

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

IPR2025-00405
Patent 11,769,910

PATENT OWNER'S PRELIMINARY RESPONSE

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2001	Second Amended Complaint, <i>Ningde Amperex Tech. Ltd. v. Zhuhai CosMX Battery Co.</i> , Case No. 2:24-cv-00728-JRG, ECF No. 23 (E.D. Tex. Jan. 28, 2025)
2002	Scheduling Order, <i>Ningde Amperex Tech. Ltd. v. Zhuhai CosMX Battery Co.</i> , Case No. 2:24-cv-00728-JRG, ECF No. 27 (E.D. Tex. Feb. 6, 2025)
2003	CosMX Invalidity Contentions Cover Pleading, <i>Ningde Amperex Tech. Ltd. v. Zhuhai CosMX Battery Co.</i> , Case No. 2:24-cv-00728-JRG (E.D. Tex. Jan. 7, 2025)
2004	Summons to attend oral proceedings in German Case No. 3 Ni 12/23 (EP) (“Germany Order 1”)
2005	Summons to attend oral proceedings in German Case No. 3 Ni 12/24 (EP) (“Germany Order 2”)
2006	Docket Navigator Statistics for Judge Rodney Gilstrap (accessed May 5, 2025)
2007	Docket, <i>Ningde Amperex Tech. Ltd. v. Zhuhai CosMX Battery Co.</i> , Case No. 2:22-cv-00232 (E.D. Tex.)
2008	Joint Motion for Entry of Protective Order, <i>Ningde Amperex Tech. Ltd. v. Zhuhai CosMX Battery Co.</i> , No. 2:24-cv-00728-JRG, ECF No. 30 (E.D. Tex. Feb. 11, 2025)
2009	Amended Final Judgment, <i>Ningde Amperex Tech. Ltd. v. Zhuhai CosMX Battery Co.</i> , Case No. 2:22-cv-00232, ECF No. 427 (E.D. Tex.)

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2010	Article, <i>Lithium battery manufacturer ATL won injunction against its Chinese rival COSMX in German Court</i> , China IP Today (April 6, 2024)
2011	General Docket, <i>Ningde Amperex Tech. Ltd. v. Zhuhai CosMX Battery Co.</i> , No. 25-1037 (CAFC)
2012	U.S. Patent No. 10,833,363 (“the ’363 Patent”)
2013	Darts IP Reports: CN109301326, CN104466097, CN206490141, CN108352492 (May 6, 2025)
2014	Dec. 20, 2021 memo titled “New PE2E Search Tool Using AI Search Features” by Acting Deputy Director Andrew Hirshfeld
2015	Declaration of Dean R. Wheeler, Ph.D.
2016	<i>Curriculum Vitae</i> of Dean R. Wheeler, Ph.D.
2017	Sigma-Aldrich Safety Data Sheet, “Lithium hexafluorophosphate solution in ethylene carbonate-d4 (99 atom % D) and ethyl-d5 methyl-d3 carbonate (98 atom % D), 1.0 M LiPF ₆ in EC-d4/EMC-d8=3:7 (v/v), battery grade”, dated July 11, 2016
2018	Safety Data Sheet, “Lithium Hexafluorophosphate in EC/EMC 3:7”, dated September 2018
2019	Sigma-Aldrich Product Specification, “Lithium hexafluorophosphate solution - in ethylene carbonate and diethyl carbonate, 1.0M LiPF ₆ in EC/DEC=50/50 (v/v), battery grade”
2020	Sigma-Aldrich Product Specification, “Lithium hexafluorophosphate solution - in diethyl carbonate, 1.0M LiPF ₆ in DEC, battery grade”

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2021	Sigma-Aldrich Product Specification, “Lithium hexafluorophosphate solution - in ethylene carbonate and dimethyl carbonate, 1.0M LiPF ₆ in EC/DMC=50/50 (v/v), battery grade”
2022	Chinese Patent Application No. CN104051787A to Yongjun et al. (including English translation, translation affidavit, and copy of original document in Chinese)
2023	Wenbo Zhang et al., <i>Interfacial processes and influence of composite cathode microstructure controlling the performance of all-solid-state lithium batteries</i> , 9 ACS Applied Materials & Interfaces, 17835–17845 (2017).
2024	BYU DIPPR® (Design Institute for Physical Properties) Thermophysical Properties Laboratory Data Information Sheet for n-Propyl Propionate
2025	<i>2016 Batteries Conference GRC</i> , available at: https://www.grc.org/batteries-conference/2016/ (accessed on 12 May 2025).
2026	<i>Hubs – Department of Energy</i> , available at: https://www.energy.gov/hubs (accessed on 12 May 2025)
2027	<i>DOE Energy Innovation Hubs</i> , available at: https://science.osti.gov/bes/Research/DOE-Energy-Innovation-Hubs (accessed on 12 May 2025)
2028	Amir-Sina Hamedi, Fezzeh Pouraghajan, Fei Sun, Mojdeh Nikpour, & Dean R. Wheeler, <i>Interplay of Electrode Heterogeneity and Lithium Plating</i> , 169 020551 J. Electrochem. Soc. (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 080502 J. Electrochem. Soc. (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 229636 J. of Power Sources (2021)
2031	Amir-Sina Hamedi, Edmund M. Shumway, & Dean R. Wheeler, <i>Electrode-Level Modeling of Silicon Anodes for Improved Cell Design</i> , 171 120539 J. Electrochem. Soc. (2024)
2032	Jerome Workman, <i>A Comprehensive Review of Spectroscopic Techniques for Lithium-Ion Battery Analysis</i> , (Dec. 4, 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).

I. INTRODUCTION

Ningde Amperex Technology Ltd. (“ATL” or “Patent Owner”) respectfully submits this Preliminary Response (“POPR”) to the Corrected Petition (“Petition”) filed by Zhuhai CosMX Battery Co., Ltd. (“Petitioner” or “CosMX”). Paper 3 (“Pet.”). The Petition seeks *inter partes* review (“IPR”) of claims 1-6 and 12-26 (the “Challenged Claims”) of U.S. Patent No. 11,769,910 (the “910 Patent,” Ex. 1001).

Petitioner fails to show that **any** of the references relied upon across *18 different grounds* disclose the Challenged Claims. In an attempt to remedy the fact that **none** of its references disclose or render obvious the claimed weight percentage value of propyl propionate (“PP”) (Z) based on a total weight of the electrolyte, and **no** reference apprehends the importance of the Y/Z ratio, Petitioner relies on its expert’s numerous unjustified, incorrect, and improper assumptions in a failed attempt to estimate a value for Z and the ratio Y/Z. Even if one were to assume that such flawed assumptions and calculations are reasonable and justified, and that the references disclose some overly broad range of Y/Z values that fall within or overlap the claimed Y/Z ranges, the Petition disregards the demonstrated criticality of such ranges. As explained below, these assumptions and lack of disclosure in the references undercut Petitioner’s ability to meet its burden for the following additional reasons.

First, in Grounds 1A-1C, 2A-2C, and 3A-3C, Petitioner relies on Zeng, which never explicitly discloses a weight percentage of the PP based on a total weight of the electrolyte solution or otherwise provides sufficient information from which to determine such value. Despite these shortcomings, Petitioner relies on an unfounded central assumption made by Petitioner's expert, Dr. Lucht, that Zeng's lithium salt is added in *solid* form in a failed attempt to back-calculate an undisclosed PP weight percentage. However, this improper assumption is diametrically opposed to the plain wording and teachings of Zeng. In fact, Zeng is clear that the lithium salt is added as a 1.0 mol/L salt *solution* to the solvent mixture (in an undefined amount) such that neither a PP weight percentage nor any alleged Y/Z ratio can be determined. Additionally, Petitioner's "close enough" argument with respect to Zeng's alleged disclosure of an X/Y ratio of 2.5 (which is above 2.3) is insufficiently tied to competent evidence to render obvious the claimed X/Y ratio range.

Second, Petitioner's attempts to cure the failures of Zeng by relying on Matsuoka in Grounds 1B-1C, 2B-2C, and 3B-3C also necessarily fail. There is no "direct disclosure of an appropriate weight percentage Z of PP" in Matsuoka and Dr. Lucht's assumption that a POSITA would somehow single out and apply Matsuoka's preferred "non-nitrile additive" ranges to *only* PP completely disregards the numerous other components of Zeng's electrolyte that would also be considered "non-nitrile additives", and therefore, the *aggregate* of which would also subject be

to any alleged “non-nitrile additive” range. Petitioner’s illogical leap is not supported by the disclosure of the references.

Third, Kim does not render obvious the claimed PP weight percentage or Y/Z ratio nor does Kim cure the other failures of Zeng, alone or in combination with Matsuoka, in Grounds 1C, 2C, and 3C. Kim is replete with internally contradicting data and woefully inadequate experimental procedure details from which a POSITA could not draw any conclusions. Petitioner mischaracterizes the measurements and teachings of Kim and fails to demonstrate that a POSITA would apply any discerned teachings to any other reference.

Fourth, despite the fact that *none* of the examples in Zhou include PP, in Grounds 4A-4C, 5A-5C, 6A-6C, Petitioner relies on Zhou and Dr. Lucht’s unsupported assumption and hindsight-driven testimony that a POSITA would have substituted PP for ethyl acetate in Zhou’s Example 8. Moreover, Petitioner fails to address the proper interpretation of Example 8 by the POSITA and wrongly assumes that Example 8 outperforms other batteries based on a clear misunderstanding of kinetic performance data depicted by Zhou’s AC impedance spectra. This lack of understanding of Zhou further undercuts the reliability of Dr. Lucht’s opinions. Kim also does not cure Zhou’s failures in Grounds 4C, 5C, and 6C.

