wt%). Dr. Lucht attempted to correct this error during his deposition, testifying that he "mistakenly used the percent signs...however, the calculations that I do in paragraph 207 are correct." Ex. 2050 177:20-180:20. A POSITA would have disregarded Example 8 at least based on this mass ratio/weight discrepancy, in addition to its inferior results. *Id.*

3. A POSITA Would Not Substitute PP for Ethyl Acetate

Even though *none* of the examples in Zhou include PP, Petitioner relies on Dr. Lucht's unsupported assumption that a POSITA would have substituted PP for ethyl acetate ("EA") in Example 8. For at least the following reasons, a POSITA would not have substituted PP for EA. Ex. 2015 ¶266; Ex. 2047 ¶¶127-135.

First, there is no preference or indication to select PP since PP is not used in any of the Comparative Examples or Examples or otherwise tested for its functionality. Ex. 1014 ¶¶[0026]-[0048], [0052]-[0055]; Ex. 2015 ¶267. The chemical interactions and effects of combinations of various compounds in electrolyte solutions are complex and unpredictable, and a POSITA would not expect predictable results from adding PP in the place of EA. *Id.*; *see also e.g.*, Ex. 2046, pp. 5-6, 9-10.

Second, even though Zhou lists PP alongside EA in a list of eight linear carboxylic acid esters, the POSITA would not "likewise expect PP to have the properties necessary to succeed in Zhou's electrolytes," as asserted by Petitioner. Ex. 2015 ¶268. A POSITA seeking higher electrolyte conductivity as Zhou would not have had a reasonable expectation of success in replacing PP for EA in Zhou's Example 8, nor would the POSITA obtain predictable results in such a substitution. PP is a larger molecule, and such substitution would increase both the melting point and the boiling point relative to the smaller EA molecule, which defeats Zhou's

identified purpose of using this solvent component. *Id.* ¶¶272-273. Having both a low melting point and a low boiling point correlates to lower viscosity, which allows lithium ions to move more quickly, i.e., “providing a more suitable channel for lithium-ion transmission and reducing the impedance of the battery system.” Ex. 2015 ¶270. PP’s boiling point is considerably higher than any other solvent in Table 1 of Zhou that is used in Examples 1-8,⁷ its melting point is also nearly 10°C higher than the melting point of EA (-84°C), and its viscosity is also 53% higher than the viscosity of EA (0.45 mPa/s at 20°C). *Id.* ¶¶269-271; Ex. 2024. Petitioner’s assumption that the PP would be substituted at a 1:1 wt% ratio, without accounting for markedly different characteristics (e.g., boiling point, viscosity, molecule size, molar mass, etc.) that defeat Zhou’s identified purpose severely undercuts the reliability of Dr. Lucht’s opinions. *Id.* ¶275; Ex. 2047 ¶130.

Finally, Petitioner fails to account for the fact that chemical reactions in a battery are unpredictable. *Id.* ¶274. All components of an electrolyte are important and interact in complex and unexpected ways; substituting one component for another, even if apparently chemically similar, can cause substantial changes to properties of interest. *Id.* Indeed, even Dr. Lucht admits the complexity of battery

⁷ “Butyl butyrate” appears to be listed in Table 1 of Zhou in error. *See* Ex. 2015 ¶ 270, n.28; Ex. 1014, ¶¶ [0011], [0026]-[0048], Table 1.

chemistry and how even small changes can have large impacts, yet blindly ignores such considerations here. Ex. 2050 57:20-59:5 (“electrolyte formulations are very complex, yes.”), 223:1-4 (“yes, [lithium-ion batteries] are very complex systems.”), 223:12-224:1 (“Q. ...perfecting the amounts of additives in solvents is not an exact or straightforward science, correct? A. I mean that is a -- that is what we do the research in, yes.”). Indeed, when Dr. Lucht was the expert for a patent owner in a separate battery case, he argued that “[l]ithium batteries are very, very sensitive to very small changes” (Ex. 2042 at 155:16-156:7) and “I mean, these -- these battery electrolyte systems are very complex. Whenever you change one thing, it can change a lot of other things.” *Id.*, 248:20-249:1; 249:2-14 (“I don't think I could say that [electrolytes with certain solvents offer superior benefits to electrolytes with a different solvent] about much of any electrolyte additive.”), 250:3-7 (“Electrolytes for lithium-ion batteries are extremely complicated. Making a general blanket statement about anything that A is always going to be better than B is not something that's a very easy statement to say.”).

