

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

IPR2025-00722
Patent 11,799,131

PATENT OWNER'S PRELIMINARY RESPONSE

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<i>R.J. Reynolds Vapor Co. v. Fontem Holdings I B.V.</i> , IPR2016-01692, Paper 45 (P.T.A.B. Mar. 2, 2018).....	26

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2001	Second Amended Complaint, <i>Ningde Amperex Tech. Ltd. v. Zhuhai CosMX Battery Co.</i> , Case No. 2:24-cv-00728-JRG, ECF No. 23 (E.D. Tex. Jan. 28, 2025)
2002	Scheduling Order, <i>Ningde Amperex Tech. Ltd. v. Zhuhai CosMX Battery Co.</i> , Case No. 2:24-cv-00728-JRG, ECF No. 27 (E.D. Tex. Feb. 6, 2025)
2003	CosMX Invalidity Contentions Cover Pleading, <i>Ningde Amperex Tech. Ltd. v. Zhuhai CosMX Battery Co.</i> , Case No. 2:24-cv-00728-JRG (E.D. Tex. Jan. 7, 2025)
2004	Summons to attend oral proceedings in German Case No. 3 Ni 12/23 (EP) (“Germany Order 1”)
2005	Summons to attend oral proceedings in German Case No. 3 Ni 12/24 (EP) (“Germany Order 2”)
2006	Docket Navigator Time-to-Trial Statistics for Judge Rodney Gilstrap (accessed July 2, 2025)
2007	Docket, <i>Ningde Amperex Tech. Ltd. v. Zhuhai CosMX Battery Co.</i> , Case No. 2:22-cv-00232 (E.D. Tex.)
2008	Joint Motion for Entry of Protective Order, <i>Ningde Amperex Tech. Ltd. v. Zhuhai CosMX Battery Co.</i> , No. 2:24-cv-00728-JRG, ECF No. 30 (E.D. Tex. Feb. 11, 2025)
2009	Amended Final Judgment, <i>Ningde Amperex Tech. Ltd. v. Zhuhai CosMX Battery Co.</i> , Case No. 2:22-cv-00232, ECF No. 427 (E.D. Tex.)

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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”

Exhibit Number	Description
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>Reserved</i>
2035	<i>Reserved</i>
2036	<i>Reserved</i>
2037	<i>Reserved</i>
2038	<i>Reserved</i>
2039	<i>Reserved</i>
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)

Exhibit Number	Description
2041	M. Abdollahifar, H. Cavers, S. Scheffler, A. Diener, M. Lippke, A. Kwade, <i>Insights into Influencing Electrode Calendering on the Battery Performance</i> . Adv. Energy Mater. 2023, 13, 2300973.

I. INTRODUCTION

Ningde Ampere Technology Ltd. (“ATL” or “Patent Owner”) respectfully submits this Preliminary Response (“POPR”) to the Petition filed by Zhuhai CosMX Battery Co., Ltd. (“Petitioner” or “CosMX”). Paper 2 (“Pet.”). The Petition seeks *inter partes* review (“IPR”) of claims 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. Because **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. Moreover, Petitioner’s reliance on a reference that fails to identify electrode compaction density values for an electrode with a single-sided coating fails. As such, Petitioner fails to meet its burden.

II. BACKGROUND¹

The '131 Patent 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. *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 ($D1/D2$), they could obtain desirable electrode characteristics. *Id.* 20:65-21:20.

III. LEVEL OF ORDINARY SKILL IN THE ART

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., 15; Ex. 2015 ¶¶ 54-56.

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

IV. CLAIM CONSTRUCTION

Petitioner contends that “[n]o claim terms require express construction,” but further asserts “that the electrode structure recited in claims 14-16—including first and second electrodes respectively having single- and double-sided coatings—corresponds to ’131 Patent Figures 2 and 3,” which is a different construction than Petitioner urged in IPR2025-00431. Pet. 15.² Petitioner is not entitled to institution of two petitions covering two different constructions. *See* Patent Owner’s Response to Petitioner’s Explanation of Parallel Petitions; *see also* *CrowdStrike, Inc. v. GoSecure, Inc.*, IPR2025-00068, Paper 25 (P.T.A.B. June 25, 2025) (informative). Regardless, 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 .

V. ARGUMENT

A. Ground 1A: Zeng and Hirai Do Not Render Obvious Claims 14-17

Petitioner relies on Zeng for all elements of claim 14, except elements [14.4]-[14.6], for which Petitioner relies on Hirai. *Id.* 18-44; Ex. 2015 ¶¶ 58-60, 65. Ground 1A fails.

² ATL reserves the right to later address constructions and/or POSITA.

1. A POSITA Would Not Select Embodiments 4 or 6

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 Zeng's embodiments are ambiguous due to at least the addition of an unknown amount of lithium salt solution, 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. 22-23; Ex. 2015 ¶¶ 76-78.

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 or elevate them from the remaining potential embodiments and there is no unambiguous data in Zeng that would encourage a POSITA to choose these embodiments over the others. Ex. 2015 ¶¶ 61-64, 73-77; 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 "[e]xcept

Embodiments 2 and 5, Embodiment 6 had the best capacity retention...and Embodiment 4 had excellent capacity retention” disregards the fact that Embodiments 2 and 5 did not contain *any* trinitrile compound. Pet., 23; Ex. 2015 ¶ 74; Ex. 1006 ¶¶ [0045]-[0046].

Embodiments 1 and 8 also did not contain any trinitrile compound and had better capacity retention rates than Embodiment 4. Ex. 2015 ¶ 74; Ex. 1006 ¶¶ [0045]-[0046]. Because capacity retention is important to Zeng, a POSITA would interpret Zeng as teaching that the addition of a trinitrile compound *negatively* impacts the capacity retention rate since 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 because Zeng *teaches away* from selecting those embodiments. *Id.* ¶¶ 74, 76; Ex. 1006 ¶¶ [0039]-[0042], [0045]-[0046]. 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.* ¶ 75.

Petitioner also fails to establish that Embodiments 4 and 6 would have been obvious to try. Pet. 22-24; Ex. 2015 ¶¶ 79-85. Zeng does not articulate the problem

or the solution of the '131 Patent. *Id.* ¶¶ 61-62, 80; 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 ¶¶ 81-83. 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.* ¶ 72; *see In re Kubin*, 561 F.3d 1351, 1359–60 (Fed. Cir. 2009).

