

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

RJ TECHNOLOGY, LLC,
Patent Owner.

Case: IPR2024-00597
U.S. Patent No. 7,749,641

**PETITION FOR *INTER PARTES* REVIEW OF CLAIMS 1-18 OF
U.S. PATENT NO. 7,749,641**

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PETITIONER'S EXHIBIT LIST

Exhibit No.	Description
1001	U.S. Patent No. 7,749,641 to Ren, et al.
1002	Declaration of Marc Juzkow
1003	Prosecution History of U.S. Patent Application No. 10/491,134 as obtained from the USPTO Patent Center
1004	Prosecution History of U.S. Patent Application No. 12/817,028 as obtained from the USPTO Patent Center
1005	JPH10189052 to Abe et al. (including Declaration of Yoshiko Ishikawa and translation) ("Abe")
1006	B. Kennedy, et al., <i>Use of lithium-ion batteries in electric vehicles</i> , J. Power Sources 90, pp.156-162 (2000).
1007	U.S. Patent No. 6,577,105 to Iwaizono ("Iwaizono")
1008	PCT Publication No. 93/21665 to Guyomard ("Guyomard")
1009	U.S. Patent Application Publication No.2002/0012830 to Uemura et al. ("Uemura")
1010	Seiko Instruments, Inc., Battery Protection IC S-8491 Series.
1011	U.S. Patent No. 5,871,863 to Miyasaka
1012	G. Au, et al., <i>Performance of the Sony Lithium-Ion Rechargeable Battery</i> , Army Research Laboratory, ARL-TR-71 (DTIC Selected Mar. 16, 1994).
1013	U.S. Patent No. 5,721,067 to Jacobs et al.
1014	Proof of Service in <i>RJ Technology, LLC v. Samsung Electronics Co., Ltd.</i> , No. 2:22-cv-00401-JRG-RSP, Dkt. 8 (Oct. 18, 2022)
1015	D. Guyomard, et al., <i>Li Metal -Free Rechargeable LiMn₂O₄/Carbon Cells: Their Understanding and Optimization</i> ,

Exhibit No.	Description
	J. Electrochem Soc., Vol. 139, No. 4, pp.937-948 (Apr. 1992).
1016	Exhibit A to the Parties ' Joint Claim Construction and Prehearing Statement filed in <i>RJ Technology, LLC v. Apple Inc.</i> , No. 8:22-cv-01874-N S-JDE, Dkt. 67-1 (May 31 , 2023).
1017	Exhibit A-138 to Plaintiffs Infringement Contentions in <i>RJ Technology LLC v. Samsung Electronics Co., Ltd.</i> , No. 22-cv-00401.
1018	U.S. Patent No. 5,853,914 to Kawakami
1019	U.S. Patent Application Publication No. 2003/0118912 A1 to Watanabe et al.
1020	U.S. Patent No. 6,872,491 to Kanai et al.
1021	U.S. Patent No. 6,926,992 to Isozaki et al.
1022	U.S. Patent No. 6,800,399 to Matsumoto
1023	U.S. Patent No. 5,618,640 to Idota et al.
1024	The $\text{Li}_{1+x}\text{Mn}_2\text{O}_4/\text{C}$ Rocking-Chair System: A Review, <i>Electrochimica Acta</i> , Vol. 38, No. 9, pp.1221-1231 (1993).
1025	J.R. Dahn et al., Rechargeable $\text{LiNiO}_2/\text{Carbon}$ Cells, <i>J. Electrochem. Soc.</i> , Vol. 138, No. 8, pp.2207-2211 (Aug. 1991)
1026	<i>RJ Technology, LLC v. Apple Inc.</i> , Order Regarding Motion to Stay, 8:22-CV-01874-JVS (JDEx), Document 106, August 2, 2023.
1027	RESERVED
1028	RESERVED
1029	RESERVED
1030	RESERVED
1031	Plaintiff <i>RJ Technology LLC</i> 's Proposed Claim Constructions, <i>RJ Technology LLC v. Apple Inc.</i> , No. 8:22-cv-1874-JVS-JDE,

Exhibit No.	Description
	Dkt. 69-7 (Jun. 23, 2023).
1032	Plaintiff RJ Technology LLC's Opening Claim Construction Brief in <i>RJ Technology, LLC v. Apple Inc.</i> , No. 8:22-cv-1874-JVS-JDE, Dkt. 70 (Jun. 23, 2023).
1033	RESERVED
1034	RESERVED
1035	RESERVED

CLAIM LISTING

Claim or Element #	Claim Language
[1P]	A method for improving the capacity, average operating voltage and specific energy of a secondary lithium ion cell or battery, characterized in that
[1A]	the charge cut-off voltage of the secondary lithium ion cell or battery is greater than 4.2 V but less than 5.8 V; and
[1B]	a ratio of positive electrode material to negative electrode material of the secondary lithium ion cell or battery is from 1:1.0 to 1:2.5 as calculated by a specific capacity with a charge voltage limited to 4.2 V.
2	A method according to claim 1, characterized in that the charge cut-off voltage of the secondary lithium ion cell or battery is within a range from 4.3 V to 5.2 V.
3	A method according to claim 1, characterized in that the charge cut-off voltage of the secondary lithium ion cell or battery is within a range from 4.3 V to 4.8 V.
4	A method according to claim 1, characterized in that the ratio of positive electrode material to negative electrode material of the secondary lithium ion cell or battery is from 1:1.15 to 1:2.5.
[5P]	A secondary lithium ion cell or battery,
[5A]	characterized in that the secondary lithium ion cell or battery has a charge cut-off voltage of greater than 4.2 V but less than 5.8 V, and
[5B]	a ratio of positive electrode material to negative electrode material of the secondary lithium ion cell or battery is from 1:1.0 to 1:2.5, as calculated by a theoretic capacity with a charge cut-off voltage set at 4.2 V.
6	A secondary lithium ion cell or battery according to claim 5, characterized in that the secondary lithium ion cell or battery has a charge cut-off voltage within a range from 4.3 V to 5.2 V.
7	A secondary lithium ion cell or battery according to claim 5, characterized in that the secondary lithium ion cell or battery has a charge cut-off voltage within a range from 4.3 V to 4.8 V.
8	A secondary lithium ion cell or battery according to claim 5,

Claim or Element #	Claim Language
	characterized in that the ratio of positive electrode material to negative electrode material of the secondary lithium ion cell or battery is from 1: 1. 15 to 1:2.5.
9	A secondary lithium ion cell or battery according to claim 5, characterized in that the secondary lithium ion cell or battery has a first overcharging protection voltage of greater than 4.35 V, and an overcharging protection release voltage of greater than 4.15 V.
10	A secondary lithium ion cell or battery according to claim 9, characterized in that the secondary lithium ion cell or battery has a first overcharging protection voltage of greater than 4.45 V, and an overcharge protection release voltage of greater than 4.25 V.
11	11. A secondary lithium ion cell or battery according to claim 5, wherein the secondary lithium ion cell or battery maintains at least 7500 of capacity after 400 cycles.
12	12. A secondary lithium ion cell or battery according to claim 5, wherein the secondary lithium ion cell or battery maintains at least 75.83% of capacity after 400 cycles.
13	A secondary lithium ion cell or battery according to claim 5, wherein the secondary lithium ion cell or battery maintains at least 80% of capacity after 400 cycles.
14	A secondary lithium ion cell or battery according to claim 5, wherein the secondary lithium ion cell or battery maintains at least 80.72% of capacity after 400 cycles.
15	A method according to claim 1, wherein the secondary lithium ion cell or battery maintains at least 75% of capacity after 400 cycles.
16	A method according to claim 1, wherein the secondary lithium ion cell or battery maintains at least 75.83% of capacity after 400 cycles.
17	A method according to claim 1, wherein the secondary lithium ion cell or battery maintains at least 80% of capacity after 400 cycles.
18	A method according to claim 1, wherein the secondary lithium ion cell or battery maintains at least 80.72% of capacity after 400.

Apple Inc., (“Petitioner”) petitions for *inter partes* review of claims 1-18 of U.S. Patent No. 7,749,641.

I. OVERVIEW

A. The ’641 Patent

The ’641 patent relates to rechargeable or “secondary” lithium ion batteries. The premise of the alleged invention is straight-forward: by choosing a proper ratio of positive electrode capacity to negative electrode capacity and increasing the charge cutoff voltage, the “capacity, average operating voltage, and specific energy of a secondary lithium ion cell or battery” can be increased. EX1001, 1:8-11, 3:7-12, 3:17-25. According to the patent a cutoff voltage of “no more than 4.2V” was conventional for lithium secondary batteries. *Id.*, 1:46-51. The ’641 patent also states that “all lithium ion batteries in the markets around the world are manufactured under this technical requirement.” *Id.*, 1:49-51, 2:38-41. As the Office would recognize only after it issued the ’641 patent—this was not true.

The ’641 patent says that while increasing the cutoff voltage increases capacity and average operating voltage in conventional batteries, the cutoff voltage was limited because higher voltages caused the electrodes to undergo “structure change,” electrolytes would decompose, and the recycle property—*i.e.*, the number of times the battery can be charged and discharged—was adversely affected. *Id.*, 1:55-63, 2:42-57. Yet, these problems had been recognized and solutions were

provided in the prior art.

According to the '641 patent, some unused capacity could be used “by increasing the charge cut-off voltage and properly adjusting the ratio of positive electrode material to negative electrode material of” the cell. EX1001, 3:7-12. The allegedly inventive combination included applying a cutoff voltage of above 4.2V and up to 5.8V and designing the battery such that a “ratio of positive electrode material to negative electrode material of a single cell is from 1:1.0 to 1:2.5 . . . as calculated by the specific capacity with the charge voltage limited to 4.2 V.” *E.g.*, *id.*, 3:20-33, 6:43-58. The '641 patent attributes the ability to raise the cutoff voltage to using more negative electrode active material than positive electrode active material—this “avoids the deposition of lithium ions on the surface of the negative electrode as metallic lithium,” thus limiting “attenuation of capacity of the cell.” EX1001, 4:64-5:7. This too was known in the art as shown, for instance, by Uemura and Abe. EX1009, ¶[0033]; EX1005, ¶[0018].

Besides this alleged difference, the batteries of the '641 patent are otherwise admittedly conventional. The positive electrode material can be chosen from “a wide range of positive electrode active substances” including lithium composite oxides, and “the practice of the present invention is not limited to the specific properties of said lithium-containing composite oxides.” EX1001, 8:12-19. A “conventional conducting agent and binder” can be used and the mixture ratios for the materials

“can be those well known in the art.” *Id.*, 8:38-41. “The separator used in the present invention is a separator well known in the art.” *Id.*, 8:43-44. The anode can be “mesophase asphalt based spherical carbon” which may be “obtained according to the conventional method.” *Id.*, 9:5-7. Electrolytes and shells “of the type well known in the art can be used in the present invention.” *Id.*, 9:8-10. The charge and discharge parameters and protection circuit designs—except, allegedly, voltage—are “commonly used in the art.” *Id.*, 9:22-36.

B. Prosecution History

The prosecution history of the child to the '641 patent shows that the '641 patent was mistakenly allowed. Indeed, after learning of additional prior art, the examiner refused to allow the child application even though the applicants relied on the same arguments and the same limitations that led to the allowance of the '641 patent.

In allowing the claims of the '641 patent, the examiner concluded that “there is nothing taught by the prior art of record to reasonably arrive at the claimed configuration” and that “one of ordinary skill in the art would not have predicted that the resulting cell would have high capacity” if the cut-off voltage was raised above 4.2V. EX1003, p.24. This allowance came after the applicants had argued that “the claimed invention *contravened* the understanding and expectations of the prior art, and, hence, would have been wholly *surprising* to one of ordinary skill.” *Id.*,

pp.46, 48, 50 (emphasis original).

The child application—Application No. 12/817,028—was filed with 8 claims. EX1004, p.246. A restriction requirement was issued and claims 4-5 were elected. *Id.*, pp.198, 210. These claims were directed to an electronic device and did not recite a cutoff voltage or the ratio of positive electrode material to negative electrode material. EX1004, p.246. The applicant added the following limitation after the claims were rejected: “wherein the ratio of positive electrode material to negative electrode material of the single lithium ion cell is from 1:1.0 to 1:2.5, as calculated by the theoretic capacity with the charge cut-off voltage set at 4.2V.” EX1004, p.167. The applicant then explained to the examiner that this was the limitation that had led to the allowance of the ’641 patent:

[R]evised claim 4 prescribes a “ratio of positive electrode material to negative electrode material [that] is from 1:1.0 to 1:2.5, as calculated by the theoretic capacity with the charge cut-off voltage set at 4.2V.” *This claim language tracks that of the claims allowed in parent application,* serial No. 10/491,134 (now U.S. patent No. 7,749,641).

EX1004, p.170 (emphasis added). The applicant quoted the reasons for allowance of the ’641 patent and explained that the information submitted in that application showed that “the result achieved with the claimed invention contravened the understanding and expectations of the art” making the resulting properties “surprising.” EX1004, p.172.

After making these arguments the applicants filed an IDS identifying WO 93/21665 to Guyomard for the first time. EX1004, p.71. This is the Guyomard reference relied upon in some of the Grounds presented in this Petition. After considering Guyomard, the examiner explained that the argument that raising the cutoff voltage above 4.2V provided results that were “wholly unforeseen by the art *is not true*.” EX1004, p.66 (emphasis added); *see also id.*, p.33 (same). The examiner further explained that the cutoff voltage was inherent in a reference that taught the claimed ratio and that it was obvious over Guyomard’s disclosure of cutoff voltages of up to 5V. EX1004, pp.18, 34. The applicants responded that the prior art did not teach a ratio of capacities calculated in the claimed manner. EX1004, pp.25-26. The applicants also continued to argue that the advantages were unforeseeable and unexpected. *Id.*, pp.26-27. These arguments were rejected first by the examiner and again in response to a Pre-Appeal Brief Request for Review. EX1004, pp.4-8. Instead of appealing to the Board, the applicants abandoned their application. *Id.*, p.2.

C. Discretionary Denial Under §325(d) Is Unwarranted.

Like the references relied upon to reject the claims of the child application when they were amended to include the requirements of the claims of the ’641 patent, the references relied upon in this Petition show that designing a battery to have at least as much capacity at the negative electrode as at the positive electrode

(i.e., a ratio of at least 1:1) was known. EX1009, ¶[0033]; EX1005, ¶[0018]. Having at least equal capacity at the negative electrode and positive electrode avoids plating and other deleterious effects that occur while intercalating lithium. EX1009, ¶[0033]; EX1002, ¶¶17 (quoting EX.1019, ¶[0005]), 21, 27 (quoting EX1023, 1:20-26), 51; EX1001, 4:57-64. Using charge cutoff voltages above 4.2V was also known in the art contrary to the statements in the '641 patent and the arguments presented to secure its allowance. *Infra* §§III.C.1.b, III.E.1.b.

The Uemura and Abe references that are a basis of the anticipation and obviousness grounds presented in this Petition were not before the Office during prosecution of the '641 patent. Nor were the Guyomard or Iwaizono references. When the Guyomard reference was cited in the child application, the Office rejected the application and concluded that statements made to secure the allowance of the '641 patent claims were “not true.” EX1004, p.66; *see also id.*, p.33. This petition thus raises issues that are not the same or substantially the same as those considered when the Office issued the '641 patent. And when similar issues were considered in connection with the child application, the claims were finally rejected and the application went abandoned. Therefore, this Petition presents new issues warranting *inter partes* review. *Cf.* 35 U.S.C. §325(d).

II. REQUIREMENTS FOR IPR

A. Standing

Petitioner certifies that the '641 patent is available for IPR. This petition is filed within one year of service of a Complaint asserting the '641 patent.

EX1014. Estoppel does not bar this Petition.