Petitioner has also not presented any argument that element [20.7] is met by *any* Ground. Petitioner cannot fix its unsupported assumptions, its failure to

overcome criticality of certain claimed ranges, or its absence of argument with respect to [20.7], and, thus, will not be able to prove that the Challenged Claims are rendered obvious.

Finally, when considering a related European patent, a German court opined that Zeng (NK5) lacks “[i]nformation on how to determine the wt-% for the individual components of the solvent and thus also for PP in the final electrolyte composition,” and “conversion of the mass fractions” “does not seem possible” using Zeng’s disclosure (Ex. 2004, 3-5); Kim (NK7) does not require PP or provide information regarding the “ratio of the trinitrile compound to PP” (*id.*, 6); and in Matsuoka’s disclosure (NK9) trinitriles are not relevant, PP is not a preferred non-nitrile additive, and thus “the ratio of trinitrile compound to PP is also not of significance” (Ex. 2005, 12).

For these reasons, the Board should deny institution.

II. BACKGROUND¹

A. Technology Overview

In lithium-ion batteries, many vital, interdependent factors contribute to properties of the solid electrolyte interphase (SEI) and there is no absolute parameter

¹ Patent Owner’s expert provided a technology overview and a summary of the ’910 Patent. Ex. 2015, § IV.A-B, ¶¶ 41-49.

circumscribing the SEI. Ex. 2015 ¶¶ 41-42. It is the combined effect of all these factors which affects the properties, quality, and efficiency of SEI. *Id.* In particular, the specific type of solvent, organic additives, and lithium salt(s) added to the electrolyte solution, and the specific concentration of each such component, can play a crucial role in determining the performance of the SEI. *Id.*

B. The '910 Patent

The '910 Patent describes a novel lithium-ion battery electrolyte solution that provides a firm protective SEI film on the surface of the cathode of an electrochemical device such as a lithium-ion battery that is not easily decomposed, effectively inhibits the increase in DC internal resistance of the lithium ion battery, and achieves high capacity density, and excellent cycle and storage performances. Ex. 1001, 1:56-63, 3:8-20. The '910 Patent achieves this by providing an electrolyte solution comprising a compound comprising a dinitrile compound, a trinitrile compound, and PP in specific weight percentage concentrations and ratios. *Id.* 1:56-63, 27:48-60, 29:19-34. The '910 Patent explains that its specific dinitrile, trinitrile, and PP weight percentage ratio ranges were unexpectedly found to provide a firm, protective SEI film on the surface of the cathode that was not easily decomposed, and which could provide performance improvements by allowing a battery to operate at a high potential of 4.45V and effectively reduce DC internal resistance of the battery. *Id.* 1:56-63, 2:9-24, 2:39-52, 29:26-34

III. LEGAL STANDARDS

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

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

IV. LEVEL OF ORDINARY SKILL IN THE ART

Each of the arguments below should be considered from the standpoint of a person of ordinary skill in the art (“POSITA”) in the field of the ’910 Patent. For purposes of this POPR, ATL adopts the definition proposed by Petitioner. Pet., 11.

ATL reserves all rights to challenge Petitioner's definition and/or further address the level of ordinary skill in the art if this proceeding is instituted.

V. CLAIM CONSTRUCTION

Petitioner contends that “[n]o claim terms require express construction for purposes of granting the Petition.” Pet., 11.² The failure of the Petition to render obvious the Challenged Claims is clear in view of the arguments below without construing any specific claim term or phrase.

VI. THE BOARD SHOULD NOT INSTITUTE *INTER PARTES* REVIEW

A. Ground 1A: Zeng Does Not Render Obvious Claims 1-6, 12, and 16-26

Petitioner alleges that Zeng alone renders obvious Challenged Claims 1-6, 12, and 16-26. Pet. 14. However, Zeng fails to teach, suggest, disclose, or otherwise render obvious at least elements [1.3], [12.3], and [20.3], [1.4] and [12.4], [20.4], and [1.2] and [12.2].

1. The Petition Fails to Show that a POSITA Would Have Selected or Implemented Embodiments 4 or 6 of Zeng

The Petition cites overlapping and baseless rationales as to why a POSITA would have selected or implemented Embodiments 4 and 6 of Zeng. Once untangled, it is clear that Petitioner has failed to provide any sufficient rationale for

² ATL reserves the right to address construction if this proceeding is instituted.

implementing Embodiments 4 and 6. Despite the fact that the various components and component amounts of the embodiments are ambiguous due to at least the addition of an unknown amount of lithium salt solution as discussed below in Section VI.A.2, Petitioner argues that “[e]ach embodiment in Zeng 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 for its single-reference obviousness challenge. Pet. 20; Ex. 2015 ¶¶ 71-73. In a clear attempt to reconstruct the Challenged Claims based solely on the teachings of the ’910 Patent, Petitioner and Dr. Lucht cherry-pick Embodiments 4 and 6 from the 15 embodiments/examples explicitly disclosed by, and the thousands of embodiments which would fit within the ranges described in, Zeng, even though Zeng is silent regarding why the two selected embodiments provide any benefits that would distinguish them from the remaining potential embodiments and there is no unambiguous data in Zeng that would encourage a POSITA to choose any particular embodiment over another. Ex. 2015 ¶¶ 63, 67-68; Ex. 1006 ¶¶ [0045]-[0046]. Petitioner’s assertion that a POSITA would have been motivated to implement Embodiments 4 and 6 with a reasonable expectation of success because “[o]ther than Embodiments 2 and 5, Embodiment 6 had the best capacity retention” completely disregards the fact that Embodiments 2 and 5 did not contain *any* trinitrile compound. Ex. 2015 ¶ 69; Ex. 1006 ¶¶ [0045]-[0046].

Embodiment 8 also did not contain any trinitrile compound and had a better capacity retention rate than Embodiment 4. *Id.* Because capacity retention is an important aspect to Zeng, a POSITA would interpret Zeng as teaching that the addition of a trinitrile compound *negatively* impacts the capacity retention rate at least inasmuch as Embodiments 2 and 5, which contained dinitrile compound(s) but no trinitrile compound(s), had better capacity retention rates than both Embodiments 4 and 6, which contained dinitrile compound(s) and a trinitrile compound, and would therefore be deterred from selecting Embodiments 4 and 6 and otherwise *teach away* from selecting those embodiments. *Id.* ¶¶ 66, 69; Ex. 1006 ¶¶ [0039]-[0042], [0045]-[0046]. Petitioner also fails to address the fact that such comparatively negative impact of the trinitrile compound on the capacity retention rates would also *teach away* from considering the relation or adjustment of a trinitrile compound to PP ratio (Y/Z), other than to *eliminate* the amount of trinitrile compound in Zeng's Embodiments 4 and 6 to zero (as in at least Embodiments 2, 5, and 8). *Id.* ¶ 70.

Petitioner also fails to establish that Embodiments 4 and 6 would have been obvious to try. Ex. 2015 ¶¶ 74-80. Zeng does not articulate the problem or the solution of the '910 Patent. *Id.* ¶¶ 55-56, 75; Ex. 1001, 1:53-63. Petitioner also fails to account for the fact that a POSITA would have recognized a large number of potential solutions to the problem the '910 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 ¶¶ 76-78. Even if Zeng aligned with the problems faced in the '910 Patent (which it does not), Petitioner fails to account for the thousands of embodiments that would fit within the ranges described in Zeng. *Id.* ¶ 67; see *In re Kubin*, 561 F.3d 1351, 1359–60 (Fed. Cir. 2009) (stating that what is “obvious to try” is erroneously equated with obviousness where “what would have been ‘obvious to try’ would have been to vary all parameters or try each of numerous possible choices until one possibly arrived at a successful result, where the prior art gave either no indication of which parameters were critical or no direction as to which of many possible choices is likely to be successful”).

Nor does Petitioner establish a reasonable expectation of success for implementing Embodiments 4 and 6 due to Zeng’s teaching to a POSITA of a comparatively *negative* impact of the trinitrile compound on capacity retention rates in Zeng’s electrolyte solutions (as compared to at least Embodiments 2 and 5), as well as Zeng’s ambiguous instructions for making those solutions, as discussed *supra*. Ex. 2015 ¶¶ 68-73, 79-81.

2. The Petition Fails to Show That Zeng Renders Obvious the Claimed Z and Y/Z Ranges of Claims 1, 12, or 20

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. Zeng is simply not concerned with the weight percentage of PP based on a total weight of the electrolyte or the Y/Z. Ex. 2015 ¶¶ 64, 82-87. Given the critical nature of the claimed ratio, Zeng’s lack of disclosure is *fatal*. See Section VI.A.2.b., *infra*.

Zeng provides insufficient information from which a POSITA could determine such weight percentage of PP or the ratio of trinitrile to PP in each of Embodiments 4 and 6. *Id.* ¶ 87. 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 attempt to 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.* ¶ 88.

