

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ZHUHAI COSMX BATTERY CO., LTD.,
Petitioner

v.

NINGDE AMPEREX TECHNOLOGY LIMITED,
Patent Owner

Case IPR2025-00405
U.S. Patent No. 11,769,910

**CORRECTED PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 11,769,910**

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EXHIBIT LIST

<u>Exhibit No.</u>	<u>Description</u>
1001	U.S. Patent No. 11,769,910 (“the ’910 Patent”)
1002	Prosecution history of U.S. Patent No. 11,769,910 (“the ’910 Patent file history”)
1003	Declaration of Dr. Brett Lucht, Ph.D.
1004	<i>Curriculum Vitae</i> of Dr. Brett Lucht, Ph.D.
1005	China Patent Application Publication No. CN 106099187A to Zeng et al. (“Zeng”)
1006	Certified English Translation of China Patent Application Publication No. CN 106099187A to Zeng et al. (“Zeng”)
1007	U.S. Patent Application Publication No. 2013/0224535 A1 to Matsuoka et al. (“Matsuoka”)
1008	U.S. Patent Application Publication No. 2017/0288268 A1 to Kim et al. (“Kim”)
1009	Japan Patent Application Publication No. 2009-252349 to Sunose et al. (“Sunose”)
1010	Certified English Translation of Japan Patent Application Publication No. 2009-252349 to Sunose et al. (“Sunose”)
1011	China Patent No. 108023117 to Su et al. (“Su”)
1012	Certified English Translation of China Patent No. 108023117 to Su et al. (“Su”)
1013	China Patent Application Publication No. CN 105552439 A to Zhou et al. (“Zhou”)
1014	Certified English Translation of China Patent Application Publication No. CN 105552439 A to Zhou et al. (“Zhou”)
1015	Chinese Patent No. 106848381 (“Hong”) and Certified Translation of Hong
1016	Petition (Paper 1) in <i>Zhuhai CosMX Battery Co. v. Ningde Amperex Tech. Ltd.</i> , IPR2023-00586 (PTAB Feb. 23, 2023)

<u>Exhibit No.</u>	<u>Description</u>
1017	Decision Denying Institution (Paper 14) in <i>Zhuhai CosMX Battery Co. v. Ningde Amperex Tech. Ltd.</i> , IPR2023-00586 (PTAB Aug. 18, 2023)
1018	National Library of Medicine PubChem web pages for adiponitrile, 1,3,6-tricyanohexane, lithium hexafluorophosphate, 1,3-propane sultone, succinonitrile, 1,2-bis(2-cyanoethoxy)ethane
1019	Millipore Sigma data sheets for ethylene carbonate (EC), propylene carbonate (PC), ethyl propionate (EP), and propyl propionate (PP)
1020	TCI America page for 1,3,6-Hexanetricarbonitrile
1021	Complaint, <i>Ningde Amperex Tech. Ltd. v. Zhuhai CosMX Battery Co.</i> , No. 2:24-cv-00728-JRG (E.D. Tex. Sept. 6, 2024), ECF 1.
1022	Unopposed Application for Extension of Time to Answer Complaint, <i>Ningde Amperex Tech. Ltd. v. Zhuhai CosMX Battery Co.</i> , No. 2:24-cv-00728-JRG (E.D. Tex. Dec. 4, 2024), ECF 16.
1023	U.S. Patent Application Publication No. 2017/0324116 A1 to Youichi Ohashi (“Ohashi”)
1024	U.S. Patent Application Publication No. 2016/0294007 A1 to Wang Kefei (“Kefei”)
1025	U.S. Patent Application Publication No. 2017/0069934 A1 to Yun-Hee Kim et al. (“Kim ’934”)

CLAIMS APPENDIX

Claim Element	Language
Claim 1	
[1.pre]	<i>An electrolyte, comprising</i>
[1.1]	<i>a dinitrile compound, a trinitrile compound, and propyl propionate,</i>
[1.2]	<i>wherein, based on a total weight of the electrolyte, a weight percentage of the dinitrile compound is X, a weight percentage of the trinitrile compound is Y ... ; wherein, about 2.2 wt% ≤ (X+Y) ≤ about 8 wt%, about 0.1 ≤ (X/Y) ≤ about 2.3, and</i>
[1.3]	<i>a weight percentage of the propyl propionate is Z; wherein ... 5 wt% ≤ Z ≤ 20 wt% or 30 wt% ≤ Z ≤ 50 wt%, and</i>
[1.4]	<i>about 0.02 ≤ (Y/Z) ≤ about 0.3;</i>
[1.5]	<i>wherein the dinitrile compound is one or more compounds selected from the group consisting of butanedinitrile, adiponitrile, ethylene glycol bis(2-cyanoethyl) ether, and 1,4-dicyano-2-butene; and</i>
[1.6]	<i>the trinitrile compound is one or more compounds selected from the group consisting of 1,3,6-hexanetricarbonitrile, 1,2,6-hexanetricarbonitrile and 1,2,3-tris(2-cyanoethoxy)propane;</i>
[1.7]	<i>wherein the electrolyte further comprises a compound having a sulfur-oxygen double bond.</i>

Claim Element	Language
Claim 2	
[2.1]	<p><i>The electrolyte according to claim 1, wherein, the dinitrile compound comprises adiponitrile, wherein,</i></p> <p><i>0.1 ≤ a weight percentage of the adiponitrile ÷ a weight percentage of the trinitrile compound ≤ 2.3,</i></p> <p><i>where the weight percent of the adiponitrile is based on the total weight of the electrolyte, and the weight percent of the trinitrile compound is based on the total weight of the electrolyte.</i></p>
Claim 3	
[3.1]	<p><i>The electrolyte according to claim 1, wherein the compound having a sulfur-oxygen double bond comprises 1,3-propanesultone, 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%.</i></p>
Claim 4	
[4.1]	<p><i>The electrolyte according to claim 1, wherein 0.1 ≤ X/Y ≤ 2.0.</i></p>
Claim 5	
[5.1]	<p><i>The electrolyte according to claim 1, wherein 0.025 ≤ Y/Z ≤ 0.3.</i></p>
Claim 6	
[6.1]	<p><i>The electrolyte according to claim 1, wherein X is 0.01-10 wt%, Y is 0.01-10 wt%.</i></p>
Claim 12	
[12.pre]	<p><i>An electrochemical device, wherein the electrochemical device comprises electrodes and an electrolyte comprising</i></p>
[12.1]	<p><i>a dinitrile compound, a trinitrile compound, and propyl propionate,</i></p>

Claim Element	Language
[12.2]	<i>wherein, based on the total weight of the electrolyte, the weight percentage of the dinitrile compound is X, the weight percentage of the trinitrile compound is Y ... ; wherein, about $2.2 \text{ wt}\% \leq (X+Y) \leq \text{about } 8 \text{ wt}\%$, about $0.1 \leq (X/Y) \leq \text{about } 2.3$,</i>
[12.3]	<i>and a weight percentage of the propyl propionate is Z; wherein ... about $5 \text{ wt}\% \leq Z \leq 20 \text{ wt}\%$ or $30 \text{ wt}\% \leq Z \leq 50 \text{ wt}\%$, and</i>
[12.4]	<i>about $0.02 \leq (Y/Z) \leq \text{about } 0.3$;</i>
[12.5]	<i>wherein the dinitrile compound is one or more compounds selected from the group consisting of butanedinitrile, adiponitrile, ethylene glycol bis(2-cyanoethyl) ether, and 1,4-dicyano-2-butene; and</i>
[12.6]	<i>the trinitrile compound is one or more compounds selected from the group consisting of 1,3,6-hexanetricarbonitrile, 1,2,6-hexanetricarbonitrile and 1,2,3-tris(2-cyanoethoxy)propane;</i>
[12.7]	<i>wherein the electrolyte further comprises a compound having a sulfur-oxygen double bond.</i>
Claim 13	
[13.1]	<i>The electrochemical device according to claim 12, wherein the electrode comprises a cathode, the cathode comprises a current collector,</i>
[13.2]	<i>a single-sided coating and a double-sided coating; a first part of the current collector is provided with the single-sided coating and a second part of the current collector is provided with the double-sided coating;</i>
[13.3]	<i>an electrode compaction density of the single-sided coating is D1, and, an electrode compaction density of the double-sided coating is D2, wherein, about $0.8 \leq D1/D2 \leq \text{about } 1.2$; and,</i>
[13.4]	<i>$3.5 \text{ g/cm}^3 \leq D2 \leq 4.3 \text{ g/cm}^3$.</i>

Claim Element	Language
Claim 14	
[14.1]	<i>The electrochemical device according to claim 13, wherein, both the single-sided coating and the double-sided coating are present on the same electrode; or, only a single-sided coating or a double-sided coating present on the same electrode</i>
Claim 15	
[15.1]	<i>The electrochemical device according to claim 13, wherein the electrode comprises an anode, the anode comprises a current collector,</i>
[15.2]	<i>a single-sided coating and a double-sided coating; a first part of the current collector is provided with the single-sided coating and a second part of the current collector is provided with the double-sided coating;</i>
[15.3]	<i>an electrode compaction density of the single-sided coating is $D1$, and, an electrode compaction density of the double-sided coating is $D2$, wherein, about $0.8 \leq D1/D2 \leq$ about 1.2; and,</i>
[15.4]	<i>$1.2 \text{ g/cm}^3 \leq D2 \leq 1.8 \text{ g/cm}^3$.</i>
Claim 16	
[16.1]	<p><i>The electrochemical device according to claim 12, wherein the dinitrile compound comprises adiponitrile, wherein,</i></p> <p><i>$0.1 \leq$ a weight percentage of the adiponitrile \div a weight percentage of the trinitrile compound ≤ 2.3,</i></p> <p><i>where the weight percent of the adiponitrile is based on the total weight of the electrolyte, and the weight percent of the trinitrile compound is based on the total weight of the electrolyte.</i></p>

Claim Element	Language
Claim 17	
[17.1]	<i>The electrochemical device according to claim 12, wherein, the compound having a sulfur-oxygen double bond comprises 1,3-propanesultone, 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 %.</i>
Claim 18	
[18.1]	<i>The electrochemical device according to claim 12, wherein X is 0.01-10 wt %, Y is 0.01-10 wt %.</i>
Claim 19	
[19.1]	<i>The electrochemical device according to claim 12, wherein $0.1 \leq X/Y \leq 2.0$.</i>
Claim 20	
[20.pre]	<i>An electrolyte,</i>
[20.1]	<i>comprising a dinitrile compound, a trinitrile compound, and propyl propionate,</i>
[20.2]	<i>wherein, based on a total weight of the electrolyte, a weight percentage of the dinitrile compound is X, a weight percentage of the trinitrile compound is Y ... ; wherein, about $2.2 \text{ wt}\% \leq (X+Y) \leq \text{about } 8 \text{ wt}\%$, about $0.1 \leq (X/Y) \leq \text{about } 6$,</i>
[20.3]	<i>and a weight percentage of the propyl propionate is Z; wherein ... $5 \text{ wt}\% \leq Z \leq 20 \text{ wt}\%$ or $30 \text{ wt}\% \leq Z \leq 50 \text{ wt}\%$, and</i>
[20.4]	<i>about $0.01 \leq (Y/Z) \leq \text{about } 0.3$;</i>
[20.5]	<i>wherein the dinitrile compound comprises at least one selected from the group consisting of butanedinitrile, adiponitrile, ethylene glycol bis(2-cyanoethyl) ether, and 1,4-dicyano-2-butene; and</i>
[20.6]	<i>the trinitrile compound is one or more compounds selected from the group consisting of 1,3,6-hexanetricarbonitrile , 1,2,6-hexanetricarbonitrile and 1,2,3-tris(2-cyanoethoxy)propane;</i>

Claim Element	Language
[20.7]	<i>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 %.</i>
Claim 21	
[21.1]	<i>The electrolyte according to claim 20, wherein, the dinitrile compound comprises adiponitrile, wherein, 0.1 ≤ a weight percentage of the adiponitrile ÷ a weight percentage of the trinitrile compound ≤ 2.3, where the weight percent of the adiponitrile is based on the total weight of the electrolyte, and the weight percent of the trinitrile compound is based on the total weight of the electrolyte.</i>
Claim 22	
[22.1]	<i>The electrolyte according to claim 20, wherein X is 0.01-10 wt%, Y is 0.01-10 wt%.</i>
Claim 23	
[23.1]	<i>The electrolyte according to claim 20, wherein 0.2 ≤ X/Y ≤ 5.</i>
Claim 24	
[24.1]	<i>The electrolyte according to claim 20, wherein 2.2 wt% ≤ X+Y ≤ 8 wt%, and 0.1 ≤ X/Y ≤ 2.3.</i>
Claim 25	
[25.1]	<i>The electrolyte according to claim 20, wherein 0.1 ≤ X/Y ≤ 2.0</i>
Claim 26	
[26.1]	<i>The electrolyte according to claim 20, wherein 0.025 ≤ Y/Z ≤ 0.3</i>

Zhuhai CosMX Battery Co., Ltd. (“Petitioner”) requests *inter partes* review (IPR) of claims 1-6 and 12-26 (“challenged claims”) of U.S. Patent No. 11,769,910 (“the ’910 Patent”) (EX1001), assigned to Ningde Amperex Technology Limited (“Patent Owner”).

I. INTRODUCTION

The ’910 Patent merely claims known electrolyte compositions that already delivered the purported benefits identified in the specification, and obvious variations thereof. The ’910 Patent describes electrolytes for high-voltage (above 4.4V) lithium-ion batteries that purportedly improve electrode stability and battery performance. The electrolytes contain: (1) a dinitrile compound (a compound having two nitrile, or cyano (-CN), groups); (2) trinitrile compound (a compound having three nitrile groups); and (3) propyl propionate (“PP”). The ’910 Patent claims recite broad weight percentage ranges for the dinitrile (X wt%), trinitrile (Y wt %), and propyl propionate (Z wt%) in the total electrolyte, and certain mathematical interrelationships—broad ranges for $X+Y$, X/Y , Y/Z , and Z .

All three were stock compounds of known electrolytes, as the prosecution history confirms. The Examiner rejected the claims over art disclosing then-claimed dinitrile (X), trinitrile (Y), and PP (Z) parameters. The applicant only secured allowance by amending the originally-claimed Z range 5-50 wt % to remove middle portion, 20-30 wt%, that was disclosed by the cited art.

This Petition presents prior art electrolytes that disclose dinitrile (*X*), trinitrile (*Y*), and PP (*Z*) values falling within and overlapping the parameters recited in the '910 Patent claims. *See* EX1006 (Zeng); EX1010 (Zhou); EX1008 (Kim); EX1015 (Hong). Accordingly, those prior art electrolytes render the '910 Patent claims obvious. *In re Peterson*, 315 F.3d 1325, 1329 (Fed. Cir. 2003) (The Federal Circuit has long held that “even a slight overlap in range establishes a *prima facie* case of obviousness.”); *see also Titanium Metals Corp. v. Banner*, 778 F.2d 775, 782-783 (Fed. Cir. 1985) (claimed composition unpatentable over prior art disclosing overlapping ranges).

The '910 Patent identifies nothing critical about its broadly-claimed *X*, *Y*, and *Z* parameters that might distinguish from the known electrolytes having the same or similar parameters and delivering the same benefits. Thus, the '910 Patent added nothing to the art worthy of the broad patent protection it seeks.

Long before the earliest claimed priority date of the '910 Patent, prior art electrolytes provided the purported benefits described in the '910 Patent—making the cathode's protective film more durable, thereby improving battery storage and cycling performance. The prior art even taught that adding a trinitrile and PP to dinitrile-based electrolytes, and changing the relative amounts of each compound, improves electrolyte performance. So, the prior art electrolytes had the same benefits claimed by the '910 Patent years before the priority date, reaffirming that the '910

Patent claims would have been obvious. *In re Baxter Travenol Labs.*, 952 F.2d 388, 392 (Fed. Cir. 1991) (“Mere recognition of latent properties in the prior art does not render nonobvious an otherwise known invention.”).

