

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 PRELIMINARY RESPONSE

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2001	Second Amended Complaint, <i>Ningde Amperex Tech. Ltd. v. Zhuhai CosMX Battery Co.</i> , Case No. 2:24-cv-00728-JRG, ECF No. 23 (E.D. Tex. Jan. 28, 2025)
2002	Scheduling Order, <i>Ningde Amperex Tech. Ltd. v. Zhuhai CosMX Battery Co.</i> , Case No. 2:24-cv-00728-JRG, ECF No. 27 (E.D. Tex. Feb. 6, 2025)
2003	CosMX Invalidity Contentions Cover Pleading, <i>Ningde Amperex Tech. Ltd. v. Zhuhai CosMX Battery Co.</i> , Case No. 2:24-cv-00728-JRG (E.D. Tex. Jan. 7, 2025)
2004	Summons to attend oral proceedings in German Case No. 3 Ni 12/23 (EP) (“Germany Order 1”)
2005	Summons to attend oral proceedings in German Case No. 3 Ni 12/24 (EP) (“Germany Order 2”)
2006	Docket Navigator 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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2010	Article, <i>Lithium battery manufacturer ATL won injunction against its Chinese rival COSMX in German Court</i> , China IP Today (April 6, 2024)
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	DOE Energy Innovation Hubs, 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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2030	Fezzeh Pouraghajan, Andrea I. Thompson, Emilee E. Hunter, Brian Mazzeo, Jake Christensen, Ram Subbaraman, Michael Wray, & Dean Wheeler, <i>The Effects of Cycling on Ionic and Electronic Conductivities of Li-ion Battery Electrodes</i> , 492 J. of Power Sources 229636 (2021)
2031	Amir-Sina Hamed, Edmund M. Shumway, & Dean R. Wheeler, <i>Electrode-Level Modeling of Silicon Anodes for Improved Cell Design</i> , 171 J. Electrochem. Soc. 120539 (2024)
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)

I. INTRODUCTION

Ningde Amperex Technology Ltd. (“ATL” or “Patent Owner”) respectfully submits this Preliminary Response (“POPR”) to the Petition (“Petition”) filed by Zhuhai CosMX Battery Co., Ltd. (“Petitioner” or “CosMX”). Paper 2 (“Pet.”). The Petition seeks *inter partes* review (“IPR”) of claims 1-7, 12, and 14-17 (the “Challenged Claims”) of Patent No. 11,799,131 (the “’131 Patent,” Ex. 1001).

Petitioner fails to show that **any** of the references relied upon across *12 grounds* render the Challenged Claims unpatentable. In an attempt to remedy the fact that **none** of its references render obvious the weight percentage value of propyl propionate (“PP”) (Z) based on a total weight of the electrolyte, and **no** reference apprehends the importance of the claimed Y/Z ratio, Petitioner relies on its expert’s unjustified, incorrect, and improper assumptions in a failed attempt to estimate a value for Z and the claimed ratio Y/Z. Even if such flawed assumptions and calculations were reasonable and justified, and even if the references were to disclose some overly broad range of Y/Z values that fall within or overlap the claimed Y/Z ranges (they do not), Petitioner disregards the criticality of such range. Petitioner’s reliance on a reference listing density values that are *physically impossible* as electrode compaction densities for LiCoO₂ (LCO) fails. These assumptions and lack of disclosure in the references undercut Petitioner’s ability to meet its burden.

First, in Grounds 1A-1C and 2A-2C, Petitioner relies on Zeng for electrolyte elements and Sunose for electrode elements of the Challenged Claims. Zeng never explicitly discloses a weight percentage of the PP based on a total weight of the electrolyte solution or otherwise provides sufficient information from which to determine such value. Petitioner also relies on an unfounded central assumption made by Petitioner's expert that Zeng's lithium salt is added in *solid* form in a failed attempt to back-calculate an undisclosed PP weight percentage and in turn, a purported value for Y/Z. However, this improper assumption contradicts the plain wording of Zeng. Additionally, Petitioner's "packing densities" and "active material densities" of Sunose clearly do not correspond to the claimed electrode compaction densities or ratio thereof as several listed "packing density" and "active material density" values are *physically impossible* values for electrode compaction densities using the materials identified.

Second, Petitioner's attempts to cure the electrolyte failures of Zeng by further relying on Matsuoka in Grounds 1B-1C and 2B-2C, also necessarily fail. There is no "explicit[] disclos[ure] of an appropriate amount of PP" in Matsuoka and Dr. Lucht's assumption that a POSITA would single out and apply Matsuoka's preferred "non-nitrile additive" ranges to *only* PP completely disregards the numerous other components of Zeng's electrolyte that would also be considered "non-nitrile

additives,” and therefore, the *aggregate* of which would also subject be to any alleged “non-nitrile additive” range. Petitioner’s illogical leap is not supported.

Third, Kim does not render obvious the PP weight percentage or the claimed Y/Z ratio nor does Kim cure the other failures of Zeng and Sunose, with or without Matsuoka, in Grounds 1C and 2C. Kim is replete with internally contradicting data and woefully inadequate experimental procedure details from which a POSITA could not draw any conclusions. Petitioner mischaracterizes the measurements and teachings of Kim and fails to demonstrate that a POSITA would apply any discerned teachings to any other reference.

Fourth, in Grounds 3A, 3C, 4A, and 4C, Petitioner relies on Zhou for electrolyte elements and Sunose for electrode elements. Despite the fact that *none* of the examples in Zhou include PP, Petitioner relies on Zhou and Dr. Lucht’s unsupported assumption and hindsight-driven testimony that a POSITA would have substituted PP for ethyl acetate in Zhou’s Example 8. Moreover, Petitioner wrongly assumes that Example 8 outperforms other batteries based on a misunderstanding of kinetic performance data depicted by Zhou. This misunderstanding of Zhou further undercuts the reliability of Dr. Lucht’s opinions. Kim also does not cure Zhou’s failures in Grounds 3C and 4C. Sunose’s “packing densities” and “active material densities” also fail to render obvious the claimed electrode compaction densities and ratio.

Finally, when considering a related European patent, a German patent court opined 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); Kim (NK7) does not require PP or provide information regarding the “ratio of the trinitrile compound to PP” (*id.*, 6); and in Matsuoka’s disclosure (NK9), 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” (Ex. 2005, 12).

II. BACKGROUND¹

A. Technology Overview

In lithium-ion batteries, many interdependent factors contribute to properties of the solid electrolyte interphase (SEI) and there is no absolute parameter circumscribing the SEI. Ex. 2015 ¶¶ 41-45. It is the combined effect of all these factors which affects the properties, quality, and efficiency of SEI. *Id.* In particular, the specific type of solvent, organic additives, and lithium salt(s) added to the

¹ Patent Owner’s expert provided a technology overview and a summary of the ’131 Patent. Ex. 2015, § IV.A-B, ¶¶ 41-53.

electrolyte solution, and the specific concentration of each such component, can play a crucial role in determining SEI performance. *Id.*

B. The '131 Patent

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 of the battery, and achieves high capacity density, and excellent cycle and storage performances, by that solution comprising a compound comprising a dinitrile compound, a trinitrile compound, and PP in specific weight percentage concentrations and ratios. *Id.* 1:55-62, 3:8-20; 27:16-19, 28:49-64. Specific dinitrile, trinitrile, and PP weight percentage 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.

The inventors of the '131 Patent 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 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 person of ordinary skill in the art would have found the claimed subject matter obvious in spite of those differences.” *Synopsys, Inc. v. Mentor Graphics Corp.*, IPR2012-00041, Paper 16, 14 (P.T.A.B. Feb. 22, 2013). Petitioner must recite where the challenged limitation is found in the reference(s) and explain why a POSITA would have modified the primary reference with the recited limitation from the secondary reference(s). *Microsoft Corp. v. Secure Web Conf. Corp.*, IPR2014-00745, Paper 12, 11-13 (P.T.A.B. Sept. 29, 2014).

IV. LEVEL OF ORDINARY SKILL IN THE ART

Each of the arguments below should be considered from the standpoint of a person of ordinary skill in the art (“POSITA”) in the field of the '131 Patent. For purposes of this POPR, ATL adopts the definition proposed by Petitioner. Pet., 16; Ex. 2015 ¶¶ 54-56.