B. Challenge and Relief Requested

Petitioner requests institution of IPR and cancelation of claims 1-18 of the '641 patent based on the following grounds:

Ground	Claims	Basis
1	1-8	Anticipated under §102(e) by Uemura
2	1-8	Obvious under §103(a) over Uemura
3	11-18	Obvious under §103(a) over Uemura
4	11-18	Obvious under §103 over Uemura in view of Guyomard
5	1-8	Anticipated under §102(b) by Abe
6	1-8	Obviousness under §103(a) over Abe
7	2-4, 6-8, 11-18	Obvious under §103 over Abe in view of Guyomard
8	9	Obvious under §103 over Uemura in view of Iwaizono
9	9-10	Obvious under §103 over Uemura in view of Iwaizono in view of Guyomard
10	9-10	Obvious under §103 over Abe in view of Guyomard and Iwaizono

C. Claim Construction

Without agreeing to the correctness of—or taking ownership of—the following constructions, Petitioner bases its challenges on claim constructions advanced by Patent Owner in co-pending district court litigation and constructions that are implicit from Patent Owner’s infringement contentions. *See W. Digital Corp. v. SPEX Techs., Inc.*, IPR2018-00084, Paper No. 14, p.11 (PTAB Apr. 25, 2018) (“37 C.F.R. § 42.104(b)(3) does not require Petitioner to express its subjective agreement regarding correctness of its proffered claim constructions or take ownership of those constructions.”).

1. *Claim 1 (preamble): “A method for improving . . . characterized in that”*

Claim 1 purports to be a method claim yet it has no steps. Petitioner’s challenges to this claim are based on the implicit positions Patent Owner has taken in its infringement contentions in co-pending litigation against Petitioner. Specifically, Patent Owner contends that “each element in the preamble is practiced in the infringing method” and that “product end users of the Accused Device directly infringe this claim *when they use the Accused Device* as it is designed to operate” EX1017, p.1 (emphasis added). Therefore, Patent Owner’s position is that claim 1 is met when the device recited in the limitations following the transitional phrase

“characterized in that” is used.¹ Petitioner applies Patent Owner’s implicit construction in this Petition. Because the batteries disclosed in each reference are “used” when the battery is charged and discharged (a process sometimes called cycling), the preamble “method” as interpreted by Patent Owner in litigation is disclosed by the references regardless of whether the preamble is limiting or not. Petitioner submits that no further construction is required.

2. *“ratio of positive electrode material to negative electrode material as calculated by a theoretic capacity with a charge cut-off voltage set at 4.2 V” (claim 5)*

Patent Owner has interpreted this phrase to mean “the ratio calculated as the product of the capacity of the cathode active material per mass unit and the amount of the cathode active material in the same mass unit divided by the product of the

¹ Patent Owner has contended in litigation against Apple that claim 1 is a *Jepson* claim and should be interpreted as a claim to a battery. EX1031, p.4. While this construction requires rewriting the claim in a manner Petitioner contends is inappropriate, even if that construction were applied, the rationale applied herein for why the various requirements of claim 1 are met would apply equally under this construction because the limitations of the claims are written as apparatus elements—not steps of a method—and Petitioner has shown how these features are taught by and/or obvious over the prior art.

capacity of the anode active material per mass unit and the amount of the anode active material in the same mass unit, when the charge cutoff voltage is 4.2 V” in its litigation against Apple. EX1016, p.4. Patent Owner identifies passages including the statement in the ’641 patent that “‘theoretical capacities of positive electrode and negative electrode’ means the capacities of the positive electrode and negative electrode calculated with a charge cut-off voltage set at 4.2 V.” EX1001, 4:4-9; EX1016, p.4. Patent Owner has further contended that the recitation of the voltage being “set at 4.2 V” “theoretical capacity” does not refer to “theoretical maximum capacity,” but instead “theoretical capacity at” 4.2 V. EX1031, p.15. Patent Owner identifies certain examples, including examples 14-18, which provide the mass of active materials (*e.g.*, lithium manganese oxide and MCMB). EX1001, 12:60-66; EX1016, p.4. Patent Owner’s litigation construction is applied herein.

3. *“a ratio of positive electrode material to negative electrode material of the secondary lithium ion cell or battery is from 1:1.0 to 1:2.5 as calculated by a specific capacity with a charge voltage limited to 4.2 V” (claim 1)*

Patent Owner’s infringement contentions imply that its construction of the ratio limitation of claim 5—which substitutes “theoretic capacity” in claim 5 for “specific capacity” in claim 1—is being applied in the same way to both claims 1 and 5. EX1017, pp.3-4, 8-9. This is confirmed by Patent Owner’s submission in the Apple case, which applies the same construction to the ratio term of both claim 1 and claim 5. EX1031, pp.8-10. As Patent Owner’s litigation positions reveal, Patent

Owner contends both claims 1 and 5 require a ratio of “capacity” (as opposed to “specific” or “theoretic” capacity) because capacity is calculated “with a charge cut-off voltage set at 4.2V.” EX1016, p.4; EX1031, pp.8-10.

For purposes of this proceeding the Petition construes this limitation of claim 1 the same way that Patent Owner has construed the ratio limitation of claim 5—by using the term “capacity” and providing for the calculation discussed above because that is how Patent owner has contended it should be construed. *Supra* §II.C.2.

4. “at least 7500 of capacity” (claim 11)

This is an obvious typographical error and should be interpreted to mean “at least 75% of capacity.” EX1003, p.34 (claim 18 renumbered as claim 11), p.43 (“at least 75% of capacity”).

III. THE CHALLENGED CLAIMS ARE UNPATENTABLE

A. Person of Ordinary Skill in the Art

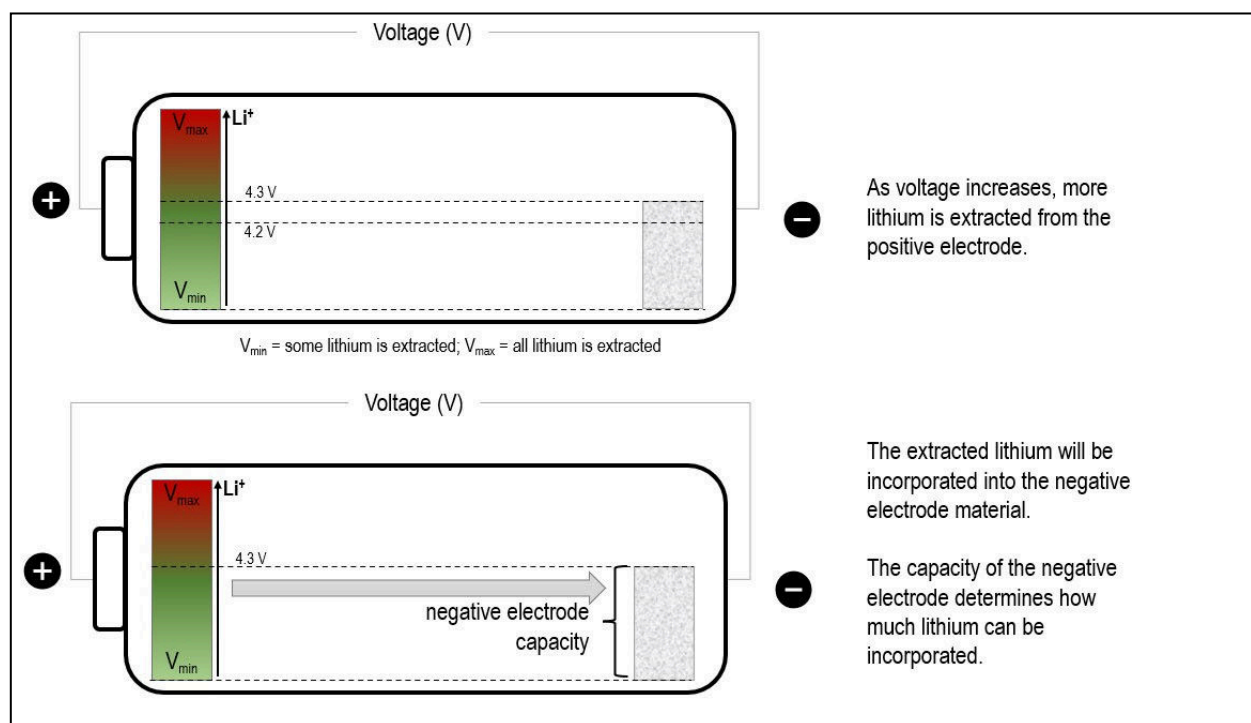
The person having ordinary skill in the art (“PHOSITA”) would have had a Master’s degree in material science, chemical engineering, chemistry, or similar field with four years experience designing testing, and building secondary lithium batteries. EX1002, ¶51. In the context of lithium-based batteries, a PHOSITA would have been aware of (1) positive electrode materials, (2) negative electrode materials, (3) separators, (4) electrolytes, (5) charge-discharge parameters, and (6) protection circuits, as well as “battery failure modes” such as plating and the formation of

dendrites. EX1002, ¶¶50-51. More experience can substitute for less education and vice-versa. *Id.*, ¶51.

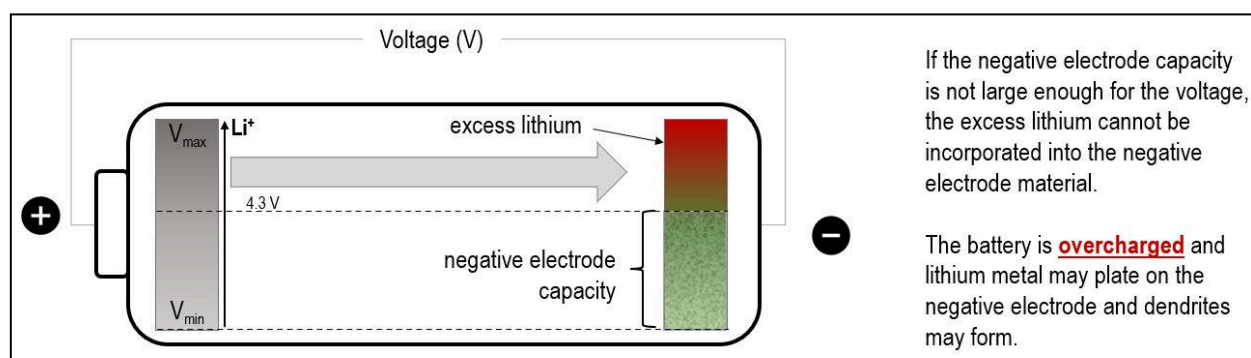
B. Electrode Capacity Ratio

The challenged claims include limitations related to the ratio of positive electrode material to negative electrode material of the secondary lithium ion cell or battery and require that ratio to be “from 1:1.0 to 1:2.5” as calculated at a voltage of 4.2V. This concept is explained by Mr. Juzkow in his declaration and further detail is provided below. EX1002, ¶¶18, 22-26.

The amount of lithium extracted from the positive electrode material is voltage dependent. EX1002, ¶22. The higher the voltage applied, the more lithium is extracted. *Id.*, ¶¶17-18, 22-26; EX1019, ¶[0005]. At some voltage all of the lithium will be extracted. EX1032, p.16. This is illustrated below where the height of the boxes indicates the capacity and the colored box on the left shows what Patent Owner calls the “maximum theoretical capacity.” The colored bar represents lithium. The red indicates excess capacity when compared with the negative electrode capacity.

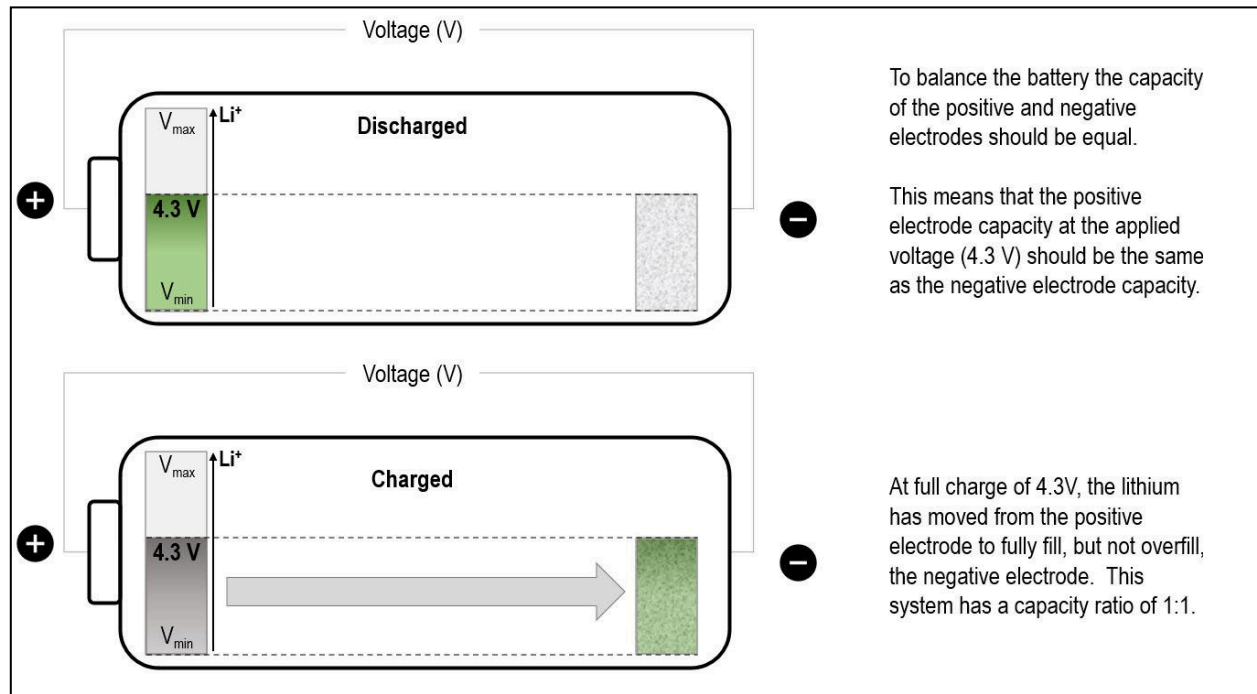


If the capacity of the negative electrode is too small based on the applied voltage, the battery will become **overcharged** and some of the lithium will not be taken into the structure of the negative electrode. EX1002, ¶¶23, 27-28 (quoting EX1023, 1:20-26), 133. This can cause lithium plating, the formation of dendrites, and damage the battery. *Id.*, ¶¶18, 21, 23, 94, 120, 133.