Nor does Petitioner establish a reasonable expectation of success 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. Ex. 2015 ¶¶ 73-75, 84-86.

2. The Petition Fails to Show That Zeng and Hirai Render Obvious the Claimed Y/Z of Claim 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 ¶¶ 90-93. But Zeng is unconcerned with the weight percentage of PP based on a total weight of the electrolyte, and with Y/Z. Ex. 2015 ¶¶ 62, 90-94. Given the critical nature of the claimed ratio, Zeng’s lack of disclosure is *fatal*. See Section V.A.2.b., *infra*.

Zeng provides insufficient information to determine a weight percentage of PP or the claimed trinitrile to PP ratio in each of Embodiments 4 and 6. *Id.* ¶ 92. 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.* ¶ 93. Indeed, Zeng is not even concerned with the mass of organic solvents, as all Zeng discloses is a *mass ratio between solvents*. *Id.*; see also, Ex. 1006 ¶¶ [0036]-[0037], [0045]-[0046].

Despite these shortcomings, 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.* ¶ 94. Such flawed assumptions render Dr. Lucht's resulting calculations unreliable. *Id.* ¶¶ 95-103. 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 LiPF₆ 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 ¶ 104. Despite this explicit recitation (which means that a POSITA would understand that LiPF₆ 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, wrongly asserting that “a POSITA would understand this to mean adding (solid) LiPF₆ to the specified...solvent mixture to reach a concentration of 1.0 mol/L LiPF₆.” Pet. 18-19, n.6 (citing Ex. 1003 ¶ 66, n.6); Ex. 2015 ¶¶ 105-106. Such assumptions that (1) LiPF₆ is in solid form, and (2) such solid LiPF₆ 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 ¶ 106. Essentially, Petitioner argues that Zeng's literal disclosure is incorrect,.

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 ¶¶ 107-108; 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 ¶ 109.

Moreover, the commercial distribution of "battery grade" 1.0 mol/L LiPF_6 premixed solutions with different solvents was well known to achieve a desired electrolyte mixture for use in batteries. Ex. 2015 ¶ 107; Exs. 2017-2021; *see also*, Ex. 1003 ¶ 66, 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. 19, n.6; Ex. 2015 ¶¶ 110-113. 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 LiPF₆ solution. Ex. 2015 ¶ 112. There is nothing in Zeng indicating an intended final concentration of LiPF₆ in the electrolyte mixtures such that Petitioner cannot discern an intention in Zeng that would be “disrupted” by the addition of LiPF₆ in a pre-mixed and not solid state. *Id.* ¶ 113.

It is based on this erroneous solid LiPF₆ salt assumption, “assuming a hypothetical case where LiPF₆ 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 estimate a “maximum weight percentage” for PP in each of Embodiments 4 and 6, followed by the acknowledgment that LiPF₆ does have a non-zero weight to result in his calculations of the alleged weight percentages of PP of less than 17.66 wt%

³ Because Zeng *does* teach using a premixed salt solution, Petitioner admits it cannot ascertain the ultimate concentration of LiPF₆ and the claimed amounts of the solvent components, so its Zeng-based grounds fail.

and less than 17.70 wt%. Ex. 1003, ¶¶ 66-70, 73-74; Ex. 2015 ¶¶ 96-103. 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. 22. Dr. Lucht fails to consider the fact that Zeng ***does not require PP to be present*** at all. Ex. 2015 ¶ 101. 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], [0032] ("with the aid of the property of low viscosity of carboxylic acid ester").

Zeng discloses the addition of a lithium salt in *solution* form, 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 ¶¶ 102, 112-116. These unknowns render Dr. Lucht's estimates of the alleged weight percentages of PP of less than 17.66 wt% and less than 17.70 wt% and, in turn, the alleged Y/Z values of >0.057 and >0.056 in Embodiments 4 and 6, incorrect. *Id.* Indeed, when considering a related European patent, a German federal

patent court confirmed 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. There is simply not enough information to reliably perform Petitioner’s calculations. Ex. 2015 ¶¶ 115-116.

b. The Y/Z Range is Critical

Even assuming 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 claim 14 because the claimed Y/Z range is *critical* to providing the advantages of the ’131 Patent and is not disclosed by Zeng. *E.I. du Pont de Nemours & Co. v. Synvina C.V.*, 904 F.3d 996, 1006 (Fed. Cir. 2018) (citation omitted); *see also* Ex. 2015 ¶ 117.

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 mixture*), and even the ratio between those values (which is not the claimed ratio) would still be broader than the claimed Y/Z range in claim 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 ¶ 118 (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 ¶ 118.

Similarly, a trinitrile compound's presence is not even required—the amount of trinitrile in Zeng's electrolyte solution may be zero. *Id.*, ¶ 119; 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). 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 ¶¶ 73-75. 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 $0.01 \leq (Y/Z) \leq \text{about } 0.3$. *Id.*, ¶ 119.

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. *Id.*, ¶ 120; Ex. 1001, 1:55-

62; 28:56-64. Zeng fails to disclose any such criticality of the claimed Y/Z value range or any advantages of the '131 Patent that such a narrow, specific Y/Z range provides. Ex. 2015 ¶¶ 117-123. Indeed, 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.* ¶¶ 123-124. Accordingly, because of the criticality of the claimed Y/Z value range, such claimed range is not obvious in view of Zeng. *E.I. du Pont*, 904 F.3d at 1008.

3. The Petition Fails to Show that Zeng and Hirai Render Obvious the Claimed First Electrode of Claim 14

Trying to remedy the absence of the claimed electrode configuration and electrode compaction densities in Zeng, Petitioner relies on a hindsight driven agglomeration of multiple different figures and examples in Hirai, alleging that Hirai in turn discloses elements [14.4]-[14.6]. Pet. 26-37; *see also*, Ex. 1003 ¶ 90-122; Ex. 2015 ¶¶ 125-136.