V. CLAIM CONSTRUCTION

Petitioner contends that “[n]o claim terms require express construction for purposes of granting the Petition.” Pet., 17.² The failure of the Petition to render obvious the Challenged Claims is clear in view of the arguments below without construing any specific claim term or phrase.

VI. ARGUMENT

A. Ground 1A: 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 allegedly relies on Sunose. *Id.* 28-40; Ex. 2015 ¶ 60. However, Zeng and Sunose fail for the following reasons.

1. A POSITA Would Not Select or Implement Embodiments 4 or 6 of Zeng

The Petition cites overlapping and baseless rationales as to why a POSITA would have selected or implemented Embodiments 4 and 6 of Zeng in its combination. Once untangled, it is clear that Petitioner has failed to provide any rationale for implementing Embodiments 4 and 6. Despite the fact that the various components and component amounts of the embodiments are ambiguous due to at

² ATL reserves the right to address constructions and/or POSITA if this proceeding is instituted.

least the addition of an unknown amount of lithium salt solution as discussed below in Section VI.A.2.a., Petitioner argues that “[e]ach Zeng embodiment is a self-contained, working example providing a complete list of compounds, amounts, and electrolyte preparation instructions” in alleged support of its reliance on Embodiments 4 and 6. Pet. 26; Ex. 2015 ¶¶ 79-81.

But Petitioner and Dr. Lucht cherry-pick Embodiments 4 and 6 from the 15 embodiments/examples explicitly disclosed by, and the thousands of embodiments which would fit within the ranges described in, Zeng, even though Zeng is silent regarding why the two selected embodiments provide any benefits that would distinguish them from the remaining potential embodiments and there is no unambiguous data in Zeng that would encourage a POSITA to choose any particular embodiment over another. Ex. 2015 ¶¶ 63-64, 75-77; Ex. 1006 ¶¶ [0045]-[0046]. Petitioner’s assertion that a POSITA would have been motivated to implement Embodiments 4 and 6 with a reasonable expectation of success because “[o]ther than Embodiments 2 and 5, Embodiment 6 had the best capacity retention...and Embodiment 4 had excellent capacity retention” completely disregards the fact that Embodiments 2 and 5 did not contain *any* trinitrile compound. Ex. 2015 ¶ 77; Ex. 1006 ¶¶ [0045]-[0046].

Embodiments 1 and 8 also did not contain any trinitrile compound and had better capacity retention rates than Embodiment 4. *Id.* Because capacity retention is

an important aspect to Zeng, a POSITA would interpret Zeng as teaching that the addition of a trinitrile compound *negatively* impacts the capacity retention rate at least inasmuch as Embodiments 2 and 5, which contained dinitrile compound(s) but no trinitrile compound(s), had better capacity retention rates than both Embodiments 4 and 6, which contained dinitrile compound(s) and a trinitrile compound, and would therefore be deterred from selecting Embodiments 4 and 6 and otherwise *teach away* from selecting those embodiments. *Id.* ¶¶ 74, 77; Ex. 1006 ¶¶ [0039]-[0042], [0045]-[0046].

Petitioner also fails to address the fact that such comparatively negative impact of the trinitrile compound on the capacity retention rates would also *teach away* from considering the relation or adjustment of a trinitrile compound to PP ratio (Y/Z), other than to *eliminate* the amount of trinitrile compound in Zeng's Embodiments 4 and 6 to zero (as in at least Embodiments 1, 2, 5, and 8). *Id.* ¶ 78.

Petitioner fails to establish that Embodiments 4 and 6 would have been obvious to try. Pet. 26-28; Ex. 2015 ¶¶ 82-89. Zeng does not articulate the problem or the solution of the '131 Patent. *Id.* ¶¶ 61-62, 83; Ex. 1001, 1:52-62. Petitioner fails to account for the fact that a POSITA would have recognized a large number of potential solutions to the problem the '131 Patent solves (including potential solutions incompatible with each other), each of which requires extensive tradeoffs and careful balance of competing effects in the electrolyte solution. Ex. 2015 ¶¶ 84-

86. Even if Zeng aligned with the problems faced in the '131 Patent (which it does not), Petitioner fails to account for the thousands of embodiments that would fit within the ranges described in Zeng. *Id.* ¶ 75; *see In re Kubin*, 561 F.3d 1351, 1359–60 (Fed. Cir. 2009) (stating that what is “obvious to try” is erroneously equated with obviousness where “what would have been ‘obvious to try’ would have been to vary all parameters or try each of numerous possible choices until one possibly arrived at a successful result, where the prior art gave either no indication of which parameters were critical or no direction as to which of many possible choices is likely to be successful”).

Nor does Petitioner establish a reasonable expectation of success for implementing Embodiments 4 and 6 due to Zeng’s teaching to a POSITA of a comparatively *negative* impact of the trinitrile compound on capacity retention rates in Zeng’s electrolyte solutions (as compared to at least Embodiments 2 and 5), as well as Zeng’s ambiguous instructions for making those solutions, as discussed *supra*. Ex. 2015 ¶¶ 76-81, 87-89.

2. The Petition Fails to Show That Zeng and Sunose Render Obvious the Claimed Y/Z Ratio of Claims 1 and 14

Zeng never discloses the weight percentage of PP (Z) used in its electrolyte solutions based on a total weight of the electrolyte or the critical claimed ratio of the weight percentages of trinitrile to PP (Y/Z). Zeng provides a relative mass ratio of

each solvent or “electrolyte solvent partial component content” in a base solvent mixture, but then adds other additives and a lithium salt solution thereto. Indeed, Zeng adds the *other* additives “on the basis of the total weight of the electrolyte solution.” Ex. 1006 ¶ [0037]; Ex. 2015 ¶¶ 93-95. But Zeng is unconcerned with the weight percentage of PP 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.2.b., *infra*.

Zeng provides insufficient information from which a POSITA could determine such weight percentage of PP or the claimed trinitrile to PP ratio in each of Embodiments 4 and 6. *Id.* ¶ 95. Indeed, Zeng discloses three different concentration units for its various components that are based on three different measurements—*total mass of the organic solvents*, *total weight of the electrolyte solution*, and *total volume of the lithium salt solution*—without actually providing those measurements, which would be necessary for a POSITA to even consider, let alone calculate, a theoretical weight percentage of the PP component based on the total weight of the electrolyte solution, and in turn, a ratio of trinitrile to PP. *Id.* ¶ 96.

Despite these clear shortcomings regarding the preparation of Embodiments 4 and 6, however, Petitioner’s argument relies solely on Dr. Lucht’s unsupported and incorrect assumptions to purportedly reach an alleged weight percentage of PP, and in turn, an alleged (but undisclosed) Y/Z ratio based on his estimated Z value.

Id. ¶ 97. Such flawed assumptions render Dr. Lucht's resulting calculations unreliable. *Id.* ¶¶ 98-106. One basic error is Petitioner's assumption that Zeng's lithium salt is added in a solid form, which permeates every calculation and renders them wrong, since the lithium salt is added as a *solution*.

a. Dr. Lucht's Assumption That Zeng's LiPF_6 is Added as a Solid is Unjustified

Each of Zeng's Embodiments rely on the description of Embodiment 1, 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]; *see also*, Ex. 2015 ¶ 107. Despite this explicit recitation (which means that a POSITA would understand that LiPF_6 is expressly added *in the form of a solution* (i.e., dissolved in a liquid)), and faced with the reality that use of an indeterminate amount of such salt solution renders impossible any calculation of the weight percentage of PP 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); Ex. 2015 ¶¶ 108-109. Such assumptions that (1) LiPF_6 is in solid form, and (2) such solid LiPF_6 is added to the solvent mixture to obtain a target 1.0 mol/L concentration of the electrolyte solution, oppose and contradict the literal text set forth in Zeng, which

expressly states that a 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, and that if they had written something else, then *that* imagined disclosure would render obvious the Challenged Claims.

Petitioner's own evidence reinforces the clear meaning in Zeng that the LiPF_6 is added to the solvent mixture, not as a solid, *but as a salt solution having a certain concentration*. See, e.g., Ex. 2015 ¶ 111; Ex. 1023 ¶¶ [0237], [0245], [0255]; Ex. 1024 ¶ [0048]; Ex. 1025 ¶¶ [0090], [0100]. Indeed, another patent application by the same applicant and two common inventors with Zeng demonstrates that when they intended to add lithium salt in *solid* form, they specifically indicated mixing the solvents in proportion and dissolving the lithium salt in the solvent mixture, such that the concentration of the lithium salt in the organic solvent is 1.0 mol/L. Ex. 2022; Ex. 2015 ¶ 112.