A POSITA grasping the complexities and unpredictable nature of battery chemistry would understand that, just because two molecules share a functional group, does not mean that they can be used interchangeably without impacting performance. Ex. 2015 ¶274; Ex. 2047 ¶¶127-129; Ex. 2042 at 155:16-156:7, 248:20-249:1, 250:3-7; Ex. 2046 at 5-6, 9, 10; Ex. 2048 (describing that although

EC and PC differ by only one methyl substituent, EC “forms almost ideal interphases on the graphitic anode,” while PC “does not form any protective interphase, leading to catastrophic exfoliation of the graphitic structure.”); Ex. 2043 ¶¶67-69 (Dr. Lucht declaration on behalf of a patent owner in another IPR proceeding indicating that even though materials are same can have different properties in different ratios); Ex. 2050 225:1-229:2. Indeed, a component may promote one desirable property and simultaneously inhibit another desirable property. Ex. 2015 ¶274 (discussing similarity of structures of EC and PC, but rejection of PC for nearly 30 years because it cannot form a good SEI film on the surface of the carbon negative electrode, despite it having other desirable electrolyte properties). That PP and EA are linear carboxylic acid esters is not enough to justify their substitution. Dr. Lucht’s opinion that “PP is structurally similar to EA, having two additional methyl groups” such that it “renders obvious substituting PP for EA in Example 8, with a reasonable expectation of success” (Pet. 67; Ex. 1003 ¶220) is a blind oversimplification of battery chemistry. Even if a POSITA were to consider the structures of EA and PP to be similar, these “similar structures” result in markedly different physical properties. Ex. 2047 ¶130.

Notwithstanding the fact that the complex and unpredictable nature of battery chemistry would deter a POSITA from selecting certain molecules based solely on their structure or physical properties, the POSITA would also understand that, at

least because EA and PP have such different physical properties, they cannot be simply swapped out for one another without impacting the performance of the resultant battery. Ex. 2047 ¶131; Ex. 2046. Kim illustrates this inability to substitute molecules simply because they have “similar structures.” EP and PP only differ by one methyl group, yet Kim’s Table 4 indicates that substituting EP with PP results in a large decrease in cycle performance (a 3% decrease in recovery capacity between Examples 1 and 2 after being cycled 250 times). Ex. 1008 Table 1 (Example 1 containing mixture of EP/PP, Example 2 containing PP), Table 4 (Example 1 had better recovery capacity than Example 2). EA is even more dissimilar to PP than EP is to PP (as acknowledged by Petitioner, EA differs from PP by *two* methyl groups), suggesting to a POSITA that swapping EA for PP could result in even worse cycle performance. Ex. 2047 ¶¶132-135.

4. Petitioner Fails to Show that Zhou and Sunose Render Obvious D1, D2, and D1/D2, or that a POSITA Would Combine Sunose with Zhou

For at least the same reasons discussed with respect to Sunose in Ground 1, *supra* Section VI.A, Sunose fails to disclose the electrode compaction densities (D1, D2) and the ratio (D1/D2) thereof as evidenced by the fact that several of the “packing densities” of Sunose are *not physically realizable* as compaction densities of an LCO active material such that a POSITA would determine that Sunose’s methodology for determining all of its density values is fundamentally flawed. Ex.

2015 ¶¶233-234, 276-277; Ex. 2047 ¶¶45-61, 138-140. Moreover, Sunose is not enabling for the purposes of preparing electrodes as claimed in the '131 Patent. Ex. 2047 ¶¶45-61, 138-140. Similarly, at least inasmuch as Sunose's packing densities (M and N) clearly do not correspond to electrode compaction densities, the range of $0.7 < N/M < 1.0$ disclosed in Sunose also does not correspond to the claimed compaction density ratio range. *Id.* Nor would a POSITA be motivated to combine Sunose with Zhou as Sunose does not say anything about electrolytes, much less the relationship between electrode compaction density and an electrolyte having the same or similar additives as Zhou. Ex. 2015 ¶¶230-231, 278-279. Indeed, the compatibility between electrode and electrolyte designs, including interactions on surfaces, requires extensive testing and any changes thereto may result in large performance differences. *See e.g.*, Ex. 2047 ¶139; Ex. 2050, 62:18-64:5 (Dr. Lucht testifying that "typically you would do a whole bunch of testing" and that both small and large changes can result in large differences). Given the complexity, one would not simply combine Zhou and Sunose without a contrived, hindsight-driven motivation. Indeed, the combination of Sunose's electrodes may deteriorate the performance in Zhou. *Id.*

As described in Section VI.A, *supra*, Sunose is replete with values that are either completely erroneous, or which otherwise must correspond to some physical characteristic other than electrode compaction density, and is not enabled such that

a POSITA would be deterred from its teachings. Ex. 2015 ¶¶278-280; Ex. 2047 ¶¶45-61, 138-140.