Hirai does not disclose any embodiment that includes both a single-sided and a double-sided coating, and Petitioner fails to make out a case to combine the

disparate embodiments it relies on.⁴ Petitioner hides this shortcoming by first pointing to Hirai's FIG. 2, asserting that either of the outermost electrodes "corresponds to the claimed *first electrode*" and either inner electrode of the same type "corresponds to the claimed *second electrode*," as recited in element [14.5]. Pet. 29. Yet, Petitioner and Dr. Lucht then point to completely different embodiments in Hirai for other recitations (e.g., the fifth means corresponding to Example 5 and the sixth means corresponding to Example 6) ***that only describe electrodes with double-sided coatings***, incorrectly implying that the "electrode density" of the outermost electrodes in such Hirai Examples disclose the claimed D1 and that Hirai discloses the claimed electrode compaction density of "about $0.8 \leq D1/D2 \leq$ about 1.2" as recited in element [14.6]. Pet. 26-37; Ex. 2015 ¶¶ 130-131. Realizing that Hirai fails to disclose that an electrode compaction density of the first electrode ***comprising the single-sided coating*** is D1 (where about $0.8 \leq D1/D2 \leq$ about 1.2), Petitioner relies on

⁴ Because Petitioner relies on distinct embodiments, Petitioner must explain why the POSITA would have combined the teachings of those embodiments specifically. See, e.g., *Abiomed, Inc. v. Maquet Cardiovascular, LLC*, IPR2017-01205, Paper 8, 8-12 (P.T.A.B. Oct. 23, 2017); *In re Stepan Co.*, 868 F. 3d 1342, 1346, n.1 (Fed. Cir. 2017).

impermissible hindsight to modify double-sided coatings in the outermost electrodes in Hirai's Examples 5 and 6 to instead use single-sided coatings.

Petitioner, without support, asserts that "a POSITA would have found it obvious to alternatively use single-sided coatings on the outermost electrodes in accordance with Hirai's typical Figures 1-2 structure, with comparable results" and "it would have been obvious to alternatively implement Example 6 with single-sided coatings on the outermost electrodes according to Hirai's typical Figures 1-2 structure." Pet. 34-36 (citing Ex. 1003 ¶¶ 106, 108). This argument fails. Ex. 2015 ¶¶ 132-133. Indeed, Petitioner's assertions that "[t]he compaction density in Example 5 was intentionally controlled, and a single-sided coating would have been equally controllable," and "[t]o achieve consistent energy density, a POSITA would have controlled the single-sided coating to the same compaction density" (Pet. 35), blatantly ignore factors a POSITA would necessarily consider. Ex. 2015 ¶¶ 134-136.

First, the "electrode densities" disclosed for Hirai's Examples 5 and 6 are *only* for electrodes having double-sided coatings with particular thicknesses and Petitioner has not shown how such densities would even be achievable with the single-sided coatings of Hirai's FIGs. 1-2. *Id.* ¶ 134; *see also e.g.*, Ex. 1010 ¶ [0245] and Table 9, ¶ [0254] and Table 11. For example, the electrode densities relied on by Petitioner (Pet. 33-37) are *average* densities for electrodes with a double-sided coating, and Hirai is silent as to whether both sides of the electrode are equally

distributed and, as such, the respective density of the coating on either side of the electrode is unknown. Ex. 2015 ¶ 134. Indeed, simply removing the active layer coating from one side of a current collector, or failing to coat the second side altogether, would not result in the exact same density as the disclosed double-sided average value. *Id.* Thus, the “electrode densities” disclosed for the double-side electrodes of Hirai’s Examples 5 and 6 are fundamentally different from the claimed D1 and a POSITA would not have controlled any alleged single-sided coating to the same compaction density.

Second, the end use of a battery requires that its constituents be designed to fit within certain spatial parameters. *Id.* Consequently, a POSITA would be discouraged from altering the outermost layer in Hirai’s Examples 5 and 6 to use a single-sided coating because to do so would necessarily involve removing the active layer coating from one side of a current collector, thereby requiring the POSITA to re-distribute that mass and volume (including the thickness and density of remaining active material coatings) so that the battery still fits within the spatial parameters. In addition, the POSITA would also necessarily re-optimize, reconsider, or otherwise vary other properties throughout the battery to maintain the battery’s performance. In other words, removing the active layer coating from one side of a current collector as asserted by Petitioner would cause a cascading series of downstream effects that the POSITA would need to, but could not reasonably, solve to maintain the

purported performance of the battery. *Id.* Moreover, Hirai's desire to "make the cell volume equal" (Ex. 1010 ¶¶ [0068], [0072], [0190]) and "make the cell thickness equal as a whole" (Ex. 1010 ¶¶ [0067], [0188], [0189]) would further discourage a POSITA from using a single-sided coating for the outermost layer in Hirai's Examples 5 and 6. Ex. 1010 ¶ [0072] (Hirai explaining that "[e]ven if the amount of the cathode or anode active material to be applied is increased, it is also possible to make the cell volume equal by making the opposed electrodes in each lamination equal in energy density (thickness)); *see also*, Ex. 2015 ¶ 134.

Worse still, Hirai's teachings regarding the electrode density value of active material double-sided layers or coatings cannot be directly used or applied as the electrode density value for a single-sided layer or coating of active material, nor would a POSITA be inspired to apply the double-sided layer data to a single-sided system. Ex. 2015 ¶ 135; *see also*, Ex. 2041. Electrode density values are affected by a multitude of parameters (e.g., content of particles, particle sizes, thickness of layer, etc.), and Hirai does not provide a POSITA any guidance on whether (much less how) such parameters of a double-sided layer or coating could or should be adjusted to achieve the same electrode density with a single-sided layer or coating. *Id.* Also, preparing double-sided layers and single-sided layers in rapid sequence on the same equipment would lead to different electrode densities of electrodes having single-sided coatings versus double-sided coatings due to different initial thicknesses. *Id.*

Hirai does not address any of these issues at least because Hirai does not even care about or provide *any* examples of the electrode density of a single-sided coating or layer.

Accordingly, Hirai cannot disclose an electrode compaction density of the single-sided coating (D1) or wherein, about $0.8 \leq D1/D2 \leq 1.2$, such that Zeng and Hirai—alone or in combination—also do not disclose or render obvious elements [14.5] and [14.6].

a. The Claimed D1/D2 Range is Critical

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 ¶¶ 66-69, 137-139. Hirai never mentions anything about specific electrolyte additives or 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.* Hirai and Petitioner provide no reason to select this narrow range.

4. A POSITA Would Not Combine Hirai with Zeng

Petitioner asserts a patchwork of conclusory reasons for their alleged motivation to combine Hirai with Zeng, but each reason necessarily fails.

First, the teachings of Zeng and Hirai are inapplicable to, and incompatible with, each other. Ex. 2015 ¶ 141; Ex. 1010 ¶¶ [0003]-[0010].