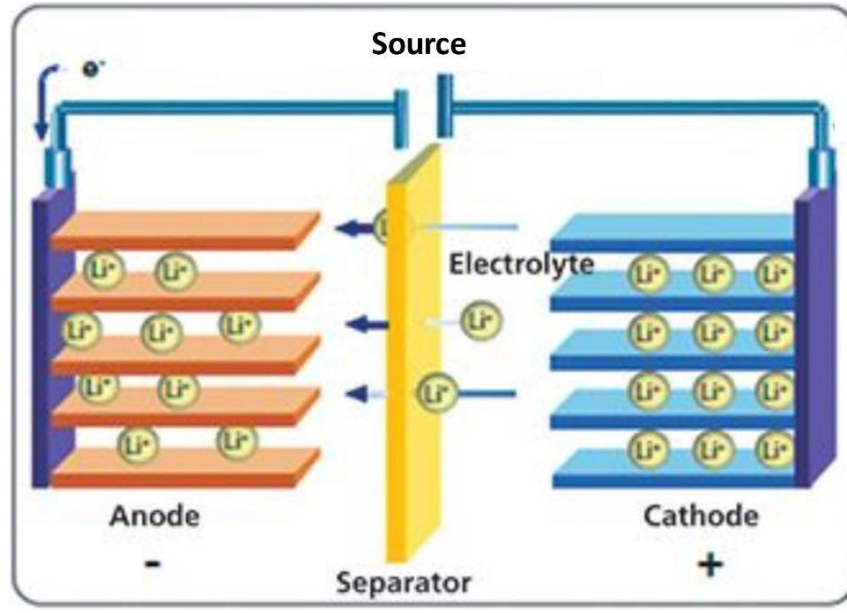
II. TECHNOLOGY BACKGROUND

A. Lithium-Ion Batteries

Lithium-ion batteries’ high energy density have made them a preferred power source for electronic devices because of their high energy density. *See* EX1006, ¶¶ [0002]-[0006]. A typical lithium-ion battery has a positive electrode (cathode), a negative electrode (anode), a separator, and an electrolyte. The cathode comprises a current collector and a layered active material that contains lithium in the discharged state. The anode comprises a current collector with a layered active material capable of receiving lithium ions. The separator prevents physical contact, and thus a short circuit, between the cathode and anode. The electrolyte facilitates lithium ion transfer between the two electrodes, and comprises lithium salt, a solvent, and optional additives. EX1003, ¶ 27.

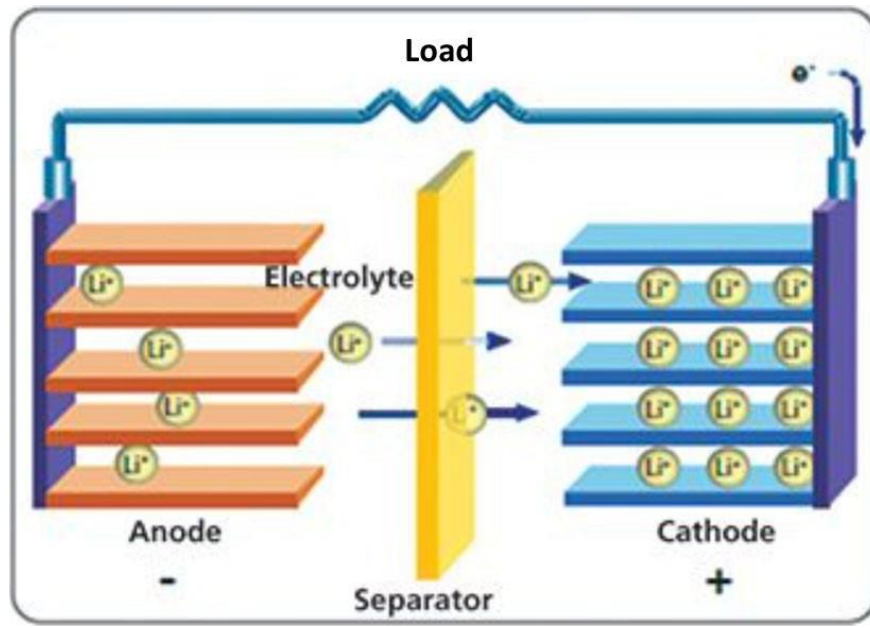
Lithium-ion batteries use a “rocking-chair” mechanism to move, or “rock,” lithium ions between the electrodes as the battery charges and discharges. EX1003, ¶ 28. As shown in the Figure below, charging the battery dislodges lithium ions from the cathode. This forces lithium ions in the electrolyte into the anode, freeing cathode electrons in to flow through an external circuit and into the anode, where they

recombine with the lithium ions and create an electrochemical potential between the electrodes. *Id.*



EX1003, ¶ 28

During discharge, the reverse occurs. A connected load provides a pathway for electrons to flow between the electrodes. The electrochemical potential drives electrons from the anode to the cathode through, powering, the load. Release of anode electrons dislodges lithium ions from the anode into the electrolyte, forcing ions in the electrolyte into the cathode where they recombine with electrons from the anode. EX1003, ¶ 29.



EX1003, ¶ 29

One charge-discharge sequence is called a cycle. Unlike primary batteries which irreversibly consume chemical energy in the cathode and cannot recharge, lithium-ion and other secondary batteries can be cycled many times. Reversing the discharge reaction returns lithium ions to the anode, thereby returning the battery to its original state for another cycle. EX1003, ¶ 30.

B. Electrolytes Containing a Trinitrile Compound and Propyl Propionate Improved SEI Layer Stability

The electrolyte must remain stable to permit sufficient ion passage between the electrodes. EX1003, ¶ 31. The solid electrolyte interphase (“SEI”) layer supports electrolyte stability. The SEI layer forms on the electrode through partial decomposition of the electrolyte, mainly during the first cycle, inhibiting further

electrolyte decomposition from side reactions during later cycles. It is electronically insulating but conductive to lithium ions, conducting to lithium ions but not electrons. *Id.*

Higher energy demands require more powerful lithium-ion batteries, making SEI layer stability crucial. *See, e.g.*, EX1006, ¶¶ [0003]-[0005]; EX1014, ¶¶ [0001]-[0005], [0008]; EX1008, ¶¶ [0001]-[0007]. As known in the industry before the '910 Patent, electrolytes containing a dinitrile compound (X)—further containing a trinitrile (Y) and PP (Z)—improved SEI layer stability and durability. *See* EX1006, ¶¶ [0037], [0049]; EX1014, ¶¶ [0058], [0059]; EX1008, ¶¶ [0014], [0040], [0090]-[0104] (Table 2), Claim 3; EX1003, ¶ 32.

III. STATEMENT OF PRECISE RELIEF REQUESTED

Petitioner requests IPR and cancellation of challenged claims 1-6 and 12-26 of the '910 Patent under § 103.

IV. THE '910 PATENT

The '910 Patent issued September 26, 2023 from Application No. 18/076,882 (“the '882 Application”), claiming priority to China Application No. 201811108529 filed September 21, 2018. EX1001.

A. Specification

Like the prior art, the '910 Patent observes, “at high voltages, the oxidation activity of the positive electrode material increases, and the stability decreases,

which makes the electrolyte decompose on the surface of the positive electrode easily or cause[s] deterioration of the battery material, resulting in a decrease in battery capacity.” EX1001, 1:33-40. The ’910 Patent addresses this issue with a conventional solution: an electrolyte composition “using a mixture of a dinitrile compound, a trinitrile compound and [PP], [which forms] a firm protective film which is not easily decomposed on the surface of the cathode at a high potential” *Id.*, 1:57-63; EX1003, ¶ 34.

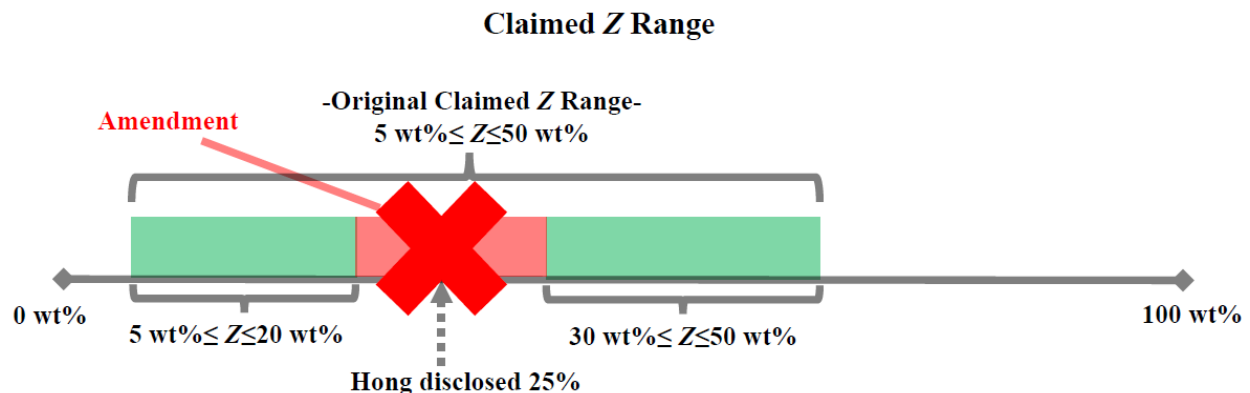
The ’910 Patent discloses various weight percentages of dinitrile (X), trinitrile (Y), and PP (Z)—based on the total weight of the electrolyte—that purportedly form a durable SEI film. EX1001, 6:1-34. The ’910 Patent provides Formulas (1)-(4) in which $X+Y$, X/Y , Z , and Y/Z fall within broad ranges, mentioning different upper and lower ends for the ranges throughout the description. *Id.*, 6:1-67, 23:30-27:60; EX1003, ¶ 35. The ’910 Patent measured performance with three metrics: inhibiting rise in internal resistance, reducing expansion rate, and maintaining voltage capacity during high-temperature battery storage and cycling. *See* EX1001, 23:30-27:58; EX1003, ¶ 35.

The ’910 Patent discloses a broad range of about 5-50 wt % for Z (PP), and mentions embodiments incrementally narrowing that range to “about 25-30%.” EX1001, 6:52-57. But the ’910 Patent does not criticize or highlight any particular Z range within the broader range—or even disclosed the specific claimed range. It

merely suggests that *Z* values outside about 5-50 wt% diminish performance. *Id.*, 29:23-26; EX1003, ¶ 36. The independent claims of the '910 Patent recite electrolytes adhering to certain ranges for Formulas (1)-(4).

B. Prosecution History

The '910 Patent prosecution history confirms that electrolytes containing a dinitrile, trinitrile, and PP were known, including electrolytes with *X*, *Y*, and *Z* parameters overlapping or very near the claimed parameters. The Examiner rejected claims to such electrolytes as unpatentable over Hong (EX1015), which disclosed electrolytes having a dinitrile, trinitrile, and PP in certain amounts by weight. Indeed, Hong anticipated the claims until an amendment removed the middle-portion of the claimed *Z* range (PP) taught by Hong—between 20 wt% and 30 wt%:



In a first Office Action, the Examiner rejected the pending claims for double patenting over parent U.S. Patent No. 10,833,363 (“the '363 Patent”) and other members of the family. EX1002, 293-301. The Examiner found the claims otherwise allowable for reciting “specific dinitriles, specific trinitriles, and [PP] in distinct

ratios and amounts relative to one another as well as other organic compound additives in specific amounts.” *Id.*, 298.

Nevertheless, the Examiner soon became aware of prior art that rendered the pending claims unpatentable. Shortly before the first Action, Petitioner filed an IPR petition challenging the related '363 Patent based on anticipation by Hong. EX1016. The applicant responded to the first Action, filing an IDS citing Hong and a terminal disclaimer to overcome the double patenting rejections. EX1002, 269-292.

The second Office Action rejected the claims as anticipated/obvious over Hong and for double patenting over other patents/applications. *Id.*, 194-209. The rejected independent claims then recited a continuous range of 5 wt%-50 wt%, without excluding the middle 20-30 wt% portion. EX1002, 440-446.

In response, the applicant amended the independent claims to simply remove the middle 20-30 wt% portion of the previously claimed 5-50 wt% range for Z (PP). *See id.*, 64-72. The applicant argued that the claims were patentable because “Hong explicitly teaches an amount between the two instantly claimed ranges, i.e., propyl propionate of 25%[.]” *Id.*, 75.¹ The applicant also filed terminal disclaimers to

¹ The applicant did not specify whether Hong’s 25% referred to a weight or volume percentage of PP, or whether this distinction was important.

overcome the new double patenting rejections. *Id.*, 56-62. The Examiner then allowed the '882 Application, citing the applicant's reasoning. *Id.*, 27-30.

Petitioner's references undercut the Examiner's reason for allowing the claims. Zeng Embodiments 4 and 6 disclose dinitrile-based electrolytes containing trinitrile and PP in the claimed Z range of 5 wt%-20 wt%, and the remaining elements of the challenged claims. Zeng, Zhou, and Su were merely cited in a large IDS—providing English Abstracts thereof only—and not substantively evaluated or applied in rejection. EX1002, 83, 383, 384. Zhou Example 8 discloses a dinitrile-based electrolyte having a trinitrile and ethyl acetate (EA), which Zhou suggests substituting with PP (another carboxylic acid ester), resulting in the claimed electrolytes. Kim, also merely cited but never substantively evaluated, *id.*, 383, further motivates substituting PP for EA in Zhou and demonstrates dinitrile-based electrolytes having a trinitrile and PP outperformed similar electrolytes lacking one or both of those compounds. Sunose and Matsuoka were not cited.

C. IPR2023-00586 ('363 Patent IPR)

The PTAB denied institution of the '363 Patent IPR petition because its Hong anticipation ground made three assumptions for which the panel found insufficient evidentiary support to show inherency. *See* EX1017, 10-12; EX1016. Petitioner's obvious Grounds, however, require none of the assumptions of the Hong anticipation ground.

V. PERSON OF ORDINARY SKILL IN ART

A person of ordinary skill in the art (“POSITA”) of the ’910 Patent would have had an advanced degree in chemistry, chemical engineering, materials science, or a related field, and two or more years of experience related to the design, research, evaluation, preparation, and/or manufacture of electrochemical energy storage devices. *See* EX1001, 1:19-21 (“the technical field of energy storage technologies, in particular to an electrolyte and an electrochemical device containing the electrolyte”); EX1003, ¶ 17. This level of skill is approximate, and more experience may compensate for less formal or different education, and vice versa.

VI. CLAIM CONSTRUCTION

In IPR, claim terms receive their ordinary and customary meaning as understood by a POSITA at the time of the invention, in light of the specification and the prosecution history. *See* 37 C.F.R. § 42.100(b); 35 U.S.C. § 282(b). No claim terms require express construction for purposes of granting the Petition, and Petitioner’s art renders obvious the challenged claims under any reasonable construction.

VII. IDENTIFICATION OF CHALLENGES AND PRIOR ART

Petitioner requests cancellation of ’910 Patent claims 1-6 and 12-26 as obvious under 35 U.S.C. § 103 as follows:

Ground		Claims	References
Zeng Grounds			
1	A	1-6, 12, 16-26	<ul style="list-style-type: none"> China Patent Application Publication No. 106099187A (“Zeng”, EX1005).
	B		<ul style="list-style-type: none"> Zeng U.S. Patent Application Publication No. 2013/0224535 (“Matsuoka”, EX1007).
	C		<ul style="list-style-type: none"> Zeng Matsuoka U.S. Patent Application Publication No. 2017/0288268 (“Kim”, EX1008).
2	A	13, 14	<ul style="list-style-type: none"> Zeng Japan Patent Application No. 2009-252349 (“Sunose”, EX1009).
	B		<ul style="list-style-type: none"> Zeng; Zeng/Matsuoka Sunose
	C		<ul style="list-style-type: none"> Zeng/Kim; Zeng/Matsuoka/Kim Sunose
3	A	15	<ul style="list-style-type: none"> Zeng Sunose China Patent No. 108023117 (“Su,” EX1011).
	B		<ul style="list-style-type: none"> Zeng; Zeng/Matsuoka Sunose Su
	C		<ul style="list-style-type: none"> Zeng/Kim; Zeng/Matsuoka/Kim Sunose Su
Zhou Grounds			
4	A	1-6, 12, 16-26	<ul style="list-style-type: none"> China Patent Application Publication No. 105552439 A (“Zhou,” EX1013).