Moreover, the commercial distribution of "battery grade" 1.0 mol/L LiPF_6 premixed solutions with different solvents was well known and an acceptable way to achieve a desired electrolyte mixture for use in batteries. Ex. 2015 ¶ 110; Exs. 2017-2021; see also, Ex. 1003 ¶ 80, n.6 (Dr. Lucht admitting such premixed solutions were available).

Petitioner's concerns that adding such a premixed salt solution would "render[] the ultimate concentration of LiPF_6 and amounts of the solvent components uncertain"³ and somehow "disrupt the carefully-crafted solvent and additive weight percentages central to Zeng's invention" also ring hollow. Pet. 21-22, n. 4; Ex. 2015 ¶¶ 113-116. Table 1 of Zeng only lists "the electrolyte solution *partial* component content," so Zeng necessarily considers the presence of other electrolyte solution components in its embodiments, such as the unknown solvent components of the 1.0 mol/L LiPF_6 solution. Ex. 2015 ¶ 115. There is nothing in Zeng indicating an intended final concentration of LiPF_6 in the electrolyte mixtures such that Petitioner cannot discern an intention in Zeng that would be "disrupted" by the addition of LiPF_6 in a pre-mixed and not solid state, as Zeng plainly describes. *Id.* ¶¶ 116-117.

It is based on this erroneous solid LiPF_6 salt assumption, "assuming a hypothetical case where LiPF_6 has zero weight" of such solid salt, and failure to consider the presence of other electrolyte solution components ("the electrolyte solution *partial* component content") in the embodiments, that Dr. Lucht purports to

³ Because Zeng *does* teach using a premixed salt solution, Petitioner admits it cannot ascertain the ultimate concentration of LiPF_6 and the claimed amounts of the solvent components, so its Zeng-based grounds fail.

estimate an upper limit weight percentage for PP in each of Embodiments 4 and 6, followed by the acknowledgment that LiPF_6 does have a non-zero weight to result in his calculations of the alleged weight percentages of PP of <17.66 wt% and <17.70 wt%. Ex. 1003, ¶¶ 80-84, 87-88; Ex. 2015 ¶¶ 98-105. Further still, however, Petitioner relies on Dr. Lucht's erroneous and unsupported assumption that "PP could not be diluted (i.e., Z could not be reduced) to a value that removes Embodiments 4 and 6 from the scope of the Challenged Claims." Pet. 25. Dr. Lucht fails to consider the fact that Zeng ***does not require PP to be present*** at all. Ex. 2015 ¶ 104. Zeng defines the amount of PP in the base mixture of organic solvents in relation to ethyl propionate such that the amount of PP in an electrolyte solution of Zeng may be zero. *Id.* (explaining that an electrolyte solution of Zeng may contain 10%-50% EP and 0% PP, especially in view of the higher viscosity, larger molecular mass, and longer chain of PP compared to EP); Ex. 1006 ¶ [0015].

Zeng discloses the addition of a lithium salt in *solution* form to the base solvent mixture in each embodiment, without the need for an explicit reference to the solvents of the solution, such that the weight percentage of PP and the ratio of trinitrile compound to PP 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 weight percentages of PP of

<17.66 wt% and <17.70 wt% and, in turn, the alleged Y/Z values of >0.057 and >0.056 in Embodiments 4 and 6, incorrect. *Id.* ¶¶ 118-119. There is simply not enough information in Zeng to reliably perform the calculations needed to reach the conclusions in the Petition. *Id.*

b. The Y/Z Range is Critical

Based on Dr. Lucht's unjustified assumptions and calculations, Petitioner asserts that Embodiments 4 and 6 of Zeng disclose Y/Z values of >0.057 and >0.056, respectively. Pet. 38-39. Even if one were to assume that Dr. Lucht's flawed assumptions and calculations are reasonable and justified, and that Zeng discloses a range of Y/Z values that fall within or overlap the claimed range, Zeng still 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) (a "claimed range that demonstrates [] unexpected results is referred to as a 'critical' range, and the patentee has the burden of proving criticality") (citation omitted).

Even if Petitioner's unsupported assertions were considered, then Zeng would still only disclose, at best, electrolyte solutions with a trinitrile weight percentage (in the **total electrolyte**) and a PP weight percentage (in a **solvent**), and even the ratio between those values (which is not the claimed ratio) would still be broader than the claimed ranges of Y/Z values in claims 1 and 14. For example, as discussed *supra*,

the presence of PP is not even required in Zeng such that the amount of PP in an electrolyte solution of Zeng may be zero. Ex. 1006 ¶¶ [0015], [0032], claim 1; Ex. 2015 ¶ 121 (Zeng may contain 10%-50% EP and 0% PP). Applying such null PP value to any of Zeng's disclosed embodiments results in a Y/Z value of 0, which is broader than and necessarily outside of the narrower claimed Y/Z range of about $0.01 \leq (Y/Z) \leq \text{about } 0.3$. Ex. 2015 ¶ 121.

Similarly, a trinitrile compound's presence is not even required in Zeng—the amount of trinitrile in Zeng's electrolyte solution may be zero. Ex. 2015 ¶ 122; Ex. 1006 ¶¶ [0017]-[0019] (structural formula I need not be a trinitrile), ¶¶ [0045]-[0046] (none of Embodiments 1-3, 5, or 7-9 contain a trinitrile based on structural formula I). As discussed *supra*, a comparison of the capacity retention rates of Zeng's Embodiments 4 and 6 (contain trinitrile) to Embodiments 2 and 5 (no trinitrile) actually *teaches away* from using any trinitrile in Zeng's electrolyte solutions. Ex. 2015 ¶¶ 77-78. Accordingly, Zeng teaches that its electrolyte solutions of Zeng may contain 0% trinitrile and applying such null trinitrile value to any of Zeng's disclosed embodiments results in a Y/Z value of 0, which is broader than and outside of the narrower claimed Y/Z range of about $0.01 \leq (Y/Z) \leq \text{about } 0.3$. Ex. 2015 ¶ 122.

The '131 Patent explains, and Petitioner fails to address, that its *specific weight percentage ratio ranges*, including Y/Z values of 0.01-0.3 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. Ex. 2015 ¶ 123; Ex. 1001, 1:55-62; 28:56-64. Zeng fails to disclose 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. Ex. 2015 ¶¶ 120-125. Indeed, Zeng does not disclose or appreciate this ratio at all. *Id.* To the extent there is any attention drawn to a combination of trinitrile and PP in Zeng, a POSITA would understand Zeng to actually *teach away* from the addition of a trinitrile compound due to its perceived effect of comparatively *lowering* (rather than improving) capacity retention rate in comparison to Zeng's Embodiments 2 and 5, as discussed *supra*. *Id.* ¶¶ 126-127. Accordingly, because of the criticality of the claimed Y/Z value ranges, such claimed ranges are not obvious in view of Zeng. *E.I. du Pont*, 904 F.3d at 1008.

3. The Petition Fails to Show that Zeng and Sunose Render Obvious D1, D2, and D1/D2

Based on yet another wrong assumption by Dr. Lucht, Petitioner cites to Sunose's "packing densities"/"active material densities" and "active material density ratios" as allegedly equating to the claimed electrode compaction densities (D1, D2) and ratio (D1/D2) thereof. Pet. 33-35. However, several of the density

values relied on in Sunose cannot be the claimed “electrode compaction density” because Sunose’s reported values are physically impossible values for electrode compaction densities using the materials identified.