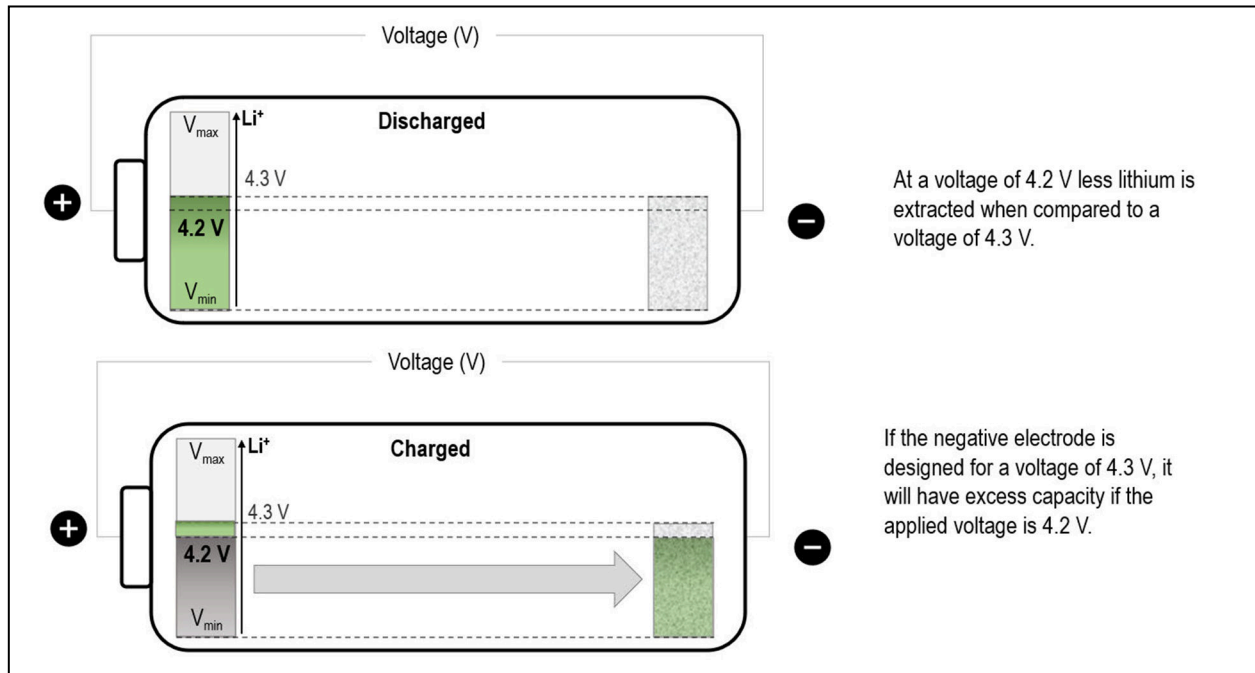


If a voltage of 4.3V is applied to a battery a certain amount of lithium will intercalate, and if the negative electrode has capacity for precisely the amount of

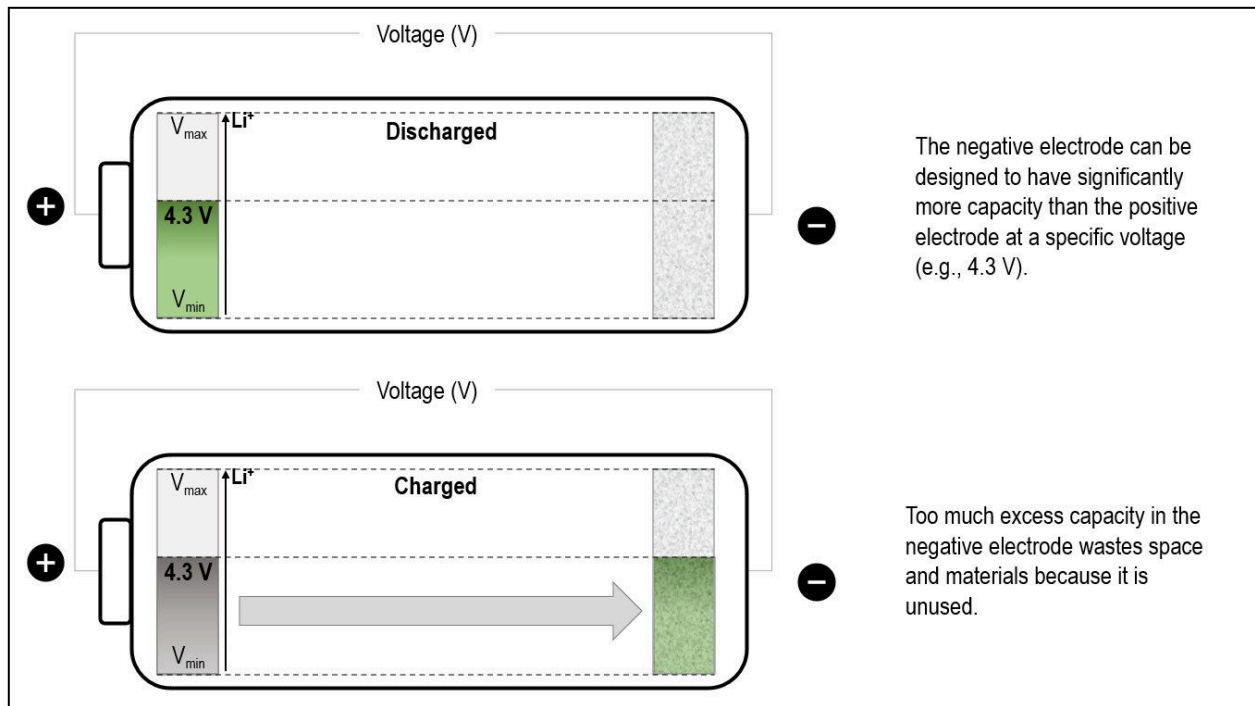
lithium extracted from the positive electrode then the battery is considered to be “balanced.” EX1002, ¶24. A balanced battery has equal capacity at the positive and negative electrodes at a particular applied voltage. *Id.*



If a negative electrode has a capacity designed for one voltage (e.g., 4.3 V), but a lower voltage is applied (e.g., 4.2 V), then the negative electrode will have excess capacity because less lithium is extracted from the positive electrode than what would have been extracted at the design voltage. EX1002, ¶25. This is illustrated below.



And, if the anode is designed such that it has significantly more capacity than is needed to handle the extracted lithium, then this results in wasted space and materials. EX1002, ¶26. This is illustrated below.



These concepts are discussed by both Uemura and Abe as explained in more detail below.

C. Ground 1 and 2: Uemura Anticipates Claims 1-8 (Ground 1) and Renders Claims 1-8 Obvious (Ground 2).

Uemura is prior art under pre-AIA 35 U.S.C. §102(e) because it was filed on July 31, 2001—before the claimed priority date of the '641 patent and published on January 31, 2002. EX1009, cover; EX1001, cover.

1. Claim 1

- a. [1P]: “A method for improving the capacity, average operating voltage and specific energy of a secondary lithium ion cell or battery, characterized in that”; [5P] “A secondary lithium ion cell or battery, characterized in that”

To the extent the preambles are limitations of claims 1 and 5, Uemura discloses them. EX1002, ¶¶106-112. Uemura describes negative and positive electrode materials for “improving cyclic resistance” of a “rechargeable lithium battery.” EX1009, ¶[0002]. Uemura’s battery has “a large capacity” and thus a higher specific energy than a battery with lower capacity. *Id.*, Abstract (“the rechargeable lithium battery having a large capacity and high cyclic resistance at high temperature can be provided . . .”); EX1002, ¶110. Uemura’s battery is a secondary lithium ion battery. EX1009, ¶[0021] (explaining how lithium ions pass from the positive electrode to negative electrode, and back to the positive electrode); EX1002, ¶109. And, the average operating voltage of Uemura’s battery is improved

over batteries that had a charge cutoff voltage of 4.2V or less because it is charged between 4.3V and 2.0V thus providing a higher voltage. EX1009, ¶[0081]; EX1002, ¶¶17, 24-25, 111. Uemura provides cycling data showing that the batteries are used by charging and discharging them, thus showing they are used in a method under the construction discussed above. EX1009, FIG. 3 (last column); *supra* §II.C.

- b. [1A]: “the charge cut-off voltage of the secondary lithium ion cell or battery is greater than 4.2 V but less than 5.8 V;” [5A] “the secondary lithium ion cell or battery has a charge cut-off voltage of greater than 4.2 V but less than 5.8 V”

Uemura discloses this limitation. EX1002, ¶113. Uemura’s secondary lithium-ion battery has a charge cutoff voltage greater than 4.2V but less than 5.8V—and specifically 4.3V. *See* EX1009, ¶[0081] (“The charge-discharge was repeatedly performed at a constant current of 0.5 mA/cm² and ***a voltage ranging from 4.3 V to 2.0 V*** at an atmospheric temperature of 60 °C by the use of the made sealed type non-aqueous solvent battery cell.” (emphasis added)); EX1002, ¶113.

- c. [1B]: “a ratio of positive electrode material to negative electrode material of the secondary lithium ion cell or battery is from 1:1.0 to 1:2.5 as calculated by a specific capacity with a charge voltage limited to 4.2 V”; [5B] “a ratio of positive electrode material to negative electrode material of the secondary lithium ion cell or battery is from 1:1.0 to 1:2.5, as calculated by a theoretic capacity with a charge cut-off voltage set at 4.2 V.”

Uemura discloses a ratio of positive electrode material to negative electrode material that is in the range of 1:1.0 to 1:2.5 and the disclosed ratios would have

been within the claimed range as calculated by a capacity with a charge cut-off voltage set at 4.2V as construed above. EX1002, ¶¶114-125.

Uemura teaches:

[A] capacity balance ratio B/A of the total capacity B of the negative electrode material to the total capacity A of the positive electrode material is *preferably fixed at a range of 1 to 1.5*. If the capacity balance ratio B/A is below 1, lithium ion holding sites on the negative electrode material becomes insufficient. As a result, branch-shaped or needle-shaped crystal (dendrite crystal) tends to occur during the charge to cause a short circuit phenomenon between the positive electrode and negative electrode. If the capacity balance ratio B/A exceeds 1.5, negative electrode sites that do not contribute to the charge-discharge are increased, leading to the wasteful use of materials.

EX1009, ¶[0033]. Uemura FIG. 3 shows a number of examples that have a ratio of positive electrode capacity (A) to negative electrode capacity (B)—referred to as “Capacity balance $P_c:N_c$ ” in the table below within the range claimed by the ’641 patent:

FIG.3

	Positive electrode material					Negative electrode material				Capacity balance Pc:Nc	Ic/Pc ×100(%) of	Number cycles
	Used transition metal material	Composition of positive electrode material	X	Y	Weight (mg)	Total capacity : Pc (mAh)	Weight (mg)	Total capacity : Nc (mAh)	Total irreversible capacity : Ic			
Example 1	Cobalt(II) nitrate	$\text{Li}_{0.67}\text{Mn}_{0.5}\text{Co}_{0.5}\text{O}_{2-\delta}$	0.033	0.5	15	1.8	6.2	2.36	0.002	(1:1.3)	0.1	300
Example 2	Cobalt(II) nitrate	$\text{Li}_{0.83}\text{Mn}_{0.5}\text{Co}_{0.5}\text{O}_{2-\delta}$	0.17	0.5	15	2.24	6.2	3.41	0.44	(1:1.5)	20.0	330
Example 3	Cobalt(II) nitrate	$\text{Li}_{0.967}\text{Mn}_{0.5}\text{Co}_{0.5}\text{O}_{2-\delta}$	0.033	0.5	15	2.6	6.2	3.27	1.18	(1:1.3)	45.0	310
Example 4	Cobalt(II) nitrate	$\text{Li}_{0.967}\text{Mn}_{0.5}\text{Co}_{0.5}\text{O}_{2-\delta}$	0.033	0.5	15	2.6	4.9	2.6	0.94	(1:1)	36.0	350
Example 5	Cobalt(II) nitrate	$\text{Li}_{0.75}\text{Mn}_{0.75}\text{Co}_{0.25}\text{O}_{2-\delta}$	0.25	0.25	15	2	6.2	2.36	0.002	(1:1.3)	0.1	330
Example 6	Nickel(II) nitrate	$\text{Li}_{0.83}\text{Mn}_{0.75}\text{Ni}_{0.25}\text{O}_{2-\delta}$	0.17	0.25	15	2.24	6.2	2.36	0.002	(1:1.3)	0.1	325
Example 7	Iron(III) nitrate	$\text{Li}_{0.83}\text{Mn}_{0.67}\text{Fe}_{0.33}\text{O}_{2-\delta}$	0.17	0.33	15	2.24	6.2	2.36	0.002	(1:1.3)	0.1	245
Example 8	Aluminium(III) nitrate	$\text{Li}_{0.83}\text{Mn}_{0.75}\text{Al}_{0.25}\text{O}_{2-\delta}$	0.17	0.25	15	2.24	6.2	2.36	0.002	(1:1.3)	0.1	310
Example 9	Chromium(III) nitrate	$\text{Li}_{0.83}\text{Mn}_{0.75}\text{Cr}_{0.25}\text{O}_{2-\delta}$	0.17	0.25	15	2.24	6.2	2.36	0.002	(1:1.3)	0.1	350
Example 10	Gallium(III) nitrate	$\text{Li}_{0.83}\text{Mn}_{0.75}\text{Ga}_{0.25}\text{O}_{2-\delta}$	0.17	0.25	15	2.24	6.2	2.36	0.002	(1:1.3)	0.1	120
Example 11	Indium(III) hydroxide	$\text{Li}_{0.83}\text{Mn}_{0.75}\text{In}_{0.25}\text{O}_{2-\delta}$	0.17	0.25	15	2.24	6.2	2.36	0.002	(1:1.3)	0.1	110
Example 12	Zirconium(IV) hydroxide	$\text{Li}_{0.83}\text{Mn}_{0.75}\text{Zr}_{0.25}\text{O}_{2-\delta}$	0.17	0.25	15	2.24	6.2	2.36	0.002	(1:1.3)	0.1	95
Example 13	Vanadium(III) oxide	$\text{Li}_{0.83}\text{Mn}_{0.75}\text{V}_{0.25}\text{O}_{2-\delta}$	0.17	0.25	15	2.24	6.2	2.36	0.002	(1:1.3)	0.1	130
Example 14	Iron(III) oxide	$\text{Li}_{0.75}\text{Mn}_{0.875}\text{Fe}_{0.125}\text{O}_{2-\delta}$	0.25	0.125	15	2	6.2	2.36	0.002	(1:1.3)	0.1	220
Example 15	Niobium(II) oxide	$\text{Li}_{0.83}\text{Mn}_{0.75}\text{Nb}_{0.25}\text{O}_{2-\delta}$	0.17	0.25	15	2.24	6.2	2.36	0.002	(1:1.3)	0.1	190
Example 16	Tantalum(V) oxide	$\text{Li}_{0.83}\text{Mn}_{0.75}\text{Ta}_{0.25}\text{O}_{2-\delta}$	0.17	0.25	15	2.24	6.2	2.36	0.002	(1:1.3)	0.1	180
Example 17	Titanium(IV) oxide	$\text{Li}_{0.83}\text{Mn}_{0.75}\text{Ti}_{0.25}\text{O}_{2-\delta}$	0.17	0.25	15	2.24	6.2	2.36	0.002	(1:1.3)	0.1	250
Comparative example		$\text{LiMnO}_2-\delta$	0	0	15	2.7	10	—	—	(1:1.3)	—	10

EX1009, FIG. 3; EX1002, ¶115. The masses of the positive and negative electrodes are provided in milligrams, which can be converted to grams (e.g., 15 mg is the same as 0.015 g). EX1002, ¶116. From the data provided in Table 3, the claimed ratio is calculated as the product of the capacity of the cathode active material per mass unit (e.g., Pc/mg) and the amount of the cathode active material in the same mass unit (mg) divided by the product of the capacity of the anode active material per mass unit (e.g., Nc/mg) and the amount of the anode active material in the same mass unit (mg) to provide the ratio recited in the claims (Pc:Nc). *Id.* Uemura publishes the resulting ratio in the column identified as “Pc:Nc,” and provides examples that fall within the scope of the claimed ratio. EX1002, ¶¶115, 117-123.

Uemura discloses and suggests that the claimed ratio is within the scope of the claims when calculated using a charge cutoff voltage of 4.2V because while Uemura's ratio would have been understood to have been calculated at 4.3V (the charge cut-off voltage), a PHOSITA would have understood that Uemura's ratio would remain within the range of the '641 patent when determined at a charge cutoff voltage of 4.2V instead of 4.3V. EX1002, ¶¶121-123.