Despite these clear shortcomings regarding the preparation of Embodiments 4 and 6, however, Petitioner’s argument relies solely on Dr. Lucht’s parade of unsupported and incorrect assumptions to purportedly calculate a “*theoretical upper limit weight percentage*” of PP, and in turn, an alleged (but never disclosed) Y/Z ratio based on his estimated Z value, in each of Embodiments 4 and 6. *Id.* ¶ 89. Such

flawed assumptions necessarily render Dr. Lucht's resulting calculations unreliable. *Id.* ¶ 90. Indeed, one basic error is Petitioner's assumption that Zeng's lithium salt is added in a solid form, which permeates each and every calculation, rendering Dr. Lucht's calculations wrong, since the lithium salt is added as a *solution*.

a. Dr. Lucht's Assumption That LiPF₆ is Added as a Solid is Unjustified

Each of the Embodiments in Zeng 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 ¶ 91. Despite this explicit recitation, such 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 and redefine the description, 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. 16, n. 3 (citing Ex. 1003 ¶ 69); Ex. 2015 ¶¶ 92-93. 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 are diametrically opposed to and necessarily 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 ¶ 93. Essentially, Dr. Lucht and CosMX argue that Zeng's literal disclosure is incorrect, and that if they had written something other than what they wrote, then *that* imagined disclosure would render obvious the Challenged Claims.

Petitioner's own evidence reinforces the clear meaning in Zeng that the LiPF_6 is added to the solvent mixture, not as a solid, *but as a salt solution having a certain concentration*. See, e.g., Ex. 2015 ¶ 95; 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 ¶ 96.

Moreover, the commercial distribution of "battery grade" 1.0 mol/L LiPF_6 premixed solutions with different solvents was well known and an acceptable way to achieve a desired electrolyte mixture for use in batteries. Ex. 2015 ¶ 94; Exs. 2017-2021; see also, Ex. 1003 ¶ 69, n.4 (Dr. Lucht admitting such premixed solutions are commercially available).

Petitioner's concerns that adding such a premixed salt solution would "render[] the ultimate concentration of LiPF₆ 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. 16, n. 3; Ex. 2015 ¶¶ 97-100. As explained by Dr. Wheeler, Table 1 of Zeng is described as only listing "the electrolyte solution *partial* component content" such that 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 ¶ 99. There is no language or other exposition 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 as is plainly described by Zeng. *Id.* ¶¶ 100-101.

It is based on this erroneous solid LiPF₆ salt assumption, "assuming 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

³ Because Zeng teaches using a premixed salt solution, Petitioner cannot determine the ultimate concentration of LiPF₆ and the claimed amounts of the solvent components, the Zeng-based grounds fail.

embodiments, that Dr. Lucht purports to estimate a “*theoretical* upper limit weight percentage” of 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 <17.66 wt% and <17.70 wt%. Ex. 1003, ¶¶ 69-73, 76-77; Ex. 2015 ¶¶ 57-60. Further still, however, Petitioner relies on Dr. Lucht’s erroneous and unsupported assumption that “the ultimate weight percentage of PP in the total electrolyte would also certainly be well above 5 wt%.” Pet. 19. Dr. Lucht fails to consider the fact that PP is *not even required to be present* in Zeng at all. Ex. 2015 ¶ 103. 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. Ex. 1006 ¶ [0015]; Ex. 2015 ¶ 103 (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).

Zeng discloses the addition of a lithium salt in *solution* form to the base solvent mixture in each embodiment, without the need for an explicit reference to the solvents of the solution, such that the weight percentage of PP and the ratio of trinitrile compound to PP in the final electrolyte solutions cannot be determined due to at least the unknown solvent components in the lithium salt solution and the unknown amount of lithium salt solution added. *Id.* ¶ 101. These unknowns render

Dr. Lucht's estimates of the alleged weight percentages of PP of <17.66 wt% and <17.70 wt% and the alleged Y/Z values of >0.057 and >0.056 in Embodiments 4 and 6 incorrect. *Id.* ¶¶ 102-103. There is simply not enough information in Zeng to reliably perform the calculations needed to reach the conclusions in the Petition. *Id.* ¶ 104.

b. The '910 Patent Establishes Criticality of the Claimed Y/Z Range

Based on Dr. Lucht's unjustified assumptions and calculations, Petitioner asserts that Embodiments 4 and 6 of Zeng disclose Y/Z values of >0.057 and >0.056, respectively. Pet. 25-26. Even if one were to assume that Dr. Lucht's flawed assumptions and calculations are reasonable and justified, and that Zeng discloses a range of Y/Z values that fall within or overlap the claimed range, Zeng still fails to render obvious Claims 1, 12, and 20 because the claimed Y/Z ranges are *critical* to providing the advantages of the '910 Patent and are not disclosed by Zeng. *E.I. du Pont de Nemours & Co. v. Synvina C.V.*, 904 F.3d 996, 1006 (Fed. Cir. 2018) (a "claimed range that demonstrates [] unexpected results is referred to as a 'critical' range, and the patentee has the burden of proving criticality") (citation omitted).

If Petitioner's unsupported assertions were considered, then Zeng would disclose, at best, electrolyte solutions with trinitrile and PP concentration ranges that are broader than the claimed ranges of Y/Z values in claims 1, 12, and 20. 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], 32, claim 1; Ex. 2015 ¶ 106 (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 $0.02 \leq (Y/Z) \leq \text{about } 0.3$ in claims 1 and 12, and about $0.01 \leq (Y/Z) \leq \text{about } 0.3$ in claim 20. Ex. 2015 ¶ 106.

Similarly, the presence of a trinitrile compound is also not considered necessary or even required in Zeng such that the amount of trinitrile in an electrolyte solution of Zeng may also be zero. Ex. 2015 ¶ 107; Ex. 1006 ¶¶ [0017]-[0019] (structural formula I need not be a trinitrile), ¶¶ [0045]-[0046] (none of Embodiments 1-3, 5, or 7-9 contain a trinitrile based on structural formula I). As discussed *supra*, a comparison of the capacity retention rates of Zeng's Embodiments 4 and 6 (contain trinitrile) to Embodiments 2 and 5 (no trinitrile) actually *teaches away* from using any trinitrile in Zeng's electrolyte solutions. Ex. 2015 ¶¶ 69-70. 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 necessarily outside of the narrower claimed Y/Z range of about $0.02 \leq (Y/Z) \leq \text{about } 0.3$ in claims 1 and 12, and about $0.01 \leq (Y/Z) \leq \text{about } 0.3$ in claim 20. Ex. 2015 ¶ 107.

The '910 Patent explains, and Petitioner fails to address, that its *specific weight percentage ratio ranges*, including Y/Z values of 0.01-0.3 (which corresponds to the claimed Y/Z range of about $0.01 \leq (Y/Z) \leq$ about 0.3 in claim 20 and subsumes the claimed Y/Z range of about $0.02 \leq (Y/Z) \leq$ about 0.3 in claims 1 and 12), were *unexpectedly* found to provide a firm, protective SEI film on the surface of the cathode that was not easily decomposed, and which could provide performance improvements by allowing a battery to operate at a high potential of 4.45V and effectively reduce DC internal resistance of the battery. Ex. 2015 ¶ 108; Ex. 1001, 1:56-61; 29:26-29. Zeng fails to disclose any such criticality of the claimed Y/Z value ranges or any advantages of the '910 Patent that such narrow, specific Y/Z value ranges provide. Ex. 2015 ¶¶ 105-110. Indeed, Zeng does not disclose or appreciate such a Y/Z ratio at all. *Id.* To the extent there is any attention drawn to a combination of trinitrile and PP in Zeng, a POSITA would understand Zeng to actually *teach away* from the addition of a trinitrile compound due to its perceived effect of comparatively *lowering* (rather than improving) capacity retention rate in comparison to at least Embodiments 2 and 5, as discussed *supra*. *Id.* ¶¶ 111-112. Accordingly, because '910 Patent establishes the criticality of the claimed Y/Z value ranges, such claimed Y/Z value ranges are not obvious in view of Zeng. *E.I. du Pont*, 904 F.3d at 1008.

3. The Petition Fails to Show that Zeng Renders Obvious the Claimed X/Y Ratio Range of Claims 1 and 12

Each of claims 1 and 12 require about $0.1 \leq (X/Y) \leq$ about 2.3. Ex. 1001, 34:17-37; Ex. 2015 ¶¶ 113-114 (identifying [1.2] and [12.2]). As explained *supra* at Section V, Petitioner elected not to construe the meaning of any of the claim terms of the '910 Patent in its Petition. Pet. 11. Despite such affirmative election not to construe “about 2.3”, Petitioner proclaims that Zeng’s X/Y values of 2.5 “are considered ‘minor variations’ within...8.7% of 2.3, rendering the claimed range obvious.” Pet. 23. Citing the specification of the '910 Patent, Petitioner asserts that “‘about’ covers ‘minor variations’ including ‘less than or equal to $\pm 10\%$ of the stated value....” *Id.*; Ex. 2015 ¶ 115. Petitioner has failed to provide a claim construction position and, further, any reason or argument for why a POSITA would understand that “about 2.3” in the context of X/Y in the elements [1.2] and [12.2] would mean “about $2.3 \pm 10\%$ ” as opposed to any of the other exemplary tolerances that the '910 Patent explains that the term “about” may refer to for different values, “such as less than or equal to $\pm 5\%$, less than or equal to $\pm 4\%$, less than or equal to $\pm 3\%$, less than or equal to $\pm 2\%$, less than or equal to $\pm 1\%$, less than or equal to $\pm 0.5\%$, less than or equal to $\pm 0.1\%$, or less than or equal to $\pm 0.05\%$.” Ex. 1001, 4:12-31 (emphasis added); Ex. 2015 ¶¶ 116-117. Petitioner’s assertion that Zeng’s alleged disclosure of an X/Y ratio of 2.5 is “‘close enough’ to the claimed range—particularly since it

falls within the '910 Patent's express 10% tolerance" is also misguided as it is insufficiently tied to competent evidence to render obvious the claimed X/Y ratio range of at least claims 1 and 12. Ex. 2015 ¶¶ 65, 118. In Petitioner's cited case, the difference between the claimed value and the prior art was 0.05%, so close that a POSITA would have expected them to have the same properties. *In re Peterson*, 315 F.3d 1325, 1329 (Fed. Cir. 2003). Petitioner presents no evidence that a POSITA would expect an X/Y ratio of 2.5 to have the same properties as the claimed value, and provides no argument for why 2.5 otherwise constitutes "less than about 2.3." Petitioner's failure to attempt to construe this claim limitation is fatal to institution where Petitioner admits that, even under its own theory, Zeng teaches an X/Y value *greater* than 2.3.