First, the reported values are *physically impossible* as electrode compaction densities as they far exceed the 5.1 g/cm³ true or crystalline density of the LiCoO₂ (LCO) active material of Sunose’s electrode plates. Ex. 2015 ¶¶ 133-145; Ex. 1010 ¶ [0041], Table 1 (identifying “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 Example 2 and Comparative Example 3, respectively); Exs. 2034-2039. 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 underlying solids and binder that make up the composite; and (2) porosity of the film. *Id.* ¶ 136. With respect to (1) crystalline density and relative amounts of underlying solids and binder that make up the composite, using a “rule of mixtures,” material scientists routinely can estimate the density of a solid composite of these materials at zero porosity. *Id.* This represents the *theoretical upper bound* of density for a film made of this combination of materials. Porosity of the film (i.e., volume fraction of pores or void space between solid materials) only scales the composite density *downward* from the theoretical upper bound of density of (1) (without any pores). *Id.*

The positive electrode plates of Sunose were prepared using LiCoO_2 and small amounts of carbon black (Denka Black) and a binder (PVDF) such that Sunose's positive electrode plates would have a theoretical maximum compaction density of 4.5 g/cm^3 . *Id.* ¶¶ 136-141; Ex. 1010 ¶¶ [0029]-[0037]; Ex. 2031 (setting forth formula in common use in materials science to describe composites). Because this value is based on a porosity of zero and an electrode with a porosity of zero is neither easy nor advisable to achieve, their electrode compaction densities would necessarily be less than 4.5 g/cm^3 . *Id.* ¶ 142. That is, because Sunose identifies several “active material densities” in its examples that are ***not physically realizable*** electrode compaction densities, the POSITA would understand that *none* of the purported “packing densities” or “active material densities” set forth in Sunose correspond to the actual compaction densities of the LCO positive electrode plates of Sunose and, thus, are unrelated to the claimed electrode compaction density. *Id.*

A POSITA would also have understood that the compaction density of an electrode is calculated after the electrode has been constructed and involves the measurements to include weight and thickness. *Id.* ¶ 143. Indeed, at least inasmuch as the single-side active material portion of Comparative Example 3 was broken, there would not be an “active material density M of [the] single-side coated portion” that could be measured. Worse still, Sunose reports a packing density of 8 g/cc , which actually corresponds to the density of solid steel, and which is much denser

than each of the constituent materials used by Sunose and, thus, cannot be a compaction density value. *Id.* ¶¶ 142, n.20, 143. Similarly, at least inasmuch as Sunose’s packing densities (M and N) clearly cannot correspond to electrode compaction densities, the range of $0.7 < N/M < 1.0$ allegedly disclosed in Sunose cannot be directly compared with the claimed compaction density ratio range of claims 1 and 14. *Id.* ¶ 144.

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. *Id.* ¶ 153. Sunose does not present sufficient data to fully diagnose its mistakes. Although Sunose’s packing densities and ratios thereof (M, N, N/M) may have some physical origin, they are incommensurable with the claimed electrode compaction densities and claimed ratio thereof. *Id.* ¶ 144.

a. 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 justified, 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. Ex. 1001, 31:53-57 (“It can be seen that when D1/D2 is within the range of 0.8-1.2, *a better cycle performance is obtained, possibly because*

the combined additives facilitate the reduction of the electrode interface resistance and the reduction of the cell polarization.”) (emphasis added); Ex. 2015 ¶¶ 146-149. Sunose never mentions such criticality of the claimed D1/D2 value ranges, nor the advantages of the ’131 Patent that such narrow, specific D1/D2 value ranges provide. *Id.* Sunose and the Petition provide no reason to select this narrow range.

4. A POSITA Would Not Combine Sunose with Zeng

Petitioner asserts that Zeng does not focus on “electrode structures” and “[a] POSITA reading Zeng would have looked to other references, like Sunose, for electrode structure and implementation details.” Pet. 36-37. The POSITA would not be motivated to combine Sunose with Zeng at least because Zeng is focused on a wide-temperature range homogenous non-aqueous electrolyte solution to provide certain performance advantages for the lithium-ion battery and Sunose is focused on trying to overcome documented shortcomings of Sunose’s roller mill equipment. *See e.g.*, Ex. 1010, ¶¶ [0007]-[0010], [0015]-[0018]; Ex. 2015 ¶¶ 151, 65-73. Sunose is disclosing a proposed solution to a manufacturing problem that is specific to the physical limitations of particular piece of roller mill equipment, so that Sunose may compact contiguous single- and double-sided coatings on that equipment, such that a POSITA would find no benefit to apply Sunose’s workarounds to generalized electrode compacting operations. Ex. 2015 ¶ 67. Indeed, the solution for increasing battery performance discussed in Zeng is chemical in nature, while the solution for

productivity discussed in Sunose is mechanical in nature and Sunose does not say anything about electrolytes, much less the relationship between electrode compaction density and an electrolyte having the same or a similar additives as Zeng. *Id.* ¶ 152. As an illustrative analogy, if Zeng and Sunose were both working to improve automobile performance, Zeng would disclose an improved gasoline fuel additive and Sunose would disclose an improved manufacturing method for bumpers. A POSITA would not find it obvious to combine the two disclosures as they teach remedies to entirely different problems in a complicated engineering system. Ex. 2015 ¶ 157.

Moreover, as set forth in Section VI.A.3, *supra*, although Sunose’s “packing densities” and ratios thereof (M, N, N/M) may have some physical origin, they are incommensurable with the claimed electrode compaction densities and ratio thereof, and Petitioner's sole reliance on Sunose for the compaction density-related limitations necessarily 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.

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

5. Dependent Claims

Claims 2, 4-7, 12, 15, and 17 are not unpatentable for the same reasons as claims 1 and 14. Ex. 2015 ¶ 159.

B. Ground 1B: 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 1A, Petitioner fails to establish that at least one Challenged Claim of Ground 1B is unpatentable in view of Zeng and Sunose, and likewise fails with respect to Zeng/Sunose in view of Matsuoka.

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's allegation that "any potential ambiguity can be dispelled by Matsuoka, which explicitly discloses an appropriate amount of PP (Z)", however, is nonsensical in view of the clear disclosure of the references. Indeed, 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. As explained hereinabove at Section VI.A.2., the weight percentage of PP based on the total

weight of the electrolyte is simply not a consideration nor relevant to Zeng. Therefore, there is no motivation to modify 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).

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

Matsuoka lists non-nitrile additives with Lowest Unoccupied Molecular Orbital (LUMO) and a 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]). However, 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 weight percentage 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 the 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 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 none are tested for functionality. *Id.* Significantly, Table 2 lists 20 additives used in the Examples and Comparative Examples of Matsuoka and neither PP compound is identified. *Id.*; Ex. 1007 ¶ [0108], Table 2. Matsuoka fails to provide any reason to select PP from the numerous other “non-nitrile additives.” *Id.* ¶¶ 166, 168.

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

A foundation of Petitioner’s reliance on Matsuoka is Dr. Lucht’s flawed assumption that a POSITA would single out and somehow apply Matsuoka’s preferred non-nitrile additive ranges *only* to PP in its proposed combination with Zeng and Sunose, completely disregarding the numerous other components of Zeng’s electrolyte that would also be considered “non-nitrile additive” components according to Matsuoka. Ex. 2015 ¶ 169.

Matsuoka teaches that such 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”). Significantly, in addition to the PP isomers, Matsuoka identifies many other example non-nitrile additive compounds that overlap with the components of Zeng’s Embodiments 4 and 6. *Id.*; Ex. 1007 ¶¶ [0038], [0040]. 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. *Id.* 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.*

Because Petitioner fails to show that Matsuoka renders obvious the claimed 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.2.b. Ex. 2015 ¶¶ 170-173. Petitioner’s allegations of overlapping Y/Z ranges of 0.1-10 and 0.033-10 and that “a POSITA would have applied Matsuoka’s teachings that PP effectively

keeps internal resistance low to optimize PP content” are nothing more than hindsight-contrived purposes and fail to appreciate that any alleged internal resistance suppression benefits of Matsuoka are with respect to Matsuoka’s fundamentally different acetonitrile- and organic lithium salt-based electrolyte system. *Id.* ¶¶ 174-177.

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

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. However, 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.

Petitioner argues that “the desire for balanced performance” would have motivated the combination with Matsuoka and that “Zeng’s and Matsuoka’s electrolyte[] compositions are substantially similar” with “the same carbonate-based solvents (EC, PC), the same ester compound (EP), the same lithium salt (LiPF₆), and

the same additive (VC)” which would have led the POSITA to “have had a reasonable expectation of success” in the combination. Pet. 53. However, the electrolyte solutions of Zeng and Matsuoka are so fundamentally different that the POSITA would not be motivated to combine or have an expectation of success. Ex. 2015 ¶¶ 178-191.