Ground		Claims	References
	C		<ul style="list-style-type: none"> • Zhou • Kim
5	A	13, 14	<ul style="list-style-type: none"> • Zhou • Sunose
	C		<ul style="list-style-type: none"> • Zhou; Zhou/Kim • Sunose
6	A	15	<ul style="list-style-type: none"> • Zhou/Sunose • Su
	C		<ul style="list-style-type: none"> • Zhou; Zhou/Kim • Sunose • Su

Petitioner’s prior art references are U.S. and foreign patent documents qualifying as prior art under §§ 102(a)(1), 102 (a)(2) even if the ’910 Patent enjoys its earliest claimed priority date:

- Zeng was filed July 13, 2016 and published November 9, 2016. EX1006.
- Matsuoka was filed in 2011 and published in 2013. EX1007.
- Kim was filed in 2016 and published October 5, 2017. EX1008.
- Sunose was filed in 2008 and published in 2009. EX1010.
- Su was filed November 30, 2017 and published May 11, 2018. EX1012.
- Zhou is a China Patent Application filed December 16, 2015 and published May 4, 2016. EX1014.

VIII. GROUND 1A: ZENG RENDERS OBVIOUS CLAIMS 1-6, 11, 12, AND 16-26

A. Overview of Zeng

Zeng discloses electrolytes containing X, Y, and Z in the claimed amounts. Zeng Embodiments 4 and 6 have 20 wt% PP *before* adding LiPF₆ and additives, suggesting or rendering obvious that the total electrolyte has less than 20 wt% PP (and more than 5 wt%). EX1003, ¶ 65. Petitioner relies on Zeng Embodiments 4 and 6 as obviating the challenged claims. *See* EX1006, ¶¶ [0045]-[0049].

Specifically, Zeng describes embodiments of “a wide-temperature-range homogeneous non-aqueous electrolyte solution that has good lithium ion transport properties, electrode plate wettability, and interfacial compatibility.” EX1006, ¶ [0009]. Zeng’s electrolytes have:

- a “multi-component homogeneous mixed solvent” (including PP);
- fluoroethylene carbonate (FEC);
- dinitrile compounds, adiponitrile (ADN) and 1,2-bis(2-cyanoethoxy)ethane (DENE); and
- at least one second nitrile “compound having the structure shown in structural formula I” which includes trinitriles.

EX1006, ¶¶ [0011]-[0018], [0024].

Regarding the role of each component, FEC has “good film-forming properties and resistance to oxidation[,]” which “ensures good high-voltage cycling performance of the battery without seriously affecting the high-temperature performance of the battery[.]” *Id.*, ¶ [0028]. The dinitrile and trinitrile complement each other. The dinitriles “stabilize the structure of the positive electrode material, compensating for the high-temperature battery gas production problem caused by the FEC,” *id.*, ¶ [0034], which “improv[es] the high-temperature performance of the battery,” *id.*, ¶ [0029]. And the trinitrile “has better solubility in the electrolyte solution, without the problem of precipitation at low temperatures”—improving low-temperature performance. *Id.*, ¶ [0030]; *see also id.*, Abstract, ¶¶ [0038], [0045] (Table 1).

Embodiments 4 and 6 contain PP as a solvent component, ADN and DENE as *dinrile* compounds, and 1,3,6-hexanetricarbonitrile (HTCN)—a *trinitrile*—as the formula I compound. *Id.*, ¶¶ [0024], [0044]-[0049]. Specifically, in both Embodiments, “ethylene carbonate, propylene carbonate, diethyl carbonate, fluorobenzene, ethyl propionate, and [PP] are mixed at a *mass* ratio of EC:PC:DEC:FB:EP:PP = 25:10:30:5:10:20[.]” *Id.*, ¶ [0037]²; *see also id.*, ¶ [0044]. “[T]hen, lithium hexafluorophosphate of a concentration of 1.0 mol/L is slowly

² Unless otherwise specified, emphasis is added.

added to the mixed solution,”³ followed by further additives in certain weight percentages. EX1006, ¶ [0037]. Thus, the base electrolyte of both Examples has 20 wt% PP before adding LiPF₆ and additives. EX1003, ¶ 69.

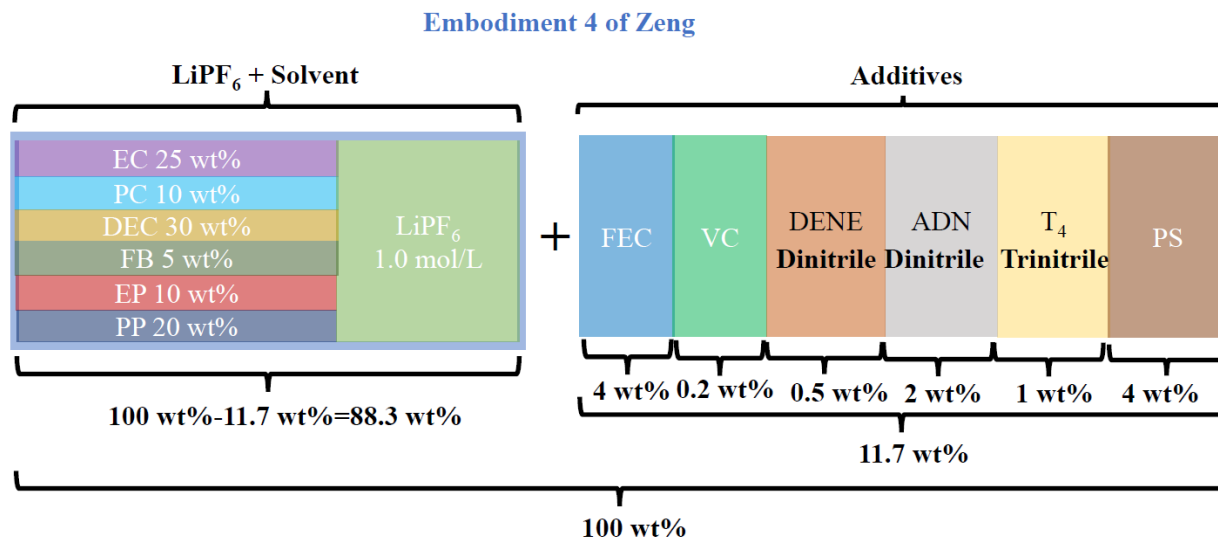
To this base electrolyte of Zeng Embodiments 4 and 6:

the following are added on the basis of the *total weight of the electrolyte solution*: 4 wt% of fluoroethylene carbonate (FEC), 2 wt% of adiponitrile (ADN) ... , 0.5 wt% of 1,2-bis(2-cyanoethoxy)ethane (DENE), 0.2 wt% of vinylene carbonate (VC), and 4.0 wt% of 1,3-propane sultone[.]

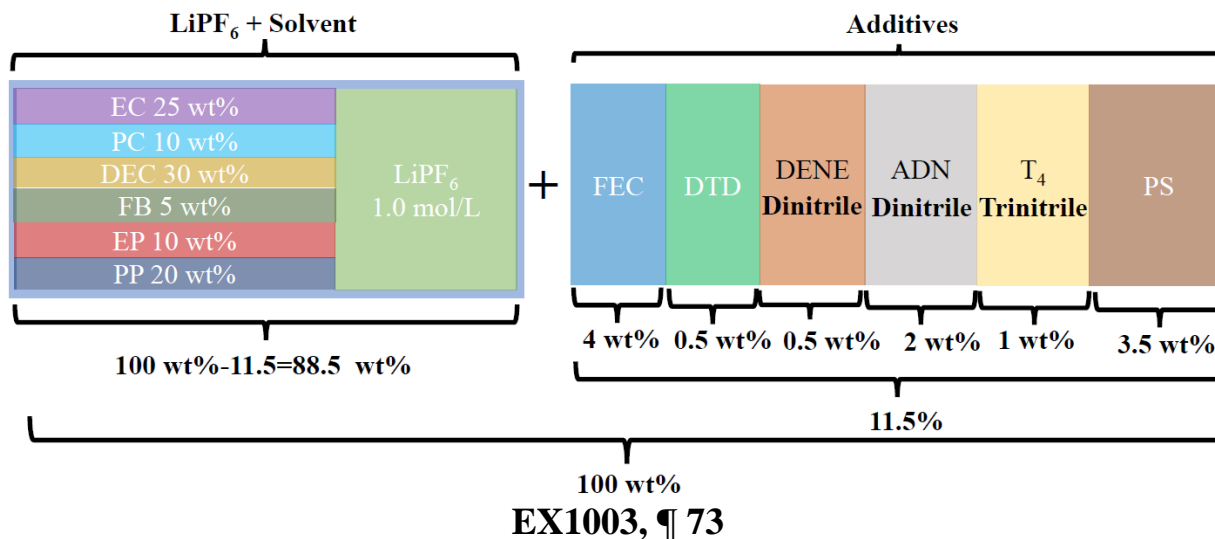
³ As Dr. Lucht explains, a POSITA would understand this to mean adding (solid) LiPF₆ to the specified EC:PC:DEC:FB:EP:PP solvent mixture to reach a concentration of 1.0 mol/L LiPF₆. EX1003, ¶ 69. While LiPF₆ is commercially available premixed in different solvents to different concentrations, Zeng already discloses a solvent mixture for its electrolytes. In such cases, it is standard practice to mix LiPF₆ in the specified solvent mixture to a target concentration (usually around 1 mol/L)—not add LiPF₆, premixed in a second solvent mixture, to that solvent mixture. *See, e.g.*, EX1003, ¶ 69; EX1023, ¶¶ [0237], [0245], [0255]; EX1024, ¶ [0048], EX1025, ¶ [0090]. Beyond rendering the ultimate concentration of LiPF₆ and amounts of the solvent components uncertain, this would disrupt the carefully-crafted solvent and additive weight percentages central to Zeng’s invention. EX1003, ¶ 69, n.4.

Id.; see also *id.*, ¶¶ [0044]-[0049]. Embodiment 4 also contained the *trinitrile* 1,3,6-hexanetricarbonitrile (HTCN, “T4”) as the Formula I nitrile. *Id.*, ¶¶ [0044]-[0049] (Table 1). Embodiment 6 was identical to Embodiment 4 except that it swapped VC for 0.5 wt% ethylene sulfate (DTD) and had slightly less PS at 3.5 wt%. *Id.*, ¶ [0046].

Thus, unlike Hong which disclosed 25% PP, Zeng Embodiments 4 and 6 both have less than 20 wt% PP in the total electrolyte, as illustrated below. EX1003, ¶¶ 70-73.



Embodiment 6 of Zeng



Weight percentage of ADN, DENE (*dinitrile*) in the total electrolyte: ADN and DENE are *dinitriles* because they have two nitrile groups. EX1003, ¶ 74; EX1018, 1, 318. As illustrated above, in both Embodiments, ADN and DENE have a combined weight percentage (the claimed X) of 2 wt%+0.5 wt%=2.5 wt% in the total electrolyte. EX1003, ¶ 74.

Weight percentage HTCN (*trinitrile*) in the total electrolyte: HTCN is a *trinitrile* because it has three nitrile groups. EX1003, ¶ 75; EX1018, 100. In Embodiments 4 and 6, HTCN has a weight percentage (the claimed Y) of 1 wt% in the total electrolyte. EX1003, ¶ 75.

Weight percentage PP in the total electrolyte: Embodiments 4 and 6 had 20 wt% PP *before* adding LiPF₆ and the remaining additives to the solvent mixture. EX1003, ¶ 76. Assuming zero weight LiPF₆, PP would have a theoretical upper limit

weight percentage in the total electrolyte of $88.3\% \times (20/(25+10+30+5+10+20))=17.66 \text{ wt\%}$ in Embodiment 4. *Id.* Similarly, in Embodiment 6, PP would have an upper limit weight percentage of $88.5\% \times (20/(25+10+30+5+10+20))=17.70 \text{ wt\%}$ in the total electrolyte. *Id.*

But LiPF_6 *does* have a non-zero weight, and Zeng teaches it was mixed in the base solvent to a concentration of 1.0 mol/L before mixing the remaining additives. EX1006, ¶ [0037]; EX1003, ¶ 77. This pushes the weight percentages Z of PP in the total electrolyte solutions down to $Z < 17.66 \text{ wt\%}$ in Embodiment 4 and $Z < 17.70 \text{ wt\%}$ in Embodiment 6. EX1003, ¶ 77. As Dr. Lucht explains, the ultimate weight percentage of PP in the total electrolyte would also certainly be well above 5 wt% because that amount would require LiPF_6 to comprise over 60 wt% of the total electrolyte. This corresponds to 4.0 mol/L solution of LiPF_6 —much greater than the typical 1.0 mol/L taught by Zeng, and atypical for lithium-ion batteries. *Id.*

To summarize, the claimed X, Y, and Z have the following values in the total electrolytes of Zeng. *Id.*, ¶ 78.

Embodiment	X (Weight Percentage ADN and DENE)	Y (Weight Percentage HTC(N))	Z (Weight Percentage PP)
4	2.5 wt%	1 wt%	<17.66 wt%
6	2.5 wt%	1 wt%	<17.70 wt%

Zeng Embodiments 4 and 6 improved high-voltage cycling performance of lithium-ion batteries, showing increased capacity retention rate over the comparative examples. EX1006, ¶¶ [0045]-[0047].

- **Rationale to Implement Zeng Embodiments 4 and 6**

Petitioner’s reliance on Zeng Embodiments 4 and 6 does not involve “selecting from large lists of elements in a single reference” as a single embodiment rendering the challenged claims unpatentable. *Contra In re Stepan Co.*, 868 F.3d 1342, 1346 n.1 (Fed. Cir. 2017). Each Embodiment in Zeng is a self-contained, working example providing a complete list of compounds, amounts, and electrolyte preparation instructions. EX1003, ¶¶ 80-82.

Nonetheless, a POSITA would have been motivated to implement Zeng Embodiments 4 and 6 with a reasonable expectation of success. EX1003, ¶ 81. The Embodiment 4 and 6 batteries significantly outperformed the Comparative Examples on capacity retention after 500 cycles. *See* EX1006, ¶¶ [0045]-[0047]. Other than Embodiments 2 and 5, Embodiment 6 had the best capacity retention at 91.6%. *Id.* This would have motivated the POSITA to implement at least Examples 4 and 6.

Moreover, it would have been “obvious to try” Zeng Embodiments 4 and 6. MPEP § 2143.I.(E); *see also* EX1003, ¶¶ 82-85.

Recognized need in the art: Zeng observes a market need for “high-energy density lithium-ion batteries” driven by “consumer terminals demand[ing] ever-higher energy density from batteries[.]” EX1006, ¶ [0003]. Conventionally, energy density was “improved primarily by selecting high-capacity, highly compact positive and negative electrode active materials and increasing the battery charge cut-off voltage.” *Id.* This reduced stability of the positive electrode, so FEC was added to reduce oxidation of the electrolyte. *Id.*, ¶ [0005]. But FEC tends to decompose at high temperatures, increasing battery expansion and internal resistance. *Id.* The industry then added organic nitriles to stabilize the electrode, but organic nitriles have poor solubility in electrolyte solutions that limits cycling and low-temperature performance. *Id.*, ¶ [0006]. Zeng thus sought a well-rounded “electrolyte solution that can remain homogeneous and stable over a wide temperature range ... to ensure that a lithium-ion battery has good high-voltage cycle performance and can perform at high and low temperatures.” *Id.*, ¶ [0008].