4. Claims 2-6, 16-19, and 21-26 Are Not Unpatentable

Claims 2-6, 16-19, and 21-26 are not unpatentable for the same reasons as discussed with respect to claims 1, 12, and 20. Ex. 2015 ¶ 119.

5. The Petitioner Forfeits Any Challenge of Claims 20-26

Petitioner relied on multiple summary tables and purported to incorporate by reference to other sections of the Petition. In Petitioner's haste, the summary table of its evidence explaining where the Petition explains that Zeng allegedly "discloses or suggests claims 12 and 16-26" is *notably missing claim 20* and each of its elements. Pet. 29-30; Ex. 2015 ¶ 124. Claim 20 requires, *inter alia*, "wherein the

electrolyte further comprises 1,3-propanesultone and *fluoroethylene carbonate*; wherein, based on the total weight of the electrolyte, a weight percentage of the 1,3-propanesultone is not less than 0.1 wt %, and not greater than 3 wt % ” Ex. 1001, 37:3-7 (emphasis added); Ex. 2015 ¶ 121. Petitioner collectively refers to these limitations as element [20.7]. Pet., xiii; Ex. 2015 ¶ 121. None of the Challenged Claims 1-6, 12, or 16-19 recite “fluoroethylene carbonate” (Ex. 1001, 34:17-36:48; Ex. 2015 ¶ 122), and the Petition fails to otherwise present any argument that element [20.7] is met by Zeng.

Petitioner does not and cannot incorporate by reference any analysis by Dr. Lucht, but even if it could, Dr. Lucht also fails to present any argument that element [20.7] is met by Zeng. Ex. 2015 ¶ 123. Like the Petition, Dr. Lucht also chose to provide a summary table with respect to the alleged application of Zeng to Claim 20. Ex. 1003, ¶ 112; *see also*, pp. 48-49 (summary table). With respect to element [20.7], Dr. Lucht’s summary table identifies as his evidence *only* his analysis in “Section IX.B.8 above regarding element [1.7]; Section IX.D.1 regarding element [3.1].” *Id.* Notably, neither element [1.7] nor element [3.1], or the paragraphs 102-103 or 106-108 of Dr. Lucht’s declaration, address the requirement of “fluoroethylene carbonate” in element [20.7] or provide any argument for why this limitation is met by any of the proposed obviousness Grounds. Ex. 2015 ¶ 123.

Accordingly, Petitioner forfeits any challenge of claim 20 (and claims 21-26 which depend therefrom).⁴

B. Ground 1B: Zeng and Matsuoka Do Not Render Obvious Claims 1-6, 12, and 16-26

For the same reasons as discussed *supra* at Section VI.A in Ground 1A, Petitioner fails to establish that at least one challenged claim of Ground 1B is unpatentable in view of Zeng. Petitioner likewise fails with respect to Zeng in view of Matsuoka.

Petitioner purports to cure, with Matsuoka, any deficiencies in Zeng argued by ATL as a result of “Zeng’s ambiguity regarding LiPF₆”. Pet. 42-43. Petitioner’s allegation that a POSITA would rely on “Matsuoka’s direct disclosure of an appropriate weight percentage Z of PP instead of a POSITA determining it from Zeng”, however, is nonsensical in view of the clear disclosure of the references. Indeed, nothing in Zeng would instigate, prompt, or otherwise motivate a POSITA to even need to determine “an appropriate weight percentage Z 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 ¶¶ 126-128. As explained hereinabove at Section VI.A.2, the

⁴ Petitioner makes this same omission for every Ground.

weight percentage of PP based on a total weight of the electrolyte is simply not a consideration or otherwise relevant to Zeng. Therefore, there is no motivation to modify the electrolyte system of Zeng as argued by Petitioner. *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. The Petition Fails to Show That a POSITA Would Have Selected PP from Matsuoka’s Numerous “Non-Nitrile Additives”

As acknowledged by Petitioner, “Matsuoka lists non-nitrile additives with LUMO [Lowest Unoccupied Molecular Orbital] and HOMO [Highest Occupied Molecular Orbital] levels appropriate for use in its electrolytes.” Pet., 44 (citing Ex. 1007 ¶¶ [0036], [0038]-[0040]). However, in leaping to the conclusion that “Matsuoka teaches two preferred weight proportion ranges **for the non-nitrile additive (e.g., PP)** in the total electrolyte” and “Matsuoka discloses Elements [1.4]/[12.4]/[20.4],”⁵ the Petition simply purports that “Matsuoka lists PP isomers as

⁵ Notably, elements [1.4], [12.4], and [20.4] refer to the claimed Y/Z ratio ranges, while elements [1.3], [12.3], and [20.3] refer to the weight percentage of PP and its claimed ranges. *See* Pet., viii-xii.

suitable additives with LUMO and HOMO energies falling in or near the most-preferred ranges.” *Id.* Petitioner conveniently 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 ¶¶ 129-131; Ex. 1007 ¶¶ [0038], [0040]. Petitioner’s alleged reliance on the PP isomers having such energies “falling in or near the most-preferred ranges” is of no consequence as nearly all of the additives in the LUMO list fall within the most-preferred LUMO ranges and a majority of the additives in the HOMO list “fall[] in or near the most-preferred [HOMO] ranges.” Ex. 2015 ¶ 131. Neither PP isomer is given special significance in Matsuoka, nor is the effect of such PP compounds clearly stated. *Id.*; Ex. 1007 ¶¶ [0038], [0040]. Indeed, each PP compound is merely listed as one of numerous possible compounds, but none are tested for actual 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 single out PP from the numerous other “non-nitrile additives.” *Id.* ¶ 132.

2. The Petition Fails to Show That Matsuoka Renders Obvious the Claimed Z and Y/Z Ranges of Claims 1, 12, or 20

The foundation of Petitioner’s reliance on Matsuoka is based 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, completely disregarding the numerous other components of Zeng's electrolyte that would also be considered "non-nitrile additive" components according to Matsuoka. Ex. 2015 ¶ 133.

Matsuoka teaches that such preferred non-nitrile additive ranges would apply to the *aggregate* of all non-nitrile components, not just a single non-nitrile additive. *Id.*; Ex. 1007 ¶ [0035] ("by a combined use of two or more ingredients...preferably contains two or more of the non-nitrile additives."), ¶ [0038] ("used singly or in combination of two or more".) Significantly, in addition to the PP isomers, Matsuoka identifies many other example non-nitrile additive compounds that overlap with the components of Zeng's Embodiments 4 and 6. Ex. 2015 ¶ 133; Ex. 1007 ¶¶ [0038], [0040]. Even if the Board were to accept Petitioner's rationale for applying Matsuoka's non-nitrile additive ranges to Zeng (which the Board should not at least for the reasons set forth below in Section VI.B.3), such non-nitrile additive ranges would necessarily apply to the *aggregate* of such overlapping components in Zeng's Embodiments 4 and 6, not just PP as Petitioner implies in its hindsight-driven assumption. Ex. 2015 ¶ 133. Petitioner's proposed combination ignores significant features of the respective references. There would be numerous variables for the POSITA to adjust so that there is no "direct disclosure of an appropriate weight percentage Z of PP." *Id.*

Because Petitioner fails to show that Matsuoka renders obvious the claimed weight percentages of PP, Petitioner also necessarily fails to show that Matsuoka renders obvious the claimed Y/Z ranges, the criticality of which is established *supra* at Section VI.A.2.b. Ex. 2015 ¶¶ 134-135.

3. The Petition Fails to Show That a POSITA Would Have Been Motivated to Combine Matsuoka with Zeng

Petitioner asserts that “[a]ny hypothetical uncertainty in Zeng’s preparation instructions would have prompted the POSITA to consider Matsuoka for implementation details regarding 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. 46. However, Zeng’s implementation details are sufficient for the purposes of Zeng—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 ¶¶ 126-128.

Petitioner argues that “the desire for balanced performance” would have been another motivation to combine Matsuoka with Zeng and that “overlap in [electrolyte] composition” and “the same carbonate-based solvents (EC, PC), ester compound (EP), LiPF₆ as the lithium salt, and VC as an additive” would have led the POSITA to “have had a reasonable expectation of success” in combining Matsuoka with Zeng. Pet. 47. However, the electrolyte solutions of Zeng and

Matsuoka are so fundamentally different that the POSITA would not be motivated to combine or have a reasonable expectation of success in combining Matsuoka with Zeng. Ex. 2015 ¶¶ 136, 138.

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 ¶ 137; 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 in a defined solvent mass ratio) would have predictable results given the inherent unpredictability of the interactions of these components. Ex. 2015 ¶ 137.