Second, Petitioner mischaracterizes Zeng’s “Background Art” summary of lithium-ion battery fields of application in a failed attempt to equate Zeng with Hirai’s focus on “large-size batteries like on-vehicle batteries.” Ex. 2015 ¶ 142 (citing Ex. 1006 ¶¶ [0002]-[0008]); Pet. 38. Indeed, Zeng lists at least the additional field of “digital”, as well as “consumer terminals” (Ex. 1006 ¶¶ [0002]-[0003]), which Hirai specifically distinguishes from its “large-size, laminated-structure batteries.” Ex. 2015 ¶ 142; Ex. 1010 ¶ [0006]. Further, Petitioner advocates a completely different narrative in IPR2025-00431, arguing there that the POSITA would be motivated to use the spiral or wound electrode configuration design of Sunose (the secondary reference relied upon in all grounds of the IPR2025-00431 petition) with Zeng to allegedly increase electrode surface area and improve battery performance. *See* IPR2025-00431, Paper 2.

Third, Petitioner’s TSM argument also necessarily fails because there is no reason a POSITA would have looked to Hirai (or had a reasonable expectation of success in combining Hirai with Zeng) for battery configuration details when Hirai

does not specify anything about electrolytes, much less the relationship between electrode compaction density and an electrolyte having the same or similar additives as Zeng. Ex. 2015 ¶ 142. Indeed, Hirai's and Zeng's electrolyte systems vary vastly (e.g., unlike Zeng, Hirai does not rely on additives, such as dinitriles and trinitriles) such that a POSITA would not be motivated to combine such teachings. *Id.*

Fourth, Petitioner's reliance on Hirai's alleged A/C ratio control "to smoothen power output of the laminated electrodes despite the temperature difference between the inner and outer portions of the battery" (Pet. 39) also fails because the problem Zeng is trying to solve and the mechanism with which Zeng is trying to solve the problem are completely unrelated to "smoothing power output" in a laminated battery. Ex. 2015 ¶ 143.

Fifth, Petitioner's "obvious to try" contentions with respect to the fifth and sixth means and Examples 5 and 6 of Hirai (Pet. 40) also necessarily fail as simply trying to combine Zeng with Hirai at all would not lead a POSITA to combine the references in the manner proposed by Petitioner. Ex. 2015 ¶ 155. Indeed, Zeng is not focused on large lithium-ion batteries or laminated structures, so Petitioner's reliance on Hirai's alleged identification of six Example techniques in a laminated structure configuration to "mak[e] the A/C ratio higher for inner electrodes" is inapposite. Regardless of whether the alleged solutions even address the problem enumerated, there are numerous possible battery configurations beyond Hirai's

complex arrangement and the requirements in the battery art are so challenging and varied from application to application, the set of possible battery configurations and combinations is effectively infinite, and the outcomes unpredictable—there is no design principle that makes Zeng and Hirai complementary or apropos to each other. Ex. 2015 ¶ 156.

Sixth, Hirai's central hypothesis is flawed and clearly erroneous. Ex. 2015 ¶¶ 144-152. Hirai's attempt to discern effects of A/C ratios at high temperatures lacks scientific validity. Ex. 2015 ¶¶ 149-152; Ex. 1010 ¶¶ [0283]-[0288], Table 17; *see also* Ex. 2030. Additionally, Hirai's design incorporating a compensating baseline A/C ratio into the cell is logically and scientifically flawed for multiple reasons. Ex. 2015 ¶¶ 145-146. First, Hirai fails to establish that the A/C ratio in fact becomes a noticeable function of position. Second, such an observation is at best a *temporary* phenomenon and would not be true under most, or even necessarily any, operating conditions. Third, even if the preceding conditions were true, it would only be a problem if the cell were being charged and stored at temperatures well below room temperature. *Id.* It is therefore fundamentally flawed to imply, as Hirai does, that the center of the cell will be at elevated temperature but still cold enough for lithium plating to be a problem. *See id.*

Moreover, at least inasmuch as Hirai's sixth means allegedly "mak[es] the center portion higher than the end portion in A/C ratio," by making "the center

portion [] to be lower than the end portion in the direction of lamination in terms of the cathode electrode density of each single battery layer” (Ex. 1010 ¶ [0072]), yet the purported corresponding Example 6 (upon which Petitioner relies) does not set forth a center portion having a lower cathode electrode density compared to the end portion, a POSITA would not be motivated to rely on any such Example. Ex. 2015 ¶¶ 153-154 (citing Ex. 1010 Tables 11 and 12 and explaining that Example 6 sets forth an example which is directly opposite of the sixth means). Petitioner’s reliance on Hirai’s FIGS. 2 and 3 (Pet at 41) is also misplaced as Hirai’s alleged teaching (based on FIG. 3) that the A/C ratio becomes problematically small in the center of the cell is also scientifically lacking. *Id.*, ¶ 147. Hirai’s FIG. 3 is incomplete and does not teach what Hirai purports to teach, namely, that as temperature is increased, the A/C ratio of the electrodes decreases by a consequential amount. *Id.*, ¶¶ 147-148. (citing Ex.1010 ¶¶ [0007], [0107]-[0109], FIG. 3).

Seventh, a POSITA would not have modified the fifth means, the sixth means, Example 5, or Example 6 of Hirai in order to implement any alleged battery structure having a single-sided coating in the outermost electrodes. *Id.*, ¶ 158; Pet. 41. First, as conceded by Petitioner, Examples 5 and 6 *only* use electrodes with double-sided coatings. Pet. 34, 36; *see also e.g.*, Ex. 1010 ¶¶ [0242]-[0245], [0253]-[0256]; Ex. 2015 ¶ 159. Second, contrary to Petitioner’s unfounded assertion that “[a]s added benefits, fewer layers may reduce manufacturing cost” (Pet. 42), the manufacturing

of cells with both single-sided and double-sided coatings is not a trivial undertaking and is actually quite difficult. Ex. 2015 ¶¶ 160-161; *see also* Ex. 1010 ¶ [0025] (Hirai itself alluding to such considerable cost). A POSITA would not be motivated to try a process that leads to such manufacturing difficulties. *Id.* Third, Petitioner’s proposed change to the coatings on the outermost current collectors (i.e., to convert the double-sided outer layers in Hirai’s examples to single-sided outer layers) also necessarily fails, at least because it would not have a significant effect on heat transfer. *Id.* ¶ 162. Moreover, given that Hirai is purportedly motivated to solve the temperature-unevenness problem (Pet. 37), Hirai itself would have been motivated to improve heat transfer from the cell center to the periphery—yet, Hirai did not make the change suggested by Petitioner. *Id.* Indeed, Petitioner’s assertion that “Hirai’s goal could be achieved with less manipulation of the A/C ratio, potentially allowing simplifying the construction of the various inner electrodes and further reducing cost” (Pet. 42) is directly contrary to Petitioner’s assertion that a POSITA would even be led to Hirai in the first place. *Id.*