First, the electrolyte component “buckets” of Zeng and Matsuoka are not comparable, such that comparisons or applicability of amounts or ranges between the two references is not possible. Matsuoka identifies at least PP, ethyl propionate (EP), and monofluorobenzene (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, not as *additives*. Ex. 2015 ¶ 179; Ex. 1007 ¶¶ [0038], [0040]; Ex. 1006 ¶ [0037]. A POSITA would not identify the teachings of Matsuoka as applicable to Zeng and would have no reason to expect that the applicability of amounts or ranges of Matsuoka’s *additive* components to the same components found in Zeng’s solution as *solvent* components (especially in view of Zeng’s solvents being present in a defined solvent mass ratio) would have predictable results given the inherent unpredictability of the interactions of these components. *Id.*

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], and Tables 3-5. Zeng’s Embodiments 4 and

6, on the other hand, do not include any mononitriles as a solvent or an additive, and only adiponitrile (a dinitrile), 1,2-bis(2-cyanoethoxy)ethane (a dinitrile), and 1,3,6-hexanetricarbonitrile (a trinitrile) as minor additives. *Id.*; Ex. 1006 ¶¶ [0045]-[0049]. Although a few of the examples in Matsuoka include a dinitrile additive, none of its examples include a trinitrile additive, so a POSITA would consider the electrolyte systems of Zeng and Matsuoka to be fundamentally different. *Id.* Indeed, as a result of such fundamental differences, a POSITA would not be given 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.”). Therefore, Petitioner’s “desire for balanced performance” argument fails.

Matsuoka also teaches away 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 (explaining that the acetonitrile-only solvent systems of the monolayer laminate batteries (SL1) of Matsuoka’s Examples 21 and 22 had higher

low-temperature discharge capacities than Examples 23, 24, and Comparative Example 8 (which had a mixed solvent electrolyte systems), and that the small battery (SC1) of Matsuoka's Example 25 had a higher low-temperature discharge capacity than Comparative Example 9 (which had a mixed solvent electrolyte system)).

Third, Matsuoka also teaches away from the use of the single inorganic lithium salt—LiPF₆—of Zeng. Ex. 2015 ¶ 187. In addition to acetonitrile, Matsuoka requires “an organic lithium salt, wherein an anion of the organic lithium salt has a LUMO [] energy in the range of -2.00 to 4.35 eV, and a HOMO [] energy in the range of -5.35 to -2.90 eV.” *Id.*; Ex. 1007 ¶ [0014]. LiPF₆ is an inorganic lithium salt having a LUMO of 4.05 eV and a HOMO of -5.39 eV. *Id.* ¶ 188; Ex. 1007 ¶ [0029], Table 1. Although Matsuoka identifies LiPF₆ as preferable *when used in combination with the required organic lithium salt* (Ex. 1007 ¶ [0030]), LiPF₆ as Zeng uses by itself, does not meet the organic lithium salt requirements or the HOMO requirements of Matsuoka's required organic lithium salt. *Id.*

Matsuoka also teaches away from electrolyte solutions incorporating only an inorganic lithium salt like Zeng because, according to Matsuoka, those have a much lower discharge capacity than an electrolyte solution incorporating Matsuoka's required organic lithium salt. Ex. 1007, Table 1, Table 3, Table 6; Ex. 2015 ¶ 189 (explaining that the organic lithium salt system of the monolayer laminate battery

(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). Petitioner does not provide a sufficient motivation to combine Matsuoka with Zeng and Sunose, and, thus, Ground 1B fails. Ex. 2015 ¶ 190.

4. Dependent Claims

Claims 2, 4-7, 12, 15, and 17 are not unpatentable for the same reasons as claims 1 and 14. Ex. 2015 ¶ 191.

C. Ground 1C: 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 1A and 1B, Petitioner also fails with respect to Ground 1C. Ex. 2015 ¶¶ 193-194. Petitioner further fails to establish that at least one challenged claim of Ground 1C is unpatentable in further view of Kim, for the reasons below. *Id.* ¶ 192.

Petitioner purports to cure, with Kim, the deficiencies in Zeng, or Zeng and 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 allegation that "Kim further focuses the POSITA on including both a trinitrile and PP in a dinitrile-based electrolyte and motivates adjusting relative amounts of these two components (i.e., *Y/Z*) to improve performance" (Pet. 56), however, is, again, nonsensical in view of

the clear disclosure of the references. As explained *supra* at Section VI.A.1., because capacity retention is an important aspect to Zeng, a POSITA would interpret Zeng as teaching that the addition of a trinitrile compound *negatively* impacts the capacity retention rate at least inasmuch as Embodiments 2 and 5 (which do not contain a trinitrile) outperform Embodiments 4 and 6 (which do), such that a POSITA would not turn to any alleged trinitrile teachings of Kim. Indeed, in another attempt to reconstruct the Challenged Claims based solely on the '131 Patent's teachings, Petitioner tries to manifest some "importance of Zeng's *Y* and *Z* proportions...in improving performance of dinitrile-based electrolytes" based on Embodiments 4 and 6 allegedly being "advantageous" and disclosing a trinitrile and PP with the other examples "lack[ing] both a trinitrile and PP," but no teaching in Zeng would prompt or otherwise "motivate[] [a POSITA] adjusting relative amounts of these two components (i.e., *Y/Z*) to improve performance," because the comparative capacity retention rate data of Zeng's Embodiments teaches otherwise. Pet. 55-56; Ex. 2015 ¶ 77.

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

Petitioner *never makes a motivation to combine argument at all* for Ground 1C and never evaluates the POSITA's reasonable expectation of success and, thus fails to make out a *prima facie* case of obviousness to combine Kim with the other

references. Pet. 55-60. 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) (cleaned up, citations omitted). Even setting aside this fatal deficiency, Kim is replete with internally contradicting data and woefully inadequate experimental procedure details from which a POSITA could not draw any conclusions. Petitioner mischaracterizes Kim's measurements and teachings and fails to demonstrate that a POSITA would apply any discerned teachings.

Petitioner asserts that Kim's experiments, specifically, Examples 1 and 2, "show electrolytes having both trinitrile and PP had better capacity retention...versus similar electrolytes missing either or both components," thereby "focusing the POSITA on the importance of trinitrile- and PP-based electrolytes." Pet. 57-58. Petitioner further asserts that Kim's Examples 1 and 2 allegedly demonstrate PP's impact on battery performance and "optimizing the trinitrile (Y)/PP (Z) ratio affects performance." *Id.*, 59. Petitioner's analysis of these examples lacks merit. Ex. 2015 ¶ 195-214.

To learn anything from Kim's disclosure, however, a POSITA must examine the experiments on which the disclosure is based. This is difficult, if not impossible, because Kim's experimental procedures are not articulated in any meaningful way that allows evaluation or reproduction—they are simply named, e.g. "thickness

increase” (Ex. 1008, FIG. 3, FIG. 5, FIG. 7), “recovery capacity” (*id.* Table 2, FIG. 4, FIG. 6), “thickness variation ratio” (*id.* Table 2, Table 3, FIG. 4, FIG. 6), and “DC capa. to ini. capacity” (*id.* FIG. 7). Even if the POSITA could (with significant effort) deduce from Table 2 what Kim meant by “recovery capacity” and “thickness variation” and how those values might be calculated from or related to underlying capacity and thickness measurements, Kim remains woefully inadequate on experimental procedure details and the POSITA would still need to depend on Kim for how to understand and therefore interpret the underlying capacity and thickness measurements. Ex. 2015 ¶ 196.