Second, Matsuoka considers acetonitrile (a mononitrile) to not only be essential to its electrolyte solution, but as the solitary or main solvent component. *Id.*; Ex. 1007 ¶¶ [0043], [0109], and Tables 3-5. Embodiments 4 and 6 of Zeng, 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 as an additive, none of the examples include a trinitrile as an additive, so a POSITA would consider the electrolyte systems of Zeng and Matsuoka to be fundamentally different. *Id.* Indeed, as a result of such fundamentally different electrolyte systems, a POSITA would not be given the slightest 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.* ¶ 139; Ex. 1007 ¶ [0041] (“by adjusting the content of the non-nitrile additive in the above described range, the excellent performance of acetonitrile can be sufficiently exhibited without impairing a basic function as a non-aqueous secondary battery.”). Therefore, Petitioner’s alleged motivation of a “desire for balanced performance” fails.

Matsuoka also teaches away from the mixed solvent electrolyte systems of Zeng due to their lower discharge capacity at low temperatures (a focus of Zeng) compared to the acetonitrile solvent-based electrolyte of Matsuoka. Ex. 1007, Table 3, Table 9; Ex. 2015 ¶¶ 140-144 (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 each of 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 ¶ 145. 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.* ¶ 146; Ex. 1007 ¶ [0029], Table 1. Although Matsuoka identifies LiPF₆ as preferable *when used in combination with the required organic lithium salt* (Ex. 1007 ¶ [0030]), LiPF₆ as Zeng uses by itself, does not meet the organic lithium salt requirements or the HOMO requirements of the required organic lithium salt of Matsuoka. *Id.*

Matsuoka also teaches away from electrolyte solutions incorporating only an inorganic lithium salt like Zeng because, according to Matsuoka, they have a much lower discharge capacity than an electrolyte solution incorporating an organic lithium salt as required by Matsuoka. Ex. 1007, Table 1, Table 3, Table 6; Ex. 2015 ¶ 147 (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, thus, Ground 1B fails. Ex. 2015 ¶ 148.

4. Claims 2-6, 16-19, and 21-26 Are Not Unpatentable

Claims 2-6, 16-19, and 21-26 are not unpatentable over Zeng and Matsuoka for at least the reasons discussed above with respect to claims 1, 12, and 20. Ex. 2015 ¶ 148.

5. Petitioner Forfeits Any Challenge of Claims 20-26

As discussed *supra* at Section VI.A.5, the Petition does not present any argument that element [20.7] is met in Ground 1B. Accordingly, Petitioner forfeits any challenge of claim 20 and claims 21-26 which depend therefrom.

C. Ground 1C: Zeng and Kim, with or without Matsuoka, Do Not Render Obvious Claims 1-6, 12, and 16-26

For the same reasons as discussed *supra* at Sections VI.A and VI.B with respect to Ground 1A and Ground 1B, Petitioner also fails to establish that at least one challenged claim of Ground 1C is unpatentable. Petitioner further fails to establish that at least one challenged claim of Ground 1C is unpatentable in further view of Kim, for the reasons below.

Petitioner purports to cure, with Kim, the deficiencies in Zeng, or Zeng and Matsuoka, argued by ATL as a result of “Elements [1.4]/[12.4]/[20.4] requir[ing] paying particular attention to the ratio of trinitrile to PP—a specific focus on the quotient of Y/Z itself—and criticize Zeng and Matsuoka for not highlighting the ratio

of HTCN to PP, specifically.” Pet. 49. Petitioner’s allegation that “Kim further focuses the POSITA on including both a trinitrile and PP in a dinitrile-based electrolyte and motivates adjusting relative amounts of these two components (i.e., Y/Z) to improve performance,” however, is, again, nonsensical in view of the clear disclosure of the references. As explained *supra* at Section VI.A.1, because capacity retention is an important aspect to Zeng, a POSITA would interpret Zeng as teaching that the addition of a trinitrile compound *negatively* impacts the capacity retention rate at least inasmuch as Embodiments 2 and 5, which do not contain a trinitrile, outperform Embodiments 4 and 6, which do contain a trinitrile, such that a POSITA would not turn to any alleged trinitrile teachings of Kim. Indeed, in another attempt to reconstruct the Challenged Claims based solely on the teachings of the ’910 Patent, Petitioner tries to manifest some “importance of these two compounds in improving performance of dinitrile-based electrolytes, and their relative amounts” based on Embodiments 4 and 6 disclosing a trinitrile and PP with the other examples “lack[ing] at least one of these two components,” but no teaching in Zeng would instigate, 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. 50-51; Ex. 2015 ¶ 69.

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

Petitioner never makes a motivation to combine argument *at all* for Ground 1C and never evaluates the POSITA's reasonable expectation of success and, thus fails to make out a *prima facie* case of obviousness to combine Kim with the other references. Pet. 49-55. Petitioner's failure to provide such an argument is fatal to this Ground and others depending on Kim. *L.A. Biomedical Rsch. Inst. at Harbor-UCLA Med. Ctr. v. Eli Lilly and Co.*, 849 F.3d 1049, 1064 (Fed. Cir. 2017) (cleaned up, citations omitted) (even "in the case of a combination of references that together disclose all the limitations of the claimed invention," there must be an "apparent reason to combine the known elements in the fashion claimed by the patent at issue" and a "reasonable expectation of success" to a POSITA in pursuing that combination"). Even setting aside this fatal deficiency, Kim is replete with internally contradicting data and woefully inadequate experimental procedure details from which a POSITA could not draw any conclusions. Petitioner mischaracterizes the measurements and teachings of Kim and fails to demonstrate that a POSITA would apply any discerned teachings.

Petitioner asserts that Examples 1 and 2 of Kim "underscore enhanced performance of electrolytes that incorporate a trinitrile and PP against those lacking one or both," by "outperform[ing] Comparative Examples 1-6 (lacking trinitrile or

PP) in resisting increase in battery thickness and capacity retention.” Pet. 51-52. Petitioner further asserts that “Kim uses four evaluation methods to show that adjusting PP, while maintaining trinitrile content in Examples 1 and 2, significantly impacts battery performance,” which would lead a POSITA to “recognize that fine-tuning trinitrile (Y)/PP (Z) ratio optimizes battery performance.” *Id.*, 53. Petitioner’s analysis of Kim’s Examples 1 and 2 lack merit. Ex. 2015 ¶ 152-171.

To learn anything from Kim’s disclosure, a POSITA must examine the “evaluation methods” on which the disclosure is based. This is difficult, if not impossible, in the case of Kim because Kim’s experimental procedures are not articulated in any meaningful way that allows evaluation or reproduction—they are simply named, e.g. “thickness increase” (Ex. 1008, FIG. 3, FIG. 5, FIG. 7), “recovery capacity” (*id.* Table 2, FIG. 4, FIG. 6), “thickness variation ratio” (*id.* Table 2, Table 3, FIG. 4, FIG. 6), and “DC capa. to ini. capacity” (*id.* FIG. 7). Even if the POSITA could (with significant effort) deduce from Table 2 what was meant by “recovery capacity” and “thickness variation” and how those values might be calculated from or related to underlying capacity and thickness measurements, Kim remains woefully inadequate on experimental procedure details and the POSITA would still need to depend on Kim for how to understand and therefore interpret the underlying capacity and thickness measurements. Ex. 2015 ¶ 153.

First, Kim does not specify how its “capacity” values are measured. Ex. 2015 ¶¶ 153-155. Depending on the intended application, many different tests can be used to measure capacity and cycling. *Id.* Likewise, Kim does not specify how or where its “thickness” values are measured, and it is not clear whether the thickness corresponds to the total thickness of the cell at a particular location or from an ensemble of locations. *Id.* It is also not clear as to how multiple values are treated, whether the thickness is measured under a particular stack pressure, among other conceivable interpretations of “thickness.” *Id.*

Second, Kim’s data shows, but Kim does not discuss, that its capacity results are highly dependent on cell format. Ex. 2015 ¶¶ 156-157. For example, Kim at Paragraph [0095] describes that Examples 1 and 2 and Comparative Examples 1 to 6 are embodied in *prismatic* cells. However, at Paragraph [0099], Kim describes embodiments of the same Examples 1 and 2 and Comparative Examples 1 to 6 as *pouch* cells—a different cell format. No description is given as to how the respective prismatic and pouch cells are manufactured or are otherwise distinct from each other, nor are there teachings as to how they should be comparatively evaluated. A POSITA comparing “recovery capacity” results from the prismatic Example 1 (Ex. 1008, Table 2) and from the pouch Example 1 (*id.* Table 3) would see a notable capacity difference or uncertainty of 4.5% for two embodiments of Example 1 exceeds the capacity differences between Example 1 and Comparative Examples 2,

3, 4, and 6 in Table 2. The POSITA could not reliably judge that Example 1 is superior in recovery capacity to these supposedly dissimilar cases. Ex. 2015 ¶ 156. 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.* ¶¶ 156-157. A POSITA would therefore not be confident in the individual measurements due to their manifest differences by cell format and a POSITA would not make any conclusory judgements about the purported efficacy embodied in Examples 1 and 2 compared to Comparative Examples, because such comparisons cannot be reliably made. *Id.*

Third, Kim's disclosure with respect to linear sweep voltammetry contradicts itself. Kim states that the thermal aging measurements on pouch cells were made after being "allowed to stand at 60°C. for **3 weeks**," whereas Table 3 indicates the same measurements were made after being "allowed to stand at 60°C. for **4 weeks**." Ex. 1008 ¶¶ [0099]-[0100] and Table 3 (emphasis added). It is not clear which of these contradictory statements is correct. Ex. 2015 ¶ 158. Additionally, FIG. 2 of Kim provides "linear sweep voltammetry" data, purporting to show that Examples 1 and 2 are more electrochemically stable electrolytes than Comparative Examples 1 to 6 would be at a particular electrode potential, meaning the smaller the current (vertical axis) at a particular potential (horizontal axis), the more stable the electrolyte. Ex. 1008, FIG. 2; Ex. 2015 ¶ 159. Because of the vertical scale used, a

POSITA cannot determine from the plot the stability/currents for Examples and Comparative Examples at more realistic potentials, i.e. around 4.4V and, contrary to Kim's assertion that Examples 1 and 2 are the most stable (Ex. 1008 ¶ [0094], Comparative Examples 1 and 2 actually have lower oxidation currents than Examples 1 and 2 at potential 6.5V, which is certainly a "higher voltage." Ex. 2015 ¶ 159.