This would have been known and understood from Uemura's explicit teachings, which explain the importance of maintaining the Pc:Nc ratio over the cycled voltages. Specifically,

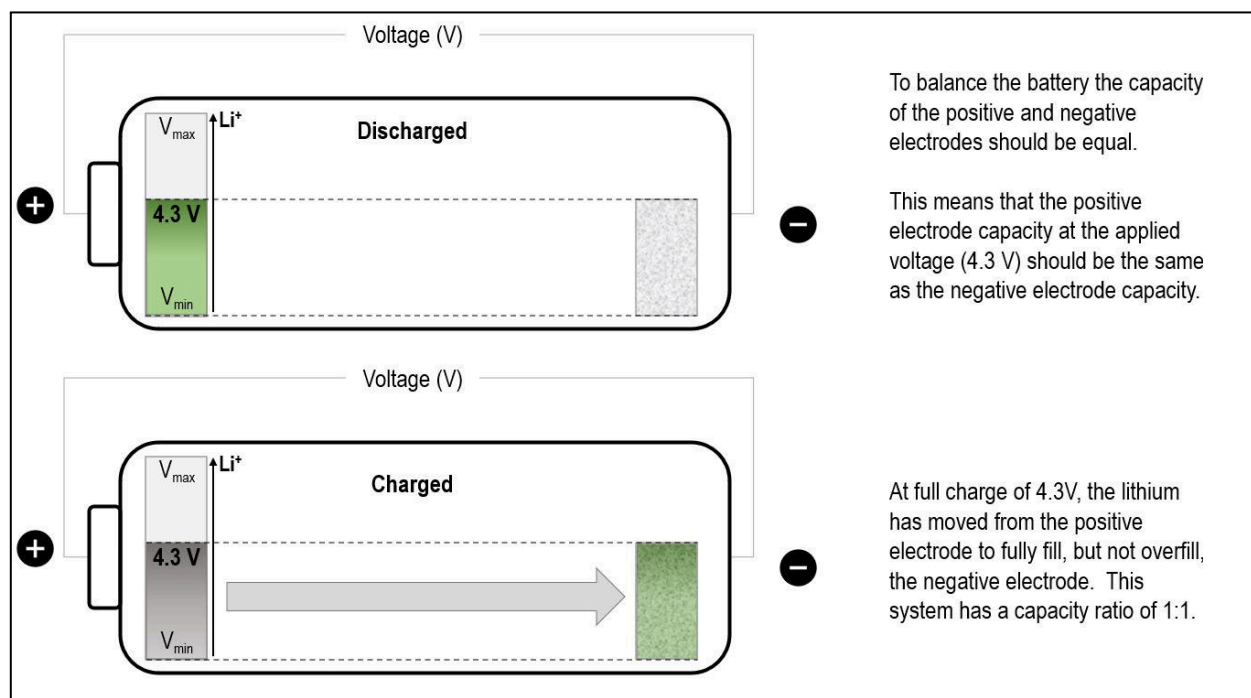
- Uemura applies a charge cutoff voltage of 4.3V to the battery cell, cycling the battery from 4.3V to 2.0V. EX1009, ¶[0081]; EX1002, ¶¶117-118.
- Uemura teaches that if the lithium ions extracted from the positive electrode cannot be accepted by the material forming the negative electrode (i.e., there are “too few lithium ion holding sites”—using Uemura's phrasing—in the negative electrode) “branch-shaped or needle-shaped crystal (dendrite crystal) tends to occur during the charge to cause a short circuit phenomenon.” EX1009, ¶[0033]; EX1002, ¶117. This is the same concern set forth in the '641 patent. EX1001, 4:57-5:7; EX1002, ¶124.

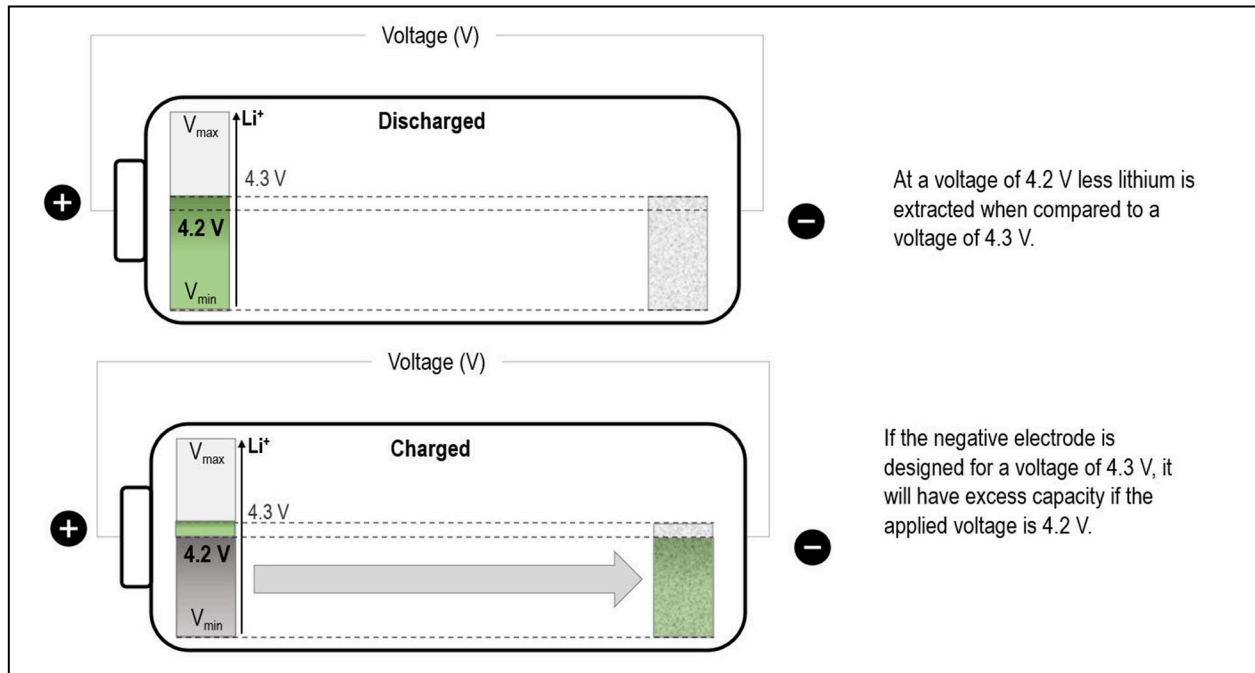
- Uemura further teaches that if there is too much negative capacity, i.e., the ratio exceeds 1:1.5, there is “wasteful use of materials” which decreases energy density. EX1009, ¶¶0033; EX1002, ¶¶117, 120.
- To avoid these negative effects, Uemura teaches that the “capacity balance ratio” is “preferably fixed at a range of 1 to 1.5” and should not fall “below 1” or exceed 1.5. EX1009, ¶¶0033].

From these teachings, a PHOSITA would have known that Uemura’s capacity balance ratio is determined at 4.3V because it is the ratio the battery is intended to operate at. EX1002, ¶¶117-118, 120. As explained above, amount of lithium extracted from the positive electrode is dependent on the applied voltage and thus the number of “lithium ion holding sites on the negative electrode material” needed to accommodate the extracted lithium is also dependent on the applied voltage (more lithium extracted means more lithium “holding sites” are needed to avoid plating and dendrite formation). EX1002, ¶¶22-26, 118, 120. Patent Owner has admitted as much in litigation against Apple when it contends that the charge cutoff voltage “determines the amount of lithium ions that participate in the reactions” and that “[t]his was well known at the time and described throughout the art and the patent.” EX1032, p14. Moreover, because Uemura’s examples have ratios ranging from 1:1 to 1:1.5, a PHOSITA knew that the ratios were determined using the cut-off voltage of 4.3V because the ratios could fall outside of the preferred range if the ratios were

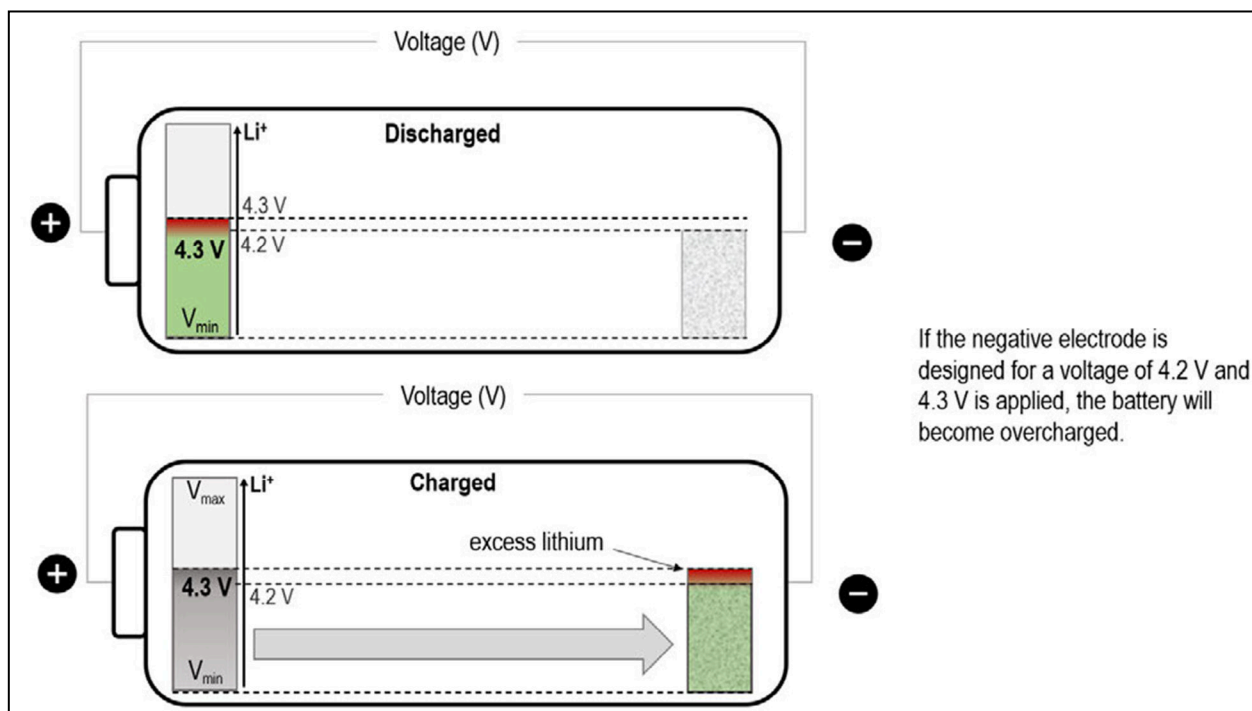
determined at another unused voltage. EX1002, ¶120.

For example, the amount of lithium extracted from the positive electrode at 4.3V will be higher than the amount of lithium extracted from the positive electrode at a lower voltage, including 4.2V, because of the higher potential being applied to the battery, which means that the negative electrode side of the ratio increases when the cut-off voltage is decreased. EX1002, ¶¶24-25, 120. This is illustrated below and described above. *Supra* §III.B.





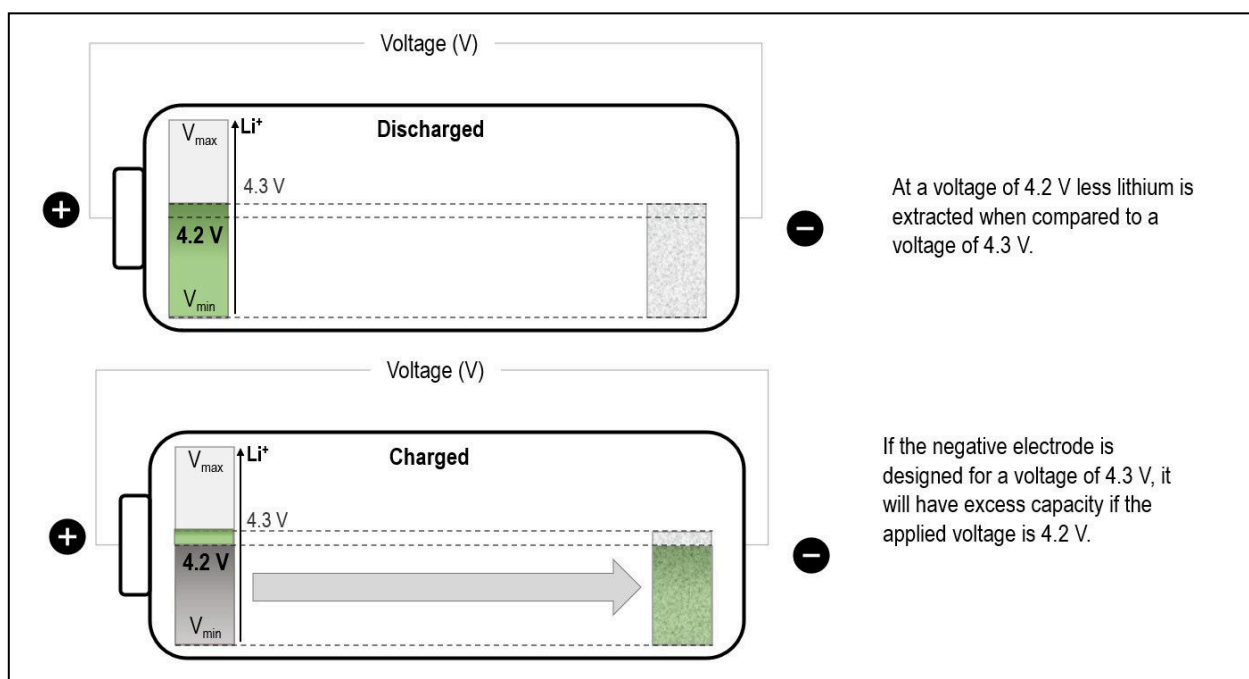
If the ratio is calculated to be 1:1 at, for example 4.2V, then dendrite formation and plating *will likely occur* according to Uemura's teachings when the charge cut-off voltage is 4.3V and the battery is overcharged. EX1002, ¶120; *see also id.*, ¶17; EX1019, ¶[0005]. This is illustrated below.



At the very least, and for all of the reasons discussed in the preceding paragraphs, a PHOSITA would have found it obvious to perform the calculation of Uemura's ratio at the actual voltage being applied to ensure that dendrites did not form and so as to avoid "wasteful use of materials" if the balance is calculated at some higher, unused voltage. EX1009, ¶[0033]; EX1002, ¶132. A PHOSITA would have reasonably expected to succeed in calculating the ratio at any appropriate voltage for the battery under consideration and the results of doing so would not have been unexpected because performing the calculation at one voltage (e.g., that used in Uemura) would have followed a same general technique to calculate the ratio at a different voltage. EX1002, ¶134.

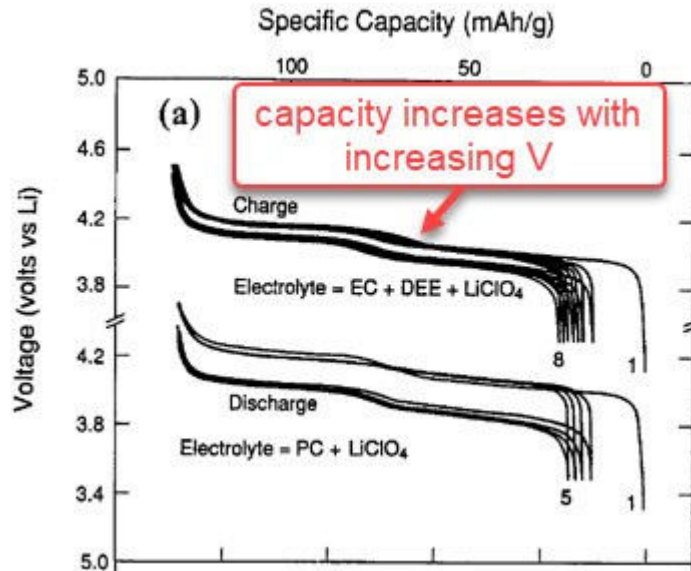
Uemura's capacity balance ratios of 1 to 1.5 conveyed to the PHOSITA

slightly higher ratios than 1:1 to 1:1.5 when calculated with a charge cutoff voltage of 4.2V because at a lower cut-off voltage (*e.g.*, 4.2V), the negative terminal will have additional capacity with respect to the positive terminal because fewer lithium ions are being extracted from the positive terminal and thus the capacity of the positive terminal decreases in comparison to the negative terminal as shown in the illustration below. EX1002, ¶121.



This would have slightly changed the ratio (raising the capacity of the negative electrode when compared to the positive electrode), but would not have changed it so much as to lead to the negative electrode to be outside of the claimed range of 1:2.5 required by the claims. EX1002, ¶¶121-123. This is evident from, for example, the charge and discharge curves for lithium manganese oxide compositions, which show that in the voltage range exceeding 4V, the amount of lithium extracted as

voltage decreases (as reflected by capacity change) decreases, meaning a smaller capacity change per rate of increase of voltage. EX1002, ¶122 (citing EX1015, p.939.)