Finite number of identified, predictable solutions: Zeng only discloses nine electrolyte solutions (Examples 1-9)—all demonstrating better capacity retention over 500 cycles and low-temperature performance than the Comparative Examples. EX1006, ¶¶ [0044]-[0047] (Table 1); EX1003, ¶ 82. Making Embodiments 4 and 6 a priority to try over others, Example 6 performed above average (91.6% vs. 91.2%)

in capacity retention and Example 4 performed about average (91.0%). EX1006, ¶¶ [0044]-[0047] (Table 1); EX1003, ¶ 82.

Reasonable expectation of success: All Zeng Embodiments were tested successfully and had better performance than the Comparative Examples. EX1006, ¶¶ [0036]-[0053]; *see also id.*, ¶ [0050] (Testing successfully showed “that the addition of FEC and ADN ... improves the high-voltage cycling performance” and “capacity retention rate of the lithium-ion battery at 500 cycles of high voltage increases incrementally” with more FEC and ADN) Zeng provides detailed preparation instructions for the electrolytes. *See id.*, ¶¶ [0036]-[0049]. The success of Embodiments 4 and 6 and preparation instructions would have given a POSITA a reasonable expectation of success.

B. Independent Claim 1

1. [1.pre]⁴

As explained in Section VIII.A, Petitioner relies on Zeng Embodiments 4 and 6 electrolytes as rendering the Challenged Claims unpatentable. EX1006, ¶¶ [0046], [0049]; EX1003, ¶ 79.

⁴ The enclosed Claims Appendix includes the Challenged Claim language with bracketed reference numerals identifying respective Claim Elements referenced in this Petition.

2. [1.1]

Zeng discloses or suggests this element. EX1003, ¶¶ 86-87. As discussed in Section VIII.A, Zeng’s Embodiments 4 and 6 electrolytes contain *a dinitrile compound* (ADN, DENE), *a trinitrile compound* (HTCN), and *PP*, as claimed. EX1018, 1, 318; EX1006, ¶¶ [0037], [0044]-[0049] (Table 1).

3. [1.2] “ ... wherein, about 2.2 wt%≤(X+Y)≤about 8 wt%, about 0.1≤(X/Y)≤about 2.3, and”

Zeng discloses or suggests this element. EX1003, ¶¶ 88-90. *X* and *Y* and have the following values in Zeng’s total electrolyte:

Embodiment	<i>X</i>	<i>Y</i>	<i>X + Y</i>	<i>X/Y</i>
4	2.5 wt%	1 wt%	3.5 wt%	2.5
6	2.5 wt%	1 wt%	3.5 wt%	2.5

Supra Section VIII.A. Thus, in both Embodiments, $X+Y=2.5 \text{ wt\%}+1 \text{ wt\%}=3.5 \text{ wt\%}$, falling in the claimed range of about 2.2 wt% to about 8 wt%.

In both Embodiments, *X/Y* equals 2.5, which is “*about 2.3*” as claimed. EX1003, ¶ 89. Indeed, the ’910 Patent states that “about” covers “minor variations” including “less than or equal to ±10% of the stated value” EX1001, 4:12-31. Thus, Zeng’s *X/Y* values are considered “minor variations” within $(2.5-2.3)/2.3=8.7\%$ of 2.3, rendering the claimed range obvious. EX1003, ¶ 89.

Moreover, the ’910 Patent teaches limiting the *X/Y* ratio at or below 6, 5, 4, or 1—without a preference for any one limit. EX1001, 6:17-25. The ’910 Patent does

not even disclose the particular claimed range or an X/Y upper limit of 2.3. Thus, a POSITA would consider Zeng's X/Y ratio of 2.5 "close enough" to the claimed range—particularly since it falls within the '910 Patent's express 10% tolerance—"that one skilled in the art would have expected them to have the same properties."

Peterson, 315 F.3d at 1329; EX1003, ¶ 89.

4. [1.3] " ... wherein ... 5 wt% ≤ Z ≤ 20 wt% or 30 wt% ≤ Z ≤ 50 wt%, and"

Zeng suggests or renders obvious this element. EX1003, ¶¶ 91-94. Zeng suggests or renders obvious that Z is less than 17.66 wt% and 17.70 wt% in Examples 4 and 6:

Example	Z
4	<17.66 wt%
6	<17.70 wt%

Supra Section VIII.A. Each range substantially overlaps the lower portion of the claimed Z range, rendering it obvious. *Peterson*, 315 F.3d at 1329; EX1003, ¶ 91.

Although not required to show obviousness of the claimed range, both Zeng Embodiments have Z values above 5 wt% of the total electrolyte. EX1003, ¶ 92. As Dr. Lucht explains, diluting PP to 5 wt% of the total electrolyte—from its 20 wt% proportion in the solvent mixture—would require reducing the entire solvent mixture to just 25 wt% of the total electrolyte, meaning LiPF_6 and the additives make up the remaining 75 wt%. *Id.* Even if such a composition worked, LiPF_6 and the "additives"

would outweigh the “solvent” by a factor of three, contradicting the basic concept of a solvent-based electrolyte in which LiPF_6 and the additives are dissolved. *Id.* Put differently, 5 wt% PP would require LiPF_6 to comprise over 60 wt% of the total electrolyte because the additives in Embodiments 4 and 6 are respectively 11.5 wt% and 11.7 wt%. *Id.* This corresponds to 4.0 mol/L LiPF_6 —much greater than the standard 1.0 mol/L taught by Zeng and atypical for lithium-ion batteries. *Id.*

Thus, Zeng Embodiments 4 and 6 render obvious a weight proportion range for PP entirely within the lower portion of the claimed Z range—respectively less than 17.66 wt% and 17.70 wt%, and certainly greater than 5 wt%. *Titanium Metals*, 778 F.2d at 782-783; EX1003, ¶ 93.

5. [1.4] “about $0.02 \leq (Y / Z) \leq$ about 0.3;”

Zeng discloses or suggests this element. EX1003, ¶¶ 95-97. The claimed Y and Z have the following values in Zeng:

Embodiment	Y	Z	Y/Z
4	1 wt%	<17.66 wt%	>0.057
6	1 wt%	<17.70 wt%	>0.056

Supra Section VIII.A. Thus, in Zeng Embodiments 4 and 6, Y/Z is respectively greater than $1/17.66 > 0.057$ and $1/17.70 > 0.056$, overlapping the claimed range of about 0.02 to about 0.3 and thus rendering it obvious. *Peterson*, 315 F.3d at 1329; EX1003, ¶ 93.

Although not required to show obviousness of the claimed range, both Embodiments' Y/Z ratios fall below the claimed upper limit of 0.3. EX1003, ¶ 96. With $Y=1$ wt%, achieving a Y/Z ratio of 0.3 or more would require Z to be 3.33 wt% or less. But diluting PP from 20 wt% in the base solvent to 3 wt% or less of the total electrolyte would require LiPF_6 and “additives” to comprise over 85% of the final mixture—atypical for lithium-ion batteries and contrary to the notion of “additives”. *Id.* Put differently, LiPF_6 and the “additives” would cause the total weight of the electrolyte to exceed 667% of the weight of the base solvent, contradicting the notion of a solvent-based electrolyte in which LiPF_6 and additives are dissolved. *Id.*

Accordingly, Zeng Embodiments 4 and 6 render obvious a Y/Z range falling within the claimed range—greater than 0.05 and certainly less than 0.3. *Titanium Metals*, 778 F.2d at 782-783; EX1003, ¶ 97.

6. [1.5] “wherein the dinitrile compound is ... adiponitrile, ethylene glycol bis(2-cyanoethyl) ether ...;”

Zeng discloses or suggests this element. EX1003, ¶ 98. Zeng Embodiments 4 and 6 have *adiponitrile* (ADN) and *ethylene glycol bis(2-cyanoethyl)* (DENE) as the claimed *dinitrile compound*. EX1006, ¶¶ [0029]-[0030]; *supra* Section VIII.A; EX1003, ¶ 98.

7. [1.6] “the trinitrile compound is ... 1,3,6-hexanetricarbonitrile ... ;”

Zeng discloses or suggests this element. EX1003, ¶ 100. Zeng Embodiments 4 and 6 both have *1,3,6-hexanetricarbonitrile* (HTCN) as the claimed *trinitrile compound*. EX1006, ¶¶ [0046], [0049]; *supra* Section VIII.A.

8. [1.7]

Zeng discloses or suggests this element. EX1003, ¶ 102. In Embodiments 4 and 6, *the electrolyte further comprises a compound having a sulfur-oxygen double bond*—1,3-propane sultone (PS)—as claimed. EX1006, ¶¶ [0037], [0049].

C. Claim 2

1. [2.1]

Zeng discloses or suggests this element. EX1003, ¶ 104. In Embodiments 4 and 6, Zeng’s *dinitrile compound* includes *adiponitrile*. EX1006, ¶¶ [0029]-[0030]. Moreover, as explained above for element [1.2], $X/Y=2.5/I=2.5$ in Embodiments 4 and 6, falling within the ’910 Patent’s 10% “about” tolerance and, further, is “close enough” to the claimed range “that one skilled in the art would have expected them to have the same properties.” *Peterson*, 315 F.3d at 1329. *Supra* Section VIII.B.3.

D. Claim 3

1. [3.1]

Zeng Embodiments 4 and 6 have 4 wt% and 3.5 wt% *1,3-propane sultone* (PS) respectively. EX1006, ¶¶ [0037], [0045]-[0047]. Although these values fall

slightly above the claimed limit of 3 wt%, they are “close enough such that one skilled in the art would have expected them to have the same properties.” *Peterson*, 315 F.3d at 1329; *see also* EX1003, ¶ 106.

The '910 Patent specification states that PS (or other compound having a sulfur-oxygen double bond) can be up to 3 wt%, 4 wt%, or 5 wt% of the total electrolyte, without preference or criticality for any one option. EX1001, 16:12-28. This is consistent with Zeng's statement that “[p]referably, ... the mass percentage of [PS] in the electrolyte solution [can be] 0.1% to 5.0%,” EX1006, ¶ [0025]. Thus, both the '910 Patent and Zeng agree that 4 wt% is “close enough” to the claimed range to have the same properties. EX1003, ¶¶ 106-107.

E. Claim 4

1. [4.1]

Zeng discloses or suggests this element. EX1003, ¶ 109. X/Y in Embodiments 4 and 6 equals 2.5. *Supra* Section VIII.B.3. While slightly above the claimed range, the '910 Patent teaches that the X/Y ratio may have an upper limit of less than or equal to about 6, 5, 4, or 1—without a preference or criticality for any one limit. *See* EX1001, 6:17-25. The '910 Patent does not even disclose the particular claimed range or a 2.0 upper limit. Thus, a POSITA would consider Zeng's X/Y ratio of 2.5 “close enough” to the claimed range “that one skilled in the art would have expected them to have the same properties.” *Peterson*, 315 F.3d at 1329.

F. Claim 5

1. [5.1]

Zeng discloses or suggests this element. EX1003, ¶ 110. In Zeng Embodiments 4 and 6, $Y/Z > 0.057$, $Y/Z > 0.056$, and would be practically limited well below 0.3, thus rendering obvious the claimed range of 0.025 to 0.3. *Titanium Metals*, 778 F.2d at 782-783; *supra* Section VIII.B.5.

G. Claim 6

1. [6.1]

Zeng discloses or suggests this element. EX1003, ¶ 111. X and Y have the following values in Zeng, falling within the claimed X and Y ranges:

Embodiment	X	Y
4	2.5 wt%	1 wt%
6	2.5 wt%	1 wt%

Supra Section VIII.B.3.

H. Claims 12 and 16-26

Claims 12 and 16-26 recite an electrolyte—substantively identical to or similar to that of claims discussed above—in an electrochemical device having electrodes. For the reasons discussed above and the additional reasons in the table below, Zeng discloses or suggests claims 12 and 16-26. EX1003, ¶¶ 112-113.

Element	Reasoning
[12.pre]	<i>See</i> Section VIII.B.1 ([1.pre]). ⁵
[12.1]	<i>See</i> Section VIII.B.2 ([1.1]).
[12.2]	<i>See</i> Section VIII.B.3 ([1.2]).
[12.3]	<i>See</i> Section VIII.B.4 ([1.3]).
[12.4]	Section VIII.B.5 ([1.4])
[12.5]	Section VIII.B.6 ([1.5]).
[12.6]	Section VIII.B.7 ([1.6]).
[12.7]	Section VIII.B.8 ([1.7]).
[16.1]	Section VIII.C.1 ([2.1]).
[17.1]	Section VIII.D. ([3.1]).
[18.1]	Section VIII.G.1 ([6.1]).
[19.1]	Section VIII.E.1 ([4.1]).
[21.1]	Section VIII.C.1 ([2.1]).
[22.1]	Section VIII.G.1 ([6.1]).
[23.1]	Section VIII.B.3 ([1.2]). In Zeng Embodiments 4 and 6, $X/Y=2.5$, falling in the claimed range.
[24.1]	Section VIII.B.3 ([1.2]). In Zhou Example 8, $X+Y=3.5$ wt% falling in the claimed range. And $X/Y=2.5$, which is “about” 2.3 and within the ’910 Patent’s 10% tolerance.
[25.1]	Section VIII.E.1 ([4.1]).
[26.1]	Section VIII.B.5 ([1.4]). In Zeng Embodiments 4 and 6, $Y/Z>0.057$, $Y/Z>0.056$, overlapping the claimed ranges.

⁵ Zeng Embodiment 4 and 6 electrolytes were used in a lithium-ion secondary battery—an *electrochemical device* that *comprises electrodes*, as claimed. *See* EX1006, ¶¶ [0028]-[0034].

IX. GROUND 2A: ZENG AND SUNOSE RENDER OBVIOUS CLAIMS 13 AND 14

Zeng does not expressly disclose all elements of claims 13 and 14, but Sunose discloses a lithium-ion battery with a cathode having the single- and double-sided coatings of these claims. A POSITA would have found it obvious to modify Zeng's battery based on Sunose to arrive at the subject matter of these claims. EX1003, ¶ 114.

A. Claim 13

1. [13.1]

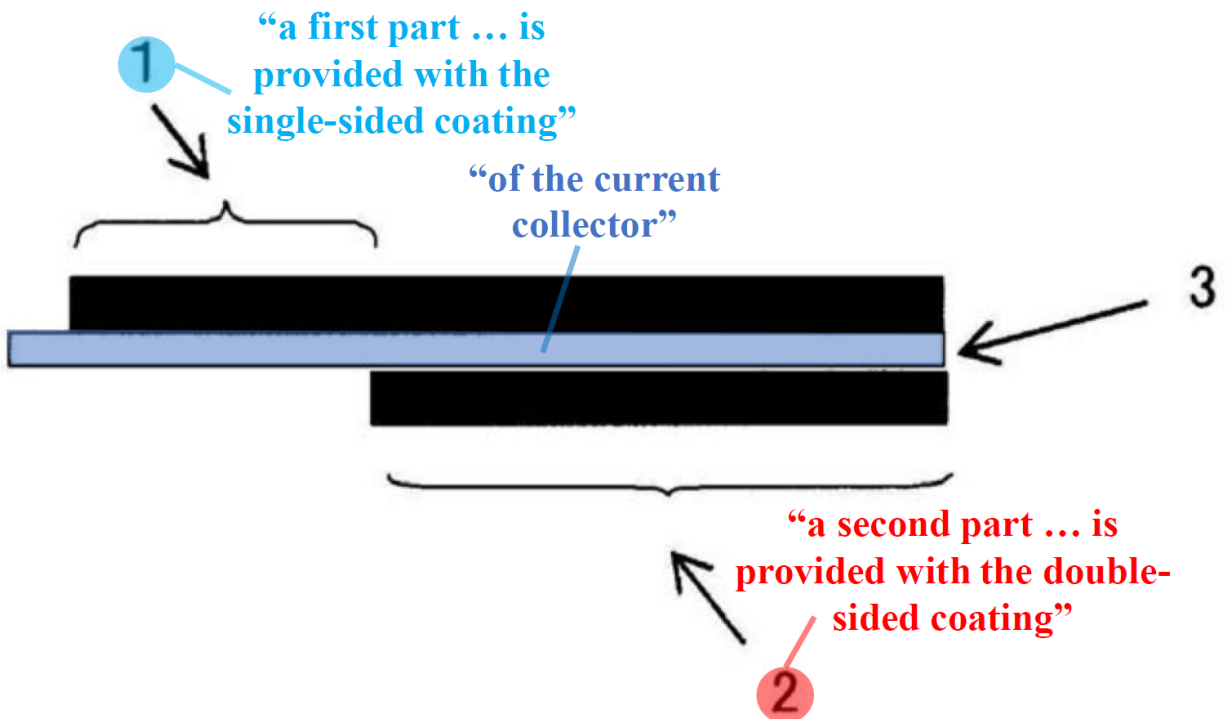
Zeng discloses electrolytes for “ensuring good high-voltage performance of a lithium-ion battery.” EX1006, Abstract. Batteries using the Embodiment 4 and 6 electrolytes were tested for performance. *Id.*, ¶¶ [0036]-[0053]. A lithium-ion battery, by definition, is an electrochemical device having a cathode that comprises a current collector as claimed. EX1001, 34:58-35:9; EX1003, ¶ 115.