Eighth, Petitioner also fails to establish a reasonable expectation of success. Ex. 2015 ¶¶ 163-165; Ex. 1006 ¶ [0003]; Ex. 1010 ¶ [0006]. There is no reason a POSITA would have looked to Hirai (or had a reasonable expectation of success in combining Hirai with Zeng) for battery configuration details when Hirai 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.* As an illustrative analogy, if Zeng and Hirai were both working to improve automobile performance, Zeng would disclose an improved gasoline fuel additive and Hirai would disclose an improved radiator for heat dissipation. A POSITA would not combine the two disclosures as they teach remedies to entirely different problems in a complicated engineering system. *Id.*, ¶¶ 164-165.

Thus, Petitioner does not provide sufficient motivation to combine and, thus, Ground 1A fails. Ex. *Id.*, ¶ 166.

5. Dependent Claims

Claims 15-17 are not unpatentable for at least the same reasons as claim 14. *Id.*, ¶ 167.

B. Ground 1B: Zeng, Hirai, and Matsuoka Do Not Render Obvious Claims 14-17

For the same reasons as discussed *supra* at Section V.A. in Ground 1A, Petitioner fails to establish that at least one Challenged Claim of Ground 1B is unpatentable in view of Zeng and Hirai, and likewise fails with respect to Zeng/Hirai in view of Matsuoka.

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 references' clear disclosures. *See* Pet. 51. Indeed, nothing

in Zeng would instigate, prompt, or otherwise motivate a POSITA to 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 ¶¶ 169-170. As explained above at Section V.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 ¶¶ 171, 177; Ex. 1007 ¶¶ [0036], [0038]-[0040]). However, Petitioner hastily concludes 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 asserting 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. 51-52. 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 ¶¶ 172-173; Ex. 1007 ¶¶ [0038], [0040]. Petitioner’s alleged reliance on the PP isomers having such energies “falling in or near most-preferred ranges” is inconsequential because almost all 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 ¶ 173. Neither PP isomer is given special significance in Matsuoka, nor is the effect of such PP compounds clearly stated. *Id.*, ¶ 172; 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.* ¶ 174.

Finally, when considering a related European patent, a German federal patent court confirmed that in Matsuoka’s disclosure (NK9), trinitriles are not relevant and PP is not a preferred non-nitrile additive, so “the ratio of trinitrile compound to PP is also not of significance” to Matsuoka. Ex. 2005, 12.

2. The Petition Fails to Show That Matsuoka Renders Obvious Claim 14's Y/Z Range

Petitioner's reliance on Matsuoka hinges on 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 Hirai, completely disregarding the numerous other components of Zeng's electrolyte that Matsuoka would also consider "non-nitrile additive" components. Ex. 2015 ¶ 176.

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.* ¶ 177; 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 V.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.*

Petitioner also fails to show that Matsuoka renders obvious the claimed Y/Z range, the criticality of which is established *supra* at Section V.A.2.b. Ex. 2015 ¶¶ 175-179. Petitioner’s allegations of overlapping Y/Z ranges of 0.1-10 and 0.033-10 (Pet. 56), that “Matsuoka [] directs the POSITA to PP, specifically, by highlighting PP’s ability to keep battery’s internal resistance low,” 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.* ¶¶ 180-185.

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

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. 54. 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 ¶¶ 170, 186.

Petitioner argues that “the desire for balanced performance” with respect to “electrolyte stability and high-rate performance at low temperatures” 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. 55. 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 ¶¶ 187-198.

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 ¶ 187; 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 ¶ 188; Ex. 1007 ¶¶ [0043], [0109], Tables 3-5. Zeng's Embodiments 4 and 6, on the other hand, do not include any mononitriles as a solvent or an additive, 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.* ¶ 189; 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.”). 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 ¶¶ 190-194 (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 ¶ 195. 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.*, ¶ 196; Ex. 1007 ¶ [0029],

Table 1. Although Matsuoka identifies LiPF_6 as preferable *when used in combination with the required organic lithium salt* (Ex. 1007 ¶ [0030]), LiPF_6 as Zeng (and Hirai) 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 (and Hirai) 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 ¶ 197 (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 Hirai, and, thus, Ground 1B fails. Ex. 2015 ¶ 198.

4. Dependent Claims

Claims 15-17 are not unpatentable for at least the same reasons as claim 14. *Id.*, ¶ 199.

C. Ground 1C: Zeng, Hirai, and Kim-'268, with or without Matsuoka, Do Not Render Obvious Claims 14-17

For the reasons discussed *supra* at Sections V.A. and V.B. with respect to Grounds 1A and 1B, Petitioner also fails with respect to Ground 1C. Ex. 2015 ¶¶ 201-202. Kim-'268 does not address the deficiencies. *Id.* ¶ 200.

Petitioner purports to cure Ground 1A and 1B's deficiencies as a result of "Element [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. 57. Petitioner's allegation that "Kim-'268 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. 58), however, is, again, nonsensical in view of the references. As explained *supra* at Section V.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 such that a POSITA would not turn to any alleged trinitrile teachings of Kim-'268. 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. 58; Ex. 2015 ¶¶ 73-75.

1. The Petition Fails to Show That a POSITA Would Have Been Motivated to Combine Kim-’268 with Zeng or Zeng/Matsuoka and Hirai

Petitioner *never makes a motivation to combine argument at all* 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-’268 with the other references. Pet. 57-62. Petitioner’s failure to provide such an argument is fatal to Kim-’268. *L.A. Biomedical Rsch. Inst. at Harbor-UCLA Med. Ctr. v. Eli Lilly and Co.*, 849 F.3d 1049, 1064 (Fed. Cir. 2017). Even setting aside this fatal deficiency, Kim-’268 is replete with internally contradicting data and woefully inadequate experimental procedure details from which a POSITA could not draw any conclusions. Petitioner mischaracterizes Kim-’268’s measurements and teachings and fails to demonstrate that a POSITA would apply any discerned teachings.