Fourth, regarding Kim's life cycle measurements, Kim lacks any information on *how* its battery cell was cycled, which would prevent a POSITA from combining the teachings of Kim and Zeng with any reasonable expectation of success (even though Petitioner fails to allege such an expectation). Indeed, key information for assessing the performance of Kim's batteries is missing, such as the voltage up to which the battery is charged or discharged and at what rate the cycling is performed. Ex. 2015 ¶ 160. Given Kim's focus on increasing the thermal stability of a battery, (Ex. 1008 ¶¶ [0055] and [0056]), information on how the battery was cycled is particularly relevant as a 0.1V higher charging voltage shortens the battery life by 50%. *Id.* Even if Kim provided information regarding how its battery cell was cycled, Kim's summary of cycle life in Table 4 is inconsistent with the data presented in FIG. 7, removing any confidence that a POSITA would have with respect to Kim's presentation of data and leading them away from relying on Kim at all. *Id.*

Although not explicitly stated by Kim, a POSITA would conclude using test calculations that the “Capacity retention” values in Table 4 of Kim were computed as the ratio of “Capacity after 250 cycles” to “Initial capacity” in Table 4. Thus, “Capacity retention” in Kim’s Table 4 corresponds directly to “DC capa. to ini. capacity” in Figure 7 of Kim. Ex. 2015 ¶ 161. However, when comparing the capacity retention values for the remaining Comparative Examples, including Comparative Examples 3, 4, 5, and 6, a POSITA would note significant discrepancies. In Figure 7, for example, Comparative Examples 5 and 6 are shown as having a 250-cycle capacity retention of around 92.5% and 92.3%, respectively. However, in Table 4, these same capacity retentions are reported for the same Comparative Examples at much lower values of 75.8% and 75.3%, respectively. Similarly, in Figure 7, the 250-cycle capacity retention of Comparative Example 3 is shown as around 88.9%, whereas in Table 4 the 250-cycle capacity retention of the same Comparative Example 3 is 92.0%. Meanwhile, there is no capacity retention curve for Comparative Example 4 in Figure 7 by which to make a comparison with Table 4. To summarize, there are notable unexplained discrepancies between Figure 7 and Table 4’s capacity retention values for the same Comparative Examples, which ultimately would deter a POSITA from relying on or applying Kim. Ex. 2015 ¶ 162.

Thus, the multiple “evaluation methods” of Kim that are relied on by Petitioner are not clear or reproducible and are therefore not usable by the POSITA. Pet. 53; Ex. 2015 ¶¶ 152-155. Additionally, the evaluation methods of Kim do not provide any particular value to a POSITA allegedly seeking to provide a firm protective SEI film on the surface of the cathode of an electrochemical device such as a lithium-ion battery that is not easily decomposed, effectively inhibits the increase in DC internal resistance of the lithium ion battery, and achieves high capacity density, and excellent cycle and storage performances. Ex. 2015 ¶167. And as shown above, all of the claimed measurements are inadequately described by Kim, scientifically problematic, and/or have no explicated connection to such objectives. *Id.*

Even if Kim’s disclosure did not provide internally contradicting data and was not woefully inadequate with respect to experimental procedure details, Examples 1 and 2 of Kim do not motivate a POSITA to adjust the relative amounts of PP and a trinitrile as Petitioner claims. Ex. 2015 ¶ 163. That is, even if a POSITA were to retain confidence in Kim’s data, which is suspect in multiple respects as discussed above, a POSITA would still note that Example 1 is superior to Example 2 in Kim’s data on cell cycle life, as shown in Table 4 and FIG. 7. Therefore, a POSITA seeking to maximize cycle life would be taught by Kim, if anything, to consider Example 1’s composition as superior to Example 2’s composition. *Id.* In particular, 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 HTCN as asserted by Petitioner). *Id.*; Pet. 52. Still further, to the extent Petitioner argues that Example 2 as compared to Comparative Examples 5 and 6 indicates "PP is better than its peers like MP or EP" and Dr. Lucht argues that "PP . . . cannot be replaced by MP or EP", these arguments (if true) would actually lead a POSITA to use PP in place of EP in Zeng's Embodiments 4 and 6. Ex. 2015 ¶ 163. Based on Petitioner's own (still-erroneous) estimations, this would result in a Z value of 26.49 wt% and 26.55 wt%, respectively, neither of which falls in the claimed Z range. *Id.*

Indeed, nothing in Kim indicates a preference for, much less mandates, the presence of PP and other alkyl propionates, such as variations of butyl (C4) or pentyl (C5) propionate are disclosed. Ex. 1008 ¶¶ [0013]-[0014] ("C3 to C5 alkyl propionate"). For example, as stated in Kim, PP is just one example of a C3 to C5 alkyl propionate that may be included individually, or in combination with *other* C3 to C5 alkyl propionates, in an amount of 10 volume percent to 80 volume percent based on the total amount of the organic solvent. *Id.* ¶¶ [0040]-[0041]. Kim provides no direct comparison between different C3-C5-alkyl propionates that would

motivate selection of PP over another C3-C5-alkyl propionate discussed in Kim, and Petitioner provides no motivation to make such a selection. Ex. 2015 ¶ 164. Thus, the POSITA reviewing Kim would not make any inference about the efficacy of various alkyl propionates and at best would see a suggestion from Example 1 that substituting C3 alkyl propionate (PP) for C2 alkyl propionate (EP) could be beneficial. *Id.*

Kim also fails to provide a POSITA with any guidance with respect to a weight percentages ratio of a trinitrile compound to PP based on a total weight of the electrolyte. Ex. 2015 ¶ 165. The solvents of Kim are only disclosed in *volume percentages*, based on the total amount of the organic solvent (Ex. 1008 ¶¶ [0013], Table 1). Thus, Kim does not contain an explicit disclosure of the amount of PP in the unit of weight percentage “based on a total weight of the electrolyte,” as is required in independent claims 1, 12, and 20 of the ’910 Patent. Kim also does not contain an implicit disclosure of the amount of PP in the unit of weight percentage based on a total weight of the electrolyte. No information can be taken from Kim that would allow a POSITA to convert the volume percentages mentioned therein into weight percentages. *Id.* Thus, Kim fails to provide a POSITA with any guidance as to a ratio based on weight percentages of components, let alone weight percentages of the components based on a total weight of the electrolyte. Indeed, a POSITA would not be motivated to turn to Kim from Zeng at least because the

solvents of Zeng are set forth in a relative mass ratio and Kim only discloses its solvents in volume percentages. *Id.*

Additionally, Kim's Examples 1 and 2 and Comparative Examples 1 to 6 use dinitrile amounts of 3 wt% or 1 wt% and use trinitrile amounts of 0 or 2 wt%. Ex. 1008, Table 1). In all cases, the dinitrile plus trinitrile amounts uniformly sum to 3 wt%. In the language of the '910 patent, *all* of Kim's embodiments are $X+Y = 3$ wt% and X/Y is either *0.5* or *infinity* (i.e. divide by zero). Ex. 2015 ¶ 166. Thus, despite Petitioner's suggestion otherwise, there is little variation and no experimentation in Kim to suggest to a POSITA that there should be a preferred or critical range of values for the combination of dinitrile (X) and trinitrile (Y) compounds, and Petitioner and Dr. Lucht fail to provide any motivation to modify Kim or Zeng to arrive at the claimed values or ranges. *Id.*

Finally, a POSITA would not be motivated to combine Kim and Zeng. Kim does not contain any teaching to prevent increases in the internal DC resistance of a battery, which is a main objective of the '910 Patent. Nor would a POSITA be led to introduce DC internal resistance as a "routine procedure for evaluating electrolyte performance" or as an additional "evaluation approach" to the four evaluation approaches of Kim as alleged by Petitioner. Pet. 55. Indeed, battery performance can be measured in numerous ways and which test(s) a POSITA would choose is dependent on a number of factors (including the battery's intended application) such

that no one test is “routine” or “merely a standard technical measure” as asserted by Petitioner. Ex. 2015 ¶¶168-169. Kim also does not contain any teachings to improve electrode plate wettability and interfacial compatibility, which are main objectives of Zeng. *See e.g.*, Ex. 1006, Abstract; Ex. 2015 ¶ 170. Instead, Kim simply aims to increase the thermal stability of a battery through the use of “an electrolyte additive including greater than or equal to about three nitrile groups.” Ex. 1008 ¶¶ [0055]-[0056]. Kim describes that this purpose may be further served by the optional addition of an additive, which is intended to suppress the generation of gas in the electrodes during storage at high temperatures. Ex. 1008 ¶ [0064]. The additive may be selected from a variety of classes of compounds and may be present in a wide range of concentrations from about 0.01 to 20% by weight of the total weight of the electrolyte composition. Ex. 1008 ¶¶ [0064]-[0065]. Examples 1 and 2 include succinonitrile (the only dinitrile compound mentioned at all in Kim) as an example of this additive, but Kim provides no single comparative example investigating whether succinonitrile has a beneficial effect on the electrolyte compositions. Ex. 2015 ¶ 170. Petitioner does not provide a sufficient motivation to combine Kim with Zeng or Zeng and Matsuoka, and, thus, Ground 1C fails.