EX1015, p.939.

Given the lower rate of lithium extraction above 4.2V, it “certainly does not reflect a 2.5 times increase in the extraction of lithium ions between cutoff voltages of 4.2V and 4.3V” and this reflects the “typical behavior for lithium-ion cells ” EX1002, ¶122. The examples of Uemura include ratios of 1:1 and 1:1.3 and the increase in negative electrode capacity would not have exceeded the claimed range when changing the cut-off voltage by 0.1V. *Id.*

Accordingly, Uemura’s capacity balance ratio of 1 to 1.5 (*i.e.*, 1:1 to 1:1.5) as determined at 4.3V overlaps with and discloses a capacity balance ratio between 1:1 and 1:2.5 determined with a charge cut-off voltage of 4.2V. Not only does this

anticipate the claimed range because Uemura's examples fall within the claimed ranges of the '641 patent, but it also renders the claimed ranges *prima facie* obvious. See *In re Applied Materials, Inc.*, 692 F.3d 1289, 1295 (Fed. Cir. 2012) (an overlap in ranges "provides sufficient motivation to optimize the ranges"); *In re Peterson*, 315 F.3d 1325, 1329 (Fed. Cir. 2003) ("A *prima facie* case of obviousness typically exists when the ranges of a claimed composition overlap the ranges disclosed in the prior art.").

2. Claims 2-3 and 6-7

Uemura discloses that the charge cut-off voltage is within a range "from 4.3V to 5.2V" as recited in claims 2 and 6 and "from 4.3V and 4.8V" as recited in claims 3 and 7. EX1002, ¶126. Specifically, Uemura's charge cut-off voltage is 4.3V as explained in connection with Limitations [1A], [5A]. This teaches an example in the ranges recited in claims 2-3 and 6-7, thus anticipating these claims and rendering them *prima facie* obvious under *Applied Materials* and *Peterson*.

3. Claims 4 and 8

Uemura discloses that the ratio of positive electrode material to negative electrode material of the secondary lithium ion cell or battery is from 1:1.15 to 1:2.5. EX1002, ¶¶127-129. Uemura teaches numerous examples, such as Example 1, in which the ratio is 1:1.3. EX1009, FIG. 3. If determined at a cut-off voltage of 4.2V instead of 4.3V, the ratio would be slightly higher, but would not exceed 1:2.5 for

the reasons explained above. *Supra* §III.B.1.c; EX1002, ¶¶121, 128.

D. Grounds 3 and 4: Obviousness of Claims 11-18 Over Uemura Alone (Ground 3) or Uemura In View of Guyomard (Ground 4)

Guyomard was published on October 28, 1993—more than one year before the filing date of the '641 patent—thus making it prior art under 35 U.S.C. §102(b). EX1008. Both Uemura and Guyomard relate to the field of lithium-ion batteries and are reasonably pertinent to the problem allegedly being solved by the '641 patent. EX1002, ¶¶88-91, 96-99. Like the '641 patent, Uemura and Guyomard seek to improve performance of Li-ion batteries over a number of charge-discharge cycles. EX1001, 3:3-16; EX1008, 1:9-15; EX1009, ¶[0002]; EX1002, ¶¶89-90, 97-98. And, like the '641 patent, each reference describes examples using complex oxides including lithium and manganese in lithium ion batteries. EX1001, 8:14; EX1008, 1:9-15; EX1009, FIG. 3; EX1002, ¶¶89, 97.

As relevant to claims 11-18, Uemura describes batteries that have increased “cyclic resistance.” EX1009, ¶¶[0002], [0012]-[0015]. Tests were performed using a charge cut-off voltage of 4.3V and “[t]he number of cycles taken to a point where the discharge capacity becomes less than 90% of the initial discharge capacity was obtained.” EX1009, ¶[0081]. The results are shown in FIG. 3, below in the “Number of cycles” column:

FIG.3

	Used transition metal material	Positive electrode material					Negative electrode material			Capacity balance Pc:Nc	Ic/Pc $\times 100(\%)$ of cycles	Number of cycles
		Composition of positive electrode material	X	Y	Weight (mg)	Total capacity : Pc (mAh)	Weight (mg)	Total capacity : Nc (mAh)	Total irreversible capacity : Ic			
Example 1	Cobalt(II) nitrate	$\text{Li}_{0.67}\text{Mn}_{0.5}\text{Co}_{0.5}\text{O}_{2-\delta}$	0.033	0.5	15	1.8	6.2	2.36	0.002	(1:1.3)	0.1	300
Example 2	Cobalt(II) nitrate	$\text{Li}_{0.83}\text{Mn}_{0.5}\text{Co}_{0.5}\text{O}_{2-\delta}$	0.17	0.5	15	2.24	6.2	3.41	0.44	(1:1.5)	20.0	330
Example 3	Cobalt(II) nitrate	$\text{Li}_{0.967}\text{Mn}_{0.5}\text{Co}_{0.5}\text{O}_{2-\delta}$	0.033	0.5	15	2.6	6.2	3.27	1.18	(1:1.3)	45.0	310
Example 4	Cobalt(II) nitrate	$\text{Li}_{0.967}\text{Mn}_{0.5}\text{Co}_{0.5}\text{O}_{2-\delta}$	0.033	0.5	15	2.6	4.9	2.6	0.94	(1:1)	36.0	350
Example 5	Cobalt(II) nitrate	$\text{Li}_{0.75}\text{Mn}_{0.75}\text{Co}_{0.25}\text{O}_{2-\delta}$	0.25	0.25	15	2	6.2	2.36	0.002	(1:1.3)	0.1	330
Example 6	Nickel(II) nitrate	$\text{Li}_{0.83}\text{Mn}_{0.75}\text{Ni}_{0.25}\text{O}_{2-\delta}$	0.17	0.25	15	2.24	6.2	2.36	0.002	(1:1.3)	0.1	325
Example 7	Iron(III) nitrate	$\text{Li}_{0.83}\text{Mn}_{0.67}\text{Fe}_{0.33}\text{O}_{2-\delta}$	0.17	0.33	15	2.24	6.2	2.36	0.002	(1:1.3)	0.1	245
Example 8	Aluminium(III) nitrate	$\text{Li}_{0.83}\text{Mn}_{0.75}\text{Al}_{0.25}\text{O}_{2-\delta}$	0.17	0.25	15	2.24	6.2	2.36	0.002	(1:1.3)	0.1	310
Example 9	Chromium(III) nitrate	$\text{Li}_{0.83}\text{Mn}_{0.75}\text{Cr}_{0.25}\text{O}_{2-\delta}$	0.17	0.25	15	2.24	6.2	2.36	0.002	(1:1.3)	0.1	350
Example 10	Gallium(III) nitrate	$\text{Li}_{0.83}\text{Mn}_{0.75}\text{Ga}_{0.25}\text{O}_{2-\delta}$	0.17	0.25	15	2.24	6.2	2.36	0.002	(1:1.3)	0.1	120
Example 11	Indium(III) hydroxide	$\text{Li}_{0.83}\text{Mn}_{0.75}\text{In}_{0.25}\text{O}_{2-\delta}$	0.17	0.25	15	2.24	6.2	2.36	0.002	(1:1.3)	0.1	110
Example 12	Zirconium(IV) hydroxide	$\text{Li}_{0.83}\text{Mn}_{0.75}\text{Zr}_{0.25}\text{O}_{2-\delta}$	0.17	0.25	15	2.24	6.2	2.36	0.002	(1:1.3)	0.1	95
Example 13	Vanadium(III) oxide	$\text{Li}_{0.83}\text{Mn}_{0.75}\text{V}_{0.25}\text{O}_{2-\delta}$	0.17	0.25	15	2.24	6.2	2.36	0.002	(1:1.3)	0.1	130
Example 14	Iron(III) oxide	$\text{Li}_{0.75}\text{Mn}_{0.875}\text{Fe}_{0.125}\text{O}_{2-\delta}$	0.25	0.125	15	2	6.2	2.36	0.002	(1:1.3)	0.1	220
Example 15	Niobium(II) oxide	$\text{Li}_{0.83}\text{Mn}_{0.75}\text{Nb}_{0.25}\text{O}_{2-\delta}$	0.17	0.25	15	2.24	6.2	2.36	0.002	(1:1.3)	0.1	190
Example 16	Tantalum(V) oxide	$\text{Li}_{0.83}\text{Mn}_{0.75}\text{Ta}_{0.25}\text{O}_{2-\delta}$	0.17	0.25	15	2.24	6.2	2.36	0.002	(1:1.3)	0.1	180
Example 17	Titanium(IV) oxide	$\text{Li}_{0.83}\text{Mn}_{0.75}\text{Ti}_{0.25}\text{O}_{2-\delta}$	0.17	0.25	15	2.24	6.2	2.36	0.002	(1:1.3)	0.1	250
Comparative example		$\text{LiMnO}_{2-\delta}$	0	0	15	2.7	10	—	—	(1:1.3)	—	10

EX1009, FIG. 3. Here, certain examples provided between 300-350 cycles before the remaining capacity dropped to 90%. EX1009, ¶[0081]. Uemura uses LiPF_6 as a source of lithium ions in its electrolyte. EX1009, ¶[0078].

Guyomard describes “electrolyte compositions for secondary (rechargeable) lithium battery cells” and specifically compositions that “are capable of resisting decomposition normally resulting from oxidation which occurs in $\text{Li}_{1+x}\text{Mn}_2\text{O}_4$ /carbon cells during recharging under conditions of greater than about 4.5 V or 55°C.” EX1008, 1:9-15. The preferred electrolyte is a particular composition using LiPF_6 or LiPF_6 to which an equal amount of LiBF_4 has been added. EX1008, 4:30-37, 7:27-8:9. “The ability of the electrolyte to extend the cycle

life of the batteries was amply demonstrated by *the remarkable fact that the cell capacities after 500 cycles was only about 10% less than after 5 cycles.*” EX1009, 9:5-9 (emphasis added). In other words, Guyomard teaches an electrolyte that remarkably improves the performance of lithium ion cells that include lithium manganese oxide and carbon active materials, resulting in a demonstrated performance of a less than 10% capacity drop over 495 cycles (after the first 5 cycles). EX1002, ¶148.

a. Application to Claims 11-18

Each of claims 11-18 recite that the battery maintain “at least” some specified percentage “of capacity after 400 cycles.” EX1001, 18:4-28. The highest percentage of remaining capacity after 400 cycles is found in claims 14 and 18 and is 80.72%. Because this claim is obvious, so too are claims 11-13 and 15-17 because they recite lower remaining capacity ranges that encompass the higher capacities recited in claims 14 and 18. Thus, claims 11-13 and 15-17 are unpatentable if claims 14 or 18 are unpatentable. And, each of these claims are unpatentable.

First, the claimed remaining capacities after 400 cycles are suggested by and obvious over Uemura. EX1002, ¶¶139-141. Specifically, Uemura describes examples, such as Examples 2 and 4 in which it took 330 and 350 cycles to have a percentage of capacity drop to 90%. EX1009, FIG. 3, ¶[0081]. The PHOSITA would have found it obvious and desirable to ensure that Uemura’s batteries would

maintain as high a remaining capacity as possible at 400 cycles (and beyond) and the PHOSITA would have seen that with 90% of capacity remaining after 330 or 350 cycles, Uemura suggests that its batteries would maintain at least 80.72% of its initial capacity after 400 cycles. EX1002, ¶¶137-141. Indeed, Uemura teaches that by using the appropriate ratio of positive to negative electrode material, dendrite formation is avoided, thus leading to a battery with high cyclability. EX1009, ¶[0033]. Therefore, Uemura itself suggests the subject matter recited in claims 11-18 and thus renders it obvious. EX1002, ¶¶141-142.

Second, the PHOSITA would have seen that Uemura's cyclability could have been further improved using Guyomard, which discloses an electrolyte suitable for use in a secondary lithium ion battery that uses lithium and magnesium in the positive terminal and carbon in the negative terminal, which can withstand high voltage charging without significant oxidation. EX1002, ¶¶143-152. Like Uemura, Guyomard discloses an example with LiPF_6 in the electrolyte. EX1008, 4:30-37, 7:27-8:9; EX1009, ¶[0078]. Uemura used 1 mol/l LiPF_6 in a solvent of two parts ethylene carbonate (EC) to one part dimethylcarbonate (DMC) (or 67 EC:33 DMC). EX1009, ¶[0078]. Guyomard teaches using between 0.5 and 2.0 M (mol/l) LiPF_6 and a mixture preferably between 80 DMC:20 EC to 20 DMC:80 EC. EX1008, 7:27-37. Guyomard then teaches that Uemura's exemplary electrolyte as optimum for room temperature, but explains that it should be adjusted slightly to achieve better

performance at higher temperatures like those being used by Uemura:

An optimum composition for operation at room temperature and below is an approximately 1M LiPF_6 solution in a solvent mixture of about 33 DMC:67EC, while *a battery operating at higher temperatures in the range of 55°C optimally uses an electrolyte consisting essentially of an approximately 1.5 M LiPF_6 solution in a solvent combination of about 67 DMC:33 EC.*

EX1008, 7:37-8:8 (emphasis added). A PHOSITA would have seen that “the range of 55°C” of Guyomard was around the 60°C that Uemura tested batteries at. EX1009, ¶¶0081]; EX1002, ¶¶148-150. And while the ratios of EC:DMC were comparable, Uemura was using a more diluted LiPF_6 that Guyomard says was more appropriate for use at room temperature. EX1009, ¶¶0078]; EX1008, 7:37-8:2; EX1002, ¶¶150-151. Using the correct electrolyte compositions and mixtures, Guyomard explains that “[t]he ability of the electrolyte to extend the cycle life of the batteries was amply demonstrated by the remarkable fact that the cell capacities after 500 cycles was only about 10% than after 5 cycles.” EX1009, 9:5-9.

Even if Uemura did not disclose or suggest a secondary lithium ion battery that would maintain 80.72% of its capacity (or 80% (claims 13 & 17), 75.83% (claims 12 and 16), or 75% (claims 11 and 15)) after 400 cycles, the PHOSITA would have found it obvious to adjust the composition of Uemura’s electrolyte to increase the molar concentration of LiPF_6 to compensate for the higher temperature

used by Uemura because Guyomard explains that a 1.5 mol/l (i.e., 1.5M) should be used at temperatures in the range of 55°C—as opposed to the 1 mol/l being used by Uemura. EX1002, ¶¶150-151. By slightly adjusting Uemura’s electrolyte in this fashion using Guyomard’s teachings, a PHOSITA would have expected to further increase the cycling properties of the resulting battery and achieve results comparable to those achieved by Guyomard such as a net decrease in capacity of less than 10% over 495 cycles (after the initial 5 cycles). EX1002, ¶151.

A PHOSITA would have been motivated to make this slight adjustment to Uemura’s electrolyte because Guyomard explicitly tells the PHOSITA to make such an adjustment for the higher temperatures used by Uemura. EX1008, 8:2-6; EX1002, ¶150. Additionally, adjusting the amount of LiPF_6 used to maintain a highly cyclable lithium ion battery at higher temperatures was merely the use of Guyomard’s known technique of providing optimal electrolytes for use at high cutoff voltages and high temperatures to improve Uemura’s similar lithium ion batteries in the same way (e.g., to achieve good cycling properties). EX1008, 7:35-8:2, 9:5-9; EX1009, ¶¶[0064], [0081]; EX1002, ¶¶148-150. Given the level of detail provided in the prior art (as discussed above), the similarity of electrolyte chemistries used Uemura and Guyomard, and similar battery materials, a PHOSITA would have had a reasonable expectation of succeeding at maintaining at least 80.72% of capacity (or 80% (claims 13 & 17), 75.83% (claims 12 and 16), or 75% (claims 11 and 15)) after 400 cycles

of Uemura's batteries as modified to use Guyomard's high temperature electrolyte. EX1002, ¶151.