2. Sunose discloses Elements [13.2] to [13.4]

- a. [13.2] “a single-sided coating and a double-sided coating; a first part of the current collector is provided with the single-sided coating and a second part of the current collector is provided with the double-sided coating;”**

As highlighted in Figure 2 below, Sunose discloses a positive electrode (cathode) with *a single-sided coating and a double-sided coating; a first part (single-side coating part 1) of the current collector (current collector 3) is provided*

with the single-sided coating and a second part (double-sided coated part 2) of the current collector (current collector 3) is provided with the double-sided coating, as claimed. EX1010, ¶¶ [0005], [0007]-[0010], [0012], [0013], [0024]; EX1003, ¶ 117.



Sunose, FIG. 2*

As shown, Sunose’s electrode has “[a] single-sided active material layer portion [1], wherein the active material layer is formed only on a single side of the current collector [3]” and “[a] two-sided active material portion [2]” with an active material layer formed on both sides of the current collector 3. EX1010, ¶ [0007]; EX1003, ¶ 118.

b. [13.3] “ ... wherein, about $0.8 \leq D1/D2 \leq$ about 1.2; and,”

[13.4] “ $3.5 \text{ g/cm}^3 \leq D2 \leq 4.3 \text{ g/cm}^3$.”

At least Sunose’s Examples 2-4 electrode plates satisfy elements [13.3] and [13.4], having single- and double-sided compaction densities $D1$, $D2$ (packing densities) falling within the claimed ranges. EX1003, ¶ 120.

Example	$D1$ (g/cm ³)	$D2$ (g/cm ³)	$D1/D2$	Citation
2	5.0	4.0	1.25	EX1010, ¶¶ [0031], [0040], Table 1
3	4.4	4.0	1.1	EX1010, ¶¶ [0032], [0040], Table 1
4	4.0	4.0	1.0	EX1010, ¶¶ [0033], [0040], Table 1

All Examples have a “packing” density $D2$ of 4.0 g/cc for the double-sided portion 2, and Examples 2 through 4 respectively have packing densities $D1$ of 5.0, 4.4, and 4.0 g/cm³. EX1010, ¶¶ [0029]-[0033], [0040]; EX1003, ¶ 121. This results in a ratio $D1/D2$ of 1.25, 1.1, and 1.0 for Examples 2-4 of Sunose, respectively. The ratios for Examples 3 and 4 fall within the claimed range, and a POSITA would reasonably consider Example 2’s ratio 1.25, which falls within the ’910 Patent’s 10% tolerance, to be “*about 1.2*,” as claimed. EX1003, ¶ 121. Additionally, Sunose’s packing density $D2$ for the double-sided portion—4.0 in all three Examples—falls within Element [13.4]’s range of 3.5 g/cm³ to 4.3 g/cm³. *Id.*

Sunose’s “packing” densities listed disclose the claimed *compaction* densities because Sunose explains that the densities were calculated after “rolling was performed using a roll press.” EX1010, ¶ [0031]; *see also id.*, ¶¶ [0028], [0030]-[0034]. This refers to the “rolling process” that “*roll[s]* the electrodes that have been coated and dried in the manufacturing process at *high density*.” EX1010, ¶ [0006]; *see also id.*, ¶¶ [0007], [0008], [0012]-[0016]. Thus, Sunose’s “packing density” refers to density after *compaction*. EX1003, ¶ 122.

3. Rationale to combine Zeng and Sunose

A POSITA would have been motivated, with a reasonable expectation of success, to configure Zeng’s cathode according to Sunose’s Examples. EX1003, ¶ 123.

- **Analogous art**

Sunose is analogous art because it falls in the same field of endeavor—lithium-ion secondary batteries, including those employing non-aqueous electrolytes. *See* EX1010, Abstract, ¶¶ [0001]-[0011], [0043], [Claim 3]; EX1003, ¶ 124. Zeng seeks to improve performance of lithium-ion batteries, which have electrode assemblies. EX1006, ¶¶ [0001]-[0006]; *see also* EX1001, 21:4-16, 23:66-24:3. Sunose’s electrode assembly improves battery performance by increasing adhesion of the electrode layers while mitigating breakage of the electrode plate during rolling. EX1010, ¶¶ [0010], [0012], [0017], [0018], [0021], [0024]; EX1003, ¶ 124.

- **Teaching, suggestion, motivation**

Zeng and Sunose would have motivated a POSITA to use Sunose's electrode assembly configuration in Zeng Embodiment 4 and 6 batteries. EX1003, ¶ 125. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417-418 (2007).

Electrode assembly implementation details: Zeng focuses on electrolyte compositions and omits configuration details for the electrode assembly. Thus, a POSITA reading Zeng would have looked to other references, like Sunose, for electrode assembly implementation details. EX1003, ¶ 126. The need to use some rolled electrode configuration in Zeng's batteries would have prompted a POSITA adopt Sunose's electrode configuration. *Id.*

Maximizing electrode area: Sunose's electrode configuration, "wherein the positive electrode plate and negative electrode plate are wound with a separator interposed therebetween," serves "to maximize the electrode area" in two ways. EX1010, ¶ [0004]; EX1003, ¶ 127. First, the spiral design permits more electrode surface area within a given space, increasing capacity. EX1010, ¶ [0004]; EX1003, ¶ 127. Second, rolling the electrode assembly exposes surfaces of the innermost and outermost ends of the rolled current collector, "increas[ing] the effective electrode area, thereby improving battery performance." EX1010, ¶ [0005]. Industry pressure, noted by Zeng and Sunose, to increase battery capacity and performance would have

motivated the POSITA to use Sunose's rolled design to increase electrode surface area for a given form factor. EX1003, ¶ 127.

Improving adhesion and reducing breakage: The desire to reduce electrode breakage and improve electrode adhesion would have enticed a POSITA to use Sunose's electrode configuration in Zeng. EX1003, ¶ 128. Sunose explains that while one rolling setting might provide the right compaction density and adhesion for the single-sided portion, that same setting excessively loads the thicker double-sided portion, weakening the electrode and increasing crack rate and breakage. EX1010, ¶¶ [0010], [0012]. Thus, Sunose controls the packing ratios M/N between the single-sided M and double-sided N portions to fall between 0.7 and 1.0, so that the one-sided portion 1 is thicker than the double-sided portion 2. *Id.*, ¶¶ [0016], [0017], [0027], [0028], [0042], FIG. 1. Then, the rolling process applies uniform pressure across both portions of the electrode, improving overall adhesion while avoiding breakage. EX1010, ¶ [0042]; EX1003, ¶ 128.

- **Reasonable expectation of success**

A POSITA would have had a reasonable expectation of success using Sunose's rolled electrode configuration in Zeng's example batteries. EX1003, ¶ 129. Zeng does not disclose any physical specifications or restrictions for its high-voltage (4.4V) lithium-ion batteries, broadly intended for "the digital, energy storage, power, and military aerospace fields." EX1006, ¶ [0002]; *see also id.*, ¶ [0035]. Sunose

generally intends its rolled electrode configuration for “consumer electronic devices,” so the POSITA would have reasonably expected Sunose’s electrode configuration to work in Zeng’s batteries. EX1010, ¶ [0002]; EX1003, ¶ 129.

B. Claim 14

1. [14.1]

The Zeng-Sunose combination includes this element. EX1003, ¶ 131. In Sunose’s electrode configuration, *both the single-sided coating 1 and the double-sided coating 2 are present on the same electrode 3*. See EX1010, Abstract, ¶ [0007], FIG. 1; EX1003, ¶ 131.

X. GROUND 3A: ZENG AND SUNOSE, FURTHER IN VIEW OF SU, RENDER OBVIOUS CLAIM 15

To the extent Zeng and Sunose lack elements of claim 15, Su discloses a lithium-ion battery with an anode configuration having the single- and double-sided coating portions of claim 15. A POSITA would have found it obvious to modify the anode of the Zeng/Sunose battery based on Su to arrive at claim 15. EX1003, ¶¶ 133-146.

A. Claim 15

1. [15.1]

Zeng discloses or suggests this element. *Supra* Section IX.A.1.

2. Su discloses Elements [15.2] to [15.4]

- a. [15.2] “a single-sided coating and a double-sided coating; a first part of the current collector is provided with the single-sided coating and a second part of the current collector is provided with the double-sided coating;”**

Su discloses or suggests this element. EX1003, ¶ 135. Su describes a lithium-ion battery having high energy density and intended for a variety of applications, including mobile devices, as well as its preparation method. EX1012, Abstract, ¶¶ [0001]-[0003], [0005], [0006], [0036].

Double-sided part of negative (anode) electrode current collector: Su’s method includes coating positive and negative electrode slurries on “*both sides of ... a negative electrode collector*” and “then drying and compacting to form ... *a double-sided negative electrode plate[.]*” EX1012, ¶ [0010]. Thus, Su discloses “*a double-sided coating*” where “*a second part of the current collector is provided with the double-sided coating,*” as claimed. EX1003, ¶ 136.

Single-sided part of negative (anode) electrode current collector: Additionally, Su “appl[ies] the negative electrode slurry on *one side* of the negative electrode current collector, and then drying and compacting to form a *single-sided negative electrode plate[.]*” EX1012, Claim 2(b), ¶¶ [0011], [0032]. Su then cuts the single- and double-sided sheets “into required sizes respectively and assembl[es] them into a cell” with “the single-sided negative electrode plate is provided on the

outermost layer, with the side without slurry facing outwards[.]” *Id.*, Claim 1(c), ¶¶ [0012], [0033], [0056], [0081]. Thus, Su also discloses that the anode has “a single-sided coating” and that “a first part of the current collector is provided with the single-sided coating,” as claimed. EX1003, ¶ 137.

b. [15.3] “ ... wherein, about $0.8 \leq D1/D2 \leq$ about 1.2; and,”

[15.4] “ $1.2 \text{ g/cm}^3 \leq D2 \leq 1.8 \text{ g/cm}^3$.”

Su discloses these elements. EX1003, ¶ 138. Specifically, Su’s Examples 2 and 3 batteries had the following single- and double-sided coating compaction densities D1, D2 for the negative electrode (anode):

Example	D1 (g/cm³)	D2 (g/cm³)	Ratio D1/D2	Capacity (Ah)	Energy Density (Wh/kg)
2	1.8	1.8	1.0	31.48	189.92
3	1.5	1.5	1.0	32.44	191.28

See EX1012, ¶¶ [0059]-[0064]; EX1003, ¶ 138. At least Su Examples 2 and 3 satisfy the D1/D2 ratio of Element [15.3] and the D2 range of element [1.4].

c. Rationale to Combine

- **Teaching, suggestion motivation**

A POSITA would have found it obvious, with a reasonable expectation of success, to implement Examples 2 and 3 of Su for the negative electrode (anode) of Zeng/Sunose. EX1003, ¶ 139. First, Su is analogous art to the ’910 Patent, Zeng, and Sunose because it also seeks to improve performance of lithium-ion batteries—using

its anode (and cathode) configuration to increase energy density. *See* EX1012, Title, Abstract, ¶¶[0005]-[0024].

Lack of anode implementation details: Sunose describes a rolled electrode configuration and focuses primarily on the positive electrode (cathode), leaving out implementation anode implementation details. But a POSITA would also need anode implementation details to make the Zeng-Sunose battery. EX1003, ¶ 140. This would have prompted a POSITA to look to Su—also describing a rolled electrode configuration—for anode implementation details, including appropriate compaction densities for the single- and double-sided coating portions of the current collector. EX1012, ¶¶ [0039]-[0040]; EX1003, ¶ 140.

Energy density: Zeng and Sunose both portray a market demand for high energy density, so a POSITA considering these references would have been concerned with increasing energy density. *See, e.g.*, EX1006, ¶ [0003]; EX1010, ¶ [0002]. Su designed its electrode configuration—including the anode—to improve energy density, and all Su's Example batteries had strong performance in capacity and energy density over more than 2000 cycles. EX1012, ¶¶ [0041], [0058], [0061], [0064], [0067], [0070], [0073], [0076]. Thus, the market need to improve energy density would have further prompted the POSITA to use Su's anode configuration in Zeng/Sunose. EX1003, ¶ 141.

- **Obvious to try**

A POSITA would have found it “obvious to try” Su’s Examples 2 and 3 anode configurations in Zeng/Sunose. MPEP § 2143.I.(E); EX1003, ¶¶ 142-145.

Recognized need in the art: Like Zeng and Sunose, Su observes an underlying market need for high energy density lithium batteries for applications including mobile devices, electric vehicles, and electric tools. EX1012, Abstract, ¶¶ [0001]-[0003]. With this market demand, “the performance of lithium ion batteries is facing higher development requirements, and high energy density has become one of the research directions of high-performance lithium-ion batteries.” *Id.*, ¶ [0003].

Finite number of identified, predictable solutions: Su only discloses seven Example batteries and one comparative Example, so a POSITA would have found it obvious to try all Examples. EX1012, ¶¶ [0050]-[0084]. Example 3 had the second best capacity (below Example 7) and above-average energy density—within 1 Wh/kg of Example 6. Example 2 had well-balanced performance above some other Examples (e.g., 1 and 5) when considering both capacity and energy density. EX1003, ¶ 144. This would have directed the POSITA to Examples 2 and 3 over some of Su’s other Examples.

- **Reasonable expectation of success**

A POSITA would have had a reasonable expectation of success because Sunose and Su both describe wound/rolled electrode configurations. EX1010, ¶¶ [0006]-[0008]; EX1012, Claims 3-5, ¶¶ [0014]-[0016], [0028], [0036]-[0040]. Both electrode current collectors of Su both have single- and double-sided coating portions. EX1012, ¶¶ [0038]-[0040]. While Sunose only describes a cathode configuration in detail, Sunose's cathode collector has a similar single-sided and double-sided configuration to that described by Su. All Su's Example batteries were successfully tested over more than 2000 cycles, with good results in capacity and energy density. EX1012, ¶¶ [0041], [0058], [0061], [0064], [0067], [0070], [0073], [0076]. Su provides instructions to prepare its lithium battery, including how to make the single- and double-sided coating parts of the anode. *See id.*, Claims 2-10, ¶¶ [0008]-[0021], [0030]-[0040]. This would have given a POSITA a reasonable expectation of success in implementing Su's Examples for the anode in the Zeng/Su combination. EX1003, ¶ 145.

XI. GROUND 1B, 2B, 3B: ZENG AND MATSUOKA RENDER OBVIOUS CLAIMS 1-6, 12, 16-26; ZENG/MATSUOKA AND SUNOSE RENDER OBVIOUS CLAIMS 13 AND 14; ZENG/MATSUOKA/SUNOSE AND SU RENDER OBVIOUS CLAIM 15

Patent Owner may argue that Zeng's ambiguity regarding adding LiPF_6 renders uncertain the weight proportion of the solvent components in the

electrolyte—negating obviousness of Elements [1.3]/[12.3]/[20.3] or hindering the POSITA’s ability to prepare Zeng’s electrolyte solutions. This argument, if raised, lacks merit.