Petitioner asserts that Kim-’268’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. 59-60. Petitioner further asserts that Kim-’268’s Examples 1 and 2 allegedly demonstrate PP’s impact on battery performance and “optimizing the trinitrile (Y)/PP (Z) ratio affects performance.” Pet. 61. Petitioner’s analysis lacks merit. Ex. 2015 ¶¶ 203-218.

To learn anything from Kim-’268’s disclosure, however, a POSITA must examine the experiments on which the disclosure is based. This is difficult, if not impossible, because Kim-’268’s experimental procedures are not articulated in any meaningful way that allows evaluation or reproduction. *See e.g.*, Ex. 1008, FIGS. 3, 5, 7 (“thickness increase”), Table 2, FIGS. 4, 6 (“recovery capacity”, Tables 2, 3, FIGS. 4, 6 (“thickness variation ratio”), and FIG. 7 (“DC capa. to ini. capacity”). Even if the POSITA could (with significant effort) deduce from Table 2 what Kim-’268 meant by “recovery capacity” and “thickness variation” and how those values might be calculated from or related to underlying capacity and thickness measurements, Kim-’268 remains woefully inadequate on experimental procedure details and would still need to depend on Kim-’268 for how to understand and therefore interpret the underlying capacity and thickness measurements. Ex. 2015 ¶ 204.

First, Kim-’268 does not specify how its “capacity” values are measured. *Id.*, ¶ 205. Many different tests can be used to measure capacity and cycling. *Id.*

Likewise, Kim-'268 does not specify how or where its “thickness” values are measured, whether the thickness corresponds to the total thickness of the cell at a particular location or from an ensemble of locations, how multiple values are treated, or whether the thickness is measured under a particular stack pressure, among other conceivable interpretations of “thickness.” *Id.*, ¶ 206.

Second, Kim-'268's data shows that its capacity results are highly dependent on cell format. *Id.*, ¶¶ 207-209. For example, Kim-'268 at Paragraph [0095] describes that Examples 1 and 2 and Comparative Examples 1-6 are embodied in *prismatic* cells. However, at Paragraph [0099], Kim-'268 describes embodiments of the same Examples 1 and 2 and Comparative Examples 1-6 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 is there an explanation 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 ¶ 207. 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.*, ¶¶ 207-208. A POSITA would therefore not be confident in the individual measurements due to their manifest differences by cell format and 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-'268's disclosure with respect to linear sweep voltammetry contradicts itself. Kim-'268 states that the thermal aging measurements on pouch cells were made after standing "for **3 weeks**," whereas Table 3 indicates the same measurements were made after standing "for **4 weeks**." Ex. 1008 ¶¶ [0099]-[0100], Table 3 (emphasis added). It is not clear which of these contradictory statements is correct. Ex. 2015 ¶ 209. Additionally, FIG. 2 of Kim-'268 provides "linear sweep voltammetry" data, purporting to show that Examples 1 and 2 are more electrochemically stable electrolytes than Comparative Examples 1-6 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 ¶ 210. 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-'268'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 ¶ 210.

Fourth, Kim-’268 lacks any information on *how* its battery cell was cycled, which would prevent a POSITA from combining the teachings of Kim-’268 with Zeng or Zeng/Matsuoka with any reasonable expectation of success (even though Petitioner fails to allege such an expectation). Key information for assessing the performance of Kim-’268’s batteries is missing. *Id.*, ¶ 211. Given Kim-’268’s focus on increasing the thermal stability of a battery (Ex. 1008 ¶¶ [0055]-[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.* Regardless, Kim-’268’s summary of cycle life in Table 4 is inconsistent with the data presented in FIG. 7, leading a POSITA away from relying on Kim-’268 at all. *Id.*

Although not explicitly stated by Kim-’268, a POSITA would conclude using test calculations that the “Capacity retention” values in Table 4 of Kim-’268 were computed as the ratio of “Capacity after 250 cycles” to “Initial capacity” in Table 4. Thus, “Capacity retention” in Kim-’268’s Table 4 corresponds directly to “DC capa. to ini. capacity” in Figure 7 of Kim-’268. Ex. 2015 ¶ 212. However, when comparing the capacity retention values for the remaining Comparative Examples 3-6, 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. 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-'268. Ex. 2015 ¶ 213.

Thus, the multiple experiments of Kim-'268 relied upon by Petitioner are not clear or reproducible and are therefore not usable by the POSITA. Pet. 58-61; Ex. 2015 ¶¶ 204-213. Additionally, Kim-'268'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 that is not easily decomposed, effectively inhibits the increase in DC internal resistance, and achieves high capacity density and excellent cycle and storage performances. All of the claimed measurements are inadequately described by Kim-'268, scientifically

problematic, and/or have no explicated connection to such objectives. Ex. 2015 ¶ 218.

Regardless, Kim-'268's Examples 1 and 2 do not motivate a POSITA to adjust the relative amounts of PP and a trinitrile as Petitioner claims. *Id.*, ¶ 214. Even if a POSITA were to retain confidence in Kim-'268'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-'268'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-'268, 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 HTC� as asserted by Petitioner). *Id.*; Pet. 59-61. Indeed, as discussed below, had Kim-'268 intended to connect any comparison of PP to HTC�, Kim-'268 would have aligned their proportion bases rather than express PP in volume percentage in the solvents and HTC� in weight percentage in the total electrolyte.

Nothing in Kim-'268 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”). As stated in Kim-'268, 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-'268 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-'268, and Petitioner provides no motivation to make such a selection. Ex. 2015 ¶ 215. Thus, the POSITA reviewing Kim-'268 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.* Indeed, when considering a related European patent, a German patent court confirmed that Kim-'268 (NK7) does not require PP or provide information regarding the “ratio of the trinitrile compound to PP.” Ex. 2004, 6.