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 specify how or where its “thickness” values are measured, and it is not clear whether the thickness corresponds to the total thickness of the cell at a particular location or from an ensemble of locations. *Id.* It is also not clear as to how multiple values are treated, whether the thickness is measured under a particular stack pressure, among other conceivable interpretations of “thickness.” *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. For example, Kim at Paragraph [0095] describes that Examples 1 and 2 and Comparative Examples 1 to

6 are embodied in *prismatic* cells. However, at Paragraph [0099], Kim describes embodiments of the same Examples 1 and 2 and Comparative Examples 1 to 6 as *pouch* cells—a different cell format. No description is given as to how the respective prismatic and pouch cells are manufactured or are otherwise distinct from each other, nor are there teachings as to how they should be comparatively evaluated. A POSITA comparing “recovery capacity” results from the prismatic Example 1 (Ex. 1008, Table 2) and from the pouch Example 1 (*id.* Table 3) would see a notable capacity difference or uncertainty of 4.5% for two embodiments of Example 1 exceeds the capacity differences between Example 1 and Comparative Examples 2, 3, 4, and 6 in Table 2. The POSITA could not reliably judge that Example 1 is superior in recovery capacity to these supposedly dissimilar cases. Ex. 2015 ¶ 199. Instead, the POSITA would infer that there is a comparatively wide band of statistical uncertainty in the measurements made for each example in the two cell formats. *Id.* ¶¶ 199-200. A POSITA would therefore not be confident in the individual measurements due to their manifest differences by cell format and a POSITA would not 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. *Id.*

Third, Kim’s disclosure with respect to linear sweep voltammetry contradicts itself. Kim states that the thermal aging measurements on pouch cells were made

after being “allowed to stand at 60°C. for **3 weeks**,” whereas Table 3 indicates the same measurements were made after being “allowed to stand at 60°C. for **4 weeks**.” Ex. 1008 ¶¶ [0099]-[0100] and Table 3 (emphasis added). It is not clear which of these contradictory statements is correct. Ex. 2015 ¶ 201. Additionally, FIG. 2 of Kim provides “linear sweep voltammetry” data, purporting to show that Examples 1 and 2 are more electrochemically stable electrolytes than Comparative Examples 1 to 6 would be at a particular electrode potential, meaning the smaller the current (vertical axis) at a particular potential (horizontal axis), the more stable the electrolyte. Ex. 1008, FIG. 2; Ex. 2015 ¶ 202. Because of the vertical scale used, a POSITA cannot determine from the plot the stability/currents for Examples and Comparative Examples at more realistic potentials, i.e. around 4.4V 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.

Fourth, regarding Kim’s life cycle measurements, Kim lacks any information on *how* its battery cell was cycled, 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). Indeed, key information for assessing the performance of Kim’s batteries is missing, such as the

voltage up to which the battery is charged or discharged and at what rate the cycling is performed. Ex. 2015 ¶ 203. Given Kim's focus on increasing the thermal stability of a battery, (Ex. 1008 ¶¶ [0055] and [0056]), information on how the battery was cycled is particularly relevant as even small differences in operating voltages, such as during charging, can have significant effects on battery life. *Id.* 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 data presented in FIG. 7, removing any confidence that a POSITA would have with respect to Kim's presentation of data and leading them away from relying on Kim at all. *Id.*

Although not explicitly stated by Kim, a POSITA would conclude using test calculations that the "Capacity retention" values in Table 4 of Kim were computed as the ratio of "Capacity after 250 cycles" to "Initial capacity" in Table 4. Thus, "Capacity retention" in Kim's Table 4 corresponds directly to "DC capa. to ini. capacity" in Figure 7 of Kim. Ex. 2015 ¶ 204. However, when comparing the capacity retention values for the remaining Comparative Examples, including Comparative Examples 3, 4, 5, and 6, a POSITA would note significant discrepancies. In Figure 7, for example, Comparative Examples 5 and 6 are shown as having a 250-cycle capacity retention of around 92.5% and 92.3%, respectively. However, in Table 4, these same capacity retentions are reported for the same Comparative Examples at much lower values of 75.8% and 75.3%, respectively.

Similarly, in Figure 7, the 250-cycle capacity retention of Comparative Example 3 is shown as around 88.9%, whereas in Table 4 the 250-cycle capacity retention of the same Comparative Example 3 is 92.0%. Meanwhile, there is no capacity retention curve for Comparative Example 4 in Figure 7 to compare against Table 4. To summarize, there are notable unexplained discrepancies between Figure 7 and Table 4's capacity retention values for the same Comparative Examples, which ultimately would deter a POSITA from relying on or applying Kim. Ex. 2015 ¶ 205.

Thus, the multiple experiments of Kim relied upon by Petitioner are not clear or reproducible and are therefore not usable by the POSITA. Pet. 57; Ex. 2015 ¶¶ 195-198. Additionally, Kim's experiments do not provide any particular value to a POSITA allegedly seeking to provide a firm protective SEI film on the surface of the cathode of an electrochemical device such as a lithium-ion battery that is not easily decomposed, effectively inhibits the increase in DC internal resistance of the lithium ion battery, and achieves high capacity density, and excellent cycle and storage performances. And as shown above, all of the claimed measurements are inadequately described by Kim, scientifically problematic, and/or have no explicated connection to such objectives. Ex. 2015 ¶ 210.

Even if Kim's disclosure did not provide internally contradicting data and were not woefully inadequate with respect to experimental procedure details, Kim's Examples 1 and 2 do not motivate a POSITA to adjust the relative amounts of PP

and a trinitrile as Petitioner claims. Ex. 2015 ¶ 206. Even if a POSITA were to retain confidence in Kim's data, which is suspect in multiple respects as discussed above, a POSITA would still note that Example 1 is superior to Example 2 in Kim's data on cell cycle life, as shown in Table 4 and FIG. 7. Therefore, a POSITA seeking to maximize cycle life would be taught by Kim, if anything, to consider Example 1's composition superior to Example 2's composition. *Id.* This would require 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.* This would teach the POSITA *away* from using an even higher fraction of PP than is used in Example 1, which is 40 vol% of the base solvent (i.e. not including salt or additives) 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, as discussed below, 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 HTCEN in weight percentage in the total electrolyte.

Nothing in Kim indicates a preference for (much less mandates) the presence of PP, and other alkyl propionates are disclosed, such as variations of butyl (C4) or pentyl (C5) propionate. Ex. 1008 ¶¶ [0013]-[0014] ("C3 to C5 alkyl propionate"). For example, as stated in Kim, PP is just one example of a C3 to C5 alkyl propionate that may be included individually, or in combination with *other* C3 to C5 alkyl

propionates, in an amount of 10 volume percent to 80 volume percent based on the total amount of the organic solvent. *Id.* ¶¶ [0040]-[0041]. Kim provides no direct comparison between different C3-C5-alkyl propionates that would motivate selection of PP over another C3-C5-alkyl propionate discussed in Kim, and Petitioner provides no motivation to make such a selection. Ex. 2015 ¶ 207. Thus, the POSITA reviewing Kim would 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.*

Kim also fails to provide a POSITA with any guidance with respect to a weight percentage ratio of a trinitrile compound to PP based on a total weight of the electrolyte. Ex. 2015 ¶ 208. The solvents of Kim are only disclosed in *volume percentages*, based on the total amount of the organic solvent (Ex. 1008 ¶¶ [0013], Table 1). Thus, Kim does not contain an explicit or implicit disclosure of the amount of PP in the unit of weight percentage “based on a total weight of the electrolyte,” as required to determine the Y/Z ratio in independent claims 1 and 14 of the ’131 Patent. No information from Kim would allow a POSITA to convert the volume percentages mentioned therein into weight percentages. *Id.* ¶¶ 208-209; Ex. 2040. Thus, Kim fails to provide a POSITA with any guidance as to a ratio based on weight percentages of components, let alone weight percentages of the components based

on a total weight of the electrolyte. Indeed, a POSITA would not be motivated to turn to Kim from Zeng at least because the solvents of Zeng are set forth in a relative mass ratio and Kim only discloses its solvents in volume percentages. *Id.*

Additionally, Kim's Examples 1 and 2 and Comparative Examples 1 to 6 use dinitrile amounts of 3 wt% or 1 wt% and use trinitrile amounts of 0 or 2 wt%. Ex. 1008, Table 1). In all cases, the dinitrile plus trinitrile amounts uniformly sum to 3 wt%. In the language of the '131 Patent, *all* of Kim's embodiments are $X+Y = 3$ wt% and X/Y is either *0.5* or *infinity* (i.e. divide by zero). Ex. 2015 ¶ 210. Thus, despite Petitioner's suggestion otherwise, there is little variation and no experimentation in Kim to suggest to a POSITA that there should be a preferred or critical range of values for the combination 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. *Id.*

Finally, a POSITA would not be motivated to combine Kim and Zeng. Kim does not contain any teaching to prevent increases in the internal DC resistance of a battery, which is a main objective of the '131 Patent. Nor would a POSITA be led to introduce DC resistance testing as "routine" or "standard practice" to Kim as alleged by Petitioner. Pet. 60. Indeed, battery performance can be measured in numerous ways and which test(s) a POSITA would choose depends on a number of factors (including the battery's intended application) such that no one test is

“routine” or “standard practice” as Petitioner asserts. Ex. 2015 ¶¶ 213-214; Ex. 2032; Ex. 2033. Kim also contains no teachings to improve electrode plate wettability and interfacial compatibility, which are main objectives of Zeng. *See e.g.*, Ex. 1006, Abstract; Ex. 2015 ¶ 211. Instead, Kim simply aims to increase the thermal stability of a battery through the use of “an electrolyte additive including greater than or equal to about three nitrile groups.” Ex. 1008 ¶¶ [0055]-[0056]. Kim describes that this purpose may be further served by the optional addition of an additive intended to suppress the generation of gas in the electrodes during storage at high temperatures. Ex. 1008 ¶ [0064]. The additive may be selected from a variety of classes of compounds and may be present in a wide range of concentrations from about 0.01 to 20% by weight of the total weight of the electrolyte composition. Ex. 1008 ¶¶ [0064]-[0065]. Examples 1 and 2 include succinonitrile (the only dinitrile compound mentioned at all in Kim) as an example of this additive, but Kim provides no single comparative example investigating whether succinonitrile has a beneficial effect on the electrolyte compositions. Ex. 2015 ¶ 211.