2. Claims 2-6, 16-19, and 21-26 Are Not Unpatentable

Claims 2-6, 16-19, and 21-26 are not unpatentable over Zeng and Kim, with or without Matsuoka, for the same reasons as discussed above with respect to claims 1, 12, and 20. Ex. 2015 ¶ 171.

3. Petitioner Forfeits Any Challenge of Claims 20-26

As discussed above in Section VI.A.5, the Petition does not present any argument that element [20.7] is met in Ground 1C. Accordingly, Petitioner forfeits any challenge of claim 20 and claims 21-26 which depend therefrom.

D. Grounds 2A-2C and 3A-3C: Claims 13-14 and 15 Are Not Rendered Obvious

The deficiencies discussed above with respect to Zeng alone or in combination with Matsuoka and/or Kim in Grounds 1A-1C apply equally to these grounds. Therefore, Petitioner fails to establish that Claims 13-15 are unpatentable. Ex. 2015 ¶¶ 172-179.

E. Ground 4A: Zhou Does Not Render Obvious Claims 1-6, 12, and 16-26

Petitioner alleges that Zhou alone renders obvious Challenged Claims 1-6, 12, and 16-26. Pet. 55. However, Zhou fails to teach, suggest, disclose, or otherwise render obvious at least the PP weight percentages of elements [1.3], [12.3], and [20.3] or the trinitrile to PP ratios of [1.4], [12.4], and [20.4]. Ex. 2015 ¶¶ 180-190.

1. The Petition Fails to Show that a POSITA Would Have Selected or Implemented Zhou in General

The Petition cites overlapping and baseless rationales as to why a POSITA would have selected or implemented Example 8 of Zeng. Pet. 55-61. Once untangled, it is clear that Petitioner has failed to provide any sufficient rationale for implementing Example 8, let alone Zhou.

Zhou is fundamentally different from the claims of the '910 Patent. A POSITA would not have selected or implemented Zhou because the electrolyte formulation purposes in Zhou are not aligned with the objective task underlying the '910 Patent. Ex. 2015 ¶¶ 191-192; Ex. 1001, 1:31-40, 1:56-63, 3:8-20, 22:57-62. It was an objective task of the '910 Patent to provide electrolyte compositions which 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.* ¶ 193. 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.* ¶ 194; 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 '910 Patent. *Id.* ¶ 195. As Dr. Wheeler

explains, a POSITA would know that small voltage differences can lead to substantial (e.g., exponential) differences in rates of reaction. *Id.* 4.35V is also considered the extreme upper voltage limit for commercially produced cells employing LiCoO₂ (also known as LCO), meaning that any operation over short or long periods of time above this voltage limit would substantially impair the life of the battery. *Id.* 4.45V, as disclosed in the '910 Patent, would be well outside the conventional operating limit for both cell safety and longevity. *Id.*

A POSITA would also find Zhou's AC impedance testing/focus to be insufficient when faced with the decomposition and premature degradation problem of the '910 Patent because the DC internal resistance of the '910 Patent is different from the AC impedance studied in Zhou. Ex. 2015 ¶¶ 196-197. DC internal resistance better provides real-world operational assessment, is particularly relevant to the power performance of the battery and its performance when under load, and is of great significance to the battery's discharge capacity and charging efficiency. *Id.* AC impedance, however, is used in battery research and development, quality control, and electrochemical analysis because it is designed to give a linear response that can be better understood with the limitation that such linear response means the AC measurement does not generally incorporate "polarization," which happens when a cell in operation experiences large potential and concentration variations. *Id.*

A POSITA also would not have selected or implemented Zhou due to multiple erroneous references to different or non-existent comparative examples in nearly every Example and Comparative Example set forth in Zhou. Ex. 2015 ¶¶ 198.

2. The Petition Fails to Show that a POSITA Would Have Selected or Implemented Zhou Example 8 In Particular

Petitioner has also failed to provide sufficient rationale for implementing Example 8 of Zhou.

First, as discussed *supra* Section VI.E.1, Petitioner’s reliance on an alleged “recognized need in the art” in Zhou for “fast charging technology” necessarily fails because it materially differs from the problem faced in the ’910 Patent—the electrolyte formulation purposes in Zhou are not aligned with the objective task underlying the ’910 Patent. Ex. 2015 ¶¶ 191-197; Ex. 1001, 1:31-40, 1:56-63, 3:8-20, 22:57-62; Ex. 1014 ¶ [0003].

Second, Petitioner relies on Dr. Lucht’s wrong assumption that Example 8 outperforms all other example batteries depicted in FIG. 4 of Zhou based on a clear misunderstanding of kinetic performance data depicted by AC impedance spectra. Ex. 2015 ¶¶ 199-203. In particular, Dr. Lucht indicates that Example 8 “outperformed four other Examples on low impedance” and specifically, “outperformed Examples 1, 2, 4, and 6 in internal impedance.” Ex. 1003 ¶¶ 191,

194; Ex. 2015 ¶ 199. Petitioner's interpretations of FIG. 4 of Zhou (reproduced below) are wrong:

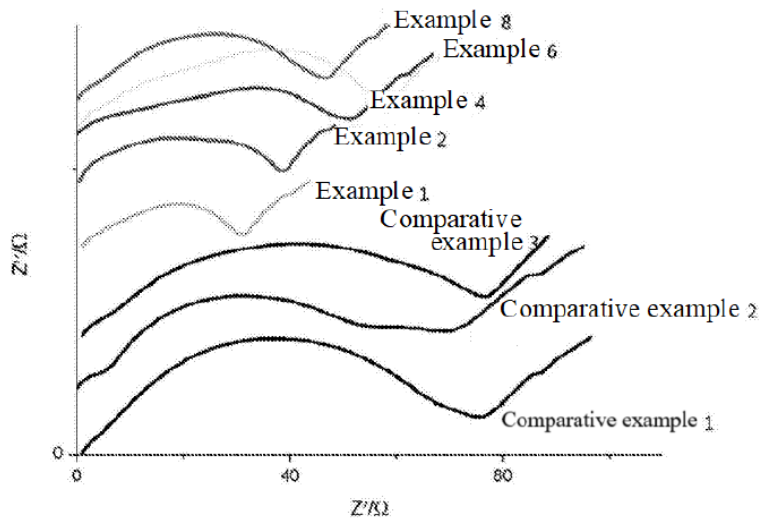


FIG. 4

Ex. 1014, FIG. 4; Ex. 2015 ¶¶ 199-200.

FIG. 4 of Zhou is a Nyquist plot and a common way of presenting AC impedance data. Ex. 2015 ¶ 201. 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.* ¶¶ 202-203; 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 ¶ 201.

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 the results depicted in FIG. 4 as Examples 1 and 2 both *outperformed* Example 8 with respect to AC internal impedance. Ex. 2015 ¶ 203. This lack of understanding of Zhou further undercuts the reliability of Dr. Lucht’s opinions with respect thereto and demonstrates why Petitioner’s proposed rationales, including an alleged motivation or obvious to try, recognized need in the art, reasonable expectation of success, and finite, predictable solutions, are not compelling.

Third, FIG. 3 of Zhou is the only figure that purports to depict battery cycle performance at high temperatures and Zhou indicates that 1,3,6-hexane trinitrile is particularly preferred to improve the high temperature performance of the battery. Ex. 2015 ¶ 204-206; Ex. 1014 ¶¶ [0023], [0024], [0049], [0050], [0059], [0063], FIGS. 1-4. Petitioner fails to address the fact that the electrolyte solutions of Examples 4 and 8 of Zhou are the only examples that include a trinitrile (1,3,6-hexane trinitrile), yet, significantly, neither Example 4 nor Example 8 is depicted in FIG. 3, such that a POSITA would not be able to draw any conclusions therefrom with respect to the effect of a trinitrile on high temperature performance or otherwise selected or implemented Example 8 over any other Examples. Ex. 2015 ¶ 207. As such, the assertion in the Petition 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. 61) 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 ¶ 208; 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 ¶ 209; 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 ¶ 210; *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 ¶ 184 (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% or if there is an additional 10 wt% of one or more of the identified solvent components. A POSITA would have disregarded Example 8 at least based on this weight discrepancy. *Id.*

3. The Petition Fails to Show that Zhou Renders Obvious the Claimed Z and Y/Z Ranges of Claims 1, 12, or 20

a. Dr. Lucht’s Assumptions With Respect to His Analysis of Example 8 are Improper

Petitioner necessarily relies on Dr. Lucht’s numerous improper assumptions because Zhou does not teach or suggest the critical ratio of the content of the trinitrile compound to the content of PP. Instead, Petitioner relies on Dr. Lucht to erroneously interpret Zhou’s Example 8. Ex. 1014 ¶¶ [0046]-[0047]; Ex. 2015 ¶ 212. Both Petitioner and Dr. Lucht assume that the mass percentages provided by Zhou in