Moreover, alternate Grounds 1B-3B rely on Matsuoka’s direct disclosure of an appropriate weight percentage *Z* of PP instead of a POSITA determining it from Zeng. Under this analysis, all challenged claim elements remain obvious. For the remaining claim elements not addressed below, Petitioner incorporates by reference its analysis above for those claim elements in Grounds 1A-3A. *Supra* Sections VIII-X.

A. Overview of Matsuoka

Matsuoka describes a “non-aqueous electrolyte solution” including the nitrile additive “acetonitrile and a lithium salt,” and a “non-nitrile additive” to improve the durability of the SEI layer formed on the electrode surface. EX1007, Abstract, ¶¶ [0015], [0035], [0044], [0056], [0057]. A durable SEI layer protects the electrodes, reducing side reactions and maintaining lower internal resistance which improves high-temperature storage and cycling performance. *Id.*, ¶¶ [0022], [0036], [0057].

Matsuoka explains that compounds having LUMO (Lowest Unoccupied Molecular Orbital) and HOMO (Highest Occupied Molecular Orbital) energy levels falling in preferred ranges make suitable non-nitrile additives. *Id.*, ¶¶ [0015], [0036],

[0039]. An ideal LUMO level improves reducibility of the non-nitrile additive, helping form the SEI film on the negative electrode while “provid[ing] good effects on ... a positive electrode and a separator” and suppressing “an increase in internal resistance caused by repeating charge-discharge cycles[.]” *Id.*, ¶ [0036]. An ideal HOMO level distributes the protective effects of the SEI layer to at least the positive electrode. *Id.*, ¶ [0039]. Together, optimum LUMO and HOMO levels suppress side reactions, improving overall performance. *Id.*, ¶ [0022].

Matsuoka lists non-nitrile additives with LUMO and HOMO levels appropriate for use in its electrolytes. EX1007, ¶¶ [0036], [0038]-[0040]. Matsuoka lists PP isomers as suitable additives with LUMO and HOMO energies falling in or near the most-preferred ranges. *Id.*, ¶¶ [0038], [0040].

B. Elements [1.4]/[12.4]/[20.4]

1. Matsuoka discloses Elements [1.4]/[12.4]/[20.4]

Matsuoka teaches two preferred weight proportion ranges for the non-nitrile additive (e.g., PP) in the total electrolyte:

	Amount of Non-nitrile Additive	Citation
Preferably	0.1 to 30 wt%	EX1007, ¶ [0041]
More preferably	0.1 to 10 wt%	

Matsuoka’s preferred range overlaps the upper and lower portions of the claimed Z range, and Matsuoka’s more preferred range overlaps the lower portion of the

claimed *Z* range. Thus, Matsuoka discloses or suggests the Elements [1.4]/[12.4]/[20.4]. *Peterson*, 315 F.3d at 1329; EX1003, ¶¶ 151-152.

2. Rationale to combine

A POSITA would have been motivated, with a reasonable expectation of success, to incorporate Matsuoka's preferred non-nitrile weight percentages as the *weight percentage of the PP Z* in Zeng's Examples 4 and 6. EX1003, ¶¶ 153-158.

- **Analogous art**

Matsuoka is analogous art because it also relates to the field of endeavor of lithium-ion batteries, including for mobile devices. EX1007, ¶¶ [0001]-[0005], [0212]. Additionally, the '910 Patent observes that, "at high voltages, the oxidation activity ... increases, ... which makes the electrolyte decompose on the surface of the positive electrode easily or cause deterioration of the battery material, resulting in a decrease in battery capacity." EX1001, 1:33-38. The '910 Patent seeks compositions that "inhibit[] the side reactions ... to improve the long-term storage performance and reliability of the electrochemical device," EX1001, 2:48-52, highlighting reducing side reactions as "important to controlling the expansion of electrochemical devices." *Id.*, 3:15-20.

Addressing this issue, Zeng uses the solvent "[f]luoroethylene carbonate (FEC), which has good film-forming properties and resistance to oxidation" and "ensures good high-voltage cycling performance of the battery without seriously

affecting the high-temperature performance of the battery.” EX1006, ¶ [0028]. Likewise, Matsuoka uses its non-nitrile additive such as PP to form a stable protective film on the negative electrode, suppressing side reactions that generate gas and rise in internal resistance that can damage the battery and/or hurt cycling performance. EX1007, ¶¶ [0011], [0022], [0036], [0042], [0057], [0104]. Thus, a POSITA would have considered Matsuoka in the proposed combinations. EX1003, ¶ 155.

- **Teaching, suggestion, motivation**

Implementation details: Any 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. The POSITA would have noted Matsuoka’s “off-the-shelf” preferred weight proportion ranges for the non-nitrile additive, such as PP, to use as for the weight percentage Z of PP in Zeng Embodiments 4 and 6. EX1003, ¶ 156.

Balanced performance: Matsuoka explains that its preferred weight proportion ranges for non-nitrile additives balance the competing advantages of electrolyte stability and high-rate performance at low temperatures. EX1007, ¶ [0041]. Specifically, increasing the amount of the non-nitrile additive improves electrolyte stability at the cost of low-temperature performance, and vice versa. *Id.* By using the non-nitrile additive in Matsuoka’s preferred weight proportion ranges,

however, “all of the cycling performance of the electrolyte solution, high-rate performance under a low temperature environment, and other battery characteristics can be further improved.” *Id.* Apart from implementation details, the desire for balanced performance would have motivated the POSITA to use Matsuoka’s preferred weight proportion ranges as the amount of PP in Zeng’s Example 4 and 6 electrolytes. EX1003, ¶ 157.

- **Reasonable expectation of success**

A POSITA would have had a reasonable expectation of success in using Matsuoka’s preferred non-nitrile weight proportions for PP in Zeng’s electrolytes. EX1003, ¶ 158. First, overlap in composition of Zeng’s electrolytes and those of Matsuoka would have reasonably ensured success. *Id.* Zeng’s and Matsuoka’s electrolytes both also include the same carbonate-based solvents (EC, PC), ester compound (EP), LiPF₆ as the lithium salt, and VC as an additive. *Compare* EX1006, ¶¶ [0011]-[0019], [0037] *with* EX1007, ¶¶ [0029], [0030], [0034]. And Zeng and Matsuoka both use electrolyte components to improve the SEI film. *Compare* EX1006, ¶¶ [0005], [0028], [0034] *with* EX1007, ¶¶ [0022], [0026], [0030]. Thus, a POSITA would have reasonably expected the preferred weight proportions of Matsuoka’s non-nitrile additive to be suitable as the weight percentage Z of PP in Zeng’s electrolytes—particularly because Matsuoka describes non-nitrile additives as generally combinable, interchangeable, and “not particularly limited.” EX1007,

¶ [0035]; EX1003, ¶ 158. A POSITA would expect the resulting solution to have a blend of performance characteristics of Zeng’s and Matsuoka’s electrolytes: (1) “a wide-temperature-range ... [with] good lithium ion transport properties, electrode plate wettability, and interfacial compatibility,” EX1006, ¶ [0009], and (2) “high-rate performance under a low temperature environment,” EX1007, ¶ [0041]. EX1003, ¶ 158.

3. The Zeng-Matsuoka combination teaches or suggests the claims

The proposed combination teaches or suggests the claimed Y/Z ranges:

Example	Y (Zeng)	Z (Matsuoka)	Y/Z
4	1 wt%	10 wt%; 30 wt%	0.1; 0.033
6			

EX1003, ¶ 159. As shown above, for example, using Matsuoka’s more preferred upper limit for PP in Examples 4 and 6 of Zeng results in $Y/Z=1/10=0.1$ wt%, falling in the claimed range 0.02 to 0.3 (elements [1.5], [12.5]) and 0.025 to 0.33 (elements [5.1] and [20.5]). *Id.*, ¶ 160. Similarly, Matsuoka’s preferred upper limit 30 wt% results in $Y/Z=1/30=0.033$ wt%--within the claimed range.

Alternatively, Matsuoka highlights PP’s ability to prevent a rise in internal resistance. EX1003, ¶ 161. The ’910 Patent acknowledges that known film-forming additives increase a battery’s internal resistance due to the SEI layer they form,

indicating a need for improvement. EX1001, 1:31-63. Seeking enhancements based on Zeng, a POSITA would recognize from Matsuoka that PP effectively suppresses rise in internal resistance and adjust the PP content in Zeng's Embodiments 4 and 6, experimenting within Matsuoka's preferred ranges of 0.1-10 wt% and 0.1-30 wt% to identify an optimum PP proportion for suppressing rise in internal resistance. EX1007, ¶ [0036]; *see also* EX1003, ¶ 161.

XII. GROUND 1C, 2C, 3C: ZENG, ZENG/MATSUOKA—FURTHER IN VIEW OF KIM—RENDER OBVIOUS CLAIMS 1-6, 12, 16-26; ZENG/SUNOSE, ZENG/MATSUOKA/SUNOSE—FURTHER IN VIEW OF KIM—RENDER OBVIOUS CLAIMS 13 AND 14; ZENG/SUNOSE/SU, ZENG/MATSUOKA/SUNOSE/SU—FURTHER IN VIEW OF KIM—RENDER OBVIOUS CLAIM 15

Patent Owner may argue Elements [1.4]/[12.4]/[20.4] require 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 HTC/N to PP, specifically. Patent Owner would be incorrect. EX1003, ¶ 163.

First, Zeng discloses an electrolyte with Y and Z falling within and overlapping the claimed ranges and relationships for Y and Z , which renders the '910 Patent claims obvious. *Peterson*, 315 F.3d at 1329; *Titanium Metals*, 778 F.2d at 782-783. Simply calling out the quotient Y/Z cannot patentably distinguish the challenged claims from prior art disclosing or rendering obvious Y and Z values that mathematically meet it. EX1003, ¶ 164.

Second, Zeng Embodiments 4 and 6 disclose dinitrile-based electrolytes containing a trinitrile and PP—in different relative amounts. EX1006, ¶¶ [0045]-[0049]. The remaining examples lacked both a trinitrile and PP. *Id.* This would have drawn attention to the importance of these two compounds in improving performance of dinitrile-based electrolytes, and their relative amounts that fall within and overlap the claimed Y/Z ranges. EX1003, ¶ 165. Patent Owner would be wrong for the following additional reasons.

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. Thus, Zeng or Zeng/Matsuoka, further in view of Kim, renders obvious claims 1-6, 12, and 16-26; Zeng or Zeng/Matsuoka and Sunose, further in view of Kim, renders obvious claims 13 and 14; and Zeng or Zeng/Matsuoka and Sunose, further in view of Kim, renders obvious claim 15.⁶ EX1003, ¶¶ 166-177.

Specifically, Kim discloses lithium-ion battery electrolytes with superior capacity retention at high temperatures after many charging cycles. EX1008,

⁶ For all remaining claim elements, Petitioner incorporates by reference its analysis above for those claim elements in Grounds 1A-3B. *See supra* Sections VIII-XI.

¶ [0005]. Kim experimented with electrolytes including a dinitrile, trinitrile, and PP, noting: after storage at 60°C for four weeks, and after 250 cycles, batteries using electrolytes that have both a trinitrile and PP exhibited improved capacity retention over batteries using electrolytes that lack at least one of these two components. EX1008, Tables 2-4.

Kim claim 1 recites the concept of using trinitrile (Formula 1) with a C3 to C5 alkyl propionate (includes PP) together. Formula 1 compound features three or more nitrile (CN) groups and an asymmetric structure. *See* EX1008, ¶ [0055]. Claim 1 identifies PP by reciting “an organic solvent including C3 to C5 alkyl propionate,” where “C3 alkyl propionate” corresponds to PP. *See* EX1008, Claim 1.

Kim’s Examples underscore enhanced performance of electrolytes that incorporate a trinitrile and PP against those lacking one or both. EX1003, ¶ 169. Only Kim Examples 1 and 2 contained both a HTCEN (trinitrile) and PP—and in different relative amounts. EX1008, ¶¶ [0090]-[0091]. The Comparative Examples lacked either HTCEN (trinitrile), PP, or both. *Id.*, ¶ [0091].

TABLE 1

	Lithium salt (LiPF ₆)	Solvent (volume %)						Additive (wt %)	
		EC	PC	DEC	MP	EP	PP	SN	HTCN
Example 1	1.15M	20	10	—	—	30	40	1	2
Example 2	1.15M	20	20	—	—	—	60	1	2
Comparative	1.15M	20	20	60	—	—	—	3	—
Example 1									
Comparative	1.15M	20	20	60	—	—	—	1	2
Example 2									
Comparative	1.15M	20	10	—	—	30	40	3	—
Example 3									
Comparative	1.15M	20	20	—	—	—	60	3	—
Example 4									
Comparative	1.15M	20	20	—	60	—	—	1	2
Example 5									
Comparative	1.15M	20	20	—	—	60	—	1	2
Example 6									

both trinitrile (HTCN) and PP, in different relative amounts

missing either trinitrile or PP

Kim, Table 1*

By disclosing one set of electrolytes (Examples 1 and 2) containing both a trinitrile and PP in different relative amounts and another set (Comparative Examples 1-6) lacking either the trinitrile or PP, Kim draws the POSITA's attention to *Y/Z*. EX1003, ¶ 170.

Moreover, the Example 1 and 2 batteries (both trinitrile and PP) outperformed Comparative Examples 1-6 (lacking trinitrile or PP) in resisting increase in battery thickness and capacity retention. *See* EX1008, ¶¶ [0097]-[0103] (Tables 3, 4), FIGS. 3-6. Evaluating the test results to determine drivers of improved performance, the POSITA would have noted differences in electrolyte composition: Examples 1 and 2 contain both a trinitrile and a PP while the Comparative Examples lack one or the

other. EX1003, ¶ 171. This would further focus the POSITA on the importance of having both components in an electrolyte solution. *Id.*

The only difference between Example 2 and Comparative Examples 5 and 6 is the substitution of PP in Example 2 with MP or EP in Comparative Examples 5 and 6, respectively. EX1008, ¶ [0090], Table 1. In all cases, the weight percentage of the substituted additive (PP, MP, or EP) remains constant at 60%. *Id.* The superior performance of Example 2 shows PP is better than its peers like MP or EP. EX1003, ¶ 172.

In Examples 1 and 2, the dinitrile and trinitrile contents are identical, but the PP weight percentage increases from 40% in Example 1 to 60% in Example 2. EX1008, ¶ [0090], Table 1. Kim uses four evaluation methods to show that adjusting PP, while maintaining trinitrile content in Examples 1 and 2, significantly impacts battery performance. *Id.*, ¶¶ [0092]-[0103]. Thus, a POSITA would recognize that fine-tuning trinitrile (Y)/PP (Z) ratio optimizes battery performance. EX1003, ¶ 173.

Not only does Kim highlight the same technique to improve electrolyte performance as the '910 Patent (adjusting Y/Z), but Kim describes the same underlying mechanism causing the improved performance. EX1003, ¶ 174. The '910 Patent observes that “[a] dinitrile compound can form a protective film on the cathode of the electrochemical device ... to inhibit the decomposition of the solvent[,]” EX1001, 1:50-53, but that the high working voltages (above 4.4V)

required by conventional electronic devices tend to decompose the protective film. *Id.*, 1:31-40, 1:53-56. Purportedly, the addition of trinitrile forms a durable SEI film on the cathode surface, which resists decomposition. *Id.*, 1:56-63. However, film-forming additives such as dinitrile and trinitrile undesirably increase the battery's DC internal resistance and thickness expansion rate, compromising storage and cycling performance. *Id.*, 22:63-67. The '910 Patent does not explain why the protective nitrile-based SEI film leads to an increase in DC internal resistance, but instead suggests further optimization to address the issue.