Again, Petitioner does not provide *any* motivation to combine Kim with Zeng/Sunose or Zeng/Matsuoka/Sunose, and, thus, Ground 1C fails.

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.

D. Grounds 2A-2C

The deficiencies discussed with respect to Zeng and Sunose in combination with Matsuoka and/or Kim in Grounds 1A-1C apply equally to these grounds and Su does not cure such deficiencies. Therefore, Petitioner fails to establish that Claims 3 and 16 are unpatentable. Ex. 2015 ¶¶ 216-219.

E. Ground 3A: 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. However, Zhou and Sunose fail to teach, suggest, disclose, or otherwise render obvious at least electrode compaction density ratio of [1.6] and [14.6] and the trinitrile to PP ratio of [1.7] and [14.7]. Ex. 2015 ¶¶ 220-235.

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

The Petition cites overlapping and baseless rationales as to why a POSITA would have selected or implemented Example 8 of Zhou. Pet. 60-66. Once

untangled, it is clear that Petitioner has failed to provide any sufficient rationale for implementing Zhou, let alone Example 8.

Zhou is fundamentally different from the electrolyte claimed by the '131 Patent. A POSITA would not have selected or implemented Zhou because 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. It was an objective of the '131 Patent to provide electrolyte compositions that prevent premature degradation of the electrolyte and thus deterioration of the battery material with reduced battery capacity, especially for electrochemical devices working at voltages above 4.4V, such as 4.45V. *Id.* ¶ 243. On the contrary, Zhou is silent with respect to cathode SEI film formation or high-voltage operation as its objective is a fast-charging electrolyte, which emphasizes better wettability, lower viscosity, and lower lithium-ion transmission resistance. *Id.* ¶ 244; Ex. 1014 ¶ [0003]. Indeed, Zhou 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 of the '131 Patent. *Id.* ¶ 245. As Dr. Wheeler explains, a POSITA would know that small voltage differences can lead to substantial (e.g., exponential) differences in rates of reaction. *Id.* 4.35V is also considered the extreme upper voltage limit for commercially produced cells employing LiCoO₂ (also known as 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 to be insufficient when faced with the decomposition and premature degradation problem of the '131 Patent because the DC internal resistance of the '131 Patent differs from the AC impedance studied in Zhou. Ex. 2015 ¶¶ 246-247. DC internal resistance represents the resistance when the battery is in working condition and produces a weighted average of multiple operationally relevant resistances, is particularly relevant to the power performance of the battery and its performance when under load, and is of great significance to the battery's discharge capacity and charging efficiency. *Id.* AC impedance, however, is used in battery research and development, quality control, and electrochemical analysis because it is designed to give a linear response that can be better understood, with the limitation that such linear response means the AC measurement does not generally incorporate "polarization," which happens when a cell in operation experiences large potential and concentration variations. *Id.*

A POSITA also would not have selected or implemented Zhou due to multiple erroneous references to different or non-existent comparative examples in nearly every Example and Comparative Example set forth in Zhou. Ex. 2015 ¶ 248.

**2. A POSITA Would Not Have Selected or Implemented
Zhou's Example 8**

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

First, Petitioner's reliance on an alleged "recognized problem/need" in Zhou for "fast charging" necessarily fails because it materially differs from the problem faced in the '131 Patent—the electrolyte formulation purposes in Zhou are not aligned with the objective task underlying the '131 Patent. Ex. 2015 ¶¶ 241-247; Ex. 1001, 1:30-39, 1:55-62, 3:8-20, 22:24-29; Ex. 1014 ¶ [0003].

Second, 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:

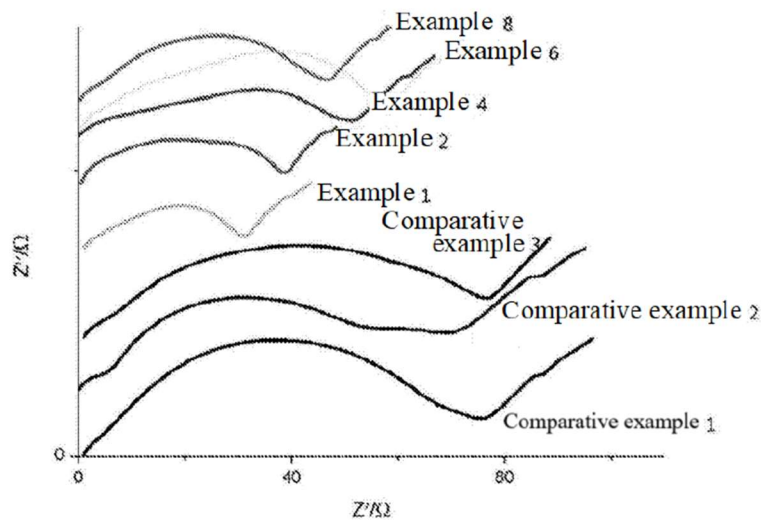


FIG. 4

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, 2, and 3 are stacked vertically simply 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:

From Figure 4, it can be found 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. Ex. 2015 ¶ 253. This misunderstanding of Zhou further undercuts the reliability of Dr. Lucht’s opinions and demonstrates why Petitioner’s proposed rationales fail.

Third, 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 the high temperature performance of the battery. 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 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, the Petition'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.

Fourth, Zhou teaches away from the combination of a dinitrile compound and a trinitrile compound in its electrolyte solutions because the dinitrile contains less nitrile groups for the same volume, such that a POSITA would not have selected or implemented Example 8 because it contains both a dinitrile compound and a trinitrile compound, which Zhou teaches the POSITA to explicitly avoid. Ex. 2015 ¶ 258; Ex. 1014 ¶¶ [0046]-[0047], [0059] ("[a]n efficient high temperature additive is the best choice. Nitrile compounds containing 2 or 3 nitrile functional groups, *such as 1,3,6-*

hexane trinitrile, contain three nitrile groups, and the density of nitrile groups per unit volume is higher. It has better compatibility with the negative electrode and is easier to protect the positive electrode. The high temperature improvement effect of other dinitrile compounds or mononitrile compounds is relatively poor. This requires more nitrile to compensate. However, excessive addition of nitrile has a negative effect on the cycle performance, especially in the case of fast charging, this phenomenon is more obvious, and the cycle performance will drop rapidly.”) (emphasis added).

Fifth, there is no unambiguous data that would indicate to or encourage a POSITA to choose any particular embodiment of Zhou over another. Ex. 2015 ¶ 259; Ex. 1014 FIGS. 1 (Examples 1 and 2 are absent), 2 (Examples 3 and 6-8 are absent), 3 (Examples 3, 4, 7, and 8 are absent and Comparative Example 1 is depicted as having two distinct curves), and 4 (Examples 3, 5, and 7 are absent), ¶¶ [0060]-[0063].