E. Grounds 5 and 6: Abe Anticipates Claims 1-8 (Ground 5) and Abe Renders Claims 1-8 Obvious (Ground 6).

Abe is prior art under pre-AIA 35 U.S.C. §102(b) because it was published on July 21, 1998. EX1005, cover. Abe discloses each limitation of claims 1 and 5 under the claim constructions applied in this Petition, as shown below. Moreover, by disclosing a range of charge cutoff voltages and capacity ratios that overlaps with the claimed range, Abe renders the claims *prima facie* obvious. *Applied Materials*, 692 F.3d at 1295; *In re Peterson*, 315 F.3d at 1329. Abe is analogous prior art to the '641 patent because it is in the field of secondary lithium ion batteries and is reasonably pertinent to the problem being solved in the '641 patent including improving the performance and cyclability of batteries. EX1005, ¶¶[0014], [0017] ("to provide a long-life non-aqueous electrolyte-based secondary battery by suppressing the decomposition reaction of the solvent" and a "high capacity"); EX1002, ¶¶92-95.

1. Claims 1 & 5

- a. [1P]: A method for improving the capacity, average operating voltage and specific energy of a secondary lithium ion cell or battery, characterized in that; [5P] A secondary lithium ion cell or battery,

Abe discloses a method for improving the capacity, average operating voltage, and specific energy of a secondary lithium ion cell, or battery. EX1002, ¶¶156-159.

Abe describes batteries that “exhibit high capacity,” EX1005, ¶¶[0011], [0017], and have “high energy density and excellent cycle characteristics,” *id.*, ¶[0008]. The batteries can have a cutoff voltage of, for example, 4.3V, thus showing that the average operating voltage was greater than the batteries discussed by the ’641 patent (i.e., those that had only 4.2V charge cutoff voltages). *Id.*, ¶[0078]; EX1001, 1:46-49, 2:38-41. Moreover, the claimed ratio is disclosed by Abe’s “design ratio” of 1.1 in the case of the example using a LiMn_2O_4 positive electrode active material and Abe’s more general disclosure of a ratio between 1:1 and 1:1.6 as discussed below. *Infra* §III.E.1.c. According to the ’641 patent, this enables the properties recited in claim 1 to be achieved with a cutoff voltage above 4.2V. EX1001, 3:7-16. In fact, all other aspects of the disclosed batteries are deemed to be conventional by the ’641 patent and the alleged method can be used in a secondary battery “according to the method of the prior art.” EX1001, 7:51-56, 8:11-19 (any lithium-containing compound can be used), 8:43-48 (any “separator well known in the art” can be used), 8:56-58 (any “carbonaceous or non-carbonaceous substance capable of doping and dedoping lithium” can be used as a negative electrode material); 9:8-10 (any “non-aqueous electrolytes and shells of the type well known in the art can be used in the present invention”). Thus, the claimed ratio and charge cutoff voltage results in the recited properties even if they are limiting. EX1002, ¶¶158-159.

- b. [1A]: “the charge cut-off voltage of the secondary lithium ion cell or battery is greater than 4.2 V but less than 5.8 V;” [5A] “the secondary lithium ion cell or battery has a charge cut-off voltage of greater than 4.2 V but less than 5.8 V”

Abe discloses the charge cut-off voltage of the secondary lithium-ion cell or battery is greater than 4.2V but less than 5.8V because Abe teaches that, for batteries using LiMn_2O_4 as the positive electrode material, “the voltage is set to a range in which no electrolyte deposition occurs, and no irreversible structural breakdown of the positive electrode active material occurs” and that this “is 4.2-4.3 V ” EX1005, ¶[0078] (“For example, LiMn_2O_4 is 4.2–4.3 V...”). Abe’s disclosure of 4.2-4.3V discloses and suggests a battery with a cutoff voltage of greater than 4.2V but less 5.8V as recited in claims 1 and 5. EX1002, ¶¶160-161.

Additionally, by disclosing a range of charge cutoff voltages that includes voltages over 4.2V, Abe’s disclosure of cutoff voltages for batteries or cells using LiMn_2O_4 as the active positive electrode material of between “4.2-4.3 V” also renders the claimed “cut-off voltage of greater than 4.2 V but less than 5.8 V” *prima facie* obvious. EX1005, ¶[0078]; *Applied Materials*, 692 F.3d at 1295; *In re Peterson*, 315 F.3d at 1329; *see also UCB, Inc. v. Actavis Labs UT, Inc.*, 65 F.4th 679, 689-690 (Fed. Cir. 2023) (“A presumption of obviousness applies ‘[w]here a claimed range overlaps with a range disclosed in the prior art.’ *Ormco Corp. v. Align Tech., Inc.*, 463 F.3d 1299, 1311 (Fed. Cir. 2006).”).

- c. [1B] “a ratio of positive electrode material to negative electrode material of the secondary lithium ion cell or battery is from 1:1.0 to 1:2.5 as calculated by a specific capacity with a charge voltage limited to 4.2 V”; [5B] “a ratio of positive electrode material to negative electrode material of the secondary lithium ion cell or battery is from 1:1.0 to 1:2.5, as calculated by a theoretic capacity with a charge cut-off voltage set at 4.2 V.”

Abe discloses that the claimed ratio of positive electrode material to negative electrode material of the secondary lithium ion cell or battery is from 1:1.0 to 1:2.5 as calculated by a capacity with a charge voltage limited to 4.2 V as construed above. EX1002, ¶¶162-168.

Abe teaches that “the design capacity of the negative electrode is adjusted so that the design capacity of the negative electrode is greater than the design capacity of the cathode.” EX1005, ¶[0078]. The “design capacity” is a capacity calculated as a product of the capacity per unit mass times the mass in the same unit: “[t]he design capacity is determined . . . from the initial charge capacity per unit weight of the active material in a predetermined charging voltage range and the amount of active material coated on the current collector.” *Id.*; EX1002, ¶¶164-165. The capacity for the example using LiMn_2O_4 as the cathode material (Example 2, *see* EX1005, ¶[0102]), is determined at a voltage, for example, between 4.2V and 4.3V. *Id.*, ¶[0078]. As examples in which the “design capacity of the negative electrode is greater than the design capacity of the cathode,” Abe teaches an example with a ratio of 1.1, or, as written in the patent, 1:1.1. *Id.*, ¶[0103] (“The (negative electrode

design capacity/positive electrode design capacity) of this non-aqueous electrolyte secondary battery were adjusted to 1.1 and the value is shown in Table 1” (*see also* Table 1)); EX1002, ¶163. This design ratio of, for example, 1.1 reflects the ratio calculated as the product of the capacity of the cathode active material per mass unit (“capacity per unit weight”) and the amount of the cathode active material (“amount of active material coated on the current collector”) in the same mass unit divided by the product of the capacity of the anode active material per mass unit and the amount of the anode active material in the same mass unit as explained above and in Abe’s paragraph [0078]. EX1002, ¶¶164-165; EX1005, ¶[0078] (explaining how the design capacity is “determined” using “initial charge capacity per unit weight of the active material in a predetermined charging voltage range” and “the amount of active material coated on the current collector” and how the “charging capacity is the amount of charge until a predetermined voltage is reached”).

Abe also discloses a range of design capacity ratios that anticipate the claim. For example, Abe explains that the negative electrode is a “graphitized vapor-phase-grown carbon fiber” and the positive electrode includes a “lithium-containing composite oxide” and that the “design capacity of the negative electrode” is “greater than that of the positive electrode.” EX1005, ¶[0018]. Specifically, the “design capacity” is “more than 1 and less than or equal to 1.6 for the design capacity of the positive electrode,” which in the terms used by the ’641 patent is a ratio of 1:1 to

1:1.6. *Id.*; EX1002, ¶166. This ratio of design capacities is determined as reflected in the claim construction applied in this Petition for the reasons discussed in the preceding paragraph because both the disclosure of the specific example (i.e., 1:1.1) and the disclosure of the range of ratios of design capacity (i.e., 1:1 to 1:1.6) are “design capacity” ratios calculated using the method discussed above. EX1005, ¶¶[0018], [0078]; EX1002, ¶¶164-165. By disclosing a range of ratios that lies within the claimed range of ratios, Abe discloses this limitation for this additional reason.

When Abe’s charge cutoff voltage is greater than 4.2V—e.g., the 4.3V disclosed by Abe for its LiMn_2O_4 cell or battery—a PHOSITA would have understood that the “design capacity” was designed for a cutoff voltage of 4.3V because that is the cutoff voltage the battery is designed for. EX1002, ¶166. As explained in more detail in connection with the Uemura grounds, *supra* §III.C.1.c, when the capacity ratio is determined with a charge cutoff voltage of 4.3V, the ratio will increase slightly when calculated with a charge cutoff voltage of 4.2V because less lithium will be extracted from the positive electrode at the lower voltage, thus resulting in more excess capacity at the negative electrode. EX1002, ¶¶120-123, 167; EX1015, p.939. But, the ratio will still remain less than 1:2.5 because the amount of lithium extracted from LiMn_2O_4 only modestly increases above 4 or 4.1V. *Supra* §III.B.1.c; EX1002, ¶167. Therefore, Abe discloses these limitations by

teaching batteries with charge cutoff voltages of 4.3V and design capacity ratios of 1.1 (i.e., 1:1.1) and a range of design capacity ratios of 1 to 1.6 (i.e., 1:1 to 1:1.6).

In the alternative, insofar as Abe's design capacity is determined at 4.2V, Abe's design capacity ratios still disclose the ratio limitation because the ratio is actually determined at 4.2V. EX1002, ¶166; EX1005, ¶[0078]. Either way, Abe conveys the claimed ratio to the PHOSITA. EX1002, ¶¶164-168.

Additionally, Abe discloses a range of ratios that render claim 1 *prima facie* obvious. Specifically, Abe explains that “the design capacity of the negative electrode is a non-aqueous electrolyte-based secondary battery having a design capacity greater than that of the positive electrode” and further that the “design capacity” is “more than 1 and less than or equal to 1.6 of the design capacity of the electrode” EX1005, ¶[0018]. This teaches a range that includes a majority of the range claimed by the '641 patent and thus, at the very least, renders it *prima facie* obvious under *Applied Materials* and *Peterson, supra*. The ratio in Abe is calculated at least at a charge cutoff voltage of 4.2V or 4.3V, and for the reasons explained above, even if it is calculated at 4.3V, Abe discloses and renders obvious the claimed range obvious.

2. Claims 2-3 and 6-7

These claims recite narrower ranges for the claimed charge cutoff voltage: (1) “from 4.3V to 5.2V” for claims 2 and 6, and (2) “from 4.3V to 4.8V” for claims 3

and 7. EX1001, 16:62-67, 17:12-20. Abe discloses a charge cutoff voltage for cells that use LiMn_2O_4 as the positive electrode material that includes voltages including 4.3V this both anticipates claims 2-3 and 6-7 and renders them *prima facie* obvious. *Supra* §III.E.1.b (citing evidence and case law). Thus, claims 2-3 and 6-7 are anticipated by, and obvious over, Abe. EX1002, ¶169.

3. *Claims 4 and 8*

Claims 4 and 8 narrow the claimed ranges of ratios of positive electrode capacity to negative electrode capacity to be from 1:1.15 to 1:2.5. EX1001, 17:1-4, 20-23. As explained above, Abe teaches that the design capacity ratio should be between 1:1 and 1:1.6. *Supra* §III.E.1.c; EX1005, ¶[0018]. This discloses and renders obvious the claimed range of ratios of positive electrode material to negative electrode material as recited in claims 4 and 8 because a ratio of, for example, 1:1.6 is within the claimed range and given the modest change in lithium extraction at voltages over 4 or 4.1V for LiMn_2O_4 , the PHOSITA would have recognized that the ratio would remain less than 1:2.5 regardless of whether the ratio is calculated at 4.2V or 4.3V. EX1002, ¶170; EX1015, p.983; *supra* §III.C.1.c (explaining reasons for this conclusion and citing evidence that is equally applicable to this Ground).

F. Ground 7: Obviousness of Claims 2-4, 6-8, and 11-18 Over Abe In View of Guyomard

Guyomard is analogous prior art to the '641 patent. *Supra* §III.D. Abe is also analogous prior art to the '641 patent. *Supra* §III.E.

Abe teaches secondary lithium ion cells that use LiMn_2O_4 as the positive electrode active material. EX1005, ¶¶[0006], [0018]-[0019], [0078], [0102]. Abe discloses that a combination of ethylene carbonate (EC) and dimethyl carbonate (DMC) in combination with a lithium salt such as LiPF_6 alone or with, for example, LiBF_4 , can be used as the electrolyte. EX1005, ¶¶[0071], [0074].

Guyomard explains that using LiPF_6 and a “mixture of dimethylcarbonate (DMC) and ethylene carbonate (EC) within the weight percent ratio range from 95 DMC: 5 EC to 20 DMC:80 EC” in combination with positive electrodes including LiMn_2O_4 as the active material can provide a battery with a cutoff voltage of, for example, 4.5V and that exhibits high cyclability (*e.g.*, 495 cycles with only 10% loss in capacity). EX1008, 7:27-35, 8:32-37, 9:5-9.

1. Claims 2-3 and 6-7

Abe discloses that the battery using LiMn_2O_4 as a positive electrode material can be charged using a cutoff voltage of 4.2V-4.3V. EX1005, ¶[0078]. While Abe discloses an endpoint of the claim range (*i.e.*, 4.3V), it does not describe a cut-off voltage of over 4.3V. Charging Abe’s cell to a cutoff voltage within the ranges claimed—*i.e.*, from 4.3V to 5.2V (claims 2 and 6) and from 4.3 to 4.8 V (claims 3 and 7)—would have also been obvious based on the teachings of Guyomard. EX1002, ¶¶172, 174, 186-187, 189.

Specifically, Guyomard teaches optimizing the electrolytes used in secondary

lithium ion cells that use LiMn_2O_4 as the active positive electrode material. The specific electrolyte materials described had “high ionic conductivity” and resulted in “no significant loss of cell capacity” thus “verifying the high voltage stability of the electrolyte.” EX1008, 8:37-9:5. The electrolytes had “outstanding oxidation resistant characteristics” *Id.*, 8:10-12. Thus, Guyomard teaches charging a LiMn_2O_4 /carbon cell to a charge cutoff voltage of, for example, 4.5V thereby teaching cutoff voltages within the claimed ranges. EX1002, ¶¶172, 174. The obviousness of using Guyomard’s electrolyte and cutoff voltages to achieve high cyclability in connection with Abe’s lithium ion battery and design capacity ratio, including motivation to combine teachings of the references is described below. *Infra* §III.F.4.