Likewise, Kim observes that a dinitrile additive, such as succinonitrile (SN), “may help formation of a film on a negative electrode as well as a positive electrode” that “suppress[es] gas generation ... when stored at a high temperature” or operated at high voltage (above 4.4V). EX1008, ¶ [0064]; *see also id.*, ¶ [0104]; EX1003, ¶ 175. Gas increases thickness and internal resistance of the battery, hurting storage and cycle performance. *Id.*, ¶¶ [0039], [0063]-[0066]. Like the '910 Patent, Kim also observes that adding to the electrolyte a trinitrile, like HTC_N, “represented by Chemical Formula 1,” gives the protective layer a “stable and strong bonding” force that reduces battery swelling typically caused by high temperature storage and cycling. *Id.*, ¶¶ [0055]-[0056]. And, Kim's Examples and claims demonstrate that adding PP further improves high temperature storage and cycling performance. *Id.*, ¶¶ [0014], [0040], [0090], [0091], claim 3.

Thus, the difference between the general teachings of the '910 Patent and Kim lies in their focus on the effect of PP. EX1003, ¶¶ 176-177. The '910 Patent explicitly states that adding PP to dinitrile and trinitrile helps suppress DC internal resistance, thereby enhancing battery performance. In contrast, Kim generally shows that the combination of PP with dinitrile and trinitrile improves cycling performance but does not specifically address the suppression of DC internal resistance. EX1008, ¶¶ [0090]-[0104]. But testing DC internal resistance was a routine procedure for evaluating electrolyte performance. EX1003, ¶ 176. Since Kim already teaches that adding PP to electrolytes containing dinitrile and trinitrile improves battery performance, it would have been routine to evaluate performance of Kim's electrolytes based on internal resistance. *Id.*

Accordingly, Kim's disclosure would have further motivated a POSITA to consider and adjust the ratio of trinitrile to PP in Zeng's electrolytes and/or incorporate Matsuoka's disclosed preferred non-nitrile additive weight percentage ranges in Zeng. EX1003, ¶ 177.

XIII. GROUND 4A: ZHOU RENDERS OBVIOUS CLAIMS 1-6, 11, 12, AND 16-26

A. Overview of Zhou

Zhou Example 8 discloses an adiponitrile-based (ADN, *dinitrile*) electrolyte containing the *trinitrile* HTCN and the linear carboxylic acid ester ethyl acetate (EA).

While Example 8 lacks PP, Zhou lists only eight alternative suitable linear carboxylic acid esters—two being EA and PP. Replacement of EA with PP would have been obvious. Example 8 has 16.56 wt% EA, so substituting EA with PP results in PP falling within the claimed Z range of 5-20 wt% of the total electrolyte. EX1003, ¶ 178.

Specifically, Zhou describes “a fast charging lithium-ion battery electrolyte [having] a high potential and a high compaction density” with “good cycle performance and high and low temperature performance.” EX1014, ¶ [0006]. Zhou’s electrolytes have:

- a solvent which “accounts for 70%-88% of the total mass of the lithium-ion battery electrolyte” and “includes a mixture of two or more of a low-boiling-point linear carbonate and a linear carboxylic acid ester”;
- a lithium salt;
- an additive package including “[a] third additive [that] is a nitrile compound containing 2 or 3 nitrile functional groups” and “accounts for 0.5%-5% of the total mass of the lithium-ion battery electrolyte[.]”

Id., ¶¶ [0008], [0009], [0016], [0018].

The solvent “adjust[s] the wetting effect and mass transfer resistance of the electrolyte system [so that] a good channel is provided for the lithium-ion

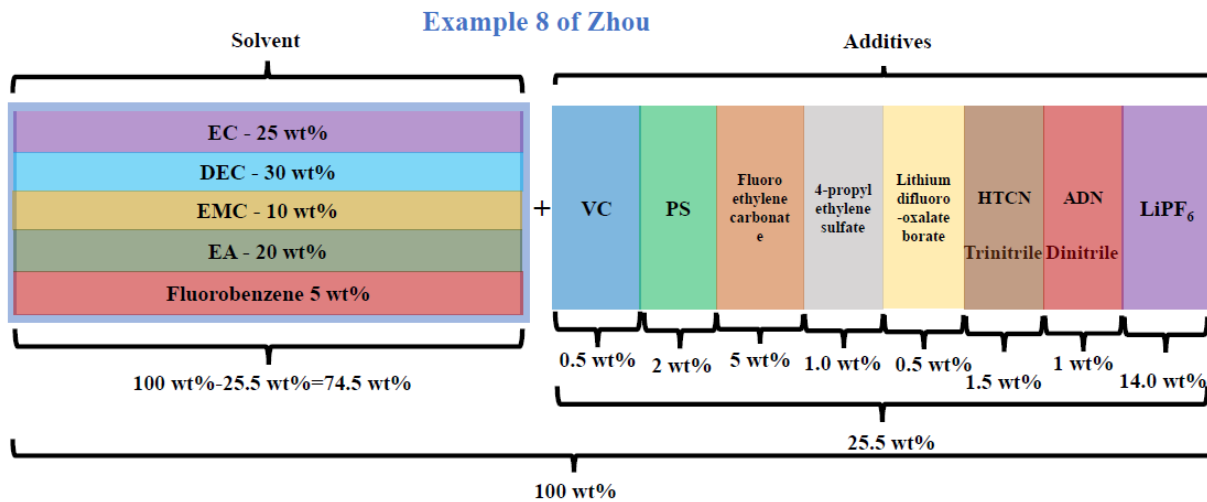
deintercalation process[.]” *Id.*, ¶ [0020]. But “the low-boiling-point linear carbonate and carboxylate” causes “incompatibility with graphite, poor battery cycle performance, and high temperature resistance[.]” *Id.*

The additives, including the nitriles, “solve the problem of incompatibility with graphite” and “eliminate the deterioration of high-temperature performance caused by the above-mentioned low-boiling-point organic solvent.” *Id.* Zhou prefers dinitriles and trinitriles as they “improve the high temperature performance of the battery[.]” *Id.*, ¶ [0059]. “1,3,6-hexane trinitrile is particularly preferred” because it is “[an] efficient high temperature additive” having “better compatibility with the negative electrode and ... protect[ing] the positive electrode.” *Id.*

In the solvent, Zhou prefers “non-methyl carboxylates ... in large quantities” because they are “more conducive to the fast charging of the system under high voltage and high compaction conditions.” *Id.*, ¶ [0058]. Zhou identifies a few suitable linear carboxylic acid esters: “[PP], ethyl propionate, propyl acetate, butyl propionate, [EA], isopropyl propionate, ethyl butyrate, and methyl acetate.” *Id.*, ¶ [0011].

When describing electrolyte compositions, Zhou refers to additives based on “the total mass of the lithium-ion battery electrolyte.” EX1014, ¶¶ [0009], [0013]-[0016], [0018]; *see also* EX1003, ¶ 183. Example 8 contains EA (PP substitute) as

a solvent, the *dinitrile* adiponitrile (ADN), and the *trinitrile* HTCN, with the overall composition shown below. EX1014, ¶ [0047].



EX1003, ¶¶ 183-184

Weight percentage of ADN (*dinitrile*) in the total electrolyte: ADN is a *dinitrile* because it has two nitrile groups in its structure. EX1003, ¶ 185; EX1018, 1. In the total Example 8 electrolyte, ADN has a weight ratio (the claimed X) of 1 wt%. EX1003, ¶ 185.

Weight percentage of HTCN (*trinitrile*) in the total electrolyte: HTCN is a *trinitrile* because it has three nitrile groups. *Id.*, ¶ 186; EX1018, 100. In the total electrolyte of Example 4, HTCN has a weight ratio (the claimed Y) of 1.5 wt%.

Weight percentage of EA in the total electrolyte: In the total electrolyte of Example 4, EA—interchangeable with PP—has a weight ratio (denoted as Z') of $(1-25.5\%) \times (20\% / (25\% + 30\% + 10\% + 20\% + 5\%)) = 16.56\%$. EX1003, ¶ 187.

Thus, X, Y, and Z' have the following values in Zhou's Example 8:

X	Y	Z' (EA)
1 wt%	1.5 wt%	16.56 wt%

EX1003, ¶ 188.

Zhou Example 8 improved battery discharge capacity over Comparative Example 3 and Examples 3-6. *See* EX1014, ¶ [0061], FIG. 1. Zhou Example 8 also had lower internal impedance than Comparative Examples 1-3 and Examples 1, 2, 4, and 6. *Id.*, ¶¶ [0057]-[0058], FIG. 4.

- **Rationale to Implement Zhou Example 8**

Petitioner's reliance on Zhou Example 8 does not involve "selecting from large lists of elements in a single reference" as a single embodiment. *Contra Stepan Co.*, 868 F.3d 1346 n.1. Each Example electrolyte in Zhou is a self-contained, working embodiment providing a complete list of compounds, amounts, and preparation instructions. EX1003, ¶ 191.

Nonetheless, a POSITA would have selected and implemented Zhou Example 8 with a reasonable expectation of success. *Id.* The Example 8 battery significantly outperformed the Comparative Example batteries in discharge capacity and low impedance, and outperformed four other Examples on low impedance. *See* EX1014, ¶¶ [0057], [0061], FIGS. 1, 4. This would have motivated the POSITA to implement Example 8. EX1003, ¶ 191.

It also would have been “obvious to try” Zhou Example 8. MPEP § 2143.I.(E); EX1003, ¶¶ 192-195.

Recognized need in the art: Zhou cites a market need for “[t]he development of fast charging technology” driven by “popularization of smart digital products [and] the application of new energy vehicles[.]” EX1014, ¶¶ [0002]-[0003]. Conventionally, “low-boiling-point organic solvents are commonly used to improve the kinetic properties of the electrolyte,” such as “better wettability [and] lower viscosity[.]” *Id.*, ¶¶ [0003]-[0004]. But these solvents hinder high-temperature performance and carboxylic acid ester organic solvents, specifically, are incompatible “with the negative electrode graphite ... caus[ing] the battery cycle performance to deteriorate.” *Id.*, ¶ [0004]. Zhou thus sought “a combination of solvents and additives that matches the fast charging electrolyte” and “[i]mprov[es] battery kinetics, high temperature performance, and cycle performance[.]” *Id.*, ¶ [0005].

Finite, predictable solutions: Zhou only discloses eight electrolyte solutions (Examples 1-8), which had better performance than the Comparative Examples. *Id.*, ¶¶ [0032]-[0048]; EX1003, ¶ 194. Making Example 8 a priority to try, Example 8 outperformed Examples 3-6 in discharge capacity and outperformed Examples 1, 2, 4, and 6 in internal impedance. EX1014, ¶¶ [0057], [0058], [0061], FIGS. 1, 4.

Reasonable expectation of success: All Zhou’s Examples were successfully tested in batteries and outperformed the Comparative Examples. EX1014, ¶¶ [0057]-[0063]. The tests showed “[a]n efficient high temperature additive,” such as “[n]itrile compounds containing 2 or 3 nitrile functional groups,” compensates for the fact that “[t]he high temperature performance is often challenged when using [a fast-charging] solvent system[.]” *Id.*, ¶ [0059]. Zhou provides detailed instructions to make its Example electrolytes. *See id.*, ¶ [0047]. Thus, a POSITA would have reasonably expected to succeed with Example 8. EX1003, ¶ 195.

B. Independent Claim 1

1. [1.pre]

As explained in Section XIII.A, Petitioner relies on Zhou Example 8 as rendering the challenged claims unpatentable. EX1014, ¶ [0047]; EX1003, ¶ 190.

2. [1.1]

As discussed in Section VII.F, Zhou’s Example 8 electrolyte contains *a dinitrile compound* (ADN) and *a trinitrile compound* (HTCN), as claimed. *See* EX1014, ¶ [0047]; EX1018, 1, 100. While Example 8 lacks PP, Zhou’s context renders obvious substituting PP for EA in Example 8, with a reasonable expectation of success. EX1003, ¶ 196.

a. Zhou discloses PP

Zhou’s solvent “includes a mixture of two or more of a low-boiling-point linear carbonate and a linear carboxylic acid ester, fluorobenzene and hydrofluoroether.” EX1014, ¶ [0008]. Zhou expressly identifies PP and EA as two of eight suitable, alternative linear carboxylic acid esters. *Id.*, ¶ [0011]. Thus, Zhou discloses that its electrolytes can include PP, as claimed. EX1003, ¶ 197.

b. Rationale to substitute PP for EA in Example 8

- **Obvious to try**

A POSITA would have found it “obvious to try” substituting PP for EA in Zhou Example 8. *See* MPEP § 2143.I.(E); EX1003, ¶¶ 198-202.

Recognized problem/need: Zhou observes that “demand for fast charging has become more urgent” due to “the popularization of smart digital product[.]” EX1014, ¶ [0002]. Fast charging demands “rapid migration of a large number of lithium-ions” which, in turn, “requires the electrolyte to have higher kinetic properties and smaller mass transfer resistance[.]” *Id.*, ¶ [0003]. Zhou explains that “low-boiling-point organic solvents are commonly used to improve the kinetic properties of the electrolyte[.]” *Id.*, ¶ [0004]. Thus, Zhou discloses that fast-charging batteries need organic solvents that improve kinetic properties of electrolytes. EX1003, ¶ 199.

Finite number of identified, predictable solutions: Zhou identifies a solution for improving kinetic performance of the electrolyte: “a mixture of ... a low-boiling-point linear carbonate and a linear carboxylic acid ester[.]” EX1014, ¶ [0008]. As Zhou found, “the melting and boiling points of the linear carbonate and carboxylate solvents ... are both low, providing a more suitable channel for lithium-ion transmission and reducing the impedance of the battery system.” *Id.*, ¶ [0055]; *see also id.*, ¶ [0020] (discussing benefits of linear carbonates carboxylic acid esters). Zhou identifies eight potential linear carboxylic acid esters—one of which (EA) is used in Example 8 and another of which is PP. EX1014, ¶ [0011]. Thus, Zhou proposes a handful of solutions to increase kinetic performance, and PP is one of them. EX1003, ¶ 200.

Reasonable expectation of success: A POSITA would have had a reasonable expectation of success in replacing one linear carboxyl acid ester (EA) with another (PP) in Zhou Example 8. EX1003, ¶ 201. Zhou lists PP alongside EA as a suitable linear carboxylic acid ester, EX1014, ¶ [0011], so the POSITA would likewise expect PP to have a low melting point and support a channel for ion conductivity. *Id.*, ¶ [0057].

Zhou teaches that large quantities, and different types, of carboxylic acid esters in electrolyte solutions “is more conducive to the fast charging of the system under high voltage and high compaction conditions.” *Id.*, ¶ [0058]. Thus, a POSITA

would not expect replacing EA with PP in Example 8 to render the electrolyte inoperable or hurt performance. Rather, one could expect the resulting electrolyte to provide a good ion channel for fast charging. EX1003, ¶ 202.

- **Simple substitution**

Replacing EA with PP in Zhou Example 8 amounts to simple substitution of one known element (the carboxylic acid ester EA) for another (the carboxylic acid ester PP) to obtain predictable results. MPEP § 2143.I.(E); EX1003, ¶¶ 203-207.

Prior art electrolyte: Zhou's Example 8 electrolyte differs from the claimed electrolyte by substitution of the carboxylic acid ester EA for another carboxylic acid ester PP. EX1003, ¶ 204.

Function of substituted components known in the art: Zhou lists PP and EA as two of a handful of alternative carboxylic acid esters. EX1014, ¶ [0011]. Zhou explains that carboxylic acid esters have low melting points and strong ion conductivity in lithium-ion battery electrolytes, reducing internal impedance and improving kinetic performance. *Id.*, ¶¶ [0009], [0057], [0058]; EX1003, ¶ 205.