Example 8 for various additives (including ADN and HTC�) and for lithium salt are all based on the total mass of the final electrolyte solution. Pet. 57 (citing Ex. 1014 ¶¶ [0009], [0013]-[0016], [0018]); Ex. 1003 ¶¶ [0183]-[0189]; Ex. 2015 ¶ 213. That is, Dr. Lucht's calculations with respect to Example 8 assumes that the denominator for determining the identified "% by mass" of each of the additives and the lithium salt is the total mass of the lithium-ion battery electrolyte (i.e., the final electrolyte solution). Ex. 2015 ¶ 213. However, Example 8 of Zhou is silent as to what the identified mass percentages are relative to and is subject to at least two other interpretations by the POSITA. *Id.* ¶ 214. For example and in view of the silence regarding identified mass percentages, a POSITA would interpret Example 8 of Zhou such that the identified mass percentages of the additives and the lithium salt are relative to *only* to the mass of the solvents, not the total mass of the electrolyte such that the denominator for determining the identified "% by mass" of each of the additives and the lithium salt is the mass of the solvents. *Id.* Alternatively, the identified mass percentages of the additives and salt are according to their respective placements in the sequence of mixing steps. *Id.* Example 8 describes three steps: (1) mix solvents in mass ratio, (2) add the additives to the mixed solvents such that the identified mass percentages are based on the mass of the mixed solvents formed in Step 1, and (3) add the lithium salt such that the mass percentage is based on the combined mass of the solvent and additives mixture formed in Step 2. *Id.* In this

interpretation, the denominator for determining the identified “% by mass” of each of the additives 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.*

In view of the silence in Example 8 with respect to the determination of the mass percentages, Petitioner and Dr. Lucht have 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 ¶ 215.

4. The Petition Fails to Show That a POSITA Would Have Substituted PP for Ethyl Acetate in Example 8 of Zhou

Despite the fact that *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. In particular, Petitioner asserts that it would have been obvious to try and a simple substitution. Pet. 61-65. For at least the following reasons, a POSITA would not have substituted PP for EA in Example 8. Ex. 2015 ¶ 216.

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 as PP is not used in any of the Comparative Examples or Examples or otherwise tested for its actual functionality. Ex. 1014 ¶¶ [0026]-[0048], [0052]-[0055]; Ex. 2015 ¶ 217. The chemical interactions and effects of complex combinations of various compounds in electrolyte solutions are extremely complex and unpredictable, and a POSITA would not expect predictable results from adding PP in the place of EA. *Id.*

Second, even though Zhou lists PP alongside EA in a list of eight linear carboxylic acid esters, the POSITA would not expect PP to have a low melting point and provide a good channel for ion conductivity. Ex. 2015 ¶ 218. 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 at least because 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.* ¶ 222. As Dr. Wheeler explains, having both a low melting point and a low boiling point correlates to lower viscosity, which allows the lithium ions to move more quickly, i.e., "providing a more suitable channel for lithium-ion transmission and reducing the impedance of the battery

system.” Ex. 2015 ¶ 220. PP’s boiling point is considerably higher than any other solvent in Table 1 of Zhou that is used in Examples 1-8⁶, its melting point is also nearly 10°C higher than the melting point of EA (-84°C), and its viscosity is also 53% higher than the viscosity of EA (0.45 mPa/s at 20°C). *Id.* ¶ 219, ¶ 220, n.14, ¶ 221; Ex. 2024. Petitioner’s assumption that that the PP would be substituted at a 1:1 weight percentage ratio, without accounting for such varying parameters (e.g., boiling point, viscosity, molecule size, molar mass, etc.) that defeat Zhou’s identified purpose severely further undercuts the reliability of Dr. Lucht’s opinions. *Id.* ¶ 224.

Finally, Petitioner’s simple swap fails to account for the fact that the chemical reactions in a battery are unpredictable. *Id.* ¶ 223. The POSITA would understand that all of the components of an electrolyte are important and interact in complex and unexpected ways and 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

⁶ “Butyl butyrate” appears to be listed in Table 1 of Zhou in error. *See* Ex. 2015 ¶ 220, n.14; Ex. 1014, ¶¶ [0011], [0026]-[0048], Table 1.

because it cannot form a good SEI film on the surface of the carbon negative electrode, despite it having other desirable electrolyte properties)

5. Claims 2-6, 16-19, and 21-26 Are Not Unpatentable

Claims 2-6, 16-19, and 21-26 are not unpatentable over Zhou for the same reasons as discussed above with respect to claims 1, 12, and 20. Ex. 2015 ¶ 225.

6. Petitioner Forfeits Any Challenge of Claims 20-26

Similar to Ground 1A, Petitioner chose to provide a summary table with respect to any application of Zhou to Claim 20 in Ground 4A. Pet. 68-69. With respect to element [20.7], the summary table recites “Sections XIII.B.8 ([1.7]), XIII.D.1 ([3.1])” as alleged “reasoning.” *Id.* Significantly, neither element [1.7] nor element [3.1] address the requirement of “fluoroethylene carbonate” in element [20.7]. Ex. 2015 ¶ 230. The Petition also does not and cannot incorporate by reference any analysis by Dr. Lucht, but even if it could, Dr. Lucht fails to present any argument that element [20.7] is met. *Id.* ¶¶ 226, 229; Ex. 1003, p. 98 (summary table). Accordingly, Petitioner forfeits any challenge of claim 20 and claims 21-26 which depend therefrom. *Id.* ¶¶ 227-228.

F. Ground 4C: Zhou and Kim Do Not Render Obvious Claims 1-6, 12, and 16-26

1. The Petition Fails to Show That Zhou and Kim Render Obvious the Claimed Weight Percentages of PP

Petitioner presents a single paragraph in support of Grounds 4C, 5C, and 6C, purporting to incorporate certain other sections of the Petition. Pet. 72-73. However, in this scattershot approach, Petitioner incorporates its analysis with respect to Kim from the Zeng/Kim combinations (Grounds 1C-3C), but nowhere sets forth or otherwise incorporates its analysis of Zhou with respect to the individual elements that rely solely on Zhou (Grounds 4A, 5A, or 6A). Pet. 72, n. 8 (instead incorporating “its analysis for those claim elements in **Grounds 1C-3C**” which do not contain Zhou) (emphasis added); *see also* Ex. 2015 ¶ 235. Petitioner’s failure dooms this ground.

The Petition asserts that “Kim further motivates considering the ratio of trinitrile to PP in Zhou and substituting EA for PP in Zhou Example 8.” Pet. 72. For the reasons discussed above, Kim is replete with internally contradicting data, statistical uncertainty, and woefully inadequate experimental procedure details from which a POSITA could draw any conclusions and would therefore be deterred from the teachings of Kim. Ex. 2015 ¶ 236. Moreover, Kim fails to provide a POSITA with any guidance with respect to a Y/Z ratio based on a total weight of the electrolyte because Kim’s solvents are only disclosed in volume percentages and no

information can be taken from Kim to convert the volume percentages into weight percentages. *Id.* ¶ 237.

Citing paragraph [0011] of Zhou, the Petition asserts that “Zhou also discloses that EA can be substituted for PP, drawing attention to PP,” however, as discussed in Ground 4A, although PP is identified as a potential linear carboxylic acid ester, there is no preference, special significance, or even the slightest indication for the POSITA to select PP as PP is not used in any of the Comparative Examples or Examples of Zhou or otherwise tested for its actual functionality. Ex. 2015 ¶ 217; Ex. 1014 ¶¶ [0026]-[0048], [0052]-[0055].

Citing paragraph [0059] of Zhou, the Petition asserts that “Zhou also cautions the POSITA against using an ‘excessive’ amount of PP because ‘it has a negative effect on the cycle performance,’ focusing attention on Y/Z.” Pet. 73. However, Paragraph [0059] of Zhou says nothing about any amount of PP, excessive or otherwise. Ex. 2015 ¶ 238.

Ground 4C fails.

2. Claims 2-6, 16-19, and 21-26 Are Not Unpatentable

Claims 2-6, 16-19, and 21-26 are not unpatentable over Zhou and Kim for the reasons as discussed with respect to claims 1, 12, and 20. Ex. 2015 ¶ 239.

3. The Petitioner Forfeits Any Challenge of Claims 20-26

The Petition does not present any argument that element [20.7] is met in Ground 4C. Accordingly, Petitioner forfeits any challenge of claim 20 and claims 21-26 which depend therefrom.

G. Grounds 5A, 5C, 6A, 6C: Claims 13-14 and 15 Are Not Rendered Obvious

The deficiencies discussed above with respect to Grounds 4A and 4C apply equally to these grounds. Therefore, Petitioner fails to establish that Claims 13-15 are unpatentable. Ex. 2015 ¶¶ 240-243.

H. Petitioner's 18 Different Flawed Grounds Merits Denial

Given that all grounds lack merit and at least six grounds are fatally flawed based on a failure to set forth a challenge to claim element [20.7] of claim 20 (and, as a result, dependent claims 21-26), it would not be an efficient use of resources for the Board to institute. *See, e.g., Chevron Oronite Co. v. Infieum USA LP*, IPR2018-00923, Paper 9, 9-11 (P.T.A.B. Nov. 7, 2018) (informative).

VII. CONCLUSION

Patent Owner respectfully submits that the Board should deny institution.

Dated: May 14, 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 13,999 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: May 14, 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** were served in their entirety on May 14, 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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