Kim-'268 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 ¶ 216. The solvents of Kim-'268 are only disclosed in *volume percentages*, based on the total amount of the organic solvent. Ex. 1008 ¶ [0013],

Table 1. Thus, Kim-'268 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." No information from Kim-'268 would allow a POSITA to convert the recited volume percentages into weight percentages. Ex. 2015 ¶¶ 216-217; Ex. 2040. Indeed, Kim-'268 suffers from the same complication as Zeng with respect to the lithium salt which appears to be added in solution form with unknown solvents. Ex. 1008 ¶¶ [0023], [0052], [0054], Table 1; Ex. 2015 ¶ 216. Kim-'268 is nonsensical at least inasmuch as the volume sum of the solvents in each Example is 100% yet Kim-'268 still purports to add additives and lithium salt (in solution) for which the volume is not accounted. Ex. 1008, Table 1; Ex. 2015 ¶ 217. Thus, Kim-'268 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-'268 from Zeng at least because the solvents of Zeng are set forth in a relative mass ratio and Kim-'268 only discloses its solvents in volume percentages. Ex. 2015 ¶ 217.

Additionally, the Examples and Comparative Examples of Kim-'268 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-'268's embodiments are $X+Y =$

3 wt% and X/Y is either **0.5** or **infinity** (i.e. divide by zero). *Id.*, ¶ 218. Thus, despite Petitioner's suggestion otherwise, there is little variation and no experimentation in Kim-'268 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 fails to provide any motivation to modify Kim-'268 or Zeng to arrive at the claims. *Id.*

Finally, a POSITA would not be motivated to combine Kim-'268 and Zeng. Kim-'268 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-'268. Pet. 62. 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 ¶¶ 221-223; Ex. 2032; Ex. 2033. Kim-'268 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 ¶ 219. Instead, Kim-'268 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-'268 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-'268) as an example of this additive, but Kim-'268 provides no single comparative example investigating whether succinonitrile has a beneficial effect on the electrolyte compositions. Ex. 2015 ¶ 219.

As discussed *supra* in Section V.B.3 with respect to Zeng, the electrolyte systems of Matsuoka and Kim '268 are also fundamentally different and a POSITA also would not be motivated to combine Matsuoka with Kim '268, Zeng, and Hirai. *Id.*, ¶ 220.

Again, Petitioner does not provide *any* motivation to combine Kim-'268 with Zeng/Hirai or Zeng/Matsuoka/Hirai, and, thus, Ground 1C fails.

2. Dependent Claims

Claims 15-17 are not unpatentable over Zeng, Hirai, and Kim-'268, with or without Matsuoka, for at least the reasons discussed with respect to claim 14. *Id.*, ¶ 224.

D. Grounds 2A-2C

The deficiencies discussed in Grounds 1A-1C apply equally to these grounds and Han does not cure such deficiencies. Therefore, Petitioner fails to establish that claim 15 is unpatentable. *Id.*, ¶¶ 225-228.

E. Ground 3A: Zhou and Hirai Do Not Render Obvious Claims 14-17

Petitioner alleges that Zhou and Hirai render obvious the Challenged Claims. Pet. 62; Ex. 2015 ¶¶ 229-242. However, Zhou and Hirai fail to teach, suggest, disclose, or otherwise render obvious at least the first electrode [14.5], D1 and the claimed electrode compaction ratio [14.6], and the trinitrile to PP ratio of [14.7]. Ex. 2015 ¶¶ 229-290.

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

Petitioner cites baseless rationales as to why a POSITA would have selected or implemented Example 8 of Zhou. Pet. 62-67. Once untangled, it is clear that Petitioner has failed to provide any sufficient rationale for implementing Zhou, let alone Example 8.

A POSITA would not have selected or implemented Zhou because Zhou's electrolyte formulation purposes are not aligned with the objective task underlying the '131 Patent. Ex. 2015 ¶¶ 249-250; 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.* ¶ 250. 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.* ¶ 251; 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.* ¶ 252. 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 LiCoO_2 (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 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 ¶¶ 253-254. 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. *Id.*, ¶ 255.

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 ¶ 256.

First, Petitioner's reliance on an alleged “recognized 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. *Id.*, ¶¶ 249-254; 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 Zhou's FIG. 4 based on his misunderstanding of kinetic performance data depicted by AC impedance spectra. Ex. 2015 ¶¶ 256-264. In particular, Dr. Lucht indicates that Example 8 "outperformed other Examples in low impedance" and specifically, "outperformed Examples 1, 2, 4, and 6 in internal impedance." Ex. 1003 ¶¶ 180, 182; Ex. 2015 ¶ 256. Petitioner's interpretations of Zhou's FIG. 4 (reproduced below) are wrong:

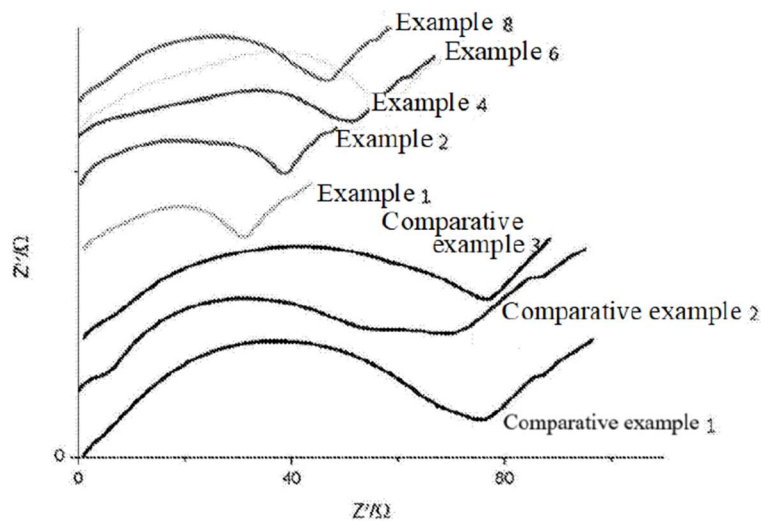


FIG. 4

Ex. 1014, FIG. 4; Ex. 2015 ¶¶ 256-257.

Zhou's FIG. 4 is a Nyquist plot and a common way of presenting AC impedance data. Ex. 2015 ¶ 258. 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.* ¶¶ 259-260; 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 ¶ 258.

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 ¶ 260. Petitioner's proposed rationales and motivations fail.