Predictable results: A POSITA could have substituted PP for EA in Zhou Example 8 with predictable results. EX1003, ¶ 206. Zhou instructs mixing the electrolyte components, including 20 wt% EA, and slowly adding and dissolving 14 wt% LiPF₆ to form the total electrolyte. EX1014, ¶ [0047]. In this process, a POSITA could have simply added 20 wt% PP instead of 20 wt% EA. EX1003, ¶ 206.

The result of this substitution would have been predictable because Zhou identifies EA and PP as fungible carboxylic acid esters that support lithium ion conductivity. EX1014, ¶¶ [0009], [0011], [0057], [0058]; EX1003, ¶ 206.

3. [1.2]

The claimed X and Y and have the following values in Zhou's Example 8:

X	Y	$X+Y$	X/Y
1 wt%	1.5 wt%	2.5 wt%	0.67

Supra Section XIII.A. Thus, in Example 8, $X+Y=1\text{ wt\%}+1.5\text{ wt\%}=2.5\text{ wt\%}$, which is “about 2.2 wt%” as claimed and within the '910 Patent's 10% tolerance. Moreover, 2.5 wt% is “close enough” to 2.2 wt% that a POSITA “would have expected them to have the same properties” in Zhou Example 8. *Peterson*, 315 F.3d at 1329. Additionally, X/Y in Example 8 is $1/1.5=0.67$, falling in the claimed range. *Titanium Metals*, 778 F.2d at 782-783; *see also* EX1003, ¶ 208.

4. [1.3]

Zhou discloses that the amount of EA (Z') is 16.56 wt% in Example 8 and renders obvious substituting PP for EA. *Supra* Section XIII.A. Thus, in the proposed obvious modification to Zhou Example 8, Z is 16.56 wt%, falling in the lower end of the recited Z range and thus rendering it obvious. EX1003, ¶ 210.

5. [1.4]

The claimed *Y* and *Z* have the following values in the obvious modification to Zhou Example 8:

<i>Y</i>	<i>Z</i>	<i>Y/Z</i>
1.5 wt%	16.56 wt%	0.091

Supra Sections XIII.A, XIII.B.2. Thus, in modified Zhou Example 8, $Y/Z=0.091$, falling in the claimed range of about 0.02 to about 0.3 and rendering it obvious. EX1003, ¶¶ 212-213.

6. [1.5]

Zhou Example 8 has adiponitrile (ADN) as the claimed *dinitrile compound*. EX1014, ¶ [0047]; *supra* Section XIII.A; EX1003, ¶ 214.

7. [1.6]

Zhou Example 8 has 1,3,6-hexanetricarbonitrile (HTCN) as the claimed *trinitrile compound*. EX1014, ¶ [0047]; *supra* Section XIII.A; EX1003, ¶ 215.

8. [1.7]

In Zhou Example 8, *the electrolyte further comprises a compound having a sulfur-oxygen double bond*—1,3-propane sultone (PS)—as claimed. EX1014, ¶ [0047]; EX1003, ¶ 216.

C. Claim 2

1. [2.1]

In Example 8, Zhou's *dinitrile compound* is *adiponitrile*. EX1014, ¶ [0047]. Moreover, $X/Y = 0.67$, falling in the claimed range of 0.1 to 2.3 and thus rendering element [2.1] obvious. *Supra* Section XIII.A; EX1003, ¶¶ 217-218.

D. Claim 3

1. [3.1]

Zhou Example 8 has 2 wt% *1,3-propane sultone* (PS), falling in the claimed range of 0.1 wt% to 3 wt% recited in element [3.1] and thus rendering it obvious. EX1014, ¶ [0047]; *supra* Section XIII.B.8; EX1003, ¶¶ 219-220.

E. Claim 4

1. [4.1]

In Zhou Example 8, $X/Y=0.67$, falling within the claimed range of 0.1 to 2.0 of element. *Supra* Section XIII.B.3. EX1003, ¶ 221.

F. Claim 5

1. [5.1]

In the obvious modification to Zhou Example 8, $Y/Z=0.091$, falling within the claimed range of 0.025 to 0.3. *Supra* Section XIII.B.5; EX1003, ¶ 223.

G. Claim 6

1. [6.1]

X and Y have the following values in Zhou’s Example 8, falling within the claimed ranges for X and Y:

X	Y
1 wt%	1.5 wt%

Supra Section XIII.A; EX1003, ¶ 225.

H. Claims 12 and 16-26

Zhou discloses or suggests the elements of claims 12 and 16-26 (EX1003, ¶¶ 227-228):

Element	Reasoning
[12.pre]	Section XIII.B.1 ([1.pre]). ⁷
[12.1]	Section XIII.B.2 ([1.1]).
[12.2]	Section XIII.B.3 ([1.2]).
[12.3]	Section XIII.B.4 ([1.3]).
[12.4]	Section XIII.B.5 ([1.4]).
[12.5]	Section XIII.B.6 ([1.5]).
[12.6]	Section XIII.B.7 ([1.6]).
[12.7]	Section XIII.B.8 ([1.7]).

⁷ Zhou tested the Example 8 electrolyte in a lithium-ion battery—an *electrochemical device* that *comprises electrodes*, as claimed. See EX1010, ¶ [0048]; EX1003, ¶ 227.

[16.1]	Section XIII.C.1 ([2.1]).
[17.1]	Section XIII.D.1 ([3.1]).
[18.1]	Section XIII.G.1 ([6.1]).
[19.1]	Section XIII.E.1 ([4.1]).
[20.pre]	Section XIII.B.1 ([1.pre]).
[20.1]	Section XIII.B.2 ([1.1]).
[20.2]	Section XIII.B.3 ([1.2]). In Zhou Example 8, $X+Y=2.5$ wt%, and $X/Y=0.67$ (both in claimed range).
[20.3]	Section XIII.B.4 ([1.3]).
[20.4]	Section XIII.B.5 ([1.4]). In Zhou Example 8, $Y/Z>0.091$, falling within the claimed range.
[20.5]	Section XIII.B.6 ([1.5]).
[20.6]	Section XIII.B.7 ([1.6]).
[20.7]	Sections XIII.B.8 ([1.7]), XIII.D.1 ([3.1]).
[21.1]	Section XIII.C.1 ([2.1]).
[22.1]	Section XIII.G.1 ([6.1]).
[23.1]	Section XIII.B.3 ([1.2]). In Zhou Example 8, $X/Y=0.67$.
[24.1]	Section XIII.B.3 ([1.2]). In Zhou Example 8, $X+Y=2.5$ wt%, and $X/Y=0.67$.
[25.1]	<i>See</i> Section XIII.E.1 ([4.1]).
[26.1]	<i>See</i> Section XIII.B.5 ([1.4]). In Zhou Example 8, $Y/Z>0.091$, overlapping the claimed range.

XIV. GROUND 5A: ZHOU AND SUNOSE RENDER OBVIOUS CLAIMS 13 AND 14

Zhou and Sunose render claims 13 and 14 obvious.

A. Claim 13

1. [13.1]

Zhou discloses electrolytes that

meet the requirements of fast charging ... with voltage of 4.35V, a negative electrode compaction density of 1.6g/cm³ or more, a high potential and a high compaction density, and ha[ve] good cycle performance and high and low temperature performance.

EX1014, ¶ [0006]. A battery using the Example 8 electrolyte was tested for performance. *Id.*, ¶¶ [0057], [0061]. A lithium-ion battery, by definition, is an electrochemical device having a cathode that comprises a current collector. EX1003, ¶ 230.

2. Sunose discloses Elements [13.2] to [13.4]

a. [13.2]

Sunose discloses this element. *Supra* Section IX.A.2.a; EX1003, ¶ 231.

b. [13.3], [13.4]

Sunose discloses these elements. EX1003, ¶¶ 232-234. *Supra* Sections IX.A.2.b. For the reasons discussed above in Ground 2A, a POSITA would have found it obvious to configure Zhou's cathode according to Sunose's Examples. *Supra* Section IX.A.3; EX1003, ¶ 233. Sunose is analogous because it also relates to lithium-ion batteries, including those employing non-aqueous electrolytes. *See* EX1010, Abstract, ¶¶ [0001]-[0011], [Claim 3]; EX1014, ¶¶ [0001]-[0008]; EX1001, 1:19-3:26; EX1003, ¶ 233. Because Zhou focuses on electrolytes and omits

description of the physical configuration of the battery, a POSITA would have looked to Sunose for implementation details for its improved electrode. *Supra* Sections IX.A.3, XIII.A. A POSITA would have had a reasonable expectation of success in using Sunose's rolled electrode configuration in Zhou's example batteries because Zhou does not describe any physical specifications or restrictions for its battery or electrode configuration. EX1003, ¶ 233.

B. Claim 14

1. [14.1]

The Zhou-Sunose combination includes this element. *Supra* Section IX.B.1; EX1003, ¶ 235.

XV. GROUND 6A: ZHOU AND SUNOSE, FURTHER IN VIEW OF SU, RENDERS OBVIOUS CLAIM 15

Zhou and Sunose, further in view of Su, renders claim 15 obvious. EX1003, ¶ 236.

A. Claim 15

1. [15.1]

Zhou discloses or suggests this element. *Supra* Section XIV.A.1; EX1003, ¶ 237.

2. Su discloses Elements [15.2] to [15.4]

a. [15.2]

Su discloses or suggests this element. *Supra* Section X.A.2.a; EX1003, ¶ 238.

b. [15.3], [15.4]

Su discloses these elements. *Supra* Section X.A.2.b. For the reasons discussed above in Ground 3A, a POSITA would have found it obvious to configure Zhou’s cathode according to Su’s Examples with a reasonable expectation of success. *Supra* Section IX.A.2.c; EX1003, ¶ 239. Zhou, Sunose, and Su are directed to analogous art—lithium-ion batteries, including those using non-aqueous electrolytes. *See* EX1014, ¶ [0006]; EX1010, Abstract, ¶¶ [0001]-[0011], [0043], [Claim 3]; EX1012, Abstract, ¶¶ [0001]-[0003]. Like Zeng, Zhou also cites a market demand for batteries with high energy density. EX1014, ¶¶ [0002]-[0005].

XVI. GROUNDS 4C, 5C, 6C: ZHOU AND KIM RENDER OBVIOUS CLAIMS 1-6, 12, 16-26; ZHOU/KIM AND SUNOSE RENDER OBVIOUS CLAIMS 13 AND 14; ZHOU/KIM/SUNOSE AND SU RENDERS OBVIOUS CLAIM 15

For the reasons discussed above in Grounds 1C-3C, Kim further motivates considering the ratio of trinitrile to PP in Zhou and substituting EA for PP in Zhou Example 8. *Supra* Section XII.⁸ Zhou draws further attention to the advantage of the trinitrile HTCN by explaining that it has “[a high] density of nitrile groups per unit

⁸ For all challenged claim elements other than Elements [1.4]/[12.4]/[20.4], Petitioner incorporates by reference its analysis for those claim elements in Grounds 1C-3C.

volume” and “better compatibility with the negative electrode and is easier to protect the positive electrode.” EX1014, ¶ [0059]. Zhou also discloses that EA can be substituted for PP, drawing attention to PP. *Id.*, ¶ [0011]. 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. EX1014, ¶ [0059]; *see also* EX1003, ¶¶ 240-242.

XVII. INSTITUTION IS APPROPRIATE

Petitioner presents substantially different prior art and arguments than those previously substantively considered by the Office. 35 U.S.C. § 325(d); *Advanced Bionics, LLC v. MED-EL Elektromedizinische Geräte GmbH*, IPR2019-01469, Paper 6, 7-10 (PTAB Feb. 13, 2020) (precedential).

Unlike the ’363 Patent Petition, Petitioner raises obviousness, not anticipation. Zeng and Zhou were merely cited in a long IDS that provided English Abstracts only and were not substantively evaluated or applied in rejection. EX1002, 348. They disclose or suggest dinitrile-based electrolyte compositions containing trinitrile and PP, and the wt% PP in their total electrolytes falls in the claimed Z range, without requiring the Hong anticipation ground assumptions. Zeng’s and Zhou’s Abstracts alone lack disclosure, relied on above, sufficient to show they render the claims unpatentable, so they were effectively not considered during prosecution. *Osteomed LLC v. Stryker Eur. Operations Holdings LLC*, IPR2022-

00487, Paper 8 at 9 (PTAB Aug. 12, 2022) (Regarding *Advanced Bionics* factor 1, the “Examiner may not have been able to consider the portions of [the reference] on which Petitioner’s challenges are based” because an “English language translation of Abstract only” was provided). Alternatively, the Office materially erred allowing the claims over omitted disclosures of Zeng and Zhou. *Sci. Design Co. v. Shell Oil Co.*, IPR2022-00158, Paper 7 at 25 (PTAB Apr. 4, 2022) (*Advanced Bionics* factor 2 not met because “Examiner, apart from initialing the asserted art in an IDS, did not indicate a substantive evaluation of the asserted art[.]”). Su (English Abstract only) and Kim were also merely cited in a long IDS but not substantively evaluated. EX1002, 83, 383. Matsuoka and Sunose were not cited.

Patent Owner asserts the ’910 Patent against Petitioner in related litigation. EX1021. IPR should be instituted under *Fintiv. Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (PTAB Mar. 20, 2020). Petitioner files this Petition before the January 20, 2025 answer deadline. EX1022. The parties invested little resources and timing remains uncertain, so IPR will help resolve the parties’ dispute. The Petition presents compelling patentability challenges, overriding any *Fintiv* concerns. Vidal 06.21.24 Memo, 2-3. If IPR is instituted, Petitioner stipulates not to pursue in the related litigation the Grounds in this Petition or any other ground Petitioner reasonably could have raised here. *Id.*, 3; *Sotera Wireless, Inc. v. Masimo Corp.*, IPR2020-01019, Paper 12 (PTAB Dec. 1, 2020).

XVIII. GROUNDS FOR STANDING

Petitioner certifies the '910 Patent is available for IPR and Petitioner is not barred or estopped from requesting IPR of any claim.

XIX. MANDATORY NOTICES (37 C.F.R. § 42.8(A)(1))

Real Party-in-Interest (37 C.F.R. § 42.8(b)(1)): The real party-in-interest is Petitioner Zhuhai CosMX Battery Co., Ltd.

Related Matters (37 C.F.R. § 42.8(b)(2)): The '910 patent is currently at issue in *Ningde Amperex Technology Limited v. Zhuhai CosMX Battery Co.*, No. 2:24-cv-00728 (E.D. Tex.).

The '910 patent is a continuation of U.S. Patent No. 10,833,363, which was involved in IPR2023-00586.

Lead and Back-up Counsel (37 C.F.R. § 42.8(b)(3)):

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Service Information (37 C.F.R. § 42.8(b)(4)): Please direct all correspondence regarding this Petition to counsel at the above addresses, COSMX-PTAB@leehayes.com and PTAB@sternekessler.com. Petitioner consents to service by email at the addresses above.

XX. CONCLUSION

Petitioner requests institution of IPR.

Respectfully submitted,

LEE & HAYES, P.C.

/James D. Stein/

James D. Stein
Registration No. 63,782
Lead Counsel for Petitioner

Date: January 5, 2025

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

This Corrected Petition for *Inter Partes* Review complies with the type-volume limitation of 14,000 words, comprising 13,994 words, excluding the parts exempted by 37 C.F.R. § 42.24(a)(1).

This Corrected Petition for *Inter Partes* Review complies with the general format requirements of 37 C.F.R. § 42.6(a) and has been prepared using Microsoft® Word in 14-point Times New Roman font.

Respectfully submitted,

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James D. Stein
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Lead Counsel for Petitioner

Date: January 5, 2025

CERTIFICATE OF SERVICE (37 C.F.R. §§ 42.6(e), 42.105(a))

I certify that the above-captioned CORRECTED PETITION FOR *INTER PARTES* REVIEW FOR U.S. PATENT NO. 11,769,910 were served in their entireties upon the Patent Owner on January 5, 2025 via FedEx® Express at the following addresses:

MAIER & MAIER, PLLC
345 South Patrick Street
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*Patent Owner's Correspondence Address of Record for
U.S. Patent No. 11,769,910*

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Respectfully submitted,

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