Finally, the solvent composition of Example 8 is wrong 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 add up to 100. 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 that such mass ratio directly corresponds to weight percentages 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 wt%, 30 wt%, 10 wt%, 20 wt%, and 5 wt%). It is unknown if there is an additional, different solvent component present at 10 wt%, if there is an additional 10 wt% of one or more of the identified solvent components, or if each wt% should be multiplied by 10/9. A POSITA would have disregarded Example 8 at least based on this weight discrepancy. *Id.*

3. Assumptions With Respect to Example 8 of Zhou are Improper

Petitioner relies on Dr. Lucht's improper assumptions to erroneously interpret Zhou's Example 8 which permeates each of his resulting calculations of the alleged weight percentages of dinitrile, trinitrile, and PP, as well as the corresponding claimed weight percentage sums and ratios. Ex. 2015 ¶¶ 262-265. Ex. 1014 ¶¶ [0046]-[0047]. Both Petitioner and Dr. Lucht assume that the mass percentages provided by Zhou in Example 8 for various additives (including ADN and HTC�) and for lithium salt are all based on the total mass of the final electrolyte solution. Pet. 62 (citing Ex. 1014 ¶¶ [0009], [0013]-[0016], [0018]); Ex. 1003 ¶¶ [0183]-[0189]; Ex. 2015 ¶ 263. That is, Dr. Lucht's calculations with respect to Example 8 assumes that the denominator for determining the identified "% by mass" of each of

the additives and the lithium salt is the total mass of the lithium-ion battery electrolyte (i.e., the final electrolyte solution). Ex. 2015 ¶ 263. However, Example 8 of Zhou is silent as to what the identified mass percentages are relative to and is subject to at least two other interpretations by the POSITA. *Id.* ¶ 264. For example and in view of the silence regarding identified mass percentages, a POSITA would interpret Example 8 of Zhou such that the identified mass percentages of the additives and the lithium salt are relative to *only* to the mass of the solvents, not the total mass of the electrolyte such that the denominator for determining the identified “% by mass” of each of the additives and the lithium salt is the mass of the solvents. *Id.* Alternatively, the identified mass percentages of the additives and salt are according to their respective placements in the sequence of mixing steps. *Id.* Example 8 describes three steps: (1) mix solvents in mass ratio, (2) add the additives to the mixed solvents such that the identified mass percentages are based on the mass of the mixed solvents formed in Step 1, and (3) add the lithium salt such that the mass percentage is based on the combined mass of the solvent and additives mixture formed in Step 2. *Id.* In this interpretation, the denominator for determining the identified “% by mass” of each additive is the mass of the solvents, and the denominator for determining the identified “% by mass” of the lithium salt is the combined mass of the solvents and the additives. *Id.*

Petitioner and Dr. Lucht have thus failed to address at least these interpretations of the relative denominator of the mass percentages identified in Example 8, and Dr. Lucht's flawed assumptions otherwise permeate each of his resulting calculations of the alleged weight percentages of dinitrile, trinitrile, and PP, as well as the corresponding claimed weight percentage sums and ratios such that they should be disregarded. Ex. 2015 ¶ 265.

4. A POSITA Would Not Substitute PP for Ethyl Acetate in Example 8 of Zhou

Even though *none* of the examples in Zhou include PP, Petitioner primarily 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 with EA in Zhou's Example 8. Ex. 2015 ¶ 266. Thus, Petitioner cannot show that Zhou and Sunose render obvious at least the claimed Z and Y/Z values.

First, although PP is identified as a potential linear carboxylic acid ester in Zhou, there is no preference, special significance, or even the slightest 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 complex combinations of various compounds in electrolyte solutions are extremely complex and

unpredictable, and a POSITA would not expect predictable results from adding PP in the place of EA. *Id.*

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 is would not have had a reasonable expectation of success in replacing PP for EA in Example 8 of Zhou, 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. As Dr. Wheeler explains, 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 1-8,⁴ its melting point is also nearly 10°C higher than the melting point of EA (-84°C), and its viscosity is

⁴ “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.

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 weight percentage ratio, without accounting for its differing parameters (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.

Finally, Petitioner’s simple swap 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, a component may promote one desirable property and simultaneously inhibit another desirable property. *Id.* (discussing similarity of structures of ethylene carbonate (EC) and propylene carbonate (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).

5. The Petition 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 1A, *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. Ex. 2015 ¶¶ 276-277. 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 cannot be directly compared with 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 a similar additives as Zhou. *Id.* ¶ 278. Indeed, insofar as Zhou attempts to improve the electrolyte for high-rate charge and discharge battery operation and teaches nothing about how the configuration or compaction of coatings on the current collector would affect this problem, and insofar as Sunose attempts to solve a compaction problem that occurred on particular roller mill equipment and teaches nothing about how electrolyte composition has bearing on such a problem, there is no logical connection between Zhou and Sunose. *Id.* ¶ 279.

As described *supra*, Sunose is replete with clearly erroneous values and a POSITA would therefore be deterred from its teachings. *Id.* ¶¶ 278-280; Section VI.A.4.

6. Dependent Claims

Claims 2, 4-7, 12, 15, and 17 are not unpatentable over Zhou and Sunose for at least the reasons discussed with respect to claims 1 and 14. Ex. 2015 ¶ 281.

F. Ground 3C: Zhou, Sunose, and Kim Do Not Render Obvious Claims 1, 2, 4-7, 12, 14, 15, and 17

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

Petitioner presents a single paragraph in support of Grounds 3C and 4C, purporting that “Kim motivates considering the ratio of trinitrile to PP in Zhou and substituting EA for PP in Zhou Example 8.” Pet. 76. For the reasons discussed above, Kim is replete with internally contradicting data, statistical uncertainty, and woefully inadequate experimental procedure details from which a POSITA could draw any conclusions and would therefore be deterred from the teachings of Kim. Ex. 2015 ¶ 284. Moreover, Kim fails to provide a POSITA with any guidance with respect to a Y/Z ratio based on a total weight of the electrolyte because Kim’s solvents are only disclosed in volume percentages and no information from Kim can convert those percentages into weight percentages. *Id.* ¶ 285.

Petitioner asserts that “Zhou discloses substituting EA with PP, drawing attention to PP,” however, as discussed in Ground 3A, although PP is identified as a potential linear carboxylic acid ester, there is no preference or slightest indication for the POSITA to select PP since PP is not used in any of the Comparative Examples

or Examples of Zhou or otherwise tested for its functionality. Ex. 2015 ¶¶ 267, 282-283; Ex. 1014 ¶¶ [0026]-[0048], [0052]-[0055].

Citing paragraph [0059] of Zhou, the Petition asserts 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. However, Paragraph [0059] of Zhou says nothing about any amount of PP, excessive or otherwise. Ex. 2015 ¶ 286.

Ground 3C fails.

2. Dependent Claims

Claims 2, 4-7, 12, 15, and 17 are not unpatentable over Zhou, Sunose, and Kim for at least the same reasons as claims 1 and 14. Ex. 2015 ¶ 287.

G. Grounds 4A and 4C

The deficiencies discussed with respect to Grounds 3A and 3C apply equally to these grounds and Su does not cure such deficiencies. Therefore, Petitioner fails to establish that Claims 3 and 16 are unpatentable. Ex. 2015 ¶¶ 288-289.

H. Petitioner’s 12 Different Flawed Grounds Merit Denial

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

I. Petitioner Disagrees with its Construction

Petitioner asserts that its own proffered construction of 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”). “Petitioner does not satisfy Rule 42.104(b)(3) when, in a proceeding applying the *Phillips* claim-construction standard, it ‘expressly disagree[s] with its proffered constructions.’” *Hologic, Inc. v. Enzo Life Sciences, Inc.*, IPR2018-00019, Paper 21, 6 (P.T.A.B. Nov. 28, 2018). This Petition fails for at least this additional reason.

VII. CONCLUSION

Patent Owner respectfully submits that the Board should deny institution.

Dated: June 9, 2025

Respectfully submitted,

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

CERTIFICATION UNDER 37 C.F.R. §42.24

Pursuant to 37 C.F.R. §42.24(d), I certify that this preliminary response complies with the type-volume limits of 37 C.F.R. §42.24(b)(1) because it contains 13,973 words, according to the word-processing system used to prepare this preliminary response, excluding the parts of this preliminary 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).

Dated: June 9, 2025

By: / Christopher TL Douglas /
Christopher TL Douglas

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §42.6(e), the undersigned hereby certifies that true and correct copies of the foregoing **PATENT OWNER'S PRELIMINARY RESPONSE and NINGDE AMPEREX TECH. EXHIBITS 2015-2040** were served in their entirety on June 9, 2025 by filing this document through the PTAB's P-TACTS Filing System as well as delivering a true and correct copy by electronic mail on Petitioner's lead and backup counsel at the following email addresses (as agreed by counsel for Petitioner):

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