5. Dependent Claims

Claims 2, 4-7, 12, 15, and 17 are not unpatentable over Zhou/Sunose for at least the above reasons. Ex. 2015 ¶281; Ex. 2047 ¶141.

F. Ground 10: Zhou, Sunose, and Kim Do Not Render Obvious Claims 1, 2, 4-7, 12, 14, 15, and 17

1. Petitioner Fails to Show That Zhou, Sunose, and Kim Render Obvious the Claimed Y/Z Ratio

Petitioner's single paragraph in support of Ground 10 (and Ground 12) purporting that "Kim motivates considering the ratio of trinitrile to PP in Zhou and substituting EA for PP in Zhou Example 8," necessarily fails. Pet. 76.

As discussed in Ground 9, there is no preference or suggestion for the POSITA (besides hindsight) to simply swap PP for EA since PP is not used in any of the examples of Zhou or otherwise tested for its functionality, nor is there any reason to expect success in making this combination given the differences between EA and PP. Ex. 2015 ¶¶267, 282-283; Ex. 2047 ¶¶142-143; Ex. 1014 ¶¶[0026]-[0048], [0052]-[0055]. And Petitioner's assertion that "Zhou also cautions the POSITA against using an 'excessive' amount of PP for its '[]negative effect on the cycle performance,' focusing attention on Y/Z" (Pet. 77 (citing Zhou [0059])), also fails as confirmed by the Board. Paper 15, 76 (confirming that Zhou's paragraph 59 fails

to support the assertion that Zhou cautions against an excessive amount of PP); Ex. 2015 ¶286.

For the same reasons discussed above in Grounds 3-4, Petitioner also does not identify any motivation to combine with respect to Kim and Kim's internally contradicting data, statistical uncertainty, and woefully inadequate experimental procedure details would deter a POSITA from the teachings of Kim. Ex. 2015 ¶¶284-285. Nor would a POSITA interpret Kim's Examples 1 and 2 as being "more successful [than] the Comparative Examples" as the Board contends (Paper 15, 76), as demonstrated by at least FIG. 7 of Kim. Ex. 2047 ¶¶95-99, 145.

Ground 10 fails.

2. Dependent Claims

Claims 2, 4-7, 12, 15, and 17 are not unpatentable over Zhou/Sunose/Kim for at least the same reasons as above. Ex. 2015 ¶287; Ex. 2046 ¶146.

G. Grounds 11-12

The deficiencies discussed with respect to Grounds 9-10 apply equally to Grounds 11-12 and Su does not cure such deficiencies. Petitioner fails to establish that Claims 3 and 16 are unpatentable. Ex. 2015 ¶¶288-289; Ex. 2047 ¶¶147-155. Moreover, even the Board indicated that "[i]t is not clear from the Petition why [Ground 12] is raised." Paper 15, 77-78.

As discussed with respect to Su in Grounds 5-8 (incorporated herein by reference), Grounds 11-12 also fail due to Petitioner's failure to present arguments that the anode of Su simultaneously meets the required D1/D2 and D2 limitations and because Petitioner cannot fix its absence of argument, Petitioner forfeits any challenge of Claims 3 and 16 under Grounds 11-12.

H. Grounds 1-12: Claims 14-17

At least inasmuch as Petitioner asserts that its own proffered construction of Claim 14 is wrong ("that both claims 1 and 14 read on the same subject matter"), Petitioner's attempt to assert Sunose as applying to a single electrode in Claims 14-17 in all Grounds 1-12 necessarily fails. Paper 8, 3 ("The [] '431 Petition challenges the claims under PO's interpretation that both claims 1 and 14 correspond to Figure 4 while the '722 Petition challenges only claims 14-17 under *the correct view* that these claims correspond to Figures 2 and 3"). Applying instead Petitioner's "correct view" that the claims correspond to a different configuration (Fig. 4), the Petition has failed to demonstrate that claims 14-17 are met by the prior art.

VII. CONCLUSION

The Challenged Claims are not unpatentable.

Dated: November 12, 2025

Respectfully submitted,

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CERTIFICATION UNDER 37 C.F.R. §42.24

Pursuant to 37 C.F.R. §42.24(d), I certify that this patent owner response complies with the type-volume limits of 37 C.F.R. §42.24(b)(2) because it contains 13,992 words, according to the word-processing system used to prepare this patent owner response, excluding the parts of this patent owner response that are exempted by 37 C.F.R. §42.24(b) (including a 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 or claim listing).

Dated: November 12, 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 RESPONSE and NINGDE AMPEREX TECH. EXHIBITS 2042-2050** were served on November 12, 2025, in their entirety, 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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