2. *Claims 4 and 8*

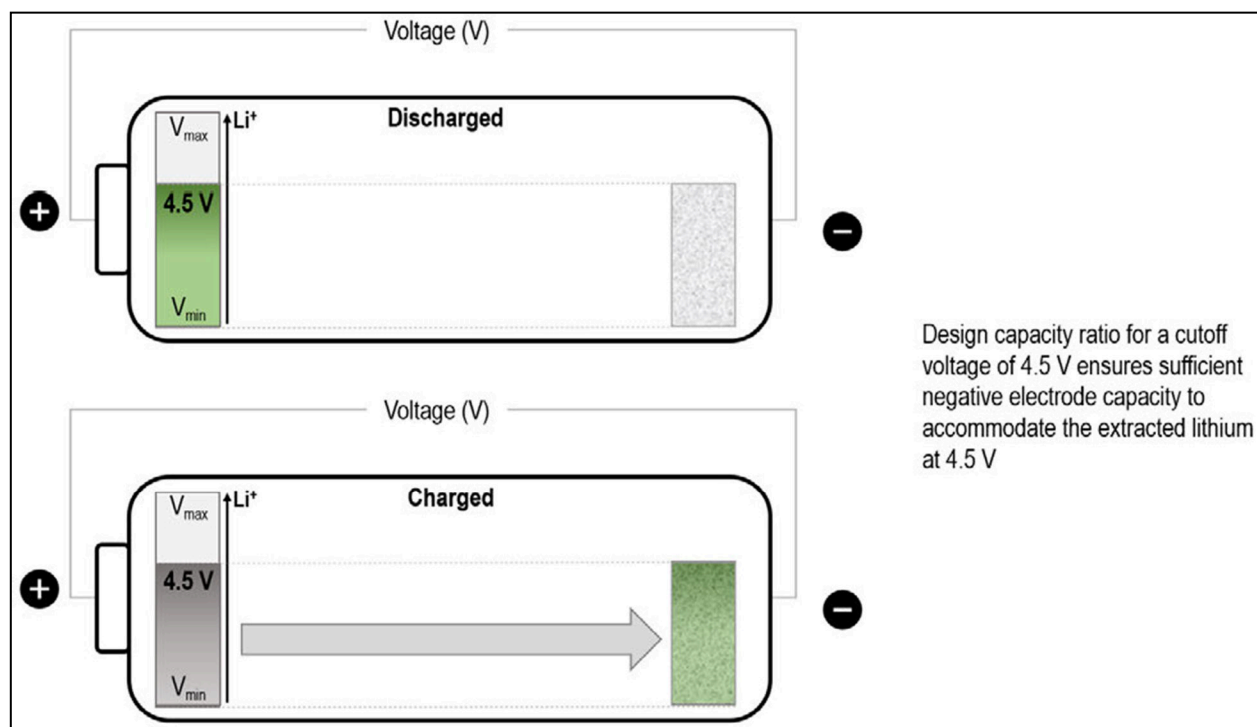
Abe teaches a range of ratios from 1:1 to 1:1.6 as explained above and this discloses and renders obvious the ratios recited in claims 4 and 8. *Supra* § III.E.1.c. Additionally, the combination of Abe in view of Guyomard further renders obvious a claimed ratio of between 1:1.15 and 1:2.5. As explained above and in further detail below, *supra* §III.F.1, *infra* §III.F.4, Abe in view of Guyomard teach a secondary lithium ion battery with a charge cutoff voltage of, for example, 4.5V. Abe further teaches that “the design capacity of the negative electrode is adjusted so that the design capacity of the negative electrode is greater than the design capacity of the

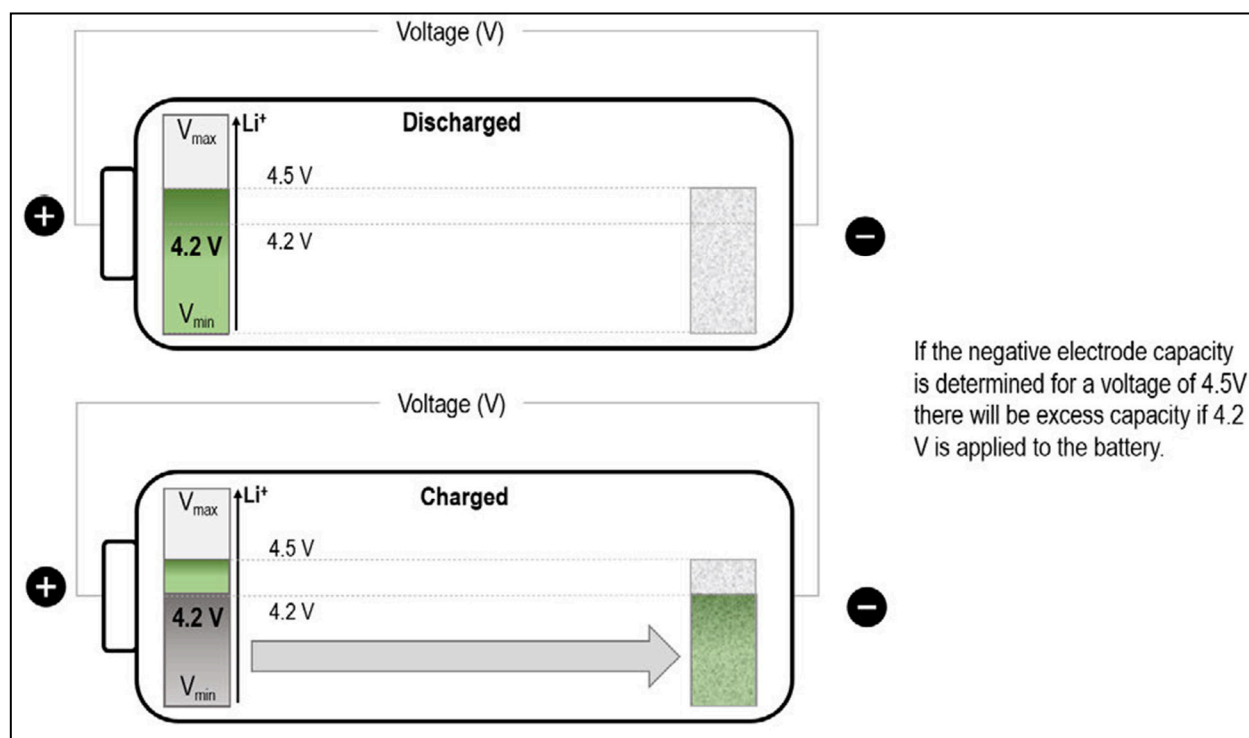
cathode.” EX1005, ¶[0078]. The design capacity is determined “in a predetermined charging voltage range.” *Id.*

Because the combined teachings of Abe and Guyomard would have led the PHOSITA to a battery with a cutoff voltage of, for example, 4.5V, *see* EX1002, ¶¶172-174, 186-187, 189, the design capacity would have been determined at a charge cutoff voltage of 4.5V in light of the combined teachings of the references and particularly Abe’s teaching that design capacity is determined “in a predetermined voltage range” such as 4.2V to 4.3V (according to Abe’s examples). EX1002, ¶176; EX1005, ¶[0078]. Based on Abe’s teachings, the PHOSITA would have ensured that “the design capacity of the negative electrode is adjusted so that the design capacity of the negative electrode is greater than the design capacity of the cathode” at, for example, 4.5V. EX1005, ¶[0078]; EX1002, ¶¶22-23, 176. This was a known technique to avoid extracting lithium from the positive electrode material and having no place for the lithium to go in the rocking chair cell’s negative electrode material structure thus leading to plating and the formation of dendrites. EX1002, ¶¶17-18, 21-23, 94, 176.

Following Abe’s instructions at Guyomard’s exemplary charge cutoff voltage of 4.5V would have led a PHOSITA to a cell with more negative electrode capacity than positive electrode capacity when calculated at a charge cutoff voltage of 4.5V, which would have also led to more negative electrode capacity than positive

electrode capacity when calculated at a charge cutoff voltage of 4.2V for the same reasons explained above in connection with the discussion of Uemura and in the section discussing capacity ratios, above. *Supra* §§III.B, III.C.1.c. Based on Abe's disclosed range of capacity ratios of 1:1 to 1:1.6 (including an example of 1.1), it would have been obvious to make that ratio higher (when calculated at a charge cutoff voltage of 4.2V) to accommodate a charge cutoff voltage of 4.5V to ensure there was more design capacity at the negative electrode thus avoiding plating and dendrite formation as shown in the illustrations below. EX1002, ¶¶17-18, 21-23, 94, 176.





Designing Abe's battery for a cutoff voltage of 4.5V would have led to a ratio in excess of 1:1.15 as calculated at a charge cutoff voltage of 4.2V because the resulting design would have added more capacity at the negative electrode to accommodate the increased cutoff voltage taught by Guyomard. EX1002, ¶176. Moreover, because it was known and desirable to keep the battery as small as reasonably possible, having too much excess negative electrode material (and thus excess negative electrode capacity) would have been unnecessary thus providing an upper practical limit on the amount of negative electrode material capacity such that it would have been obvious to make it so that its capacity was less than 2.5 times greater than the positive electrode capacity. EX1002, ¶¶177 (citing EX1005, ¶¶[0018], [0103]; EX1009, ¶[0033]), 186-187.

3. *Claims 11-18: Capacities After 400 Cycles*

Claims 11-18 recite percentages of remaining capacity after 400 cycles. The highest remaining capacity after 400 cycles is found in claims 14 and 18—i.e., 80.72%. A showing that a battery or cell with 80.72% remaining capacity after 400 cycles—along with the remainder of the limitations found in the independent claims—was in the prior art, or was obvious from it, and demonstrates that the remainder of the claimed capacities (i.e., 75% (claims 11 & 15), 75.83% (claims 12 and 16), and 80% (claims 13 and 17)) are also anticipated or obvious.

While Abe explains that a goal of the invention is to “provide a long life” battery that has “excellent cycle characteristics,” EX1005, ¶¶[0014], [0017], [0121], Abe does not publish results of cycling experiments done on these batteries past 50 cycles. *Id.*, ¶[0098] (Table 3). Nevertheless the claimed remaining capacity after 400 cycles would have been obvious based on Abe in view of Guyomard. EX1002, ¶¶179-181, 183-189.

Guyomard uses electrolytes made from the same lithium compounds and solvents as some of those disclosed by Abe and explains that they will not decompose under higher voltages such as 4.5V and 4.9V, and thus allow a cell to have high cyclability at high voltage. In fact, between charge cycles 5 and 500, Guyomard explains that “[t]he ability of the electrolyte to extend the cycle life of the batteries was amply demonstrated by the remarkable fact that the cell capacities after

500 cycles was only about 10% less than after 5 cycles.” EX1008, 9:5-9. This discloses the claimed percentages of remaining capacities after 400 cycles as recited in each of claims 11-18 because 90% (the remaining capacity after a 10% capacity loss) is over the narrowest claimed range of more than 80.72%, thus meeting the broader ranges recited in the remainder of these claims too. EX1002, ¶¶179-181. It would have been obvious to obtain the claimed percentages of remaining capacity after 400 cycles using Abe’s batteries with Guyomard’s electrolytes as explained in further detail below. *Infra* §III.F.4.

4. *Obviousness of Claims 2-4, 6-8, and 11-18; Motivation to Combine Abe and Guyomard*

The PHOSITA would have found it obvious to use Guyomard’s electrolyte compositions in Abe’s battery designs and apply Guyomard’s increased charge cutoff voltages to Abe, thus achieving the claimed cyclability properties for several reasons. EX1002, ¶¶182-190. First, the combined teachings of the references provide an express motivation to make the claimed combination. EX1002, ¶186. Specifically, Abe teaches one useful positive electrode material is LiMn_2O_4 . EX1005, ¶¶[0078], [0102]. Abe explains that “the voltage” for these batteries “is set to a range in which no electrolyte decomposition occurs, and no irreversible structural breakdown of the positive electrode active material occurs.” *Id.*, ¶[0078]. For LiMn_2O_4 positive electrodes in Abe’s exemplary batteries and cells the cutoff voltage “is 4.2-4.3 V” *Id.* This disclosure reflects a general understanding of

those skilled in the art about batteries made using LiMn_2O_4 active materials and is taught in the background of Guyomard too. EX1002, ¶186. Guyomard explains that using “a strongly oxidizing intercalation material as a positive electrode” leads to concerns about “the risk of electrolyte decomposition from oxidation at the higher operating voltages, i.e. greater than about 4 V.” EX1008, 2:18-22. When cycling a $\text{Li}_{1+n}\text{Mn}_2\text{O}_4$ / carbon cell using conventional electrolytes at “even slightly greater than 4.3 V, electrolyte oxidation occurs,” which can “jeopardize the capacity, cycle life, and capacity of the battery cell.” *Id.*, 3:9-13. But Guyomard found a solution to this problem.

Guyomard describes “a class of electrolyte compositions that is exceptionally useful for minimizing electrolyte decomposition in secondary batteries comprising strongly oxidizing positive electrode materials”—like those in Abe. EX1008, 3:34-37; EX1005, ¶[0078]; EX1002, ¶185. Guyomard’s particular electrolyte compositions have a range “of effective stability” that “extends up to about 5.0 V at 55°C, as well as at room temperature (about 25°C).” EX1008, 4:7-10. Guyomard discloses optimal amounts of electrolyte materials and accommodates for different ambient temperatures. EX1008, 7:26-8:9; EX1002, ¶185. And, the electrolytes are encompassed by the broad disclosure of electrolyte materials in Abe. EX1005, ¶¶[0071]-[0074] (referring to LiPF_6 , LiBF_4 , and mixtures including DMC and EC); EX1002, ¶185. Therefore, Guyomard read together with Abe provides a PHOSITA

with express motivation to use the electrolyte compositions disclosed by Guyomard in the cells of Abe to result in (1) higher capacity and energy density in the battery, (2) good cyclability performance (e.g., less than 10% decrease after the first 5 cycles through the 500th cycle), and (3) low oxidation of the electrolyte at higher voltages as taught by Guyomard. EX1002, ¶186.

Second, using Guyomard's electrolyte composition in Abe's battery would have merely used a known technique—applying Guyomard's specific electrolyte compositions in a battery that used carbon and LiMn_2O_4 as electrode active materials to allow higher voltages and reduce decomposition of the electrolytes, EX1008, 7:27-8:9, 8:13-18, 8:32-9:9—to improve similar devices (e.g., Abe's battery using a LiMn_2O_4 and carbon/graphite negative electrode), EX1005, ¶¶[0078], [0087], [0102], in the same way (i.e., allowing higher charge cutoff voltages while maintaining excellent cyclability and low oxidation of the electrolyte). EX1002, ¶187.

The PHOSITA would have reasonably expected to succeed in making this combination for several reasons. EX1002, ¶188. First, both Abe and Guyomard describe batteries with LiMn_2O_4 positive electrodes and carbon/graphite negative electrodes—thus disclosing the same types of active materials. EX1005, ¶¶[0078], [0087], [0102]; EX1008, 7:27-8:9, 8:13-18, 8:32-9:9. Second, the electrolyte materials that Guyomard optimized are included among the materials disclosed as

useful electrolytes in Abe. EX1005, ¶¶[0072], [0074]; EX1008, 7:27-8:9 (both discussing the use of LiPF_6 (possibly with LiBF_4) and EC and DMC). Thus, a PHOSITA would have seen that both the active materials and electrolytes were very similar and compatible and would have seen that Guyomard describes an optimal concentration of lithium salts and solvent ratios to improve the cyclability of cells using LiMn_2O_4 at high voltages including 4.5V and 4.8V. EX1002, ¶185, 187-188. Given the interrelated teachings and details provided, following the teachings of the references to make the combination would have been routine and the PHOSITA would have reasonably expected to achieve a well-functioning battery that was capable of being charged to high voltages (e.g., 4.5V) and exhibit good cyclability properties falling within the scope of the claims. EX1002, ¶¶188-189.

Making this combination would have led the PHOSITA to: (1) the cutoff voltages recited in claims 2-3 and 6-7, (2) the ratio of positive to negative electrode capacities recited in claims 4 and 8, and (3) the remaining capacities after 400 cycles recited in claims 11-18 as discussed above. *Supra* §§III.F.1-III.F.3.

G. Grounds 8 and 9: Obviousness Of Claim 9 Over Uemura In View of Iwaizono (Ground 8) And Obviousness of Claims 9-10 Over Uemura in view of Guyomard and Iwaizono (Ground 9).

Iwaizono was filed as a PCT application on May 17, 2000 and has a § 371(c)(1), (2), (4) date of January 11, 2001, which is treated as its effective filing date. *See* MPEP §2136.I(C)(3)(a); 35 U.S.C. §102(e) (pre-AIPA). Iwaizono is thus

prior art under 35 U.S.C. §102(e) (1998).