Third, Zhou's FIG. 3 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. *Id.*, ¶ 261-264; Ex. 1014 ¶¶ [0023], [0024], [0049]-[0050], [0059], [0063], FIGS. 1-4. Petitioner fails to address the fact that the electrolyte solutions of Zhou's Examples 4 and 8 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 ¶ 264. As such, Petitioner's assertion that "[t]he tests showed 'an efficient high temperature additive,' such as 'nitrile compounds containing 2 or 3 nitrile functional groups,' compensates for the fact that 'the high temperature performance is often challenged when using a fast charging solvent system'" (Pet. 91) 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 ¶ 265; 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 ¶ 266; 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 ¶ 267; *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 ¶ 173 (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. *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 ¶¶ 269-272; Ex. 1014 ¶¶ [0046]-[0047]. 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. 63 (citing Ex. 1014 ¶¶ [0009]-[0018]); Ex. 1003 ¶ 173; Ex. 2015 ¶ 270. 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 ¶ 270. However, Zhou's Example 8 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.* ¶ 271. For example and in view of the silence regarding identified mass percentages, a POSITA would interpret Zhou's Example 8 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 ¶ 272.

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 and Petitioner cannot show that Zhou/Hirai render obvious at least the claimed Y/Z.

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 ¶ 274. 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. Ex. 2015 ¶ 274.

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.” *Id.*, ¶ 275. 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.* ¶¶ 276-277. Having both a low melting point and a low boiling point correlates to lower viscosity, allowing 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.” *Id.*, ¶ 277. PP’s boiling point is

considerably higher than any other solvent in Table 1 of Zhou,⁵ its melting point is nearly 10°C higher than the melting point of EA (-84°C), and its viscosity is also 53% higher than the viscosity of EA (0.45 mPa/s at 20°C). *Id.* ¶¶ 275-279; 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.* ¶¶ 280, 282.

Finally, Petitioner’s simple swap fails to account for unpredictability of chemical reactions in a battery. *Id.* ¶ 281. 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 “Butyl butyrate” appears to be listed in Table 1 of Zhou in error. *See* Ex. 2015 ¶ 277, n.17; Ex. 1014, ¶¶ [0011], [0026]-[0048], Table 1.

5. The Petition Fails to Show that Zhou and Hirai Render Obvious the Claimed First Electrode or that a POSITA Would Combine Hirai with Zhou

Petitioner's arguments with respect to Hirai and the alleged combination of Hirai with Zhou is woefully inadequate. First, Petitioner purports to incorporate by reference, with one sentence, its analysis of Hirai's alleged disclosure from the Zeng/Hirai combination of Ground 1A with respect to elements [14.4]-[14.6]. Pet. 72. For at least the same reasons discussed with respect to Hirai in Ground 1A, *supra* Section V.A., Hirai necessarily fails to disclose at least the claimed first electrode comprising a single sided coating with an electrode compaction density (D1) and the ratio (D1/D2) thereof, nor would a POSITA be motivated to combine Hirai with Zhou. Ex. 2015 ¶¶ 283-284.

Petitioner's further assertions of "analogous art" and that "Hirai and Zhou motivate the POSITA to use Hirai's large-battery electrode structure in Zhou's battery" ring hollow. Pet. 73; Ex. 2015 ¶¶ 285-290. Indeed, not only is Petitioner's reliance on Zhou's "Background technology" section (Ex. 1014, ¶¶ [0002]-[0005]), as allegedly defining a specific-use case for Zeng's batteries misplaced, but Zhou lists at least the additional field of "3C digital products" (*id.*, ¶ [0002]) which Hirai specifically distinguishes from its "large-size, laminated-structure batteries." Ex. 2015 ¶ 285; Ex. 1010, ¶ [0006]. Moreover, Zhou's recitation of a list of fields in which lithium-ion batteries are "widely used" that includes "and other fields"

effectively covers *all* possible applications of lithium-ion batteries and makes any alleged focus on applications meaningless. *Id.* ¶ 286; Ex. 1014, ¶ [0002].

As described *supra*, Hirai is irrelevant and a POSITA would therefore be deterred from its teachings. *Id.* ¶¶ 287-288; Section V.A; *see also*, Ex. 2030.

6. Dependent Claims

Claims 15-17 are not unpatentable for at least the reasons discussed with respect to claim 14. Ex. 2015 ¶ 291.

F. Ground 3C: Zhou, Hirai, and Kim-'268 Do Not Render Obvious the Challenged Claims

1. Petitioner Fails to Show That Zhou/Hirai/Kim-'268 Render Obvious the Claimed Y/Z Ratio

Petitioner presents a single paragraph in support of Grounds 3C and 4C. Pet. 75-76. As previously discussed, Kim-'268 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 Kim-'268. Ex. 2015 ¶¶ 292-294. Moreover, Kim-'268 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-'268's solvents are only disclosed in volume percentages and no information from Kim-'268 can convert those percentages into weight percentages. *Id.* ¶ 295.

Petitioner asserts that “Zhou...draw[s] 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 ¶¶ 274, 292-293; Ex. 1014 ¶¶ [0026]-[0048], [0052]-[0055].

Citing paragraph [0059] of Zhou, Petitioner 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. 76. However, Paragraph [0059] of Zhou says nothing about any amount of PP, excessive or otherwise. Ex. 2015 ¶ 296.

Ground 3C fails.

2. Dependent Claims

Claims 15-17 are not unpatentable over Zhou, Hirai, and Kim-’268 for at least the same reasons as claim 14. *Id.*, ¶ 297.

G. Grounds 4A and 4C

The deficiencies discussed with respect to Grounds 3A and 3C apply equally to these grounds and Han does not cure such deficiencies. Petitioner fails to establish that claim 15 is unpatentable. *Id.*, ¶¶ 298-299.

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 Chevron Oronite Co. v. Infieum USA LP*, IPR2018-00923, Paper 9, 9-11 (P.T.A.B. Nov. 7, 2018) (informative).

VI. CONCLUSION

Patent Owner respectfully submits that the Board should deny institution.

Dated: August 5, 2025

Respectfully submitted,

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

CERTIFICATION UNDER 37 C.F.R. §42.24

Pursuant to 37 C.F.R. §42.24(d), I certify that this preliminary response complies with the type-volume limits of 37 C.F.R. §42.24(b)(1) because it contains 13,967 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: August 5, 2025

By: / Christopher TL Douglas /
Christopher TL Douglas

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §42.6(e), the undersigned hereby certifies that true and correct copies of the foregoing **PATENT OWNER'S PRELIMINARY RESPONSE and NINGDE AMPEREX TECH. EXHIBITS 2015-2033 AND 2040-2041** were served in their entirety on August 5, 2025 by filing this document through the PTAB's P-TACTS Filing System as well as delivering a true and correct copy by electronic mail on Petitioner's lead and backup counsel at the following email addresses (as agreed by counsel for Petitioner):

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