The '641 patent teaches that overcharge protection voltages and overcharge release voltages can be provided via “the well known structure” of a protecting circuit. EX1001, 9:29-36. The particular circuit used is not “specifically limited.” *Id.* Further, according to the '641 patent known protection circuits had an overcharge release voltage of 4.15V. *Id.*, 1:51-55. Because the charge cutoff voltage is increased above 4.2V, the patent explains that both the overcharge protection voltage and the overcharge release voltage are also increased. *Id.*, 9:29-45. Increasing the overcharge protection and overcharge protection release voltages to accommodate cutoff voltages of greater than 4.2V would have been obvious as explained below based on Uemura with Iwaizono alone or with Guyomard. EX1002, ¶¶191-206.

Iwaizono describes an example of a known protecting circuit. EX1007, Abstract. Iwaizono discloses “[a] protective circuit for protecting a rechargeable [*i.e.*, secondary] battery from battery breakdown caused by prolonged overcharging, and a protection element incorporated in this circuit.” EX1007, Abstract; *see also id.*, 1:60-2:4, 2:55-59, FIG. 1. Iwaizono teaches “[a] rechargeable battery 3, comprising a lithium ion rechargeable battery [that] is equipped with a main protective circuit A that protects the battery against overcharging, overdischarging, and over-current, and a sub-protective circuit B that redundantly protects the rechargeable battery 3 against overcharging in conjunction with the main protective

circuit A.” *Id.*, 9:33-39. Iwaizono is thus analogous to the ’641 patent because it is in the same field and solves the same problem as the protective circuit for a secondary battery discussed by the ’641 patent. EX1002, ¶¶100-103.

1. Ground 8: Claim 9 Would Have Been Obvious Over Uemura In View of Iwaizono.

Claim 9 would have been obvious over Uemura in view of Iwaizono. As explained in connection with Ground 1, Uemura teaches a charge cutoff voltage of 4.3V. EX1009, ¶[0081]. Iwaizono’s examples use voltage settings appropriate for a cutoff voltage of 4.2V, but Iwaizono also recognizes that the settings can be adjusted to appropriate voltages. *See, e.g.*, EX1007, 15:35-40 (“[I]f the voltage at which charging has been completed is set on the charger side to 4.20 V, then the charge-prohibiting voltage for the main control means 1 is set to 4.30 V, and the detected set voltage in a prolonged overcharging state for the sub-control means 40 is set to 4.45 V.”), 9:57-60 (referring to “a predetermined first charge-prohibiting voltage” which is “deemed an overcharging state”), 13:13-18 (same). The PHOSITA would have appreciated that Uemura’s cutoff voltage would have necessitated a higher overcharge protection voltage and a higher overcharge protection release voltage than that used for batteries charged at a cutoff voltage of 4.2V because of the higher cutoff voltage—thus increasing the voltage that would be “deemed an overcharging state.” EX1002, ¶¶195, 198-199; EX1007, 9:57-60, 13:13-18.

Iwaizono teaches a first overcharging protection voltage of greater than

4.35V. Specifically, Iwaizono’s main protective circuit A prevents overcharging past “a first charge-prohibiting voltage (such as 4.30 V)” and a sub-protective circuit B prevents overcharging past “a second charge-prohibiting voltage (*such as 4.45 V*) that is higher than the first charge-prohibiting voltage,” thus providing redundancy. *Id.*,.” EX1007, 9:55-65 (emphasis added), 10:32-37. This second charge-prohibiting voltage is a first overcharging protection voltage as claimed. EX1002, ¶195.

Additionally, in the context of the combined teachings of Uemura and Iwaizono, because Uemura’s cutoff voltage is 4.3 V, and Iwaizono’s values are set for an exemplary cutoff voltage of 4.2 V, a PHOSITA would have also found it obvious to have a first charge cutoff voltage of 4.4 V and a second charge cutoff voltage of 4.55V based on the teaching of Iwaizono that the first overcharging protection voltage is set at 0.1V higher than the cutoff voltage and the second overcharging protection voltage is set at 0.25V higher than the cutoff voltage. EX1002, ¶199. Thus, based on the combined teachings of Uemura and Iwaizono, the claimed overcharging protection voltage of greater than 4.35V would have been an obvious way to implement Iwaizono’s protection circuitry in Uemura’s batteries. EX1002, ¶199. Applying Iwaizono’s battery protection techniques to Uemura’s battery would have used a known technique to improve Iwaizono’s battery (*i.e.*, Iwaizono’s known protection circuit adjusted to accommodate the appropriate overcharging conditions) to improve Uemura’s similar battery in the same way (*i.e.*,

to protect the battery from overcharging conditions using a known protection circuit in the battery). EX1002, ¶201.

With respect to the claimed overcharging protection release voltage over greater than 4.15V, Iwaizono teaches that using either circuit A or circuit B, the charging will be turned off “until a first charge-permitting voltage that is lower than the first charge-prohibiting voltage is detected.” *Id.*, 10:1-3; 10:63-65. This lower “first charge-permitting voltage” would have been understood to be the “overcharging protection release” because it releases the overcharging protection for the battery and allows charging to resume, *i.e.*, “once the overcharging state goes away, the circuit can be reset to a normal state.” *Id.*, 18:3-7; EX1002, ¶196.

The PHOSITA would have known and found it obvious that the “first charge-permitting voltage” would have been chosen to be greater than 4.15V because (1) as the ’641 patent admits it was known that commercial Li-ion batteries with a cutoff voltage of 4.2V had an “overcharge release voltage of its protection circuit [that] is controlled below 4.15 V...” EX1001, 1:49-55; EX1002, ¶196, and (2) those skilled in the art knew that overcharge protection voltage circuits typically had a difference between the overcharge protection voltage and an overcharge protection release voltage of between 0.2V and 0.3V as indicated by a datasheet from Seiko Instruments. EX1002, ¶197 (citing Seiko datasheet, EX1010, at p.2 (“The difference between the excess charge detection voltage and the excess charge release voltage

can be selected in the range of 0.2 V to 0.3 V”)).

The PHOSITA therefore would have found it obvious to allow for charging to resume after overvoltage protection was employed to limit charging, at a voltage slightly below the cut-off voltage, e.g., at 4.25V, in the case of Uemura’s 4.3V charge cutoff voltage to accommodate for Uemura’s charge cutoff voltage of 4.3V. EX1002, ¶197-199. This would have merely used a known technique of employing a “first charge-permitting voltage” as in Iwaizono to accommodate for Uemura’s higher charge cutoff voltage. EX1002, ¶201. And, the PHOSITA would have been led to use Iwaizono in connection with Uemura for its conventional purpose: to protect the battery from potentially damaging or dangerous overvoltage states using a known technique in a conventional manner. EX1002, ¶¶27-29, 192, 201. Thus, using Iwaizono’s overcharge protection circuit adjusted to Uemura’s cutoff voltage would have merely used a known technique (i.e., applying an overcharge protection circuit as in Iwaizono) to improve Uemura’s similar lithium ion battery in the same way. EX1002, ¶201. Adapting Iwaizono to Uemura’s higher voltage application would have been within the grasp of the PHOSITA because, as Mr. Juzkow explains, it “would have required only routine skill associated with tailoring the voltage requirements to meet Uemura’s requirements” and such is suggested in Iwaizono’s disclosure of “predetermined voltages” and what is “deemed” to be an overcharging state. EX1002, ¶201 (citing EX1007, 9:57-63, 13:13-17, 14:41-46).

Moreover, the PHOSITA would have reasonably expected to succeed in incorporating the Iwaizono overcharge protection circuit adjusted to accommodate for Uemura's charge cutoff voltage because Iwaizono includes detailed teachings of how to configure the overcharge protection circuit, including detailed circuit diagrams, and indicates that the voltages are exemplary showing that the ability to adjust voltages are within the level of skill in the art. EX1007, 9:57-61, 11:4-7, 13:13-17, 14:41-46; EX1002, ¶202. It was the "normal practice to provide a battery protection device" such as that described by Iwaizono. EX1007, 1:13-18. Indeed, the '641 patent itself shows that any conventional circuit can be used by merely modifying the charge cutoff voltage—leaving it to the ordinarily skilled artisan to determine how to do this. EX1001, 9:24-36 ("the well known structure can be used, provided that" the voltages are adjusted).

2. *Ground 9: Obviousness of Claims 9-10 Over Uemura In View of Guyomard and Iwaizono.*

The combination of Uemura in view of Guyomard as well as the reasons a PHOSITA would have been motivated to combine Uemura's secondary lithium ion cell with Guyomard's electrolyte is discussed above in connection with the discussion of Ground 4. *Supra* §III.D. The use of Guyomard's electrolytes would have been expected to allow the charging of Uemura's batteries or cells using lithium manganese complex oxide materials as the positive electrode active material to a charge cutoff voltage of 4.5V or even 4.9V without degradation of the batteries or

cells as taught by Guyomard. *See* EX1008, 8:32-9:9 (discussing use of “charging cut-off voltages of 4.9 V and 4.5 V” depending on temperature and the fact that “there was no significant loss of cell capacity, verifying the high voltage stability of the electrolyte”). And, applying these higher charge cutoff voltages which would have been enabled by using Guyomard’s electrolytes—would have resulted in increasing capacity of the battery because the higher voltages caused intercalation of more lithium in the battery, as admitted by Patent Owner. EX1002, ¶¶17 (citing EX1019, ¶[0005]); *see also id.*, ¶¶22-26; EX1032, p.14:12-20.

Using a higher charge cutoff voltage would have led a PHOSITA to further increase the overcharge protection voltage and overcharge protection release voltage to bracket the cutoff voltage as taught by Iwaizono (as explained above). *Supra* §III.G. Thus, for example, using a charge cutoff voltage of 4.5V based on the combined teachings of Uemura and Guyomard would have led a PHOSITA to select an overcharge protection voltage above 4.35V and even above 4.45V as recited in claims 9 and 10. EX1002, ¶¶204-206. Otherwise, the charging would be terminated at a voltage lower than the cutoff voltage, which would have prevented the battery or cell to be charged to the cutoff voltage. EX1002, ¶205. Moreover, the overcharge protection release voltage would be greater than 4.15V and greater than 4.25V as recited in claims 9 and 10—and likely at 4.35V or 4.45V based on the knowledge that it was typical to have a difference of between 0.2V and 0.3V between the

protection release voltage and the overcharge protection voltage. EX1002, ¶206; *see also id.*, ¶197 (citing and reproducing EX1010, p.1). This is because the PHOSITA would have understood to use an overcharge protection release voltage of 4.45V or 4.4V based on the understanding that the release voltage should be slightly less than the cutoff voltage. EX1002, ¶206; *supra* §III.G.1. This principle is taught by Iwaizono through its teaching that the overcharge protection voltage should be set above the cutoff voltage but below a voltage that causes “the battery temperature begin[] to rise sharply,” Ex. 1007, 10:66-11:13, and that the first charge-permitting voltage (overcharging protection release voltage) “is lower than” the overcharge protection voltage. *Id.*, 10:1-3; 10:63-65.

Applying the teachings of Iwaizono as modified to accommodate the charge cutoff voltage of the combined Uemura/Guyomard lithium ion battery (e.g., 4.5V or 4.9V) would have been obvious and would have caused the resulting overcharge protection circuit to fall within the claimed ranges for the same reasons explained with respect to Ground 8 (while noting that the voltages would have been higher based on Guyomard’s teachings). *Supra* §III.G.1. The reasons that Uemura and Guyomard would have obviously produced a battery with a charge cutoff voltage of at least 4.5V is discussed in connection with Ground 4 above, and the reasons for adding Iwaizono and adjusting the voltages to accommodate the higher cutoff voltage are the same as those described with respect to Ground 8, above. *Supra*

§§III.D, III.G.1.

H. Ground 10: Obviousness of Claims 9-10 Over Abe In View of Guyomard and Iwaizono

The combination of Abe and Guyomard is discussed above in connection with Ground 7 and the motivations to modify Abe's cell or battery using LiMn_2O_4 as the positive electrode active material by including Guyomard's electrolyte and increased charge cutoff voltage are equally applicable to this Ground. *Supra* §III.F. Not only would the obvious combination of Abe and Guyomard have allowed for increased capacity after a large number of cycles, but it also would have led to a battery with increased capacity because the resulting battery would have been charged to a cutoff voltage of, for example, 4.5V. *Id.* Thus, the resulting combination would have benefitted from an appropriately designed overcharge protection circuit to accommodate the higher voltages. EX1002, ¶207.

For the same reasons discussed with respect to Grounds 8 and 9, it would have been obvious to implement Iwaizono's protection circuit in Abe's battery to provide overcharging protection. *Supra* §§III.G.1, III.G.2. Indeed, Abe even mentions such a protection circuit, but does not provide the details of its implementation thus leading the PHOSITA to seek out such details in the prior art. EX1005, ¶[0009] ("To avoid such problems, the lithium-ion secondary battery is supplied with a safety device to prevent overcharging or over-discharging."); EX1002, ¶208. Because the cutoff voltage in the battery designed in accordance with the combined teachings of

Abe and Guyomard would have been 4.5V or greater, the overcharge protection voltage and the overcharge protection release voltages would have been within the ranges claimed by claims 9 and 10 for the same reasons discussed with respect to Grounds 8 and 9 (an overcharge protection voltage of 4.65V and an overcharge protection release voltage of 4.35V or 4.45V would have been an obvious choice). EX1002, ¶207; *supra* §III.G.2.

IV. PTAB DISCRETION SHOULD NOT PRECLUDE INSTITUTION

The co-pending litigation was stayed on October 4, 2023. *See* EX1026. Therefore, ***Fintiv* Factors 1-4** favor institution. **Factor 5** is neutral. **Factor 6** favors institution as this Petition presents a compelling case of invalidity. For at least these reasons, the Board should not discretionarily deny based on the *Fintiv* factors.

V. MANDATORY NOTICES UNDER 37 C.F.R. § 42.8(a)(1)

A. Real Party-In-Interest Under 37 C.F.R. § 42.8(b)(1)

Petitioner, Apple Inc., is the real party-in-interest.

B. Related Matters Under 37 C.F.R. § 42.8(b)(2)

Petitioner is not aware of any disclaimers, reexamination certificates or petitions for *inter partes* review for the '641 Patent. The '641 Patent is the subject of civil actions: *RJ Technology LLC v. Apple Inc.*, Case No. 8-22-cv-01874 (CDCA), filed October 13, 2022; *RJ Technology LLC v. Samsung Electronics Co., Ltd. et al.*, Case No. 2-22-cv-00401 (EDTX), filed October 13, 2022, *Apple Inc. v. RJ Technology LLC*, Case No. IPR2023-01350 (PTAB), filed August 23, 2023 and *Samsung Electronics Co., Ltd. v. RJ Technology LLC*, Case No. IPR2023-01183 (PTAB), filed July 21, 2023.

C. Lead And Back-Up Counsel Under 37 C.F.R. § 42.8(b)(3)

Petitioner provides the following designation of counsel.

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D. Service Information

Please address all correspondence and service to the address listed above.

Petitioner consents to electronic service by email at IPR50095-0143IP2@fr.com.

VI. PAYMENT OF FEES – 37 C.F.R. § 42.103

Petitioner authorizes the Patent and Trademark Office to charge any fees to Deposit Account No. 06-1050.

VII. CONCLUSION

The Challenged Claims are unpatentable. Petitioner authorizes charge of fees to Deposit Account 06-1050.

Respectfully submitted,

Dated: February 22, 2024

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CERTIFICATION UNDER 37 CFR § 42.24

Under the provisions of 37 CFR § 42.24(d), the undersigned hereby certifies that the word count for the foregoing Petition for *Inter Partes* Review contains less than the 14,000 allowed under 37 CFR § 42.24.

Dated: February 22, 2024

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CERTIFICATE OF SERVICE

Pursuant to 37 CFR §§ 42.6(e)(4)(i) *et seq.* and 42.105(b), the undersigned certifies that on February 22, 2024, a complete and entire copy of this Petition for *Inter Partes* Review and all supporting exhibits were provided via Federal Express, to the Patent Owner by serving the correspondence address of record as follows:

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